SITE CHARACTERIZATION

PHASE II DATA SUMMARY REPORT

WORK ASSIGNMENT D004433-22

MEEKER AVENUE PLUME TRACKDOWN **SITE NO. 2-24-121**
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA **KINGS (C), NY**

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

Alexander B. Grannis, Commissioner

DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B

URS Corporation
77 Goodell Street
Buffalo, New York 14203

Final
April 2008

G3359T

PHASE II

DATA SUMMARY REPORT

SITE CHARACTERIZATION

MEEKER AVENUE PLUME TRACKDOWN

SITE ID NO. 2-24-121

GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA,

BROOKLYN, NEW YORK

PREPARED FOR:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF ENVIRONMENTAL REMEDIATION

REMEDIAL BUREAU B

WORK ASSIGNMENT NO. D004433-22

PREPARED BY:

URS CORPORATION

77 GOODELL STREET

BUFFALO, NEW YORK 14203

FINAL

APRIL 2008

TABLE OF CONTENTS

TABLES
(Following Text)

FIGURES
(Following Tables)

FIGURES
(Continued)

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ADT	Aquifer Drilling and Testing, Inc.
aka	also known as
amsl	above mean sea level
ASP	Analytical Services Protocol
bgs	below ground surface
BP	British Petroleum
C&D	construction and demolition
CO	carbon monoxide
COC	chain-of-custody
Con-Test	Con-Test Analytical Laboratory
DCA	dichloroethane
DCE	dichloroethene, aka dichloroethylene
DNAPL	dense non-aqueous phase liquid
DOT	Department of Transportation
DUSR	Data Usability Summary Report
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Approval Program
EM	electromagnetic
EPM	Environmental Planning and Management, Inc.
FAP	Field Activities Plan
FID	flame ionization detector
Frank's	Frank's Vacuum Truck Service, Inc.
FSP	Field Sampling Plan
GeoLogic-NY	GeoLogic NY, Inc.
GPR	ground penetrating radar
HASP	Health and Safety Plan
HC-V	Hampton-Clarke, Inc.- Veritech Laboratory
HDPE	high-density polyethylene
HSA	hollow stem auger
ID	inside diameter
IDW	investigation derived wastes
L	liter
LEL	lower explosive limit
mg/kg	milligrams per kilogram (parts per million)
mL	milliliter
MW	monitoring well
MTBE	Methyl tert-butyl ether
NAVD	North American Vertical Datum
NYC	New York City
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
OD	outside diameter

(Continued)

PCB	polychlorinated biphenyl
PCE	perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene
PID	photoionization detector
PMWP	Project Management Work Plan
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RQD	rock quality designation
RSI	Radar Solutions International
SAP	Sampling and Analysis Plan
TAGM	Technical and Administrative Guidance Memorandums
TCE	trichloroethene, aka trichloroethylene
TCL	target compound list
TIC	tentatively identified compound
TOGS	Technical and Operational Guidance Series
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)
$\mu g/m^3$	micrograms per cubic meter
UHP	ultra high purity
URS	URS Corporation
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WA	Work Assignment

1.0 INTRODUCTION

This Data Summary Report has been prepared to summarize the field activities and analytical results for the Meeker Avenue Plume Trackdown Site in the Greenpoint/East Williamsburg Industrial Area section of Brooklyn, New York. The work for this site was issued to URS Corporation (URS) as Work Assignment (WA) No. D004433-22. This Site Characterization Data Summary Report presents data and information gathered during the Phase II field investigation conducted from November 5 through December 27, 2007.

1.1 Site Background

1.1.1 Site Location and Description

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). The original site investigation area was bounded by the former Mobil Brooklyn Refinery/current British Petroleum (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 (Figure 2). During the first phase of fieldwork, 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, the southern boundary of the site investigation area along Richardson Street between Vandervoort and Morgan Avenues was extended one block south to Frost Street. Also, the boundary in the northwest corner of the site investigation area was extended west from Kingsland Avenue between Norman and Nassau Avenues to Monitor Street. The area located north of Nassau Avenue and east of Van Dam Street and south of Meeker Avenue is primarily used for commercial /industrial purposes. Residential areas are located in both the northwest 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 and along Vandervoort Avenue from Lombardy Street to Division Place).

The site investigation area is located in a region of historic petroleum refining and storage operations that occupied a significant portion of the Greenpoint area since approximately 1866, and by 1870 over 50 refineries were located along the banks of Newtown Creek. Currently, bulk oil storage terminals exist north of the site, including the BP Terminal, and the ExxonMobil Brooklyn Terminal (Brooklyn Terminal). The former Paragon Oil facility was located on the site along Newtown Creek, north of Bridgewater Street, between Meeker Avenue and Apollo Street. Peerless Importers, Inc., currently is 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 area at the 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. 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 Associates) on behalf of ExxonMobil from 1990 to the present and have further defined the extent of the Off-Site Plume. The Off-Site Plume area consists of the area underlain by the petroleum free product plume that is not on the BP Terminal or the Peerless Imported, Inc. properties. Currently, the extent of the Off-Site Plume area is less than what it was in 1990 due to the operation of the Off-Site Free Product Recovery System (Off-Site System). The Off-Site System has recovered approximately 3,900,000 gallons since it became operational in 1995.

The current Off-Site Plume area boundary measured by Roux Associates on August 27, 2007 (Roux. October 31, 2007) is shown on Figure 2.

1.1.2 Previous Investigations

In September 2005, Roux Associates on behalf of ExxonMobil sampled soil-gas at 23 temporary locations in the Off-Site Plume area (Roux, October 18, 2005). The soil-gas samples collected in September 2005 indicated the presence of tetrachloroethene (PCE) at concentrations of 1,500 and 1,040 parts per billion by volume (ppbv) at locations SG-20 (southwest corner of Vandervoort Avenue and Anthony Street) and SG-21 (west side of Morgan Avenue between Nassau

Avenue and Norman Avenue) respectively, and at much lower concentrations throughout the remainder of the Off-Site Plume area. In addition, trichloroethene (TCE) was detected at concentrations of 831 and 28,100 ppbv at SG-17 (west side of Apollo Street between Nassau Avenue and Meeker Avenue) and SG-21 respectively, and at much lower concentrations throughout the remainder 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.

Between June and September 2006, Roux Associates performed a soil-gas investigation in the Off-Site Plume area (Roux, November 10, 2006). A total of 50 permanent soil-gas monitoring points were installed. This included 20 nested monitoring points (one shallow and one deep) in the commercial/ industrial areas and 10 deep monitoring points in the residential areas. Elevated concentrations of PCE were detected at 191 and 137 ppbv at the MP-018D (northwest corner of Morgan and Nassau Avenues) and MP-033 (west side of Van Dam Street between Nassau and Meeker Avenues) locations, respectively. Elevated concentrations of TCE were detected at 1,530 and 131 ppbv at the MP-016 (east side of Apollo Street between Bridgewater Street and Nassau Avenue) and MP-018D locations, respectively.

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 a concentration of 7,760 micrograms per kilogram (µg/kg) in the 0-4 foot sample from boring SB-29 (southeast corner at the intersection of Gardner Avenue and Thomas Street). PCE was also detected at concentration of 89.9, 569, and 1,1060 micrograms per liter (µg/L) in ExxonMobil wells MW-018 (east side of Vandervoort Avenue between Anthony and Cherry Streets), MW-023 (southwest corner at the intersection of Gardner Avenue and Thomas Street), and MW-030 (east side of Varick Avenue between Anthony and Cherry Streets), respectively.

1.2 Summary of Phase I Findings

The Phase I field investigation was conducted from May 7 through July 10, 2007. Field activities associated with the Phase I field investigation included: obtaining historical information

reports (e.g., Sanborn maps) from Environmental Data Resources, Inc.; obtaining utility clearances and permits; utility locating by a private subcontractor; manual and/or Vac-Tron® utility clearance for monitoring well installation; installation of 23 soil-gas conduits; installation of 20 groundwater monitoring wells; collection of 27 soil-gas samples from 21 newly installed and 6 existing soil-gas conduits; collection of 26 soil samples from 20 monitoring well borings; collection of 28 groundwater samples from 20 newly installed and 8 existing monitoring wells; daily pick-up of investigation derived waste for disposal and a site survey. A copy of the Phase I Data Summary Report (URS. October 2007) has been provided on a compact disc in Appendix A.

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

- Soil-gas samples from north of Meeker Avenue indicated that PCE has impacted soil-gas quality at all locations sampled, the highest concentrations may be found in the vicinity of SG-008, which is located adjacent to a former metal working facility and research lab and approximately 400 feet southeast of a former dry cleaner located on the southwest corner of Kingsland and Norman Avenues. Soil-gas has also been impacted to a lesser extent by TCE, most notably in the vicinity of SG-007, which is located approximately 300 feet south of SG-008, as shown on Figures 3 and 4.
- Soil-gas samples from south of Meeker Avenue indicated that PCE has impacted soil-gas quality at all locations sampled, the highest concentrations may be found in the vicinity of SG-015, SG-018, SG-022, and SG-023. SG-023 is located approximately 200 feet east of the former dry cleaner identified on the Sanborn maps between Beadel Street, Morgan Avenue, and Division Place. The remaining soil-gas samples are located either side-gradient or downgradient of the former dry cleaner. Soil-gas has also been impacted to a lesser extent by TCE, most notably in the vicinity of SG-015, SG-018, SG-022, and SG-023, as shown on Figures 3 and 4.
- A soil sample from the 5-6 feet bgs interval from monitoring well location DEC-016 that is located adjacent to a former brass foundry was the only sample that exceeded TAGM 4046 criteria, with 220 milligrams per kilogram (mg/kg) of PCE.
- Groundwater samples from north of Meeker Avenue indicated that groundwater has been impacted slightly above Class GA groundwater standards for PCE at DEC-001 and

DEC-003. Also, groundwater has been impacted above Class GA groundwater standards for TCE at DEC-001, DEC-003 and MW-092, as shown on Figures 5 and 6.

- Groundwater samples from south of Meeker Avenue indicate that groundwater has been impacted above Class GA groundwater standards for PCE at all locations except for MW-019. The highest concentrations of PCE appear to be centered on DEC-14 (downgradient and side-gradient of two former dry cleaners and side-gradient from a drum recycling facility); DEC-16 (adjacent to a former brass foundry); and DEC-018 (adjacent to a former soap manufacturer). Also, groundwater has been impacted above Class GA groundwater standards for TCE at all locations except for DEC-019 and MW-019. The highest concentrations of TCE appear to be centered on DEC-005 (adjacent to a metal working facility) and DEC-018. Based on the groundwater results there appears to be potentially two point sources for PCE (DEC-014 and DEC-016); one point source for PCE and TCE (DEC-018); and one point source for TCE (DEC-005), as shown on Figures 5 and 6.

1.3 Project Scope

In accordance with the NYSDEC Scope of Work (NYSDEC, February 1, 2007) URS prepared a Project Management Work Plan (PMWP) and budget estimate (Final, April 2007), a Field Activities Plan (FAP, April 2007) which includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HASP, April 2007).

The work assignment provided by the NYSDEC indicates that the fieldwork associated with the Meeker Avenue Site Characterization will proceed in four phases (or time periods) in order to help identify the PCE and TCE source areas.

Tasks performed during the Phase II field investigation included:

- Reviewing historical information reports (e.g., Sanborn maps) from Environmental Data Resources, Inc.;
- Obtaining utility clearances and permits;

- Utility locating by Radar Solutions International of Waltham, MA;
- Installation of 28 soil-gas conduits by GeoLogic-NY, Inc. of Homer, NY (GeoLogic-NY);
- Advancement of 11 direct-push soil borings by GeoLogic-NY;
- Advancement of 15 direct-push groundwater sample locations by GeoLogic-NY;
- Manual and/or Vac-Tron® utility clearance for monitoring well installation by Aquifer Drilling and Testing, Inc., of New Hyde Park, NY (ADT);
- Installation of 14 groundwater monitoring wells by ADT;
- Collection of 55 soil-gas samples from 28 newly installed and 27 existing soil-gas conduits for analysis by Con-Test Analytical Laboratory, of East Longmeadow, MA (Con-Test);
- Collection of 14 soil samples from 11 direct-push soil borings for analysis by Hampton-Clarke, Inc – Veritech Laboratory, of Fairfield, NJ (HC-V);
- Collection of 14 groundwater samples from 14 direct-push groundwater sample locations for analysis by HC-V;
- Collection of 16 soil samples from 14 monitoring well borings for analysis by HC-V;
- Collection of 44 groundwater samples from 14 newly installed and 30 existing monitoring wells for analysis by HC-V;
- Daily pick-up of investigation derived waste for disposal through Frank's Vacuum Truck Service of Niagara Falls, NY (Frank's); and
- Site survey by NAIK Consulting Group, P.C. (formerly NAIK-PRASAD, Inc.), of Edison, NJ.

1.4 Data Presentation

This Data Summary Report has six sections. Section 2.0 includes a description of field activities that occurred during the Phase II fieldwork. Section 3.0 includes a description of the subsurface conditions that have been found at the site. Section 4.0 includes a description and summary of the analytical results for the soil-gas, subsurface soils, direct-push groundwater and

groundwater samples from monitoring wells collected during the Phase II fieldwork. Section 5.0 consists of the conclusions derived from the Phase I and Phase II analytical results and also includes recommendations for the Phase III fieldwork. Section 6.0 contains a list of references cited. Tables, Figures, and Appendices follow the text.

2.0 FIELD ACTIVITIES

Field activities performed during Phase II of the site characterization are discussed below.

2.1 Utility Clearance

Prior to site work, each subcontractor arranged for all appropriate utility clearances. This included (but was not limited to) contacting the New York City Departments of Environmental Protection and Transportation, the Transit Authority, Consolidated Edison, Keyspan, and Verizon in addition to using the Dig-Safe number for New York City – (800) 272-4480.

2.2 Geophysical Survey for Utility Markouts

On November 5, 2007, Radar Solutions International (RSI) mobilized a crew with ground penetrating radar (GPR) and electromagnetic (EM) induction equipment to the site for the purpose of screening for and identifying the presence of underground utilities in areas where drilling for monitoring well installations, direct-push borings (e.g., Geoprobe®), and soil-gas conduit installations were proposed.

A 10-foot square reference grid was established around each monitoring well and direct-push boring location prior to collecting the geophysical data. A GSSI SIR-2000 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 Ditch Witch 950 RT locating system, which consists of a locator and a transmitter.

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

2.3 Soil-Gas Conduit Installation

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., street opening permits) for conducting intrusive activities. Twenty-eight permanent soil-gas conduits (SG-012B, SG-013B and SG-024 through SG-049) were installed from November 26 through November 30, 2007 by GeoLogic-NY, under the direction of a NYSDEC representative and a URS geologist. The locations of the soil-gas conduits are shown on Figure 7. All locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a 1.5 inch outer diameter (OD) rod with an expendable point to a depth of approximately 8 feet below ground surface (bgs). No soil samples were collected.

A 6-inch long double woven stainless steel Geoprobe® vapor sampling implant was inserted through the rod and connected to an anchor, positioning the implant at the bottom of the probe hole. Polyethylene tubing [$^{3}/_{8}$ inch outside diameter (OD)] connected to the implant was extended to the top of each conduit, where it 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 conduits were completed with 4-inch diameter aluminum flush-mount protective casings, secured with approximately 1 foot 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-gas conduit location. No investigation derived wastes (IDW) were generated during the soil-gas conduit installation. A photograph of a completed soil-gas conduit can be found in Appendix C. A typical soil-gas conduit construction log is provided in Appendix D. Copies of the daily field notes are provided in Appendix E.

2.4 Soil-Gas Sampling

Between December 3 and December 7, 2007, soil-gas samples were collected from 50 soil-gas conduits (23 new DEC soil-gas conduits; 21 existing DEC soil-gas conduits; and 6 existing ExxonMobil soil-gas conduits) plus quality assurance/quality control (QA/QC) samples. Roux Associates acting on behalf of ExxonMobil, provided URS with split-samples from the six

ExxonMobil conduits (MP-008D, MP-018D, MP-021, MP-024, MP-025, and MP-026). There was no loss in the Summa® canister vacuum pressure in the attempt to collect a sample at locations SG-012B, SG-013B, SG-026, SG-028 and SG-029. Soil-gas conduits SB-012B and SG-013B are replacement locations for SB-012 and SG-013, which could not be sampled during the Phase I fieldwork due to suspected screen blockage. Geologic information gathered during the installation of monitoring wells DEC-023, DEC-024, and DEC–025 has indicated the presence of a stiff to hard clayey silt in the vicinity of SG-012B, SG-013B, SG-026, SG-028 and SG-029 from approximately 2 to 29 feet below ground surface (bgs). The presence of the stiff to hard clayey silt may prevent migration of soil-gas to the above mentioned soil-gas conduits.

The soil-gas samples were collected in accordance with the procedures outlined in the FAP (URS, April 2007) using laboratory evacuated 6-liter Summa® canisters with 1 hour flow regulators (i.e., calibrated at the flow rate of approximately 0.08 L per minute) provided by Con-Test. Per *New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006), a helium tracer gas was utilized during the sampling of each soil-gas conduit. The tracer gas was used to verify that the infiltration of outdoor (ambient) air was not occurring during sample collection. A two-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 (UHP) 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-gas conduit using a Gillian GilAir-3 air sample pump.

A Dielectric MGD-2002 helium detector was used to check for the presence of the tracer gas in the soil vapor; if less that 10% of the tracer gas was detected, a sample was collected. Following the collection of the soil-gas 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. No elevated concentrations of helium were detected prior to or following the sample collection from any of the soil-gas conduits.

Outdoor (ambient) air samples were collected from points upwind of the sample locations. The outdoor ambient air sample was collected by opening a summa canister fitted with a one-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 F.

A chain-of-custody (COC) form was maintained and accompanied the samples, which were shipped, via Federal Express to Con-Test, a NYSDOH Environmental Laboratory Approval Program (ELAP) accredited laboratory. The samples were analyzed for the target compound list (TCL) volatile organic compounds (VOCs) listed in Table 1, following United States Environmental Protection Agency (USEPA) Method TO-15.

2.5 Direct-Push Soil Borings

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., street opening permits) for conducting intrusive activities. Eleven direct-push soil borings (SB-01 through SB-11) were advanced on November 16, 2007 and November 27, 2007, by GeoLogic-NY, under the direction of a NYSDEC representative and a URS geologist. The locations of the direct-push soil borings are shown on Figure 7.

All boring locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a 2-inch outside diameter (OD) by 4-foot long acetate lined Macrocore sampler to a maximum of 33 feet bgs. A URS geologist scanned each Macrocore sample with a MiniRae 2000 photoionization detector (PID) at one-foot intervals, and described the subsurface materials encountered. Descriptions of the cores and related information from each boring were recorded on soil boring logs (Appendix G). All downhole equipment was decontaminated with a non-phosphate detergent and potable water between each sample collected. Upon completion, the boreholes were backfilled with bentonite pellets; the surface was repaired with concrete patch; and the location was marked with spray paint.

Typically, one soil sample was collected from each boring; the sample was collected from the interval exhibiting odors, staining, or the highest PID reading. Two samples were collected from boring SB-11 and three from borehole SB-08 because of high PID readings. Site photographs are provided in Appendix C, copies of the daily field notes are provided in Appendix E and soil boring logs are provided in Appendix G.

A COC form was maintained and accompanied the sample containers to HC-V, which is a NYSDOH ELAP accredited laboratory. The soil samples were analyzed for target compound list TCL VOCs as listed in Table 1 plus tentatively identified compounds (TICs) following USEPA SW846 Method 8260B.

2.6 Direct-Push Groundwater Sampling

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., street opening permits) for conducting intrusive activities. Fifteen direct-push groundwater sample locations (GW-01 through GW-15) were attempted between November 12, 2007 and November 25, 2007 by GeoLogic-NY, under the direction of a NYSDEC representative and a URS geologist. Direct-push groundwater sample location GW-11 could not be advanced beyond 48 feet bgs during three attempts, all three borings did not reach the water table and therefore a groundwater sample was not collected from GW-11. The locations of the direct-push groundwater sample locations are shown on Figure 8.

All boring locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic push unit was utilized to advance a screen point sampler to approximately one-foot below the water table which was encountered up to a depth of 55 feet bgs. The screen point was threaded into the leading end of a probe rod. While the sampler was driven to the desired depth, O-ring seals at the drive head and expendable drive points provided a watertight seal. At the desired depth, chase rods were used to enable the retraction of the tool sting while the screen was held in place. Groundwater was purged (a small volume to ensure that the sample is representative of the zone being sampled) and then collected using dedicated/disposable high-density polyethylene (HDPE) tubing and a check valve. Upon the completion of the sampling, the screen point sampler was removed; the borehole backfilled

with bentonite pellets; the surface was repaired with concrete; and the location marked with spray paint.

One groundwater sample was collected from each boring. Site photographs are provided in Appendix C and copies of the daily field notes are provided in Appendix E.

A COC form was maintained and accompanied the sample containers to HC-V. The samples were analyzed for TCL VOCs as listed in Table 1, plus TICs following USEPA SW846 Method 8260B.

2.7 Groundwater Monitoring Well Installation

2.7.1 Pre-Boring Clearing

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., street opening permits) for conducting intrusive activities. On November 6, 2007, ADT mobilized a Vac-Tron® unit to perform location specific utility clearance at each of the proposed monitoring well locations. A total of 14 monitoring well locations were cleared. At each location, a two-foot square (four square feet) area of the sidewalk was cut. An approximately one foot diameter by five-foot deep hole was excavated using post-hole diggers, pry bars, an air knife, and hand digging along with the Vac-Tron® unit. After the location was cleared for drilling, the hole was backfilled flush with the sidewalk using the excavated spoils (small rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete.

2.7.2 Soil Borings

During the period of November 6 through December 7, 2007, ADT utilized a Central Mine Equipment Company (CME) 55LC track-mounted drill rig for the installation of 14 monitoring wells (DEC-007, DEC-013, DEC-022D, and DEC-023 through DEC-033). This drill rig is a dual-purpose hollow-stem augers (HSA)/mud rotary rig designed to work in areas requiring low clearance.

The soil borings were advanced using 4 ¼-inch inside diameter (ID) HSAs. Split spoon samples were collected continuously using standard penetration techniques (ASTM D1586-84) unless an obstruction was encountered that required the advancement of the augers to drill past the obstruction. At some well locations, auger refusal was encountered due to the presence of cobbles and boulders. As a result, ADT switched to mud-rotary drilling techniques to advance the borings to the required depths. The final boring depths ranged from 32 to 62 feet bgs. All IDW generated from the monitoring well installation was containerized in Department of Transportation (DOT) approved 55-gallon drums and picked up by Frank's on a daily basis for off-site disposal at a permitted facility.

Each split spoon sample was screened with a PID. Up to two soil samples were collected from each boring; one soil sample was collected from the interval just above water table, the second sample was collected from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading were encountered, then only one sample from the interval just above water table was collected. Three samples were collected from borehole DEC-025 because of high PID readings. Site photographs are provided in Appendix C, copies of the daily field notes are provided in Appendix E and soil boring logs are provided in Appendix G.

A COC form was maintained and accompanied the sample containers to HC-V. The samples were analyzed for TCL VOCs as listed in Table 1, plus TICs following USEPA SW846 Method 8260B.

2.7.3 Well Construction

The monitoring wells were constructed with 10 to 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 at most locations. At location DEC-022D, a 10-foot screen was set below a localized confining layer. A 10 to 20 mesh 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. 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 unauthorized well access. The concrete apron thickness was consistent with the thickness of the existing pavement/sidewalk. Site photographs are provided

in Appendix C, monitoring well construction logs are provided in Appendix H. Figure 8 shows the locations where groundwater monitoring wells were installed.

2.8 Monitoring Well Development

At least 24 hours after the monitoring wells were installed, the wells were developed by URS personnel with the pump and surge development method using a Wattera Hydrolift pump with dedicated/disposable HDPE tubing and HDPE check valves. Prior to well development, a 100-foot long Solonist oil/water interface probe was used to check for the presence/ thickness of any free product. During well development, water quality parameters (pH, specific conductivity, temperature and turbidity) were measured using a Hanna 991301 Multiparameter Meter and a Lamotte 2020 turbidimeter and recorded. A monitoring well was considered developed when a minimum of 5 well volumes was removed, and water quality parameters had stabilized. Well development logs may be found in Appendix I. Well development water was collected into DOT approved 55-gallon drums and picked up daily by Frank's for off-site disposal at a permitted facility.

2.9 Groundwater Sampling

Between December 10 through December 27, 2007, URS sampled 44 (14 newly installed DEC wells, 20 existing DEC wells and 10 existing ExxonMobil) monitoring wells using low-flow sampling procedures. Roux Associates acting on behalf of ExxonMobil, provided URS with split-samples from the ten ExxonMobil locations (MW-004, MW-014, MW-018, MW-019, MW-020, MW-023, MW-030, MW-092, MW-095 and MW-098).

Prior to sample collection, standing water was purged from each well with a QED SamplePro Micropurge bladder pump using dedicated/disposable bladders and HDPE tubing. Wells were purged at a rate of 1-liter per minute or less and the purge rate was adjusted to minimize draw down. During the purging of the well, water quality parameters (pH, specific conductivity, temperature, dissolved oxygen, turbidity) were measured using a Horiba U-22 Multi-parameter Instrument with a flow-through cell and documented on a purge log. Samples were collected after the water quality

parameters stabilized. Purge logs are provided in Appendix J. Purge water was collected into DOT approved 55-gallon drums, and was picked up daily by Frank's for proper disposal.

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

2.10 Monitoring Well Maintenance

During Phase II fieldwork, well maintenance was performed on all DEC wells. It was noted during the collection of a synoptic round of water levels on September 11, 2007, that the well pads and flush-mount curb boxes at DEC-005 and DEC-0016 had been damaged. The flush-mount curb boxes and well pads were replaced on DEC-005 and DEC-016 on November 30, 2007. In addition, all DEC wells had the well ID stenciled adjacent to the wells and all the boltholes were tapped out and lubricated with an anti-seize paste.

2.11 Investigation Derived Waste Disposal

Frank's 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 are provided in Appendix K.

2.12 Site Survey

NAIK Consulting Group surveyed the area, including all monitoring well, soil-gas conduit, direct-push soil boring, and direct-push groundwater sampling locations during the field investigation for location and elevation. The survey provides 100-scale mapping and does not include elevated roadways and expressways [i.e., Brooklyn-Queens Expressway (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. Copies of survey field notes and site sketches are provided in Appendix L. A site survey drawing is provided in Appendix M.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The topography of the site investigation area varies from approximately 6 feet above mean sea level (amsl) at the bulkhead along Newtown Creek to approximately 56 feet amsl in the central part of the site. The site is located on an unconfined surficial glacial aquifer system consisting of outwash deposits that are underlain by a confining unit. Based upon subsurface data obtained during this and previous investigations, the site is underlain in most areas from the surface downward by: a fill unit, a sand unit, a discontinuous till unit, and a discontinuous clay/silt unit.

The fill unit varies from approximately 0 to 9 feet thick 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.) and has been found at most boring locations. The sand unit has been found underlying the fill unit at most boring locations and is represented by stratified sands of varying textures containing some to no fines. The entire thickness of the sand unit has not been penetrated, however it was found to be approximately 63 feet thick at location DEC-016 (Anthony Street between Porter and Varick Avenues). The discontinuous till unit was noted in borings in the western and southwestern portion of the site (i.e., west of Morgan Avenue north of Meeker Avenue and west of Porter Avenue south of Meeker Avenue) and consists of a heterogeneous mixture of sand, silt, and clay and varying amounts of gravel, cobbles and boulders. The discontinuous clay/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 except in the central northeast portion of the site where it is absent. The thickness of the clay/silt unit, where present, varies from 0.5 to over 10 feet thick.

Figure 9 depicts the locations of cross-sections A-A', B-B', C-C', D-D', and E-E' which are shown on Figure 10 through Figure 14.

3.2 Investigation Area Hydrogeology

The primary hydrogeologic unit identified beneath the investigation area is the surficial aquifer present in the sand unit. Perched groundwater has been found in some site borings (DEC-004, DEC-006, DEC-007, DEC-015, DEC-017, DEC-22, DEC-30, SB-008, and SB-011) where less permeable units are present above the sand unit (i.e., till and or clay/silt unit). The water table surface may be found between approximately 13 and 54 feet bgs depending on the well location. The water table on the northern portion of the site has been influenced by the operation of the Off-Site System operated by ExxonMobil since approximately 1995. The operation of the Off-Site System has produced localized cones of depression resulting in an inward hydraulic gradient around the perimeter of the Off-Site Plume area, which has prevented the expansion of the Off-Site Plume. The Off-Site System was temporarily shutdown between March 9, 2007 and June 27, 2007. The Off-Site System resumed operation on June 28, 2007.

On December 18, 2007, a round of synoptic groundwater level measurements were obtained from 44 monitoring wells (34 DEC wells and 10 ExxonMobil wells). The water level measurements are provided in Table 2. A potentiometric surface map based on the water level measurements is provided in Figure 15. It should be noted that the groundwater level measurements from DEC-006 and DEC-022 were not used in the contouring on Figure 15 because they represent perched groundwater levels and not the actual potentiometric surface. Historic water level measurements are also included in Table 2. The water level measurements during December 2007, in general, were consistently lower (approximately 1-foot) across the site when compared to the previous measurements (i.e., June 2007 and September 2007). At this time it cannot be determined if the change in water elevation is seasonal or due to the influence of the Off-Site System.

The groundwater flow in the study area north of Meeker Avenue is east to northeastwards towards the Off-Site System with a groundwater mound at DEC-002 and MW-020. The horizontal hydraulic gradient on the northern portion of the site ranges from 0.037 to 0.031 foot per foot (ft/ft)]. The gradient is the steepest between the groundwater mounds at DEC-002 and MW-20 and surrounding wells (0.031 and 0.019 ft/ft respectively).

The groundwater flow in the area south of Meeker Avenue generally appears to be flowing northward towards the Off-Site System. A groundwater mound is found at MW-019 and tends to flow semi-radially away from the well. The horizontal gradient on the southern portion of the site east of Porter Avenue is generally towards the Off-Site System at 0.005 to 0.012 ft/ft. The gradient is steepest between DEC-018 and MW-030 (0.012 ft/ft). The hydraulic gradient on the southern portion of the site west of Porter Avenue is generally very shallow with a general flow direction to the northeast towards the Off-Site System at <0001 to 0.001 ft/ft. The steepest gradient east of Porter Avenue is between MW-019 and surrounding wells (0.034 to 0.022 ft/ft).

4.0 ANALYTICAL RESULTS

4.1 Soil-Gas Analytical Results

A summary of detected VOCs in the soil-gas and outdoor air samples is presented in Table 3. The location of detected chlorinated hydrocarbons, including concentrations of PCE and its breakdown products, are shown on Figure 16. There are no current promulgated criteria for contaminants in soil-gas samples. Table 4 provides a statistical summary of the detected parameters for the Phase II sampling event as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. Table 5 provides a historical summary of the detected parameters for all samples collected by URS since Phase I. The complete validated analytical results from the December soil-gas sampling are presented in the DUSR in Appendix N. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

It should be noted that the concentrations of PCE and TCE, when compared to the Phase I round of sampling (June 2007), were consistently lower during the December 2007 sampling event, in some cases by an order of magnitude.

4.1.1 PCE Soil-Gas Detections

In the southern portion of the site investigation area (i.e., south of Meeker Avenue) along Vandervoort Avenue and Beadel Street between Lombardy Street and Division Place, PCE was detected at concentrations ranging from 1.2 micrograms per cubic meter ($\mu g/m^3$) to 310,000 $\mu g/m^3$. The highest concentrations were found at locations SG-023 (5,100 $\mu g/m^3$), SG-048 (5,400 $\mu g/m^3$), SG-043 (6,800 $\mu g/m^3$), and SG-049 (310,000 $\mu g/m^3$) as shown on Figure 17. SG-049, located at the southwest corner of the intersection of Richardson Street and Vandervoort Avenue, appears to be located at or near a potential source of contamination, which is the dry cleaner located in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. The soil-gas concentrations of PCE decrease in a northward direction from SG-049 and appears to mimic groundwater flow. The PCE concentrations at locations SG-043 and SG-023 and at SG-038 suggest

additional sources of soil-gas contamination, based on the significant increase in concentration when compared to up-gradient (south) soil-gas locations. SG-043 is located at the southwest corner of the Beadel Street and Vandervoort Avenue intersection and is adjacent to a former metal working facility. SG-023 is on the north side of Beadel Street approximately 100 feet west of SG-043. A dry cleaner and rug cleaner were also located in the buildings in the block bound by Beadel Street and Division Place between Vandervoort and Morgan Avenues. SG-038 is located on the west side of Vandervoort Avenue midway between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. Figure 18 depicts the Phase II PCE soil-gas results with the results of the updated historical record review that was performed prior to the Phase II investigation.

In the northern portion of the site investigation area (i.e., north of Meeker Avenue), PCE contamination was centered around locations SG-008 and SG-027 (150 and 270 $\mu g/m^3$, respectively). SG-008 is located adjacent to a former metal working facility and research lab. Both locations are southeast of a former dry cleaner identified on the Sanborn maps, located on the southwest side of the Kingsland and Norman Avenues intersection.

4.1.2 TCE Soil-Gas Detections

TCE was detected in the same general areas where PCE was found, as shown on Figure 19. Concentrations ranged from 0.38 $\mu g/m^3$ to 19,000 $\mu g/m^3$, with the highest concentration at SG-049 (19,000 $\mu g/m^3$), located at the southwest corner of the Richardson Street and Vandervoort Avenue intersection. SG-049 also had the highest PCE concentration of the soil-gas samples collected. The soil-gas concentrations of TCE decrease in a northward direction from SG-049 and appear to mimic groundwater flow. The concentration at location SG-038 suggests the presence of separate source of soil-gas contamination due to the significant increase in the concentration at this location in comparison to up-gradient soil-gas locations. In addition, the concentration of TCE is significantly higher than that of PCE at this location, which also suggests a source, and not the result of the PCE degradation. Figure 20 depicts the Phase II TCE soil-gas results with the results of the updated historical record review that was performed prior to the Phase II investigation.

In the northern portion of the site investigation area, the highest concentration of TCE contamination was centered around locations SG-007 and SG-027 (380 and 240 µg/m^3, respectively). Both locations are found southeast of a former dry cleaner identified on the Sanborn maps at the southwest side of the Kingsland and Norman Avenues intersection.

4.1.3 PCE Degradation Product Soil- Gas Detections

The presence of PCE and TCE degradation products has also been detected in the soil-gas samples. Both cis-1,2-dichloroethene (cis-1,2 DCE) and trans-1,2-dichloroethene (trans-1,2-DCE) have been detected in the soil-gas samples. Concentrations of cis-1,2-DCE ranged from 0.28 µg/m^3 to 39,000 µg/m^3, with the highest concentration at SG-049. Concentrations of trans -1,2-DCE ranged from 0.48 µg/m^3 to 790 µg/m^3, with the highest concentration also at SG-049. Vinyl chloride has also been detected in the soil-gas samples, concentrations ranged from 1.1µg/m^3 to 180 µg/m^3, with the highest concentration at SG-016. SG-016 is located on the north side of Beadel Street between Morgan and Vandervoort Avenues and is north of a former dry cleaner that was located on Morgan Avenue between Beadel Street and Division Place.

4.1.4 Additional Chlorinated Hydrocarbon Soil-Gas Detections

1,1,1-Trichloroethane (1,1,1-TCA), which is not a degradation product of PCE or TCE, was detected in a significant number of samples, with concentrations ranging from 6,600 µg/m^3 to 0.33 µg/m^3. The highest concentrations were centered along Vandervoort Avenue between Lombardy and Beadle Streets at locations SG-023 (1,000µg/m^3), SG-022 (2,800µg/m^3), SG-042 (3,000µg/m^3), and SG-040 (6,600 µg/m^3). A former drum storage area and a current scrap metal recycling facility is located on the southeast corner of the intersection of Vandervoort Avenue and Lombardy Street. No significant levels of 1,1,1-TCA in soil-gas were found in the northern portion of the site investigation area.

1,1-Dichloroethane (1,1-DCA), which is a degradation product associated with PCE, TCE, and 1,1,1-TCA was detected in a significant number of samples, with concentrations ranging from 0.24 µg/m^3 to 2,000 µg/m^3. 1,1-DCA is also used as a solvent and degreaser. The highest

concentration of 1,1-DCA was found at location SG-040 (2,000 µg/m^3), which is adjacent to the drum storage area at the southeast intersection of Vandervoort Avenue and Lombardy Street. Location SG-040 also had a high concentration of cis-1,2-DCE (2,700 µg/m^3) in comparison to the PCE and TCE levels (76 and 350 µg/m^3, respectively), while 1,1,1-TCA was not detected. No significant levels of 1,1-DCA in soil-gas were found in the northern portion of the site investigation area.

4.2 Soil Analytical Results

The soil sample results were compared to Technical and Administrative Guidance Memorandum (TAGM) #4046, *Determination of Soil Cleanup Objectives and Cleanup Levels* (January 24, 1994). A summary of the detected TCL VOCs in the soil samples is presented in Table 6 with results exceeding TAGM 4046 criteria indicated with a circle. Table 7 provides a historical summary of the detected parameters for all soil samples collected by URS since Phase I. Table 8 provides a statistical summary of the detected parameters for both the Phase I and Phase II sampling events as follows: the number of detections; the minimum, maximum and average values; and the location and depth of the maximum value. The complete validated analytical results from the Phase II soil samples are presented in the DUSR in Appendix N. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

The only soil sample from the Phase II sampling that had detections exceeding TAGM 4046 criteria was from location SB-08, which is located at the northeast corner of the building located on 72-86 Anthony Street between Porter and Varick Avenues, as shown in Figure 21. A total of three soil samples [3-4, 9-10 and 17-18 feet bgs) were taken from the SB-08 location, however only the sample from 3-4 feet bgs contained compounds that exceeded criteria. Five VOCs were detected above their respective criteria: ethylbenzene [5.6 milligrams per kilogram (mg/kg)], isopropylbenzene (9.8 mg/kg), PCE (130 mg/kg), TCE (0.79 mg/kg) and, xylene (280 mg/kg). For the building located at 72-86 Anthony Street, a brass foundry was identified at that location until the 1992 Sanborn maps, and a junkyard occupies the property on the north side of Anthony Street (111 Anthony Street).

Also shown on Figure 21 are results for sample location DEC-016 collected during Phase I fieldwork. DEC-016 is located approximately 20 feet to the west of SB-08 and contained 220 mg/kg

of PCE in the 5-6 foot bgs sample. Three additional samples collected from DEC-016 (21-22, 37-38, and 52-53 feet bgs) had detections for PCE, but none that exceeded criteria. Based on the results from locations DEC-016 and SB-08, there appears to be a shallow source of adversely impacted soil in the vicinity of the northeast corner of the building located at 72-86 Anthony Street. This soil may be providing a continuing source impacting groundwater found in DEC-016.

4.3 Direct-Push Groundwater Analytical Results

A summary of the detected TCL VOCs in the direct-push groundwater (i.e., 'GW-' prefix) samples is presented in Table 9 with results exceeding Division of Water Technical and Operational Guidance Series (TOGS) No. 1.1.1 Class GA groundwater criteria indicated with a circle. The locations of detected VOCs that have exceeded their respective criteria are shown on Figure 22. Isoconcentration contours of PCE and TCE in the direct-push groundwater samples are shown on Figures 23 and 24, respectively. Table 10 provides a statistical summary of the detected parameters for the direct-push groundwater samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the direct-push groundwater samples are presented in the DUSR in Appendix N. The Form Is and data summary tables provided in the DUSR include the reporting limit for each non-detected compound.

4.3.1 Direct-Push Groundwater PCE Detections

PCE was detected in the direct-push groundwater samples with concentrations exceeding groundwater criteria at 12 of the 14 direct-push groundwater locations. The detected concentrations ranged from 2.5 micrograms per liter (µg/L) to 4,800 µg/L. The highest concentrations were centered along Varick Avenue between Anthony and Lombardy Streets at locations GW-08 (4,800 µg/L) and GW-10 (3,000 µg/L). Both GW-08 and GW-10 are located downgradient of DEC-018, which was suspected to be near a source of contamination during the Phase I investigation. DEC-018 is located adjacent to a former lacquer storage/soap manufacturer, which is at the northeast corner of the Varick Avenue and Lombardy Street intersection. Based on the direct-push sample results, the concentration of PCE in the groundwater immediately downgradient of DEC-018 (i.e., GW-10 and DEC-08) is two orders of magnitude greater than those upgradient of DEC-018 (i.e., GW-12, GW-13, GW-14, and

GW-15), which suggests the source of the PCE in the groundwater in the vicinity of DEC-018 is from the former lacquer storage/soap manufacturer. The concentrations of PCE in the groundwater decrease to the north and northeast. The pattern of the PCE plume in the groundwater may reflect the influence of the Off-Site Recovery system on the potentiometric surface.

4.3.2 Direct-Push Groundwater TCE Detections

TCE was detected at concentrations exceeding groundwater criteria at 11 of the 14 direct-push groundwater locations. Concentrations ranged from 2.5 µg/L to 200 µg/L. The highest concentrations were centered along Varick Avenue between Cherry and Lombardy Streets at locations GW-01 (130 µg/L), GW-08 (200 µg/L) and GW-10 (100 µg/L). Based on the direct-push sample results, the concentration of TCE in the groundwater immediately downgradient of DEC-018 (i.e., GW-10 and DEC-08) is one order of magnitude greater than those upgradient of DEC-018 (i.e., GW-12, GW-13, GW-14, and GW-15). The concentrations of TCE in the groundwater decrease to the north and northeast of DEC-018 and may be related to PCE degradation. The pattern of the TCE plume in the groundwater may reflect the influence of the Off-Site Recovery system on the potentiometric surface.

4.3.3 Direct-Push Groundwater Chlorinated Hydrocarbon Degradation Product Detections

PCE/TCE degradation products have also been detected in the direct-push groundwater samples. Concentrations ranged from a high of 250 µg/L of cis-1,2-DCE at GW-03 to a low of 1.3 µg/L of 1,1-dichloroethene at GW-08. Concentrations of these compounds suggest their presence is directly related to chemical degradation.

4.4 Groundwater Analytical Results

A summary of the detected TCL VOCs in the Phase II groundwater samples collected from monitoring wells is presented in Table 11 with results exceeding TOGS No. 1.1.1 Class GA groundwater criteria indicated with a circle. The locations of detected VOCs that have exceeded their

respective criteria are shown on Figure 25. Isoconcentration contours of PCE and TCE in the Phase II groundwater samples are shown on Figures 26 and 28, respectively. Table 12 provides a statistical summary of the detected parameters for the Phase II groundwater samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. Table 13 provides a historical summary of the detected parameters for all groundwater samples collected by URS since Phase I. Table 14 provides a statistical summary of the detected parameters for all groundwater samples collected during Phases I and II. The complete validated analytical results from the Phase II groundwater samples are presented in the DUSR in Appendix N. The Form Is and data summary tables provided in the DUSR including the reporting limit for each non-detected compound.

4.4.1 Groundwater PCE Detections

PCE was detected in 32 of the 44 groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 1.5 µg/L to 39,000 µg/L (Figure 26). In the southern portion of the site investigation area (i.e., south of Meeker Avenue), the highest concentrations of PCE were detected at DEC-031 (33,000 µg/L), DEC-013 (7,800 µg/L), DEC-029 (7,200 µg/L), DEC-018 (7,000 µg/L), DEC-016 (6,100 µg/L), DEC-014 (5,900 µg/L), and DEC-30 (4,400 µg/L). DEC-031, which is located at the southwest corner of Vandervoort Avenue and Richardson Street, is adjacent to a former dry cleaner and printing plate manufacturer. Based on the sample results, the concentration of PCE in the groundwater downgradient of DEC-031 (i.e., DEC-014 and DEC-030) is two to three orders of magnitude greater than those upgradient and side gradient of DEC-031 (i.e., DEC-032 and DEC-033). This suggests the source of the PCE in the groundwater is near DEC-031. The concentrations of PCE in the groundwater decrease to the north and northeast of DEC-031. Based on the PCE isoconcentration contours, DEC-016, located on Anthony Street between Porter and Varick Avenues adjacent to a former brass foundry and DEC-018, located on the north east corner of the intersection of Varick Avenue and Lombardy Streets adjacent to a former lacquer storage and soap manufacturer, do not appear to be associated with the source near DEC-031. DEC-016 and adjacent sample SB-08 were the locations with high concentrations of PCE detected in soil (see Figure 21). DEC-018 and DEC-016 appear to be near one or more sources of PCE with concentrations decreasing to the north and northeast (see Section 4.3.1). Figure 27

depicts the Phase II PCE groundwater results with the results of the historical record review that was performed during the Phase I investigation.

In the northern portion of the site investigation area, PCE contamination was centered around DEC-024, which had a concentration of 39,000 µg/L. DEC-024 is located adjacent to a former dry cleaner that was located on the southwest corner of Kingsland and Norman Avenues. Based on the sample results, the concentration of PCE in the groundwater downgradient of DEC-024 (i.e., DEC-025 and DEC-003) is one to two orders of magnitude greater than those upgradient /side gradient of DEC-024 (i.e., DEC-023), which suggests the source of the PCE in the groundwater is near DEC-024.

4.4.2 Groundwater TCE Detections

TCE was detected in 33 of the 44 groundwater samples collected, at concentrations exceeding groundwater criteria, with concentrations ranging from 1.4 µg/L to 66,000 µg/L (Figures 28). In the southern portion of the site investigation area, the highest concentrations of TCE were detected at DEC-005 (66,000 µg/L) and DEC-018 (1,800 µg/L). The concentrations of TCE at location DEC-005 suggests the presence of an additional source of contamination due to the significant increase in the concentrations at this point when compared to well locations upgradient from this point (DEC-004, DEC-027, DEC-008). In addition, the concentration of TCE is four orders of magnitude higher than the reporting limit of PCE at this location (PCE was not detected at this location), which may also indicate TCE is from a potential source, and not the result of PCE degradation. As noted with the direct push groundwater results (Section 4.3.2), the concentration of TCE in relation to the PCE concentration found at DEC-018 is indicative of PCE degradation at this location and not a separate source. Figure 29 depicts the Phase II TCE groundwater results with the results of the historical record review that was performed during the Phase I investigation.

In the northern portion of the site investigation area, TCE contamination was centered around DEC-024, located on Kingsland Avenue, just south of Norman Avenue, with a concentration of 500 µg/L. Concentrations of TCE decrease to the east, which mimics groundwater flow. The concentration of TCE in relation to the PCE concentration at DEC-024 and downgradient wells is indicative of PCE degradation and not a separate source.

4.4.3 Groundwater PCE Degradation Product Detections

The presence of PCE and TCE degradation products has also been detected in the Phase II groundwater samples. Cis-1,2-DCE has been detected in 27 of the 44 Phase II groundwater samples. Concentrations of cis-1,2-DCE ranged from 7.3 µg/L to 1,200 µg/L, with the highest concentration at DEC-005. Vinyl Chloride was detected in five Phase II groundwater samples with concentrations ranging from 7.8 µg/L to 40 µg/L. The highest concentration of vinyl chloride was detected at DEC-024.

4.4.4 Additional Chlorinated Hydrocarbon in Groundwater Detections

1,1,1-TCA, which is not a degradation product of PCE or TCE, was only detected in one groundwater sample with concentration of 46 µg/L, at DEC-016, located on Anthony Street between Porter and Varick Avenues. This location is approximately 700 feet northeast of SG-040, which is the location where the highest concentration of 1,1,1-TCA was found in soil gas. SG-040 is located near the southeast intersection of Vandervoort Avenue and Lombardy Street, near a former drum storage area and a current scrap metal recycling facility. No 1,1,1-TCA in soil-gas was detected in the northern portion of the site investigation area.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of this Phase of the investigation, the following conclusions are provided:

Soil-Gas

Based on the data gathered during the Phase I and Phase II investigations, the soil-gas at the site has adversely been impacted by chlorinated solvents. There appears to be five potential source areas within the site boundary. The horizontal extent of impacted soil-gas has not fully been determined at three of the five potential source areas. The soil-gas plumes in the area south of Meeker Avenue have coalesced however, the individual potential sources are apparent. The five potential sources are discussed below, as are any potential data gaps.

- Soil-gas samples from north of Meeker Avenue indicate that PCE and TCE have impacted soil-gas quality at most locations sampled, with the highest concentrations found in the vicinities of SG-007 and SG-027. SG-027 is approximately 150 feet southeast of a former dry cleaner located on the southwest corner of Kingsland and Norman Avenues. SG-007 is located approximately 300 feet south of a former metal working facility and research lab that was located on Sutton Avenue between Norman and Nassau Avenues. The south to southwest portion of the impacted soil-gas plume has not been delineated. An attempt was made during both Phase I and Phase II to determine the south to southwest extent however, attempts to obtain samples from SG-012, SG-013, SG-028 and SG–029 were unsuccessful presumably due to the presence of clayey silt in the subsurface. It should be noted that additional soil-gas points were installed at SG-012 and SG–013 (SG-012B and SG–013B) during Phase II in an unsuccessful attempt to obtain soil-gas samples from these locations.

- To the south of Meeker Avenue, soil-gas sample SG-038 indicates a potential source of PCE and TCE near this location. SG-038 is found on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. The concentrations at location SG-038 may indicate the

presence of an additional potential source of soil-gas contamination due to the significant increase in the concentrations at this point when compared to soil-gas locations upgradient from this point. In addition, the concentration of TCE is significantly higher than that of PCE at this location, which may also indicate a potential source, and not the result of PCE degradation. To the north, concentrations decrease. The eastern portion of the impacted soil-gas plume has not been delineated. This plume is at the northern extent of the soil-gas plume identified south of Meeker Avenue.

- Results from soil-gas sample SG-042 indicate a potential source of 1,1,1-TCA and 1,1-DCA near this location. SG-042 is found on the east side of Vandervoort Avenue between Lombardy and Beadel Streets and is located adjacent to a former drum storage area and current metal recycling facility. SG-042 appears to be at the center of the1,1,1-TCA and 1,1-DCA plume. The extent of the 1,1,1-TCA and 1,1-DCA has been delineated within the area of Vandervoort Avenue between Lombardy and Beadel Streets. This plume is at the center of the soil-gas plume identified south of Meeker Avenue.

- Results from soil-gas sample SG-049 indicate a potential source of PCE and TCE near this location. SG-049 is found on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street and is located next to a former dry cleaner that was found in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. SG-049 appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast. The southern, eastern, and western extent of the plume originating near SG-049 has not been delineated. This plume is at the southern extent of the soil-gas plume identified south of Meeker Avenue.

- Results from soil-gas sample SG-043 indicate a potential source of PCE and TCE near this location. SG-043 is found on the southwest corner of the intersection of Vandervoort Avenue and Beadel Street and is located next to a former dry cleaner that was found in the block bound by Beadel Street and Division Place between Morgan and Vandervoort Avenues. SG-043 appears to be located at or near a potential source of contamination, due to the significant increase in the concentrations at these points when compared to soil-gas locations upgradient from these points. This plume is at the center of the soil-gas plume identified south of Meeker Avenue and appears to have merged

with the plume originating from near SG-049. The extent of this plume appears to be delineated.

Soils

Based on the data gathered during the Phase I and Phase II investigations, the soil at the site has adversely been impacted by chlorinated solvents at only one location. Based on the results from DEC-016 and SB-08, there appears to be a shallow source of impacted soil in the vicinity of the northeast corner of the building located at 86 Anthony Street. The impacted soil may be adversely impacting the groundwater in the vicinity of DEC-016. The horizontal extent of impacted soil has not fully been determined, however the shallow source appears to be within the northeast corner of the building and on the property adjacent to the northeast corner building.

Groundwater

Based on the data gathered during the Phase I and Phase II investigations, the groundwater at the site has adversely been impacted by dissolved phase chlorinated solvents. There appears to be five potential source areas within the site boundary. The horizontal extent of impacted groundwater has not fully been determined at four of the five potential sources. The vertical extent of impacted groundwater has not been investigated at this time. The five potential sources are discussed below, as are the potential data gaps.

- Groundwater samples from north of Meeker Avenue indicate that groundwater has been impacted by PCE and TCE. A potential source appears to be near DEC-024. DEC-024 is adjacent to a former dry cleaner that was located on the southwest corner of Kingsland and Norman Avenues. The southern, eastern, and western extent of the plume originating near DEC-024 has not been delineated. In addition, the vertical extent of impacted groundwater near DEC-024 has not been assessed.
- To the south of Meeker Avenue, groundwater samples indicate a potential source of PCE and TCE is near DEC-018. DEC-018 is located on the north east corner of the intersection of Varick Avenue and Lombardy Street, adjacent to a former lacquer storage and soap manufacturer. Phased II direct-push groundwater samples have partially

delineated the extent of impacted groundwater found in the vicinity of DEC-018. The concentration of PCE in the groundwater immediately downgradient of DEC-018 is two orders of magnitude greater than those upgradient of DEC-018, which may indicate the source of the PCE in the groundwater is near DEC-018. The concentrations of PCE in the groundwater decrease to the north and northeast. The northern extent of impacted groundwater associated with DEC-018 appears to be moving north beneath the BQE and into the Off-Site Plume Area. The western extent of the impacted groundwater associated with DEC-018 appears to extend approximately 150 feet west of DEC-017 (Figure 23). The eastern extent of impacted groundwater associated with DEC-018 has not been delineated. The vertical extent of impacted groundwater near DEC-018 has not been assessed.

- Groundwater samples indicate a potential source of PCE is near DEC-016. DEC-016 is located near the northeast corner of the building located at 86 Anthony Street. Phase II direct-push groundwater samples have partially delineated the extent of impacted groundwater found in the vicinity of DEC-016. The southern extent of impacted groundwater associated with DEC-016 has not been delineated. The vertical extent of impacted groundwater near DEC-016 has not been assessed.

- Groundwater samples indicate a potential source of TCE is near DEC-005. DEC-005 is located on the east side of Vandervoort Avenue between Anthony and Lombardy Streets and is located adjacent to a former and current metal working facility. The horizontal extent of the TCE in the vicinity of DEC-005 appears to have been delineated (Figure 28). The vertical extent of impacted groundwater near DEC-005 has not been assessed.

- Groundwater samples indicate a potential source of PCE is near DEC-031. DEC-031 is located on the southwest corner of the intersection of Vandervoort Avenue and Richardson Street and is located next to a former dry cleaner that was found in the block bound by Richardson and Frost Streets between Morgan and Vandervoort Avenues. DEC-031 appears to be located at or near a potential source of contamination, with concentrations decreasing to the north and northeast. The northeastern, southwestern, and eastern extent of impacted groundwater associated with DEC-031 has not been delineated. The vertical extent of impacted groundwater near DEC-031 has not been assessed.

The following recommendations are offered for consideration by the Department:

- URS will submit Freedom of Information Law (FOIL) requests to the Fire Department of New York, New York City Building Department, New York City Department of Environmental Protection for records on suspected sources. A separate FOIL request will be submitted for each suspected source address to each of these agencies.

Soil-Gas

- Additional soil-gas conduits should be installed at the locations shown on Figure 30 during Phase III fieldwork. The additional soil-gas points will fill existing data gaps (as discussed above) and further delineate the horizontal extent of impacted soil-gas that has not been determined at three of the five potential sources.

- Collect soil-gas samples only from newly installed Phase III soil-gas locations, since the primary use of the data is to delineate extent.

Direct Push Soil Borings

- Based on the Phase II groundwater sample results from monitoring well location DEC-031 and the PID reading from the split-spoon samples collected in the associated boring, direct-push borings should be advanced in the vicinity of the former dry cleaner to locate and delineate the horizontal and vertical extent of PCE impacted subsurface soil. The direct-push borings should be advanced to approximately 35 feet bgs or sampler refusal. Up to two soil samples will be collected from each boring, with one soil sample collected from the interval just above water table or sampler refusal, and the second sample 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 water table or sampler refusal will be collected. The samples will be analyzed for TCL VOCs plus TICs by USEPA SW846 Method 8260B. The proposed direct-push boring locations are shown on Figure 30.

- An expedited 2-week turn-around-time will be requested for the direct-push soil sample results. The new data along with the historical data will be evaluated by the NYSDEC Project Manager and the URS Project Geologist to determine if placement of any additional monitoring wells and/or soil-gas conduits are necessary during the Phase III fieldwork.

Direct-Push Groundwater Points

- Based on the Phase II direct-push groundwater sample results, the eastern extent of contaminated groundwater associated with DEC-018 has not been delineated. Additional direct-push groundwater sample locations may aid in the delineation of PCE and TCE impacted groundwater in this area and will provide information for future monitoring well placement. The proposed direct-push groundwater sample locations are shown on Figure 31.

- An expedited 2-week turn-around-time will be requested for the direct-push groundwater sample results. The new data along with the historical data will be evaluated by the NYSDEC Project Manager and the URS Project Geologist to determine if placement of any additional monitoring wells and/or soil-gas conduits are necessary during the Phase III fieldwork.

Monitoring Wells

- Additional water table (shallow) monitoring wells should be installed at the locations shown on Figure 31 to fill existing data gaps (as discussed above) and further delineate the horizontal extent of impacted groundwater that has not been determined at four of the five potential sources. Additional Phase III monitoring well locations may be recommended based on the expedited direct-push soil and groundwater sample results. Any additional monitoring well locations will require approval from the NYSDEC Project Manager prior to their installation.
- Deep monitoring wells should be installed adjacent to DEC-003 and DEC-006 to determine if the groundwater encountered in these wells are perched or represents the true potentiometric surface. A review of the geologic logs of these wells and the wells

surrounding them suggest that these wells may not be representative of the true groundwater surface and thus are providing false negative type data. DEC-003 is located to the southeast of DEC-024 near a TCE plume. The installation of a deep monitoring well at DEC-003 will assist in determining the horizontal extent of the impacted groundwater and may assist in the origin of PCE and TCE in SG-007 and SG-008. DEC-006 is located along the northeast axis of the PCE plume originating from DEC-031. The installation of a deep monitoring well at DEC-006 will assist in determining the horizontal extent of the impacted groundwater. Split spoon samples will be collected continuously from the bottom of the existing borings to ten feet below the bottom of a less permeable unit (i.e., till and or clay/silt unit). The wells will be constructed with a 10-foot screen, which will be set immediately below the bottom of the less permeable unit. The proposed monitoring well locations are shown on Figure 31.

- Deep monitoring wells should be installed adjacent to DEC-005, DEC-016, DEC-018, DEC-024 and DEC-031 to assess the vertical extent of impacted groundwater at these locations. The deep wells should be advanced approximately 35 feet below the bottom of the existing well at each location or to the top of a less permeable unit (i.e., till and or clay/silt unit). Split spoon samples will be collected continuously from the bottom of the existing borings to approximately 35 feet below the bottom of the existing well at each location or to the top of a less permeable unit. The wells will be constructed with a 10-foot screen. The proposed monitoring well locations are shown on Figure 31.

- Exxon/Mobil wells MW-081, MW-083 and MW-085 will be added to the Phase III groundwater sampling event. These monitoring wells are located side gradient and down gradient of DEC-024. These wells will assist in delineating the northern extent of the PCE and TCE plumes centered on DEC-024.

- During Phase III groundwater sampling, DEC-022, and possibly DEC-003 and DEC-006, (dependent on findings during well installation) will not be sampled because they represent perched groundwater conditions and thus are not representative of the groundwater quality within the water table aquifer.

- Additionally, groundwater samples should not be collected from the following wells because they have had very low or non-detected concentrations of chlorinated solvents and are outside or at the edges of the identified plume areas: MW-004, MW-014, MW-

018, MW-019, MW-020, DEC-002, DEC-010, DEC-011, DEC-020, DEC-021, and DEC-033.

6.0 REFERENCES

Environmental Planning & Management, Inc. (EPM). January 2006. Draft-Contaminated Material Investigation Findings Report, Kosciuszko Bridge Project, Kings & Queens Counties, New York, P.I. N. X729.77.123

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

New York State Department of Environmental Conservation, Division of Water (NYSDEC). April 2000. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. Technical and Operational Guidance Series (TOGS) No. 1.1.1, Class GA.

New York State Department of Health (NYSDOH). October 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York

Roux Associates, Inc. (Roux). October 14, 2005. Off-Site Soil Vapor Investigation, Phase I & II Report, Greenpoint, Brooklyn, NY

Roux Associates, Inc. (Roux). October 31, 2006. 3d Quarter of 2006 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

Roux Associates, Inc. (Roux). October 31, 2006. 3d Quarter of 2006 Progress Report, Recovery and Containment System, Greenpoint, Brooklyn, New York

Roux Associates, Inc. (Roux). November 10, 2006. Phase IV Soil Vapor Report, Off-Site Commercial/Industrial/Residential Area, Brooklyn, New York

Roux Associates, Inc. (Roux). April 30, 2007. 1st Quarter of 2007 Progress Report, Brooklyn Terminal Free-Product Recovery System, ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Roux Associates, Inc. (Roux). July 30, 2007. 2d Quarter of 2007 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

Roux Associates, Inc. (Roux). October 31, 2007. 3d Quarter of 2007 Progress Report, Off-Site Free-Product Recovery System, Greenpoint, Brooklyn, New York

URS Corporation (URS). April 2007a. Final - Project Management Work Plan (PMWP) and budget estimate.

URS Corporation (URS). April 2007b. Final - Field Activities Plan (FAP)

URS Corporation (URS). October 2007. Final – Site Characterization, Phase I Data Summary Report.