



Department of
Environmental
Conservation

SITE CHARACTERIZATION

PHASE VIII

WORK ASSIGNMENT D007622-27

**MEEKER AVENUE PLUME TRACKDOWN
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA**

**SITE NO. 224121
KINGS (C), NY**

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

DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B

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

**Final
September 2015**

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257 WEST GENESEE STREET, SUITE 400
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SEPTEMBER 2015

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APPENDICES

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ATTACHMENTS

Attachment 1	Roux Associates, Inc. Plates
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LIST OF ACRONYMS AND ABBREVIATIONS

1,1-DCA	1,1-dichloroethane
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane
4,4-DDD	dichlorodiphenyldichloroethane
4,4-DDE	dichlorodiphenyldichloroethylene
4,4-DDT	dichlorodiphenyltrichloroethane
AARCO	AARCO Environmental Services Corporation
Accutest	Accutest Laboratories
Albert	Albert Plating Works Inc.
AMCE	ACME Architectural Products, Inc.
ADT	Aquifer Drilling and Testing, Inc.
amsl	above mean sea level
ASP	Analytical Services Protocol
AST	above ground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BP	British Petroleum
BOD	biochemical oxidant demand
BQE	Brooklyn Queens Expressway
BTEX	benzene, toluene, ethylbenzene, xylenes
B. Thayer	B. Thayer Associates, Inc.
C&D	construction and demolition
Cascade	Cascade Drilling, L.P.
cis-1,2-DCE	cis-1,2-dichloroethene
CD	compact disc
CESQG	Conditionally Exempt Small Quantity Generator
CFCs	chlorofluorocarbons
cm/sec	centimeters per second
CN	cyanide
CO	Certificates of Occupancy
COC	chain-of-custody
Con Edison	Consolidated Edison Company of New York, Inc.
Con-Test	Con-Test Analytical Laboratory
CRA	Conestoga-Rovers & Associates
CSIA	compound-specific stable isotope analysis
CVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene, aka dichloroethylene
DEP	Department of Environmental Protection
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DOT	Department of Transportation
DSNY	City of New York Department of Sanitation
DUSR	Data Usability Summary Report
Dynes/cm	dynes per centimeter
EDR	Environmental Data Resources, Inc.

ELAP	Environmental Laboratory Approval Program
EM	electromagnetic
EOA	Expanded Outreach Area
EPM	Environmental Planning and Management, Inc.
EPNER	EPNER Technology Inc.
ESA	environmental site assessment
ExxonMobil	ExxonMobil Environmental Services Company
FAP	Field Activities Plan
FDNY	New York City Fire Department
ft/ft	foot per foot
FOIL	Freedom of Information Law
FSP	Field Sampling Plan
FWRIA	Fish and Wildlife Resources Impact Analysis
Glacier	Glacier Drilling, LLC.
GPR	ground penetrating radar
Hampton-Clarke	Hampton-Clarke, Inc.
HASP	Health and Safety Plan
HDPE	high density polyethylene
HSA	hollow stem auger
ID	inside diameter
IDW	investigation derived waste
Impact Environmental Inc.	Impact Environmental Consulting, Inc. Incorporated
JCB	J.C. Broderick & Associates, Inc.
Klink Cosmo Site	Former Klink Cosmo Cleaners
L	liter
LEL	lower explosive limit
LNAPL	light non-aqueous phase liquid
LQG	large quantity generator
mg/kg	milligrams per kilogram (parts per million)
MGP	manufactured gas plant
MIP	membrane interface probe
mL	milliliter
MTBE	Methyl tert-butyl ether
mV	millivolt
MW	monitoring well
NAD83	North American Datum of 1983
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NYC	New York City
NYCDOB	New York City Department of Buildings
NYCDOFAR	New York City Department of Finance Assessment Roll
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OASIS	Open Accessible Space Information System
OD	outside diameter
Off-Site System	Off-Site Free Product Recovery System

ORP	oxidation/reduction potential
Pace	Pace Analytical
PCBs	polychlorinated biphenyls
PCE	perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene
PEST/PCBs	pesticides/polychlorinated biphenyls
PID	photoionization detector
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RQD	rock quality designation
Roux	Roux Associates, Inc.
RSI	Radar Solutions International
SC	Site Characterization
SCGs	standards, criteria and guidance values
Spic and Span Site	Former Spic and Span Cleaners and Dyers, Inc.
SQG	small quantity generator
Summit	Summit Drilling
SVI	soil vapor intrusion
SVOC	semi-volatile organic compound
TAGM	Technical and Administrative Guidance Memorandum
TAL	target analyte list
TCE	trichloroethene, aka trichloroethylene
TCL	target compound list
TDS	total dissolved solids
Test America	Test America Laboratories, Inc.
3 rd Rock	3 rd Rock LLC
TIC	tentatively identified compound
TKN	total kjedahl nitrogen
TOC	total organic carbon
TOGS	Technical and Operational Guidance Series
TPH	total petroleum hydrocarbons
TSS	total suspended solids
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)
µg/m ³	micrograms per cubic meter
USCG	United States Coast Guard
USCS	Unified Soil Classification System
URS	URS Corporation - New York
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WA	Work Assignment
WATTS	Watts Architecture and Engineering, Inc.
Zebra	Zebra Technical Services, LLC.

1.0 INTRODUCTION

This Site Characterization (SC) Phase VIII Report has been prepared to summarize the field activities and analytical results associated with the eighth round of SC field activities performed at the Meeker Avenue Plume Trackdown Site (Site ID No. 224121) in the Greenpoint/East Williamsburg Industrial Area section of Brooklyn, New York (Figure 1-1). The work for the Phase VIII investigation was issued to URS Corporation - New York (URS) as Work Assignment (WA) No. D007622-27 in September 2014 by the New York State Department of Environmental Conservation (NYSDEC). The Phase VIII SC was issued to complete additional SC activities in areas west of Morgan Avenue and in the Expanded Outreach Area (EOA) targeting potential sources identified during SC Phases I through VII. SC Phases I through VII were conducted under Contract C007540-05 in July 2011, and amended in November 2011 to WA C007540-05.1 due to a change in the drilling subcontractor, budget, and schedule.

The Phase VIII SC report presents data and information gathered prior to and during the Phase VIII field investigation, which was conducted from October 27, 2014 through December 19, 2014. Throughout the multiple SC phases and additional Remedial Investigations (RIs) conducted in areas identified as sources of contamination, the Meeker Avenue Plume Trackdown Site has been divided into five investigation areas (Figure 1-2): 1) Former Spic and Span Cleaners & Dyers Inc. Site (NYSDEC Site ID No. 224129); 2) Former Klink Cosmo Cleaners Site (NYSDEC Site ID No. 224130); 3) ACME Steel Area which is occupied by the Former ACME Steel Metal Works (NYSDEC Site ID No. 224131) and the Former ACME Steel Brass Foundry (NYSDEC Site ID No. 224132); 4) the EOA which is situated within a portion of the ExxonMobil Greenpoint Petroleum Remediation Area; and 5) the West of Morgan Avenue Area which extends west of Morgan Avenue to Kingsland Avenue between Meeker Avenue and Frost Street. The Former Lombardy Street Lacquer Mfg. Site has been recently designated as a source area (NYSDEC Site ID No. 224182) and is situated along the eastern end of the ACME Steel Area and is bounded by Lombardy Street to the south, Cherry Street to the north, Varick Avenue to the west, and Stewart Avenue to the east.

1.1 Site Background

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

1.1.1 Site Location and Description

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

In September 1978, the United States Coast Guard (USCG) noted the signs of an oil spill entering Newtown Creek from the northeastern end of Meeker Avenue. A subsequent investigation concluded that the area of the spill under the Greenpoint/East Williamsburg Industrial Area was in excess of 52 acres and the total spill volume, as estimated in 1979, was approximately 17 million gallons of petroleum products (Roux, October 14, 2005). The current BP property was determined to be the source of the petroleum free product plume. Investigation and remediation activities were conducted by Roux Associates, Inc. (Roux) on behalf of ExxonMobil Environmental Services Company (ExxonMobil) from 1990 to the present and have further defined the extent of the Off-Site Plume. The Off-Site Plume area consists of the area underlain by the petroleum-free product plume that is not on the BP Terminal or the Peerless Importers, Inc. properties. Currently, the extent of the Off-Site Plume area is less than what it was in 1990 due to the operation of the Off-Site Free Product Recovery System (Off-Site System). The Off-Site System has recovered over 6,751,215 gallons of free product since it became operational in 1995 (Roux, March 13, 2015).

The original Meeker Avenue Plume Trackdown site investigation area was bounded by the former ExxonMobil Brooklyn Refinery/current BP Terminal to the north (Norman Avenue/Bridgewater Street), Newtown Creek to the east, Lombardy Street to the south, and

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

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

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

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

1.1.2 Previous Investigations

ACME Steel Area

Impact Environmental Consulting, Inc. - March 1998

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

Impact Environmental Consulting, Inc. - March 1998

In March 1998, Impact Environmental conducted a Phase I ESA at 72 Anthony Street for ACME (Impact Environmental, March 30, 1998b). A copy of the Phase I ESA may be found in

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

Impact Environmental Consulting, Inc. - June 1998

In June 1998, Impact Environmental conducted a Phase II ESA at 46-60 Anthony Street/95 Lombardy Street for ACME. A copy of the Phase II ESA may be found in PDF format on a CD which is included in Appendix A of the Phase IV Data Summary Report (URS, May 2009). The scope of the Phase II ESA was based on the recommendations of the Phase I ESA and

included a remote survey [i.e., ground penetrating radar (GPR)] of a floor drain located in the northeast portion of the building and the collection of a soil sample from 0-2 feet below ground surface (bgs) below the floor drain. The remote survey conducted confirmed that the floor drain directly discharged to the subsurface soils. The soil sample contained the volatile organic compounds (VOCs) PCE and TCE, at 1,190 and 99.2 micrograms per kilogram ($\mu\text{g}/\text{kg}$), respectively. In addition, the semi-volatile organic compounds (SVOCs) di-n-butylphthalate, pyrene and bis(2-ethylhexyl)phthalate were detected at 4,460, 539 and 1,690 $\mu\text{g}/\text{kg}$, respectively. Metals, which included arsenic (4.93 milligrams per kilogram [mg/kg]), barium (114 mg/kg), cadmium (6.53 mg/kg), chromium (123 mg/kg), lead (906 mg/kg) and mercury (0.045 mg/kg), were also detected. Cadmium, chromium and lead exceeded their respective criteria found in the Technical and Administrative Guidance Memorandum (TAGM) #4046, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, January 24, 1994). The Phase II ESA concluded that on-site operations had impacted the environmental quality beneath the property and recommended that corrective actions were required to mitigate the contaminated soil associated with the floor drain.

ExxonMobil Greenpoint Petroleum Remediation Area

Environmental Planning and Management, Inc. – September 2005

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

Roux Associates, Inc. – September 2005

In September 2005, Roux, on behalf of ExxonMobil, sampled soil vapor at 23 temporary locations in and around the perimeter of the Off-Site Plume area (Roux, October 14, 2005). The

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

Roux Associates, Inc. – September 2006

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

1.2 Findings of Previous Phases of Site Characterization and Remedial Investigation
Fieldwork

Prior to the SC Phase VIII fieldwork, URS has conducted seven phases of site investigation including obtaining information from Environmental Data Resources, Inc. (EDR), two limited groundwater sampling events at the Meeker Avenue Plume Trackdown site and two multiple phase RIs. Plate 1 shows the monitoring well locations installed and sampled by URS, direct-push groundwater sample boring locations, direct push soil sample boring locations,

membrane interface probe (MIP) boring locations, and ExxonMobil monitoring wells sampled by URS. Plate 2 shows the soil vapor implant locations installed and sampled by URS and ExxonMobil soil vapor implant locations sampled by URS. The following sections discuss the findings from the seven SC phases. Also discussed are the results of groundwater split samples from seven wells for compound-specific stable isotope analysis (CSIA) of cis-1,2-dichloroethene (cis-1,2-DCE), PCE and TCE, a limited groundwater sampling event conducted in 2009, a Phase I, Phase II, Phase III Off-Site, and Phase III On-Site RI at the Former Spic and Span Cleaners and Dyers Inc. Site (NYSDEC Site ID No. 224129), and a RI at the Former Klink Cosmo Cleaners Site (NYSDEC Site ID No. 224130). The Site Characterization Phase VII Report is included in Appendix A.

1.2.1 Summary of SC Phase I Findings

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

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

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

associated near locations that potentially have used PCE and TCE (i.e., two former dry cleaners, a former dry cleaners/dye works, a drum recycling facility, a research lab, a former brass foundry, two metal working facilities, and a former soap manufacturer).

1.2.2 Summary of SC Phase II Findings

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

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

- There appear to be five distinct areas of elevated soil vapor concentrations within the site boundary, as shown on Figures 1-7 and 1-8. The horizontal extent of impacted soil vapor was not fully determined at three of the five areas identified. The impacted soil vapor plumes in the area south of Meeker Avenue appear to have coalesced.
- Analytical results from soil samples indicated that a shallow source of impacted soil exists in the vicinity of the northeastern corner of the building located at 72 Anthony Street. Soil samples from boring SB-08 confirmed the presence of PCE in shallow soils at a concentration that exceeded TAGM 4046 criteria. Soil boring SB-08 is located within 20 feet of monitoring well DEC-016. The results of the sample from SB-08 confirm the results of soil samples taken from DEC-016 during the Phase I field investigation.
- There appear to be five potential source areas within the site boundary where dissolved phase chlorinated solvents have adversely impacted the shallow groundwater, as shown on Figures 1-9 and 1-10. The horizontal extent of impacted shallow groundwater was not fully determined at four of the five potential source areas. The potential impact of dissolved phase chlorinated solvents to deeper groundwater was not investigated at the five potential sources during Phase II fieldwork.

1.2.3 Summary of SC Phase III Findings

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

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

- The five areas of elevated soil vapor concentrations identified within the site boundary during the Phase II field investigation were further delineated during Phase III, as shown on Figures 1-11 and 1-12. The horizontal extent of impacted soil vapor was not fully delineated at two of the five areas.
- Soil borings performed in the vicinity of the EPM soil boring located at the southeastern intersection of Gardner Avenue and Thomas Street did not indicate the presence of chlorinated solvent impacted soils in this area.
- A dense non-aqueous phase liquid (DNAPL) containing 700,000 mg/kg of PCE was collected from monitoring well DEC-024D.
- The results of groundwater samples collected during Phase III have allowed URS and the NYSDEC to identify four sources of dissolved phase chlorinated solvents in the shallow groundwater, as shown on Figures 1-13 and 1-14. In addition, there are potentially two other sources, but insufficient information was gathered to positively identify these locations as sources without additional investigation. The horizontal extent of impacted

shallow groundwater was not fully determined at the two potential source areas. The potential impact of dissolved phase chlorinated solvents to deeper groundwater was investigated at all four source areas and two potential source areas. Data indicated that deeper groundwater was impacted in each of those areas. The vertical extent of impacted groundwater was not fully determined at the four source areas and the two potential source areas.

1.2.3.1 SC Phase III Source Characterization

Four sources and two potential sources of PCE and/or TCE contamination were identified within the study area. The description and location of the four sources and two potential sources are discussed below.

1.2.3.1.1 Sources

- The Former Spic and Span Cleaners and Dyers, Inc. [aka Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 315 Kingsland Avenue (Brooklyn Tax District, Block 02657, Lot 0009) was identified as a source of groundwater contamination. Based on Sanborn map data, this facility was located at the above address from the early 1900s until the mid-1960s. DNAPL containing 700,000 of mg/kg PCE was collected from monitoring well DEC-024D. DEC-024D is located on Kingsland Avenue adjacent to the southeastern corner of the former facility.
- The Former Metal Works located at 95 Lombardy (Brooklyn Tax District, Block 02819, Lot 0008) was identified as a source of groundwater contamination. Based on Sanborn map data, the facility has been utilized from the 1930s to approximately 2009 as a metal fabricator and painting facility. ACME is listed in the EDR report as a generator of F001 waste (spent halogenated solvents used in degreasing) for this facility. Monitoring wells DEC-005 and DEC-005D are located on the western side of the building on Vandervoort Avenue. Groundwater samples from these wells indicate significant TCE contamination and the potential presence of DNAPL given the increasing TCE concentrations with depth.
- A former brass foundry located at 72 Anthony Street (Brooklyn Tax District, Block 02820, Lot 0005) was identified as a source of soil and groundwater contamination.

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

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

1.2.3.1.2 Potential Sources

- The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street (Brooklyn Tax District, Block 02821, Lot 0001), is a potential source of groundwater contamination. Based on Sanborn map data, the facility was utilized during the 1930s for lacquer storage and as a manufacturer of powdered soap from the early 1950s to 1989. Monitoring wells DEC-018 and DEC-018D are located on the Varick Avenue or western side of the building, near Lombardy Street. Groundwater samples from these wells indicate significant PCE and TCE contamination. The PCE and TCE contamination in the shallow groundwater zone is centered on DEC-018, suggesting the contamination is near its source.
- The former Curtis Electro N.Y., Inc. facility located at 126 Cherry Street (Brooklyn Tax District, Block 02814, Lot 0010), is a potential source of groundwater contamination. Based on Sanborn map data, the facility was utilized as a light fixture manufacturer from

the mid-1960s until sometime after 1995. Monitoring wells DEC-049 and DEC-049D are located adjacent to the facility on the corner of Stewart Avenue and Cherry Street. Groundwater samples from these wells indicate significant PCE and TCE contamination that increases with depth.

1.2.4 Summary of SC Phase IV Findings

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

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

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

- The results of the groundwater samples collected during Phase IV allowed URS and the NYSDEC to identify the area in the immediate vicinity of DEC-018 as a potential source of PCE and TCE in the shallow groundwater (Figures 1-15 and 1-17). The horizontal extent of PCE and TCE in the shallow groundwater has been delineated to the west, north, and east. PCE and TCE concentrations decrease by up to four orders of magnitude in wells downgradient and sidegradient from DEC-018. PCE and TCE degradation products have typically been found at the highest concentrations in shallow groundwater monitoring wells located closest to the Off-Site Plume area boundary. This is likely caused by the degradation of the non-chlorinated hydrocarbons associated with the Off-Site Plume, which has produced an oxygen-deficient environment. The southern/southeastern extent of PCE and TCE in the shallow groundwater has not been delineated.
- It was found that deep groundwater, in the area of MW-097/097D, has been significantly impacted by both PCE and TCE (Figures 1-16 and 1-18). Concentrations decrease by one to two orders of magnitude moving to the east and south away from the monitoring well pair. The horizontal extent of PCE and TCE in deep groundwater has not fully been determined. Data gaps exist to the north and west of MW-097/097D. The horizontal extent of the PCE impacted deep groundwater occupies a larger footprint than the horizontal extent of PCE in the shallow groundwater. This suggests that multiple shallow sources are contributing to the PCE and TCE, found in deep groundwater. The full vertical extent of impacted groundwater has not been determined.
- The former Curtis Electro N.Y., Inc. facility, which was located at 126-140 Cherry Street (Tax District of Brooklyn, Block 02814, Lot 0010), is no longer considered a potential source of groundwater contamination. Based upon data obtained during the Phase IV investigation, it was determined the concentrations of PCE and TCE that were detected previously in DEC-049 and DEC-049D, which are adjacent to the former Curtis Electro N.Y., Inc. facility, are likely related to the impacted groundwater originating from near DEC-018/018D (i.e., further upgradient). No separate source of PCE and/or TCE exists near DEC-049 and DEC-049D as had been previously hypothesized.

1.2.4.1 SC Phase IV Source Characterization

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

1.2.4.1.1 Sources

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

- An identified source of groundwater contamination is the building housing the Former Spic and Span Cleaners and Dyers, Inc. [a.k.a. Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 260 Norman Avenue/315-325 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0009) and 307-313 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0015). The site is listed as the Former Spic and Span Cleaners and Dyers, Inc. (Spic and Span Site), NYSDEC Site ID No. 224129.
- A source of groundwater contamination is the Former Klink Cosmo Cleaners, which was located at 364 Richardson Street (Tax District of Brooklyn, Block 02860, Lot 0001). The site is listed as the Former Klink Cosmo Cleaners (Klink Cosmo Site), NYSDEC Site ID No. 224130.
- A source of groundwater contamination is a former metal works, operated by ACME Architectural Products, Inc., located at 95 Lombardy Street (Tax District of Brooklyn, Block 02819, Lot 0008) and 46-60 Anthony Street (Tax District of Brooklyn, Block 02819, Lot 0011). The site is listed as the ACME Steel Metal Works Site, NYSDEC Site ID No. 224131.
- A source of soil and groundwater contamination is a former brass foundry and a stainless steel door finishing facility operated by ACME Architectural Products, Inc., located at 72

Anthony Street (Tax District of Brooklyn, Block 02820, Lot 0005) and 90 Anthony Street (Tax District of Brooklyn, Block 02820, Lot 0001). The site is listed as the ACME Steel Brass Foundry Site, NYSDEC Site ID No. 224132.

1.2.4.1.2 Potential Sources

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

- The facility that was occupied by a laundry, a dyer, and dry cleaners, located at 262-268 Monitor Street (Brooklyn Tax District, Block 02608, Lot 0082), and 252 Monitor Street (Brooklyn Tax District, Block 02608, Lot 0099) may be a potential source of PCE and/or TCE. The facility was utilized as a laundry, dyers, and dry cleaners from approximately 1965 at least 2007 based on Sanborn Map data.
- The facility that was occupied by a laundry located at 242 Monitor Street/253A-257 Norman Avenue (Brooklyn Tax District, Block 02608, Lot 0095) may be a potential source of PCE and/or TCE. The facility was utilized as a laundry from approximately 1933 to 1951 based on Sanborn Map data and a review of certificates of occupancy.
- The former Rose & Co. Dye Works occupied four Lots: 355 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0078); 347-353 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0079); 341 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0084); and 337-339 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0085). The former facility may be a potential source of PCE and/or TCE. The facility was utilized as a laundry and dry cleaners from approximately 1944 to 1986 based on Sanborn Map data and a review of certificates of occupancy. The Sanborn maps identified six USTs, listed for use as benzene tanks from 1942-1965 and then as solvent tanks from 1965 to at least 2007, on Block 02608 Lots 0084 and 0085.
- The facility that is occupied by a current metal works, located at 96-102 Anthony Street/157-163 Lombardy Street (Brooklyn Tax District, Block 02820, Lot 0028) may be a potential source or a contributing source to the presence of PCE and/or TCE in the

environment. The facility started metal working in 1977 based on a review of certificates of occupancy.

- The facility that is occupied by a current metal works, located at 104-110 Anthony Street/169 Lombardy Street/503-519 Varick Avenue (Brooklyn Tax District, Block 02820, Lot 0021) may be a potential source or a contributing source to the presence of PCE and/or TCE in the environment. The facility adjoins 157 Lombardy Street to the east.
- The facility that was occupied by a former soap manufacturer and lacquer storage, located at 171-179 Lombardy Street/496-508 Varick Avenue (Brooklyn Tax District, Block 02821, Lot 0001) appears to be a potential source of groundwater contamination. Based on Sanborn Map data, the facility was utilized during the 1930s for lacquer storage, and as a manufacturer of powdered soap from the early 1950s to 1989. Monitoring wells DEC-018 and DEC-018D are located on the Varick Avenue or west side of the building, near Lombardy Street. Groundwater samples from these wells indicate significant PCE and TCE contamination in shallow groundwater.
- The facility that was occupied by a former metal works, located at 122-132 Anthony Street/181-193 Lombardy Street (Brooklyn Tax District, Block 02821, Lot 0011) may be a potential source or a contributing source to the presence of PCE and/or TCE in the environment. The facility started metal working in 1953 based on a review of certificates of occupancy.

1.2.5 Summary of SC Phase V Findings

The Phase V field investigation was conducted from June 15 through July 13, 2009. The investigation area for Phase V was limited to the area located north of Nassau Avenue and south of Meserole Avenue between Sutton Street to the east and Monitor Street to the west. The purpose of the Phase V fieldwork was to assist in determining: 1) the horizontal extent of the dissolved phase plume originating from near the Spic and Span Site (DEC-024/024D); 2) if there were additional potential sources of PCE and TCE impacting shallow groundwater to the north of the Spic and Span Site; 3) the horizontal extent of impacted deep groundwater, if present; 4) if the clayey silt unit that was encountered in well DEC-024D is present at other well locations in the area; 5) the depth and areal extent of the clayey silt unit, if encountered; and 5) if DNAPL is

present at the top of the clayey silt unit at locations other than DEC-024D. Using data obtained during the five phases of the investigation performed by URS, it was determined that there are four sources and seven potential sources of PCE and TCE contamination within the overall study area. A complete description of the field investigation and results may be found in the Phase V Data Summary Report (URS, October 2009).

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

- In the area north of Meeker Avenue, soil has been impacted by chlorinated solvents and petroleum related compounds. A soil sample with elevated PCE concentrations was collected from DEC-024DR. DNAPL containing 730,000 mg/kg PCE was collected from monitoring well DEC-024D at a depth similar to the depth of the soil sample from DEC-024DR. Because the soil sample was collected below the water table in a zone with decreasing permeability, the impacted soil in the vicinity of DEC-024DR may be the result of lateral spreading of DNAPL. The horizontal extent of PCE impacted soil was not determined since PCE was found in only one location at significant concentrations. Light non-aqueous phase liquid (LNAPL) was found in DEC-034 and DEC-054. Petroleum related compounds had impacted soil at DEC-034, DEC-053, and DEC-054.
- Figures 1-19 and 1-21 present PCE and TCE concentrations for shallow overburden groundwater; Figures 1-20 and 1-22 present PCE and TCE isoconcentration contours for deep overburden groundwater. Groundwater north of Meeker Avenue has been impacted by dissolved phase chlorinated solvents. The area in the immediate vicinity of DEC-024/024D/024DR was identified as a source of PCE and TCE in shallow groundwater based on the presence of DNAPL in DEC-024D and DEC-024DR.

1.2.5.1 Sources

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

1.2.5.2 Potential Sources

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

1.2.6 Groundwater Split Sampling and Compound-Specific Stable Isotope Analysis

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

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

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

1.2.6.1 Sources

No additional sources were identified based on the CSIA sampling results.

1.2.6.2 Potential Sources

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

1.2.7 2009 Groundwater Sampling Event

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

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

- PCE was detected in 19 of the 20 groundwater samples collected, with 17 samples at concentrations exceeding groundwater criteria. Figure 1-23 depicts isoconcentration contours for PCE in the shallow groundwater and includes the locations of the sources and potential sources in the Former Klink Cosmo Cleaners Area.
- TCE was detected in 16 of the 20 groundwater samples collected, with 10 samples at concentrations exceeding groundwater criteria. Figure 1-24 depicts isoconcentration contours for TCE in the shallow groundwater and includes the locations of sources and potential sources.

1.2.8 Spic and Span Remedial Investigation Results

URS has performed four phases of RI field activities at the Spic and Span Site, NYSDEC Site ID No. 224129. A Phase I RI Report was prepared in July, 2011 (URS, July 2011) based on the Phase I RI field investigations which were conducted between January and March 2011. A Phase II RI Report was prepared in September 2012 (URS, September 2012) based on the Phase II RI field investigations which were conducted between November 2011 and February 2012. An Off-Site (i.e., off-site areas impacted by contamination migrating from the 315 Kingsland Avenue property) Phase III RI report was prepared in September, 2014 (URS, September 2014) based on the Off-Site Phase III RI field investigations which were conducted between January and May 2014. An On-Site (i.e., 315 Kingsland Avenue property) Phase III RI Report was prepared in March 2015 (URS, March 2015) based on the On-Site Phase III RI field investigations which were conducted between May and July 2014. In addition, a UST Report was prepared (i.e., 315 Kingsland Avenue Underground Storage Tank Investigation and Data Summary Report

associated with NYSDEC Spill No. 14-02556) as a separate component of the On-Site Phase III Report. The following is a summary of analytical results.

1.2.8.1 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.

1.2.8.1.1 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 feet to more than 138 feet thick.
- An inclusive sand layer containing DNAPL and high 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 regional aquiclude 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 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 2.91×10^{-2} cm/sec (DEC-063) to 8.32×10^{-5} cm/sec (DEC-060). In the shallow overburden, the mean value of K is 8.03×10^{-3} cm/sec for the sand clayey silt/sand unit, and 3.15×10^{-4} cm/sec for the sandy silt. In the deep overburden, the mean value of K is 1×10^{-3} cm/sec for the sand/silty sand, and 9.32×10^{-5} cm/sec for the sandy silt.

1.2.8.1.2 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 northern extent of the inclusive sand layer near SSB-32 contains vertical sand stringers saturated with DNAPL, which allow vertical migration of DNAPL. DNAPL was observed in nearby borings SSB-29 and SSB-30 to approximately 63 feet bgs. 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 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.

1.2.8.1.3 Non-Aqueous Phase Liquids

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 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.

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.

1.2.8.1.4 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. Monitoring wells located near the southwest corner of the Crown property (i.e., DEC-058) reported concentrations of CVOCs up to four 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. 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 ($\mu\text{g/L}$), respectively; downgradient of the site in DEC-058 and DEC-058D, to the northeast at concentrations of 13,000 and 35,000 $\mu\text{g/L}$, respectively; to the east in DEC-060 and DEC-060D at concentrations of 22,000 and 13,000 $\mu\text{g/L}$, respectively, and in DEC-036 and DEC-036D at concentrations of 4,200 and 4,500 $\mu\text{g/L}$, respectively; and to the southeast in DEC-003DD at a concentration of 11,000 $\mu\text{g/L}$, and DEC-061 and DEC-061D at concentrations of 1,400 and 8,200 $\mu\text{g/L}$, respectively. PCE was detected at 1 $\mu\text{g/L}$ 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.

1.2.8.1.5 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.

1.2.8.1.6 Qualitative Human Health Exposure Assessment

Results of the Qualitative Human Health Exposure Assessment indicate that under current conditions, potential pathways are complete for construction workers during intrusive activities for subsurface soil and soil vapor, and for onsite employees and the public due to indoor air. Potentially completed pathways exist for future use for subsurface soil and soil vapor for construction workers, outdoor air for the public, and indoor air for onsite employees and the public.

1.2.8.1.7 Fish and Wildlife Resources Impact Analysis

Results of the Fish and Wildlife Resources Impact Analysis (FWRIA) indicate that the site is located in an old, highly developed, urbanized area. Plant communities in the project area include a mowed lawn and trees, mowed lawn and vegetated areas on disturbed sites. These communities are associated with residential, recreational, commercial and industrial areas in the project area. No plant communities were identified on the Site. The results of the FWRIA Step I

analysis indicate that there is limited potential for wildlife at the Site. Because of its location in an urbanized area and the presence of the building and sidewalks which cover most of the surface of the area, the Site provides very little if any suitable habitat for wildlife other than Norway rat, house mouse, and perching birds. The site does not provide any current or potential value to humans as a nature recreation area.

1.2.8.2 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).

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.

1.2.8.3 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. 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.
- 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. 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 1-25 and 1-27.
- As shown in Figures 1-25 through 1-28, 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.

- 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 $\mu\text{g}/\text{m}^3$ and 2,800 $\mu\text{g}/\text{m}^3$, respectively. PCE was also detected at a concentration of 8.5 $\mu\text{g}/\text{m}^3$ 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.

1.2.8.3.1 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 to beneath the Crown property. Groundwater data collected in June 2014 from RW-17 (Roux August 13, 2014) reported concentrations of PCE at 200 µg/L, TCE at 27 µg/L, cis-1,2-DCE at 51 µg/L, and vinyl chloride at 6 µg/L.

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

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

1.2.8.3.2 Recommendations

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

- Additional shallow and deep groundwater monitoring well pairs should be installed on the west side of Hausman Street between Norman and Nassau Avenues to determine the horizontal and vertical extent of CVOC-impacted groundwater migrating to the ExxonMobil recovery well RW-22.
- Additional deep monitoring wells should be installed on the 297 Norman Avenue property (MV Transportation) to determine the horizontal extent of CVOC impacted deep groundwater migrating to the ExxonMobil recovery well RW-17.
- An additional deep monitoring well should be installed on the west side of the Crown property (i.e., MW-46D). The deep well will assist in assessing deep groundwater flow dynamics and the movement of CVOCs in deep groundwater after ExxonMobil recovery wells RW-27 and RW-28 are operational.
- An additional deep monitoring well should be installed on the southeast corner of the Crown property (i.e., MW-083D) to determine the horizontal extent of CVOC impacted deep groundwater migrating to the ExxonMobil RW-17.
- The shallow monitoring wells should be constructed with a 15-foot long 2- inch ID PVC screen and PVC riser. The deep monitoring wells should be constructed with 10 feet of 2-inch ID, PVC 0.010-inch slot screen and PVC riser. A #0 or #1 size sand pack should be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry should then be installed around the riser to an elevation of 2-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing should complete each well. All wells on the Crown property should be finished with a flush-mounted curb boxes equipped with heavy duty one-piece cast collars due to the heavy truck traffic.
- Up to two soil samples should be collected from each boring location: one soil sample from the interval just above water table, and the second sample from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading are encountered, then only one sample from the interval just above the water table should be collected, as per the Field Activity Plan [FAP (URS, April 2010)]. All soil samples should be analyzed for TCL VOCs plus TICs by USEPA SW846 Method 8260B.

1.2.8.4 Spic and Span On-Site Phase III RI

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 the On-Site Phase III RI.

1.2.8.4.1 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 regional aquiclude 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 2.91×10^{-2} cm/sec (DEC-063) to 8.32×10^{-5} cm/sec (DEC-060). In the shallow overburden, the mean value of K is 8.03×10^{-3} cm/sec for the sand clayey silt/sand unit, and 3.15×10^{-4} cm/sec for the sandy silt. In the deep overburden, the mean value of K is 1.00×10^{-3} cm/sec for the sand/silty sand, and 9.32×10^{-5} cm/sec for the sandy silt.

1.2.8.4.2 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 bottom of the northern extent of the inclusive sand layer near SSB-32 contains vertical sand stringers saturated with DNAPL. DNAPL was observed 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.

1.2.8.4.3 Non-Aqueous Phase Liquids

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 curblineline of Kingsland Avenue and may extend into the street area (Figure 1-29).

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

1.2.8.4.4 Groundwater

On-Site Area

PCE and its degradation products were detected in numerous groundwater monitoring wells in both shallow and deep overburden groundwater (Figure 1-30). 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, therefore, the geochemical conditions could be enhanced via in-situ bioremediation technologies to further promote higher rates of reductive dechlorination. During the Feasibility Study, this and other remedial technologies such as in-situ chemical oxidation will be evaluated.

1.2.8.4.5 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.

The locations of the VOCs detected in sub-slab soil vapor samples collected during the Spic & Span On-Site Phase III RI, including PCE and its breakdown products, are shown on Figure 1-31. PCE was detected in the sub-slab soil vapor at concentrations ranging from 57 $\mu\text{g}/\text{m}^3$ at location 315-04 to 350 $\mu\text{g}/\text{m}^3$ at location 315-01. PCE was detected at 43 $\mu\text{g}/\text{m}^3$ in the outdoor air sample. TCE was detected in the sub-slab soil vapor at concentrations ranging from 31 $\mu\text{g}/\text{m}^3$

at location 315-05 to 1,300 $\mu\text{g}/\text{m}^3$ 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 $\mu\text{g}/\text{m}^3$ at location 315-06; however, the outdoor air acetone concentration was 600 $\mu\text{g}/\text{m}^3$.

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

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

1.2.8.4.6 Conceptual Site Model

Figure 1-32 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.

1.2.8.4.7 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. 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.

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

- Nine soil borings should be advanced along Kingsland Avenue adjacent to the buildings that housed Spic and Span. The borings should be installed through the sidewalk to assist in delineating the horizontal and vertical extent of the DNAPL identified in the On-Site source area, and further refine proposed DNAPL extraction well locations. The borings should be advanced in a grid like pattern using a remote access drill rig(s) or direct-push unit(s).
- Up to two soil samples should be collected from each boring location. At a minimum, one soil sample should be collected from the interval just above water table; the second sample should be collected from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading are encountered, then only one sample from the interval just above the water table should be collected, as per the Field Activities Plan (FAP) (URS, April 2010). All soil samples should be analyzed for TCL VOCs plus TICs by 8260B.
- If DNAPL is encountered in any new monitoring or extraction well(s) during drilling, well development or purging, a DNAPL sample should be collected for laboratory analyses. The DNAPL sample(s) should be analyzed for TCL VOCs plus TICs by 8260B, TCL SVOCs plus TICs by 8270C, petroleum hydrocarbon scan by 8100 (modified), specific gravity by ASTM D4052, surface tension by ASTM D-971, and viscosity by ASTM D-445.
- Groundwater samples should be collected from the newly installed monitoring wells. All groundwater samples should be analyzed for TCL VOCs plus TICs. Prior to the

start of groundwater sampling, a synoptic round of water levels/LNAPL gauging should be collected from all monitoring wells in the Spic and Span area.

Off-Site Area(s)

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

- Additional shallow and deep groundwater monitoring well pairs (DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, DEC-139D) should be installed on the east side of Hausman Street between Norman and Nassau Avenues to determine the horizontal and vertical extent of CVOC-impacted groundwater migrating to the ExxonMobil recovery well RW-22.
- Additional deep monitoring wells (AMW-17D and PW-1D) are proposed on the 297 Norman Avenue property (MV Transportation) to determine the horizontal extent of CVOC-impacted deep groundwater migrating to the ExxonMobil recovery well RW-17.
- An additional deep monitoring well should be installed on the west side of the Crown property (i.e., MW-046D). The deep well will assist in assessing deep groundwater flow dynamics and the movement of CVOCs in deep groundwater after ExxonMobil recovery wells RW-27 and RW-28 are operational.
- An additional deep monitoring well should be installed on the southeast corner of the Crown property (i.e., MW-083D) to determine the horizontal extent of CVOC-impacted deep groundwater migrating to the ExxonMobil RW-17.

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

Up to two soil samples should be collected from each boring location: one soil sample from the interval just above water table; and the second sample from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading are encountered, then only one sample from the interval just above the water table should be collected, as per the FAP (URS, April 2010). All soil samples should be analyzed for TCL VOCs plus TICs by USEPA SW846 Method 8260B.

Groundwater samples should be collected from the newly installed monitoring wells. All groundwater samples should be analyzed for TCL VOCs plus TICs. Prior to the start of groundwater sampling, a synoptic round of water levels/LNAPL gauging should be collected from all monitoring wells in the Spic and Span area. At well locations where LNAPL is encountered, a groundwater sample should be collected from the well by lowering a capped tremie pipe into the well to a depth at least 5 feet below the LNAPL layer. The tremie pipe should be secured to limit movement and the cap should be pushed out from the bottom end of the tremie pipe to allow the sample tubing to be lowered to the desired sampling depth without coming into contact with the LNAPL. The cap should be attached to the tremie pipe for retrieval. A peristaltic pump should be used to purge the wells containing LNAPL.

Recommendations were implemented in January through March 2015 and data reduction is ongoing and will be compiled as a separate submittal to NYSDEC in 2015.

1.2.9 Klink Cosmo Remedial Investigation Results

URS has performed three phases of RI field activities at the Klink Cosmo Site, NYSDEC Site ID No. 224130 and additional remedial investigations are ongoing in the source area situated beneath the 460 Morgan Avenue property. The Phase I RI Report was prepared in December, 2011 (URS, December 2011) based on the field investigation which was conducted between May and July 2011. A Phase II RI Report was prepared in November 2012 (URS, November 2012) based on the Phase II RI field investigations which were conducted between February and April 2012. The Off-Site Phase III RI Letter Report was prepared in September 2014. The following is a summary of analytical results.

1.2.9.1 Soil

Soil sample results were compared to background, unrestricted use, residential, restricted residential and protection of groundwater criteria. PCE and its daughter compound TCE were not found to exceed any soil criteria at any locations.

1.2.9.2 Non-Aqueous Phase Liquid

During the RI Phase I field activities, LNAPL found in DEC-048 was analyzed and a fuel oil was detected at a concentration of 950,000 mg/kg. NYSDEC Spill No. 1103190 was assigned on June 21, 2011 to the LNAPL found in this area. The specific gravity measured 0.8608, and organic compounds detected in the sample were consistent with fuel oil(s).

1.2.9.3 Groundwater

Based on the RI Phase II groundwater sampling results, PCE was detected in numerous groundwater monitoring wells in both shallow and deep overburden groundwater. Figure 1-33 and Figure 1-34 depict the concentrations of PCE detected in the shallow and deep overburden groundwater, respectively. PCE was either not detected or detected below SCGs in several monitoring wells upgradient of the site (ND in DEC-032, 2.1 µg/L in DEC-033, 2.5 µg/L in DEC-047, 4.4 D µg/L in DEC-048, ND in DEC-091), and in DEC-004 (1.2 µg/L) downgradient of the site. In the deep overburden, PCE was either not detected or detected below SCGs upgradient of the site (3.5 µg/L in DEC-046D), and in DEC-031D (3.6 µg/L) and DEC-044D (ND) north of the property, in DEC-011D (1.9 µg/L) west of the property, and in DEC-045D (ND), DEC-066D (ND), and DEC-091D (3.3 µg/L) east of the property. The highest concentration of PCE in the shallow overburden was detected at DEC-14R (15,000 µg/L) located downgradient of the site, followed by DEC-029 (12,000 µg/L) located downgradient of DEC-14R, DEC-031 (9,200 µg/L) located on the northeast corner of the Klink Cosmo property, and DEC-090 (2,400 µg/L) located downgradient of DEC-031. The highest concentration of PCE in the deep overburden was detected at DEC-089D (1,200 µg/L), followed by DEC-006DD (320 µg/L), and DEC-015D (310 µg/L), located downgradient of the site. Elevated concentrations of PCE were found at DEC-029TC (4,500 µg/L) which is located downgradient of the Klink Cosmo property above the top of the Raritan Formation. The concentration of PCE at DEC-031TC (1.9 µg/L) which is located at the northeast corner of the former Klink Cosmo building, is three orders of magnitude lower.

TCE and cis-1,2-DCE were generally detected above criteria, but at lower concentrations than PCE, to the north and northeast of the Klink Cosmo Site. Vinyl chloride was only sporadically detected and exceeded criteria in DEC-009 (north of the site) at 37 µg/L. Similar to wells with PCE and TCE, during Phase I and II, some degradation products have typically been found in monitoring wells to the northeast and east indicating some degradation of the plume due to reductive dechlorination. The absence of significant daughter breakdown products indicates that substantial chlorinated hydrocarbon reduction is not occurring at a large scale.

Based upon the RI Phase II sampling event, a dissolved chlorinated solvent plume originates at the Klink Cosmo Site. The horizontal extent of the chlorinated solvents around the perimeter of the site has been mostly delineated; however, the source area beneath the former operational area of the dry cleaning facility has yet to be characterized. RI Phase II PCE concentrations were marginally lower as compared to RI Phase I concentrations except in the area of DEC-015D, DEC-007D, and DEC-006DD, which were higher. It appears that the chlorinated solvent plume in the shallow and deep overburden has higher concentrations of PCE immediately north and east of the Klink Cosmo Site. The extent of PCE has a larger footprint in the shallow groundwater compared to the deep groundwater and appears to be moving with regional deep groundwater flow towards the northeast and comingles with the dissolved chlorinated solvent plume originating within the ACME Steel Areas. The vertical extent of PCE and TCE impacted groundwater was determined to extend down to the top of the Raritan Formation. The horizontal extent of PCE impacted groundwater in the deep overburden near the top of the Raritan Formation has not fully been delineated. The impacted groundwater appears to be migrating to the northeast and extends into the ACME Steel Areas in the vicinity the intersection of Porter Avenue and Lombardy Street. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

Based upon the data collected to assess the potential for degradation of PCE in the groundwater system as presented above, there is evidence that some 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 Klink Cosmo Site. Based upon the geochemical conditions in the groundwater system, the aquifer is only slightly conducive for naturally occurring reductive dechlorination. It is possible that the geochemical conditions could

be enhanced via in-situ bioremediation technologies to further promote higher rates of reductive dechlorination.

Based on the RI Phase III groundwater sampling results, PCE and its degradation products were detected at concentrations exceeding groundwater criteria in shallow and deep groundwater monitoring wells (DEC-111 and DEC-111D, respectively) which are located immediately downgradient of the Klink Cosmo Site, adjacent to the former JR Cooperage facility.

PCE and TCE have also been detected in groundwater sample DEC-006TC at concentrations exceeding groundwater criteria. The sample was collected immediately above the top of the Raritan Formation at approximately 115 feet bgs. The PCE concentration at DEC-006TC (i.e., 4,900 µg/L) is similar to the concentration detected at DEC-029TC (i.e., 4,500 µg/L) during the RI Phase II sampling event. DEC-029TC is located upgradient of DEC-006TC at the top of the Raritan Formation. This indicates the PCE contamination maybe continuing to migrate to the northeast in the direction of groundwater flow in the deep groundwater zone above the top of the Raritan Formation from the Klink Cosmo Site area. However, since DEC-006TC is within the zone of potential impact from the nearby ACME Steel Sites, the PCE contamination could be attributed to the ACME Steel Sites, or a combination of the ACME Steel Sites and Klink Cosmo Site.

1.2.9.4 Soil Vapor

Soil vapor in the Klink Cosmo Area has been adversely impacted by the presence of PCE, TCE and their daughter products. The concentrations of PCE and TCE detected during the Phase II RI are shown on Figures 1-35 and 1-36, respectively. The elevated soil vapor concentrations were generally present to the west, north and the eastern perimeter of the former Klink Cosmo Cleaners building and immediately downgradient (SG-060, SG-082, SG-083, SG-084, SG-086, SG-087, SG-116, SG-117, SG-118, and SG-119). A second area of elevated soil vapor concentration was found north/northwest of the site (i.e., SG-048 and SG-056).

The approximate size of the PCE and TCE soil vapor plumes from RI Phase I and II are similar in size and appear to mimic the extent of the dissolved phase shallow groundwater plume. The exception to this is the concentrations that exist along the west side of the former Klink Cosmo Cleaners building (i.e., SG-086 and SG-087) and north/northwest of the site (i.e., SG-048 and SG-056).

1.2.9.5 Qualitative Human Health Exposure Assessment

Based upon soil sampling results around the perimeter of the site, there are no completed exposure pathways under either the current or future use scenarios because there were no contaminants of potential concern detected in soil around the perimeter of the site. It is possible that there may be completed exposure pathways for soil under either or both the current or future use scenarios if contaminated soil is discovered in the source area. There are potential exposure pathways from soil vapor through the inhalation of VOCs to construction workers, onsite employees, and the public under both the current and future use scenarios. Exposure pathways are not complete for the public under current conditions for outdoor air, or for any receptors for groundwater.

1.2.9.6 Fish and Wildlife Resources Impact Analysis

Results of the FWRIA indicate that the site is located in an old, highly developed, urbanized area. Plant communities in the project area include a mowed lawn and trees, mowed lawn, and vegetated areas on disturbed sites. These communities are associated with residential, recreational, commercial and industrial areas in the project area. No plant communities were identified on the site. The results of the FWRIA Step I analysis indicate that there is limited potential for wildlife at the site. Because of its location in an urbanized area and the presence of the building and sidewalks which cover most of the surface of the site, the site provides very little if any suitable habitat for wildlife other than Norway rat, house mouse and perching birds. The site does not provide any current or potential value to humans as a nature recreation area.

1.2.10 Summary of SC Phase VI Findings

URS prepared a Site Characterization Phase VI Report for the investigation area in April, 2012 (URS, April 2012) based on field investigations conducted between August 2, 2011 through October 28, 2011 and November 15, 2011 through January 13, 2012. The following is a summary of analytical results.

1.2.10.1 Soil

Spic and Span Area

A shallow source of PCE and DNAPL has been identified within the inclusive sand layer in the vicinity of SSB-11, which is located along the eastern side of the Former Spic and Span Cleaners building, along Kingsland Avenue. Plate 1 depicts the soil boring locations. The inclusive sand layer has been found to contain elevated concentrations of PCE and DNAPL. The bottom of the northern edge of the inclusive sand layer has vertical sand stringers present with DNAPL in them and represents a vertical pathway from the shallow zone through the glacial till unit into the lower units. DNAPL was noted in sand stringers located within the top of the clayey silt unit at SSB-30 at approximately 63 feet bgs. The northern edge of the inclusive sand layer is approximately 35 feet from DEC-024D and DEC-024DR, where DNAPL has been found at the top of the clayey silt unit. The north/south (horizontal) extent of the inclusive sand layer appears to have been delineated and a vertical profile has been established. The eastern and western extent of the impacted inclusive sand layer in the vicinity of SSB-11 has not been delineated.

An unrelated shallow source of PCE contamination was identified in the vicinity of DEC-025 and DEC-025D, which is located on the east side of Kingsland Avenue, south of the Former Spic and Span Cleaners building in front of 300 Kingsland Avenue. The highest concentration of PCE (2,000 mg/kg) was found within the top 2.5 feet below the sidewalk at SSB-03, and within the top 2.5 feet at both DEC-025D and SSB-08 (1,300 mg/kg at both locations). SSB-16, which is located approximately 10 feet south of DEC-025D, had the highest PID readings (336 to 1,528 ppm) in the upper 20 feet. Below 20 feet, PID readings in SSB-16 significantly decreased with depth and were 0 ppm below 26.0 feet bgs. The remainder of the borings around DEC-025 and DEC-025D had significantly lower PID readings. It appears that the most PCE impacted soil is within the top 20 feet of soil, between 30 feet north and 10 feet south of DEC-025 and DEC-025D. The north/south horizontal extent of the impacted soil appears to have been delineated and a vertical profile has been established. The eastern extent of the impacted soil near DEC-025/025D 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.

Klink Cosmo Area

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

ACME Steel Areas

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

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

West of Morgan Avenue Area

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

1.2.10.2 Non-Aqueous Phase Liquids

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

- PCE was detected in DEC-024R at 110,000,000 µg/kg; TCE was detected at 220,000 µg/kg; cis-1,2-DCE was detected at 7,300 µg/kg; and 1,2,4-trichlorobenzene was detected at 9,400 µg/kg.
- Laboratory measured parameters from the DNAPL sample from DEC-024DR include: viscosity of 1.21 centipoise, surface tension of 26.4 dynes/cm, and specific gravity of 1.2942.

1.2.10.3 Groundwater

Isoconcentration contours of PCE in the SC Phase VI groundwater samples are shown on Figures 1-37, 1-38, and 1-39 for the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively. Figures 1-40, 1-41, and 1-42 present the isoconcentration contours for TCE in the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively.

Spic and Span Area

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

Klink Cosmo Area

Based upon the observed concentrations of VOCs from the SC Phase VI groundwater sampling event, a dissolved chlorinated solvent plume appears to originate at the Klink Cosmo Site. The horizontal extent of the chlorinated solvents has been mostly delineated. It appears that the chlorinated solvent plume in the shallow and deep overburden have higher concentrations of

PCE immediately north and east of the Klink Cosmo site. The extent of PCE has a larger footprint in the shallow groundwater compared to the deep groundwater and appears to be moving to the northeast and comingling with the dissolved chlorinated solvent plume originating within the ACME Steel Areas. The vertical extent of PCE and TCE impacted groundwater was determined to extend down to the top of the Raritan Formation. The horizontal extent of PCE impacted groundwater in the deep overburden near the top of the Raritan Formation has not fully been delineated. The impacted groundwater appears to be migrating to the northeast and extends into the ACME Steel Areas in the vicinity of the intersection of Porter Avenue and Lombardy Street. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

ACME Steel Areas

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

West of Morgan Avenue Area

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

1.2.10.4 Soil Vapor

The concentrations of PCE and TCE detected in soil vapor during SC Phase VI are shown on Figures 1-43 and 1-44, respectively.

Spic and Span Area

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

Klink Cosmo Area

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

ACME Steel Areas

A limited number of soil vapor locations were sampled in the southeast portion of the ACME Steel Brass Foundry Area. The concentrations found within the ACME Steel Brass Foundry Area showed no discernible trend in previously sampled locations. At SG-022, SG-040, and SG-042, 1,1,1-trichloroethane was detected at 2,200, 42,000 and 5,000 $\mu\text{g}/\text{m}^3$, respectively.

These locations are located southeast and south of ACME Steel Metal Works building located at 95 Lombardy Street.

West of Morgan Avenue Area

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

1.2.10.5 Sources

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

- The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street and 514 Varick Avenue (Brooklyn Tax District, Block 02821, Lot 0001) is a source of soil and groundwater contamination. Based on Sanborn map data, the facility had been utilized during the 1930s for lacquer storage and as a soap powder manufacturer from the early 1950s to 1989. A shallow source of soil contamination at DEC-080 and DEC-080D (i.e., PCE) was identified while clearing the boring locations for utilities. PCE was detected in the soil at DEC-080D in the 0 to 2.0-foot and 5.0 to 6.0-foot bgs interval at 11,000 and 1,100 mg/kg, respectively. PCE was detected in the groundwater at DEC-080 and DEC-080D at 1,600 and 16,000 $\mu\text{g}/\text{L}$, respectively.
- The facility that contained a former warehouse, located at 300 Kingsland Avenue (Brooklyn Tax District, Block 02685, Lot 0052) is a source of soil and groundwater contamination. Based on Sanborn map data, the facility has been utilized from 1905 to at least 1942 for sorting and storage, as a wholesale grocery warehouse from 1965 to 1987, and as a warehouse from 1988 to the present. An unsubstantiated claim by a local

resident indicated that at one time the Former Spic and Span Cleaners used the warehouse to house their delivery trucks. This claim is plausible and the facility may have been used for the sorting and storage of clothing associated with the Former Spic and Span Cleaners. A shallow source of soil contamination (i.e., PCE) was found while clearing the boring location for DEC-025D for utilities. PCE was detected in the soil at DEC-025D in the 0 to 1.5-foot and 1.5 to 2.0-foot bgs interval at 140 and 1,300 mg/kg, respectively.

1.2.10.6 Potential Sources

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

- The facility that contained the former Belmet Products was located at 485 Morgan Avenue (Brooklyn Tax District, Block 02841, Lot 0020) and 43 Beadel Street (Brooklyn Tax District, Block 02834, Lot 0034). Belmet Products occupied these properties from at least 1951 to 1995 and worked with metal products. EDR listed the former Belmet Products as a F001 waste generator and also a Resource Conservation and Recovery Act (RCRA) small quantity generator (SQG). The Sanborn maps also indicate that the property at Block 02841, Lot 0020 was a carpet cleaner in 1933 and a garage in 1951. The Sanborn maps also indicate that the property at Block 02834, Lot 0034 was occupied by a gas station in 1933 and 1951.
- The property at 34 Beadel Street/45 Division Place (Brooklyn Tax District, Block 02841, Lot 0010) and 48 Beadel Street (Brooklyn Tax District, Block 02841, Lot 0018) historically contained a warehouse and plating facility from at least 1951 to 1995.
- The property at 35 Division Place (Brooklyn Tax District, Block 02841, Lot 0035) is currently, and historically has been, occupied by dry cleaning facilities (Aphrodite

Cleaners, French Valet Cleaner and Naxos Cleaners). EDR listed the former French Valet Cleaners as a RCRA SQG. The Sanborn maps also indicate that the property at Block 02841, Lot 0035 was also part of the metal works found at 45 Division Place (Brooklyn Tax District, Block 02841, Lot 0010) in 1951.

- The property at 25 Division Place (Brooklyn Tax District, Block 02841, Lot 0001) currently houses EPNER Technology Inc. (EPNER), which is a metal plating business. EDR listed EPNER as a F001 waste generator and also a RCRA large quantity generator (LQG). The Sanborn maps also indicate that the property at Block 02841, Lot 0001 has been used as a wholesale paint and hardware store in 1951 and for manufacturing (not specified) from 1965 to the present.
- The property at 18 Division Place (Brooklyn Tax District, Block 02849, Lot 0010) is currently occupied by Goodman Bros. Steel Drum Co. Inc. Sanborn maps indicate that the property historically has been a cooperage since 1933. EDR listed the cooperage as a F001 waste generator and also a RCRA LQG.
- The property at 297 Richardson Street (Brooklyn Tax District, Block 02850, Lot 0001) currently houses Adar Medical Uniforms. Sanborn maps indicate that the property historically contained manufacturing and steel working.
- The properties at 38 Division Place (Brooklyn Tax District, Block 02850, Lot 0010) and 42-50 Division Place (Brooklyn Tax District, Block 02850, Lot 0014), were formerly associated with Albert Plating Works Inc. (Albert). The property at Block 02850, Lot 0014 performed rayon dying in 1933. Albert occupied both properties from at least 1951 through 1995.
- The property at 87 Debevoise Avenue (Brooklyn Tax District, Block 02858, Lot 0021) performed shellac manufacturing from at least 1933 to 1995 according to Sanborn maps.
- The property at 84 Debevoise Avenue (Brooklyn Tax District, Block 02859, Lot 0001) which currently houses Eliou and Scopelitis Steel has records at the NYSDEC and is listed as being a RCRA waste generator. The property has been occupied since at least 1965.
- The property 310 Richardson Street (Brooklyn Tax District, Block 02859, Lot 0011) is identified on Sanborn maps as a sign manufacturer from at least 1951 to 1995.

- The property at 329 Frost Street (Brooklyn Tax District, Block 02859, Lot 0016) previously housed a drum cleaning and painting facility. Sanborn maps indicate that the property housed steel drum reconditioning and painting in 1951 and a drum cleaning and storage operations from 1965 to 1981.

1.2.11 Summary of SC Phase VII Findings

The Phase VII field investigation was conducted from June 11, 2012 through September 26, 2012 and December 10, 2012 through March 27, 2013. The field activities of Phase VII were primarily to:

- determine the horizontal extent of PCE DNAPL on top of the clayey silt unit in the Spic & Span Area;
- delineate the horizontal and vertical extent of PCE and TCE sidegradient of the Former Klink Cosmo Cleaners site;
- determine if there are additional sources contributing to the PCE and TCE impacted shallow groundwater and delineate the horizontal and vertical extent of PCE impacted soil near the Acme Steel Area; and
- determine if there are potential source area(s) of PCE and/or TCE in the West of Morgan Avenue Area.

A complete description of the field investigation and results may be found in the Site Characterization Phase VII Report (URS, November 2013) included in Appendix A.

1.2.11.1 Soil

Spic and Span Area

Soil samples from DEC-092D, located south of DEC-024, were collected from within the Spic and Span Area. PCE and TCE were detected above unrestricted use criteria at several depths (16-17 feet bgs, 53.5-54.5, 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 the soils at the top of the clayey silt unit in DEC-092D which was also observed in SSB-29 and SSB-30.

Klink Cosmo Area

Soil samples from DEC-009D, DEC-097D and DEC-028TC were collected from within the Klink Cosmo Area. There were no unrestricted use criteria exceedances in either soil sample.

ACME Steel Areas

Soil samples DEC-009D, DEC-097D, and DEC-028TC were collected from within the ACME Steel Metal Works Area. There were no unrestricted use criteria exceedances in these soil samples.

Soil samples were collected from ASB-02 through ASB-19, DEC-094D, DEC-095, DEC-095D, and DEC-095DA within the ACME Steel Brass Foundry Area, in the vicinity of 514 Varick Avenue. There were no exceedances in any of the ASB soil samples with the exception of ASB-06 which exceeded unrestricted use criteria for cis-1,2-DCE, PCE and TCE at 0.5-1.5 feet bgs, and for PCE at 9.5-10 feet bgs. Cis-1,2-DCE also exceeded unrestricted use criteria in DEC-094D (0.5-1-foot bgs), DEC-095 (1-1.5 feet bgs), DEC-095D (6-7 feet bgs), and DEC-095DA (4-4.5 feet bgs). PCE exceeded unrestricted use criteria in DEC-094D (0.5-1-foot bgs, 2.5-3 feet bgs, and 6-7 feet bgs), in DEC-095 (1-1.5 feet bgs and 2-2.5 feet bgs), DEC-095D (4.5-5 feet bgs and 6-7 feet bgs), and in DEC-095DA (4-4.5 feet bgs). TCE exceeded unrestricted use criteria in DEC-094D (0.5-1-foot bgs), DEC-095 (1-1.5 feet bgs), and DEC-095DA (4-5 feet bgs). During the second round of SC Phase VII monitoring well installation, the soil sample from DEC-106 (38-39 feet bgs) exceeded unrestricted use and protection of groundwater criteria for ethylbenzene and xylene.

The soil samples collected from the soil borings (ASB-02 through ASB-19) and DEC-094/DEC-094D and DEC-095/DEC-095 have confirmed a shallow source of PCE along the east side of Varick Avenue. The PCE impacted soil appears to be in the top 10 feet of soil and was found adjacent to a cesspool found between DEC-095 and DEC-095D and in the vicinity of DEC-080/DEC-080D and DEC-094/DEC-094D.

West of Morgan Avenue Area

The only VOC exceeding unrestricted use criteria was acetone found at low levels in DEC-098 (29.5-30 feet bgs, and 34.5-35 feet bgs).

1.2.11.2 Non-Aqueous Phase Liquids

- One sample of DNAPL was collected from DEC-092D on January 21, 2013. PCE was detected at 450,000 mg/kg.
- One sample of LNAPL was collected from DEC-021 on August 7, 2012. No PCE was detected. The only VOC detected was isopropylbenzene at 0.062 mg/kg. PAHs were detected including: acenaphthene (100 mg/kg), anthracene (44 mg/kg), bis(2-ethylhexyl)phthalate (41 mg/kg), fluoranthene (19 mg/kg), phenanthrene (460 mg/kg), and pyrene (40 mg/kg). The concentration of petroleum products was calculated based on a Fuel Oil #6 standard, at 1,500,000 mg/kg because the chromatographic pattern most resembles Fuel Oil #6; however, the concentration is skewed because multiple petroleum products and product degradation are present in the sample.
- One sample of LNAPL was collected from DEC-106 on March 3, 2013. Analysis indicated a mixture of Diesel/Fuel Oil #2 and Kerosene.

1.2.11.3 Groundwater

Two rounds of groundwater sampling were conducted during the SC Phase VII. The first round was performed between July 23, and August 7, 2012 during which time, URS collected groundwater samples from 174 monitoring wells. The second round was performed between February 25 and March 6, 2013 during which time, URS collected groundwater samples from 180 monitoring wells.

Overall, a review of the Phase VII July/August 2012 and Phase VII February/March 2013 groundwater sampling results throughout the SC Area indicated that at locations where CVOC analytes were detected in monitoring wells, the CVOC analytes were generally detected at similar concentrations over the two events. The CSIA results aided in determining the overall lateral and vertical extent of discrete CVOC plumes associated with previously identified and newly identified potential source areas.

Isoconcentration contours of PCE in the SC Phase VII July/August 2012 groundwater samples are shown on Figures 1-45, 1-46, and 1-47 for the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively. Figures 1-48, 1-49, and 1-50

present the isoconcentration contours for TCE in the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively. Isoconcentration contours of PCE in the SC Phase VII February/March 2013 groundwater samples are shown on Figures 1-51, 1-52, and 1-53 for the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively. Figures 1-54, 1-55, and 1-56 present the isoconcentration contours for TCE in the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively.

Spic and Span Area

Based upon the results of previous rounds of groundwater samples collected, and confirmed by the SC Phase VII groundwater sampling events, a dissolved phase chlorinated solvent plume originates at the Spic and Span Site. The horizontal and vertical extent of the dissolved phase plume has mostly been determined, with the exception of the concentrations: beneath the building 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 Spic and Span Area originates from the same source. The horizontal extent of the dissolved phase plume in shallow and deep groundwater appears to originate around the Spic and Span building 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 – 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.

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.

Klink Cosmo Area

Based upon the results of previous rounds of groundwater samples, and confirmed by the SC Phase VII groundwater sampling events, a dissolved phase chlorinated solvent plume originates at the Klink Cosmo site. The horizontal extent of the chlorinated solvents has been mostly delineated. It appears that the chlorinated solvent plumes in the shallow and deep overburden have higher concentrations of PCE immediately north and east of the Klink Cosmo site. The extent of PCE has a larger footprint in the shallow groundwater compared to the deep groundwater and appears to be moving with regional deep groundwater flow towards the northeast and comingles with the dissolved phase chlorinated solvent plumes originating within the ACME Steel Areas (i.e., CSIA PCE Source 1 – mostly shallow groundwater), and a newly identified discrete source in the shallow groundwater near DEC-013 as determined by the CSIA evaluation (i.e., CSIA PCE Source 2 – shallow groundwater). The vertical extent of PCE and TCE impacted groundwater was determined to extend down to the top of the Raritan Formation east and northeast of the Klink Cosmo site. The horizontal extent of PCE impacted groundwater in the deep overburden near the top of the Raritan Formation has not fully been delineated. PCE has migrated vertically downward to the top of the Raritan Formation (DEC-029TC and DEC-031TC) adjacent to and downgradient of the Klink Cosmo property. The chlorinated solvent plume is not expected to extend beyond the top of the Raritan Formation due to its vast areal extent and low permeability.

Based upon the data collected to assess the potential for degradation of PCE in the groundwater system as presented above, there is evidence that some 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 Klink Cosmo site.

ACME Steel Areas

Based upon the results of previous rounds of groundwater samples, and confirmed by the SC Phase VII groundwater sampling events, several discrete dissolved phase chlorinated solvent plumes originate in the vicinity of the ACME Steel Areas. The complete horizontal extents of the

chlorinated solvent plumes have not been fully delineated. The overall lateral extent of PCE has a larger footprint in the shallow groundwater when compared to the overall lateral extent of PCE in the deep groundwater. Discrete source areas appear to originate from the former Brass Foundry location on Anthony Street in the vicinity of DEC-016R extending to DEC-017 (i.e., CSIA PCE Source 4 – shallow groundwater), and DEC-040 (CSIA Source 3 – shallow groundwater), and from an apparent shallow soil source of PCE near well pairs DEC-080/080D (CSIA PCE Source 7 – shallow and deep groundwater), and near DEC-041 and DEC-018 which was not explicitly identified by Zymax, and would appear to encompass DEC-041 and DEC-018 in shallow groundwater.

The source of TCE originating at the ACME Steel Brass Foundry site (i.e., near DEC-016R) has migrated with groundwater flow toward the north/northeast (i.e., MW-30R), with the highest concentrations of TCE observed near MW-30D and MW-30R. Based upon the 2013 CSIA evaluation, TCE concentrations are attributable to a discrete primary source of TCE, and are not attributable to degradation of PCE. The TCE plume is designated as CSIA TCE Source 1 in the shallow and deep groundwater. CSIA results collected from DEC-005 in September 2009 indicate the presence of an independent source of TCE in the vicinity of the ACME Steel Metal Works site that does not appear to be associated with TCE Source 1 designated from the March 2013 CSIA results.

The vertical extent of PCE and TCE impacted groundwater is not expected to extend beyond the top of the Raritan Formation due to its vast areal extent and low permeability. The overall extent of PCE and TCE in the shallow and deep groundwater above the top of the Raritan Formation is likely the result of a combination of PCE and TCE migration from the multiple sources in the ACME Steel Areas, with some impact from the Klink Cosmo CSIA PCE Source 1 shallow and deep groundwater.

West of Morgan Avenue Area

PCE and its degradation products were detected in groundwater monitoring wells in the shallow overburden groundwater during the two rounds of groundwater sampling conducted during the SC Phase VII. PCE was detected at the maximum concentrations in DEC-076 at concentrations of 13,000 and 30,000 µg/L; however, the groundwater sample from DEC-098 exhibited the highest degree of contamination and mixture of solvents. High levels (>1,000 µg/L) were detected in DEC-098 for: 1,1,1-trichloroethane (2,800 and 3,500 µg/L), 1,1-dichloroethane

(2,900 and 2,900 µg/L), cis-1,2-dichloroethene (95,000 and 99,000 µg/L), acetone (3,600 µg/L), benzene (1,100 and 1,100 µg/L), chlorobenzene (1,300 µg/L), methylene chloride (1,100 and 1,100 µg/L), toluene (9,200 and 11,000 µg/L), vinyl chloride (2,200 and 2,300 µg/L), and xylenes (3,600 and 2,000 µg/L). PCE and TCE plumes are present in the West of Morgan Avenue Area near potential sources. There does not appear to be widespread lateral migration beyond the perched groundwater area.

Based upon the observed concentrations of VOCs from the SC Phase VII groundwater sampling events, a discrete chlorinated solvent plume appears to originate in the vicinity of DEC-076, DEC-098, DEC-101, and DEC-102. It appears that groundwater flows to DEC-102 and the concentration of PCE in the groundwater may be due to groundwater flow and not a separate source of PCE. The complete horizontal and vertical extent of the chlorinated solvents has not been delineated. The source(s) of PCE have not been identified with certainty.

Based on the results of the Mann-Kendall statistical trend analysis, the following general observations were made:

- In the shallow and deep overburden monitoring wells in the West of Morgan Avenue Area there do not appear to be any trends in PCE/TCE concentrations.

1.2.11.4 Soil Vapor

Isoconcentration contours of PCE and TCE detected in soil vapor during SC Phase VII are shown on Figures 1-57 and 1-58, respectively.

Spic and Span Area

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

Klink Cosmo Area

Soil vapor samples were collected to the north and northeast of the Klink Cosmo Area during the SC Phase VII field investigation. In general, the concentrations found within the Klink Cosmo Area showed no discernible trend compared to previously sampled locations. Concentrations were found to be similar to those detected during the SC Phase VI field

investigation, with concentrations of PCE being detected at 24,000 $\mu\text{g}/\text{m}^3$ and 42,000 $\mu\text{g}/\text{m}^3$ in SG-048 and SG-056, respectively.

ACME Steel Areas

Soil vapor samples were collected in the southeast portion of the ACME Steel Brass Foundry Area during the SC Phase VII field investigation. The concentrations found within the ACME Steel Brass Foundry Area showed no discernible trend compared to previously sampled locations. Concentrations were found to be similar to those detected during the SC Phase VI field investigation, with concentrations of PCE being detected at 3,100 $\mu\text{g}/\text{m}^3$ and 19,000 $\mu\text{g}/\text{m}^3$ in SG-022 and SG-040, respectively.

West of Morgan Avenue Area

Soil vapor samples were collected in the West of Morgan Avenue Area during the SC Phase VII field investigation. The concentrations found within the existing soil vapor locations in the West of Morgan Avenue Area showed no discernible trend compared to previously sampled locations. The new soil vapor locations SG-130 and SG-132 indicted a PCE and TCE soil vapor plume migrating to the southern site boundary.

1.2.11.5 Sources

Data obtained during the SC Phase VII confirmed the presence of one source of PCE contamination which is shown on Plates 1 and 2. A description and the location of the one source is discussed below. In addition, the source situated at 300 Kingsland that was previously identified in the Phase VI report as a potential independent source is no longer considered an independent source. The rationale for no longer considering it an independent source is discussed below.

Former Soap Manufacturer and Lacquer Storage Facility

The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street and 514 Varick Avenue (Brooklyn Tax District, Block 02821, Lot 0001) is a source of soil and groundwater contamination. Based on Sanborn map data, the facility had been utilized during the 1930s for lacquer storage and as a soap powder manufacturer from the early 1950s to 1989. During the Phase VI investigation, a shallow source of soil contamination was

identified at DEC-080 and DEC-080D (i.e., PCE) while clearing the boring locations for utilities. PCE was detected in the soil at DEC-080D in the 0 - 2.0-foot and 5.0 - 6.0-foot bgs interval at 11,000 and 1,100 mg/kg, respectively. PCE was detected in the groundwater at DEC-080 and DEC-080D at 1,600 and 16,000 µg/L, respectively. During the Phase VII investigation, soil samples collected from the soil borings (ASB-02 through ASB-19) and DEC-094/DEC-094D and DEC-095/DEC-095 have confirmed a shallow soil source of PCE along the east side of Varick Avenue. The PCE impacted soil was identified in the top 10 feet of soil and was found adjacent to a cesspool situated at ASB-06, DEC-094D, DEC-095, DEC-095D and DEC-095DA. PCE was detected in the soil at ASB-06 in the 0.5 - 1.5-foot and 9.5 - 10.0-foot bgs interval at 1,400 and 98 mg/kg, respectively; DEC-094D in the 0.5 - 1.0-foot, 2.5 - 3.0-foot, and 6.0 - 7.0-foot bgs interval at 150, 790, and 22 mg/kg, respectively; DEC-095 in the 1.0-1.5-foot and 2.0 - 2.5-foot bgs interval at 23,000 and 1,800 mg/kg, respectively; DEC-095D in the 6.0 - 7.0 foot bgs interval at 34 mg/kg; and DEC-095DA in the 4.0 - 4.5 foot bgs interval at 3,200 mg/kg.

PCE was detected in the groundwater at DEC-080 and DEC-080D at 1,700 and 14,000 µg/L, respectively; DEC-094 and DEC-094D at 8,400 and 370 µg/L, respectively; DEC-095 and DEC-095D at 440 and 87 µg/L, respectively; and MW-30R and MW-30D at 700 and 35 µg/L, respectively. CSIA results indicate that a separate, unique PCE source exists at DEC-080 and DEC-080D (designated as PCE Source 7 in the Zymax report) which is not associated with the PCE source identified sidegradient in DEC-016R and DEC-017 (designated as PCE Source 4 in the Zymax report).

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 VI investigation, a shallow source of soil contamination (i.e., PCE) was identified while clearing the 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 indicate that the PCE found in the shallow groundwater downgradient of 300 Kingsland Avenue (DEC-003D) is the same found immediately downgradient of the former Spic and Span building (DEC-036 and DEC-060), indicating that the PCE identified at DEC-025D is isotopically identical to the PCE identified at

the Spic and Span Site. 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, NYSDEC Site Number 224129.

1.2.11.6 Potential Sources

A total of fourteen potential source areas were identified within the study area during SC Phase VII (Plates 1 and 2). Three of the potential sources were identified as part of the SC Phase VII and the remaining eleven had been previously identified during prior SC Phases. Several of the potential sources remain as areas where additional information needs to be gathered to determine if any of these areas are responsible for, or are contributing to, the presence of PCE and/or TCE in the environment. In addition to dry cleaners, numerous other facilities that may have used PCE and/or TCE as degreasers or processed drums containing degreasers (e.g., metal plating operations, metal working facilities, and drum recycling/storage facilities) have been identified.

No data was gathered during Phase VII that would definitively exonerate any of the eleven previously identified potential sources. These potential sources may be associated with the soil vapor and groundwater contamination that is found in the West of Morgan Avenue Area. The eleven previously identified potential sources are listed below.

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

- The property located at 35 Division Place (Brooklyn Tax District, Block 02841, Lot 0035) is currently, and historically has been, occupied by dry cleaning facilities (Aphrodite Cleaners, French Valet Cleaner and Naxos Cleaners). EDR listed the former French Valet Cleaners as RCRA SQG. The Sanborn maps also indicate that the property at Block 02841, Lot 0035 was also part of the metal works found at 45 Division Place (Brooklyn Tax District, Block 02841, Lot 0010) in 1951.
- The property located at 25 Division Place (Brooklyn Tax District, Block 02841, Lot 0001) currently houses EPNER Technology Inc., which is a metal plating business. EDR listed EPNER as a F001 waste generator and also a RCRA LQG. The Sanborn maps also indicate that the property at Block 02841, Lot 0001 has been used as a wholesale paint and hardware store in 1951 and for manufacturing (not specified) from 1965 to present.
- The property located at 18 Division Place (Brooklyn Tax District, Block 02849, Lot 0010) is currently occupied by Goodman Bros. Steel Drum Co. Inc. Sanborn maps indicate that the property historically has been a cooperage since 1933. EDR listed the cooperage as a F001 waste generator and also a RCRA LQG. This property has been listed as a Class 2 Site (DEC Site ID No. 224211) on the Registry of Inactive Hazardous Waste Disposal Sites by the NYSDEC as of July 2015 based on information obtained by the NYSDEC as part of other investigations.
- The property located at 297 Richardson Street (Brooklyn Tax District, Block 02850, Lot 0001) currently houses Adar Medical Uniforms. Sanborn maps indicate that the property historically contained manufacturing and steel working.
- The properties located at 38 Division Place (Brooklyn Tax District, Block 02850, Lot 0010) and 42-50 Division Place (Brooklyn Tax District, Block 02850, Lot 0014), were formerly associated with Albert Plating Works Inc. The property located at Block 02850, Lot 0014 performed rayon dying in 1933. Albert occupied both properties from at least 1951 through 1995.
- The property located at 87 Debevoise Avenue (Brooklyn Tax District, Block 02858, Lot 0021) performed shellac manufacturing from at least 1933 to 1995 according to Sanborn maps.

- The property located at 84 Debevoise Avenue (Brooklyn Tax District, Block 02859, Lot 0001) which currently houses Eliou and Scopelitis Steel has records at the NYSDEC as being a RCRA waste generator. The property has been occupied since at least 1965.
- The property located at 310 Richardson Street (Brooklyn Tax District, Block 02859, Lot 0011) is identified on Sanborn maps as a sign manufacturer from at least 1951 to 1995.
- The property located at 329 Frost Street (Brooklyn Tax District, Block 02859, Lot 0011) previously housed a drum cleaning and painting facility. Sanborn maps indicate that the property housed steel drum reconditioning and painting in 1951 and a drum cleaning and storage operation from 1965 to 1981.

Description of the three potential sources identified as part of the SC Phase VII are found below. These potential sources contained operations that may be associated with the PCE found in soil vapor at SG-056 and groundwater contamination that is found in the vicinity of DEC-004, DEC-013 and DEC-013D. Based on CSIA results, PCE contamination found in groundwater from DEC-004 and DEC-013 is not related to the Klink Cosmo Site and represents an additional and separate source.

- The property located at 93 Division Place (Brooklyn Tax District, Block 02842, Lot 0030) previously and currently houses a rug cleaner. Sanborn maps and COs indicate that this property and the one adjoining to the north (Brooklyn Tax District, Block 02842, Lot 0015) has housed a rug cleaner since at least 1951 to the present. The property adjoining to the north (Brooklyn Tax District, Block 02842, Lot 0015) was associated until at least 1994. From approximately 1951 to at least 1968 the property at 93 Division Place was associated with the Crescent Dry Cleaning Company, Inc., and then the United Crescent Dry Cleaning Corp. (approximately 1931 to at least 1968) which was located on the southeast corner of Beadel Street and Morgan Avenue and included properties located at Brooklyn Tax District, Block 02842, Lots 006, 10, 12, 15, 30, 36, 38, and 40. The EDR radius search indicated that as of 1994 the property also housed a 3,000 gallon UST for fuel oil.
- The property located at 72 Division Place (Brooklyn Tax District, Block 02851, Lot 0010) formerly housed a dyeing operation and a printing and die cutting operation. The building currently houses a granite countertop operation. Sanborn maps indicate that this

property and the adjoining building to the west (Brooklyn Tax District, Block 02851, Lot 001) housed the Banner Yarn Dyeing Corporation from at least 1951 to at least 1977. From at least 1979 to 1988 the two properties housed the Famos Envelope Company and from 1989 to at least 1994 housed a printing and die cutting operation.

- The property located at 100 Division Place (Brooklyn Tax District, Block 02851, Lot 0015) previously housed JR Cooperage. The building currently houses a bus and truck repair shop. Sanborn maps indicate that this property contained a filling station in the northeast corner from at least 1951 to at least 1965. Starting in 1965, drum storage occupied the west half of the property with iron storage in the southwest corner. New buildings associated with JR Cooperage were erected in 1971 and 1979. JR Cooperage was in business until early 2013 when the property was converted to a bus and truck repair shop. The EDR radius search indicated that as of 1994, four 550 gallon gasoline USTs were located on the property. EDR also indicated that JR Cooperage was a RCRA SQG. EDR also contained records of the following waste being shipped off the property: D002 – non-listed corrosive, D007 – chromium 5.0 mg/L, D009-mercury, and D008-lead.

1.2.12 Expanded Outreach Area Soil Vapor Intrusion Investigation – Phase I

URS prepared a Soil Vapor Intrusion Investigation Phase I Report in January 2013 (URS, January 2013) to summarize the field activities and analytical results associated with the first phase of soil vapor intrusion (SVI) field activities performed in the Expanded Outreach Area (EOA) which was conducted from July 19, 2012 through August 15, 2012. The EOA is the area bounded by Morgan Avenue to the west, Norman Avenue/Bridgewater Street to the north, Stewart Avenue to the east, and Meeker Avenue/BQE to the south.

The purpose of the EOA SVI was to determine the potential sources of chlorinated volatile organic compounds (CVOCs) that have historically been detected by Roux, acting on the behalf of Exxon Mobil, in the EOA. The presence of the CVOCs may present a SVI issue to overlying residences/commercial/industrial buildings.

As part of the EOA SVI Phase I investigation, URS performed a records review, installed 35 soil vapor implants, and collected soil and soil vapor samples from implant locations. A complete description of the field investigation and results may be found in the Soil Vapor Intrusion Investigation Phase I Report (URS, January 2013).

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

Soil

- VOCs were not detected in EOA SVI Phase I Investigation soil samples exceeding SCGs.

Soil Vapor

- PCE was detected in 31 of the 38 soil vapor samples collected, at concentrations ranging from 10 $\mu\text{g}/\text{m}^3$ to a maximum of 5,400 $\mu\text{g}/\text{m}^3$ at location SG-161. SG-161 is located adjacent to the Premier Dye Polish Corporation on Bridgewater Street. The second highest concentration of PCE was detected at SG-140 (1,300 $\mu\text{g}/\text{m}^3$) which is located south of the Adhesives Manufacturer on Apollo Street.
- TCE was detected in 24 of the 38 samples collected, at concentrations ranging from 1.4 $\mu\text{g}/\text{m}^3$ to a maximum of 12,000 $\mu\text{g}/\text{m}^3$ at location SG-161. SG-161 is located adjacent to the Premier Dye Polish Corporation, where the PCE concentration was 5,400 $\mu\text{g}/\text{m}^3$. The second highest concentration of TCE was found at SG-150 (1,500 $\mu\text{g}/\text{m}^3$) which is located adjacent to the former GKM property on Bridgewater Street.
- Cis-1,2-DCE was detected in 10 of the 38 samples collected, at concentrations ranging from 0.42 $\mu\text{g}/\text{m}^3$ to a maximum of 3,500 $\mu\text{g}/\text{m}^3$ at location SG-138. SG-138 is located adjacent to the Seldner & Enequist Chemical Works on Apollo Street.
- 1,1,1-TCA was detected in 31 of the 38 samples collected, at concentrations ranging from 0.85 $\mu\text{g}/\text{m}^3$ to a maximum of 11,000 $\mu\text{g}/\text{m}^3$ at location SG-161. SG-161 is located adjacent to the Premier Dye Polish Corporation.
- 1,1-DCA was detected in 13 of the 38 samples collected, at concentrations ranging from 0.53 $\mu\text{g}/\text{m}^3$ to a maximum of 1,900 $\mu\text{g}/\text{m}^3$ at location SG-161. SG-161 is located adjacent to the Premier Dye Polish Corporation. An additional high concentrations of 1,1-DCA was detected at SG-154 (1,100 $\mu\text{g}/\text{m}^3$) on Varick Avenue.
- 1,1,2-TCA was detected in 10 of the 38 samples collected, at concentrations ranging from 1.90 $\mu\text{g}/\text{m}^3$ to a maximum of 17,000 $\mu\text{g}/\text{m}^3$ at location SG-134. SG-134 is located adjacent to the former Taylor & Co. Foundry on Hausman Street. Additional high concentrations of 1,1,2-TCA were detected at SG-159 (3,300 $\mu\text{g}/\text{m}^3$) which is located

adjacent to a former paint and lacquer manufacturer located on Meeker Avenue and at SG-138 ($2,600 \mu\text{g}/\text{m}^3$) which is located adjacent to the former Seldner & Enequist Chemical Works on Apollo Street.

1.2.13 Expanded Outreach Area Soil Vapor Intrusion Investigation – Phase II

URS prepared a Soil Vapor Intrusion Investigation Phase II Report in March 2013 (URS, March 2013) to summarize the field activities and analytical results associated with the second phase of SVI field activities performed in the EOA which was conducted from December 11, 2012 through January 11, 2013.

The purpose of the EOA SVI Phase II Investigation fieldwork was to collect additional information around 4 potential sources identified during the Phase I Investigation, and to determine if any of these areas are responsible for, or are contributing to, the presence of CVOCs in the environment. As part of the EOA SVI Phase II investigation, URS installed 15 new soil vapor implants and collected samples for 15 new and 35 existing soil vapor implants. A complete description of the field investigation and results may be found in the Soil Vapor Intrusion Investigation Phase II Report (URS, March 2013).

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

Soil

- VOCs were not detected in EOA SVI Phase II Investigation soil samples exceeding SCGs.

Soil Vapor

- PCE was detected in 46 of the 56 soil vapor samples collected, at concentrations ranging from $0.76 \mu\text{g}/\text{m}^3$ to a maximum of $660 \mu\text{g}/\text{m}^3$ at location SG-161. SG-161 is located adjacent to the Premier Dye Polish Corporation.
- TCE was detected in 32 of the 56 samples collected, at concentrations ranging from $0.76 \mu\text{g}/\text{m}^3$ to a maximum of $2,200 \mu\text{g}/\text{m}^3$ at location SG-161.

- Cis-1,2-DCE, a daughter compound of PCE and TCE, was detected in 9 of the 56 samples collected, at concentrations ranging from 0.42 $\mu\text{g}/\text{m}^3$ to a maximum of 84 $\mu\text{g}/\text{m}^3$ at location SG-161.
- 1,1,1-TCA was detected in 24 of the 56 samples collected, at concentrations ranging from 0.59 $\mu\text{g}/\text{m}^3$ to a maximum of 3,400 $\mu\text{g}/\text{m}^3$ at location SG-161.
- 1,1-DCA is a daughter compound of 1,1,1-TCA and was detected in 8 of the 56 samples collected at concentrations ranging from 0.52 $\mu\text{g}/\text{m}^3$ to a maximum of 640 $\mu\text{g}/\text{m}^3$ at location SG-161.
- 1,1,2-TCA was detected in 7 of the 56 samples collected, at concentrations ranging from 0.94 $\mu\text{g}/\text{m}^3$ to a maximum of 5,200 $\mu\text{g}/\text{m}^3$ at location SG-181. SG-181 is located adjacent to a former paint and lacquer manufacturer located on Meeker Avenue. SG-134 reported a concentration of 17,000 $\mu\text{g}/\text{m}^3$ 1,1,2-TCA during the Phase I investigation, but 1,1,2-TCA was not detected during the Phase II sampling effort.

CVOCs detected during the EOA SVI Phase II Investigation were generally lower, by up to five orders of magnitude, in existing soil vapor implants when compared to the Phase I results. The decrease in concentrations of detected CVOCs was observed across the entire EOA. During late October 2012, Hurricane Sandy impacted the New York Metropolitan area. Infiltration of large volumes of precipitation has been observed to significantly impact concentrations (i.e., decreasing concentrations) of VOCs detected in soil vapor. Similar changes in soil vapor results have been observed at the Meeker Plume Trackdown Site historically and during soil vapor sampling associated with the Remedial Investigations performed at the Former Spic and Span Site (NYSDEC Site ID No. 224129) and the Former Klink Cosmo Cleaners Site (NYSDEC Site ID No. 224130).

1.2.14 Expanded Outreach Area Soil Vapor Intrusion Investigation – Phase III

URS prepared a Soil Vapor Intrusion Investigation Phase III Report in March 2014 (URS, March 2014) to summarize the field activities and analytical results associated with the third phase of SVI field activities performed in the EOA which was conducted from October 7, 2013 through October 10, 2013. A soil vapor implant inspection, concrete sidewalk flag

restoration and monitoring well inspection effort was conducted between July 29, 2013 and October 10, 2013 as part of the EOA SVI Phase III activities. No new soil vapor implants were installed during Phase III.

The purpose of the EOA SVI Phase III Investigation fieldwork was to collect additional information around 4 potential sources identified during the Phase I Investigation, to determine if any of these areas are responsible for, or are contributing to, the presence of CVOCs in the environment; and collect a complete round of soil vapor samples from the EOA. As part of the EOA SVI Phase III investigation, URS collected samples from 50 existing soil vapor implants. A complete description of the field investigation and results may be found in the EOA Phase III Report (URS, March 2014).

Based upon the results of the EOA SVI Phase III investigation, the following conclusions were made:

Soil Vapor

- PCE was detected in 45 of the 50 soil vapor implants sampled, at concentrations ranging from 1.5 $\mu\text{g}/\text{m}^3$ to a maximum of 1,200 $\mu\text{g}/\text{m}^3$ at location SG-154, which is located adjacent to GKM.
- TCE was detected in 32 of the 50 soil vapor samples, at concentrations ranging from 0.63 $\mu\text{g}/\text{m}^3$ to a maximum of 2,800 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- Cis-1,2-DCE, a daughter compound of PCE and TCE, was detected in 9 of the 50 soil vapor implants sampled, at concentrations ranging from 0.44 $\mu\text{g}/\text{m}^3$ to a maximum of 94 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- 1,1,1-TCA was detected in 23 of the 50 soil vapor implants sampled, at concentrations ranging from 0.94 $\mu\text{g}/\text{m}^3$ to a maximum of 3,500 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.

- 1,1-DCA is a daughter compound of 1,1,1-TCA and was detected in 10 of the 50 soil vapor implants sampled at concentrations ranging from 0.70 $\mu\text{g}/\text{m}^3$ to a maximum of 1,200 $\mu\text{g}/\text{m}^3$ at location SG-154, which is located adjacent to GKM.
- 1,1,2-TCA was detected in 1 of the 50 soil vapor implants sampled, at a concentration of 97 $\mu\text{g}/\text{m}^3$ at location SG-157, which is located adjacent to a former paint and lacquer manufacturer on Varick Avenue. SG-134 reported a concentration of 17,000 $\mu\text{g}/\text{m}^3$ of 1,1,2-TCA during the Phase I investigation, but 1,1,2-TCA was not detected during the Phases II and III sampling efforts at this location.

CVOCs detected during the Phase III sampling event were at concentrations generally higher in existing soil vapor implants when compared to the Phase II results across the entire EOA; however, they were generally lower in the same implants when compared to the Phase I results. The lower concentrations observed during Phase II may have been attributed to the large volumes of precipitation that occurred during late October 2012 associated with Superstorm Sandy. In the time between the Phase II and Phase III sampling events, water present in the subsurface most likely percolated down through the vadose zone to the water table, resulting in the subsequent increase in detected CVOC concentrations in the EOA soil vapor samples.

1.2.15 Expanded Outreach Area Soil Vapor Intrusion Investigation – Phase IV

URS prepared a Soil Vapor Intrusion Investigation Phase IV Report in January 2015 (URS, January 2015) to summarize the field activities and analytical results associated with the fourth phase of SVI field activities performed in the EOA which was conducted from August 18, 2014 through August 26, 2014. Soil vapor implant inspection and maintenance activities were performed between August 21, 2014 and August 25, 2014 as part of the EOA SVI Phase IV activities. No new soil vapor implants were installed during Phase IV.

The purpose of the EOA SVI Phase IV Investigation fieldwork was to collect additional information around 4 potential sources identified during the Phase I Investigation, to determine if any of these areas are responsible for, or are contributing to, the presence of CVOCs in the environment; and collect a complete round of soil vapor samples from the EOA after an extended dry period of weather. As part of the EOA SVI Phase IV investigation, URS collected samples from 50 existing soil vapor implants. Isoconcentration contours of PCE and TCE in the EOA SVI

Investigation Phase IV soil vapor samples are shown on Figures 1-59 and 1-60, respectively. A complete description of the field investigation and results may be found in the EOA Phase IV Report (URS, January 2015).

Based upon the results of the EOA SVI Phase IV investigation, the following conclusions were made:

Soil Vapor

- PCE was detected in 47 of the 50 soil vapor implant locations sampled, at concentrations ranging from 2.3 $\mu\text{g}/\text{m}^3$ to a maximum of 5,800 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- TCE was detected in 29 of the 50 soil vapor implant locations sampled, at concentrations ranging from 0.97 $\mu\text{g}/\text{m}^3$ to a maximum of 8,300 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- Cis-1,2-DCE, a daughter compound of PCE and TCE, was detected in 6 of the 50 soil vapor implant locations sampled, at concentrations ranging from 0.79 $\mu\text{g}/\text{m}^3$ to a maximum of 90 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- 1,1,1-TCA was detected in 28 of the 50 soil vapor implant locations sampled, at concentrations ranging from 0.59 $\mu\text{g}/\text{m}^3$ to a maximum of 7,400 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- 1,1-DCA is a daughter compound of 1,1,1-TCA and was detected in 8 of the 50 soil vapor implant locations sampled at concentrations ranging from 0.47 $\mu\text{g}/\text{m}^3$ to a maximum of 610 $\mu\text{g}/\text{m}^3$ at location SG-161, which is located adjacent to the Premier Dye Polish Corporation.
- 1,1,2-TCA was detected in 4 of the 50 soil vapor implants sampled at concentrations ranging from 0.76 $\mu\text{g}/\text{m}^3$ to a maximum of 68 $\mu\text{g}/\text{m}^3$ at location SG-142, which is located adjacent to a Fur Dyeing facility on Van Dam Street. SG-134 adjacent to the former Taylor & Co. Foundry on Hausman Street reported a concentration of 17,000 $\mu\text{g}/\text{m}^3$ of

1,1,2-TCA during the Phase I investigation, but 1,1,2-TCA was not detected during Phases II, III or IV sampling efforts at this location.

CVOCs detected during the Phase IV sampling event were generally higher in existing soil vapor implants when compared to the Phase III results across the entire EOA; the Phase IV results were comparable to the Phase I results. Plate 3 presents select CVOC detections in ExxonMobil OU-7 from Roux soil gas locations (August 2010 through August 2014).

1.2.16 Source Characterization

1.2.16.1 Sources

Using data obtained during the EOA SVI Investigation Phase I, and supported by data gathered during the Phase II, Phase III and Phase IV investigations and sampling efforts, one source of CVOC contamination has been identified and is shown on Figure 1-61. A description and location of the source is discussed below.

- Premier Dye Polish Corporation, located at 25 Bridgewater Street (Brooklyn Tax District, Block 02664, Lot 0127) is a likely source of soil vapor contamination. Based on an EDR radius search, as of November 11, 2011, three ASTs containing 1,1,1-TCA, ranging from a 550 to a 2,000 gallon capacity, were located at the site. Soil vapor results from implants surrounding the Premier Dye Polish Corporation contained the following CVOC concentrations:
 - SG-161, which is located on Bridgewater Street, contained PCE at 5,400, 660, 1,100 and 5,800 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. TCE was detected at 12,000, 2,200, 2,800 and 8,300 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. Cis-1,2-DCE was detected at 320, 84, 94 and 90 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. 1,1,1-TCA was detected at 11,000, 3,400, 3,500 and 7,400 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. 1,1-DCA was detected at 1,900, 640, 450 and 610 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. Freon-11 was detected at 2,000, 1,000, 940 and 2,100 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.

- SG-176, which is located on Bridgewater Street, contained PCE at 17, 430 and 1,300 µg/m³ during the Phases II, III and IV sampling events, respectively. TCE was detected at 10 160 and 350 µg/m³ during the Phases II, III and IV sampling events, respectively. 1,1,1-TCA was detected at 61, 320 and 500 µg/m³ during the Phases II, III and IV sampling events, respectively. 1,1-DCA was detected at 35, 58 and 84 µg/m³ during the Phases II, III and IV sampling events, respectively.

1.2.16.2 Potential Sources

A total of 16 potential sources were identified within the EOA through historical research. Of the 16 potential sources, 4 were identified during the EOA Phase I Investigation as areas where additional information was needed to be gathered to determine if any of these areas are responsible for, or are contributing to, the presence of CVOCs in the environment. Data gathered during the Phase II, Phase III and Phase IV investigations suggests they are likely sources of CVOCs. Plate 4 presents select CVOC soil vapor analytical results (August 2012 through August 2014) with potential source areas.

Descriptions and locations of the 4 potential sources are discussed below and shown on Figure 1-61.

- Taylor & Co. Foundry formerly located at 314 Norman Avenue (Brooklyn Tax District, Block 02660, Lot 0001); 640 Morgan Avenue (Brooklyn Tax District, Block 02660, Lot 0020); 650 Morgan Avenue (Brooklyn Tax District, Block 02660, Lot 0030); and 634 Morgan Avenue (Brooklyn Tax District, Block 02660, Lot 0050) is a potential source of soil vapor contamination. Buildings on the lots were occupied by a foundry from at least 1905 to 1991, metal manufacturing in 1997 and an auto repair garage in 1997. Soil vapor results from implants surrounding the former Taylor & Co. Foundry contained the following CVOC concentrations:
 - SG-134, which is located on Hausman Street contained 1,1,2-TCA at 17,000 µg/m³ during the Phase I sampling, but was ND during the Phases II, III and IV sampling events. In addition, PCE was ND, 6.6, 260 and 20 µg/m³ during the Phases I, II, III and IV sampling events, respectively.

- SG-136, which is located on Hausman Street, contained PCE at 270, 31, 250 and 240 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. TCE was detected at 84, 9.3, 53 and 55 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
- SG-169, which is located on Hausman Street, contained PCE at 22, 47 and 1,100 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively and Freon 12 at 600, 230 and 430 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively.
- SG-170, which is located on Morgan Avenue, contained PCE at 42, 220 and 270 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively. TCE was detected at 1, 18 and 8.6 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively.
- SG-171, which is located on Hausman Street, contained PCE at 11, 72 and 130 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively. 1,1,1-TCA was detected at 66, 170 and 230 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively. Freon 12 was detected at 5.1, 3.0 and 2.3 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively. 1,1-DCA was detected at 8.8, 8.4 and 12 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively.
- S&E Chemical Works formerly located at 86-88 Hausman Street (Brooklyn Tax District, Block 02661, Lot 0044); 90 Hausman Street (Brooklyn Tax District, Block 02661, Lot 0046); 92 Hausman Street (Brooklyn Tax District, Block 02661, Lot 0048); 94-104 Hausman Street (Brooklyn Tax District, Block 02661, Lot 0050); and 103 Apollo Street (Brooklyn Tax District, Block 02661, Lot 0015) was in operation from at least 1916 to 1951. In addition, a building located at 83 Apollo Street (Brooklyn Tax District, Block 02661, Lot 0016) was associated with the S&E Chemical Works from 1916 to 1951 and later became an adhesives manufacturer (1965-1996). Soil vapor results from implants surrounding the former S&E Chemical Works contained the following CVOC concentrations:
 - SG-138, which is located on Apollo Street, contained PCE at 900, 52, 210 and 450 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.

- SG-139, which is located on Apollo Street, contained PCE at 820, 110, 670 and 1,300 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. TCE was detected at 110, 19, 69 and 110 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
- SG-140, which is located on Apollo Street, contained PCE at 1,300, 350, 1,100 and 1,300 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
- The former GKM property located at 47 Bridgewater Street (Brooklyn Tax District, Block 02663, Lot 0028) is a potential source of soil vapor contamination. From EDR radius reports it has been determined that GKM disposed of F001 and F002 waste. GKM was also a RCRA LQG in 1981, a RCRA SQG in 1999 and 2002, and a RCRA Conditionally Exempt Small Quantity Generator (CESQG) as of 2004. Soil vapor results from implants surrounding the former GKM property contained the following CVOC concentrations:
 - SG-150, which is located on Bridgewater Street, contained TCE at 1,500, 240, 1,300 and 2,400 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
 - SG-152, which is located on Varick Avenue, contained TCE at 680, 130, 600 and 210 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
 - SG-154, which is located on Varick Avenue, PCE was ND during the Phases I, II and IV sampling events. However, during Phase III the concentration was 1,200 $\mu\text{g}/\text{m}^3$. Similarly, TCE was ND during the Phases I, II and IV sampling events and 270 $\mu\text{g}/\text{m}^3$ during the Phase III sampling event. Vinyl chloride was ND, 54 and 300 $\mu\text{g}/\text{m}^3$ and ND during the Phases I, II, III and IV sampling events, respectively. 1,1-DCA was detected at 1,100, 460, 1,200 and 94 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. Chloroethane was detected at 15,000, 7,000, 29,000 and 480 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. 1,2-DCA was detected at 1,100, ND, 3,100 $\mu\text{g}/\text{m}^3$ and ND during the Phases I, II, III and IV sampling events, respectively.
- A paint and lacquer manufacturer formerly located at 855 Meeker Avenue (Brooklyn Tax District, Block 02694, Lot 0021) and 857-869 Meeker Avenue (Brooklyn Tax District,

Block 02694, Lot 0015) is a potential source of soil vapor contamination. The paint and lacquer manufacturer was in operation from at least to 1951 to 1988. In addition, fur dyeing was performed in an adjacent building located at 843-845 Meeker Avenue (Brooklyn Tax District, Block 02694, Lot 0022) from at least 1942 to 1951. Soil vapor results from implants surrounding the former paint and lacquer manufacturer and fur dyeing facility contained the following CVOC concentrations:

- SG-157, which is on Varick Avenue, PCE was ND, 30, 95 and 190 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. 1,1,2-TCA was detected at 8.8 and 97 $\mu\text{g}/\text{m}^3$ during the Phases II and III sampling events, respectively, but ND during the Phases I and IV sampling events.
- SG-158, which is on Meeker Avenue, contained PCE at ND, 660 and 570 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively. 1,2-DCA was detected at 190 $\mu\text{g}/\text{m}^3$ during the Phase II sampling event and ND for both the Phases III and IV sampling events.
- SG-159, which is on Meeker Avenue, contained PCE at ND, ND, 40 and 99 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively. 1,1,2-TCA was detected at 3,300 and 110 $\mu\text{g}/\text{m}^3$ during the Phase I and Phase II sampling events, respectively, and ND for both the Phases III and IV sampling events.
- SG-160, which is on Meeker Avenue, contained PCE at 510, 56, 380 and 620 $\mu\text{g}/\text{m}^3$ during the Phases I, II, III and IV sampling events, respectively.
- SG-181, which is on Meeker Avenue, contained PCE at 140 and 650 $\mu\text{g}/\text{m}^3$ during the Phases II and III sampling events, respectively, but was ND during the Phase IV sampling event. 1,1,2-TCA was detected at 5,200 $\mu\text{g}/\text{m}^3$ during the Phase II sampling event and ND during both the Phases III and IV sampling events.
- SG-182, which is on Meeker Avenue, contained PCE at 9.8, 43 and 82 $\mu\text{g}/\text{m}^3$ during the Phases II, III and IV sampling events, respectively.

1.3 Site Characterization Phase VIII Project Objectives and Scope

The following recommendations made in the Phase VII report included additional Site Characterization activities as follows:

1.3.1 Meeker Avenue Plume Trackdown Area

- A CSIA sampling effort should be conducted on soil from known areas of shallow soil contamination (i.e., DEC-016R/016D, DEC-025/025D, DEC-080/080D, DEC-095, and ASB-06). The purpose of the soil CSIA will be to fingerprint the shallow soil sources of PCE contamination and to help correlate the shallow soil source of PCE with dissolved phase groundwater contamination.
- A CSIA sampling effort should be conducted on groundwater samples from DEC-003DD, DEC-005, DEC-005D, DEC-024, DEC-025, DEC-025D, DEC-026, DEC-026D, DEC-039, and DEC-039D to determine if the PCE and TCE in these wells is related to any known sources of groundwater contamination.
- If DNAPL is encountered in any new monitoring well(s) during drilling, well development or purging, a DNAPL sample should be collected for laboratory analyses. The DNAPL sample(s) should be analyzed for Target Compound List (TCL) VOCs plus Tentatively Identified Compounds (TICs) by 8260B, TCL SVOCs plus TICs by 8270C, petroleum hydrocarbon scan by 8100 (modified), specific gravity by ASTM D4052, surface tension by ASTM D-971, and viscosity by ASTM D-445.
- A CSIA sampling effort should be conducted on DNAPL from monitoring wells DEC-024D, DEC-024DR and DEC-092D. The purpose of the CSIA will be to fingerprint the DNAPL and determine how the presence of DNAPL is related to the dissolved phase groundwater contamination in the Spic and Span Area.

1.3.2 West of Morgan Avenue Area

Eleven shallow and one deep well were recommended in the West of Morgan Avenue Area. The recommended depth of the deep monitoring well was approximately 70 feet bgs. Table 1-1 presents a monitoring well location rationale for the West of Morgan Avenue Area.

A complete round of groundwater samples collected from all new and existing DEC wells within the West of Morgan Avenue Area was recommended. All groundwater samples were to be analyzed for TCL VOCs plus TICs. A synoptic round of water levels from all DEC wells located within the Meeker Avenue Plume Trackdown Site was recommended.

Up to 10 additional soil vapor implants were recommended for installation in the West of Morgan Avenue Area.

A complete round of soil vapor samples collected from all new and existing DEC soil vapor implants sampled during the SC Phase VII and from select existing soil vapor locations along Morgan Avenue (i.e., SG-059, SG-061R, SG-086, SG-087, SG-120 and SG-122) was recommended.

1.3.3 Spic and Span Area

No additional monitoring wells were suggested.

1.3.4 Klink Cosmo Area

No additional monitoring wells were suggested.

1.3.5 ACME Steel Areas

No additional monitoring wells were suggested.

1.3.6 Expanded Outreach Area

Eight shallow monitoring wells to an approximate depth of 50 to 70 feet bgs were recommended for installation within the EOA. Table 1-2 presents a monitoring well location rationale for the Expanded Outreach Area.

A complete round of groundwater samples collected from all new DEC wells within the EOA was recommended. All groundwater samples were to be analyzed for TCL VOCs plus TICs.

1.4 Data Presentation

This Phase VIII Site Characterization Report has six sections. Section 1 includes background information and a synopsis of URS' activities to date in the investigation area.

Section 2 includes a description of field activities that occurred during the Site Characterization Phase VIII fieldwork. Section 3 includes a description of the subsurface conditions that have been found within the project boundary. Section 4 includes a description and summary of the analytical results for the soil, groundwater, soil vapor, and CSIA samples from locations sampled during the SC Phase VIII fieldwork. Section 5 consists of the conclusions and recommendations derived from the SC Phase VIII field effort. Section 6 contains a list of references cited. Tables, Figures, Appendices, and Attachments immediately follow the text.

2.0 FIELD ACTIVITIES

Site Characterization Phase VIII field activities were performed in the West of Morgan Avenue Area and EOA from October 27, 2014 through December 19, 2014. Field activities were also performed on Hausman Street as part of the Former Spic and Span Site DNAPL Recovery Pilot Test in the EOA, from January 5 through February 25, 2015. These activities are discussed below. Site photographs are provided in Appendix B and copies of the daily field notes are provided in Appendix C.

2.1 Utility Clearance

Prior to site work, each subcontractor arranged for appropriate utility clearance mark-outs. This included, but was not limited to, contacting the NYC Departments of Environmental Protection and Transportation, the Transit Authority, Consolidated Edison Company of New York, Inc. (Con Edison), National Grid, Verizon, and Dig-Safely for New York City – 811 or (800) 272-4480.

2.2 Geophysical Survey for Utility Markouts

Between October 27 and 28, 2014, Radar Solutions International (RSI) of Waltham, Massachusetts, mobilized a two person crew with GPR and electromagnetic (EM) induction equipment to the West of Morgan Avenue Area and EOA. On January 5 and 6, 2015, RSI mobilized a one person crew with GPR and EM equipment to the Spic and Span Area including Hausman Street. The purpose of the geophysical survey was to screen for and identify the presence/location of underground utilities in areas where drilling for soil vapor implants, borings and monitoring well installations were proposed.

A 10-foot square reference grid was established around each soil vapor implant, boring and/or monitoring well location prior to collecting the geophysical data. The size of the grid was adjusted to accommodate additional borings and avoid above ground obstructions. Additionally, four swaths along Bridgewater Street, Varick Avenue, Nassau Avenue, and Meeker Avenue in the EOA were investigated, where geoprobe borings at unspecified locations were to be drilled.

A GSSI SIR-3000 digital radar system was used to perform the GPR survey. GPR data were acquired along lines spaced 1.0 to 2.5 feet apart. The EM induction equipment used to

determine the location of buried utilities was a Radio detection RD8000 locating system and a McLaughlin's Verifier GX digital locator.

RSI marked utilities and anomalies by spray-painting the outline on the pavement as they were located. URS personnel supervised and assisted RSI. A copy of RSI's report is provided in Appendix D.

2.3 Soil Borings and Groundwater Monitoring Well Installation

Between October 27 and November 17, 2014, URS provided oversight for the advancement of thirty six soil borings and the installation of monitoring wells in twenty of the soil borings. The soil borings and monitoring wells were advanced/installed within both the West of Morgan Avenue Area and EOA. Between January 5 and 16, 2015, URS provided oversight for the advancement/installation of six additional monitoring well borings on Hausman Street. The following sections describe the soil boring and monitoring well installation program for the SC Phase VIII and additional monitoring well fieldwork.

2.3.1 Pre-Boring Clearing

Prior to any intrusive activities, the drilling subcontractors obtained NYC DOT street opening permits for conducting intrusive activities. Between October 27 and November 5, 2014, Zebra Technical Services, LLC. (Zebra) of Lynbrook, New York, a subsidiary of Cascade Drilling, L.P. (Cascade) of Northborough, Massachusetts, mobilized one Vac-Tron[®] unit to perform location-specific utility clearance at each of the proposed twenty monitoring well boring locations within the West of Morgan Avenue Area and EOA. Between November 10 and 17, 2014, AARCO Environmental Services Corporation (AARCO) of Lindenhurst, New York, mobilized one Vac-Tron[®] unit to perform location-specific utility clearance at each of the proposed sixteen soil boring locations within the EOA. Between January 5 and 6, 2015, Glacier Drilling, LLC. (Glacier) of Durham, Connecticut, mobilized one Vac-Tron[®] unit to perform location-specific utility clearance at each of the proposed six soil boring locations on Hausman Street.

At each location, a two-foot by two-foot square area of the sidewalk was cut. An approximately one-foot diameter by five-foot deep hole was excavated using post-hole diggers, pry bars, and an air knife along with the Vac-Tron[®] unit. After a location was cleared for drilling,

the hole was backfilled flush with the sidewalk using the excavated spoils (rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete.

Soil samples were collected from three monitoring well boring locations (DEC-123, DEC-127, and DEC-137) during utility clearing. Soil samples were collected from intervals exhibiting odors, staining, or elevated PID reading(s) and were analyzed for TCL VOCs plus tentatively identified compounds (TICs). The samples collected from DEC-123 and DEC-127 were transported under chain-of-custody (COC) via laboratory courier to Hampton-Clarke, Inc., (Hampton-Clarke) of Fairfield, New Jersey, which is a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory. The sample collected from DEC-137 was shipped under COC via Federal Express to Pace Analytical (Pace) of Melville, New York, , which is also a NYSDOH ELAP certified laboratory.

2.3.2 West of Morgan Avenue Area Monitoring Well Borings

During the period of October 28, 2014 through November 5, 2014, Cascade utilized a track-mounted Boart Longyear BL100C Sonic drill rig to advance 12 monitoring well borings (DEC-125 through DEC-135) as listed in Table 1-1 and as shown on Plate 1. Of the 12 well borings, 11 were shallow overburden (water table) wells and one was a deep overburden well.

The well borings at the shallow and deep locations were advanced using a 4-inch inside diameter (ID) inner sampler and a 6-inch ID outer casing. Soil samples were collected continuously from the ground surface to the terminus of each boring. The procedure for the advancement of the borehole was to advance the inner sampler to the appropriate interval (5 or 10 feet) and then advance the outer casing over the inner sampler to the desired depth. After the outer casing was advanced, the inner sampler was retrieved and the sample core collected was placed in a polyethylene sample tube. The process was repeated until the desired depth was reached. At locations where a monitoring well pair was installed (DEC-126 and DEC-126D), only the deep well location was sampled and logged. Following the installation of the deep well, the corresponding shallow well was advanced to a pre-determined depth and installed without logging or the collection of soil samples. The shallow well borings were advanced to depths between 20 and 47 feet bgs. The deep well boring was advanced to a depth of 60 ft bgs.

All investigation derived waste (IDW) generated from the monitoring well borings was containerized in NYSDOT approved 55-gallon drums and picked up by AARCO on a daily basis for off-site disposal at a permitted facility.

Soil samples were screened with a PID. Up to two soil samples were collected from each boring; one soil sample was collected from the interval just above the water table, the second sample was collected from the interval 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. Monitoring well boring logs are provided in Appendix E.

A COC form was maintained and accompanied the soil sample containers to Hampton-Clarke, Inc, of Fairfield, New Jersey (Hampton-Clarke). Soil samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260C. Grab samples taken at DEC-126D were submitted to 3rd Rock, LLC (3rd Rock) of East Aurora, New York, for geotechnical analysis of grain size distribution (ASTM D422), Atterberg Limits (ASTM D4318), and falling head permeability (ASTM D5084). Results of the geotechnical analyses are discussed in Section 3.3.

2.3.3 Expanded Outreach Area Soil/Monitoring Well Borings

During the period of November 6 through 12, 2014, Cascade utilized a track-mounted Boart Longyear BL100C Sonic drill rig to advance eight shallow overburden monitoring well borings (DEC-117 through DEC-124) as listed in Table 1-2 and as shown on Plate 1. The well borings were advanced using the procedures previously described in Section 2.3.2. The soil borings were advanced to depths between 35 and 58 feet bgs.

During the period of November 10 through 17, 2014, AARCO utilized a track-mounted Geoprobe® 7822 DT hydraulic direct-push unit to advance a 2-inch OD by 5-foot long acetate lined Macrocore sampler at 16 soil borings (ESB-01 through ESB-16) as shown on Plate 1. Soil samples were collected continuously from the ground surface to the terminus of each boring. The soil borings were advanced to depths between 35 and 50 feet bgs.

All IDW generated from the soil/well borings 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.

Soil samples were screened with a PID. Up to two soil samples were collected from each boring; one soil sample was collected from the interval just above the water table, the second sample was collected from the interval exhibiting odors, staining, or elevated PID readings. If no odors, staining, or elevated PID readings were encountered, then only one sample from the interval just above the water table was collected. Temporary groundwater sampling points were installed in soil borings ESB-01 through ESB-16 to collect groundwater samples. Upon completion, soil borings that were not converted to monitoring wells were backfilled with bentonite chips and the top four inches was patched with concrete. Soil/monitoring well boring logs are provided in Appendix E.

A COC form was maintained and accompanied the soil sample and groundwater sample containers to Hampton-Clarke. Soil samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260C. Groundwater samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260C.

2.3.4 Additional Monitoring Well Borings

During the period of January 7 through 16, 2015, Glacier utilized a track-mounted Geoprobe 8140 LS Sonic drill rig to advance 6 monitoring well borings (DEC-137 through DEC-139) as shown on Plate 1. Of the 6 well borings, 3 were shallow overburden (water table) wells and 3 were deep overburden wells.

The well borings at the shallow and deep locations were advanced using a 4-inch inside diameter (ID) inner sampler and a 6-inch ID outer casing. At each monitoring well pair, only the deep well location was sampled and logged. Soil samples were collected continuously from the ground surface to the terminus at each deep boring (DEC-137D, DEC-138D, and DEC-139D). The well borings were advanced using the procedures previously described in Section 2.3.2. Following the installation of the deep well, the corresponding shallow well was advanced to a pre-determined depth and installed without logging or the collection of soil samples. The shallow well borings were advanced to depths between 38 and 47 feet bgs. The deep well borings were advanced to depths between 85 and 90 ft bgs.

All IDW generated from the monitoring well borings was containerized in NYSDOT approved 55-gallon drums and picked up by AARCO on a daily basis for off-site disposal at a permitted facility.

Soil samples were screened with a PID. Up to two soil samples were collected from each deep boring; one soil sample was collected from the interval just above the water table, the second sample was collected from the interval 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. Monitoring well boring logs are provided in Appendix E.

A COC form was maintained and accompanied the soil sample containers to Pace. Soil samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260C.

2.3.5 Shallow and Deep Overburden Monitoring Well Construction

A total of 20 (i.e. 19 shallow and one deep overburden) monitoring wells were installed during the SC Phase VIII fieldwork in the West of Morgan Avenue Area and EOA. A total of 6 (i.e. 3 shallow and 3 deep overburden) monitoring wells were installed during the Spic and Span Site DNAPL Recovery Pilot Test on Hausman Street. Twenty shallow monitoring wells were constructed with 15 feet of 2-inch ID, Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser. The 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. Bentonite chips were then installed around the riser to an elevation of 1-foot below grade. Two shallow monitoring wells, DEC-130 and DEC-134, were installed at a higher elevation due to the presence of a zone of perched groundwater overlying a lower permeability unit in the subsurface stratigraphy. Monitoring well DEC-130 was constructed with 13 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and 5 feet of 2-inch ID, Schedule 40 PVC riser. Monitoring well DEC-134 was constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and 5 feet of 2-inch ID, Schedule 40 PVC riser. A #1 size sand pack was installed from the bottom of the well up to 1 foot above the top of the well screen. Bentonite chips were then installed around the riser to an elevation of 1-foot below grade. The total depth of the shallow monitoring wells ranged from 15 to 58 feet bgs.

Well construction details for the 4 deep monitoring wells varied by location. The one monitoring well that was installed in the West of Morgan Avenue Area (DEC-126D) was set at a total depth of 60 feet bgs. The three wells that were installed on Hausman Street (DEC-137D,

DEC-138D, and DEC-139D) were set at a total depth ranging from 85 to 90 feet bgs. The deep wells were constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. 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/pellets and/or bentonite grout was then installed around the riser to an elevation of 1-foot below grade.

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 F.

2.4 Monitoring Well Development

Between November 5 and 20, 2014, and at least 24 hours after the monitoring wells were installed in the West of Morgan Avenue Area and EOA, the wells were developed by URS personnel with the pump and surge development method using a Waterra Inertial Hydrolift with dedicated/disposable high density polyethylene (HDPE) tubing and check valves. Monitoring well DEC-117 was inadvertently missed during the initial development activities and URS personnel returned to develop DEC-117 on January 13, 2015. Between January 13 and 19, 2015, and at least 24 hours after the monitoring wells were installed on Hausman Street, the wells were developed by URS personnel using the procedures described above. 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 and turbidity) were measured using a Hanna 991301 Multiparameter Meter and a Lamotte 2020 turbidimeter and recorded. A monitoring well was considered developed when a minimum of five well volumes was removed and water quality parameters had stabilized. Monitoring well development logs may be found in Appendix G.

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

2.5 Groundwater Level Measurements

A synoptic round of groundwater levels was collected on December 12, 2014, from the wells installed in the West of Morgan Avenue Area and EOA, and used to develop groundwater contour elevation maps during the investigation so that groundwater flow directions could be

determined. Groundwater levels were collected on February 24 and 25, 2015, from the wells installed on Hausman Street, but were not used in the development of the groundwater contour elevation maps. Monitoring wells within the area were checked for depth to groundwater and thickness of accumulated non-aqueous phase liquid (NAPL), if any. Water levels were determined using a 100-foot long Solinst oil/water interface probe. Groundwater elevations were adjusted if LNAPL was present, based upon the (laboratory) measured specific gravity of the product present in the individual monitoring well. Water level measurements are provided in Table 2-2.

2.6 Non-Aqueous Phase Liquid Gauging

During the SC Phase VIII fieldwork, existing and newly installed monitoring wells were checked for the presence of NAPL. On December 12, 2014, LNAPL was observed in DEC-120, DEC-122, and DEC-123 with a thickness ranging between 0.44 to 3.00 feet. The newly installed monitoring wells on Hausman Street were also checked for the presence of NAPL on February 24 and 25, 2015, however NAPL was not observed in the wells.

2.7 Light Non-Aqueous Phase Liquid Sampling

Three LNAPL samples were collected during the SC Phase VIII fieldwork. On December 11, 2014, URS collected a LNAPL sample from DEC-120 and DEC-122, and on December 15, 2014, URS collected the LNAPL sample from DEC-123 using a weighted dedicated/disposable HDPE bailer with nylon rope.

The LNAPL samples were transported under COC via laboratory courier to Hampton-Clarke. The LNAPL samples were analyzed for TCL VOCs plus TICs, TCL SVOCs plus TICs, fuel fingerprint by Method 8015 Modified, and specific gravity by American Society for Testing and Materials (ASTM) Method D1298.

2.8 Groundwater Sampling

Between November 10 and 17, 2014, URS collected groundwater samples from temporary sample points installed in soil borings ESB-01 through ESB-16 (see section 2.3.3). The groundwater samples were collected using dedicated HDPE bailers and nylon rope. A COC form was maintained and accompanied the groundwater sample containers to Hampton-Clarke. All

groundwater samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260C.

Between December 8 and 19, 2014, URS collected groundwater samples from 47 monitoring wells (20 newly installed DEC wells and 27 existing DEC wells) plus Quality Assurance/Quality Control (QA/QC) samples using low-flow sampling procedures. On February 25, 2015, URS resampled monitoring well DEC-117 after it was properly developed. On February 24 and 25, 2015, URS also collected groundwater samples from the 6 newly installed monitoring wells on Hausman Street plus QA/QC samplings using low-flow sampling procedures.

Prior to sample collection, standing water was purged from each well with a Geopump 2 peristaltic pump or a QED SamplePro Micropurge bladder pump using dedicated/disposable bladders and HDPE tubing. At DEC-120 and DEC-122, where LNAPL was encountered, dedicated HDPE bailers with nylon rope were used to purge the wells and collect a groundwater sample. At DEC-123, where LNAPL was encountered, a groundwater sample was collected from the well by lowering a capped tremie pipe into the well to a depth at least 5 feet below the LNAPL layer. The tremie pipe was secured to limit movement and the cap was pushed out from the bottom end of the tremie pipe to allow the sample tubing to be lowered to the desired sampling depth without coming into contact with the LNAPL. The cap was attached to the tremie pipe for retrieval. A peristaltic pump was used to purge well DEC-123 and collect a groundwater sample.

Wells were purged at a rate of 1-liter per minute or less and the purge rate was adjusted to minimize draw down. During the purging of the well, water quality parameters (pH, specific conductivity, temperature, dissolved oxygen, turbidity) were measured using a Horiba U-52 Multi-parameter Instrument with a flow-through cell and documented on a purge log. Samples were collected after the water quality parameters stabilized. Monitoring well purge logs are provided in Appendix H. Purge water was collected into DOT approved 55-gallon drums and picked up daily by AARCO for proper disposal.

Samples collected during the December 8 to 19, 2014, groundwater sampling event were transported under COC via laboratory courier to Hampton-Clarke. Samples collected on February 24 and 25, 2015, were shipped under COC via Federal Express to Pace. All groundwater samples were analyzed for TCL VOCs plus TICs. Twelve monitoring wells (DEC-

076, DEC-098, DEC-099, DEC-100, DEC-101, DEC-125, DEC-126, DEC-126D, DEC-127, DEC-129, DEC-130, and DEC-131) were also sampled for TCL SVOCs plus TICs, TCL pesticides, TCL polychlorinated biphenyls (PCBs), and target analyte list (TAL) metals. In addition, two monitoring wells (DEC-076 and DEC-098) were sampled for CSIA. CSIA sampling locations are listed in Table 2-3. CSIA samples were shipped under COC via Federal Express to Accutest Laboratories (Accutest) of Marlborough, Massachusetts.

2.9 Soil Vapor Implant Installation

Prior to any intrusive activities, the subcontractor obtained NYC DOT street opening permits for conducting intrusive activities. Ten permanent soil vapor implants (SG-201 through SG-210) were installed on November 3 and 4, 2014 by AARCO under the direction of a URS geologist. Locations of existing and newly installed soil vapor implants are shown on Plate 2. All locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6610 DT hydraulic direct-push unit was utilized to advance a 2-inch OD by 5-foot long acetate-lined Macrocore sampler to a maximum depth of 8 feet bgs.

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

A 6-inch long double-woven stainless steel Geoprobe® vapor sampling implant was connected to an anchor and positioned above the clayey silt layer (if present) or at the bottom of the probe hole. Polyethylene tubing (³/₈-inch OD) was connected to the implant and was cut above the ground surface. The annular space around the implant (screen) was backfilled with #1 silica sand to 6 inches above the implant. A bentonite slurry was placed immediately above the sand for the seal, and extended to the ground surface. The implants were completed with 5-inch diameter aluminum flush-mount protective casings, secured with approximately 6-inches of concrete. Each flush mount casing cover was secured with a ⁹/₁₆-inch bolt.

All downhole equipment was decontaminated with a non-phosphate detergent and potable water between each soil vapor implant location using hand washing methods. No IDW

solids were generated during soil vapor implant installation. Soil vapor implant construction logs are provided in Appendix I.

All samples were transported under COC via laboratory courier to Hampton-Clarke and samples were analyzed for TCL VOCs plus TICs.

2.10 Soil Vapor Sampling

Between November 19 and 21, 2014, soil vapor samples were collected from 25 existing and 10 newly installed soil vapor implants plus QA/QC samples. Soil vapor samples could not be collected from six locations due to either no loss of vacuum (i.e., SG-090), regulator malfunction (i.e., SG-057), or water in the line (i.e., SG-201, SG-202, SG-203, and SG-204). Soil vapor sampling locations are shown on Plate 2.

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

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

One outdoor (ambient) air sample was collected each day from a location upwind of the sample locations. The outdoor ambient air sample was collected by opening a summa canister fitted with a 1-hour flow controller and drawing in the ambient air.

Field duplicate samples were collected using stainless steel ‘T’ fittings. Copies of the completed Summa Canister Sampling Field Data Sheets from the sampling event are provided in Appendix J. A COC form was maintained and accompanied the air and soil vapor samples, which were shipped, via Federal Express, to Test America, a NYSDOH ELAP accredited laboratory. The soil vapor and outdoor air samples were analyzed for the TCL VOCs listed in Table 2-1, following USEPA Method TO-15.

2.11 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 Site Survey

NAIK Consulting Group originally surveyed the area, including all new monitoring wells installed and/or sampled for location and elevation in August 2007. URS surveyed additional monitoring well, soil vapor and soil boring locations in March and June 2011. B. Thayer Associates surveyed additional monitoring well, soil vapor and soil boring locations in November and December 2011. URS surveyed SC Phase VII monitoring well, soil vapor and soil boring locations in July 2012. B. Thayer Associates surveyed additional SC Phase VII monitoring well locations in January 2013.

MJ Engineering and Land Surveying, P.C. surveyed SC Phase VIII monitoring well, soil vapor and soil boring locations between mid-November and early-December, 2014. Monitoring wells DEC 137, DEC-137D, DEC-138, DEC-138D, DEC-139, and DEC-139D were surveyed by B. Thayer Associates in March 2015. The survey provides 100-scale mapping and does not include elevated roadways and expressways (i.e., BQE). All surveying was performed under the supervision of a New York State licensed land surveyor. All vertical control points were referenced to the North American Vertical Datum 1988 (NAVD 1988). Horizontal datum was

referenced to the North American Datum of 1983 (NAD83), New York State Plane Coordinate System, Long Island Zone. The complete site survey drawing is provided in Appendix L.

3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

The site investigation area is located within the Atlantic Coastal Plain physiographic province of New York State (Broughton, et al. 1966). The Atlantic Coastal Plain is characterized by low relief with elevations ranging from sea level to almost 400 feet 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, the site is underlain from the surface down, by: the upper glacial aquifer; the Raritan Formation; and crystalline bedrock (Figures 3-1 and 3-2). The upper glacial aquifer is of Wisconsin age and consists of a terminal moraine, a ground moraine, and glacial outwash deposits whose area is characterized as an unsorted and unstratified mixture of clay, sand, gravel and boulders. The Raritan Formation is recognized as a confining unit which has been described as light to dark 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: 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.

As of December 2013, the Raritan Formation was positively encountered in ten top of clay well locations on-site at depths between 108.5 and 138.0 feet bgs (elevations of -56.95 to -121.19 feet amsl) and was described as gray with white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, fine sand and silt, clays with carbonized plant fragments, clays with varying amounts of sand to silts with varying amounts of sand and clay and is discussed in greater detail below.

3.2 Site Geology

Due to the highly heterogeneous nature of the geology across the Meeker Avenue Plume Trackdown site, the site geology is described below in the context of the five site areas as described in Section 1.3. The ACME Steel Metal Works Area and the ACME Steel Brass Foundry Area geology will be discussed as one since these areas overlap each other. Figure 3-3 presents the locations of the monitoring wells and cross sections developed during the SC Phase VIII and previous investigations, and also monitoring wells installed on Hausman Street during the Spic and Span Site DNAPL Recovery Pilot Test. Cross sections A-A' through Q-Q' are presented on Figures 3-4 through 3-19A. Figure 3-20 depicts the elevation of the top of the Raritan Formation, which appears to dip away from a high point located at DEC-018TC toward the west-northwest.

3.2.1 Spic and Span Area

Cross sections A-A', B-B' and C-C' are shown on Figures 3-4, 3-5, and 3-6, respectively, and represent the cross-sections for the Spic and Span Area. Based upon subsurface data obtained during 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.

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 3-5). 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 3-5. 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 3-6).

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 (DEC-023D, DEC-024DR, DEC-035D, DEC-053D and DEC-055D) 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 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 3-20. The top of the Raritan Formation dips to the north/northwest.

3.2.2 Klink Cosmo Area

Cross sections D-D', E-E', H-H', I-I', J-J', K-K', and M-M' are shown on Figures 3-7, 3-8, 3-11, 3-12, 3-13, 3-14, and 3-16, respectively. Based upon subsurface data obtained during previous investigations, the upper glacial aquifer has been penetrated and the top of the Raritan Formation has been encountered at the top of clay locations. The following textural units have been found in the upper glacial aquifer in most borings, from the surface downward: a fill unit; a sand unit or a discontinuous glacial till unit; a sand unit if the discontinuous glacial till unit was

encountered at the surface; a discontinuous clayey silt unit within the sand unit; sand and gravel unit; and the Raritan Formation. Due to the heterogeneous nature of the geology, some but not all of the units may or may not be present at each boring. The thickness of the upper glacial aquifer in the Klink Cosmo Area is approximately 108.5 to more than 113.0 feet. The Raritan Formation was encountered between -68.83 and -74.05 feet amsl.

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

3.2.3 ACME Steel Metal Works and Brass Foundry Areas

Cross sections D-D', E-E', F-F', and G-G' are shown on Figures 3-7, 3-8, 3-9 and 3-10, respectively. Based upon subsurface data obtained during previous investigations, the upper glacial aquifer was penetrated and the top of the Raritan Formation has been encountered at the top of clay locations. The following textural units have been found in the upper glacial aquifer in most borings in the ACME Steel Areas, from the surface downward: a fill unit; a silty sand/sandy silt unit; a sand unit if the silty sand was encountered at the surface; a discontinuous clayey silt/silt unit within the sand unit; and the Raritan Formation. Due to the anisotropic nature of the geology, some but not all of the units may be present at each boring. The thickness of the upper glacial aquifer in the ACME Steel Areas is approximately 110.0 to 120.0 feet. The Raritan Formation was encountered between -56.95 and -65.32 feet amsl.

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

3.2.4 West of Morgan Avenue Area

Cross sections H-H', I-I', J-J', K-K', L-L' and M-M' are shown on Figures 3-11, 3-12, 3-13, 3-14, 3-15, and 3-16, respectively. Based upon subsurface data obtained during this investigation, only the upper glacial aquifer has been penetrated. The following textural units have been identified in the upper glacial aquifer in most borings in this area, from the surface downward: a fill unit; a silty sand/sandy silt unit; a sand unit; and a discontinuous and sporadically localized clayey silt/silt unit within the sand unit. Due to the heterogeneous nature of the geology, some but not all of the units may be present at each boring.

A fill unit is present, varying in thickness from approximately 0 to 9 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). The silty sand/sandy silt unit was noted at the surface in some borings. The sand unit is present at all the boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous and sporadically localized clayey silt/silt unit has been observed as an inclusive unit within the sand unit, and was identified in some of the borings in this area. The thickness of the clayey silt/silt unit, where present, varies from 1.0 to over 7.0 feet thick. At some locations (i.e., DEC-072, DEC-074, DEC-075, DEC-077, DEC-078, DEC-126D, DEC-130, and DEC-132) a less permeable unit (clayey silt or silt unit) was found near the bottom of the boring and at these instances, the wells were set within the top foot of the unit. A thick silt unit was encountered at DEC-073 from 5.0 to 49.0 feet bgs and trends north/south. The thick silt unit may impede eastward shallow groundwater flow from wells situated to the west of this location. In the

vicinity of DEC-073, the full vertical and horizontal extent of this silt unit is not yet known and likely represents a lower permeability unit which likely affects groundwater flow. Hydraulically perched groundwater occurs at several well locations, and where present, perched groundwater is approximately 9.84 to 15.94 feet higher than the wells to the east of the silt unit. This results in steep horizontal hydraulic gradients which trend north-south, between Division Place and Frost Street. The steep gradients were observed approximately between Debevoise Avenue and Morgan Avenue.

3.2.5 Expanded Outreach Area

Cross sections N-N', O-O', P-P', and Q-Q' are shown on Figures 3-17, 3-18, 3-19, and 3-19A, respectively. Based upon subsurface data obtained during this investigation, only the upper glacial aquifer has been penetrated. The following textural units have been identified in the upper glacial aquifer in most borings in this area, from the surface downward: a fill unit with localized peat; a sand unit or a discontinuous silty sand/sandy silt unit; a sand unit if the discontinuous silty sand/sandy silt unit was encountered at the surface; and a discontinuous sand and gravel unit within the sand unit. Due to the heterogeneous nature of the geology, some but not all of the units may be present at each boring.

A fill unit is present, varying in thickness from approximately 0 to 11 feet, with the exception of DEC-118 where fill mixed with peat was found at a depth of 20 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). The silty sand/sandy silt unit was noted at the surface in some borings. The sand unit is present at all the boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous sand and gravel unit has been observed as an inclusive unit within the sand unit, and has been observed in borings DEC-119, DEC-124, DEC-139D, ESB-05, ESB-08, and MW-097D.

Based upon investigations conducted by Roux as part of the ExxonMobil product recovery work, and as presented in their 2014 Annual Progress Report (Roux, March, 2015), Attachment 1 to this SC contains a modification request for Long Island Well Permit Number 2-

6101-00107/00027 as submitted by ExxonMobil which includes Roux recovery well design details; Plate 9 of Roux's March 2015 Report, shows the regional aquifer groundwater elevations based on Roux's March 18, 2011, gauging event; Plate 3 of the Roux report, shows the transect lines for generalized hydrogeologic cross sections in the EOA; and Plates 5 and 7 of the Roux report, present two generalized hydrogeologic cross-sections depicting the conditions beneath the EOA, including Section B-B' (Plate 5) oriented east-west and Section D-D' (Plate 7) oriented north-south, along Newtown Creek.

In general, subsurface stratigraphy as characterized by Roux is consistent with information obtained by URS as part of the SC phases.

3.3 Geotechnical Test Results

Geotechnical analyses of select soil samples were performed by 3rd Rock, over the various SC phases and RI investigations as part of the Meeker investigations. One sample was collected during SC Phase VIII operations from boring DEC-126D from 59 to 60 feet bgs for multiple geotechnical analyses. Similar to previously collected samples, the following geotechnical analyses were conducted: grain size distribution (ASTM D422); Atterberg Limits (ASTM D4318); USCS classification, and falling head permeability (ASTM D5084). Soil samples collected for geotechnical analysis included those from: the shallow overburden; the deep overburden; sand above the top of clay; and the top of Raritan Formation confining unit. Results are presented in Appendix M, summarized on Table 3-1 and presented below.

These results indicate that the majority of the overburden is sand with gravel (permeabilities 10^{-2} and 10^{-3} centimeters per second [cm/sec]) with silt and clay (e.g., clay with sand, silty sand, clayey sand) layers and lenses with relatively low permeability (10^{-4} to 10^{-7} cm/sec) present. In general, these layers and lenses were not observed to be laterally or vertically extensive throughout the greater Meeker Trackdown area. The sand material found above the top of the confining unit (i.e., Raritan Formation) has a permeability of approximately three orders of magnitude higher than the clay material (i.e., 10^{-3} cm/sec). Results from the top of the Raritan Formation confining unit material underlying the area at an approximate depth of 105 feet indicate low permeabilities of 10^{-6} cm/sec or less.

3.4 Investigation Area Hydrogeology

The primary hydrogeologic unit identified beneath the investigation area is the upper glacial aquifer which is underlain by the Raritan Formation unit at an approximate depth of 108 to 138 feet bgs. Locally perched groundwater has been found in some site borings in the Spic and Span Area, Klink Cosmo Area, and West of Morgan Avenue Area (DEC-003, DEC-076, DEC-077, DEC-098, DEC-099, DEC-105, DEC-130, and DEC-132).

The water table surface may be found between approximately 10 and 57 feet bgs depending on the well location. The water table in the northern and northeastern portions of the Spic and Span and EOA Areas has been affected by the operation of the Off-Site System operated by ExxonMobil since approximately 1995. The operation of the Off-Site System has produced localized cones of depression resulting in an inward hydraulic gradient around the perimeter of the Off-Site Plume area, which has prevented the expansion of the Off-Site Plume.

On December 12, 2014, a round of synoptic groundwater level measurements was obtained from 118 monitoring wells within the SC Phase VIII investigation area. The water level measurements are provided in Table 2-2. During the December 12, 2014 round of water level measurements, LNAPL was measured in three monitoring wells (DEC-120, DEC-122, and DEC-123) at thicknesses ranging between 0.44 to 3.00 feet. Water levels were adjusted in these monitoring wells based on the sample-specific specific gravity measurements presented on Table 2-2. Specific gravity values were previously determined by URS and Roux during previous phases and site investigations. A potentiometric surface map based on the water level measurements in the shallow/perched groundwater zone, generally west of Morgan Avenue is provided in Figure 3-21. A potentiometric surface map based on the water level measurements from the shallow overburden wells, generally east of Morgan Avenue, using a 1-foot contour interval, is provided in Figure 3-22. Figure 3-23 depicts a potentiometric surface map based on the water level measurements from the shallow overburden wells in the Klink Cosmo Area using a 0.1-foot contour interval. A potentiometric surface map from the deep overburden wells using a 0.5-foot contour interval is provided in Figure 3-24. An inferred potentiometric surface map for the top of Raritan Formation wells is provided in Figure 3-25. Groundwater levels were collected on February 24 and 25, 2015, from the wells installed on Hausman Street, but were not used in the development of the groundwater contour elevation maps.

Groundwater in the shallow/perched zone in the West of Morgan Avenue Area appears to flow from the north (northwest of Epner Technologies), south (Shelack Manufacturing), and west (Goodman Bros. Steel Drum Co. Inc.), and converges beneath Debevoise Avenue. The zone of convergence is generally bordered to the north by Division Place and to the south by Richardson Street. Groundwater flow near the east side of the shallow/perched zone is towards the east.

The groundwater flow in the shallow overburden is generally to the north and northeast in the Klink Cosmo, ACME Steel, and EOA Areas, at generally 10 to 15 feet lower elevations. Horizontal hydraulic gradients ranged from 0.0001 to 0.0267 ft/ft. The lowest horizontal gradients were identified in the West of Morgan Avenue Area and Klink Cosmo Area (0.0001 to 0.0002 ft/ft); and the steepest horizontal gradients were identified in West of Morgan Avenue Area (0.0184 to 0.0267 ft/ft) and the ACME Steel Areas (0.0058 to 0.0233 ft/ft).

The groundwater flow in deep overburden groundwater is to the east in the Spic and Span Area; to the northeast in the Klink Cosmo Area; and to the northeast and north in the ACME Steel Areas. The groundwater flow at the top of Raritan Formation in the Klink Cosmo Area is to the east.

The vertical hydraulic gradients between shallow and deep well pairs varied in direction across the SC investigation area as indicated on Table 3-2. The vertical hydraulic gradients ranged from -0.057 to 0.098 ft/ft with the steepest downward (positive) gradients at well pairs DEC-001R/001D, DEC-070/070D, and DEC-108/108D (Spic and Span Area), and DEC-011/011D and DEC-126/DEC-126D (West of Morgan Avenue Area). The steepest upward (negative) gradient was at DEC-016R/016D (ACME Steel Areas). Vertical hydraulic gradients over much of the investigation are relatively flat as evidenced by vertical gradients approaching zero (-0.003 to 0.003 ft/ft). The vertical hydraulic gradients between shallow and deep well pairs varied slightly between rounds of water levels. The largest changes in vertical hydraulic gradients between shallow and deep well pairs over the last four synoptic rounds of water levels was seen in wells located closest to the ExxonMobil Off-Site System, where a groundwater extraction system is operating to depress the water table and capture LNAPL and groundwater for treatment and disposal.

The vertical hydraulic gradients in top of Raritan Formation well clusters varied by location. In the Klink Cosmo Area, vertical hydraulic gradients between the shallow and top of Raritan Formation wells at DEC-006D/006TC, DEC-028/028TC and DEC-031/031TC were slightly positive or downwards to slightly negative or upwards (0.002, -0.009, and -0.003 ft/ft, respectively). The vertical hydraulic gradients between shallow and top of clay well pairs varied very slightly between rounds of water levels.

In the Klink Cosmo Area, vertical hydraulic gradients between the deep and top of Raritan Formation wells at DEC-006DD/006TC, DEC-028D/028TC, DEC-029D/029TC and DEC-031D/031TC were slightly positive or downwards to slightly negative or upwards (0.001 to -0.007 ft/ft). The vertical hydraulic gradients between deep and top of clay well pairs varied very slightly between rounds of water levels.

3.4.1 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 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 2012, the average pumping rate for RW-17 was 26 gallons per minute (gpm). The operation of RW-17 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. 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 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 has installed new 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.

The operation of Roux recovery wells (RW-A, RW-J, RW-K, RW-L, and RW-24A) form a cone of depression bordered by Nassau Avenue to the north, Meeker Avenue to the south, Apollo Street to the West, and Varick Street to the east. Groundwater generally flows laterally inward towards these recovery wells; to the east from the west side of Van Dam Street and to the west from the east side of Van Dam Street. The regional aquifer groundwater elevations based on Roux's March 18, 2011, gauging event, are included as Plate 9 in Attachment 1 of this SC Phase VIII Report.

3.5 Slug Test Results

Slug test results for the various stratigraphic units from previous investigations are presented on Table 3-3.

3.6 Standards, Criteria and Guidance Values

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

3.6.1 Soil

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

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

3.6.1.1 Background Soil Analytical Results

A summary of the detected analytical results in the background soil samples compared to unrestricted and protection of groundwater SCGs is presented in Table 3-4. Table 3-4 lists the detected analytical results for background soil samples within/near residences compared to residential SCGs for RI soil samples. Results exceeding criteria are indicated with circles and/or squares on the table. Table 3-5 provides a statistical summary of the detected TCL parameters for background soil samples as follows: the number of detections; the minimum, maximum and average values; the location and depth of the maximum value, and the number of exceedances of unrestricted use criteria. The complete validated analytical results from the SC background soil samples are presented in the Data Usability Summary Report (DUSR) in Appendix O, of the Phase VI Data Summary Report (URS, April 2012) on a compact disc. One VOC, toluene, was detected below unrestricted use criteria at six of the eight sampling locations. As indicated on Table 3-4, SVOCs, including PAHs, were detected in the majority of samples. One SVOC, di-n-butylphthalate, exceeded unrestricted use criteria at one location (SS-02). The pesticides 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in all samples and exceeded unrestricted use criteria at all locations. Additionally, dieldrin exceeded unrestricted use criteria at two locations; gamma-chlordane was detected at three locations below unrestricted use criteria.

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

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

3.6.1.2 Part 375 Criteria and CP-51

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

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

The project area falls within multiple zoning districts identified by the New York City Department of City Planning (http://www.nyc.gov/html/dcp/html/zone/zh_zmactable.shtml) including residential, manufacturing, and industrial. The current zoning and land use of

individual properties may be determined through the NYCityMap (<http://gis.nyc.gov/doitt/nycitymap>).

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

3.6.2 Groundwater

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

3.6.3 Surface Water/Sediments

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

3.6.4 Soil Vapor and Outdoor Air

There are no criteria for soil vapor or outdoor air analytical data.

4.0 ANALYTICAL RESULTS

The following sections discuss the results of the soil, groundwater, NAPL, CSIA, and soil vapor sample analyses for the SC Phase VIII fieldwork at the Meeker Avenue Plume Trackdown site, as well as the soil and groundwater analyses for the monitoring wells installed on Hausman Street as part of the Spic and Span Site DNAPL Recovery Pilot Test. The following discussion presents analytical results for the EOA and West of Morgan Avenue Area as described in Section 1.3, and the analytical results for wells installed on Hausman Street. The complete validated analytical results from the SC Phase VIII samples and the samples collected on Hausman Street are presented in the DUSR in Appendix N, on a 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.

4.1 Soil Analytical Results

The soil sample results were compared to appropriate Part 375 criteria identified for the soil samples discussed in Section 3.6. During SC Phase VIII, 56 soil samples were collected during the period October 31, 2014 through November 18, 2014 and included: 10 from soil vapor implant locations; 29 from monitoring well locations; and 17 from soil boring locations. Four soil samples were collected from the wells installed on Hausman Street between January 5 and 14, 2015. At several locations, more than one sample was collected from multiple depths.

A summary of the detected analytical results in Phase VIII soil samples and the soil samples collected on Hausman Street as compared to soil background concentrations, unrestricted use, and protection of groundwater SCGs is presented in Table 4-1. A summary of the detected analytical results in Phase VIII soil samples and the soil samples collected on Hausman Street as compared to residential and restricted residential use SCGs are presented in Table 4-2. Tables 4-3 A through E provide a statistical summary of the detected VOCs for soil samples collected by URS during SC Phase VIII and the additional well installation on Hausman Street. The complete validated analytical results from the SC Phase VIII soil samples and the soil samples collected on Hausman Street 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. Soil data from SC Phase VIII and the additional wells on Hausman Street exceeding criteria is presented on Figures 4-1, 4-2, 4-3 and 4-4. Figures 4-1 and 4-2 show unrestricted use

criteria, protection of groundwater criteria, and soil background for the EOA and West of Morgan Avenue Area, respectively. Figures 4-3 and 4-4 show soil data exceeding residential and restricted residential use criteria for the EOA and West of Morgan Avenue Area, respectively.

Reported concentrations of only non-chlorinated VOCs in soil samples collected from DEC-117, DEC-118, DEC-119, DEC-120, DEC-121, DEC-122, DEC-123, DEC-124, DEC-134, DEC-137D, DEC-138D, DEC-139D, ESB-01, ESB-02, ESB-03, ESB-05, ESB-06, ESB-07, ESB-10, ESB-11, ESB-12, ESB-13, ESB-14, ESB-15 and ESB-16 exceeded both unrestricted use and protection of groundwater criteria as follows:

- Acetone exceeded these criteria at DEC-134 (12-12.5 feet bgs);
- Benzene exceeded these criteria at DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 feet bgs), DEC-120 (29.5-30 feet bgs), DEC-121 (47.5-48 feet bgs), and DEC-137D (28-29 feet bgs);
- Ethylbenzene exceeded these criteria in DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 and 24.5-25 feet bgs), DEC-119 (27.5-28 feet bgs), DEC-120 (29.5-30 and 34-34.5 feet bgs), DEC-121 (44-44.5 and 47.5-48 feet bgs), DEC-122 (38.5-39 feet bgs), DEC-124 (41-41.5 and 44.5-45 feet bgs), DEC-137D (28-29 feet bgs), DEC-138D (35-36 feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs), ESB-03 (22.5-23 feet bgs), ESB-06 (33.5-34 feet bgs), ESB-07 (33.5-34 feet bgs), ESB-12 (34-34.5 feet bgs), ESB-13 (36-36.5 feet bgs), ESB-14 (42.5-43 feet bgs) and ESB-15 (34.5-35 feet bgs);
- Isopropylbenzene exceeded these criteria in DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 feet bgs), DEC-120 (29.5-30 and 34-34.5 feet bgs), DEC-121 (44-44.5 and 47.5-48 feet bgs), DEC-124 (44.5-45 feet bgs), DEC-137D (28-29 feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs), ESB-03 (22.5-23 feet bgs), ESB-06 (33.5-34 feet bgs), ESB-07 (33.5-34 feet bgs), ESB-13 (36-36.5 feet bgs), ESB-14 (42.5-43 feet bgs) and ESB-15 (34.5-35 feet bgs);
- Toluene exceeded these criteria in DEC-118 (21-21.5 and 24.5-25 feet bgs), DEC-120 (34-34.5 feet bgs), DEC-121 (44-44.5 and 47.5-48 feet bgs), DEC-137D (28-29

feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs) and ESB-03 (22.5-23 feet bgs); and

- Xylenes (total) exceeded one or both of these criteria at DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 and 24.5-25 feet bgs), DEC-119 (25-25.5 and 27.5-28 feet bgs), DEC-120 (29.5-30 and 34-34.5 feet bgs), DEC-121 (44-44.5 and 47.5-48 feet bgs), DEC-122 (35.5-36 and 38.5-39 feet bgs), DEC-123 (34.5-35 feet bgs), DEC-124 (41-41.5 and 44.5-45 feet bgs), DEC-137D (28-29 feet bgs), DEC-138D (35-36 feet bgs), DEC-139D (34-35 feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs), ESB-03 (22.5-23 feet bgs), ESB-05 (34.5-35 feet bgs), ESB-06 (33.5-34 feet bgs), ESB-07 (33.5-34 feet bgs), ESB-10 (38.5-39 feet bgs), ESB-11 (33.5-34 feet bgs), ESB-12 (34-34.5 feet bgs), ESB-13 (36-36.5 feet bgs), ESB-14 (42.5-43 feet bgs), ESB-15 (34.5-35 feet bgs) and ESB-16 (35-35.5 feet bgs).

Soil samples collected from DEC-117, DEC-118, DEC-120, ESB-01, ESB-02 and ESB-03 exceeded residential use criteria as follows:

- Benzene exceeded this criteria at DEC-118 (21-21.5 feet bgs);
- Ethylbenzene exceeded this criteria in DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 feet bgs);
- Isopropylbenzene exceeded this criteria in DEC-118 (21-21.5 feet bgs); and
- Xylenes (total) exceeded this criteria at DEC-118 (21-21.5 feet bgs), DEC-120 (34-34.5 feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs) and ESB-03 (22.5-23 feet bgs).

Soil samples collected from DEC-117, DEC-118, DEC-120, ESB-01, ESB-02 and ESB-03 exceeded restricted residential use criteria as follows:

- Benzene exceeded this criteria at DEC-118 (21-21.5 feet bgs);
- Ethylbenzene exceeded this criteria in DEC-117 (23-23.5 feet bgs), DEC-118 (21-21.5 feet bgs); and

- Xylenes (total) exceeded this criterion at DEC-118 (21-21.5 feet bgs), DEC-120 (34-34.5 feet bgs), ESB-01 (24.5-25 feet bgs), ESB-02 (24.5-25 feet bgs) and ESB-03 (22.5-23 feet bgs).

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

4.1.1 Expanded Outreach Area

Soil samples from locations DEC-117 through DEC-124, DEC-137D, DEC-138D, DEC-139D, and ESB-01 through ESB-16 were collected from within the EOA. PCE was not detected in any of the soil samples. TCE was only detected in DEC-120 (29.5-30 feet bgs), DEC-122 (35.5-36 feet bgs) and DEC-124 (41-41.5 feet bgs) each at a concentration of 0.12 mg/kg, below the unrestricted use and protection of groundwater criteria of 0.47 mg/kg. Compounds exceeding unrestricted use, protection of groundwater, residential use and/or restricted residential use criteria were all petroleum-related compounds (i.e., benzene, ethylbenzene, isopropylbenzene, toluene and/or xylene), as shown on Figures 4-1 and 4-3.

4.1.2 West of Morgan Avenue Area

Soil samples from locations DEC-125 through DEC-135 and SG-201 through SG-210 were collected from the West of Morgan Avenue Area. PCE was detected only in soil samples DEC-127 (4.5-5 feet bgs), DEC-129 (14.5-15 feet bgs) and SG-204 (7.5-8 feet bgs) at concentrations of 0.14 mg/kg, 0.0024 mg/kg and 0.0023 mg/kg, respectively, below the unrestricted use and protection of groundwater criteria of 1.3 mg/kg. TCE was only detected in DEC-127 (4.5-5 feet bgs) and SG-208 (5.5-6 feet bgs) at concentration of 0.0043 mg/kg and 0.0031 mg/kg, respectively, below the unrestricted use and protection of groundwater criteria of 0.47 mg/kg. In the West of Morgan Avenue Area soil samples, only acetone exceeded unrestricted use and protection of groundwater criteria, at location DEC-134 (12-12.5 feet bgs) as shown on Figures 4-2 and 4-4.

4.2 Non-Aqueous Phase Liquid

4.2.1 Dense Non-Aqueous Phase Liquid Analytical Results

DNAPL samples were not collected during the SC Phase VIII fieldwork or from the additional wells on Hausman Street. A DNAPL sample was collected from DEC-136 March 2015 as part of the Spic and Span DNAPL Recovery Pilot Test. Results from DNAPL samples collected and analyzed during previous SC, Spic and Span DNAPL Recovery Pilot Test, and RI phases are summarized below.

Sample ID	Thickness (ft)	Specific Gravity	Viscosity (centipoise)	Surface Tension (dynes/cm)	PCE Concentration (mg/kg)	Remarks
DEC-024D	NM	--	--	--	700,000	URS, May 29, 2008
DEC-024D	1.5	--	--	--	730,000	URS, June 22, 2009
DEC-024DR	NM	1.2942	1.211	26.4	110,000	URS, November 9, 2011
DEC-092D	2.0	1.4466	1.056	4.8	450,000	URS, January 21, 2013 for thickness/March 3, 2013 for analytical parameters
DEC-136	14.5	1.5079	0.918	32.8	2,000,000	URS, February 5, 2015

4.2.2 Light Non-Aqueous Phase Liquid Analytical Results

LNAPL was detected in DEC-120, DEC-122 and DEC-123 in the EOA during the SC Phase VIII field investigation. LNAPL was not detected in any of the additional wells installed on Hausman Street. Samples were collected on December 11 and 15, 2014, the results of which are presented on Table 4-4. Analytical results indicated the following:

- VOC detected included benzene, cyclohexane, isopropylbenzene, methylcyclohexane, toluene and xylene;
- SVOCs detected include 1,1-biphenyl, dibenzofuran and the PAHs 2-methylnaphthalene, acenaphthene, fluorene, naphthalene, and phenanthrene;

- The petroleum product identified in all three samples was gasoline; and
- Specific gravity ranged from 0.8021 to 0.8241.

LNAPL sample results collected and analyzed during all SC and RI phases are summarized below.

Sample ID	Density (g/mL) or Specific Gravity	Viscosity (centipoise)	Surface Tension (dynes/cm)	PCE Concentration (mg/kg)	Remarks
DEC-034	0.8218	2.14	25.3	1.1	URS/Roux split, July 9, 2009
DEC-054	0.8019	1.46	22.9	ND	URS/Roux split, July 1, 2009
DEC-053	0.7847	--	--	ND	URS, March 9, 2011; gasoline and petroleum compounds
DEC-048	0.8608	--	--	ND	URS, June 24, 2011; ID is No. 2 fuel- 950,000 mg/kg
DEC-021	0.9974	1.2004	55	ND	URS, August 7, 2012; ID is No. 6 fuel - 1,500,000 mg/kg; PAHs detected
DEC-106	0.8162	1.853	13	14	URS, March 3, 2013; ID is a mixture of Diesel and Kerosene; PAHs detected
DEC-120	0.8031	--	--	ND	URS, December 11, 2014; gasoline.
DEC-122	0.8021	--	--	ND	URS, December 11, 2014; gasoline.
DEC-123	0.8241	--	--	ND	URS, December 15, 2014; gasoline.

4.3 Groundwater Analytical Results

A summary of the detected TCL VOCs in the 67 groundwater samples (including QA/QC samples) collected from 63 monitoring wells during the SC Phase VIII December 2014 sampling event and in the 7 groundwater samples (including QA/QC samples) collected from 6 monitoring wells installed on Hausman Street on February 24 and 25, 2015, is presented in Table 4-5. Results exceeding TOGS No. 1.1.1 Class GA groundwater criteria are indicated with a circle. During the SC Phase VIII December 2014 sampling event, 12 groundwater samples were also analyzed for

TCL SVOCs, TCL pesticides/PCBs and TAL metals. Results for the additional parameters are presented in Table 4-6. Table 4-7 provides a statistical summary of the detected parameters for the SC Phase VIII December 2014 groundwater samples and the groundwater samples collected from the additional wells on Hausman Street. Complete validated analytical results from the SC Phase VIII December 2014 groundwater samples and the groundwater samples collected from the additional wells on Hausman Street 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.

The locations of detected compounds that have exceeded their Class GA groundwater criteria are shown on Figures 4-5 and 4-6 for the EOA and West of Morgan Avenue Area, respectively. Isoconcentration contours of PCE in the shallow groundwater are shown on Figures 4-7 (EOA) and 4-8 (West of Morgan Avenue Area) with the source and potential source areas. The maximum detected PCE concentrations in shallow groundwater in the West of Morgan Avenue Area were identified in monitoring wells DEC-076 (14,000 µg/L) and DEC-127 (13,000 µg/L) near the intersection of Debevoise Avenue and Division Place. A shallow PCE plume appears to emanate radially from this area and extends to the southeast. The maximum detected PCE concentration in shallow groundwater in the EOA was in monitoring well DEC-121 (220 µg/L) located on Nassau Avenue between Apollo and Hausman Streets.

Figures 4-9 (EOA) and 4-10 (West of Morgan Avenue Area) present the isoconcentration contours for TCE in the shallow groundwater. The maximum TCE concentrations in shallow groundwater in the West of Morgan Avenue Area were detected in monitoring wells DEC-076 (340 µg/L) and DEC-127 (260 µg/L), at the same locations where PCE was the highest, and in DEC-071 (300 µg/L) and DEC-074 (290 µg/L) near the intersection of Morgan Avenue and Beadel Street. The highest TCE concentration in shallow groundwater in the EOA was detected in monitoring well DEC-137 (770 µg/L) on Hausman Street midway between Nassau and Norman Avenues. The highest concentration of cis-1,2-DCE within the West of Morgan Avenue Area was detected at DEC-098 (61,000 µg/L). Figure 4-10A presents the isoconcentration contours for cis-1,2-DCE in shallow groundwater.

In the deep overburden groundwater in the EOA at DEC-001D, located on Morgan Avenue midway between Nassau and Norman Avenues, PCE and TCE were detected at 5,300 and 270 µg/L, respectively, and in DEC-139D on Hausman Street at 340 and 35 µg/L, respectively. In the deep overburden groundwater in the West of Morgan Avenue Area at DEC-010D, located on Morgan Avenue midway between Beadel Street and Division Place, PCE and TCE were detected at 210 and 92 µg/L, respectively, and in DEC-126D on Division Place and Debevoise Avenue at 28 and 19 µg/L, respectively. Isoconcentration contours of PCE in the SC Phase VIII December 2014 and the additional wells on Hausman Street deep groundwater samples are shown on Figures 4-11 (EOA) and 4-12 (West of Morgan Avenue Area). Figures 4-13 (EOA) and 4-14 (West of Morgan Avenue Area) present the isoconcentration contours for TCE in the deep groundwater.

Degradation products of PCE/TCE were typically found at the highest concentrations in DEC-098, DEC-126D and DEC-076 in the West of Morgan Avenue Area and DEC-124, DEC-117, DEC-121, DEC-137, DEC-139D, ESB-01 and ESB-16 in the EOA. The highest concentrations of vinyl chloride within the West of Morgan Avenue Area were detected in DEC-098 (5,900 µg/L) and DEC-126D (33 µg/L), located on the south side of Division Place between Debevoise and Kingsland Avenues. In the EOA the highest vinyl chloride concentrations were in DEC-124 (220 µg/L) and ESB-16 (160 µg/L), located on both sides of Meeker Avenue between Van Dam Street and Varick Avenue. The maximum concentrations of BTEX compounds were detected in ESB-08 and DEC-120 in the EOA near Nassau and Varick Avenues, and in DEC-098 in the West of Morgan Avenue Area.

Of the 12 groundwater samples analyzed for SVOCs, pesticides, PCBs and metals from the West of Morgan Avenue Area, DEC-098 exceeded SCGs for phenolic compounds (i.e., 2,4,5-trichlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, cresol, pentachlorophenol, and phenol), naphthalene and diethylphthalate. DEC-076 and DEC-127 had exceedances for naphthalene. All samples had 2 or more metal exceedances for cadmium, iron, lead, magnesium, manganese, nickel and/or sodium. No samples were collected for SVOCs, pesticides, PCBs or metals from wells located in the EOA.

4.3.1 West of Morgan Avenue Area

Comparison to Previous Results

A review of the SC Phase VII February/March 2013 and SC Phase VIII December 2014 groundwater sampling results from the West of Morgan Avenue Area indicated that at locations where analytes were detected in monitoring wells, the analytes were generally detected at similar concentrations over the two events with the following exceptions:

- The concentration of PCE at DEC-072 increased by an order of magnitude, from non-detect to 44 µg/L;
- The concentration of PCE at DEC-076 decreased by over half , from 30,000 µg/L to 14,000 µg/L. The December 2014 concentration is similar to the July 2012 concentration;
- The concentration of TCE at DEC-072 increased by a factor of 20 , from 5.1 µg/L to 110 µg/L;
- The concentration of TCE at DEC-074 increased by 2 orders of magnitude, from 2.2 µg/L to 290 µg/L. The December 2014 concentration is similar to the July 2012 concentration; and
- The concentration of vinyl chloride doubled at DEC-098, from 2,300 µg/L to 5,900 µg/L.

4.4 CSIA

Results from the two groundwater samples collected from the West of Morgan Avenue Area for CSIA are provided in Table 4-8. The results suggest the PCE found in monitoring wells DEC-076 and DEC-098 may be from separate sources or from source(s) released at different times. There is insufficient data (only 2 samples) to perform any statistical analysis, therefore the interpretation is speculative at this point. A copy of the CSIA report can be found in Appendix O. No samples for CSIA were collected from monitoring wells in the EOA.

4.5 Soil Vapor Analytical Results

4.5.1 West of Morgan Avenue Area

All Phase VIII soil vapor samples were collected from the West of Morgan Avenue Area. No soil vapor samples were collected from the EOA during SC Phase VIII. A summary of detected VOCs in soil vapor collected during the SC Phase VIII is presented in Table 4-9. Table 4-10 provides a statistical summary of the detected parameters. The locations of the VOCs detected in soil vapor, including PCE and its breakdown products, are shown on Figure 4-15. Isoconcentration contours of PCE and TCE in the SC Phase VIII soil vapor samples are shown on Figures 4-16 and 4-17, respectively.

Three outdoor air samples were collected during the field investigations to represent background air conditions. Maximum concentrations ranged from 31 $\mu\text{g}/\text{m}^3$ (acetone) to 0.56 $\mu\text{g}/\text{m}^3$ (carbon tetrachloride). VOCs detected in all three ambient air samples include: chloromethane, dichlorodifluoromethane, n-butane, toluene and trichlorofluoromethane. Benzene, carbon tetrachloride, chlorodifluoromethane, hexane and n-heptane were detected in two of the three ambient air samples. 1,2,4-trimethylbenzene, 2,2,4-trimethylpentane, acetone, methylene chloride, PCE and xylene were detected in one of the three outdoor air samples.

PCE was detected at 23 of 29 soil vapor locations with concentrations ranging from 1.8 $\mu\text{g}/\text{m}^3$ to a maximum of 160,000 $\mu\text{g}/\text{m}^3$ at location SG-095. [This is the same location of the maximum PCE concentration of 130,000 $\mu\text{g}/\text{m}^3$ and 120,000 $\mu\text{g}/\text{m}^3$ detected during SC Phase VI and Phase VII, respectively.] Additional locations with elevated concentrations of PCE include:

- SG-112 located at southeast corner of Morgan Avenue and Lombardy Street at 89,000 $\mu\text{g}/\text{m}^3$;
- SG-086 located at southeast corner of Morgan Avenue and Richardson Street at 34,000 $\mu\text{g}/\text{m}^3$;
- SG-130 located at north side of Richardson Street midway between Morgan and Debevoise Avenues at 30,000 $\mu\text{g}/\text{m}^3$;
- SG-054 located at west side of Morgan Avenue, midway between Beadel Street and Division Place at 6,300 $\mu\text{g}/\text{m}^3$;

- SG-127 located at west side of Morgan Avenue just south of Division Place at 4,700 $\mu\text{g}/\text{m}^3$;
- SG-097 located at west side of Morgan Avenue, just north of Division Place at 2,400 $\mu\text{g}/\text{m}^3$;
- SG-206 located at north side of Richardson Street, just west of Morgan Avenue at 2,300 $\mu\text{g}/\text{m}^3$;
- SG-124 and SG-132 located at south side of Division Place and north side of Frost Street, respectively, east of Debevoise Avenue at 1,500 $\mu\text{g}/\text{m}^3$; and
- SG-210 at north side of Frost Street, almost midway between Debevoise and Morgan Avenues at 1,200 $\mu\text{g}/\text{m}^3$.

Other locations with concentrations above the NYSDOH air guideline immediate action value of 300 $\mu\text{g}/\text{m}^3$ for PCE include SG-123 (820 $\mu\text{g}/\text{m}^3$), SG-059 (810 $\mu\text{g}/\text{m}^3$), SG-207 (500 $\mu\text{g}/\text{m}^3$) and SG-205 (480 $\mu\text{g}/\text{m}^3$).

TCE was detected at 25 of 29 soil vapor locations sampled at concentrations ranging from 0.44 $\mu\text{g}/\text{m}^3$ to a maximum of 17,000 $\mu\text{g}/\text{m}^3$ at location SG-091. In general, TCE was detected at all locations where PCE was detected (with the exceptions of SG-091, SG-126 and SG-129), at generally lower concentrations. The concentration of TCE was higher than the PCE concentration at locations:

- SG-124 (1,800 $\mu\text{g}/\text{m}^3$ TCE vs. 1,500 $\mu\text{g}/\text{m}^3$ PCE);
- SG-125 (770 $\mu\text{g}/\text{m}^3$ TCE vs. 230 $\mu\text{g}/\text{m}^3$ PCE);
- SG-092 (420 $\mu\text{g}/\text{m}^3$ TCE vs. 150 $\mu\text{g}/\text{m}^3$ PCE); and
- SG-096 (160 $\mu\text{g}/\text{m}^3$ TCE vs. 72 $\mu\text{g}/\text{m}^3$ PCE).

Locations where TCE was found but PCE was not detected include SG-091 (17,000 $\mu\text{g}/\text{m}^3$), SG-126 (13 $\mu\text{g}/\text{m}^3$) and SG-129 (3.9 $\mu\text{g}/\text{m}^3$).

Locations with elevated TCE concentrations (i.e., greater than the immediate action concentration of 250 $\mu\text{g}/\text{m}^3$) and elevated PCE concentrations (i.e., greater than 300 $\mu\text{g}/\text{m}^3$) include SG-095 (7400 $\mu\text{g}/\text{m}^3$), SG-054 (2500 $\mu\text{g}/\text{m}^3$), SG-124 (1800 $\mu\text{g}/\text{m}^3$), SG-130 (1500

$\mu\text{g}/\text{m}^3$), SG-132 (1400 $\mu\text{g}/\text{m}^3$), SG-206 (1100 $\mu\text{g}/\text{m}^3$), SG-112 (1000 $\mu\text{g}/\text{m}^3$), SG-127 (820 $\mu\text{g}/\text{m}^3$), SG-086 (540 $\mu\text{g}/\text{m}^3$), SG-207 (450 $\mu\text{g}/\text{m}^3$), and SG-210 (360 $\mu\text{g}/\text{m}^3$).

Locations where elevated TCE concentrations (i.e., greater than the TCE immediate action concentration of 250 $\mu\text{g}/\text{m}^3$) and PCE concentrations were below immediate action levels include SG-125 (770 $\mu\text{g}/\text{m}^3$) and SG-092 (420 $\mu\text{g}/\text{m}^3$).

Additional VOCs detected in soil vapor samples include the PCE/TCE degradation products cis-1,2-DCE [highest concentration at SG-096 (260 $\mu\text{g}/\text{m}^3$)], 1,1-DCE [highest concentration at SG-054 (760 $\mu\text{g}/\text{m}^3$)], 1,1-DCA [highest concentration at SG-054 (190 $\mu\text{g}/\text{m}^3$)] and VC [highest concentration at SG-126 (30 $\mu\text{g}/\text{m}^3$)]. 1,1,1-Trichloroethene was detected in SG-091 at 6,500 $\mu\text{g}/\text{m}^3$, followed by SG-210 and SG-132 each at 78 $\mu\text{g}/\text{m}^3$. Benzene, toluene, ethylbenzene and xylene (BTEX) and related compounds [e.g., 1,3- and 1,4-dichlorobenzene, 1,2-dichloropropane, 1,3,5-trimethylbenzene, 2,2,4-trimethylpentane, n-butane, and hexane-related compounds (e.g., cyclohexane)] with the highest concentrations were detected in SG-126, including n-butane at 76,000 $\mu\text{g}/\text{m}^3$. These contaminants suggest possible petroleum or fuel source(s). Chlorofluorocarbons (CFCs) detected in soil vapor samples include: 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113); chlorodifluoromethane (HCFC-22); and trichlorofluoromethane (Freon 11).

Compounds listed in NYSDOH's soil vapor intrusion guidelines but not mentioned previously include carbon tetrachloride, detected in six samples with the highest concentration at SG-132 (6 $\mu\text{g}/\text{m}^3$) and methylene chloride, detected in two samples, the highest concentration at SG-128 (3 $\mu\text{g}/\text{m}^3$).

4.6 Source Characterization Assessment

URS searched the Open Accessible Space Information System (OASIS) for each Block and Lot associated with each of the identified sources and potential sources of PCE and TCE. OASIS provides access to data from such sources as, but not limited to, the: New York City Department of Buildings (NYCDOB); New York City Department of Finance Assessment Roll (NYCDOFAR); New York City Digital Tax Map; New York City (NYC) zoning guide; and NYC Watershed Resources. The NYCDOB site in addition to containing information about the

subject property also included Certificates of Occupancy (CO) where available. Data obtained from OASIS is provided in Appendix P and is organized by Block and Lot.

4.6.1 Potential Sources

4.6.1.1 West of Morgan Avenue Area

A total of eleven potential source areas were identified within the West of Morgan Avenue Area during the SC Phases (Plates 1 and 2). Several of the potential sources remain as areas where additional information needs to be gathered to determine if any of these areas are responsible for, or are contributing to, the presence of PCE, TCE, and/or 1,1,1-TCA and other chlorinated VOCs in the environment. In addition to dry cleaners, numerous other facilities that may have used PCE and/or TCE as degreasers or processed drums containing degreasers (e.g., metal plating operations, metal working facilities, and drum recycling/storage facilities) have been identified.

With the exception of the Shelack Mfg. potential source located on Debevoise Avenue, no data was gathered during SC Phase VIII that would definitively exonerate any of the remaining ten previously identified potential sources. Tables 4-11 and 4-12 summarize groundwater and soil vapor analytical results, respectively, by potential source areas in the West of Morgan Avenue Area. These potential sources may be associated with the soil vapor and groundwater contamination that is found in the West of Morgan Avenue Area. The eleven previously identified potential sources in the West of Morgan Avenue Area are listed below.

- The property located at 35 Division Place is currently and historically has been occupied by dry cleaning facilities (Former Aphrodite Cleaners, French Valet Cleaner and Naxos Cleaners). The Sanborn maps also indicate that the property was also part of the metal works found at 45 Division Place in 1951. Monitoring wells downgradient/adjacent of the property include DEC-076, DEC-077, DEC-078, DEC-010, and DEC-010D. Upgradient wells include DEC-075 and DEC-072. Concentrations of PCE, TCE and cis-1,2-DCE in the adjacent well DEC-076 are higher than in the downgradient/adjacent wells DEC-077 and DEC-078. The highest concentration of PCE was in a nearby adjacent well, DEC-

076. Concentrations of PCE and TCE were similar to concentrations of PCE and TCE in adjacent well DEC-077.

Soil vapor sample locations surrounding the property starting in the north, and going clockwise are SG-093, SG-089, SG-095 and SG-204. Samples were not collected from SG-203 and SG-204. The highest soil vapor concentrations of PCE were in SG-095 on the south side of the facility, which was also the location where the elevated TCE and breakdown product soil vapor concentrations were observed. Other nearby locations include SG-091, SG-096, SG-124, SG-94 and SG-203. SG-091 had higher concentrations of TCE and 1,1,1-TCA.

Based on the groundwater results, it cannot be concluded definitively whether the property is or is not a source of PCE in groundwater. Based on the soil vapor results, the property remains a potential source of PCE.

- Across from Former Aphrodite Cleaners are the properties located at 38 Division Place and 42-50 Division Place which were formerly associated with Albert Plating Works, Inc. There are no clearly defined upgradient or downgradient wells immediately adjacent to this potential source that are situated in definitive positions to evaluate upgradient and downgradient contaminant concentrations.

Soil vapor sample locations adjacent to the facility include SG-124 and SG-125. The concentrations of PCE in soil vapor are two or more orders of magnitude lower than the PCE concentration directly north on Division place (SG-095), which is adjacent to Aphrodite Cleaners. TCE and breakdown product concentrations are also significantly lower in SG-124 and SG-125 than in SG-095.

Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the convergence of groundwater flow in the area, a definitive determination of the source of PCE remains inconclusive.

- The facility that contained the Former Belmet Products is located at 485 Morgan Avenue and 43 Beadel Street. Upgradient monitoring wells include DEC-073 and DEC-078. Downgradient wells include DEC-074, DEC-010, and DEC-010D. Concentrations of PCE, TCE and breakdown products in the shallow overburden are relatively similar in the

upgradient and downgradient monitoring wells, and slightly higher in the downgradient deeper zone (DEC-010D). Concentrations of 1,1-TCA were higher in the upgradient wells compared to the downgradient wells.

Adjacent soil vapor sample locations include SG-054 and SG-097. The concentration of PCE is highest in SG-054, whereas TCE is highest in SG-091 located on the north side of Beadel Street. SG-091 also has the highest concentration of 1,1,1-TCA of in the West of Morgan Avenue Area.

Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the nearby convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive. While the highest concentration of 1,1,1-TCA in soil vapor was adjacent to this building, the highest concentration of 1,1,1-TCA in groundwater was several blocks to the southwest, in DEC-098. However, based on the soil vapor results the building remains a potential source of 1,1,1-TCA.

- The property located at 34 Beadel Street/45 Division Place and 48 Beadel Street historically contained a warehouse and plating facility from at least 1951 to 1995. Upgradient/adjacent monitoring wells are DEC-075 and DEC-072. Hydraulically adjacent/downgradient wells are listed on Table 4-11. The highest concentrations of PCE, TCE and breakdown products were found in the more distant downgradient well DEC-127. The other downgradient/adjacent wells exhibited significantly lower concentrations of PCE and breakdown products.

Soil vapor sample location SG-096 is on the south side of the facility. Another nearby soil vapor sample location is SG-091, located across Beadel Street, on the north side. Relatively low concentrations of PCE and TCE were found in SG-096, but cis-1,2-DCE was among the highest in the November 2014 sampling event. The nearby location SG-091 had the highest concentrations of TCE and 1,1,1-TCA, as previously noted (under the Former Belmet Products).

Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater, but it remains inconclusive.

- The property located at 25 Division Place currently houses EPNER Technology Inc., which is a metal plating business. EDR listed EPNER as a F001 waste generator and also a RCRA LQG. The Sanborn maps also indicate that the property has been used as a wholesale paint and hardware store in 1951 and for manufacturing (not specified) from 1965 to present. Upgradient of the facility is monitoring well DEC-075. Downgradient/adjacent monitoring wells are listed in Table 4-11. The concentrations of PCE, TCE and breakdown products are highest in adjacent monitoring well DEC-127. Concentrations of PCE and breakdown products decrease towards the east and south.

Soil vapor sample locations adjacent to the property include SG-204 and SG-093; however, SG-204 could not be sampled. SG-093 did not contain any chlorinated VOCs in the November 2014 sampling event. It should be noted that SG-095, located adjacent to the building next door (Former Aphrodite Cleaners) exhibited the highest concentration of PCE in soil vapor in the November 2014 sampling event.

Based on the groundwater and soil vapor results, the property should still be considered a potential source of PCE in groundwater. Additional investigations should target this area.

- The property located at 18 Division Place is currently occupied by Goodman Bros. Steel Drum Co. Inc. Sanborn maps indicate that the property historically has been a cooperage since 1933. EDR listed the cooperage as a F001 waste generator and also a RCRA LQG. The upgradient monitoring well is DEC-130. Downgradient wells are DEC-076, DEC-098, DEC-099, DEC-101, DEC-125, DEC-126, DEC-126D, and DEC-129. Low levels of PCE, TCE and breakdown products were detected in the downgradient wells DEC-125 and DEC-129. Concentrations of PCE, TCE, cis-1,2-DCE, and other breakdown products are one to two orders of magnitude higher in the downgradient wells DEC-126 and DEC-101. The highest concentration of 1,1,1-TCA was in DEC-098. It should be noted that the shallow overburden groundwater flow in the vicinity of DEC-126, DEC-101 and DEC-131 is relatively flat and groundwater converges from several directions into this area.

Soil vapor sample locations adjacent to the property include SG-123 and SG-203. Other nearby soil vapor sample locations are SG-202, SG-205 and SG-128. SG-202 and SG-203 could not be sampled. Higher concentrations of PCE and TCE were reported in SG-123 compared to the other nearby locations.

Based on the groundwater results, the property should be considered a likely source of PCE, cis-1,2-DCE, and 1,1,1-TCA in groundwater.

- The property located at 297 Richardson Street currently houses Adar Medical Uniforms. Sanborn maps indicate that the property historically contained manufacturing and steel working. Upgradient monitoring wells include DEC-099, DEC-101, DEC-104, and DEC-131. Downgradient wells include DEC-076, DEC-102, DEC-128, DEC-132, and DEC-133. Upgradient well DEC-101 and downgradient well DEC-102 contained similar concentrations of PCE, TCE and breakdown products. It should be noted that DEC-076, which contained the highest overall concentration of PCE, is situated where groundwater converges in the area from several directions which complicates the assessment.

Adjacent soil vapor sample locations include SG-126, SG-129 and SG-130. Elevated concentrations of PCE and TCE were identified in SG-130. PCE was not detected in SG-129 and SG-126.

Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive.

- The property located at 87 Debevoise Avenue performed shellac manufacturing from at least 1933 to 1995 according to Sanborn maps. Upgradient monitoring wells include DEC-104 and DEC-134. Downgradient wells are DEC-100, DEC-103 and DEC-131. Concentrations of PCE, TCE and breakdown products are very low or non-detect in all these monitoring wells.

Nearby soil vapor sample locations are located at SG-209 and SG-128. The PCE and TCE concentrations are higher in SG-128, but the distance from the property (located on the north side of Richardson Street) suggests this property is not the primary source of PCE in soil vapor.

Based on the groundwater and soil vapor results, it appears that the property may not be a primary source of PCE in groundwater. However, additional investigations are needed to make a definitive determination.

- The property located at 84 Debevoise Avenue, which currently houses Eliou and Scopelitis Steel, has records at the NYSDEC as being a RCRA waste generator. The property has been occupied since at least 1965. Monitoring well DEC-104 is upgradient, while DEC-105, DEC-102, and DEC-132 are downgradient. Downgradient well DEC-102 followed by DEC-132 had the highest concentrations of PCE, TCE and breakdown products. However, the convergence of groundwater in the vicinity of DEC-101 and DEC-132, combined with a relative groundwater high in DEC-134, complicates the assessment and makes the determination of the source of PCE inconclusive.

Soil vapor sample locations adjacent to the property include SG-132 and SG-210. Elevated concentration of PCE and TCE were found in both locations.

Based on the groundwater and soil vapor results, this property remains as a potential source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive.

- The property located at 310 Richardson Street is identified on Sanborn maps as a sign manufacturer from at least 1951 to 1995. This property shares the same upgradient and downgradient monitoring wells as the Eliou and Scopelitis Steel property. No soil vapor sample locations are located adjacent to the property. The nearest soil vapor implant is across Richardson Street (SG-130), which contains elevated concentrations of PCE and TCE.

The convergence of groundwater in the vicinity of DEC-101 and DEC-132 complicates the assessment and makes the determination of the source of PCE inconclusive.

- The property located at 89 Debevoise Avenue previously housed a drum cleaning and painting facility. Sanborn maps indicate that the property housed steel drum reconditioning and painting in 1951 and a drum cleaning and storage operations from 1965 to 1981. Upgradient wells include DEC-104 and DEC-134. Downgradient wells include DEC-100, DEC-103, and DEC-131. Very low concentrations to no detections of PCE, TCE, or breakdown products were reported in these wells. No soil vapor sample locations are located adjacent to the property. The nearest soil vapor implants are situated on Frost Street (SG-208 and SG-209), which had little or no chlorinated VOCs detected.

Based upon the groundwater and nearby soil vapor sampling results, this property does not appear to be a source of chlorinated VOCs.

Summary

Based upon the concentrations of chlorinated VOCs in the shallow groundwater zone, a definitive determination of the sources of the PCE contamination remains inconclusive for most potential sources. Discontinuous zones of lower permeability strata in the subsurface contribute to a zone of locally perched groundwater in the West of Morgan Avenue Area. The convergence of groundwater in the vicinity of Debevoise Avenue complicates the assessment of source origination. The horizontal extent of the chlorinated solvents has not been fully delineated in shallow or deep overburden groundwater. The highest concentrations of PCE in shallow groundwater were found in wells DEC-076 and DEC-127 located in the northern portion of the groundwater convergence zone. Elevated PCE concentrations were also found in soil vapor at SG-095 and SG-124. These elevated concentrations may result from a combination of potential sources including EPNER Technology Inc., the Former Aphrodite Cleaners, and Goodman Bros. Steel Drum Co. Inc. Elevated concentrations of PCE degradation products were also found in shallow groundwater in wells DEC-098 and DEC-126 and soil vapor in SG-123, also located near Goodman Bros. Steel Drum Co. Inc. Elevated concentrations of PCE in soil vapor samples SG-054 and SG-097 suggest that the Former Belmet Products may also be a potential source upgradient of these locations. It should be noted that the Former Belmet Products facility is located east of the north/south silt unit found in DEC-073 outside of the groundwater convergence/perched water zone, with flow towards the east in that area. Elevated concentrations of PCE and TCE in groundwater in DEC-101, DEC-102, and DEC-132 and elevated concentrations of PCE and TCE in soil vapor samples SG-132 and SG-210 also suggest that Eliou and Scopelitis Steel may also contribute to the observed soil vapor contamination. The vertical extent of contamination has not been completely delineated either. Currently there is one deep well (DEC-126D) in the vicinity of where PCE contamination was observed in shallow groundwater. However, concentrations of PCE and TCE are one order of magnitude less than concentrations found in shallow well DEC-126. Further investigation including the installation of deep wells around these potential sources and another round of groundwater sampling will help

delineate the horizontal and vertical extent of the PCE contamination in shallow and deep overburden groundwater, and help to determine the sources of contamination.

4.6.1.2 Expanded Outreach Area

Potential Sources

A total of 17 potential sources were identified within the EOA through historical research (Table 4-13 and depicted on Plates 1 and 2). Of the 17 potential sources, five were identified during the EOA Phase I Investigation as areas where additional information was needed. Data gathered during the Phase II, Phase III and Phase IV investigations suggests they are likely sources of CVOCs. However, these results needed to be evaluated further using data from the groundwater investigation completed in the EOA as part of the SC Phase VIII and the additional wells installed on Hausman Street.

Descriptions and locations of the five potential sources and evaluation for each of the potential sources are discussed below.

- Premier Dye Polish Corporation, located at 25 Bridgewater Street, was identified as having three ASTs, ranging from a 550 to a 2,000 gallon capacity, containing 1,1,1-TCA. Upgradient wells include DEC-001, DEC-001R, DEC-001D, DEC-070, DEC-070D, DEC-108, DEC-108D, DEC-117, DEC-120, DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, and DEC-139D. Downgradient wells include DEC-118, DEC-119, DEC-122, and ExxonMobil recovery wells RW-C, RW-D, RW-H and RW-I. 1,1,1-TCA was not detected above SCGs in any of the upgradient or downgradient wells even though elevated concentrations of 1,1,1-TCA were detected in nearby soil vapor sample locations. The concentrations of PCE, TCE and/or breakdown products in the downgradient wells were generally less than or similar to the upgradient wells. Identification of the Premier Dye Polish Corporation as a potential source remains inconclusive.
- Taylor & Co. Foundry formerly located at 314 Norman Avenue, 640 Morgan Avenue, 650 Morgan Avenue and 634 Morgan Avenue was identified as a potential source based

on soil vapor results from SG-134, SG-136, SG-169, SG-170, and SG-171. Upgradient wells include DEC-001, DEC-001R, DEC-001D, DEC-070, DEC-070D, DEC-108 and DEC-108D. The nearest downgradient well is DEC-117. Other downgradient wells include DEC-118, DEC-120, DEC-121, DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, and DEC-139D but are situated in areas that may be impacted from other potential sources. The highest concentrations of PCE, TCE and breakdown products were in the upgradient well DEC-001D immediately adjacent but upgradient to the property. It is suspected that the CVOC concentrations in DEC-001D are likely attributable to the Spic and Span property. The highest concentrations of PCE and TCE in downgradient wells were found in DEC-139D and DEC-137, respectively. Downgradient well DEC-121 also has elevated levels of PCE, TCE and breakdown products when compared to upgradient shallow monitoring wells. However, this well is also downgradient from S&E Chemical Works, making identification of the source inconclusive based on the results of this well alone. Additional investigations are needed to make a definitive source determination.

- S&E Chemical Works formerly located in the buildings located on 86-88, 90, 92, 94-104 Hausman Street and 103 Apollo Street, in addition to a building located at 83 Apollo which later became an adhesives manufacturer (1965-1996), was considered a potential source based on the soil vapor results from SG-138, SG-139 and SG-140. Upgradient monitoring wells include DEC-001, DEC-001R, DEC-001D, DEC-070, DEC-070D, DEC-108, DEC-108D, DEC-117, DEC-137, DEC-137D, DEC-138, and DEC-138D. Downgradient wells include DEC-118, DEC-121, and ExxonMobil recovery wells RW-21, RW-22 and RW-23. As with Taylor & Co. Foundry, the highest concentrations of PCE, TCE and breakdown products were in the upgradient well DEC-001D. It is suspected that the CVOC concentrations in DEC-001D are likely attributable to the Spic and Span property. Downgradient well DEC-121 has similar levels of PCE, TCE and breakdown products when compared to upgradient shallow monitoring wells. Recovery well RW-22 has elevated concentrations of PCE, TCE and breakdown products, however this well is fairly deep into the aquifer (80 feet bgs). These wells are also downgradient of

Taylor & Co. Foundry, and Spic and Span, making identification of the source inconclusive.

- The former GKM property located at 47 Bridgewater Street was identified as a potential source of soil vapor contamination based on the EDR radius reports which identified GKM as a generator of F001 and F002 waste. GKM was also a RCRA LQG in 1981, a RCRA SQG in 1999 and 2002, and a RCRA CESQG as of 2004. Soil vapor results from SG-150, SG-152 and SG-154 also support identifying this location as a potential source. Upgradient wells include DEC-001, DEC-001R, DEC-001D, DEC-070, DEC-070D, DEC-108, DEC-108D, DEC-117, DEC-120, DEC-137, DEC-137D, DEC-138, DEC-138D, DEC-139, and DEC-139D. Downgradient wells include DEC-118, DEC-119, DEC-122, and ExxonMobil recovery well RW-J. The highest concentrations of PCE, TCE and breakdown products were in upgradient well DEC-001D and in the downgradient recovery well RW-J. None of the downgradient shallow wells had detections of PCE, TCE or breakdown products (with the exception of chloroethane). Identification of the former GKM property as a potential source remains inconclusive.
- A paint and lacquer manufacturer formerly located at 855 and 857-869 Meeker Avenue and a fur dyeing performed operations in an adjacent building located at 843-845 Meeker Avenue were identified as potential sources based on soil vapor results from SG-157, SG-158, SG-159, SG-160, SG-181, and SG-182. PCE, TCE and breakdown products in groundwater were found in downgradient recovery wells RW-A, RW-K, RW-L and RW-24W while the shallow downgradient wells DEC-120 and DEC-122 were non-detect for PCE, TCE and breakdown products (with the exception of chloroethane). Downgradient monitoring well DEC-121 reported PCE and TCE at concentrations higher than the upgradient well DEC-124. Upgradient well DEC-124 had concentrations of breakdown products higher than the PCE and TCE concentrations. Identification of the former paint and lacquer manufacturer and fur dyeing properties as a potential source remains inconclusive.

Summary

Based upon the concentrations of chlorinated VOCs in the shallow groundwater zone from data collected during the SC Phase VIII groundwater sampling event, the additional wells on Hausman Street, EOA SVI soil vapor sampling events, previous Roux investigations, and groundwater gradients, the identification of Premier Dye Polish Corporation, Taylor & Co. Foundry, S&E Chemical Works, the former GKM property, and a former paint and lacquer manufacturer on Meeker Avenue as potential sources of PCE contamination remains inconclusive.

The operation of Roux recovery wells (RW-A, RW-J, RW-K, RW-L, and RW-24W) form a cone of depression bordered by Bridgewater Street to the north, Meeker Avenue to the south, Apollo Street to the West, and Varick Avenue to the east. As a result of the operation of the recovery wells, groundwater generally flows to the east from the west side of Van Dam Street and to the west from the east side of Van Dam Street.

Elevated concentrations of PCE and TCE in wells DEC-139D and DEC-137, respectively, immediately downgradient of Taylor Co. Foundry, elevated concentrations of PCE and TCE found in shallow groundwater well DEC-121, downgradient of both Taylor Co. Foundry and S&E Chemical Works and elevated concentrations of PCE found in soil vapor at SG-138, SG-139, and SG-140, downgradient of S&E Chemical Works indicate that these locations are potential sources. However, these potential sources are also in close proximity to the Spic and Span property, complicating the source identification.

Elevated concentrations of TCE found in soil vapor at SG-150, SG-152, and SG-154, suggest that the former GKM property may contribute to soil vapor contamination. Elevated concentrations of PCE and TCE in downgradient Roux recovery wells (RW-A, RW-K, RW-L and RW-24W) suggest that the paint and lacquer manufacturer may contribute to PCE contamination in shallow groundwater. The vertical extent of contamination has not been completely delineated. The Roux recovery wells were installed to depths of up to 95 feet bgs. Several deep wells have been installed to the west of the EOA on Morgan Avenue and Hausman Street as part of the Spic and Span Off-Site RI and Pilot Study. However, no NYSDEC deep

groundwater wells have been installed in the EOA east of Hausman Street. Further investigation including the installation of deep wells around these potential sources, and another round of groundwater sampling will help delineate the horizontal and vertical extent of the PCE contamination in shallow and deep groundwater, and further aid in evaluating potential sources.

5.0 SUMMARY AND CONCLUSIONS

5.1 Conclusions

Based upon the results of the SC Phase VIII, the additional wells on Hausman Street, and previous site investigations, the following conclusions are provided.

5.1.1 Geology

- The potentiometric surface occurs between approximately 11 and 57 feet bgs across the Meeker Avenue Plume Trackdown Site.
- Groundwater in the shallow/perched zone in the West of Morgan Avenue Area appears to flow from the north, south, and west and converges at Debevoise Avenue. This shallow/perched zone is generally bordered to the north by Division Place and to the south by Richardson Street. Groundwater flow in the shallow/perched zone is generally towards the east.
- Shallow overburden groundwater flow in the EOA is to the north and northeast.
- Shallow overburden groundwater flow in the Klink Cosmo Area is to the north and northeast. The flow of the deep overburden groundwater in the Klink Cosmo Area is to the northeast.
- Shallow overburden groundwater flow in the ACME Steel Areas is to the north and northeast. The flow of the deep overburden groundwater in the ACME Steel Areas is to the north and northeast.
- Horizontal hydraulic gradients range from 0.0001 to 0.0267 ft/ft. The lowest horizontal gradients were identified in the West of Morgan Avenue and Klink Cosmo Areas (0.0001 to 0.0002 ft/ft). The steepest horizontal gradients were identified in West of Morgan Avenue Area (0.0184 to 0.0267 ft/ft) and the ACME Steel Areas (0.0058 to 0.0233 ft/ft).
- A thick silt unit was encountered at DEC-073 from 5 to 49 feet bgs and appears to trend north/south west of Morgan Avenue. The thick silt unit may impede eastward shallow groundwater flow from wells to the west of this location. Hydraulically perched groundwater occurs at several well locations, and where present, perched groundwater is

approximately 9.84 to 15.94 feet higher than wells to the east of the silt unit. This results in a steep hydraulic gradient toward Morgan Avenue, generally between Division Place and Frost Street.

- The entire thickness of the upper glacial aquifer has been penetrated throughout most of the Meeker Avenue Plume Trackdown Site and it varies from approximately 108.5 to 138 feet.
- The top of the Raritan Formation was encountered across the site. The elevation of the Raritan Formation varied at depths between -56.95 to -121.19 feet amsl and has been described as gray with white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, fine sand and silt, clays with carbonized plant fragments and, clays with varying amounts of sand, to silts with varying amounts of sand and clay. The top of the Raritan Formation slopes towards the west and northwest. The Raritan Formation is a well-defined regional aquiclude and has significant lateral extent. Permeabilities within the unit are less than 10^{-6} cm/sec.

5.1.2 Soil

5.1.2.1 West of Morgan Avenue Area

PCE, TCE, 1,1,1-TCA and the other CVOC breakdown products were not detected in any of the soil samples above unrestricted use criteria in the West of Morgan Avenue Area soil samples. Only acetone in DEC-134 and DEC-098 exceeded unrestricted use and protection of groundwater criteria.

5.1.2.2 Expanded Outreach Area

PCE, TCE, 1,1,1-TCA and the other CVOC breakdown products were not detected in any of the soil samples above unrestricted use criteria in the EOA. Compounds exceeding unrestricted use, protection of groundwater, residential use and/or restricted residential use criteria were all petroleum-related compounds (i.e., benzene, ethylbenzene, isopropylbenzene, toluene and/or xylene) and are likely associated with the ExxonMobil plume.

5.1.3 Non-Aqueous Phase Liquids

DNAPL samples were not collected from the EOA or West of Morgan Avenue Area. LNAPL samples were collected from three monitoring well locations within the EOA: DEC-120; DEC-122; and DEC-123. No PCE was detected in the samples from these locations. Gasoline was the primary petroleum product identified in the EOA LNAPLs. LNAPL was not observed in monitoring wells sampled from the West of Morgan Avenue Area.

5.1.4 Groundwater

5.1.4.1 West of Morgan Avenue Area

The maximum detected PCE concentrations in shallow groundwater in the West of Morgan Avenue Area were identified in monitoring wells DEC-076 and DEC-127 near the intersection of Debevoise Avenue and Division Place. A PCE plume appears to emanate radially from this area and extends to the southeast. The maximum TCE concentrations in shallow groundwater in the West of Morgan Avenue Area were detected at the same locations where PCE was the highest, and in DEC-071 and DEC-074 near the intersection of Morgan Avenue and Beadel Street. Cis-1,2-DCE was detected at the highest concentrations in DEC-098, DEC-126D, and DEC-076 along Division Place, and near the intersection with Debevoise Avenue.

PCE and TCE were detected in the deep overburden groundwater in the West of Morgan Avenue Area at DEC-010D, on Morgan Avenue midway between Beadel Street and Division Place, and in DEC-126D on Division Place and Debevoise Avenue.

5.1.4.2 Expanded Outreach Area

The maximum detected PCE concentration in shallow groundwater in the EOA was observed at monitoring well DEC-121 located on Nassau Avenue between Apollo and Hausman Streets. The highest TCE concentration in the EOA was detected in monitoring well DEC-137 on Hausman Street midway between Nassau and Norman Avenues.

PCE and TCE were detected in the deep overburden groundwater in the EOA at DEC-001D located on Morgan Avenue midway between Nassau and Norman Avenues.

5.1.5 Soil Vapor

5.1.5.1 West of Morgan Avenue Area

Soil vapor samples were only collected in the West of Morgan Avenue Area during the SC Phase VIII field investigation. The samples showed no discernible trend compared to previously sampled locations.

5.1.5.2 Expanded Outreach Area

No soil vapor samples were collected from the EOA during Phase VIII.

5.2 Source Characterization

Soil, soil vapor, groundwater and CSIA data indicate the presence of sources and potential sources of PCE and TCE contamination in Meeker Avenue site areas as summarized below.

5.2.1 West of Morgan Avenue Area

Potential Sources

A total of eleven potential source areas were identified within the West of Morgan Avenue study area during the SC Phases (Plates 1 and 2). With the exception of the Shelack Mfg. property on Debevoise Avenue, no data was gathered during Phase VIII that would definitively exonerate any of the remaining ten previously identified potential sources. The eleven previously identified potential sources in the West of Morgan Avenue Area are listed below.

The property located at 35 Division Place is currently and historically has been occupied by dry cleaning facilities (Former Aphrodite Cleaners, French Valet Cleaner and Naxos Cleaners). The Sanborn maps also indicate that the property was also part of the metal works found at 45 Division Place in 1951. Based on the groundwater results, it cannot be concluded definitively whether the property is or is not a source of PCE in groundwater. Based on the soil vapor results, however, the property remains a potential source of PCE.

Across from the Former Aphrodite Cleaners are the properties located at 38 Division Place and 42-50 Division Place which were formerly associated with Albert Plating Works Inc. Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive.

The facility that contained the Former Belmet Products is located at 485 Morgan Avenue and 43 Beadel Street. Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive. While the highest concentration of 1,1,1-TCA in soil vapor was adjacent to this building, the highest concentration of 1,1,1-TCA in groundwater was several blocks to the southwest, in DEC-098. However, based on the soil vapor results the building remains a potential source of 1,1,1-TCA.

The property located at 34 Beadel Street/45 Division Place and 48 Beadel Street historically contained a warehouse and plating facility from at least 1951 to 1995. Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater, but it remains inconclusive.

The property located at 25 Division Place currently house EPNER Technology Inc., which is a metal plating business. EDR listed EPNER as a F001 waste generator and also a RCRA LQG. Based on the groundwater and soil vapor results, the property should still be considered a potential source of PCE in groundwater. Additional investigations should target this area.

The property located at 18 Division Place is currently occupied by Goodman Bros. Steel Drum Co. Inc. Sanborn maps indicate that the property historically has been a cooperage since 1933. EDR listed the cooperage as a F001 waste generator and also a RCRA LQG. It should be noted that the shallow overburden groundwater contour in the vicinity of DEC-126, DEC-101 and DEC-131 is relatively flat and groundwater converges from several directions into the area. Based on the groundwater results, the property should be considered a likely source of PCE, cis-1,2-

DCE, VC, and 1,1,1-TCA in groundwater. This property has been listed as a Class 2 Site (DEC Site ID No. 224211) on the Registry of Inactive Hazardous Waste Disposal Sites by the NYSDEC as of July 2015 based on information obtained by the NYSDEC as part of other investigations.

The property located at 297 Richardson Street currently houses Adar Medical Uniforms. Sanborn maps indicate that the property historically contained manufacturing and steel working. Based on the groundwater and soil vapor results, it appears that the property may not be a source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive.

The property located at 87 Debevoise Avenue performed shellac manufacturing from at least 1933 to 1995 according to Sanborn maps. Based on the groundwater and soil vapor results, it appears that the property may not be a primary source of PCE in groundwater. However, additional investigations are needed to make this determination.

The property located at 84 Debevoise Avenue which currently houses Eliou and Scopelitis Steel has records at the NYSDEC as being a RCRA waste generator. Based on the groundwater and soil vapor results, this property remains as a potential source of PCE in groundwater. However, due to the convergence of groundwater in the area, a definitive determination of the source of PCE remains inconclusive.

The property located at 310 Richardson Street is identified on Sanborn maps as a sign manufacturer from at least 1951 to 1995. This property shares the same upgradient and downgradient monitoring wells as the Eliou and Scopelitis Steel property. No soil vapor implants are located adjacent to the property. Due to the convergence of groundwater in the vicinity of DEC-101 and DEC-132, a definitive determination of the source of PCE remains inconclusive.

The property located at 329 Frost Street previously housed a drum cleaning and painting facility. Sanborn maps indicate that the property housed steel drum reconditioning and painting in 1951 and a drum cleaning and storage operations from 1965 to 1981. No soil vapor implants are located immediately adjacent to the property. Based upon the groundwater and nearby soil vapor sampling results, this property does not appear to be a source of CVOCs.

Results from the two groundwater samples collected from the West of Morgan Avenue Area for CSIA are provided in Table 4-8. The results suggest the source of PCE found in monitoring wells DEC-076 and DEC-098 may be from separate sources or from source(s) released at different times. There is insufficient data (only 2 samples) to perform any statistical analysis, therefore the interpretation is speculative at this point. No samples for CSIA were collected from monitoring wells in the EOA.

Summary

Based upon the concentrations of chlorinated VOCs in the shallow groundwater zone, a definitive determination of the sources of the PCE contamination remains inconclusive for most potential sources. Discontinuous zones of lower permeability strata in the subsurface contribute to a zone of locally perched groundwater in the West of Morgan Avenue Area. The convergence of groundwater in the vicinity of Debevoise Avenue complicates the assessment of source origination. The horizontal extent of the chlorinated solvents has not been fully delineated in shallow or deep overburden groundwater. The highest concentrations of PCE in shallow groundwater were found in wells DEC-076 and DEC-127 located in the northern portion of the groundwater convergence zone. Elevated PCE concentrations were also found in soil vapor at SG-095 and SG-124. These elevated concentrations may result from a combination of potential sources including EPNER Technology Inc., the Former Aphrodite Cleaners, and Goodman Bros. Steel Drum Co. Inc. Elevated concentrations of PCE degradation products were also found in shallow groundwater in wells DEC-098 and DEC-126 and soil vapor in SG-123, also located near Goodman Bros. Steel Drum Co. Inc. Elevated concentrations of PCE in soil vapor samples SG-054 and SG-097 suggest that the Former Belmet Products may also be a potential source upgradient of these locations. It should be noted that the Former Belmet Products facility is located east of the north/south silt unit found in DEC-073 outside of the groundwater convergence/perched water zone, with flow towards the east in that area. Elevated concentrations of PCE and TCE in groundwater in DEC-101, DEC-102, and DEC-132 and elevated concentrations of PCE and TCE in soil vapor samples SG-132 and SG-210 also suggest that Eliou and Scopelitis Steel may also contribute to the observed soil vapor contamination. The vertical extent of contamination has not been completely delineated either. Currently there is one deep well (DEC-126D) in the vicinity of where PCE contamination was observed in shallow

groundwater. However, concentrations of PCE and TCE are one order of magnitude less than concentrations found in shallow well DEC-126. Further investigation including the installation of deep wells around these potential sources and another round of groundwater sampling will help delineate the horizontal and vertical extent of the PCE contamination in shallow and deep overburden groundwater, and help to determine the sources of contamination.

5.2.2 Expanded Outreach Area

Potential Sources

A total of 17 potential sources were identified within the EOA through historical research (Table 4-13). Of the 17 potential sources, five were identified as areas where additional information was needed. Data gathered during the EOA Phase II, Phase III and Phase IV investigations suggests they are likely sources of CVOCs. However, these results needed to be evaluated further using data from the groundwater investigation completed in the EOA as part of the SC Phase VIII and the additional wells installed on Hausman Street.

Descriptions and locations of the five potential sources are discussed below.

- Premier Dye Polish Corporation, located at 25 Bridgewater Street was identified as having three 1,1,1-TCA ASTs. The concentrations of PCE, TCE and/or breakdown products in the downgradient wells were generally less than or similar to the upgradient wells. However, significant concentrations of 1,1,1-TCA were detected in soil vapor samples near this property. Identification of the Premier Dye Polish Corporation as a potential source remains inconclusive.
- Taylor & Co. Foundry formerly located at 314 Norman Avenue, 640 Morgan Avenue; 650 Morgan Avenue and 634 Morgan Avenue was identified as a potential source based on soil vapor results. The highest concentrations of PCE, TCE and breakdown products were in the upgradient well DEC-001D immediately adjacent to the property. It is suspected that the CVOC concentrations in DEC-001D are likely attributable to the Spic and Span property. Downgradient wells DEC-121, DEC-137, and DEC-139D have elevated levels of PCE, TCE and breakdown products when

compared to upgradient shallow monitoring wells. However, well DEC-121 is also downgradient from S&E Chemical Works, making identification of the source inconclusive based on the results of this well alone.

- S&E Chemical Works formerly located in the buildings located on 86-88, 90, 92, 94-104 Hausman Street and 103 Apollo Street, in addition to a building located at 83 Apollo which later became an adhesives manufacturer (1965-1996), was considered a potential source based on the soil vapor results. As with Taylor & Co. Foundry, the highest concentrations of PCE, TCE and breakdown products were in the upgradient well DEC-001D. It is suspected that the CVOC concentrations in DEC-001D are likely attributable to the Spic and Span property. Downgradient well DEC-121 has similar levels of PCE, TCE and breakdown products when compared to upgradient shallow monitoring wells. Recovery well RW-22 has elevated concentrations of PCE, TCE and breakdown products, however this well is fairly deep into the aquifer (80 feet bgs). These wells are also downgradient of Taylor & Co. Foundry, and Spic and Span, making identification of the source inconclusive.
- The former GKM property located at 47 Bridgewater Street was identified as a potential source of soil vapor contamination based on the EDR radius reports which identified GKM as a generator of F001 and F002 waste. GKM was also a RCRA LQG in 1981, a RCRA SQG in 1999 and 2002, and a RCRA CESQG as of 2004. Soil vapor results support identifying this location as a potential source. The highest concentrations of PCE, TCE and breakdown products were in upgradient well DEC-001D and in the downgradient recovery well RW-J. None of the downgradient shallow wells had detections of PCE, TCE or breakdown products (with the exception of chloroethane). Identification of the former GKM property as a potential source remains inconclusive.
- A paint and lacquer manufacturer formerly located at 855 and 857-869 Meeker Avenue and a fur dyeing performed operations in an adjacent building located at 843-845 Meeker Avenue were identified as a potential source based on soil vapor results. PCE, TCE and breakdown products in groundwater were found in downgradient recovery wells RW-A, RW-K, RW-L and RW-24W while the shallow downgradient

wells DEC-120 and DEC-122 were non-detect for PCE, TCE and breakdown products (with the exception of chloroethane). Upgradient well DEC-124 had concentrations of breakdown products higher than the PCE and TCE concentrations. Identification of the former paint and lacquer manufacturer and fur dyeing properties as a potential source remains inconclusive.

Summary

Based upon the concentrations of chlorinated VOCs in the shallow groundwater zone from data collected during the SC Phase VIII groundwater sampling event, the additional wells on Hausman Street, EOA SVI soil vapor sampling events, previous Roux investigations, and groundwater gradients, the identification of Premier Dye Polish Corporation, Taylor & Co. Foundry, S&E Chemical Works, the former GKM property, and a former paint and lacquer manufacturer on Meeker Avenue as potential sources of PCE contamination remains inconclusive.

The operation of Roux recovery wells (RW-A, RW-J, RW-K, RW-L, and RW-24W) form a cone of depression bordered by Bridgewater Street to the north, Meeker Avenue to the south, Apollo Street to the West, and Varick Avenue to the east. As a result of the operation of the recovery wells, groundwater generally flows to the east from the west side of Van Dam Street and to the west from the east side of Van Dam Street.

Elevated concentrations of PCE and TCE in wells DEC-139D and DEC-137, respectively, immediately downgradient of Taylor Co. Foundry, elevated concentrations of PCE and TCE found in shallow groundwater well DEC-121, downgradient of both Taylor Co. Foundry and S&E Chemical Works and elevated concentrations of PCE found in soil vapor at SG-138, SG-139, and SG-140, downgradient of S&E Chemical Works indicate that these locations are potential sources. However, these potential sources are also in close proximity to the Spic and Span property, complicating the source identification.

Elevated concentrations of TCE found in soil vapor at SG-150, SG-152, and SG-154, suggest that the former GKM property may contribute to soil vapor contamination. Elevated concentrations of PCE and TCE in downgradient Roux recovery wells (RW-A, RW-K, RW-L

and RW-24W) suggest that the paint and lacquer manufacturer may contribute to PCE contamination in shallow groundwater. The vertical extent of contamination has not been completely delineated. The Roux recovery wells were installed to depths of up to 95 feet bgs. Several deep wells have been installed to the west of the EOA on Morgan Avenue and Hausman Street as part of the Spic and Span Off-Site RI and Pilot Study. However, no NYSDEC deep groundwater wells have been installed in the EOA east of Hausman Street. Further investigation including the installation of deep wells around these potential sources, and another round of groundwater sampling will help delineate the horizontal and vertical extent of the PCE contamination in shallow and deep groundwater, and further aid in evaluating potential sources.

5.3 Recommendations

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

5.3.1 West of Morgan Avenue Area

- Two shallow monitoring wells should be installed to an approximate depth of 30 to 50 feet bgs at the location shown on Figure 5-1. The rationale for the additional shallow monitoring wells is presented in Table 5-1. The shallow monitoring wells should be constructed with 15 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. The screens should be nominally set between 5 feet above and 10 feet below the water table. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete the well.
- Fifteen deep monitoring wells should be installed to an approximate depth ranging from of 55 to 85 feet bgs at the locations shown on Figure 5-1. The rationale for the additional deep monitoring wells is presented in Table 5-1. The deep monitoring wells should be constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser

to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete each well. Due to overhead utilities, proposed monitoring well PW-03D may have to be advanced using a track-mounted Geoprobe® 7822 DT hydraulic direct-push unit or similar low-clearance direct-push/sonic unit to advance a 2-inch OD by 5-foot long acetate-lined Macrocore sampler to a maximum depth of 45 feet bgs. The monitoring well may need to be constructed as a Micro Well with 15 feet of 1-inch ID, Schedule 40 PVC with a pre-packed screen and Schedule 40 PVC riser 1-inch diameter depending upon drilling tooling requirements for overhead clearance.

- A complete round of soil vapor samples should be collected from all existing DEC soil vapor implants within the vicinity of the potential source locations in the West of Morgan Avenue Area. The soil vapor samples should be analyzed for VOCs by TO-15, as per the FAP.
- Three synoptic rounds of groundwater elevation monitoring at monthly intervals to assess and evaluate groundwater flow conditions for potential seasonal impacts.

5.3.2 Expanded Outreach Area

- Nine shallow monitoring wells should be installed to an approximate depth of 35 to 55 feet bgs at the locations shown on Figure 5-2. The rationale for the additional shallow monitoring wells is presented in Table 5-1. In general, the shallow monitoring wells should be constructed with 15 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. The screens should be nominally set between 5 feet above and 10 feet below the water table at most locations. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete each well. Due to overhead utilities, proposed monitoring wells PW-07S, PW-11S, and PW-12S may have to be advanced using a track-mounted Geoprobe® 7822 DT hydraulic direct-push unit or similar low-clearance direct-push/sonic unit to advance a 2-inch OD by 5-foot long acetate-lined Macrocore sampler to a maximum depth of 45 feet bgs. The monitoring well may need to be constructed as a Micro Well with 15 feet of 1-inch ID, Schedule 40

PVC with a pre-packed screen and Schedule 40 PVC riser 1-inch diameter, depending upon drilling tooling requirements for overhead clearance.

- Six deep monitoring wells should be installed to an approximate depth of 60 to 90 feet bgs at the locations shown on Figure 5-2. The rationale for the additional deep monitoring wells is presented in Table 5-1. The deep monitoring wells should be constructed with 10 feet of 2-inch ID, Schedule 40 PVC 0.010-inch slot screen and riser. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete each well. 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 readings are encountered, then only one sample from the interval just above the water table should be collected, as per the FAP (URS, April 2010). All soil samples should be analyzed for TCL VOCs plus TICs by 8260B.

5.3.3 Spic and Span Area

No additional monitoring wells are suggested at this time.

5.3.4 Klink Cosmo Area

No additional monitoring wells are suggested at this time.

5.3.5 ACME Steel Areas

No additional monitoring wells are suggested at this time.

5.3.6 Additional Fieldwork

- If DNAPL is encountered in any new monitoring well(s) during drilling, well development or purging, a DNAPL sample should be collected for laboratory analyses.

The DNAPL sample(s) should be analyzed for TCL VOCs plus TICs by 8260B, TCL SVOCs plus TICs by 8270C, petroleum hydrocarbon scan by 8100 (modified), specific gravity by ASTM D4052, surface tension by ASTM D-971, and viscosity by ASTM D-445.

- A complete round of groundwater samples should be collected from all new and existing DEC wells within the West of Morgan Avenue Area and EOA. All groundwater samples should be analyzed for TCL VOCs plus TICs and natural attenuation parameters [i.e., alkalinity, chloride, nitrate, nitrite, sulfate, total iron, dissolved iron, ferrous iron (field parameter), TOC and methane/ethane/ethane]. Select samples should be analyzed for TCL SVOCs in the West of Morgan Avenue Area. Prior to the start of groundwater sampling, a synoptic round of water levels should be collected from all DEC wells located within the Meeker Avenue Plume Trackdown Site.
- A CSIA sampling effort should be conducted on soils from known areas of shallow soil contamination (i.e., DEC-016R/016D, DEC-025/025D, DEC-080/080D, DEC-095, and ASB-06). The purpose of the soil CSIA will be to fingerprint the shallow soil sources of PCE contamination and to help correlate the shallow soil source of PCE with dissolved phase groundwater contamination.
- A CSIA sampling effort should be conducted on groundwater samples at monitoring well locations to be determined after the next groundwater sampling event. The groundwater data should be evaluated and approximately 15 locations should be sampled for CSIA parameters.

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