ON-SITE PHASE III
REMEDIAL INVESTIGATION REPORT

WORK ASSIGNMENT NO. 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

Joseph Martens, Commissioner

DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B

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March 2015
ON-SITE PHASE III REMEDIAL INVESTIGATION

FOR THE

FORMER SPIC AND SPAN CLEANERS & DYERS, INC. SITE

SITE ID NO. 224129

BROOKLYN, KINGS COUNTY, NEW YORK

PREPARED FOR:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF ENVIRONMENTAL REMEDIATION

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OURS CORPORATION

257 WEST GENESEE STREET, SUITE 400

BUFFALO, NEW YORK 14202

MARCH 2015
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<th>Definition</th>
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<tbody>
<tr>
<td>AARCO</td>
<td>AARCO Environmental Services, Corporation</td>
</tr>
<tr>
<td>ADT</td>
<td>Aquifer Drilling and Testing, Inc.</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>
</tr>
<tr>
<td>bgs</td>
<td>below ground surface</td>
</tr>
<tr>
<td>BP</td>
<td>British Petroleum</td>
</tr>
<tr>
<td>BQE</td>
<td>Brooklyn-Queens Expressway</td>
</tr>
<tr>
<td>B. Thayer</td>
<td>B. Thayer Associates</td>
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<tr>
<td>BTEX</td>
<td>benzene, toluene, ethylbenzene, xylenes</td>
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<tr>
<td>cis-1,2-DCE</td>
<td>cis-1,2-dichloroethene, aka cis-1,2-dichloroethlyene</td>
</tr>
<tr>
<td>C&amp;D</td>
<td>construction and demolition</td>
</tr>
<tr>
<td>CD</td>
<td>compact disc</td>
</tr>
<tr>
<td>cm/sec</td>
<td>centimeters per second</td>
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<tr>
<td>COC</td>
<td>chain-of-custody</td>
</tr>
<tr>
<td>Con Edison</td>
<td>Consolidated Edison Company of New York</td>
</tr>
<tr>
<td>CPCs</td>
<td>chemicals of potential concern</td>
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<tr>
<td>Crown</td>
<td>Crown Enterprises, Inc.</td>
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<tr>
<td>CSIA</td>
<td>compound-specific stable isotope analysis</td>
</tr>
<tr>
<td>CVOC</td>
<td>chlorinated volatile organic compound</td>
</tr>
<tr>
<td>4,4-DDD</td>
<td>dichlorodiphenyltrichloroethane</td>
</tr>
<tr>
<td>4,4-DDE</td>
<td>dichlorodiphenyldichloroethylene</td>
</tr>
<tr>
<td>4,4-DDT</td>
<td>dichlorodiphenyldichloroethylene</td>
</tr>
<tr>
<td>DCA</td>
<td>dichloroethane</td>
</tr>
<tr>
<td>DCE</td>
<td>dichloroethene, aka dichloroethylene</td>
</tr>
<tr>
<td>1,2-DCE</td>
<td>1,2-dichloroethene</td>
</tr>
<tr>
<td>DEP</td>
<td>Department of Environmental Protection</td>
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<tr>
<td>DIIs</td>
<td>drop inlets</td>
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<td>DNAPL</td>
<td>dense non-aqueous phase liquid</td>
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<tr>
<td>DOB</td>
<td>Department of Buildings</td>
</tr>
<tr>
<td>DOT</td>
<td>Department of Transportation</td>
</tr>
<tr>
<td>DSNY</td>
<td>City of New York Department of Sanitation</td>
</tr>
<tr>
<td>DUSR</td>
<td>Data Usability Summary Report</td>
</tr>
<tr>
<td>ELAP</td>
<td>Environmental Laboratory Approval Program</td>
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<tr>
<td>EM</td>
<td>electromagnetic</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>ExxonMobil Brooklyn Terminal</td>
</tr>
<tr>
<td>FAP</td>
<td>Field Activities Plan</td>
</tr>
<tr>
<td>Glacier</td>
<td>Glacier Drilling, LLC</td>
</tr>
<tr>
<td>gpm</td>
<td>gallons per minute</td>
</tr>
<tr>
<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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<tr>
<td>HASP</td>
<td>Health and Safety Plan</td>
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<tr>
<td>HDPE</td>
<td>high-density polyethylene</td>
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LIST OF ACRONYMS AND ABBREVIATIONS
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HSA  hollow stem augers
ID  inside diameter
IDW  investigation derived wastes
K  hydraulic conductivity
L  liter
L/min  liters per minute
LNAPL  light non-aqueous phase liquid
MEK  methyl ethyl ketone
META  META Environmental, Inc.
mg/kg  milligrams per kilogram (parts per million)
ml  milliliter
MW  monitoring well
MTBE  Methyl tert-butyl ether
NAD83  North American Datum of 1983
NAPL  non-aqueous phase liquid
NAVD  North American Vertical Datum
NYC  New York City
NYCDEP  New York City Department of Environmental Protection
NYCDOT  New York City Department of Transportation
NYCRR  New York Codes, Rules and Regulations
NYS  New York State
NYSDEC  New York State Department of Environmental Conservation
NYSDOH  New York State Department of Health
NYSDOT  New York State Department of Transportation
OD  outside diameter
Off-Site System  Off-Site Free Product Recovery System
ORP  Oxidation/Reduction Potential
Pace  Pace Analytical Service
PCBs  polychlorinated biphenyls
PCE  perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene
PID  photoionization detector
ppbv  parts per billion by volume
ppm  parts per million
PVC  polyvinyl chloride
QA/QC  Quality Assurance/Quality Control
RAGS  Risk Assessment Guidance for Superfund
RCRA  Resource Conservation Recovery Act
RI  Remedial Investigation
Roux  Roux Associates, Inc.
RQD  rock quality designation
RSI  Radar Solutions International
SAP  Sampling and Analysis Plan
SC  Site Characterization
LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

SCGs  Standards, Criteria, and Guidance values
SPDES  Spill Discharge Elimination System
Spic and Span  Former Spic and Span Cleaners & Dyers, Inc.
SVOC  semi-volatile organic compound
TAGM  Technical and Administrative Guidance Memorandums
TAL  Target Analyte List
3rd Rock  3rd Rock LLC
TCE  trichloroethene, aka trichloroethylene
TCL  target compound list
TICs  tentatively identified compounds
TKN  total kjeldahl nitrogen
TOC  total organic carbon
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
USFWS  United States Fish and Wildlife Service
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
Zebra  Zebra Environmental Corporation
1.0 INTRODUCTION

This Remedial Investigation (RI) Report has been prepared to summarize the field activities and analytical results from the On-Site Phase III RI field investigation 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 On-Site Phase III RI field investigation, which was conducted from May 28 and July 18, 2014; data collected during the Off-Site Phase III RI field investigation which was conducted from January 20 through May 7, 2014; Meeker Avenue Plume Trackdown Site Characterization (SC) Phase VII field investigation conducted from June 11 through September 26, 2012 and December 10, 2012 through March 27, 2013; and data from the Phase II RI field investigation, which was conducted from November 7, 2011 through February 15, 2012.

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 July 2014, a source of groundwater contamination was identified at the buildings housing the Former Spic and Span Cleaners and Dyers, Inc. [a.k.a. Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 260 Norman Avenue/315-325 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0009) and 307-313 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0015) 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/Hausman Avenue 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 Investigations by URS

To date, URS has completed seven phases of Site Characterization fieldwork at the Meeker Avenue Plume Trackdown Site (NYSDEC Site Number 224121) within which the Spic and Span Site is located. Additional SC field activities (i.e., SC Phase VIII) are ongoing in areas east of the Spic and Span Site and south of Meeker Avenue. Only data gathered during the Phases I, II, III, V, VI and VII SC field activities are relevant to the Site. In addition Phases I and II RI fieldwork, an off-site portion of the Phase III RI fieldwork, one off-site groundwater sampling event at a downgradient property, and the 315 Kingsland Avenue Underground Storage Tank Investigation and Data Summary Report (i.e., associated with NYSDEC Spill No. 14-02556) have been performed. Relevant information pertaining to the Site area from the above-mentioned reports is summarized below.

1.2.1.1 Summary of Spic and Span Phases I and II RI

The Phase II RI report was a comprehensive report that summarized the field activities associated with the Phases I and II RI field investigations and data gathered during six of seven previous SC investigations. The Phase I RI field investigation was conducted from January 24 through March 25, 2011 and the Phase II RI field investigation was conducted from November 7, 2011 through February 15, 2012. A complete description of the field investigations and results may be found in the Phase II RI Report (URS, September 2012). Plate 1 provides the locations of all monitoring well and boring locations; Plate 2 provides the locations of all soil vapor implant locations.

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 feet to more than 138 feet thick.

1-3
• An inclusive sand layer containing dense non-aqueous phase liquid (DNAPL) and high tetrachloroethene (PCE) concentrations was identified within the glacial till unit between SSB-26 and SSB-32, which are located adjacent to the Site building along the west side of Kingsland Avenue.

• The top of the Raritan Formation was encountered across the Site. The elevation of the Raritan Formation varied between approximately -104 to -121 feet above mean sea level (amsl) and has been described as gray clay with white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, fine sand and silt, clays with carbonized plant fragments and, clays with varying amounts of sand, to silts with varying amounts of sand and clay. The top of the Raritan Formation slopes towards the west and northwest. The Raritan Formation is a well-defined aquiclude regionally and has significant lateral extent. Permeabilities within the unit are less than $10^{-6}$ centimeters per second (cm/sec).

• The water table surface was found between approximately 11 and 25 feet below ground surface (bgs). In the immediate vicinity of the Site, the groundwater flow was north to northeast. The horizontal hydraulic gradient ranged from approximately 0.01 to 0.02 foot per foot (ft./ft.).

• The hydraulic conductivity (K) 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.

**Soil**

**Site Source Area**

A shallow source of PCE and DNAPL 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 south of DEC-024D and DEC-024DR, where DNAPL has also been identified 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 was not delineated and is assumed to extend beneath Kingsland Avenue. The western extent of the impacted soil was not delineated however, it likely extends beneath the Site building located at 315 Kingsland Avenue and possibly into the courtyard. The courtyard area may have been used to load and unload dry cleaning materials.

**300 Kingsland Avenue Off-Site 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 On-Site source area, adjacent to 300 Kingsland Avenue. The highest concentration of PCE [2,000 milligrams per kilogram (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). 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.

**NAPLs**

During the SC Phase V investigation in 2009, a 1.5-foot thick layer of DNAPL was observed in DEC-024D. During the SC Phase VI and Phases I and II RI, DNAPL was detected, but not in measureable quantities, in both DEC-024D and DEC-024DR. DNAPL samples were collected from DEC-024D during the SC Phases III and V and from DEC-024DR during the SC Phase VI.

The DNAPL sample collected 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 in DEC-024D was detected at a concentration of 730,000 mg/kg or 73% and trichloroethene (TCE) was detected at 720 mg/kg (0.072%). 1,2,4-Trichlorobenzene, 1,1-biphenyl and bis(2-ethylhexyl)phthalate were also detected in the DNAPL, at significantly lower concentrations (0.017% or lower) during the SC Phase V.

PCE was detected in DEC-024DR at 110,000 mg/kg (i.e., 11%); TCE was detected at 220 mg/kg (0.022%); cis-1,2-dichloroethene (cis-1,2-DCE) was detected at 7.3 mg/kg; and 1,2,4-trichlorobenzene was detected at 22 mg/kg in DEC-024DR during the SC Phase VI.

Laboratory measured 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.

Light non-aqueous phase liquid (LNAPL) has historically been measured in several monitoring wells: DEC-024; DEC-034; DEC-053; DEC-054; and DEC-058. During the Phase II RI field activities on January 23, 2012, LNAPL was detected in DEC-034, DEC-053, DEC-054, and DEC-058 with thicknesses ranging between 0.28 feet and 2.74 feet.

**Groundwater**

Groundwater sampling results indicated that a shallow dissolved-phase chlorinated volatile organic compound (CVOC) groundwater plume is originating from the Spic and Span Site and is migrating to the northeast towards the Crown Enterprises, Inc. (Crown) property (Figure 1-1). Monitoring wells located near the southwest corner of the Crown property (i.e., DEC-058) reported concentrations of CVOCs up to 4 orders of magnitude greater than groundwater standards.

PCE and its degradation products were detected during the Phase I and II RIs in numerous groundwater monitoring wells in both shallow and deep overburden groundwater (Figures 1-2 through 1-5). During Phase II RI, high concentrations of dissolved phase PCE were detected adjacent to the Site in DEC-057 and DEC-057D at concentrations of 8,400 and 37,000 micrograms per liter (µg/L), respectively; downgradient of the site in DEC-058 and DEC-058D, to the northeast at concentrations of 13,000 and 35,000 µg/L, respectively; to the east in DEC-060 and DEC-060D at concentrations of 22,000 and 13,000 µg/L, respectively, and in DEC-036 and DEC-036D at concentrations of 4,200 and 4,500 µg/L, respectively; and to the southeast in DEC-003DD at a concentration of 11,000 µg/L, and DEC-061 and DEC-061D at concentrations of 1,400 and 8,200 µg/L, respectively. PCE was detected at 1 µg/L and its degradation products were not detected in the upgradient top of clay monitoring well
DEC-035TC). PCE was detected in top of clay monitoring wells sampled during the Phase II RI, but at concentrations that did not exceed groundwater criteria at DEC-058TC downgradient of the Site (1 µg/L) and DEC-063TC adjacent to the Site (3 µg/L).

TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria generally to the north and east of the Site, as well as in DEC-024 at 200 µg/L; the maximum vinyl chloride concentration was detected in DEC-058 at 1,800 µg/L immediately downgradient of the Site and adjacent to the Crown property. Additionally, benzene, toluene, ethylbenzene and xylenes (BTEX) and/or petroleum-related compounds were detected in DEC-053, DEC-054, DEC-058D, and DEC-037R.

Based upon the January 2012 groundwater sampling event, the horizontal and vertical extent of the dissolved phase plume was mostly determined with the exception of: beneath the 260 Norman Avenue/315-325 Kingsland Avenue building where the source of PCE contamination is likely located; beneath 300 Kingsland Avenue where a secondary source of PCE is apparent; east of DEC-037R in the shallow overburden; and east of DEC-003D in the deeper overburden.

The horizontal extent of the dissolved phase plume in shallow and deep groundwater appears to originate around the 260 Norman Avenue/315-325 Kingsland Avenue building, and a second, as yet unknown source has been identified around DEC-025D near 300 Kingsland Avenue. The dissolved phase 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 detected in top of clay wells, upgradient of the Site (i.e., DEC-035TC), adjacent to the Site (i.e., DEC-063TC) and downgradient to the northeast (i.e., DEC-058TC), all at concentrations less than groundwater 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.

Based upon the data collected to assess the potential for degradation of PCE in the groundwater system, 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 Site and beneath the 300 Kingsland Avenue building. Based upon the geochemical conditions (e.g., anaerobic and low oxidation/reduction potential) 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.

**Soil Vapor**

Soil gas in the Site 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 On-Site source area (SG-067 and SG-099), 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 vapor point installed in September 2005 which, historically has had higher TCE concentrations than PCE concentrations.

The approximate size of the PCE and TCE soil vapor plumes from Phases I and II RIs are similar in size and appear to also mimic the extent of the dissolved phase shallow groundwater plume. The exceptions to this are the concentrations that exist mid-block on Morgan Avenue which indicate a separate source of soil vapor TCE contamination exists.

**1.2.1.2 Summary of SC Phase VII Report**

The SC Phase VII was conducted from June 11, 2012 through September 26, 2012 and December 10, 2012 through March 27, 2013 as part of the overall SC at the Meeker Avenue Plume Trackdown Site. The purpose of the SC Phase VII investigation in the Spic and Span area was to determine the horizontal extent of PCE DNAPL on the top of the clayey silt unit in the vicinity of SSB-11 and south of DEC-024D and DEC-024DR.

Based upon the results of the SC Phase VII investigation, the following conclusions for the Spic and Span area were provided.

**Geology**

- Shallow overburden groundwater flow in the Spic and Span area is to the north, northeast, and east. The flow of the deep overburden groundwater in the Spic and Span area is to the east and northeast.
An inclusive sand layer containing DNAPL and high PCE concentrations was identified within the glacial till unit in the vicinity of SSB-11, which is located adjacent to the former Spic and Span Cleaners building.

**Soil**

Soil samples were collected from DEC-092D, located south of DEC-024. PCE and TCE were detected above unrestricted use criteria at several depths (16-17 feet bgs, 53.5-54.5 feet bgs, and 58-59 feet bgs). The highest concentrations of both PCE and TCE were at the 53.5-54.5-foot depth interval. These findings are consistent with the results from the soil borings performed nearby at SSB-29 and SSB-30. DNAPL was observed in SSB-30 and at the top of the clayey silt unit in DEC-092D.

**Groundwater**

Volatile organic compounds (VOCs) and iron were detected at concentrations above their Class GA groundwater SCGs in numerous groundwater monitoring wells during the first (Figure 1-6) and second (Figure 1-7) rounds of groundwater sampling conducted during the SC Phase VII. The highest concentrations of PCE were detected in DEC-024D (120,000 and 110,000 µg/L) and DEC-024DR (77,000 and 78,000 µg/L) which are located adjacent to the Site building located at 315 Kingsland Avenue; and in DEC-092D (49,000 and 5,400 µg/L). High concentrations of PCE were detected adjacent to the Site building located at 315 Kingsland Avenue; in DEC-057 (2,200 and 5,000 µg/L) and DEC-057D (49,000 and 55,000 µg/L) for shallow and deep groundwater; downgradient of the site in DEC-058 (28,000 and 12,000 µg/L), DEC-058D (47,000 and 48,000 µg/L) and DEC-083D (1,200 and 1,300 µg/L) located to the northeast; to the east in DEC-060 (29,000 and 35,000 µg/L), DEC-060D (20,000 and 17,000 µg/L), DEC-036 (6,600 and 6,000 µg/L), DEC-036D (2,000 and 1,600 µg/L), DEC-037D (1,000 and 970 µg/L) and DEC-037R ( 4,300 and 8,700 µg/L); and to the southeast in DEC-061 (1,300 and 1,500 µg/L), DEC-061D (7,500 and 8,900 µg/L), and in DEC-003DD (15,000 and 18,000 µg/L).

TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria to the north, east and south of the Spic and Span Site; the maximum concentration was detected in DEC-058. BTEX and/or fuel-related compounds were detected in DEC-003DD, DEC-024D, DEC-034, DEC-037D, DEC-053, DEC-054, DEC-057, DEC-
058/058D, DEC-067, DEC-068 and DEC-092D. Iron was detected above criteria generally across the site area but is considered to be naturally occurring in the groundwater system.

**CSIA**

Based on the compound-specific stable isotope analysis (CSIA) analysis, all shallow monitoring locations within the Site area appear to have the same source of PCE. These results indicate that the PCE results found at DEC-003D, which is located downgradient of 300 Kingsland Avenue, are related to those immediately downgradient of the Site (i.e., DEC-036, DEC-037R, and DEC-060). This supports the claim by neighborhood residents that the property at 300 Kingsland Avenue was utilized by Site operations. The shallow source of PCE in the soil adjacent to the 300 Kingsland Avenue property appears to be associated with past operations at the On-Site area.

Based on the CSIA results, PCE values in the shallow overburden groundwater and deep groundwater, it appears that there are two independent sources of PCE in the shallow and deep groundwater.

**Summary**

Based upon the results of previous rounds of groundwater samples collected, and confirmed by the SC Phase VII groundwater sampling events, a dissolved phase CVOC plume originates at the On-Site area. The horizontal and vertical extent of the dissolved phase CVOC plume has mostly been determined, with the exception of: beneath the On-Site area where the source of PCE contamination is likely located; beneath 300 Kingsland Avenue where a secondary, but related source of PCE is apparent; east of DEC-037R in the shallow overburden; and east of DEC-003D in the deep overburden. CSIA results indicate that the PCE in shallow groundwater throughout the Site area originates from the same source. The horizontal extent of the dissolved phase CVOC plume in shallow and deep groundwater appears to originate around the On-Site area and 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 to 65 feet bgs), although the CSIA results indicated a distinct PCE source is apparent in the deep groundwater near DEC-024D and DEC-092D. These wells contained DNAPL with a high percent level of PCE, and the source material in these wells could be representative of different manufacturers of PCE product used by the dry cleaner throughout its operational history. 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.

No PCE or TCE was detected in the four top of Raritan monitoring wells during the SC Phase VII sampling event. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

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 Site and beneath the 300 Kingsland Avenue building.

**Potential Source – 300 Kingsland Avenue**

The facility that contained a former warehouse, located at 300 Kingsland Avenue (Brooklyn Tax District, Block 02821, Lot 0001), is no longer considered an independent source of soil and groundwater contamination. During the Phase I RI investigation, a shallow source of soil contamination (i.e., PCE) was identified while clearing a boring location (i.e., DEC-025D) for utilities. PCE was detected in the soil at DEC-025D in the 0 - 1.5-foot and 1.5 - 2.0-foot bgs interval at 140 and 1,300 mg/kg, respectively. During the Phase VII investigation, data obtained from the CSIA sampling and forensic analysis indicated that the PCE found in the shallow groundwater downgradient of 300 Kingsland Avenue (DEC-003D) was the same as found immediately downgradient of the Site (DEC-036 and DEC-060), indicating that the PCE identified at DEC-025D is isotopically identical to the PCE identified at the On-Site area. These results substantiate a claim by a local resident that at one time the former Spic and Span Cleaners used the building at 300 Kingsland Avenue to house their delivery trucks. Based upon the CSIA analytical results, 300 Kingsland Avenue is considered part of the Spic and Span Site.

1.2.1.3 Crown Property

URS performed a groundwater sampling event at the Crown property which is located northeast (i.e., downgradient) of the Site in January 2013. The purpose of the sampling event was to evaluate if the downgradient extent of the shallow dissolved-phase CVOC groundwater plume originating from the Site was migrating beneath the Crown property. The results of this groundwater sampling event were reported in the Letter Report – Crown Property Groundwater Sampling Event (URS, April 2013). ExxonMobil is currently operating two groundwater recovery wells (RW-17 east...
of the Crown property and RW-22 southeast of the Crown property). Locations are provided on Plate 1. Recovery well construction well details are provided in Appendix A. Details are presented in Section 1.2.2.

Results of the January 2013 groundwater sampling event indicated that:

• The operation of ExxonMobil groundwater recovery well RW-17 on the property to the east of the Crown property may have increased the downward vertical gradients in the vicinity of DEC-058. The increase in the downward vertical gradients may be causing the dissolved phase CVOCs to migrate beneath the shallow overburden groundwater zone on the Crown property.

• PCE and its degradation products were not detected in shallow overburden groundwater beneath the Crown property. However, the potential exists for the presence of CVOCs in the deeper groundwater beneath the Crown property. This conclusion is based upon the November 2012 groundwater analytical data from RW-17. CVOCs from the Site appear to be migrating toward RW-17 (Roux, August 13, 2014) beneath the Crown property in the deep overburden groundwater.

1.2.1.4 Spic and Span Off-Site Phase III RI

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 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 property towards ExxonMobil recovery well RW-17. 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 RI field investigation indicated that:

• 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 Site is to the east and northeast.

• Deep overburden groundwater flow in the vicinity of the 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 Site.

• VOCs were detected at concentrations above their Class GA groundwater SCGs in shallow and deep groundwater monitoring wells located downgradient of the Site to the east and at the Crown property to the northeast (Figure 1-8). 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).

• As shown in Figures 1-9, 1-9A, 1-10 and 1-10A, 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 Site. There is a northeast and east-southeast component of the plume. One component of the dissolved CVOC plume is migrating northeast from the Site towards RW-17, beneath the Crown property. A second component of the dissolved CVOC plume is moving east-southeast from the 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. Concentrations of CVOCs in paired monitoring wells were up to an order of magnitude higher in the deep overburden groundwater when compared to the shallow overburden groundwater.

• During the Off-Site Phase III RI field investigation 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.
• Analytical results from an LNAPL sample collected from DEC-112 indicated kerosene at 390,000 mg/kg (39%), a viscosity of 1.919 centistokes, surface tension of 26 dynes/cm, and specific gravity of 0.8136.

• PCE and TCE were detected in soil vapor immediately downgradient of the Site in SG-188 at 1,800 micrograms per cubic meter ($\mu$g/m$^3$) and 2,800 $\mu$g/m$^3$, respectively. PCE was also detected at a concentration of 8.5 $\mu$g/m$^3$ at SG-192 on Sutton Street. TCE was not detected in any other soil vapor samples.

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

1.2.2 **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 $\mu$g/L, TCE at 27 $\mu$g/L, cis-1,2-DCE at 51 $\mu$g/L, and vinyl chloride at 6 $\mu$g/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) 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. Recovery well construction details can be found in Appendix A.

1.3 Objectives of the On-Site Phase III RI

The On-Site Phase III RI field investigation was completed to determine if the source of PCE DNAPL found in existing monitoring wells located in the sidewalk adjacent to the Site building at 315 Kingsland Avenue exists beneath the Site building and/or in the courtyard located to the south of the Site building. In addition, geologic information gathered during the On-Site Phase III RI field investigation will be used to assist in the design of a Pilot Test planned for the Site.

Activities associated with the On-Site Phase III RI field investigation consisted of:
• Utility clearance by a geophysical contractor at all soil vapor, soil boring, and monitoring well locations and traced utility locations within the Site building and courtyard;

• Dye-testing of drains within the Site building located at 315 Kingsland Avenue in an attempt to determine their outfall;

• A soil vapor survey within the Site building located at 315 Kingsland Avenue;

• Collection of sub-slab soil vapor samples plus ambient air and Quality Assurance/Quality Control (QA/QC) samples from 6 locations within the Site building located at 315 Kingsland Avenue;

• Advancement of ten soil borings within the Site building located at 315 Kingsland Avenue using direct-push drilling methods down to approximately 55 bgs. All boring locations were cleared to 5 feet bgs by Vac-Tron© prior to drilling;

• Advancement of three soil borings within the Site building located at 315 Kingsland Avenue using conventional drilling methods down to approximately 70 feet bgs;

• Installation of one monitoring well pair (one shallow and one deep monitoring well) in two of the three soil borings within the Site building located at 315 Kingsland Avenue using conventional drilling methods;

• Advancement of eight soil borings in the courtyard located to the south of the Site building located at 315 Kingsland Avenue using sonic drilling methods down to approximately 55 feet bgs. All boring locations were cleared to 5 feet bgs by Vac-Tron© prior to drilling;

• Installation of three monitoring well pairs (one shallow and one deep monitoring well per pair) in six of the eight soil borings within the courtyard using sonic drilling methods;

• Development of eight new monitoring wells;

• Collection of a synoptic round 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 eight new and fourteen existing monitoring wells;
• Performance of a DNAPL recovery test at three existing monitoring wells;

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

• Survey of all new soil vapor implant, soil boring 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 Remedial Investigation 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 REMEDIAL INVESTIGATION FIELD ACTIVITIES

Field activities were performed during the On-Site Phase III RI between May 28 and July 18, 2014. Site photographs are provided in Appendix B and copies of the daily field notes are provided in Appendix C. The layout of the Site building located at 315 Kingsland Avenue and courtyard are shown on Figure 2-1.

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), KeySpan, 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 May 28 and 29, 2014, 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 and soil borings were proposed.

A geophysical survey 5-foot square reference grid was established inside of the Site building located at 315 Kingsland Avenue and in the courtyard area. A GSSI SIR-2000 digital radar system was used to perform the GPR survey. GPR data were acquired along lines spaced 2.5 feet apart. The survey grid locations are shown on Figure 2-2. The EM induction equipment used to determine the location of buried utilities and trace utilities was a McLaughlin’s Verifier G2 digital locator. RSI marked utilities and anomalies by spray-painting the outline on the pavement as soon as they were located. A copy of RSI’s report is provided in Appendix D.

Based on the geophysical survey results, RSI made the following determinations:

- A utility vault is located near the center of the northern wall inside of the Site building located at 315 Kingsland Avenue. The vault contains water and sewer lines;
• A suspected underground storage tank (UST) was detected in the center of the southern third of the On-Site building located at 315 Kingsland Avenue and was estimated to be 1,000 gallons;

• Subsurface utility lines were located within the On-Site building located at 315 Kingsland Avenue and were found to run north/south along both the eastern and western walls and are depicted in Figure 2-1;

• The large floor drain located in the middle of the Site building located at 315 Kingsland Avenue appears to drain to the west. There appears to be a “T” connection 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 side of the eastern wall;

• A small floor drain located in the middle of the northern third of the Site building located at 315 Kingsland Avenue drains south into the large floor drain;

• An approximately 8-foot wide by 18-foot long subsurface utility vault is located at the eastern end of the courtyard adjacent to the sidewalk. The vault contains water and sewer lines. It appears that 4 inch drain lines exit the southeast corner of the Site building located at 315 Kingsland Avenue and drain into the vault;

• Utility lines are located along both the northern and southern wall down the length of the courtyard; and

• Three subsurface anomalies were identified within the courtyard that may potentially be USTs or other subsurface structures including former boilers and/or former boiler stack foundations. One is in the northwest corner of the courtyard, one is in the southeast corner of the courtyard, and one is approximately halfway down the length of the courtyard.

2.3 Sewer Dye Testing

On June 16, 2014, URS performed a dye test in an attempt to determine the outfall of the large floor drain located in the middle of the Site building located at 315 Kingsland Avenue which 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. URS obtained water and sewer maps from the NYCDEP which may be found in Appendix E.

URS mixed approximately 90 gallons of water and fluorescent red Bright Dye® for the dye test. URS poured the 90 gallons of the water/dye mixture into the large floor drain and performed visual observations at: 1) the vault located in the courtyard (Figure 2-1); 2) the combined sewer manhole in the intersection of Norman Avenue and Kingsland Avenue (Appendix E); and 3) the combined sewer manhole in the intersection of Monitor Street and Kingsland Avenue (Appendix E). No indication of the dye was observed. Red dye was however observed in the two-foot by two-foot floor grate located in the northwest portion of the room within the Site building.

2.4 Soil Vapor Survey and Sub-Slab Soil Vapor Sampling

On June 14, 2014, URS personnel performed a soil vapor survey at 23 locations within the main room and two rooms located west of the main room in the Site building located at 315 Kingsland Avenue (Figure 2-3). Six of the soil vapor survey locations were within the vicinity of the UST. At each soil vapor survey location, URS utilized a hammer drill equipped with a 3/8-inch drill bit to drill through the concrete slab, which varied from 4 to 36 inches thick. After drilling through the slab, URS used a MiniRae 3000 photoionization detector (PID) connected to a 2-foot length of 1/8-inch inside diameter (ID) by ¼-inch outside diameter (OD) Teflon-lined polyethylene tubing to measure the concentrations of volatile organic compounds (VOCs) in parts per million (ppm). The results of the soil vapor survey are shown on Figure 2-3.

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 2-4).

At each sub-slab sample location, an electric hammer drill was used to advance a 1-inch diameter hole approximately ½-inch into the concrete slab, followed by a ⅜-inch diameter hole through the remaining thickness of the concrete slab. All concrete debris was removed using a hand brush to prevent it from entering the hole. The sub-slab soil vapor samples were collected through a ⅛-inch ID by ¼-inch OD Teflon-lined polyethylene tubing which was inserted through the hole in the slab. The tubing was sealed to the concrete slab with modeling clay.
The sub-slab soil vapor samples were collected in accordance with the procedures outlined in the Field Activities Plan (FAP) (URS, April 2010) using laboratory evacuated 6-liter Summa® canisters with 24-hour flow regulators (i.e., calibrated at the flow rate of approximately 0.004 liter per minute (L/min) provided by Eurofins/Air Toxics of Folsom, CA, a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) accredited laboratory. Pursuant to NYSDOH’s Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006), a helium tracer gas was utilized during the sampling at each sub-slab soil vapor location. The tracer gas was used to verify that the infiltration of ambient air was not occurring during sample collection. A one-quart enclosure was placed over the sealed tubing running through the concrete slab. The tubing was run through an outlet and a silicone gasket was used to seal the interface between the tubing and the enclosure. The enclosure was then sealed at the concrete slab with a polyurethane foam gasket. A tank containing ultra-high purity helium (99.999%) was connected to the side port of the enclosure and enough helium was released to displace any ambient air and to maintain a positive pressure within the enclosure. Following the application of the tracer gas, one liter of soil vapor was purged using a Gillian GilAir-3 air sample pump at a rate of approximately 0.02 L/min into a 1 liter Tedlar bag.

The contents of the Tedlar bag were measured for helium using a Radiodetection/Dielectric MGD-2002 Multi-Gas Detector. If the helium concentration was less than 10%, the enclosure was removed and the tubing was connected to the Summa canister via the flow controller and sampling commenced. If the concentration of helium exceeded 10%, the clay seal between the sample tubing and the concrete slab was redone and the seal was retested. The sub-slab sample locations passed the helium test the first time and sample collection was initiated. The contents of the Tedlar bags containing the sub-slab purged air were subsequently discharged outside the building.

The sub-slab samples were collected over a 24-hour period using 6-liter Summa® canisters equipped with flow controller valves pre-calibrated at the laboratory (i.e., calibrated at the flow rate of approximately 0.004 L/min). Upon opening the canister valve, the initial vacuum pressure was read from the built-in gauge on the flow controller and recorded onto the Summa Canister Sampling Field Data Sheets. After the 24 hour sampling period, the canister vacuum was recorded on the Summa Canister Sampling Field Data Sheets and the valve was then closed. After sampling was completed,
the tubing and seal were removed and the sub-slab sample locations were then filled to grade with hydraulic cement.

One outdoor (ambient) air sample was collected from a location in the courtyard. The outdoor ambient air sample was collected by opening a summa canister fitted with a 24-hour flow controller and drawing in the ambient air. A field duplicate sample was collected at location 315-1-SS using a stainless steel ‘T’ fitting. Copies of the completed Summa Canister Sampling Field Data Sheets from the sampling event are provided in Appendix F.

All samples were transported under chain-of-custody (COC) via FedEx to Eurofins/Air Toxics. The samples were analyzed for VOCs following United States Environmental Protection Agency (USEPA) Compendium Method TO-15, as listed in Table 2-1.

2.5 Soil Borings and Monitoring Well Installation

Between June 2 and 24, 2014 URS provided oversight for the advancement of eighteen soil borings and the installation of monitoring wells in eight of the soil borings (Figure 2-5). The soil borings and monitoring wells were advanced/installed within both the Site building located at 315 Kingsland Avenue and the courtyard area.

2.5.1 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 June 2 and 5, 2014 Glacier Drilling, LLC of Durham, CT (Glacier) mobilized one Vac-Tron® unit to perform location-specific utility clearance at each of the proposed two soil boring and six monitoring well locations within the adjacent courtyard. Between June 2 and 4, 2014 Zebra Environmental Corporation of Lynbrook, NY (Zebra) mobilized one Vac-Tron® unit to perform location-specific utility clearance at each of the proposed ten soil boring and two monitoring well locations within the On-Site building located at 315 Kingsland Avenue. 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.

2.5.2 315 Kingsland Avenue Soil Borings

Between June 5 and 19, 2014, Zebra utilized a track-mounted Geoprobe® 6610 DT hydraulic push unit to advance a 2-inch OD by 5-foot long acetate lined Macrocore sampler at the 10 previously cleared soil borings located within the Site building located at 315 Kingsland Avenue. The soil borings were advanced to depths between 44 and 55 feet bgs. Refusal was encountered at all locations. Upon completion, each soil boring was backfilled with bentonite chips and the top 4 inches was patched with concrete.

Between June 17 and 24, 2014, Associated Environmental Services, Ltd. of Hauppauge, NY (Associated), utilized a skid-mounted CME LC-60 drill rig to advance three borings within the Site building located at 315 Kingsland Avenue to allow for the installation of monitoring wells. The soil borings were advanced using 4 1/4-inch hollow stem augers (HSAs). The borings were advanced without sampling down to where Zebra encountered refusal after which, split spoon samples were collected continuously using standard penetration techniques (American Society for Testing and Materials [ASTM] D1586-84) until the terminus of the boring.

Each Macrocore sample/split spoon was screened with a PID. Up to five soil samples were collected from each boring; one soil sample was collected from the interval just above the water table, the second and/or additional samples were collected from the intervals exhibiting odors, staining, or elevated PID reading(s). If no odors, staining, or elevated PID readings were encountered, then only one sample from the interval just above the water table was collected. Soil boring logs are provided in Appendix G.

For the soil samples collected from 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.

2.5.3 Courtyard Soil Borings

Between June 5 and 19, 2014, Glacier utilized a track-mounted Geoprobe® 8140LS Roto Sonic drill rig for the advancement of eight soil/well borings within the courtyard. The soil borings at the six shallow and deep monitoring well locations were advanced using a 4-inch OD inner sampler and a 6-inch OD outer casing with sonic drilling methods. Soil samples were collected continuously from the ground surface to the terminus of each boring. The procedure for the advancement of the borehole was to advance the inner sampler the appropriate interval (5 or 10 feet) and then advance the outer casing over the inner sampler to the desired depth. After the outer casing was advanced, the inner sampler was retrieved and the collected sample core 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 monitoring well location was sampled and logged. Following the installation of the deep monitoring well, the corresponding shallow monitoring well was advanced to a pre-determined depth and installed without logging or the collection of any soil samples. Soil borings not completed as monitoring wells were backfilled with bentonite chips and the top 4 inches was patched with concrete.

Each sample core was 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; and one or more sample 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 G.

For the soil samples collected from soil borings, a COC form was maintained and accompanied the soil sample containers to Pace, a NYSDOH ELAP accredited laboratory. The soil samples were analyzed for TCL VOCs plus TICs, following USEPA SW846 Method 8260B, as listed in Table 2-1.

All IDW generated from the monitoring well installation was containerized in DOT approved 55-gallon drums and picked up by AARCO on a daily basis for off-site disposal at a permitted facility.
2.5.4 **Shallow and Deep Monitoring Well Construction**

With the exception of DEC-116, all shallow and deep monitoring wells installed during the On-Site Phase III RI field activities 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.

Three of the four shallow monitoring wells (i.e., DEC-113, DEC-114, and DEC-115) were constructed with 15 feet of 2-inch ID, Type 304 stainless steel 0.010-inch continuous wire wrap screen. 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 1-foot bgs. The fourth shallow monitoring well, DEC-116, was constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. The screen was nominally set between 20 feet above and 30 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. Bentonite chips were then installed around the riser to an elevation of approximately 1-foot bgs.

The four deep monitoring wells were constructed with 10 feet of 2-inch ID, Type 304 stainless steel 0.010-inch continuous wire wrap screen with a 2-foot long stainless steel sump. Each deep well was screened across the clayey silt unit. 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 screens up to the ground surface. A bentonite slurry was then installed around the riser to an elevation of approximately 2 feet below grade via tremie pipe.

Each monitoring well was finished with a locking well cap, a 2-foot square concrete apron, and a flush-mounted curb box. Security bolts were installed in the well covers to minimize the potential for unauthorized well access. The concrete apron for each well pad was approximately 6 inches thick. Monitoring well construction logs are provided in Appendix H.
2.6 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. Well development logs may be found in Appendix I. 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.

2.7 Groundwater Level Measurements

On July 14 and 15, 2014, a round of water levels was collected from the 84 existing and 8 new monitoring wells in the Site area. Monitoring wells were checked for depth to groundwater and non-aqueous phase liquid (NAPL), if any. Water levels were measured using a 200-foot long Solinst oil/water interface probe. Table 2-2 presents groundwater level measurements and the presence/absence of NAPL in monitoring wells. Groundwater elevations were adjusted if LNAPL was present, based upon the (laboratory) measured specific gravity of the product. LNAPL was measured in DEC-034, DEC-083 and DEC-112. Historically, LNAPL was previously encountered in monitoring wells DEC-053, DEC-054, DEC-058 and DEC-107; however, no measurable product was encountered in these wells during the July 2014 measurements.

2.8 Non-Aqueous Phase Liquid Gauging

During the On-Site Phase III RI field investigation, LNAPL was detected in: DEC-034 (at a thickness of 0.01 feet); DEC-083 (thickness of 0.89 feet) and DEC-112 (thickness of 3.48 feet).
2.9  **Groundwater Sampling**

URS personnel collected groundwater samples between July 16 and July 17, 2014 from 22 (14 existing and 8 new) monitoring wells. Prior to sample collection, standing water was purged from each well using a Geopump 2 peristaltic pump or 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-024. 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 J.

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.

In addition, URS personnel collected 2 groundwater grab samples, one on June 11 and one on June 12, 2014 from a dry well located in the southwest corner of the courtyard. The samples were collected from depths of 5-6 feet bgs and 45-46 feet bgs using a peristaltic pump and HDPE tubing through a pipe. Approximately one pipe volume was purged from the dry well before collecting the sample.

2.10  **DNAPL Bail-Down Tests**

On June 4, 9, and 10, 2014, URS performed DNAPL bail-down tests at DEC-024D, DEC-024DR, and DEC-092D. These locations historically contained measurable and recoverable amounts of DNAPL. The purpose of the bail-down tests was to determine the feasibility of DNAPL recovery at the Site. On each day the bail down test was conducted, URS removed DNAPL from each of the three monitoring wells using weighted, dedicated/disposable, 1-liter HDPE bailers. The procedure for DNAPL recovery 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 settle out;

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

4. Steps 1 through 3 were repeated until 2 consecutive bailers without any measurable DNAPL were observed.

A summary of the DNAPL recovered per well during each event is provided on Table 2-3 and graphs are provided in Figures 2-6, 2-7 and 2-8 for DEC-024D, DEC-024DR and DEC-092D, respectively. A total of 5.58 liters of DNAPL was removed from the three monitoring wells over the course of the bail-down tests.

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 K.

2.12 Monitoring Well Maintenance

Monitoring well inspections and maintenance was performed on all NYSDEC monitoring wells that were entered during the On-Site Phase III RI field investigation. 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 L. A list of recommended maintenance that is/was required is summarized on Table 2-4.

2.13 Site Survey

B. Thayer Associates of Woodbury, NY (B. Thayer), was contracted to survey additional monitoring well and soil boring locations in June 2014. 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 complete Site survey drawing is provided in Appendix M.
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 standards, criteria, and guidance values (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

3-1
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 -56.95 to -121.19 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. 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 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 SSB-26 and SSB-32. Where identified in borings, the inclusive sand has been found between approximately 12 and 24 feet bgs. 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, and DEC-092D 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 3-6. 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 3-2 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 30 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. These were used to develop groundwater contour elevation maps so that groundwater flow directions could be determined. Potentiometric surface maps based on the February 24, 2011; March 2, 2011; March 21, 2011; January 23, 2012; March 2014; and July 14-15, 2014 water level measurements from the shallow overburden wells, using a 1-foot contour interval, are provided in
Figure 3-7 through 3-12, respectively. Potentiometric surface maps based on the water level measurements from the deep overburden wells, using either a 0.5-foot or 1-foot contour interval, are provided in Figure 3-13 through 3-18 for February 24, 2011; March 2, 2011; March 21, 2011; January 23, 2012; March 2014; and July 14-15, 2014, respectively. Potentiometric surface maps based on the water level measurements from the top of Raritan formation wells, using either a 0.2 or 0.5-foot contour interval, are provided in Figures 3-19 through 3-21 for January 23, 2012; March 2014; and July 14-15, 2014, respectively. Water level measurements are included in Table 2-2. Vertical hydraulic gradient calculations are provided on Table 3-3.

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 foot per foot (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, 0.066, 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 **Influence of ExxonMobil Recovery Wells**

The operation of ExxonMobil recovery wells RW-17 and RW-22 appear to have influenced the shallow and deep groundwater flow direction. RW-17 is in the northeast corner of the property located on the 297 Norman Avenue property (MV Transportation) which is immediately east of the Crown property. During 2012, the average pumping rate for RW-17 was 26 gallons per minute (gpm). The operation of RW-17 (at 26 gpm) appears to have locally impacted the groundwater flow and has potentially drawn groundwater northeast from the Spic and Span site, beneath the Crown property. The most recent groundwater data collected in March 2014 from RW-17 (e-mail from Roux July 3, 2014) reported concentrations of PCE at 260 µg/L, TCE at 29 µg/L, cis-1,2-DCE at 58 µg/L, and vinyl chloride at 8 µg/L.

RW-22 is located southeast of the Spic and Span Site at 90-92 Hausman Street. During 2012, the average pumping rate for RW-22 was 36 gpm. The operation of RW-22 appears to have locally impacted the groundwater flow and has potentially drawn groundwater southeast from the Spic and Span Site. The most recent groundwater data collected in March 2014 from RW-22 (e-mail from Roux July 3, 2014) reported concentrations of PCE at 97 µg/L, TCE at 280 µg/L, cis-1,2-DCE at 80 µg/L, and vinyl chloride at 9 µg/L in RW-22.

ExxonMobil installed recovery wells (RW-27P and RW-27W at location RW-27 and RW-28) in the vicinity of the Spic and Span 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) 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 it is unknown when RW-27 and RW-28 will go on-line; however their operation will most likely influence the groundwater flow direction in the vicinity of the Spic and Span Site. Recovery well construction details can be found in Appendix A.
3.6.3 Slug Test Results

Slug test results are presented on Table 3-4. 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 surface of the Site is entirely covered by buildings and/or pavement/sidewalks. Minimal onsite 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 M.

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 M.

3.9 Subsurface Site Structures

During the geophysical survey, three suspected USTs/unknown subsurface structures were located within the “T” shaped courtyard (Appendix D). 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, observations by URS indicated 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 Values**

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

**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, hence site background SCGs are not included on tables where only VOCs were analyzed.

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 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 restricted residential and 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.

**Surface Water/ Sediments**

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

**Sub-Slab Soil Vapor**

There are no criteria for sub-slab soil vapor analytical data.
4.0 NATURE AND EXTENT OF CONTAMINATION

The following sections discuss the results of the soil, groundwater and soil vapor/air sample analyses for the On-Site Phase III RI fieldwork at the Spic and Span site, and information on NAPL collected from previous investigations.

4.1 Soil Analytical Results

Thirty-five soil samples were collected and analyzed for VOCs during the On-Site Phase III RI from 14 locations during the period June 5 through June 23, 2014. At some locations, more than one sample was obtained from multiple depths. The soil sample results were compared to appropriate Part 375 criteria identified in Section 3.10.

A summary of the detected soil analytical results as compared to unrestricted use and protection of groundwater SCGs is presented in Table 4-1. Table 4-2 lists the detected analytical results for soil samples as compared to residential and restricted residential SCGs. Because no VOCs exceeded unrestricted use criteria in the site background soil samples, the tables do not include site background SCGs. The complete validated analytical results from the On-Site Phase III RI soil samples are presented in the Data Usability Summary Report (DUSR) in Appendix N, on compact disc (CD). Data summary tables, Form I and Form Ie (TICs) are provided in the DUSR and include the reporting limit for each non-detected compound. Tables 4-3A through 4-3D provide statistical summaries of detected VOCs for soil samples collected as follows: the number of detections; the minimum, maximum and average values; and the location and depth of the maximum value as compared to unrestricted use criteria, protection of groundwater criteria, residential use criteria, and restricted residential use criteria. Soil data exceeding criteria is presented on Figure 4-1A for Unrestricted Use and Protection of Groundwater and Figure 4-1B for Residential and Restricted Residential Use.

Unrestricted Use and Protection of Groundwater Soil Criteria

Soil sample results were compared to unrestricted use and protection of groundwater criteria. 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).

**Residential and Restricted Residential Soil Criteria**

Soil sample results were compared to restricted residential and residential use criteria as presented on Table 4-2. 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.

### 4.2 Non-Aqueous Phase Liquid Analytical Results

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

#### 4.2.1 Dense Non-Aqueous Phase Liquid Analytical Results

The results of 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>Remarks</th>
</tr>
</thead>
<tbody>
<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-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-024D</td>
<td>NM</td>
<td>NM</td>
<td>NM</td>
<td>700,000 (70%)</td>
<td>URS, May 29, 2008</td>
</tr>
</tbody>
</table>
4.2.2 **Light Non-Aqueous Phase Liquid Analytical Results**

LNAPL has been found in DEC-034, DEC-053, DEC-054, and DEC-058. LNAPL was collected for analysis from DEC-034, DEC-053, and DEC-054. Compounds detected in samples DEC-034, DEC-053 and DEC-054 were attributed to petroleum related compounds. The analysis of the LNAPL from DEC-053 determined that the primary constituents were leaded and unleaded gasoline, with lesser amounts of fuel oil and other petroleum related compounds. LNAPL sample results 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>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC-034</td>
<td>0.8218</td>
<td>2.14</td>
<td>25.3</td>
<td>1.1</td>
<td>URS/Roux split, July 9, 2009</td>
</tr>
<tr>
<td>DEC-054</td>
<td>0.8019</td>
<td>1.46</td>
<td>22.9</td>
<td>ND</td>
<td>URS/Roux split, July 1, 2009</td>
</tr>
<tr>
<td>DEC-053</td>
<td>0.7852</td>
<td>NM</td>
<td>NM</td>
<td>ND</td>
<td>URS, March 9, 2011; gasoline and petroleum compounds</td>
</tr>
</tbody>
</table>

NM = not measured  
ND = not detected

4.3 **Groundwater Analytical Results**

A summary of the detected TCL VOCs in the On-Site Phase III RI groundwater samples collected from monitoring wells is presented in Table 4-5. 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 4-2. Isoconcentration contours of PCE in the groundwater samples are shown on Figures 4-3 and 4-4 for the shallow and deep overburden, 4-3
respectively. Isoconcentration contours of TCE in the groundwater samples are shown on Figures 4-5 and 4-6 for the shallow and deep overburden, respectively. Table 4-6 provides a statistical summary of the detected parameters for the On-Site Phase III RI groundwater samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the On-Site Phase III RI groundwater samples are presented in the DUSR in Appendix N. Data summary tables, Form I and Form Ie (TICs) are provided in the DUSR and include the reporting limit for each non-detected compound.

4.3.1 Groundwater PCE Detections

PCE was detected in 20 of the 22 monitoring well locations sampled during the On-Site Phase III RI at concentrations ranging from 1 µg/L to 170,000 µg/L. Thirteen of the 22 monitoring wells sampled had concentrations exceeding groundwater criteria (Figure 4-2). PCE was not detected above the SCG in the aqueous samples collected from the dry well. The highest concentration of PCE in the shallow groundwater was detected at DEC-057 (21,000 µg/L); remaining concentrations in shallow groundwater were 19 µg/L and below. The highest concentration of PCE in the deep groundwater was detected at DEC-024D (170,000 µg/L), followed by DEC-024DR (88,000 µg/L), DEC-116D (83,000 µg/L), and DEC-057D (48,000 µg/L).

Figure 4-3 depicts isoconcentration contours for PCE in the shallow groundwater from analytical data collected during the On-Site Phase III RI. The concentrations of PCE in shallow wells such as DEC-023, DEC-035, and DEC-024 are comparable or less than in the Phases I and II RI sampling events, and higher in (downgradient) DEC-057 compared to Phases I and II RI.

Figure 4-4 depicts isoconcentration contours for PCE in the deep groundwater from analytical data collected during the On-Site Phase III RI. 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.

4.3.2 Groundwater TCE Detections

TCE was detected in 8 of the 22 monitoring well locations sampled during the On-Site Phase III RI, at concentrations ranging from 2 µg/L to 1,900 µg/L. Seven of the 22 monitoring well locations had concentrations exceeding groundwater criteria. TCE was not detected in dry well
samples. The highest concentration of TCE in the shallow overburden was detected at DEC-057 (100 µg/L), followed by DEC-024 (6 µg/L); all other detections were below the SCG of 5 µg/L. The highest concentration of TCE in the deep overburden was detected at DEC-024D (1,900 µg/L), followed by DEC-116D (880 µg/L) and DEC-024DR (800 µg/L). Figure 4-5 depicts isoconcentration contours for TCE in the shallow groundwater from analytical data collected during the On-Site Phase III RI. Figure 4-6 depicts isoconcentration contours for TCE in the deep groundwater from analytical data collected during the On-Site Phase III RI.

4.3.3 PCE and TCE Degradation Product Detections

PCE and TCE degradation products were detected in the On-Site Phase III RI groundwater samples at concentrations exceeding groundwater criteria (Figure 4-2). Cis-1,2-DCE was detected in 14 of the 22 RI monitoring wells sampled during the On-Site Phase III RI with concentrations ranging from 1 µg/L to 1,600 µg/L. Nine of the 22 locations had concentrations above groundwater criteria. Cis-1,2-DCE was not detected in dry well samples. The range of cis-1,2-DCE varied with the highest concentration detected at DEC-024 (1,600 µg/L) followed by DEC-024D (320 µg/L) and DEC-024DR (99 µg/L). Trans-1,2-DCE exceeded criteria in 2 monitoring well locations, with 7 µg/L in DEC-024 and 6 µg/L in DEC-024D. Vinyl chloride was detected at concentrations ranging from 2 µg/L to 1,100 µg/L in 7 of the 22 monitoring well locations sampled and exceeded criteria in 6 of the wells, with the highest concentration detected at DEC-024 (1,100 µg/L) followed by DEC-057 (110 µg/L).

Similar to wells with PCE and TCE, degradation products have typically been found in monitoring wells in the vicinity of the Spic and Span Site (i.e., DEC-036/036D, DEC-057, DEC-058/058D, and DEC-060/060D), indicating the degradation of the plume due to reductive dechlorination. This is most likely due to the petroleum hydrocarbons associated with the ExxonMobil Off-Site Plume. Fuel hydrocarbons serve as electron donors. Their presence, combined with low redox conditions, can allow bacteria to reductively dechlorinate chlorinated hydrocarbons. Compounds related to petroleum products (i.e., 1,2,4-trichlorobenzene, benzene, isopropylbenzene, toluene and/or methyl tert-butyl ether) have been detected above criteria in wells DEC-023, DEC-024, DEC-024D, DEC-024DR, DEC-114, DEC-115, DEC-116, and DEC-116D.
4.4 **Soil Vapor Survey and Sub-Slab Soil Vapor Analytical Results**

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. In the six readings obtained from vicinity of the UST, PIDs ranged from 1.7 to 4.2 ppm. 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.

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 4-7. A summary of detected VOCs in sub-slab soil vapor samples and the outdoor air sample collected during the On-Site Phase III RI is presented in Table 4-7. Table 4-8 provides a statistical summary of the detected parameters for the On-Site Phase III RI sub-slab soil vapor samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the outdoor air and sub-slab soil vapor samples are presented in the DUSR in Appendix N. Data summary tables and Form I’s are provided in the DUSR and include the reporting limit for each non-detected compound.

During the On-Site Phase III RI, 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: benzene, toluene, ethylbenzene, and xylene and related compounds (e.g., 1,2,4- and 1,3,5-trimethylbenzene), hexane-related compounds (e.g., cyclohexane, n-hexane), and 1,1,1-trichloroethane. These contaminants suggest possible petroleum or fuel source(s). The VOC with the highest detected concentration was acetone at 2,600 µg/m³ at location 315-06; however, the acetone concentration detected in the outdoor air sample was 600 µg/m³.

4.5 **DNAPL Observations**

DNAPL observations and solvent-like odors were recorded at the Site throughout various phases of the RI and SC Phases. The DNAPL observations and solvent-like odors were recorded during the advancement of soil borings, installation of monitoring wells, and during well development. The DNAPL observations and solvent-like odors were made in the sidewalk along Kingsland Avenue
in front of 307 and 315 Kingsland Avenue and within the building located at 315 Kingsland Avenue. A summary of subsurface DNAPL observations and solvent-like odors are presented in Table 4-9. The lateral extent of the DNAPL observations and solvent-like odors is shown on Figure 4-8.

**Inclusive Sand Layer**

DNAPL and solvent-like odors were recorded within the inclusive sand layer which is located within the till unit, between SSB-26 and SSB-32 at approximately 12.0 to 24.0 feet bgs. DNAPL was observed within the inclusive sand layer at SSB-26. Percent level concentrations of PCE were detected in the inclusive sand layer at SSB-11 [190,000 mg/kg (15-16 feet bgs)] and SSB-26 [230,000 mg/kg (16-17 feet bgs)]. 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. 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.

**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)] and SSB-32 [32,000 mg/kg (47-48 feet bgs) and 22,000 mg/kg (52-53 feet bgs)].

**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-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. Percent level concentrations of PCE were measured where sand stringers were present in the upper surface of the lacustrine clayey silt unit at SSB-29 [290,000 mg/kg (56-57 feet bgs)] and SSB-30 [170,000 mg/kg (54-55 feet bgs)]. Elevated concentrations of PCE were noted in
the silt/clayey silt at 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)].

DNAPL has been observed, sampled, and removed from three monitoring wells (DEC-024D, DEC-024DR, and DEC-092D) that are screened across the lower sand unit/lacustrine clayey silt unit interface (Figure 3-4). The results of a bail-down test performed at these wells indicated 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 5.58 liters of DNAPL were removed from the three wells over the course of the bail-down test.

4.6 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.

4.6.1 UST

An un-documented UST (NYSDEC Sill No. 14-02556) was discovered within the center of the southern third of the On-Site building located at 315 Kingsland Avenue. The 315 Kingsland Avenue UST Data Summary Report is included in Appendix O. 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 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. Results are presented on Table 4-10.

The results of the liquid sample collected from the UST indicated the presence of acetone (1,600 \,\mu g/L) and methylene chloride 2,800 \,\mu g/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. Resource Conservation Recovery Act (RCRA) characteristics indicated that 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.

4.6.2 **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.

4.7 **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 and migrated downward to both the inclusive sand layer and lower sand unit.

Soil samples collected from SSB-32 and SSB-33, 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 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.

4.8 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 On-Site Phase III RI, 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 Phase III RI; and this On-Site Phase III RI.

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 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 ft./ft.

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

5.1.2 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 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.

**5.1.3 NAPLs**

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.

5.1.4 **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.

**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 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/Hausman Avenues) 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.

5.1.5 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. 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.

PCE was detected in the sub-slub 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).

5.2 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 will 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. The proposed extraction well locations are shown on Figure 5-1. Prior to drilling, all utilities in the vicinity of the proposed wells will be located and marked out. The wells will be flush-mount, with concrete curb boxes. Any adjacent asphalt pavement or sidewalk flags that are damaged during drilling will be replaced. The extraction wells will 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 will be installed beneath ten foot 0.020-inch slot continuous wire wrap stainless steel well screens. The riser will be 4-inch Schedule 40 PVC. The annular space around the well within the borehole will
be Filpro #2 or #3 sand pack to two feet above the screen; the remaining annular space will be filled with bentonite.

- Initially, passive DNAPL recovery will be conducted. Following passive recovery, surfactant-enhanced DNAPL recovery could be considered. An evaluation of the passive DNAPL recovery will 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 will be two-inch diameter. The deep monitoring well will 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 will be installed beneath ten foot 0.010-inch slot continuous wire wrap stainless steel well screen. The riser will be 2-inch Schedule 40 PVC. The annular space around the well within the borehole will be #1 sand pack to two feet above the screen; the remaining annular space will be filled with bentonite.

The shallow monitoring well will 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 will be installed from the bottom of the well up to 2 feet above the top of the well screen. Bentonite chips will then installed around the riser to an elevation of approximately 1-foot bgs. All wells will be finished with a flush-mounted curb box.

The rationale for the monitoring well locations can be found in Table 5-1 and the proposed locations are shown on Figure 5-1.

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). The rationale for the soil boring locations can be found in Table 5-1 and the proposed locations are shown on Figure 5-1.

- 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 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 (included in Appendix O), 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 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. The rationale for the monitoring well locations can
be found in Table 5-2 and the proposed locations (DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, DEC-139D) are shown on Figure 5-2.

- Additional deep monitoring wells 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. The rationale for the monitoring well locations can be found in Table 5-2 and the proposed locations (AMW-17D and PW-1D) are shown on Figure 5-2. Due to the lack of a site access agreement, it is anticipated these wells will not be installed.

- 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. The rationale for the monitoring well location can be found on Table 5-2 and the proposed location is shown on Figure 5-2.

- 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 rationale for the monitoring well location can be found on Table 5-2 and the proposed location is shown on Figure 5-2.

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.
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

NYSDEC, May 2010. Department of Environmental Remediation, DER-10 Technical Guidance for Site Investigation and Remediation

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


