DNAPL RECOVERY PILOT TEST REPORT

WORK ASSIGNMENT UNDER C007540-2.1

FORMER SPIC AND SPAN CLEANERS & DYERS, INC. SITE
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA

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

Marc Gerstman, Acting Commissioner
DIVISION OF ENVIRONMENTAL REMEDIATION
Remedial Bureau B

URS Corporation – New York
257 West Genesee Street, Suite 400
Buffalo, New York 14202

November 2015
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<td>AARCO</td>
<td>AARCO Environmental Services, Corporation</td>
</tr>
<tr>
<td>aka</td>
<td>also known as</td>
</tr>
<tr>
<td>amsl</td>
<td>above mean sea level</td>
</tr>
<tr>
<td>ASP</td>
<td>Analytical Services Protocol</td>
</tr>
<tr>
<td>Associated</td>
<td>Associated Environmental Services, Ltd.</td>
</tr>
<tr>
<td>ASTM</td>
<td>AMERICAN Society for Testing and Materials</td>
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<tr>
<td>bgs</td>
<td>below ground surface</td>
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<td>BP</td>
<td>British Petroleum</td>
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<td>BQE</td>
<td>Brooklyn-Queens Expressway</td>
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<td>B. Thayer</td>
<td>B. Thayer Associates</td>
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<td>BTEX</td>
<td>benzene, toluene, ethylbenzene, xylenes</td>
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<td>cis-1,2-DCE</td>
<td>cis-1,2-dichloroethene, aka cis-1,2-dichloroethylene</td>
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<td>CD</td>
<td>compact disc</td>
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<td>cm/sec</td>
<td>centimeters per second</td>
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<tr>
<td>COC</td>
<td>chain-of-custody</td>
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<td>Con Edison</td>
<td>Consolidated Edison Company of New York</td>
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<td>CPCs</td>
<td>chemicals of potential concern</td>
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<td>Crown</td>
<td>Crown Enterprises, Inc.</td>
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<td>CVOC</td>
<td>chlorinated volatile organic compound</td>
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<td>DCA</td>
<td>dichloroethane</td>
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<tr>
<td>DCE</td>
<td>dichloroethene, aka dichloroethylene</td>
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<td>1,2-DCE</td>
<td>1,2-dichloroethene</td>
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<td>DEP</td>
<td>Department of Environmental Protection</td>
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<tr>
<td>DIs</td>
<td>drop inlets</td>
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<td>DNAPL</td>
<td>dense non-aqueous phase liquid</td>
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<td>DOB</td>
<td>Department of Buildings</td>
</tr>
<tr>
<td>DOT</td>
<td>Department of Transportation</td>
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<td>DSNY</td>
<td>City of New York Department of Sanitation</td>
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<td>DUSR</td>
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<td>ELAP</td>
<td>Environmental Laboratory Approval Program</td>
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<td>EM</td>
<td>electromagnetic</td>
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<td>ExxonMobil</td>
<td>ExxonMobil Brooklyn Terminal</td>
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<tr>
<td>gpm</td>
<td>gallons per minute</td>
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<td>GPR</td>
<td>ground penetrating radar</td>
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<tr>
<td>ft./ft.</td>
<td>foot per foot</td>
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<td>HASP</td>
<td>Health and Safety Plan</td>
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<td>HDPE</td>
<td>high-density polyethylene</td>
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<td>HSA</td>
<td>hollow stem augers</td>
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<td>ID</td>
<td>inside diameter</td>
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<td>investigation derived wastes</td>
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<td>K</td>
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<td>liter</td>
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<td>L/min</td>
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<td>Acronym</td>
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<tr>
<td>LNAPL</td>
<td>light non-aqueous phase liquid</td>
</tr>
<tr>
<td>MEK</td>
<td>methyl ethyl ketone</td>
</tr>
<tr>
<td>mg/kg</td>
<td>milligrams per kilogram (parts per million)</td>
</tr>
<tr>
<td>mL</td>
<td>milliliter</td>
</tr>
<tr>
<td>MW</td>
<td>monitoring well</td>
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<td>NAD83</td>
<td>North American Datum of 1983</td>
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<td>NAVD</td>
<td>North American Vertical Datum</td>
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<td>NYC</td>
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<td>NYSDOH</td>
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<td>NYSDOT</td>
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<td>OD</td>
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<td>PCBs</td>
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<td>PCE</td>
<td>perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene</td>
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<td>PID</td>
<td>photoionization detector</td>
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<tr>
<td>ppbv</td>
<td>parts per billion by volume</td>
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<td>ppm</td>
<td>parts per million</td>
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<td>PVC</td>
<td>polyvinyl chloride</td>
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<td>QA/QC</td>
<td>Quality Assurance/Quality Control</td>
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<td>RCRA</td>
<td>Resource Conservation Recovery Act</td>
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<td>RQD</td>
<td>rock quality designation</td>
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<td>SAP</td>
<td>Sampling and Analysis Plan</td>
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<td>SPDES</td>
<td>Spill Discharge Elimination System</td>
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<td>Spic and Span</td>
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<td>SVOC</td>
<td>semi-volatile organic compound</td>
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<td>TAGM</td>
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<td>Target Analyte List</td>
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<td>3rd Rock LLC</td>
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<td>TCE</td>
<td>trichloroethene, aka trichloroethylene</td>
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<td>tentatively identified compounds</td>
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LIST OF ACRONYMS AND ABBREVIATIONS (Continued)
(Continued)

TOGS  Technical and Operational Guidance Series
µg/kg  micrograms per kilogram (parts per billion)
µg/L  micrograms per liter (parts per billion)
µg/m³  micrograms per cubic meter
USCG  United States Coast Guard
USCS  Unified Soil Classification System
URS  URS Corporation - New York
USEPA  United States Environmental Protection Agency
UST  underground storage tank
VC  vinyl chloride
VOCs  volatile organic compounds
WA  Work Assignment
1.0 INTRODUCTION

This dense non-aqueous phase liquid (DNAPL) Recovery Pilot Test Report has been prepared to summarize the field activities and analytical results from the DNAPL Recovery Pilot Test at the Former Spic and Span Cleaners & Dyers, Inc. (Spic and Span) Site [New York State Department of Environmental Conservation (NYSDEC) Site Number 224129] in the Greenpoint/East Williamsburg Industrial Area section of Brooklyn, New York. The work for the Spic and Span Site (Site) was issued to URS Corporation – New York (URS) as Work Assignment No. C007540-2.1. This report presents data and information gathered prior to and during the Pilot Test, which was conducted from January 5 to March 27, 2015.

1.1 Site Background

The Site is located in the Greenpoint/East Williamsburg Industrial Area section of the Borough of Brooklyn, New York (Figure 1-1) and is located within the Meeker Avenue Plume Trackdown Site (NYSDEC Site Number 224121) investigation area. During the investigation phases at the Meeker Avenue Plume Trackdown Site conducted between May 2007 and March 2015, a source of groundwater contamination was identified at the buildings housing the Former Spic and Span Cleaners and Dyers, Inc. also known as 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) and is considered to be the On-Site source area. In January 2009, the above mentioned source of groundwater contamination was listed as NYSDEC Class 2 Inactive Hazardous Waste Disposal Site (Site Number 224129). Impacted areas situated downgradient to the north, northeast, and east are considered to be the Off-Site area. Geographical site and background information is provided in the following sections.

1.1.1 Site Location and Description

The Former Spic and Span Site area consists of the area bound by Meserole Avenue to the north, Morgan Avenue and Hausman Street to the east, Nassau Avenue to the south and Monitor Street to the west. The Site area is a mixture of residential and manufacturing, including both commercial and industrial facilities. The two Site buildings located at 307-313 Kingsland Avenue (307 Kingsland Avenue), that formerly housed a portion of the Spic and Span operations are
currently utilized as a movie prop rental business and associated warehouse. The Site building located at 260 Norman Avenue/315-325 Kingsland Avenue (315 Kingsland Avenue) that also formerly housed a portion of the Spic and Span operations is currently unoccupied. The majority of the Site and the majority of the Site area are covered by one-story and multi-story buildings and/or pavement/concrete. Residential areas are generally south of the Site, although residents live within a multi-story building located on the Site. The residential building space and unoccupied space are situated in adjacent structures.

The Site 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 located northeast of the site. 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 east of the site along Newtown Creek, north of Bridgewater Street, between Meeker Avenue and Apollo Street. Peerless Importers, 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 as documented by Roux Associates, Inc. (Roux) (Roux, October 14, 2005). The current BP property was determined to be the source of a petroleum-free product plume east of the Spic and Span site. Investigation and remediation activities were conducted by Roux on behalf of ExxonMobil from 1990 to the present, further defining 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 approximately 6.7 million gallons of free product since it became operational in 1995 (Roux, August 13, 2014).
1.2 Previous Investigations

1.2.1 Spic and Span Off-Site Phase III Remedial Investigation

URS performed the Off-Site Phase III RI field investigation between January 20 and May 7, 2014. The Off-Site Phase III RI field investigation was completed to fill data gaps concerning the downgradient extent of the chlorinated volatile organic compounds (CVOC) groundwater plume originating from the Site in the shallow and deep overburden groundwater zones. In addition, deep monitoring wells were installed to assist in determining if CVOC-impacted groundwater is migrating into the deeper groundwater zone and migrating beneath the Crown Enterprise, Inc. (Crown) property towards ExxonMobil recovery well RW-17. The Crown property is located on the northeast side of the intersection of Kingsland and Norman Avenues (Figure 1-1). The results of the Off-Site Phase III RI field investigation were reported in the Letter Report – Off-Site Phase III Remedial Investigation (URS, September 2014). Results of the Off-Site Phase III field investigation are provided below. Plate 1 provides the locations of all monitoring well and boring locations. Plate 2 provides the locations of all soil vapor implant locations.

1.2.1.1 Geology

- The potentiometric surface may be found between 11.44 and 29.91 feet bgs in the wells sampled. Perched groundwater was encountered at four locations (DEC-001, DEC-002, DEC-003, and MW-44).

- Shallow overburden groundwater flow in the vicinity of the Spic and Span Site is to the east and northeast.

- Deep overburden groundwater flow in the vicinity of the Spic and Span Site is to the east and east-northeast.

- The operation of ExxonMobil recovery wells RW-17 and RW-22 appear to have influenced the shallow and deep groundwater flow direction resulting in the horizontal and vertical migration of dissolved phase CVOCs from the Spic and Span Site.
1.2.1.2 Soil

- Tetrachloroethene (PCE) was detected above Unrestricted Use or Protection of Groundwater criteria in DEC-107D (5.7 mg/kg 38-39 feet bgs and 1.7 mg/kg 63-64 feet bgs). PCE exceeded Residential Use criteria in DEC-107D (5.7 mg/kg 38-39 feet bgs).
- Trichloroethene (TCE) was not detected above Unrestricted Use or Protection of Groundwater criteria.
- Cis-1,2-dichloroethene (DCE) was detected above Unrestricted Use and Protection of Groundwater criteria in DEC-107D (0.26 mg/kg 38-39 feet bgs).

1.2.1.3 Groundwater Analytical Results

- PCE and its degradation products were detected in shallow groundwater monitoring wells located downgradient of the Spic and Span Site to the east and at the perimeter of the Crown property to the northeast. Concentrations of PCE and TCE in the shallow groundwater are shown on Figures 1-2 and 1-3, respectively.
- PCE and its degradation products were detected in deep groundwater monitoring wells located downgradient of the Spic and Span Site to the east and beneath the Crown property to the northeast. The highest concentration of PCE was detected at MW-085D (90,000 µg/L), followed by DEC-107D (65,000 µg/L), MW-087D (8,400 µg/L), DEC-112D (7,100 µg/L), DEC-001D (5,500 µg/L), and DEC-110D (4,300 µg/L). Concentrations of PCE and TCE in the deep groundwater are shown on Figures 1-4 and 1-5, respectively.
- The operation of ExxonMobil recovery wells RW-17 and RW-22 appears to have affected migration of dissolved phase of the CVOC plume originating from the Spic and Span Site. There is a northeast and east–southeast component of the plume. One component of the dissolved CVOC plume is migrating northeast from the Spic and Span Site towards RW-17, beneath the Crown property. A second component of the dissolved CVOC plume is moving east-southeast from the Spic and Span Site towards RW-22 which is located on Hausman Street between Norman and Nassau Avenues.
- In addition, the operation of ExxonMobil recovery wells RW-17 and RW-22 appears to have affected vertical migration of PCE and its degradation products from the shallow to the deep
groundwater regimes. Concentrations of CVOCs in paired monitoring wells were up to an order of magnitude higher in the deep groundwater when compared to the shallow groundwater.

1.2.1.4 **Light Non-Aqueous Phase Liquid**

- During the RI Off-Site Phase III field investigation, light non-aqueous phase liquid (LNAPL) was detected in 9 monitoring wells (DEC-034, DEC-053, DEC-058, DEC-083, DEC-112, MW-042, MW-043, MW-045, and MW-082) with thicknesses ranging between 0.02 feet and 2.99 feet.

- Analysis of the LNAPL sample collected from DEC-112 indicated 39% kerosene content, a viscosity of 1.919 centipoise, surface tension of 26 dynes/cm, and specific gravity of 0.8136.

1.2.1.5 **Soil Vapor**

- PCE and TCE were detected in soil vapor immediately downgradient of the Spic and Span Site in SG-188 at 1,800 micrograms per cubic meter (µg/m³) and 2,800 µg/m³, respectively. PCE was also detected at a concentration of 8.5 µg/m³ at SG-192 on Sutton Street. TCE was not detected in any other soil vapor samples.

- Additional volatile organic compounds (VOCs) detected in the 11 soil vapor samples were: 1,1-DCE, 1,2,4-trimethylbenzene, cis-1,2-DCE, trans-1,2-DCE, 1,3-butadiene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,4-dioxane, 2,2,4-trimethylpentane, acetone, carbon disulfide, chloroform, cyclohexane, dichlorodifluoromethane, ethanol, isopropyl alcohol, methylene chloride, n-heptane, n-hexane, trichlorofluoromethane, vinyl chloride, and benzene, toluene, ethylbenzene, xylenes (BTEX).

Based upon the soil vapor sampling results, the CVOC soil vapor plume originating from the Spic and Span Site has nearly been fully delineated.

1.2.1.6 **Investigations by Roux**

Historic groundwater sampling data collected from monitoring wells situated on the Crown property by Roux, acting upon the behalf of ExxonMobil, has shown that little to no CVOCs were
detected in groundwater samples collected from the shallow overburden groundwater zone. Several of the wells on the Crown property are located only a short distance from CVOC-impacted wells situated around the perimeter of the Crown property. The nearby off-property perimeter wells contained elevated concentrations of CVOCs (i.e., DEC-058 vs. MW-85). ExxonMobil is currently operating two groundwater recovery wells (RW-17 and RW-22) in the vicinity of the Site and performs quarterly sampling of the effluent of these recovery wells.

RW-17 is located in the northeast corner of the property located on the 297 Norman Avenue property (MV Transportation) which is immediately east of the Crown property. RW-17 consists of a 12-inch diameter well with a 55-foot long stainless steel screen (10-65 feet bgs) equipped with a 5-foot long stainless steel sump (65-70 feet bgs) and stainless steel riser. During 2013, the average pumping rate for RW-17 was 24 gallons per minute (gpm). For the first half on 2014, the average pumping rate of RW-17 was 35 gpm. The operation of RW-17 appears to have locally impacted the groundwater levels and groundwater flow and has potentially drawn groundwater northeast from the Spic and Span Site, beneath the Crown property. Groundwater data collected in June 2014 from RW-17 (Roux August 13, 2014) reported concentrations of PCE at 200 µg/L, TCE at 27 µg/L, cis-1,2-DCE at 51 µg/L, and vinyl chloride at 6 µg/L.

RW-22 is located southeast of the Site at 90-92 Hausman Street. RW-22 consists of a 12-inch diameter well with a 50-foot long stainless steel screen (28-78 feet bgs) equipped with a 5-foot long stainless steel sump (78-83 feet bgs) and stainless steel riser. During 2013, the average pumping rate for RW-22 was 33 gpm. For the first half on 2014, the average pumping rate of RW-22 was 26 gpm. The operation of RW-22 appears to have locally impacted the groundwater levels and groundwater flow and has potentially drawn groundwater southeast from the Site. Groundwater data collected in June 2014 from RW-22 (Roux August 13, 2014) reported concentrations of PCE at 84 µg/L, TCE at 290 µg/L, cis-1,2-DCE at 87 µg/L, and vinyl chloride at 11 µg/L.

ExxonMobil has installed new recovery wells (RW-27P and RW-27W at location RW-27 and RW-28) in the vicinity of the Site. RW-27P and RW-27W are located at 369 Kingsland Avenue, which is northwest of the Crown property. RW-27P consists of a 6-inch diameter well with a 20-foot long stainless steel screen (3-23 feet bgs) equipped with a 5-foot long stainless steel sump (23-28 feet bgs) and stainless steel riser. RW-27W consists of a 6-inch diameter well with a 20-foot long stainless steel screen (38-58 feet bgs) equipped with a 5-foot long stainless steel sump (58-63 feet bgs)
bgs) and stainless steel riser. RW-28 is located on the southwest corner of the Crown property. RW-28 consists of a 12-inch diameter well with a 30-foot long stainless steel screen (10-40 feet bgs) equipped with a 5-foot long stainless steel sump (40-45 feet bgs) and stainless steel riser. At this time, RW-28 and RW-27 were not on-line; however, their operation will most likely influence the groundwater levels and groundwater flow direction in the vicinity of the Site.

1.2.1.7 Recommendations

The following recommendations were offered for consideration to the Department following the Off-Site Phase III RI.

- Additional shallow and deep groundwater monitoring well pairs should be installed on the west side of Hausman Street between Norman and Nassau Avenues to determine the horizontal and vertical extent of CVOC-impacted groundwater migrating to the ExxonMobil recovery well RW-22.

- Additional deep monitoring wells should be installed on the 297 Norman Avenue property (MV Transportation) to determine the horizontal extent of CVOC impacted deep groundwater migrating to the ExxonMobil recovery well RW-17.

- An additional deep monitoring well should be installed on the west side of the Crown property (i.e., MW-46D). The deep well will assist in assessing deep groundwater flow dynamics and the movement of CVOCs in deep groundwater after ExxonMobil recovery wells RW-27 and RW-28 are operational.

- An additional deep monitoring well should be installed on the southeast corner of the Crown property (i.e., MW-083D) to determine the horizontal extent of CVOC impacted deep groundwater migrating to the ExxonMobil RW-17.

- The shallow monitoring wells should be constructed with a 15-foot long 2- inch ID PVC screen and PVC riser. The deep monitoring wells should be constructed with 10 feet of 2-inch ID, PVC 0.010-inch slot screen and PVC riser. A #0 or #1 size sand pack should be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry should then be installed around the riser to an elevation of 2-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing should complete
each well. All wells on the Crown property should be finished with a flush-mounted curb boxes equipped with heavy duty one-piece cast collars due to the heavy truck traffic.

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 Field Activity Plan [FAP (URS, April 2010)]. All soil samples should be analyzed for target compound list (TCL) VOCs plus tentatively identified compounds (TICs) by USEPA SW846 Method 8260B.

1.2.2 Spic and Span On-Site Phase III Remedial Investigation

Based upon the results of the previous site investigations and the On-Site Phase III RI, performed between May 28 and July 18, 2014, the following conclusions were provided.

1.2.2.1 Geology

- The following textural units have been found in the upper glacial aquifer in most borings, from the surface downward: a fill unit; a glacial till unit; an inclusive sand unit within the glacial till unit; a sand unit ; a lacustrine clayey silt unit; a fine sand and silt unit; a sand/sand and gravel unit; and the Raritan Formation. Due to the heterogeneous nature of the geology, some but not all of the units were identified at each boring. The thickness of the upper glacial aquifer in the Spic and Span area is approximately 125 to more than 138 feet thick.

- An inclusive sand layer containing DNAPL and high PCE concentrations was identified within the glacial till unit in the vicinity of SSB-11, and between SSB-26 and SSB-32 which are located adjacent to the Spic and Span Site.

- The top of the Raritan Formation was encountered across the Site. The elevation of the Raritan Formation from approximately between -104 to -121 feet amsl and has been described as gray clay with color variations with white banding, brown, brownish gray, greenish gray, and dark gray to greenish brown, mixed with 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.

- The water table surface in the greater Spic and Span area may be found between approximately 11 and 30 feet bgs. In the immediate vicinity of the Spic and Span property, the depth to groundwater is approximately 12 feet bgs and the groundwater flow is north to northeast. The horizontal hydraulic gradient in shallow overburden groundwater was approximately 0.02 foot per foot (ft./ft.).

- The hydraulic conductivity in the overburden ranged from $2.91 \times 10^{-2}$ cm/sec (DEC-063) to $8.32 \times 10^{-5}$ cm/sec (DEC-060). In the shallow overburden, the mean value of K is $8.03 \times 10^{-3}$ cm/sec for the sand clayey silt/sand unit, and $3.15 \times 10^{-4}$ cm/sec for the sandy silt. In the deep overburden, the mean value of K is $1.00 \times 10^{-3}$ cm/sec for the sand/silty sand, and $9.32 \times 10^{-5}$ cm/sec for the sandy silt.

1.2.2.2 Soil

A few VOCs, including PCE, were detected and exceeded unrestricted use criteria. Locations which exceeded criteria for unrestricted use also exceeded protection of groundwater criteria. PCE exceeded unrestricted use and protection of groundwater criteria in SSB-43 (51 mg/kg at 53-54 feet bgs; 200 mg/kg at 55-56 feet bgs; and 3,300 mg/kg at 60-60.5 feet bgs). TCE and other CVOC degradation products did not exceed criteria in On-Site Phase III RI soil samples.

Exceedances for petroleum-related and other compounds included: acetone exceeding unrestricted use and protection of groundwater criteria in DEC-113D (0.058 mg/kg at 18-18.5 feet bgs); and isopropylbenzene exceeding unrestricted use and protection of groundwater criteria in 5 soil samples: DEC-114D (38 mg/kg at 19-20 feet bgs; 3.8 mg/kg at 21-22 feet bgs), SSB-35 (26 mg/kg at 16-17 feet bgs), SSB-38 (16 mg/kg at 19-20 feet bgs), and SSB-39 (4 mg/kg at 21-22 feet bgs).

PCE exceeded both restricted residential and residential use criteria in SSB-43 (51 mg/kg at 53-54 feet bgs; 200 mg/kg at 55-56 feet bgs; and 3,300 mg/kg at 60-60.5 feet bgs). No other VOCs exceeded residential or restricted residential use criteria.
Spic and Span Building On-Site Source Area

PCE DNAPL, acting as a source of dissolved phase contamination, has been identified within the inclusive sand layer between approximately SSB-26 and SSB-32 at approximately 12 to 22 feet bgs. The inclusive sand layer contains elevated concentrations of PCE and DNAPL. The bottom of the northern extent of the inclusive sand layer near SSB-32 contains vertical sand stringers saturated with DNAPL, to approximately 63 feet bgs in SSB-29 and SSB-30. These sand stringers represent a vertical pathway from the shallow zone through the glacial till unit into the lower sand unit at approximately 25 to 55 feet bgs. DNAPL was noted in sand stringers which are present in SSB-30 at a depth of 17 feet to an approximate depth of 63 feet bgs near the top of the lower permeability clayey silt. The northern edge of the inclusive sand layer is approximately 35 feet from DEC-024D and DEC-024DR, where DNAPL has also been identified at the top of the clayey silt unit. DNAPL is also present in DEC-092D which is set 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 extent of the impacted soil has not been delineated and is assumed to extend beneath Kingsland Avenue. The western extent of the impacted soil has been delineated and extends beneath the eastern edge of the Spic and Span building.

300 Kingsland Avenue Source Area

A shallow source of PCE contamination was identified in the vicinity of DEC-025/025D, which is located on the east side of Kingsland Avenue, south of the Spic and Span Site, adjacent to 300 Kingsland Avenue. The highest concentration of PCE (2,000 mg/kg) was found within the top 2.5 feet below the sidewalk at SSB-03 followed by the top 2.5 feet at both DEC-025D and SSB-08 (1,300 mg/kg at both). SSB-15, which is located approximately 10 feet south of DEC-025D, had the highest PID readings [336 to 1,528 parts per million (ppm)] in the upper 20 feet. Below 20 feet, PID readings in SSB-16 decreased to 0 ppm at depths below 26 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 15 feet of soil, between 10 feet north and 20 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 established. The eastern extent of the impacted soil near DEC-025/025D has not been delineated and may extend beneath the building at 300 Kingsland Avenue.
The western extent of the impacted soil has not been delineated and is assumed to extend under Kingsland Avenue.

1.2.2.3 Non-Aqueous Phase Liquids (NAPL)

The DNAPL sample from DEC-024DR during the SC Phase VI fieldwork was collected following the redevelopment of the well which initially contained a trace of DNAPL. This indicates that DNAPL can be drawn into the wells from the surrounding formation for recovery. Analytical results for the DNAPL found in DEC-024D and DEC-024DR indicated:

- PCE concentration in DEC-024D was 73% and TCE was 0.072%.
- PCE concentration in DEC-024DR was 11% and TCE was 0.022%.
- Physical parameters from the DNAPL sample from DEC-024DR include: viscosity of 1.21 centistokes, surface tension of 26.4 dynes/cm, and specific gravity of 1.2942.

The lateral extent of DNAPL extends from approximately DEC-092D to DEC-024D/DEC-024DR along the sidewalk adjacent to the 315 Kingsland Avenue building, and from near DEC-116D/SSB-43 to the western curbline of Kingsland Avenue and may extend into the street area.

LNAPL has historically been measured in several monitoring wells: DEC-024, DEC-034, DEC-053, DEC-054, DEC-058, DEC-083, DEC-112, MW-042, MW-043, MW-045 and MW-082. During the On-Site Phase III RI field activities, LNAPL was detected in DEC-034, DEC-083 and DEC-112 with thicknesses ranging between 0.01 feet and 3.48 feet.

1.2.2.4 Groundwater

On-Site Area

PCE and its degradation products were detected in numerous groundwater monitoring wells in both shallow and deep overburden groundwater. High concentrations of PCE were detected: adjacent to the Spic and Span building in DEC-057 and DEC-057D at concentrations of 21,000 and 48,000 µg/L, respectively; DEC-024D and DEC-024DR at concentrations of 170,000 and 88,000 µg/L, respectively; and DEC-116D at a concentration of 83,000 µg/L; and downgradient of the site in DEC-092D to the southeast at a concentration of 1,400 µg/L. TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected, with the highest concentrations at DEC-024D (1,900
µg/L) and DEC-24 (1,600 µg/L), respectively. The highest concentration of vinyl chloride was detected in DEC-024 (1,100 µg/L). Additionally, BTEX and/or fuel-related compounds (e.g., isopropylbenzene, methyl tert-butyl ether) were detected in DEC-023, DEC-024, DEC-024D, DEC-024DR, DEC-114, DEC-115, DEC-116 and DEC-116D. Isoconcentration contours of PCE and TCE in the shallow groundwater are shown on Figures 1-6 and 1-7, respectively. Isoconcentration contours of PCE and TCE in the deep groundwater are shown on Figures 1-8 and 1-9, respectively.

Overall Plume Extent

Based upon groundwater sampling events, the horizontal and vertical extent of the dissolved phase plume has mostly been determined. The horizontal extent of the dissolved phase plume in shallow and deep groundwater appears to originate around the Spic and Span Site where the highest PCE concentrations were detected in the wells with DNAPL. The second source identified around DEC-025D near 300 Kingsland Avenue was attributed to Spic and Span operations based on information from nearby residents. The plume is spreading with groundwater flow towards the northeast, east and with a southerly component, and via downward migration to deeper geologic zones (i.e., approximately 60 – 65 feet bgs). Although PCE was detected in 3 of the 4 top of clay wells sampled during the Phase II RI, the concentrations did not exceed groundwater standards, criteria and guidance (SCGs). The vertical extent of PCE and TCE impacted groundwater extends down to the top of the clayey silt unit, approximately 60 feet bgs. The plume appears to be spreading laterally along the clayey silt interface and into the lower sand unit to areas toward the northeast (i.e., Crown Property and Exxon Mobil well RW-17), and toward the east-east/southeast (i.e., as far as Morgan Avenue and Hausman Street) toward ExxonMobil well RW-22.

Based upon the data collected to assess the potential for degradation of PCE in the groundwater system as presented above, there is evidence that reductive dechlorination is occurring in the vicinity of the Site. Rates of degradation are very difficult to determine due to the unknown quantity of source material present beneath the Spic and Span Site and beneath the 300 Kingsland Avenue building. Based upon the geochemical conditions in the groundwater system, the aquifer is conducive for naturally occurring reductive dechlorination, and therefore, the geochemical conditions could be enhanced via in-situ bioremediation technologies to further promote higher rates of reductive dechlorination. During the Feasibility Study, this and other remedial technologies such as in-situ chemical oxidation will be evaluated.
1.2.2.5 Soil Vapor and Sub-Slab Soil Vapor

PID readings from the 23 soil vapor survey locations within the main room and two rooms located west of the main room in the Site building located at 315 Kingsland Avenue ranged from 1.7 to 18.7 ppm (Figure 1-10). Results did not indicate the presence of significantly elevated VOCs in the vicinity of the UST or elsewhere in the main room or other two rooms.

Between June 23 and 24, 2014, URS personnel collected sub-slab soil vapor samples at six locations within the main room and two rooms located west of the main room in the Site building located at 315 Kingsland Avenue (Figure 1-11). The locations of the VOCs detected in sub-slab soil vapor samples collected during the On-Site Phase III RI, including PCE and its breakdown products, are shown on Figure 1-12. PCE was detected in the sub-slab soil vapor at concentrations ranging from 57 µg/m³ at location 315-04 to 350 µg/m³ at location 315-01. PCE was detected at 43 µg/m³ in the outdoor air sample. TCE was detected in the sub-slab soil vapor at concentrations ranging from 31 µg/m³ at location 315-05 to 1,300 µg/m³ at location 315-05. TCE was not detected in the outdoor air sample. Additional VOCs detected in many of the sub-slab soil vapor samples and the outdoor air sample include petroleum-related compounds, hexane-related compounds, and 1,1,1-trichloroethane. The VOC with the highest detected concentration was acetone at 2,600 µg/m³ at location 315-06; however, the outdoor air acetone concentration was 600 µg/m³.

Soil gas in the Spic and Span area has been adversely impacted by the presence of PCE, TCE and their daughter products. The source of the elevated soil vapor concentrations appears to be centered adjacent to and immediately downgradient of the Spic and Span Site (SG-67 and SG-99), nearby 300 Kingsland Avenue (SG-071, SG-012, and SG-013) and mid-block on Morgan Avenue (SG-004 and SG-008). The elevated concentrations mid-block on Morgan Avenue coincide with the location of elevated concentrations obtained by Roux from a temporary soil-gas point installed in September 2005 which historically has higher TCE concentrations than PCE concentrations.

The approximate sizes of the PCE and TCE plumes from Phases I and II RI are similar in size and appear to also mimic the extent of the dissolved phase shallow groundwater plume. The exception to this is the concentrations that exist mid-block on Morgan Avenue appear to indicate a separate source of soil vapor TCE contamination exists. The mid-block area of Morgan Avenue previously housed the Herzberg’s Fine Art Dyeing, Inc. (1942), Taylor and Co. Inc. which was a
foundry (1942-1980), Baltic Metal Works (1951-1965), and United Resin Products, Inc. (1979-present).

1.2.2.6 Recommendations

The following recommendations are offered for consideration by the NYSDEC. The recommendations include additional Remedial Investigation/Feasibility Study (RI/FS) activities.

On-Site Source Area(s)

- An SVE/Air Sparging Pilot Test was proposed as part of C007540 WA#2.1 and was recommended in the Spic and Span RI Phase II Report to assess the potential effectiveness of soil vapor with/without air sparging in the vicinity of shallow DNAPL source area near SSB-11. However, since the preparation of that report, in light of recent site investigation results, and following discussions with the NYSDEC in October 2014, it was decided that the SVE/Air Sparging pilot test would not be conducted, and instead, a DNAPL Recovery Pilot Test would be conducted for the following reasons:

  ➢ Measurable levels of DNAPL and high concentrations of PCE are present in the subsurface. An SVE/AS system would not address this as it would not be effective in removing DNAPL or high concentrations of dissolved-phase contaminants.

  ➢ With the introduction of oxygen into the DNAPL layer, the product would be forced to desorb from soil, and migrate away from the source area. Considering that there are several potential migration pathways (buried utilities such as water and sewer lines, underground storage tanks and associated piping) and vertical sand stringers within the subsurface at the site, migration of the product away from the source and collection area would be highly likely. In addition, air sparging would negatively impact the naturally occurring reductive dechlorination that is ongoing in the aquifer system.

  ➢ Additionally, the fill and clay/silt layers near the surface are very tight and do not promote airflow, which is necessary in order for an AS/SVE system to be effective.
- A recommendation to conduct a DNAPL Recovery Pilot Test with and/or without surfactant additives was accepted by the NYSDEC during the October 2014 meeting. The DNAPL Recovery Pilot Test would consist of the following:

  - Installation of two DNAPL extraction wells located within the source area (i.e., one near SSB-32 and one near DEC-092D), and periodic DNAPL collection. Prior to drilling, all utilities in the vicinity of the proposed wells would be located and marked out. The wells would be flush-mount, with concrete curb boxes. Any adjacent asphalt pavement or sidewalk flags that are damaged during drilling would be replaced. The extraction wells would be four-inch diameter and be screened from the top of the clay/silt layer to ten feet above the clay/silt layer. A two foot long stainless steel sump would be installed beneath ten foot 0.020-inch slot continuous wire wrap stainless steel well screens. The riser would be 4-inch Schedule 40 PVC. The annular space around the well within the borehole would be Filpro #2 or #3 sand pack to two feet above the screen; the remaining annular space would be filled with bentonite.

  - Initially, passive DNAPL recovery would be conducted. Following passive recovery, surfactant-enhanced DNAPL recovery could be considered. An evaluation of the passive DNAPL recovery would be conducted to assess its effectiveness and the potential need for surfactant-enhanced recovery.

- An additional shallow and deep groundwater monitoring well pair (DEC-136 and DEC-136D) should be installed on the Kingsland Avenue between SSB-25 and SSB-26 to further delineate the southern extent of CVOC plume. The monitoring wells would be two-inch diameter. The deep monitoring well would be screened from the top of the clay/silt layer to ten feet above the clay/silt layer. A two foot long stainless steel sump would be installed beneath ten foot 0.010-inch slot continuous wire wrap stainless steel well screen. The riser would be 2-inch Schedule 40 PVC. The annular space around the well within the borehole would be #1 sand pack to two feet above the screen; the remaining annular space would be filled with bentonite.

The shallow monitoring well would be constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and PVC riser. The screen should be nominally set between 20 feet...
above and 30 feet below ground surface. A #1 size sand pack would be installed from the bottom of the well up to 2 feet above the top of the well screen. Bentonite chips would then installed around the riser to an elevation of approximately 1-foot bgs. All wells would be finished with a flush-mounted curb box.

Prior to the installation of the DNAPL extraction wells, approximately nine (9) soil borings should be advanced in the sidewalk area adjacent to 315 Kingsland Avenue building to further refine the lateral and vertical extent of DNAPL.

- Nine soil borings should be advanced along Kingsland Avenue adjacent to the buildings that housed Spic and Span. The borings should be installed through the sidewalk to assist in delineating the horizontal and vertical extent of the DNAPL identified in the On-Site source area, and further refine proposed DNAPL extraction well locations. The borings should be advanced in a grid like pattern using a remote access drill rig(s) or direct-push unit(s).

- Up to two soil samples should be collected from each boring location. At a minimum, one soil sample should be collected from the interval just above water table; the second sample should be collected 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 Field Activities Plan (FAP) (URS, April 2010). All soil samples should be analyzed for TCL VOCs plus TICs by 8260B.

- If DNAPL is encountered in any new monitoring or extraction 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 semivolatile organic compounds (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.

- Groundwater samples should be collected from the newly installed monitoring wells. All groundwater samples should be analyzed for TCL VOCs plus TICs. Prior to the start
of groundwater sampling, a synoptic round of water levels/LNAPL gauging should be collected from all monitoring wells in the Spic and Span area.

**Off-Site Area(s)**

As recommended in the Off-Site Phase III RI Report, the following scope elements in the Off-Site area are provided below and are components of the revised Pilot Test:

- Additional shallow and deep groundwater monitoring well pairs (DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, DEC-139D) should be installed on the east side of Hausman Street between Norman and Nassau Avenues to determine the horizontal and vertical extent of CVOC-impacted groundwater migrating to the ExxonMobil recovery well RW-22.

- Additional deep monitoring wells (AMW-17D and PW-1D) are proposed on the 297 Norman Avenue property (MV Transportation) to determine the horizontal extent of CVOC-impacted deep groundwater migrating to the ExxonMobil recovery well RW-17.

- An additional deep monitoring well should be installed on the west side of the Crown property (i.e., MW-046D). The deep well will assist in assessing deep groundwater flow dynamics and the movement of CVOCs in deep groundwater after ExxonMobil recovery wells RW-27 and RW-28 are operational.

- An additional deep monitoring well should be installed on the southeast corner of the Crown property (i.e., MW-083D) to determine the horizontal extent of CVOC-impacted deep groundwater migrating to the ExxonMobil RW-17.

The shallow monitoring wells should be constructed with a 15-foot long 2-inch ID PVC screen and PVC riser. The deep monitoring wells should be constructed with 10 feet of 2-inch ID, PVC 0.010-inch slot screen and PVC riser. A #0 or #1 size sand pack should be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry should then be installed around the riser to an elevation of 2-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing should complete each well. All wells on the Crown property should be finished with a flush-mounted curb box equipped with a heavy duty one-piece cast collar due to the heavy truck traffic.
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 USEPA SW846 Method 8260B.

Groundwater samples should be collected from the newly installed monitoring wells. All groundwater samples should be analyzed for TCL VOCs plus TICs. Prior to the start of groundwater sampling, a synoptic round of water levels/LNAPL gauging should be collected from all monitoring wells in the Spic and Span area. At well locations where LNAPL is encountered, a groundwater sample should be 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 should be secured to limit movement and the cap should be 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 should be attached to the tremie pipe for retrieval. A peristaltic pump should be used to purge the wells containing LNAPL.

These recommendations were implemented in January through March 2015 and associated data is incorporated into this submittal through March 2015.

Additional recommendations for removal of the UST and DNAPL is ongoing as part of an Interim Remedial Measure (IRM) under Contract D007622, WA #30. The data collected during the IRM will be compiled as a separate submittal to NYSDEC in 2016.

1.3 **Objectives of the DNAPL Recovery Pilot Test**

The objectives of the DNAPL Recovery Pilot Test were to:

- Determine the effectiveness of DNAPL recovery in two DNAPL extraction wells located in the sidewalk adjacent to the Site building at 315 Kingsland Avenue.
- Determine the horizontal and vertical extent of CVOC-impacted groundwater migrating east-southeast toward ExxonMobil recovery well RW-22.
- Assess flow dynamics and the movement of CVOCs in deep groundwater after ExxonMobil recovery wells RW-27 and RW-28 are operational.
- Determine the horizontal extent of CVOC-impacted deep groundwater migrating to the northeast towards ExxonMobil recovery well RW-17.

Activities associated with the Pilot Test consisted of:

- Utility clearance by a geophysical contractor at all soil boring, extraction well and monitoring well locations;

- Advancement of eight soil borings in the sidewalk adjacent to the Site building located at 315 Kingsland Avenue using direct-push, rotosonic, and hollow-stem auger drilling methods down to approximately 55 bgs. All boring locations were cleared to 5 feet bgs by Vac-Tron© prior to drilling;

- Installation of one monitoring well pair (one shallow and one deep monitoring well) in the sidewalk adjacent to the Site building located at 315 Kingsland Avenue using sonic drilling methods;

- Installation of two extraction wells (EW-01 and EW-02) in the sidewalk adjacent to the Site building located at 315 Kingsland Avenue using sonic drilling methods;

- Installation of three monitoring well pairs (one shallow and one deep monitoring well per pair) in the sidewalk on the east side of Hausman Street, adjacent to RW-22, using sonic drilling methods;

- Installation of two deep monitoring wells (MW-046D and MW-083D) in the northwestern and southeastern portions of the Crown property using sonic drilling methods;

- Development of 10 new monitoring wells and 2 extraction wells;

- Collection of water levels in the Site area. In addition, gauging for product thickness was performed in the new and existing monitoring wells;

- Collection of groundwater plus QA/QC samples from 10 new and two existing monitoring wells, and two new extraction wells;

- Performance of DNAPL recovery at the two new extraction wells and monitoring well DEC-136;
• Collection of soil samples using a bucket auger from 3 locations directly beneath the concrete floor within the 315 Kingsland Avenue building;

• Removal of all investigation derived waste (IDW) from the Site on a daily basis; and

• Survey of all new soil boring, extraction well and monitoring well locations. The survey was tied into the existing Site survey.

1.4 Report Organization

This report has six sections. Section 1 includes background information and a synopsis of URS’ activities at this site. Section 2 includes a description of field activities that occurred during the Pilot Test fieldwork. Section 3 includes a description of the local and regional geology and hydrogeology. Section 4 discusses the nature and extent of the contamination. Section 5 presents a summary and recommendations for the next phase of the project. Section 6 contains a list of references cited. Figures, Plates, Tables and Appendices immediately follow the text.
2.0 DNAPL RECOVERY PILOT TEST FIELD ACTIVITIES

Field activities associated with the DNAPL Recovery Pilot Test were conducted between January 5 and March 27, 2015. Site photographs are provided in Appendix A and copies of the daily field notes are provided in Appendix B.

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 New York City (NYC) Departments of Environmental Protection and Transportation (NYCDEP and NYCDOT), the Transit Authority, Consolidated Edison Company of New York (Con Edison), National Grid, and Verizon, in addition to using the Dig Safe number for New York City (New York 811) 811 or (800) 272-4480.

2.2 Geophysical Survey for Utility Markouts

On January 5 and 6, 2015, Radar Solutions International of Waltham, MA (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 monitoring wells, extraction wells and soil borings were proposed.

A geophysical survey 5-foot square reference grid was established on the sidewalk adjacent to the Site building located at 315 Kingsland Avenue. A geophysical survey was also conducted at 6 proposed well locations along the east side of Hausman Street and at two locations within the Crown Enterprises Property. A GSSI SIR-3000 digital radar system was used to perform the GPR survey. GPR data were acquired along lines spaced 2.5 feet apart. The EM induction equipment used to determine the location of buried utilities and trace utilities was a McLaughlin’s Verifier GX digital locator. RSI marked utilities and anomalies by spray-painting the outline on the pavement as soon as they were located. A copy of RSI’s report is provided in Appendix C.

2.3 Soil Borings and Monitoring Well Installation

Between January 5 and February 5, 2015, URS provided oversight for the advancement of twenty-one soil borings, the installation of monitoring wells in ten of the soil borings, and the
installation of extraction wells in two of the soil borings (Figure 2-1). One monitoring well pair (DEC-136 and DEC-136D), two extraction wells (EW-01 and EW-02) and nine soil borings (SSB-48 through SSB-56) were advanced/constructed within the sidewalk that lies adjacent to 315 Kingsland Avenue. Two deep wells (MW-046D and MW-083D) were constructed within the Crown Enterprises Property. The remaining three well pairs (DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, and DEC-139D) were constructed along Hausman Street to the east of the site.

2.3.1  **Pre-Boring Clearing**

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Between January 5 and January 15, 2015, Glacier Drilling, LLC of Durham, CT (Glacier) and Associated Environmental Services of Hauppauge, NY (Associated) mobilized one Vac-Tron® unit each to perform location-specific utility clearance at each of the proposed monitoring/extraction well and soil boring locations. At each location, a two-foot by two-foot square area of the concrete was cut. An approximately two-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. A URS geologist screened the soils being removed with a PID and classified the soils. After the location was cleared for drilling, the hole was backfilled flush with the concrete surface using the excavated spoils (rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete.

2.3.2  **Soil Borings**

Between January 5 and February 5, 2015, Glacier utilized a track-mounted Geoprobe® 8140 LS Roto Sonic drilling rig to advance the soil borings that were completed as monitoring wells and extraction wells. Associated also mobilized to the site and was tasked with drilling and sampling nine soil borings, using a Geoprobe® 7822 DT direct-push drilling rig. However, after three days of difficult drilling through cobbles and boulders along Kingsland Avenue, Associated left the project and was replaced by another drilling crew from Glacier using a Geoprobe® 8040 DT direct-push drilling rig to complete the soil borings.

The well borings that were advanced using the Sonic drill rig were advanced using a 4-inch inside diameter (ID) inner sampler and a 6-inch ID outer casing. 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 to 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. At locations where a monitoring well pair was installed, only the deep well location was sampled and logged. Following the installation of the deep well, the corresponding shallow well was advanced to a pre-determined depth and installed without logging or the collection of soil samples. The shallow well borings were advanced to depths between 29.5 and 47 feet bgs. The deep well borings were advanced to depths between 55 and 90 feet bgs.

The soil borings that were advanced using a direct-push drill rig were advanced using a 2-inch OD by 5-foot long acetate lined Macrocore sampler. The soil borings were advanced to depths between 50 and 60 feet bgs. However, refusal was encountered at multiple soil boring locations, and hollow-stem and solid-stem augers were utilized to advance through cobbles and boulders. In some instances, the procedure using hollow-stem and solid stem augers was effective, and the direct push methods were utilized after the cobbles and boulders were penetrated. In other instances, refusal was still encountered and these locations were advanced using sonic methods. Upon completion, each soil boring was backfilled with bentonite chips and the top 4 inches was patched with concrete.

Soil samples were screened with a PID. Up to four 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 boring logs are provided in Appendix D.

For the soil samples collected from well/soil borings, a COC form was maintained and accompanied the soil sample containers to Pace Analytical Service of Melville, NY (Pace), a NYSDOH ELAP accredited laboratory. The soil samples were analyzed for target compound list (TCL) VOCs plus tentatively identified compounds (TICs), following USEPA SW846 Method 8260B, as listed in Table 2-1.

All IDW generated from the monitoring well installation was containerized in Department of Transportation (DOT) approved 55-gallon drums and picked up by AARCO Environmental Services.
Corporation of Lindenhurst, NY (AARCO), on a daily basis for off-site disposal at a permitted facility.

2.3.3 **Shallow and Deep Monitoring Well Construction**

Shallow and deep monitoring wells DEC-136 and DEC-136D and extraction wells EW-01 and EW-02, installed adjacent to 315 Kingsland Avenue were constructed using continuous wrap stainless steel screens in the event DNAPL was present in the monitoring wells. PVC integrity degrades when in direct contact with concentrated chlorinated solvents.

Shallow monitoring well DEC-136 was constructed with 15 feet of 2-inch ID, Type 304 stainless steel 0.010-inch continuous wire wrap screen and a 2-foot long stainless steel sump. The screen was nominally set between 5 feet above and 10 feet below the water table. A #1 size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. Schedule 40 PVC riser was attached to the well screen up to the ground surface. Bentonite chips were then installed around the riser to an elevation of approximately 3-feet bgs. Deep monitoring well DEC-136D, was constructed with 10 feet of 2-inch ID, Type 304 stainless steel 0.010-inch continuous wire wrap screen and a 2-foot long stainless steel sump. The screen was set from 43 feet to 53 feet bgs. A #1 size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. Schedule 40 PVC riser was attached to the well screen up to the ground surface. A 2-foot bentonite pellet seal was installed above the sand pack, followed by a bentonite slurry seal to approximately 3 feet bgs via tremie tube.

Extraction wells EW-01 and EW-02 were constructed of 4-inch ID, Type 304 stainless steel 0.020-inch continuous wire wrap screen and a 2-foot long stainless steel sump. The 15 foot long screens were set from 40 to 55 feet bgs for EW-01 and from 43.5 feet to 58.5 feet bgs for EW-02. A #3 size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. Schedule 40 PVC riser was attached to the well screen up to the ground surface. A 2-foot bentonite pellet seal was then installed above the sand pack, followed by a bentonite slurry seal to approximately 2 feet bgs via tremie tube.
Three shallow monitoring wells (DEC-137, DEC-138, and DEC-139) were installed along Hausman Street to the east of the site. The shallow wells were constructed with 15 feet of 2-inch inside diameter (ID), Schedule 40 PVC -0.010-inch slot screen and 2-inch ID, Schedule 40 PVC riser. The screens were nominally set between 5 feet above and 10 feet below the water table (approximate depths between 30 to 50 feet bgs). A #1 size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite seal was then installed around the riser to an elevation of approximately 2-foot below grade.

Two deep monitoring wells (MW-046D and MW-083D) were installed on the Crown property and three deep monitoring wells (DEC-137D, DEC-138D, and DEC-139D) were installed on Hausman Street during the Pilot Test field activities. The deep monitoring wells were constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010 inch screen and 2-inch ID, Schedule 40 PVC riser. Monitoring wells MW-046D and MW-083D were also constructed with a 2-foot long PVC sump. Monitoring wells MW-046D and MW-083D were set at a total depth of 54 and 70 feet bgs, respectively. Monitoring wells DEC-137D, DEC-138D, and DEC-139D were set at a total depth ranging from 85 to 90 feet bgs. A #1 size sand pack was installed from the bottom of the well up to 2 feet above the top of the screen. A two feet thick bentonite pellet seal was then placed above the sand pack followed by a bentonite slurry seal to approximately 2 feet bgs via tremie tube.

Each monitoring/extraction 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. Extraction well and monitoring well construction logs are provided in Appendices E and F, respectively.

2.4 Monitoring Well Development

At least 24 hours after the monitoring wells were installed, URS developed the wells with the pump and surge development method using a Waterra Inertial Hydrolift pump with dedicated/disposable high density polyethylene (HDPE) tubing and dedicated/disposable HDPE check valves. Prior to well development, a 100-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, 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 100 gallons was removed, and water quality parameters had stabilized. Monitoring well DEC-117 located on Hausman Street was also included in the Pilot Test well development activities because it was inadvertently missed during the Site Characterization Phase VIII field activities. Well development logs may be found in Appendix G. Well development water was collected in DOT approved 55-gallon drums and picked up daily by AARCO for off-site disposal at a permitted facility.

2.5 **Groundwater Level Measurements**

Between February 24 and 26, 2015, water levels were collected from the 11 new monitoring wells and extraction wells in the Site area. Monitoring/extraction wells were checked for depth to groundwater and NAPL, if any. Water levels were measured using a 200-foot long Solinst oil/water interface probe. Table 2-2 presents groundwater level measurements. A groundwater level was unable to be determined for monitoring well DEC-136 because only NAPL was detected in this well.

2.6 **Non-Aqueous Phase Liquid Gauging**

During the Pilot Test fieldwork, existing and newly installed monitoring wells and extraction wells were checked for the presence of NAPL. Between February 4 and 6, 2015, DNAPL was observed in DEC-024D, DEC-024DR, DEC-092D, DEC-136, EW-01, and EW-02. The DNAPL checks for DEC-024D, DEC-024DR, and DEC-092D were made using dedicated/disposable HDPE bailers to verify the presence of DNAPL in the wells. The NAPL checks for DEC-136, EW-01, and EW-02 were made using a Waterra Inertial Hydrolift pump with dedicated/disposable HDPE tubing and dedicated/disposable HDPE check valves.

2.7 **Non-Aqueous Phase Liquid Sampling**

On February 5, 2015, URS collected a sample from DEC-136 using a Waterra Inertial Hydrolift pump with dedicated/disposable HDPE tubing and dedicated/disposable HDPE check valve. When sampling was completed, the dedicated/disposable HDPE tubing, check valve, 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. The hazardous waste manifest is provided in Appendix H.
The NAPL sample was transported under COC to Pace. The NAPL sample was analyzed for TCL VOCs plus TICs, specific gravity by ASTM method D1298, surface tension by ASTM method D-971, and viscosity by ASTM method D-445.

2.8 **Groundwater Sampling**

URS personnel collected groundwater samples between February 24 and 26, 2015 from 12 (1 existing and 11 new) monitoring/extraction wells. Monitoring well DEC-117 located on Hausman Street was also included in the Pilot Test groundwater sampling activities after it was properly developed on January 13, 2015. Prior to sample collection, standing water was purged from each well using a QED SamplePro Micropurge bladder pump equipped with dedicated/disposable bladders and HDPE tubing.

Wells were purged at a rate of 1 L/min 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-52 Multi-parameter Instrument with a flow-through cell and documented on a purge log. Samples were collected after the water quality parameters stabilized and a minimum of one well volume had been removed. One blind field duplicate sample was collected from location DEC-138. All IDW including purge water, bailers, and HDPE tubing was collected and placed into DOT approved 55-gallon drums and removed by AARCO on a daily basis for off-site disposal at a permitted facility. Purge logs are provided in Appendix I.

All samples were transported under COC via laboratory courier to Pace. The samples were analyzed for TCL VOCs plus TICs following USEPA SW846 Method 8260B, as listed in Table 2-1.

2.9 **DNAPL Recovery**

From February 4 through 6 and March 23 through 27, 2015, URS performed DNAPL recovery at existing wells DEC-024D, DEC-024DR, and DEC-092D, which have historically contained measurable and recoverable amounts of DNAPL, and newly installed wells DEC-136, EW-01, and EW-02. URS removed DNAPL from wells DEC-024D, DEC-024DR, and DEC-092D using weighted, dedicated/disposable, 36 inch long 1-liter HDPE bailers. The procedure for DNAPL recovery by bailer was as follows:
1. A bailer was lowered into the bottom of the well and allowed to sit for 30 seconds;

2. Upon removal, any emulsion within the bailer was allowed to separate into two distinct phases;

3. The height (in inches) of DNAPL in the bailer was recorded and the entire contents of the bailer were drummed;

4. Steps 1 through 3 were repeated until two consecutive bailers without any measurable DNAPL were observed.

URS removed DNAPL from wells DEC-136, EW-01, and EW-02 using a Waterra Inertial Hydrolift pump. The procedure for DNAPL recovery by Waterra was as follows:

1. Dedicated HDPE tubing with a check valve was lowered into the bottom of the well;

2. Groundwater and DNAPL was pumped directly into a 55 gallon drum;

3. The pump was allowed to run for several minutes before being turned off to allow the well to recharge;

4. This process was repeated several times per day while measuring the approximate amount of DNAPL recovered. The DNAPL recovery was estimated by tracking the start and stop time DNAPL was discharged into the drum by visual observation and using the calculated pump rate (liters/minute).

A summary of the DNAPL recovered per well during each event is provided on Table 2-3 and graphs are provided in Figures 2-2 through 2-7 for DEC-024D, DEC-024DR, DEC-092D, DEC-136, EW-01, and EW-02, respectively. Based on the measurements summarized in Tables 2-3, approximately 593 liters of DNAPL has been recovered from monitoring well DEC-136. A total of approximately 622 liters of DNAPL has been removed from the six monitoring/extraction wells through March 27, 2015.

2.10 Bucket Auger Soil Sampling

On March 24, 2015, URS personnel used a bucket auger to collect soil samples directly beneath the concrete floor at three locations (BA-01, BA-02, and BA-03) inside the building at 315 Kingsland Avenue. A jackhammer was used to cut through the concrete floor. A 4-inch diameter
bucket auger was then used to collect soil samples to a maximum depth of 17 inches bgs (BA-02). Upon completion, each location was backfilled flush with the concrete surface using the remaining soil and patched with concrete.

A URS geologist screened the soils being removed with a PID and classified the soils. One soil sample was collected from each boring. A COC form was maintained and accompanied the soil sample containers to Pace. The soil samples were analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/polychlorinated biphenyls (PCBs,), and target analyte list (TAL) Metals, as listed in Table 2-1.

2.11 **Investigation Derived Waste Disposal**

AARCO 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.

2.12 **Monitoring Well Maintenance**

Monitoring well inspections and maintenance was performed on all NYSDEC monitoring wells that were installed during the DNAPL Recovery Pilot Test. If maintenance was necessary and performed, it is noted on the form. Maintenance includes: tapping out bolt holes, replacement of security bolts, addition of an anti-seize paste to security bolts, and location ID stenciling adjacent to the locations. Completed inspection forms are provided in Appendix J.

2.13 **Site Survey**

B. Thayer Associates of Woodbury, NY (B. Thayer), a URS subcontractor surveyed additional monitoring well and soil boring locations in March 2015. The survey provides 100-scale mapping and does not include elevated roadways and expressways (i.e., the Brooklyn-Queens Expressway [BQE]). The survey was tied into the existing site survey. 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 (NAD 83), New York State Plane Coordinate System, Long Island Zone. The Site survey drawing is provided in Appendix K.
3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA AND GEOLOGY

This section discusses the physical characteristics of the study area including: surface features, demography and land use, geology, hydrogeology, geotechnical results, utilities and SCGs.

3.1 Surface Features

The elevation of the Spic and Span property is approximately at 20 feet amsl. The topography of the Site investigation area slopes gently downward to the north and northwest to approximately 6 feet amsl at the bulkhead along Newtown Creek and to approximately 10 feet amsl at the intersection of Monitor Street and Norman Avenue. The elevation to the south and east of the On-Site area rises to approximately 30 feet near the intersection of Morgan and Nassau Avenues and the edge of Monsignor McGolrick Park.

The entire On-Site property and the majority of the project area are covered by one-story and multi-story buildings and/or pavement/concrete. The On-Site building situated at 260 Norman Avenue/315-325 Kingsland Avenue is protected from trespassers by locked doors and windows. Vehicle access is through a secured and locked overhead door on Kingsland Avenue.

Limited green space is present in the area and generally on nearby residential properties. Surface soil is present in landscape boxes adjacent to area sidewalks; however, given the nature of the urban environment the soil should not be construed as representative of clean surface soil. Monsignor McGolrick Park is a 9.13 acre park 1,200 feet southwest of the Site bounded by Monitor and Russell Streets and Nassau and Driggs Avenues (Plate 1).

3.2 Demography and Land Use

The Site is located in the Greenpoint/East Williamsburg Industrial Area section of the Borough of Brooklyn, Kings County, New York. The population of the Brooklyn (Kings County) is 2,592,149 according to the 2013 Census estimate. The area is a mixture of residences and manufacturing facilities, including both commercial and industrial facilities. The two Site buildings located at 307-313 Kingsland Avenue (307 Kingsland Avenue), that formerly housed a portion of the Spic and Span operations are currently utilized as a movie prop rental business and associated warehouse. The Site building located at 260 Norman Avenue/315-325 Kingsland Avenue (315 Kingsland Avenue) that also formerly housed a portion of the Spic and Span operations is currently
unoccupied. The majority of the On-Site area and the majority of the Site area are covered by one-
story and multi-story buildings and/or pavement/concrete. Residential areas are generally south of
the Site, although residents live within a multi-story building located on the Site. The residential
building space and unoccupied space are situated in adjacent structures. Petroleum refining and
storage operations occupy a significant portion of the Greenpoint area, especially to the north and
east.

Land use in New York City is regulated by the City’s Zoning Resolution, which has two
parts: zoning text and zoning maps. The zoning text establishes zoning districts and sets forth
regulations governing their land use and development. The zoning 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 four zoning districts identified by the New York City
Department of City Planning (http://www.nyc.gov/html/dcp/html/zone/zh_zmaptable.shtml). These
zoning districts are: R6, R6B, M1-2, and M3-1. The current (2012) zoning and land use of
individual properties was determined through the NY City Map (http://gis.nyc.gov/doitt/nycitymap).

R6 and R6B Residential Districts (medium density) - Primary permitted uses in the R6
district include medium density residential. A mixture of building types are allowed and range from
small apartment buildings set back on small lots to row houses to large-scale apartment towers. The
“B” suffix indicates a contextual district, where supplemental regulations require a new development
to maintain the scale and form of the existing neighborhood context. Residential properties along
Monitor Street, and the majority of Kingsland and Nassau Avenues, are zoned R6B.

M1-2 Manufacturing District (light industrial) - Permitted uses in the M1-2 district include
typical light industrial, office and retail uses. M1 districts are often a buffer between M2 or M3
manufacturing districts and adjacent residential or commercial districts. Residences are generally not
included within M1 districts unless as part of a Special Mixed Use District. The “2” suffix refers to
supplemental parking requirements. The majority of properties south of Norman Avenue are located
in the M1-2 district.

M3-1 Manufacturing District (heavy industrial) - Permitted uses in the M-3 industrial district
include heavy industry that generate potential nuisance effects such as noise, traffic or pollutants and
include power plants and fuel supply depots. The “1” suffix refers to supplemental parking requirements. Properties north of Norman Avenue and along the east side of Morgan Avenue are zoned M3-1.

Two properties have two zoning districts listed. The property at 284 Kingsland (Lot 48) is listed as both R6 and M1-2. The property at 307 Kingsland Avenue (Lot 15) is listed as both R6B and M1-2.

3.3 Regional Geology

The Spic and Span Site 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 amsl. 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 in the Meeker Avenue vicinity, the Site is underlain from the surface down by the upper glacial aquifer, the Raritan Formation, and crystalline bedrock. 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 gray, 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 by the USGS: 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.

The Raritan Formation was positively encountered in ten top of clay well locations at depths between approximately 108.5 and 138.0 feet bgs (elevations of -57 to -121 feet amsl) and was described as gray clay with color variations of white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, and texture variations of 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.

### 3.4 Site Geology

Figure 3-2 presents the locations of the monitoring wells and cross sections developed during the RI. Cross sections A-A’ and B-B’ are shown on Figures 3-3 and 3-4, respectively, and represent the cross-sections based on soil borings from the Spic and Span area. Table 3-1 summarizes the site stratigraphy. Table 3-2 summarizes the stratigraphy from bucket auger soil samples collected beneath the concrete floor inside the building at 315 Kingsland Avenue. Based upon subsurface data obtained during this and previous investigations, the upper glacial aquifer was penetrated and the top of the Raritan Formation was encountered at the top of clay monitoring well locations (i.e., DEC-035TC, DEC-058TC, DEC-062TC, and DEC-063TC). The following textural units have been found in the upper glacial aquifer in most borings, from the surface downward: a fill unit; a glacial till unit; an inclusive sand unit within the glacial till unit; a sand unit; a lacustrine clayey silt unit; a fine sand and silt unit; a sand/ sand and gravel unit; and the Raritan Formation. Due to the heterogeneous nature of the geology, some but not all of the units were identified at each boring. The thickness of the upper glacial aquifer in the Spic and Span area is approximately 125 to more than 138 feet thick. Figure 3-5 depicts the elevation of the top of the Raritan Formation in the Spic and Span area, which appears to dip towards the west-northwest.

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.).

A 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 glacial till
unit found at the surface pinches out to the north and northeast between DEC-057 and DEC-054 to the north and DEC-058 to the northeast, and beneath the 315 Kingsland Avenue building/adjacent courtyard. At these locations and the wells located north of these locations, the sand unit may be found at the surface.

An inclusive sand layer was identified at approximately 12-22 feet bgs within the glacial till unit in the vicinity of SSB-11 (Figure 3-4). The inclusive sand layer contained elevated concentrations of PCE and DNAPL in DEC-136, EW-01, EW-02, SSB-32, and SSB-33. The inclusive sand unit is present along Kingsland Avenue, adjacent to the Former Spic and Span building and is found laterally north and south between DEC-136D and SSB-32 (Figure 3-6). Where identified in borings, the inclusive sand has been found between approximately 12 and 24 feet bgs. Figure 3-7 shows the approximate thickness of the inclusive sand layer. The inclusive sand unit’s thickness is greatest at SSB-28 (approximately 10 feet thick) and thins to the north (approximately 1-foot thick at SSB-33) and south (approximately 3.5 feet thick at DEC-136D). The bottom of the northern edge of the inclusive 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 northern edge of the inclusive sand layer is approximately 35 feet from DEC-024D and DEC-024DR. The north/south (horizontal) extent of the inclusive sand layer appears to have been delineated and a vertical profile has been established as depicted in Figure 3-4. The eastern extent of the inclusive sand layer has not been delineated and is assumed to extend under Kingsland Avenue. The western extent of the inclusive sand layer appears to connect with the lower sand unit beneath the Site buildings and courtyard (Figure 3-3).

Beneath the sidewalk area adjacent to 315 Kingsland Avenue, a lower sand unit is present between approximately 20 to 60 feet bgs at the majority of boring locations and is represented by stratified sands of varying textures containing some to no fines.

A lacustrine clayey silt unit has been observed as an inclusive unit within the sand unit, and was observed in most of the borings at the site. The thickness of the clayey silt unit, where present, varies from 0.5 to over 7 feet thick. The presence of the clayey silt unit (i.e., a low permeability unit) at well locations DEC-024D, DEC-024DR, DEC-092D, and EW-01 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 (i.e., approximately -30 feet amsl). This clayey silt unit was also identified in nearby
wells at depths ranging from 50 feet bgs (i.e., approximately -30 feet amsl) at DEC-024DR to 65 feet bgs (i.e., approximately -49 feet amsl) at DEC-023D. The elevation of the top of the clayey silt unit is depicted in Figure 3-8. The clayey silt unit’s thickness is greatest at DEC-063D (approximately 7 feet thick) and thins to the north (approximately 1-foot thick at DEC-034D and DEC-058D) and east (approximately 2.5 feet thick at DEC-062D). The lacustrine clayey silt has a lower permeability which has impeded further downward migration of DNAPL and dissolved phase contaminants.

The fine sand and silt unit beneath the sand unit 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. This unit is laterally discontinuous and texturally variable in nature and was typically found north of Norman Avenue and east of Kingsland Avenue.

A sand/sand and gravel unit was identified overlying 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 clay with color variations of green brown, brown, or white with brown banding; and varied texturally with silt and some sand, clay with some sand, clay and silt, or fine sand and silt and was encountered between 125 and 138.5 feet bgs (approximately -104 and -121 feet amsl). An isopleth of the top of the Raritan formation is provided on Figure 3-5. The top of the Raritan Formation dips to the north/ northwest.

3.5 Geotechnical Test Results

During RI Phase I, two soil samples from Shelby tubes were analyzed in March 2011 by 3rd Rock, LLC (3rd Rock) of East Aurora, NY for grain size distribution (ASTM D422), Atterberg Limits (ASTM D4318), and falling head permeability (ASTM D5084). Additional soil samples from grab samples and Shelby tubes were collected between August to September 2011 and between December 2011 and January 2012 and analyzed by 3rd Rock for the same parameters. Results are summarized on Table 3-3 and discussed below.

3.5.1 Geotechnical Samples from Overburden Aquifer

Overburden samples from SSB-13 and SSB-14 (near DEC-025/025D) with depths between 5 and 32 feet were generally poorly graded sand, silty sand, and clayey sand with a Unified Soil Classification System (USCS) classification of SP, SM, and SC-SM. Soils were identified as either
non-plastic or of low plasticity. Two samples were analyzed by ASTM D5084 Method C for permeability. Results were \(9.4 \times 10^{-3}\) and \(1.9 \times 10^{-2}\) cm/sec.

Deep overburden samples were collected from SSB-14, DEC-059D, DEC-063D, and DEC-067D with depths between 50 and 66 feet bgs. Results confirm the classification of ML for the depth intervals in the monitoring wells DEC-059D and DEC-063D provided in the boring logs. Soils were identified as non-plastic. The measured permeability values of the silt/sandy silt layer varied between \(1.2 \times 10^{-4}\) and \(6.1 \times 10^{-6}\) cm/sec, which is 1 to 3 orders of magnitude less than those of the shallow overburden above.

### 3.5.2 Geotechnical Samples from Top of Raritan Formation

Samples were collected from the top of the Raritan Formation, and included samples from the mixture of sand and clay material from above the clay in DEC-035TC (140-140.9 feet bgs) and DEC-058TC (141-142.5 feet bgs and 142.5-145 feet bgs) and from the clay in DEC-062TC (137.5-140 feet bgs and 140-140.5 feet bgs) and DEC-063TC (125-127.5 feet bgs). USCS classifications in the Raritan ranged from SM to SC-SM and CL-ML. Soils were identified as either non-plastic or of low plasticity. The measured permeability values were \(1.2 \times 10^{-6}\) and \(4.9 \times 10^{-8}\) for the mixture of sand and clay above the clay, and varied between \(1.1 \times 10^{-7}\) to \(3.4 \times 10^{-8}\) cm/sec for the clay.

### 3.6 Groundwater Levels and Hydrogeology

The primary hydrogeologic unit identified beneath the investigation area is the upper glacial aquifer. Groundwater in the area is present in unconfined conditions; however, locally confined conditions are possible due to the presence of interbeds of sand, clay, and silt. The water table surface may be found between approximately 11 and 38 feet bgs depending on the well location. The water table has been influenced 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, which has prevented the expansion of the Off-Site Plume.

#### 3.6.1 Groundwater Levels

Several rounds of synoptic groundwater levels were obtained from monitoring wells in the Site area during previous investigations. These were used to develop groundwater contour elevation
maps so that groundwater flow directions could be determined. A potentiometric surface map based on the July 14-15, 2014 water level measurements from the shallow overburden wells, using a 1-foot contour interval, is provided on Figure 3-9. A potentiometric surface map based on the water level measurements from the deep overburden wells, using either a 0.5-foot or 1-foot contour interval, is provided on Figure 3-10 for July 14-15, 2014. A potentiometric surface map based on the water level measurements from the top of Raritan formation wells, using either a 0.2 or 0.5-foot contour interval, is provided on Figure 3-11 for July 14-15, 2014. Water level measurements collected from the wells installed during the Pilot Test field activities are included in Table 2-2. Vertical hydraulic gradient calculations are provided on Table 3-4.

Water levels were adjusted in monitoring wells DEC-034, DEC-083 and DEC-112 where LNAPL was found to be present based on specific gravity measurements.

In the immediate vicinity of the Spic and Span property, the shallow and deep groundwater flow is north to northeast. The horizontal hydraulic gradient of the shallow groundwater flow was approximately 0.02 ft./ft. In the immediate vicinity of the Spic and Span property, the top of clay groundwater flow is east to northeast.

The vertical hydraulic gradients in shallow and deep well pairs varied in direction across the investigation area. In July 2014, vertical hydraulic gradients in well pairs DEC-023/023D, DEC-024/024D, DEC-114/114D were slightly positive or downwards (0.002, 0.003 and 0.001 ft./ft., respectively) based upon the water level information. Vertical hydraulic gradients in well pairs DEC-055/DEC-055D, DEC-057/DEC-057D, DEC-058/058D, DEC-059/059D, DEC-060/060D, DEC-062/DEC-062D, and DEC-116/DEC-116D were positive or downwards to a greater extent (0.204, 0.053, 0.111, 0.036, 0.324 and 0.033 ft./ft., respectively). The vertical hydraulic gradients in well pair DEC-035/035D, DEC-063/DEC-063D, DEC-113/DEC-113D and DEC-115/115D were slightly negative or upwards (-0.001, -0.005, -0.002 and -0.009 ft./ft., respectively) based upon the water level information.

The vertical hydraulic gradients in top of clay well triplets varied in direction across the investigation area during RI Phase I field activities. Vertical hydraulic gradients between the shallow and top of clay wells at DEC-035/035TC, DEC-058/058TC, DEC-062/062TC and DEC-063/063TC were positive or downwards (0.057 to 0.087 ft./ft.). Vertical hydraulic gradients between the deep
and top of clay wells at DEC-035D/035TC, DEC-058D/058TC, DEC-062D/062TC, and DEC-
063D/063TC were positive or downwards (0.003 to 0.101 ft./ft.).

3.6.2 Slug Test Results

Slug test results from previous investigations are presented on Table 3-5. In all cases, the rising head and falling head results were well within one order of magnitude of each other. The representative hydraulic conductivity (K) was computed as the geometric mean of the rising and falling head values. In cases where a constant static head was not established prior to the start of the falling head test, and since rising head tests are considered to be more representative of hydraulic conductivity (Bouwer, 1989), the K value considered to be representative is the rising head value (DEC-058D, DEC-060D, DEC-061D, and DEC-062D).

The hydraulic conductivity in the overburden ranged from $2.91 \times 10^{-2}$ cm/sec (DEC-063) to $8.32 \times 10^{-5}$ cm/sec (DEC-060). In the shallow overburden, the mean value of K is $8.03 \times 10^{-3}$ cm/sec for the sand clayey silt/sand unit, and $3.15 \times 10^{-4}$ cm/sec for the sandy silt. In the deep overburden, the mean value of K is $1 \times 10^{-3}$ cm/sec for the sand/silty sand, and $9.32 \times 10^{-5}$ cm/sec for the sandy silt.

3.7 Surface Water and Hydrology

The Site slopes slightly to the west and north and is bounded by streets on the north and east. The site is entirely covered by buildings and/or pavement/sidewalks. Minimal On-Site ponding was observed during field investigations. There are stormwater drop inlets (DIs) on the northeast corner of the Site along Kingsland Avenue near Norman Avenue. Three additional DIs are located near the intersection of Norman Avenue and Kingsland Avenue. DI locations are shown on the site survey, which may be found in Appendix K.

The nearest surface water body is Newtown Creek located approximately 1,500 feet northeast of the Site. Newtown Creek is classified as a Class SD (marine waters) surface water body by the NYSDEC. The best usage of Class SD waters is fishing. These waters shall be suitable for fish, shellfish, and wildlife survival. The classification may be given to those waters that, because of natural or man-made conditions, cannot meet the requirements of primary and secondary contact recreation and fish propagation. While Newtown Creek may not be suitable for swimming and other recreational activities that involve human contact with surface water, individuals use Newtown Creek
for swimming. Water is not withdrawn from Newtown Creek for potable use. Numerous stormwater drains from surrounding roadways and permitted Spill Discharge Elimination System (SPDES) outfalls discharge into Newtown Creek, including those discharging groundwater collected and treated on the nearby Exxon/Mobil remediation site.

Surface water levels within Newtown Creek vary depending on the tide. High tide in Newtown Creek is generally at an elevation of 4 to 5 feet; low tide is generally at an elevation of 0 to -1 feet (http://www.saltwatertides.com).

3.8 Utilities

Utilities on and near the Site include underground water, electric, natural gas, sanitary and storm sewer. Overhead electric and communication lines run north-south adjacent to the Site within the western sidewalk along Kingsland Avenue and east-west within the north sidewalk along Norman Avenue. Fire hydrants are located on Kingsland and Norman Avenues. Approximate utility information is provided on the site survey which may be found in Appendix K.

3.9 Subsurface Site Structures

During the geophysical survey performed during the Spic and Span On-Site Phase III RI, three suspected USTs/unknown subsurface structures were located within the “T” shaped courtyard (Appendix C). One is in the northwest corner at the top of the “T”, one is in the southwest corner of the top of the “T” and one is approximately halfway down the length of the “T”, just west of the 8-foot wide by 18-foot long utility vault.

Three apparent dry wells and a potential tank/former boiler were found in the courtyard (Figure 2-1). One apparent dry well was uncovered at a depth of 3 feet bgs in the northwest corner of the courtyard. A 4-inch concrete pad covered the top of the dry well and the dry well was filled with water. The bottom of the dry well was at approximately 9.5 feet bgs. Two apparent dry wells were uncovered in the southwest corner of the courtyard at the top of the “T”. The western dry well was uncovered at a depth of 1.8 feet bgs and had a 4-inch concrete pad cover. The dry well was approximately 6-8 feet in diameter and brick lined. The eastern dry well was found directly beneath the concrete surface and had a 5-inch concrete pad cover. Based on Sanborn maps for the Site, the eastern dry well location coincides with a former brick smoke stack.
An apparent tank/former boiler was located halfway down the length of the “T” just west of the 8-foot wide vault. During boring pre-clearing operations, URS observed that the top of the apparent tank had been cut off and it was backfilled with brick. The tank/former boiler was approximately 20 feet long and consisted of ½-inch thick riveted steel and was sitting in a brick lined vault. The annulus between the tank and the vault wall was backfilled with brick, concrete and steel pipes of various diameters. Based on the 1916 and 1942 Sanborn maps for the Site, the apparent tank is located approximately where two horizontal boilers were located.

3.10 Standards, Criteria and Guidance

For each medium, detected concentrations of individual contaminants were compared to applicable SCGs. The site-specific SCGs were determined for the individual media as follows:

Soil

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

On August 3, 2011, eight soil samples were obtained from the 0 to 2-foot depth interval from eight locations in Monsignor McGolrick Park as part of the SC Phase VI field activities. These samples were analyzed for TCL/TAL contaminants. Detected concentrations were considered to be representative of site-specific background for the Spic and Span site. It should be noted that no VOCs were detected above unrestricted use criteria in the background soil samples.

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 Technical and Administrative Guidance Memorandum (TAGM) #4046, Determination of Soil Cleanup Objectives and Cleanup Levels, 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.

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 property...
of location of the soil boring is a consideration in the determination of the appropriate soil SCGs. The majority of properties within the investigation area south of Nassau Avenue to the BQE and west of Kingsland Avenue are zoned residential. The majority of properties north of Nassau Avenue, and east of Morgan Avenue, are zoned manufacturing. The majority of properties east of Kingsland Avenue are zoned manufacturing. A few dual-zoned residential and manufacturing properties are present.

As discussed in Section 3.2, 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. Therefore, 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 residential and restricted residential land use soil cleanup criteria for the soil samples are used on the soil analytical data tables in Section 4.

**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.
4.0 NATURE AND EXTENT OF CONTAMINATION

The following sections discuss the results of the soil, groundwater and NAPL sample analyses for the DNAPL Recovery Pilot Test fieldwork at the Spic and Span site, and information on NAPL collected from previous investigations. The complete validated analytical results from the Pilot Test samples are presented in the Data Usability Summary Reports (DUSR) in Appendix L, on compact disc (CD). Data summary tables, Form I and Form Ie (TICs) are provided in the DUSRs and include the reporting limit for each non-detected compound.

4.1 Soil Analytical Results

Forty soil samples plus 5 field duplicates from 20 locations were collected and analyzed for VOCs during the DNAPL Recovery Pilot Test during the period January 5 through March 24, 2015. At several locations, more than one sample was obtained from multiple depths. The bucket auger (BA) samples were also analyzed for TCL SVOCs, TCL Pesticides, TCL PCBs and TAL metals. The soil sample results were compared to appropriate Part 375 criteria identified in Section 3.10.

A summary of the detected TCL VOC analytical results for soil samples as compared to unrestricted use, protection of groundwater, and site background SCGs is presented in Table 4-1. Table 4-2 lists the detected TCL VOC analytical results for soil samples as compared to residential and restricted residential SCGs. Table 4-3 lists the detected non-VOC analytical results for soil samples as compared to unrestricted use, protection of groundwater, and background SCGs. Table 4-4 lists the detected non-VOC analytical results for soil samples as compared to residential and restricted residential SCGs. Tables 4-5A through 4-5E provide statistical summaries of detected compounds for soil samples as follows: the number of samples; (including QC samples); the number of detections; the minimum, maximum and average values; the number of exceedances; and the location and depth of the maximum value as compared to unrestricted use criteria, protection of groundwater criteria, site background criteria, residential use criteria, and restricted residential use criteria, respectively. Soil data exceeding criteria is presented on Figure 4-1 for Unrestricted Use, Protection of Groundwater, and Site Background criteria and Figure 4-2 for Residential and Restricted Residential Use.
Unrestricted Use, Protection of Groundwater Site Background Soil Criteria

Soil sample results were compared to unrestricted use, protection of groundwater, and site background criteria as presented on Table 4-1 (VOCs only) and Table 4-3 (non-VOCs). PCE exceeded unrestricted use and protection of groundwater criteria in EW-02, MW-046D, SSB-48, and SSB-50 through SSB-56. Concentrations at concentrations ranging from 1.4 mg/kg at MW-046D (7-8 feet bgs) to 36,000 mg/kg at EW-02 (57-57.5 feet bgs).

Several CVOC degradation products also exceeded their respective unrestricted use and protection of groundwater criteria in Pilot Test soil samples including:

- TCE at 21 mg/kg in EW-02 (57-57.5 feet bgs), 1.6 mg/kg in SSB-52 (40-41 feet bgs), SSB-54 (4 mg/kg and 43 mg/kg in SSB-54 (34-35 feet bgs and 38-40 feet bgs), respectively), 20 mg/kg and 8.9 mg/kg in SSB-55 (39.5-40 feet bgs and 44-45 feet bgs, respectively), and 63 mg/kg in SSB-56 (18-19 feet bgs);

- cis-1,2-DCE at 0.26 mg/kg in SSB-51 (15-16 feet bgs) and 0.81 mg/kg in SSB-54 (38-40 feet bgs); and

- vinyl chloride at 4 mg/kg and 43 mg/kg in SSB-54 (34-35 feet bgs and 38-40 feet bgs, respectively).

Several petroleum-related and other VOC compounds also exceeded their respective unrestricted use and protection of groundwater criteria including: 1,2,4-trichlorobenzene (EW-02); acetone (SSB-55); benzene (DEC-137D and MW-046D); ethylbenzene (DEC-137D and DEC-138D); isopropylbenzene (DEC-137D, MW-046D, SSB-48, and SSB-56); toluene (DEC-137D); and xylene [DEC-137D, DEC-138D, DEC-139D, MW-046D, and MW-083D] (unrestricted use only).

Only bucket auger (BA) soil samples collected inside the building directly beneath the concrete floor at 315 Kingsland Avenue were analyzed for SVOCs, pesticides, PCBs and metals. No pesticides or PCBs were detected and of the SVOCs detected, no concentrations exceeded unrestricted use, protection of groundwater, or site background criteria.

Metals detected at concentrations exceeding unrestricted use criteria include: cadmium, chromium, iron, and vanadium in BA-01; iron, lead, and silver in BA-02; and cadmium, chromium, copper, iron, and lead in BA-03. No metals exceeded protection of groundwater criteria. Only iron in was detected at concentrations exceeding site background criteria in BA-01, BA-02, and BA-03.
Residential and Restricted Residential Soil Criteria

Soil sample results were compared to residential and restricted residential use criteria as presented on Table 4-2 for VOCs and Table 4-4 for non-VOCs. PCE exceeded residential use criteria in EW-02, SSB-48, and SSB-50 through SSB-56. Concentrations of PCE exceeding residential use criteria ranged from 8 mg/kg in SSB-52 (52.7-53.2 feet bgs) to 36,000 mg/kg in EW-02 (57-57.5 feet bgs). PCE exceeded restricted residential use criteria in EW-02, and SSB-51 through SSB-56. Concentrations of PCE exceeding restricted residential use criteria ranged from 96 mg/kg in SSB-52 (40-41 feet bgs) to 36,000 mg/kg in EW-02 (57-57.5 feet bgs).

TCE exceeded its residential use criteria at 21 mg/kg in EW-02 (57-57.5 feet bgs) and 20 mg/kg in SSB-55 (39.5-40 feet bgs); and both the residential use and restricted residential use criteria at 43 mg/kg in SSB-54 (38-40 feet bgs) and 63 mg/kg in SSB-56 (18-19 feet bgs).

Benzene was the only petroleum-related VOC detected exceeding residential and restricted residential use criteria at 9 mg/kg in DEC-137D (28-29 feet bgs).

Cadmium, chromium, and/or iron exceeded residential use criteria in the bucket auger samples and only cadmium exceeded restricted residential use criteria.

4.2 Non-Aqueous Phase Liquid Analytical Results

A summary of the detected compounds in all DNAPL samples collected by URS during previous investigations is presented in Table 4-6.

4.2.1 Dense Non-Aqueous Phase Liquid Analytical Results

The results of all DNAPL samples collected in the Spic and Span area are summarized below.
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Specific Gravity</th>
<th>Viscosity (centistokes)</th>
<th>Surface Tension (dynes/cm)</th>
<th>PCE Concentration (mg/kg)</th>
<th>Collected by and Date</th>
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</thead>
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<tr>
<td>DEC-024D</td>
<td>NM</td>
<td>NM</td>
<td>NM</td>
<td>700,000 (70%)</td>
<td>URS, May 29, 2008</td>
</tr>
<tr>
<td>DEC-024D</td>
<td>NM</td>
<td>NM</td>
<td>NM</td>
<td>730,000 (73%)</td>
<td>URS, June 22, 2009</td>
</tr>
<tr>
<td>DEC-024DR</td>
<td>1.2942</td>
<td>1.211</td>
<td>26.4</td>
<td>110,000 (11%)</td>
<td>URS, November 9, 2011</td>
</tr>
<tr>
<td>DEC-092D</td>
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<td>NM</td>
<td>NM</td>
<td>450,000 (45%)</td>
<td>URS, January 21, 2013</td>
</tr>
<tr>
<td>DEC-092D</td>
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<td>1.056</td>
<td>4.8</td>
<td>NM</td>
<td>URS, March 3, 2013</td>
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<td>DEC-136</td>
<td>1.5079</td>
<td>0.918</td>
<td>32.8</td>
<td>2,000,000 (200%)*</td>
<td>URS, February 5, 2015</td>
</tr>
</tbody>
</table>

NM = not measured
* Concentration greater than 100% because of compounding errors from dilutions during analysis.

4.3 **Groundwater Analytical Results**

A summary of the detected TCL VOCs in the Pilot Test groundwater samples is presented in Table 4-7. Results exceeding TOGS No. 1.1.1 Class GA groundwater criteria are indicated with a circle. The locations of detected VOCs that have exceeded their respective criteria are shown on Figure 4-3. Isoconcentration contours of PCE using the most recent analytical data from each groundwater sampling location north of Meeker Avenue and west of Van Dam Street in the shallow groundwater are shown on Figure 4-4 and the deep overburden in Figure 4-5. Isoconcentration contours of TCE in the shallow groundwater samples are shown on Figure 4-6 and the deep overburden in Figure 4-7. Table 4-8 provides a statistical summary of the detected parameters for the Pilot Test groundwater samples as follows: the number of samples; the number of detections; the minimum, maximum and average values; the number of exceedances; and the location of the maximum value. Table 4-9 lists PCE and TCE concentrations from the most recent analytical data for each groundwater sample location.
4.3.1 **Groundwater PCE Detections**

PCE was detected in 10 of the 12 monitoring well locations sampled during the Pilot Test at concentrations ranging from 5 µg/L to 97,000 µg/L. Eleven of the 12 monitoring wells sampled had concentrations exceeding groundwater criteria (Figure 4-3). The highest concentration of PCE in the shallow groundwater was detected at DEC-138 (46 µg/L). Shallow well DEC-136 was not sampled for dissolved VOC contaminants as part of the Pilot Test because it contained PCE DNAPL. The highest concentration of PCE in the deep groundwater was detected at EW-01 (97,000 µg/L), followed by EW-02 (78,000 µg/L).

The maximum detected PCE concentration in the most distant Off-Site shallow groundwater sampled during the Pilot Test was in monitoring well DEC-138 (46 µg/L) located on Hausman Street. The concentrations of PCE in shallow wells DEC-117, DEC-137, DEC-138, and DEC-139 are comparable or less than shallow wells situated on Sutton Street and points east that were sampled during the Off-Site Phase III RI sampling event.

The maximum detected PCE concentration in On-Site deep groundwater sampled during the Pilot Test was in monitoring well EW-01 (97,000 µg/L) located adjacent to the courtyard at 315 Kingsland Avenue. The maximum detected PCE concentration in Off-Site deep groundwater sampled during the Pilot Test was in monitoring well DEC-139D (340 µg/L) located on Hausman Street. In general, concentrations of PCE in the deep groundwater are higher than those in the shallow groundwater; the plume is larger in horizontal extent in the deep groundwater.

Using the most recent groundwater data for each sample location, the highest concentration of PCE in the shallow overburden (Figure 4-4) was in monitoring well DEC-060 (35,000 µg/L) adjacent to 300 Kingsland Avenue and in the deep overburden (Figure 4-5) at monitoring well DEC-024D (170,000 µg/L) adjacent to 315 Kingsland Avenue.

4.3.2 **Groundwater TCE Detections**

TCE was detected in 9 of the 12 monitoring well locations sampled during the Pilot Test, at concentrations ranging from 2 µg/L to 1,200 µg/L. Eight of the 12 monitoring well locations had concentrations exceeding groundwater criteria. The highest concentration of TCE in the shallow overburden sampled during the Pilot Test was detected at DEC-137 (770 µg/L), followed by DEC-
138 (230 µg/L). The highest concentration of TCE in the deep overburden sampled during the Pilot Test was detected at EW-01 (1,200 µg/L), followed by EW-02 (460 µg/L).

Using the most recent groundwater data for each sample location, the highest concentration of TCE in the shallow overburden (Figure 4-6) was at DEC-060 (5,000 µg/L) and in the deep overburden (Figure 4-7) at MW-085D (7,800 µg/L) adjacent to the Crown property.

4.3.3 PCE and TCE Degradation Product Detections

PCE and TCE degradation products were detected in the Pilot Test groundwater samples at concentrations exceeding groundwater criteria (Figure 4-3). Cis-1,2-DCE was detected in 9 of the 12 monitoring wells sampled during the Pilot Test, each above groundwater criteria, with concentrations ranging from 8 µg/L to 300 µg/L. The range of cis-1,2-DCE varied with the highest concentration detected at DEC-137 (300 µg/L) followed by EW-01 (230 µg/L). Trans-1,2-DCE exceeded criteria in 1one monitoring well (DEC-137D at 10 µg/L). Vinyl chloride was detected at concentrations ranging from 1 µg/L to 55 µg/L in 6 of the 12 monitoring well locations sampled and exceeded criteria in 5 of the wells, with the highest concentration detected at DEC-137 (55 µg/L) followed by DEC-117 (45 µg/L). 1,1-dichloroethane (DCA) exceeded criteria in DEC-137 and EW-01 (both at 9 µg/L). 1,1-DCE exceeded criteria in DEC-137 (12 µg/L), EW-01 (21 µg/L) and EW-02 (6 µg/L). 1,2-DCA exceeded criteria in DEC-0138D (1 µg/L) and DEC-139D (3 µg/L).

While not a PCE or TCE degradation product 1,1,1-TCA was detected above criteria in EW-01 (6 µg/L) and EW-02 (9 µg/L).

Compounds associated with petroleum products (i.e., BTEX, 1,2,4-trichlorobenzene, isopropylbenzene, and/or methyl tert-butyl ether) have been detected above criteria in wells DEC-117, DEC-137, DEC-138, DEC-138D, DEC-139, DEC-139D and EW-01.

4.3.4 Overall Plume Extent

Based upon the most recent groundwater sampling events, the horizontal and vertical extent of the dissolved phase plume has mostly been determined. As shown on Figures 4-4 and 4-5 for PCE and Figures 4-6 and 4-7 for TCE, the horizontal extent of the dissolved phase plume in shallow and deep groundwater appears to originate around the Spic and Span Site where the highest PCE concentrations were detected in the wells with DNAPL. The second source identified around DEC-
025D near 300 Kingsland Avenue was attributed to Spic and Span operations based on information from nearby residents. The plume is spreading with groundwater flow towards the northeast, east and with a southerly component, and via downward migration to deeper geologic zones (i.e., approximately 60 – 65 feet bgs). PCE was not detected in the 4 top of clay wells last time they were sampled (February-March 2013) although previous results from these top of clay wells had detections of PCE, albeit below SCGs. The vertical extent of PCE and TCE impacted groundwater extends down to the top of the clayey silt unit, approximately 60 feet bgs. The plume appears to be spreading laterally along the clayey silt interface and into the lower sand unit to areas toward the northeast (i.e., Crown Property) towards Exxon Mobil well RW-17, and toward the east-east/southeast (i.e., as far as Morgan Avenue and Hausman Street) toward ExxonMobil well RW-22.

Based upon the data collected to assess the potential for degradation of PCE in the groundwater system as presented above, there is evidence that reductive dechlorination is occurring in the vicinity of the Site. Rates of degradation are very difficult to determine due to the unknown quantity of source material present beneath the Spic and Span Site and beneath the 300 Kingsland Avenue building. Based upon the geochemical conditions in the groundwater system, the aquifer is conducive for naturally occurring reductive dechlorination, and therefore, the geochemical conditions could be enhanced via in-situ bioremediation technologies to further promote higher rates of reductive dechlorination. During the Feasibility Study, this and other remedial technologies such as in-situ chemical oxidation will be evaluated.

4.4 DNAPL Observations

DNAPL observations and solvent-like odors were recorded at the Site throughout various phases of the SC and RI Phases. The DNAPL observations and solvent-like odors were recorded during the advancement of soil borings, installation of monitoring wells, and during well development and/or sampling. A summary of subsurface DNAPL observations and solvent-like odors are presented in Table 4-10. The lateral extent of the DNAPL based on observations and solvent-like odors is shown on Figure 4-8.

4.4.1 Inclusive Sand Layer

DNAPL and solvent-like odors were recorded within the inclusive sand layer which is located within the till unit, between SSB-25 and SSB-32 at approximately 12.0 to 24.0 feet bgs as
shown on Figure 3-4. DNAPL was observed within the inclusive sand layer at SSB-11, SSB-26, SSB-28 and DEC-136. Percent level concentrations of PCE were detected in the inclusive sand layer at SSB-11 [190,000 mg/kg (15-16 feet bgs)], SSB-26 [230,000 mg/kg (16-17 feet bgs)] and SSB-28 [14,000 mg/kg (16.5-17.5 feet bgs)]. The boring for DEC-136 was not continuously sampled because of pairing with DEC-136D. The presence of DNAPL in DEC-136 has been confirmed through the free product found in the monitoring well during well development and subsequent pumping during the pilot test. A total of approximately 156 gallons of DNAPL has been removed from DEC-136 during the pilot test.

The bottom of the northern extent of the inclusive sand layer near EW-01, SSB-32 and SSB-33 contains vertical sand stringers. In addition vertical sand stringers and lenses were noted in SSB-32 and SSB-33 within the glacial till between 35 and 47 feet bgs. These sand stringers represent a vertical pathway from the inclusive sand layer through the glacial till unit into the lower sand 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 extent of the inclusive sand layer has not been delineated and is assumed to extend under Kingsland Avenue. The western extent of the inclusive sand layer appears to connect with the lower sand unit beneath the On-Site buildings and courtyard.

4.4.2 **Lower Sand Unit**

DNAPL and solvent-like odors were recorded within the lower sand unit. Elevated concentrations of PCE were noted in the lower sand unit at DEC-024DR [1,000 mg/kg (45-46 feet bgs)], SSB-32 [32,000 mg/kg (47-48 feet bgs) and 22,000 mg/kg (52-53 feet bgs)], SSB-33 [29,000 mg/kg (45-46 feet bgs)], SSB-52 [8 mg/kg (52.7-53.2 feet bgs)], SSB-55 [2,300 mg/kg (54.5-55 feet bgs) and SSB-56 [630 mg/kg (59.5-59.75 feet bgs)]. DNAPL was observed in SSB-54 at approximately 38 feet bgs. Solvent-like odors combined with elevated photoionization detector (PID) readings were observed at SSB-53 through SSB-56, EW-01, and EW-02 toward the bottom of the lower sand unit near the sand/silt interface.

4.4.3 **Lower Sand Unit/Lacustrine Clayey Silt Unit Interface**

DNAPL and solvent-like odors were recorded at the lower sand unit/lacustrine clayey silt unit interface. Sand stringers were observed in the upper surface of the lacustrine clayey silt at SSB-
DNAPL was noted in the sand stringers present in the upper surface of the lacustrine clayey silt unit at SSB-30, and in SSB-54 (38 feet bgs). Percent level concentrations of PCE were measured where sand stringers were present in the upper surface of the lacustrine clayey silt unit at EW-02 [36,000 mg/kg (57-57.5 feet bgs)], DEC-092D 22,000 mg/kg (53.5-54.5 feet bgs)] SSB-29 [290,000 mg/kg (56-57 feet bgs)], SSB-30 [170,000 mg/kg (54-55 feet bgs)], SSB-32 [22,000 mg/kg (52-53 feet bgs)] and SSB-53 [7,100 mg/kg (50-51 feet bgs)]. Elevated concentrations of PCE were noted in the silt/clayey silt at DEC-092D [7,900 mg/kg (58-59 feet bgs)], SSB-32 [30 mg/kg (57-58 feet bgs)], SSB-33 [75 mg/kg (59-60 feet bgs)], SSB-43 [51 mg/kg (53-54 feet bgs), 200 mg/kg (55-56 feet bgs), and 3,300 mg/kg (60-60.5 feet bgs)] and SSB-54 [100 mg/kg (53.5-54 feet bgs)].

DNAPL has been observed, sampled, and/or removed from borings/monitoring/extraction wells (EW-01, EW-02, DEC-024D, DEC-024DR, DEC-092D, SSB-54, and SSB-55) that were advanced in or screened across the lower sand unit/lacustrine clayey silt unit interface (Figure 3-4). The results of a bail-down test and pilot test performed at these wells indicted that DNAPL is recoverable at these locations. In addition, the recoverable amount of DNAPL increased during each subsequent event at two of the three locations (Table 2-3). A total of 7.7 gallons of DNAPL were removed from the five wells over the course of the bail-down and pilot tests.

### 4.5 Potential Subsurface DNAPL Source(s)

DNAPL found in the subsurface at the Site may be the result of one of the three following sources or a combination of any or all three of the potential sources. The first possible source of DNAPL at the Site may have resulted from the UST and any associated piping found in the building at 315 Kingsland Avenue. The second possible source may have been surface spills during past operations that flowed into the trench style floor drain located in the center of the floor in the building at 315 Kingsland Avenue and associated piping. The third possible source may be the vault/sewer pipes exiting the courtyard which connect to the sewer main located in Kingsland Avenue or unknown sewer pipes exiting from any of the former Site buildings. A more detailed description of each of the potential sources is given below.

#### 4.5.1 UST

An undocumented UST was discovered within the center of the southern third of the On-Site building located at 315 Kingsland Avenue (NYSDEC Spill No. 1402556). The historic
use/contents of the UST are unknown. The tank was measured to be approximately 4 feet in diameter and 10 feet long (approximately a 1,000 gallon capacity). Approximately 4 inches (40 gallons) of a clear liquid with a solvent/thinner type odor was found in the bottom of the tank. A sample of the UST liquid was collected and submitted for laboratory analyses. The laboratory reported that the sample was aqueous in nature with an oil layer. A mixture of the oil/water was analyzed. Results are presented on Table 4-11. There was insufficient volume received by the laboratory to perform SVOC, PCB and flashpoint (ignitability) analysis as requested on the COC.

The results of the liquid sample collected from the UST indicated the presence of acetone (1,600 µg/L) and methylene chloride (2,800 µg/L). In addition, 2-hexanone, 4-methyl-2-pentanone, methyl ethyl ketone (2-butanone), and xylenes were also detected in the liquid, at significantly lower concentrations. Comparison of the results to Resource Conservation Recovery Act (RCRA) characteristics indicated that the volatile constituent of the liquid was non-hazardous. The specific gravity of the liquid was 1.009.

The bottom of the UST and associated piping are at a depth that could have potentially allowed for any leaking/spilled PCE liquid to migrate downward to both the inclusive sand layer and/or lower sand unit. At this time, no soil samples have been collected from directly below the UST.

Although the current contents of the UST do not indicate the presence of PCE, the historic contents of the UST and any associated piping are unknown. The presence of soil and PCE containing DNAPL downgradient of the UST location make the UST and any associated piping a potential source of DNAPL in the subsurface.

4.5.2 **Trench-Style Floor Drain**

A large trench-style floor drain is currently located near the center of the Site building at 315 Kingsland Avenue. Anchor bolts found in the floor surrounding the trench-style floor drain could indicate that at one time a piece of machinery may have been situated over the drain where spills may have occurred. The trench-style floor drain appears to drain to the west. A “T” in the line before it exits the main room is tied into the line running north/south, along the western wall. There also appears to be a connection to the large floor drain that is tied into a line running north/south, along the interior of the eastern wall. These drains lead to the utility vault in the courtyard.
At this time, no soil samples have been collected from directly below the trench-style floor drain or any of the drain lines. The bottom of the trench-style floor drain and any associated piping are at a depth that would potentially allow for any leaking/spilled PCE liquid to migrate downward to both the inclusive sand layer and/or lower sand unit. The presence of soil and PCE containing DNAPL downgradient of the trench-style floor drain location and associated piping make the trench-style floor drain and any associated piping a potential source of DNAPL in the subsurface.

4.5.3 Vault/Sewer Pipes

An approximately 8-foot wide by 18-foot long utility vault is located at the eastern end of the “T” shaped courtyard along the sidewalk, between the buildings located at 313 Kingsland Avenue and 315 Kingsland Avenue. The vault contains water and sewer lines. These drain lines are made of vitrified clay and appear to correspond to the line running north/south, along the interior of both the eastern and western interior walls of the 315 Kingsland Avenue building. The trench-style floor drain appears to drain into a pipe which appears to drain into pipes along the western interior walls of the 315 Kingsland Avenue building which subsequently drains into the utility vault in the adjacent courtyard. In addition, sewer lines exit the property through the vault going east under the sidewalk into the sewer main located in Kingsland Avenue.

The bottom of the vault and sewer lines exit the property through the utility vault going east, under the sidewalk into the sewer main at a depth that could have potentially allowed spills that may have occurred during the former operations associated with Spic and Span Cleaners. The spills may have leaked out of the bottom of the vault and/or a damaged/broken sewer line(s) and migrated downward to both the inclusive sand layer and lower sand unit.

Soil samples collected from EW-02, SSB-30, SSB-32, SSB-33, SSB-54, SSB-55 and SSB-56, located within the sidewalk closest to the vault and sewer lines which exit the property, contained elevated concentrations of PCE in both the inclusive sand layer, glacial till unit below the inclusive sand layer, lower sand unit, and/or at the top of the lacustrine clayey silt unit. The bottom of the northern extent of the inclusive sand layer near SSB-32 contains vertical sand stringers. In addition vertical sand stringers were noted in SSB-32 within the glacial till between 40 and 47 feet bgs. These sand stringers represent a vertical pathway from the inclusive sand layer through the glacial till unit into the lower sand unit. Elevated PCE concentrations were noted in soil between 53 and 60.5 feet.
bgs at SSB-43 near the UST inside the 315 Kingsland Avenue building and between 38 to 54 feet bgs in SSB-53 and SSB-54 east of the UST under the sidewalk on Kingsland Avenue.

4.6 **Extent of DNAPL**

Approximately 12 feet of DNAPL was measured in DEC-136 at the commencement of the pilot test. Based on the stratigraphic data as shown on Figure 3-7 the inclusive upper sand layer is estimated to be approximately 303 cubic yards. Using a conversion of 201.9 gallons per cubic yard, and estimated 30 percent porosity, the inclusive sand layer has a potential of containing approximately 18,300 gallons of aqueous materials including groundwater and DNAPL. The potential quantity of DNAPL lower sand unit/lacustrine clayey silt unit interface has not been estimated, however, it could be substantial and on the order of hundreds or thousands of gallons. Based on DNAPL observations, the extent of DNAPL in the vicinity of the site is shown on Figure 4-8.

The solubility of PCE in water is 150,000 µg/L at 25°C. Based on this solubility, it can be generally assumed that DNAPL is present if the concentration of PCE in groundwater is 20% to 50% of saturation (between 30,000 µg/L to 75,000 µg/L). The highest historical concentration of PCE detected in groundwater was 170,000 µg/L in DEC-024D, where DNAPL was confirmed. DNAPL was observed in the following wells: DEC-024, DEC-024DR, DEC-092D, DEC-116D, EW-01 and EW-02 all of which had historical PCE concentrations greater than 15,000 µg/l. The concentration of PCE in groundwater from location DEC-057D has been between 37,000 and 76,000 µg/L, however, DNAPL has not been directly observed at that location.

4.7 **Conceptual Site Model**

Figure 4-9 depicts the Conceptual Site Model indicating completed exposure pathways. Potential pathways are complete for construction/utility workers during intrusive activities under current and future activities for subsurface soil, soil vapor, and groundwater, and additionally to the public for outdoor air for future intrusive activities that may release VOCs from soil vapor and/or fugitive dust. The exposure pathway is potentially complete through indoor air exposure to workers/residents under current and future conditions.
5.0 SUMMARY AND RECOMMENDATIONS

5.1 Summary

Based upon the results of the previous site investigations and the DNAPL Recovery Pilot Test, the following conclusions are provided. Field investigations performed in the Spic and Span area are: the SC Phases I, II, III, V, VI and VII; Phases I and II RI; Off-Site and On-Site Phase III RI; and this Pilot Test.

5.1.1 Geology

- The following textural units have been found in the upper glacial aquifer in most borings, from the surface downward: a fill unit; a glacial till unit; an inclusive sand unit within the glacial till unit; a sand unit; a lacustrine clayey silt unit; a fine sand and silt unit; a sand/sand and gravel unit; and the Raritan Formation. Due to the heterogeneous nature of the geology, some but not all of the units were identified at each boring. The thickness of the upper glacial aquifer in the Spic and Span area is approximately 125 to more than 138.5 feet thick.

- An inclusive sand layer containing DNAPL and high PCE concentrations was identified within the glacial till unit in the vicinity of SSB-11, and between DEC-136D and SSB-32 which are located adjacent to the Spic and Span Site.

- The top of the Raritan Formation was encountered across the Site. The elevation of the Raritan Formation from approximately between -104 to -121 feet amsl and has been described as gray clay with color variations with white banding, brown, brownish gray, greenish gray, and dark gray to greenish brown, mixed with 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.

- The water table surface in the greater Spic and Span area may be found between approximately 11 and 38 feet bgs. In the immediate vicinity of the Spic and Span property, the depth to groundwater is approximately 12 feet bgs and the groundwater flow is north to
northeast. The horizontal hydraulic gradient in shallow overburden groundwater was approximately 0.02 ft./ft.

- The hydraulic conductivity in the overburden ranged from $2.91 \times 10^{-2}$ cm/sec (DEC-063) to $8.32 \times 10^{-5}$ cm/sec (DEC-060). In the shallow overburden, the mean value of $K$ is $8.03 \times 10^{-3}$ cm/sec for the sand clayey silt/sand unit, and $3.15 \times 10^{-4}$ cm/sec for the sandy silt. In the deep overburden, the mean value of $K$ is $1.00 \times 10^{-3}$ cm/sec for the sand/silty sand, and $9.32 \times 10^{-5}$ cm/sec for the sandy silt.

5.1.2 Soil

PCE exceeded unrestricted use and protection of groundwater criteria in EW-02, MW-046D, SSB-48, and SSB-50 through SSB-56. Concentrations at concentrations ranging from 1.4 mg/kg to 36,000 mg/kg.

CVOC degradation products also exceeded their respective unrestricted use and protection of groundwater criteria in Pilot Test soil samples. They include TCE between 1.6 mg/kg and 63 mg/kg; cis-1,2-DCE between 0.26 mg/kg in and 0.81 mg/kg; and vinyl chloride between 4 mg/kg and 43 mg/kg.

Petroleum-related and other VOC compounds exceeded their respective unrestricted use and/or protection of groundwater criteria including: 1,2,4-trichlorobenzene; acetone; benzene; ethylbenzene; isopropylbenzene; toluene; and xylene. Metals detected at concentrations exceeding unrestricted use criteria include: cadmium, chromium, copper, iron, lead, silver and/or vanadium. No metals exceeded protection of groundwater criteria. Only iron in was detected at concentrations exceeding site background criteria.

PCE exceeded residential use criteria ranging from 8 mg/kg to 36,000 mg/kg. Concentrations of PCE exceeding restricted residential use criteria ranged from 96 mg/kg to 36,000 mg/kg. TCE exceeded its residential use criteria between 21 mg/kg and 63 mg/kg and restricted residential use criteria between 43 mg/kg and 63 mg/kg. Benzene was the only petroleum-related VOC detected exceeding residential and restricted residential use criteria. Cadmium, chromium, and/or iron exceeded residential use criteria in the bucket auger samples and only cadmium exceeded restricted residential use criteria.
5.1.3 **Groundwater**

PCE, TCE and its degradation products were detected in numerous groundwater monitoring wells in both shallow and deep overburden groundwater. The highest concentrations of PCE detected during the pilot test sampling event were in the extraction wells EW-01 and EW-02 at concentrations of 97,000 µg/L and 78,000 µg/L, respectively. The highest concentration of TCE during the pilot test sampling event was detected at EW-01 (1,200 µg/L) followed by DEC-137 (770 µg/L). In general, concentrations of PCE and TCE in the deep groundwater are higher than those in the shallow groundwater; the plume is larger in horizontal extent in the deep groundwater. 1,1,1-TCA, which is not a breakdown product of PCE or TCE was detected above criteria in EW-01 and EW-02.

Using the most recent groundwater data for each sample location, the highest concentration of PCE in the shallow overburden was in monitoring well DEC-060 (35,000 µg/L) adjacent to 300 Kingsland Avenue and in the deep overburden at monitoring well DEC-024D (170,000 µg/L) adjacent to 315 Kingsland Avenue. The highest concentration of TCE in the shallow overburden was at DEC-060 (5,000 µg/L) and in the deep overburden at MW-085D (7,800 µg/L) adjacent to the Crown property.

5.1.3.1 **Overall Plume Extent**

Based upon the most recent groundwater sampling events, the horizontal and vertical extent of the dissolved phase plume has mostly been determined. The horizontal extent of the dissolved phase plume in shallow and deep groundwater appears to originate around the Spic and Span Site where the highest PCE concentrations were detected in the wells with DNAPL. The second source identified around DEC-025D near 300 Kingsland Avenue was attributed to Spic and Span operations based on information from nearby residents. The plume is spreading with groundwater flow towards the northeast, east and with a southerly component, and via downward migration to deeper geologic zones (i.e., approximately 60 – 65 feet bgs). The vertical extent of PCE and TCE impacted groundwater extends down to the top of the clayey silt unit, approximately 60 feet bgs in the On-Site source area. The plume appears to be spreading laterally along the clayey silt interface and into the lower sand unit to areas toward the northeast (i.e., Crown Property) towards Exxon Mobil well RW-17, and toward the east-east/southeast (i.e., as far as Morgan Avenue and Hausman Street) toward ExxonMobil well RW-22 to depths of approximately 90 feet bgs.
There is evidence that reductive dechlorination is occurring in the vicinity of the Site. The aquifer is conducive for naturally occurring reductive dechlorination, and therefore, the geochemical conditions could be enhanced via in-situ bioremediation technologies to further promote higher rates of reductive dechlorination. This and other remedial technologies such as in-situ chemical oxidation will be evaluated during the Feasibility Study.

5.1.4 DNAPL

DNAPL and solvent-like odors were recorded within the inclusive sand layer which is located within the till unit, between SSB-25 and SSB-32 at approximately 12.0 to 24.0 feet bgs. DNAPL was observed within the inclusive sand layer at SSB-11, SSB-26, SSB-28 and DEC-136. Percent level concentrations of PCE were detected in the inclusive sand layer at SSB-11, SSB-26 and SSB-28. The presence of DNAPL in DEC-136 has been confirmed through the free product found in the monitoring well during well development and subsequent pumping during the pilot test. A total of approximately 156 gallons of DNAPL has been removed from DEC-136 during the pilot test.

DNAPL and solvent-like odors were recorded within the lower sand unit. Elevated concentrations of PCE were noted in the lower sand unit at DEC-024DR, SSB-32, SSB-33, SSB-52, SSB-54, SSB-55 and SSB-56. DNAPL was observed in SSB-54 at approximately 38 feet bgs. Solvent-like odors combined with elevated photoionization detector (PID) readings were observed at SSB-53 through SSB-56, EW-01, and EW-02 toward the bottom of the lower sand unit near the sand/silt interface.

DNAPL and solvent-like odors were recorded at the lower sand unit/lacustrine clayey silt unit interface. Sand stringers were observed in the upper surface of the lacustrine clayey silt at SSB-29 and SSB-30. DNAPL was noted in the sand stringers present in the upper surface of the lacustrine clayey silt unit at SSB-30, and in SSB-54. Percent level concentrations of PCE were measured where sand stringers were present in the upper surface of the lacustrine clayey silt unit at EW-02, DEC-092D, SSB-29, SSB-30, SSB-32 and SSB-53. Elevated concentrations of PCE were noted in the silt/clayey silt at DEC-092D, SSB-32, SSB-33, SSB-43 and SSB-54.

Approximately 12 feet of DNAPL was measured in DEC-136 at the commencement of the pilot test. Based on the stratigraphic data and an estimated 30 percent porosity, the inclusive sand layer has a potential of containing approximately 18,300 gallons of aqueous materials including
groundwater and DNAPL. The potential quantity of DNAPL lower sand unit/lacustrine clayey silt unit interface has not been estimated, however, it could be substantial and on the order of hundreds or thousands of gallons.

DNAPL has been observed, sampled, and/or removed from borings/monitoring/extraction wells (EW-01, EW-02, DEC-024D, DEC-024DR, DEC-092D, SSB-54, and SSB-55) that were advanced in or screened across the lower sand unit/lacustrine clayey silt unit interface. The results of a bail-down test and pilot test performed at these 5 wells (i.e., EW-01, EW-02, DEC-024D, DEC-024DR and DEC-092D) indicted that DNAPL is recoverable at these locations. In addition, the recoverable amount of DNAPL increased during each subsequent event at two of the three locations. Approximately 7.7 gallons (29 liters) of DNAPL were removed from wells EW-01, EW-02, DEC-024D, DEC-024DR and DEC-092D over the course of the bail-down and pilot tests. Approximately 156 gallons (593 liters) of DNAPL has been removed from well DEC-136 during the pilot test. A total of approximately 164 gallons of DNAPL has been removed from the On-Site area wells over the course of the bail-down and pilot tests.

5.2 **Recommendations**

The following recommendations are offered for consideration by the NYSDEC. The recommendations include additional Interim Remedial Measures (IRM), which are ongoing as part of Contract D007622, WA #30 (approved by the Department on July 21 2015), and proceeding with the Feasibility Study under Contract C007540, WA #2.1. The Department may consider additional shallow DNAPL recovery wells targeting the upper sand unit between DEC-136 and EW-01.
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


NYSDEC. December 2006. 6 NYCRR Part 375 Environmental Remediation Programs

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NYSDEC. October, 2010. CP-51 Soil Cleanup Guidance.


6-1