PARCEL 8

QUEENS COUNTY, NEW YORK

Remedial Action Work Plan

NYSDEC BCP Number: C241087

Prepared for:

Queens West Development Corporation

633 Third Avenue

New York, New York 10017

and

Avalon Riverview II, LLC, Avalon Riverview North, LLC & QWDC

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Prepared by:

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&

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FLS Project No. 10011-007-3

SEPTEMBER 2010

CERTIFICATIONS

I, Arnold F. Fleming, am currently a registered professional engineer licensed by the State of New York. I have primary direct responsibility for implementation of the remedial program for the Queens West Parcel 8 Site (NYSDEC BCA Index No. W2-1059-05-0 Site No. C241087).

I certify that this Remedial Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that the Site description presented in this RAWP is identical to the Site descriptions presented in the Brownfield Cleanup Agreement for Parcel 8 and related amendments.

I certify that this plan includes proposed use restrictions, Institutional Controls, Engineering Controls, and plans for all operation and maintenance requirements applicable to the Site and provision for development of an Environmental Easement to be created and recorded pursuant ECL 71-3605. This RAWP requires that all affected local governments, as defined in ECL 71-3603, will be notified that such Easement has been recorded. This RAWP requires that a Site Management Plan must be submitted by the Applicant for the continual and proper operation, maintenance, and monitoring of all Engineering Controls employed at the Site, including the proper maintenance of all remaining monitoring wells, for approval by the Department.

I certify that this RAWP has a plan for transport and disposal of all soil, fill, fluids and other material removed from the property under this Plan, and that all transport and disposal will be performed in accordance with all local, State and Federal laws and requirements. All exported material will be taken to facilities licensed to accept this material in full compliance with all Federal, State and local laws.

I certify that this RAWP has a plan for import of all soils and other material from off-Site and that all activities of this type will be in accordance with all local, State and Federal laws and requirements.

I certify that that this RAWP has a plan for nuisance control during the remediation and all invasive development work, including a dust, odor and vector suppression plan and that such plan is sufficient to control dust, odors and vectors and will prevent nuisances from occurring.

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

NYS Professional Engineer # 050411	Date	Signature

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

FINAL REMEDIAL ACTION WORK PLAN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

List of Acronyms

ADT	Aquifer Drilling and Testing Inc.
AOC	Area of Concern
AKRF	AKRF Engineers, Inc.
AWQS	Division of Water Technical Operational and Guidance Series (TOGS) 1.1.1 Class GA Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
CAMP	Community Air Monitoring Program
C & D	Construction and Demolition
CLASS GA	NYSDEC TOGS 1.1.1 Class GA Ambient Water Quality Standards and Guidance Values
cm	Centimeters
CPP	Citizen Participation Plan
COC	Chain-of-Custody
COC	Certificate of Completion
CSOs	Combined Sewer Outfalls
cy	Cubic yards
(D)	Deep
DER-10	New York State Department of Environmental Protection Draft Technical Guidance for Site Investigation and Remediation, May 2010
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen

DUSR	Data Usability Summary Report
Dup	Duplicate Sample
ERL	Effects Range Low
ERM	Effects Range Medium
ELAP	Environmental Laboratory Accreditation Program
EM	Electromagnetic
Excitation Well	An injection well or well point designed/advanced specifically for the purpose of producing subsurface porosity dilation waves to dispense or disperse treatment amendments or otherwise promote remediation
FER	Final Engineering Report
ft-ag	feet above grade
ft-bg	feet below grade
FLS	Arnold F. Fleming, P.E. & Fleming-Lee Shue, Inc.
GW	Groundwater
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HSA	Hollow Stem Auger
J	Estimated Value
LCS	Laboratory Control Sample
LNAPL	Light Non-aqueous Phase Liquid
LOWESS	Locally weighted scatter plot smoothing
LUW	Environ 2008 Lands Under Water Report
MS	Matrix Spike
MS/MSD	Matrix Spike/Matrix Spike Duplicate

OM & M	Operations Monitoring and Maintenance
ORCA	Oxygen Release Compound Advanced™
OSHA	Occupational Safety and Health Association
ORP	Oxidation Reduction Potential
OVM	Organic Vapor Monitor
NAPL	Non-Aqueous Phase Liquid
ND	Non-Detect
NYSDEC	New York State Department of Environmental Conservation
NYCDEP	New York City Department of Environmental Protection
NYCDOB	New York City Department of Buildings
NYSDOH	New York State Department of Health
NYSDOH-ELAP	New York State Department of Health Environmental Laboratory Approval Program
MW	Monitoring Well
p(50)	50^{th} percentile (median)
p(x)	xth percentile
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethylene
PEL	Permissible Exposure Level
PID	Photoionization Detector
PPBV	Parts Per Billion by Volume
PPMV	Parts Per Million by Volume

QA/QC	Quality Assurance / Quality Control
QWDC	Queens West Development Corporation
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
R	Rejected
RCA	Reinforced Concrete Aggregate
RE	Remedial Engineer
RI	Remedial Investigation
RIR	Remedial Investigation Report
RL	Analytical Reporting Limit(s)
RSCOs	Recommended Soil Cleanup Objectives
S-ISCO™	Surfactant Enhanced *in situ* Chemical Oxidation
SB	Soil Boring
SCOs	Part 375 Commercial Use Soil Cleanup Objectives
sec	Seconds
SG	Soil Gas
(S)	Shallow
SMP	Site Management Plan
SRI	Supplemental Remedial Investigation
SRIWP	Supplemental Remedial Investigation Work Plan
SU	Standard Units
SSDS	Sub-slab Depressurization System
SVOCs	Semi-Volatile Organic Compounds

TAL	Target Analyte List
TAGM 4046	Technical and Administrative Guidance Memorandum 4046
TAGM RSCOs	NYSDEC Technical Assistance Guidance Memorandum 4046 Recommended Soil Cleanup Objectives
TCE	Trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TM	Truck Mounted
TOGS	New York State Department of Environmental Conservation Technical and Operational Guidance Series 1.1.1 Water Quality Standards and Guidelines
TSCA	Toxic Substances Control Act
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
Track 1 – SCOs	NYSDEC Brownfield Cleanup Program Subpart 375-6.8 Track 1 - Unrestricted Use Soil Cleanup Objectives
Track 4 – SCOs	NYSDEC Brownfield Cleanup Program Subpart 375-6.8 Track 4 - Restricted Use Soil Cleanup Objectives
U	Below Detection Limit
USGS	United States Geological Survey
USTs	Underground Storage Tanks
QBD	Queens Borough Datum
QWD	Queens West Development
QWDC	Queens West Development Corporation

RAWP	Remedial Action Work Plan
RCRA	Resource Conservation Recovery Act
µS	Micro siemens
VOCs	Volatile Organic Compounds
Warren Chemical	Warren Chemical Company

EXECUTIVE SUMMARY

Site Description/Physical Setting/Site History

Parcel 8 is adjacent to the East River in the Hunters Point neighborhood of Long Island City, Queens County, New York. The Site fronts the western side of Center Boulevard between 48th Avenue and 47th Road. The Site, once home to numerous industrial and commercial operations, is now vacant and is owned by the Queens West Development Corporation (QWDC), a subsidiary of Empire State Development Corporation. The Site is designated as Block 19, Lot 19 by the New York City Department of Assessment and occupies 0.73 acres (31,799 ft^2). The street address is 4-56 47th Road, Long Island City, New York. A Site Location Map is included as Figure 1. A Site layout and aerial view of Parcel 8 is presented as Figure 2.

Parcel 8 is part of a larger 74-acre shoreline tract of land known as the Queens West Development (QWD) that extends along the East River from Anable Basin on the north to Newtown Creek on the south.

Parcel 8 has been included in the New York State Brownfield Cleanup Program (BCP) as Site No. C241087, subject to a Brownfield Cleanup Agreement (BCA) between Avalon Riverview II LLC and Avalon Riverview North[1] LLC and QWDC, as Volunteer, and the New York State Department of Environmental Conservation (NYSDEC) (Index No. W2-1059-05-03). The Site is surrounded by areas in various states of development, redevelopment and environmental cleanup. A day care center lays along 48th Avenue approximately a half–block away from the Site. Two schools, one across the street along Center Boulevard, about a half-block away from the Site, and another roughly one-half mile from Parcel 8 are in the area. To the east, across Center Boulevard, is Parcel 9, which was impacted by some of the same historical operations that affect Parcel 8. Parcel 9 has since been remediated under BCA (Site No. C241049) and received its Certificate of Completion for Restricted Residential use (Track 4), on December 29, 2006. A residential building has been constructed on Parcel 9 and has been occupied since July 2007.

Future development of Parcel 8 will include a Queensboro Public Library and/or a headquarters for the QWD parks, including the existing Gantry Plaza State Park and Peninsula Park, which border the Site on the south and west, respectively.

Summary of the Remedial Investigation

FLS performed a Remedial Investigation (RI) of Parcel 8 from July 2008 through January 2009. The RI followed an earlier Off-Site Investigation for Site 9, described in a report dated August 26, 2005, prepared by AKRF, as well as the off-Site sampling performed for Stage 2 Operable

[1] Avalon Riverview North, LLC was previously known as, and was listed on the March 30, 2005 BCA as Avalon Riverview III, LLC. The name change was reflected in the Amended BCA dated 3/10/2010.

Units 1 and 2 and Lands Under Water to the north of Site 8 by TRC under the Voluntary Cleanup Program (Sites V00505A, V00505B and V0050C). Based on the findings in the Off-Site Investigation report, FLS prepared a Remedial Investigation Work Plan (RIWP) to complete the investigation of Parcel 8. The Work Plan was approved by the NYSDEC on July 8, 2008.

Components of the RI, detailed in the April 2009 Remedial Investigation Report (RIR) (included as Appendix A), included the following elements:

- Ambient Air Sampling
  - Collection of on-Site and background ambient air samples

- Exploratory Soil Gas Investigation
  - 74 soil gas points installed by Exploration Technologies, Inc. (ETI) to determine location of source material

- Shallow Soil Gas Investigation
  - 11 analytical samples

- Test Pitting Investigation
  - 13 test pits (TP-1 through TP-13) installed to determine shallow soil conditions
  - 27 analytical samples

- Sediment Sampling
  - 3 sediment samples collected from an off-Site East River inlet

- Surface Water Sampling
  - 3 analytical samples

- Soil Boring Investigation
  - 17 soil borings (SBs) installed
  - 70 analytical samples

- Groundwater Investigation
  - 14 monitoring wells (MWs) installed
  - 18 analytical samples
  - Rising head hydraulic conductivity tests performed
  - Tidal influence investigation

RI Findings

The Site contains historic urban fill consisting of brown medium to coarse sands intermixed with concrete, brick and ash, from the ground surface to approximately 7 to 25 ft-bg, followed by brown medium to coarse sands, silts, and clays, to approximately 29 to 30 ft ft-bg, where a heavily consolidated grey silt/till begins. A lens of silt and silty clay occurs over approximately 85 percent of the Site and begins at approximately 15 to 18 ft-bg and ends at approximately 18 to 25 ft-bg. This unit partially separates a shallow groundwater unit (approximately 10 to 20 ft-bg)

and a deeper groundwater unit (approximately 20 to 30 ft ft-bg). Bedrock is anticipated to begin at 30 to 35 ft-bg.

The majority of the contamination consists of a coal tar-derived DNAPL mass sorbed to saturated soils from approximately 10 ft-bg to 22 ft-bg, A smaller portion of the contaminant mass occurs from 24 ft-bg to approximately 30 ft-bg and in the shallow soils from the surface to the water table, approximately 8 to 10 feet-bg. The total contaminant mass was estimated at approximately 74,000 to 100,000 pounds of organic contaminant. Of this, about 99 percent consists of semi-volatile organic compounds (SVOCs). Many of the SVOC concentrations exceed the Part 375 Commercial Soil Cleanup Objectives (SCOs), which are the guidelines proposed for remediation of Parcel 8.[2] Arsenic, lead, copper and PCBs exceeded the Part 375 Commercial SCOs in some shallow soils.

Groundwater is impacted principally by BTEX compounds and naphthalene, concentrations of which are elevated and exceed the TOGS Class GA AWQS. The concentrations are highest closest to the location of the greatest contaminant mass. Groundwater flow on Parcel 8 is primarily to the west and does not appear influenced by tidal conditions to an extent that would affect contaminant migration. Based on the data collected to date, groundwater concentrations of BTEX and naphthalene appear to drop substantially near the downgradient Site boundary. Groundwater along the eastern quarter of Parcel 8 flows eastward toward Center Boulevard. The contamination on Center Blvd. is being addressed under a Voluntary Cleanup Agreement for site no. V00194A.

Soil gas concentrations on Parcel 8 are very low and are not measurable in ambient air using conventional methods near the Site surface, where only ambient air quality is detectable. The ambient air quality on Parcel 8 is the same or slightly better than ambient air in the vicinity.

During the RI, an underground storage tank (UST), metal and concrete debris, and some relict metal piping were observed on Site.

Qualitative Human Health Exposure Assessment

Parcel 8 is completely fenced off and secured from public access. Based on the results of the Qualitative Human Health Exposure Assessment provided in the RIR (Appendix A) the following potential contaminant receptor populations, with a slight, intermittent risk, have been identified:

- School and daycare population
- Off-Site residents/building occupants
- Park employees and visitors

[2] Throughout the document other standards and guidelines are sometimes used for comparison purposes. For example, many of the VOCs, and SVOCs exceed the Part 375 Protection of Groundwater SCOs, but all pesticides, all but one PCB and nearly all metals were below the Protection of Groundwater SCOs.

The RIR addressed potential receptors for Parcel 8 in its current state, leaving potential receptors affected during remediation to be addressed in this RAWP. Based on an analysis of contaminant pathways, exposure to site contaminants may potentially occur via the following pathways:

- Soil Dermal Contact by On-Site Environmental and Construction Workers
- Groundwater Dermal Contact by On-Site Environmental and Construction Workers
- Inhalation of Vapors and Particulates by On-Site Environmental and Construction Workers
- Inhalation of Vapors and Particulates by Off-Site Residents, Building Occupants, Park Users, and Passers-by

These potential exposures are associated with the remediation/construction phase of the redevelopment and are temporary and of limited duration. Worker exposure to contaminated soil and groundwater will be addressed by adherence to health and safety protocols. Potential exposure of neighborhood residents and other offsite populations will be addressed through compliance with the Community Air Monitoring Plan (CAMP) provided in Section 5.4.12 of this RAWP. Potential exposure of future on-site building occupants and maintenance workers performing routine operations will be addressed through implementation of the engineering and institutional controls described below, discussed in greater detail in the Site Management Plan (SMP) that will be implemented as required by an environmental easement to be placed on the property.

Summary of the Remedy

A Track 4 remedy has been selected which will address both the Site contaminants and receptor pathways so that following remediation any remaining contamination will be isolated from contact with the public or Site workers. One of the key objectives is to remove the bulk of the contaminant mass. Remediation will include the following key elements:

1. Excavation of the top four feet of soil over the entire area of the Site. The shallow soil excavation will proceed in the open without an enclosure, although odor suppressant foam will be on hand and will be utilized as needed.

2. Hot Spots of metals and PCBs identified during the RI, as well as grossly contaminated soil observed during soil excavation of the top four feet of soil, will be removed to a depth where endpoint sample meets the Commercial Use SCOs, or to the depth of the water table and/or the maximum depth possible without sheeting or shoring. Soil removal identified in remedial components 1 and 2 will remove approximately 3 percent of the total organic contaminant mass from the Site. The remedial performance goals for shallow soil removal are the Part 375 commercial use SCOs.

   Soils which are not grossly contaminated below approximately 4 ft-bg, and below Hot Spot excavation areas will remain in place.

   Excavation (components 1 and 2) will be completed in lifts or strips so that the existing soil cover will remain in place and minimize exposure of subsurface soils. Only a small portion

will be excavated at a time. The strips will be approximately 10 to 20 feet wide with a length that will accommodate "load and go" removal of soils into trucks. Alternatively, no more than a 60-foot by 60-foot excavation (3,600 ft^2) will be made in any one day so as to accommodate up to 30 trucks per day. In this manner, only soil that can be removed without stockpiling will be excavated. Post excavation samples will be collected for expedited turn around and the results forwarded to the Department for review. If acceptable, clean cover will be placed over the excavation to grade and the next strip will begin. The process will continue until excavation is complete. The clean cover is anticipated to be recycled concrete aggregate currently stockpiled on Stage 3 approximately ¼ mile south of the Site.

3. Screening for indications of gross contamination (by visual means, odor, and monitoring with PID) of all excavated soil during any intrusive Site work.

4. Appropriate off-Site disposal of all material removed from the Site in accordance with all Federal, State and local rules and regulations for handling, transport, and disposal

5. Collection and analysis of end-point samples subsequent to removal of shallow soil, Hot Spots and gross contamination. Endpoint samples will be collected at 4 ft-bg, and along the Site sidewalls and analyzed for VOCs, SVOCs, metals, PCBs, and pesticides/herbicides. In the areas of Hot Spot and gross contamination excavation, endpoint samples will be collected at the bottom of the Hot Spot and/or gross contamination excavation and along the sidewalls of each excavation in accordance with the procedures in DER-10, and similarly analyzed.

6. Import of materials to be used for backfill and cover in compliance with: (1) Part 375-6.7(d) and~~chemical limits and other specifications included in Table [x],~~ (2) all Federal, State and local rules and regulations for handling and transport of material;

7. Installation of a demarcation barrier between the residual soil and approved fill material. Hot Spot and gross contamination excavations will be filled to 4 ft-bg with soils meeting Part 375-6.7(d) prior to installation of the demarcation barrier.

8. Installation of a composite cover system consisting of, at a minimum, 2 feet of clean soil and/or 6 inches of asphalt or concrete.

9. S-ISCO™ will address the bulk of the contaminant source mass. The greater part of the mass occurs from approximately 10 ft-bg to 22 ft-bg, (i.e., the treatment zone) and encompasses about 67 percent of the contaminant mass (67,000 pounds). Combined with the removal of the top four feet of soil and the Hot Spot and gross contamination removal, it is anticipated that approximately 70 percent of the total contaminant mass will be removed or destroyed in place. Additional S-ISCO™ treatment will address deep contamination atop the till layer near the southwest corner of Parcel 8.

10. All activities associated with the remedial action, including permitting requirements, will be conducted in accordance with the applicable Federal, State and local rules and regulations.

11. Recording of an Environmental Easement requiring implementation of engineering and institutional controls described in a Department-approved Site Management Plan to manage residual contamination.

    Publication of a Site Management Plan for long term management of residual contamination, as required by the Environmental Easement, that will: (i) require installation of an active sub-slab depressurization system and vapor barrier for any occupied buildings constructed on the

Site, (ii) detail procedures for future maintenance of engineering controls and management of any residual Site contamination and (iii) address procedures for future Oxygen Release Compound Advanced™ (ORCA) application, if necessary, including monitoring parameters to prevent migration of contaminated groundwater off site. The work sequencing of the remedial elements is as follows:

- In situ subsurface remediation. This phase needs to occur first because injection wells need to be installed and the existing surface soil acts as necessary overburden to well installation and performance. The existing monitoring wells also need to remain in place for monitoring. This phase is expected to begin in the summer.
- Removal of 4 feet of soil over the entire Site and post-excavation sampling. This needs to be done in the cold weather to minimize the potential for odor generation.
- Removal of Hot Spot areas and grossly contaminated soil and post-excavation sampling and addition of approved fill. This needs to be done in the cold weather to minimize the potential for odor generation. Install demarcation barrier.
- Backfill with approved cover material which meets the requirements of Part 375-6.7(d).
- Implementation of Institutional and Engineering Controls.

REMEDIAL ACTION WORK PLAN

1.0 INTRODUCTION

Avalon Riverview II LLC and Avalon Riverview III LLC (collectively, Avalon) entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) in March 2005, to investigate and remediate Parcel 8 a 0.73-acre property located at the western side of Center Boulevard between 48th Avenue and 47th Road in Long Island City, Queens County, New York. On March 11, 2010, the site owner, QWDC was added as a party to the BCA. Avalon and QWDC are Volunteers in the Brownfield Cleanup Program. Commercial use is proposed for the property. When completed, the Site will contain a Queensboro Public Library and/or a park headquarters for Gantry Plaza State Park, Peninsula Park, and other State parks within the QWD. Refer to the Brownfield Cleanup Program (BCP) application for additional details.

This Remedial Action Work Plan (RAWP) summarizes the nature and extent of contamination as determined from data gathered during the RI, performed between June 2008 and January 2009, and information obtained from reports by AKRF, TRC Engineers, Inc. and others from 1985 to 2006. It provides an evaluation of a Track 4 cleanup and other applicable Remedial Action alternatives, their associated costs, and the recommended and preferred remedy. The remedy described in this document is consistent with the procedures defined in DER-10 and complies with all applicable standards, criteria and guidance. The remedy described in this document also complies with all applicable Federal, State and local laws, regulations and requirements. The NYSDEC and New York State Department of Health (NYSDOH) have determined that this Site does pose a significant threat to human health and the environment. The RI for this Site did not identify fish and wildlife resources.

A formal Remedial Design document will not be prepared.

1.1 SITE LOCATION AND DESCRIPTION

The Site is located in the County of Queens, Long Island City, New York and is identified as Block 19 and Lot 19 on the New York City Tax Map. The street address is 4-56 47th Road, Long Island City, New York. A United States Geological Survey (USGS) topographical quadrangle (Figure 1) shows the Site location. The Site is situated on an approximately 0.73-acre area bounded by 47th Road to the north, 48th Avenue to the south, Center Boulevard to the east, and Peninsula Park to the west (see Figure 1). A boundary map is attached to the BCA as required by Environmental Conservation Law (ECL) Title 14 Section 27-1419. The 0.73-acre property is fully described in Appendix B – Metes and Bounds. A global positioning system coordinate for the starting point is included.

1.2 CONTEMPLATED REDEVELOPMENT PLAN

The Remedial Action to be performed under the RAWP is intended to make the Site protective of human health and the environment consistent with the contemplated end use. The proposed redevelopment plan and end use is described here to provide the basis for this assessment. However, the Remedial Action contemplated under this RAWP may be implemented independent of the proposed redevelopment plan.

Site development plans at the time of this report are not yet finalized. However, the contemplated use of Parcel 8 is as a two-story slab-on-grade public library (no basement) with a floor plan of 18,000 ft^2 (Option A) or a library and park ranger headquarters with a floor plan of 30,000 ft^2 (Option B); occupying approximately 50 percent or 90 percent of the Site area, respectively (Appendix C). In either case the library would front Center Boulevard. In the case of Option A the western side of Parcel 8 would remain open as an extension of Peninsula Park. The sketches in Appendix C show the conceptual building footprints and layout. Although uncertain at this time, Option A is most likely.

1.3 DESCRIPTION OF SURROUNDING PROPERTY

There are two schools and a daycare center within a 0.5 mile radius of Parcel 8. These include an elementary school (PS 78) and a daycare (Little Ones), located approximately 300 feet southeast of Parcel 8 in a multi-unit residential building. Another public school lies approximately 0.5 mile east of Parcel 8. Multi-unit residential buildings surround the site to the north, east and southeast. Open space parks are located to the south and west of the site. The area further east and northeast includes park, residential and commercial development. Industrial and manufacturing developments are located northeast and southeast of Parcel 8. A map including the surrounding land uses and sensitive receptors in included as Figure 3.

2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS

The Site was investigated in accordance with the scope of work presented in the NYSDEC-approved Supplemental Remedial Investigation Work Plan (SRIWP) dated July 2008. The investigation was conducted between July 2008 and January 2009. The RIR was submitted to NYSDEC on April 28, 2009. On March 11, 2010, the site owner, Queens West Development Corporation (QWDC) was added as a party to the BCA. Appendix A contains the RIR.

2.1 SUMMARY REMEDIAL INVESTIGATIONS PERFORMED

The following is a summary of work performed on-Site, which is detailed in the Parcel 8 RIR. Appendix A is a CD containing the RIR and its tables, figures, and appendices.

2.1.1 Borings and Wells

Seventeen soil borings (SB-25 through SB-27, SB-29 through SB-38, SB-40, MW-7R, MW-18, and MW-22) were installed on-Site to depths of approximately 29 to 30 ft-bg, to the compact confining layer.

Fourteen monitoring wells (MW-7R, MW-11(D), MW-12(D), MW-13(S), MW-14(S), MW-15(D), MW-16(S), MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, and MW-23) were installed concurrently with soil boring installations with the exception of MW-14(S) and MW-23(S). The wells were installed to characterize both the shallow and deep water-bearing strata and to assess where contaminant impacts were greatest. They were also installed to differentiate between coal tar impacts and impacts attributable to other hydrocarbon-based products.

2.1.2 Test Pit Investigation

Thirteen test pits were excavated to depths of 2 to 5 ft-bg throughout the Site. The purpose behind the test pits was to identify and locate physical objects such as tanks, piping, foundations, and to locate gross contamination. Analytical samples were collected from surface and shallow soils to assess whether these soils pose an unacceptable risk to the public and to characterize them for disposal or capping.

2.1.3 Surface Water Investigation

FLS collected three surface water samples (SW-O, SW-N, and SW-S) for analysis for VOCs, SVOCs, metals, pesticides, and PCBs.

2.1.4 Sediment Investigation

Three sediment cores were advanced 10 feet into the sediment below the river bottom in the inlet bordering Peninsula Park on the south side.

2.1.5 Samples Collected

Two to five grab soil samples were collected from each soil boring (total of 70 samples) at varying depths for laboratory analyses in order to identify and delineate impacts to the soil and to characterize the overall level of contamination throughout the soil column to the confining layer.

Eighteen groundwater samples MW-2, MW-7R, MW-8, MW-9, MW-10, MW-11, (D) MW-12 (D), MW-13 (S), MW-14 (S), MW-15 (D), MW-16 (S), MW-17 (S), MW-18 (D), MW-19 (D), MW-20 (S), MW-21 (S), MW-22 (D), and MW-23 (S), a duplicate sample (DUP1) of MW-11 (D) and a field blank (FIELD BLANK), were collected.

Five test pits were sampled from the northern half of the Site (TP-1, 2, 3, 4 and 5) and five test pits were sampled from the southern half of the Site (TP-7, 8, 9, 10 and 11). Two composite samples were collected from the surface to 2 feet, one from the five northern and one from the five southern test pits. In addition, one discrete sample was taken from TP-5.

FLS collected three surface water samples (SW-O, SW-N, and SW-S) for VOCs, SVOCs, metals, pesticides, and PCBs.

A total of 10 sediment samples were collected. Three samples were collected from each sediment sample core and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) metals, pesticides, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH). One duplicate (D) sample was also collected.

2.1.6 Chemical Analytical Work Performed

The samples were analyzed for TCL VOCs, SVOCs, TAL metals, pesticides, and PCBs. The analytical parameters varied somewhat depending on the sample medium and depth. Appendix A contains complete details of all sampling performed during the RI.

2.1.7 Geophysical Investigation

A geophysical investigation, utilizing ground penetrating radar (GPR), was conducted to locate buried structures, underground storage tanks (USTs), piping, or other subsurface objects associated with former uses of the Site. The geophysical survey identified numerous anomalies that were subsequently investigated during the test pit phase of the investigation (Section 3.3 of the RIR Appendix A).

2.1.8 Tidal Survey

Groundwater in monitoring wells MW-10 (shallow) and MW-19 (deep) and tidal fluctuations in a stilling well in the East River were measured over one lunar cycle (December 9, 2008 to January 13, 2009) to gauge tidal effects on groundwater on Parcel 8.

2.1.9 Rising Head Conductivity Tests

Rising head conductivity tests were performed in all on-Site monitoring wells.

2.1.10 Documentation

Figures 7 and 8 in Appendix A are spider diagrams showing AKRF and FLS sample locations where soil concentrations exceeded the Part 375 Commercial Use SCOs. Table 4 in Appendix A presents the soil boring analytical results.

Figure 12 in Appendix A is a spider diagram showing groundwater concentrations exceeding the TOGSs. Table 8 in Appendix A presents the groundwater analytical results.

Table 3 in Appendix A presents the test pit sample analytical results.

Table 9 in Appendix A presents the surface water sample analytical results.

Table 17 in Appendix A presents the sediment sample analytical results.

Below is a summary of RI findings.

2.2 SIGNIFICANT THREAT

The NYSDEC and NYSDOH have determined that this Site poses a significant threat to human health and the environment. Notice of that determination has been provided for public review. A copy of the notice is included in Appendix D.

2.3 SITE HISTORY

The Site history was developed from several sources including Sanborn maps, historical photographs, previous AKRF and TRC Engineers, Inc. reports, and a detailed history of Long Island City (Seyfried 1984).

2.3.1 Past Uses and Ownership

Historically, Parcel 8 housed mainly chemical manufacturing and processing operations, although in later years Parcel 8 was used for warehousing and equipment storage. On the earliest

Sanborn map (1898), the Site is shown with a solid structure belonging to the Warren Chemical and Manufacturing Company (Warren Chemical), a producer of roofing materials, tar paper and asphalt, and other structures including tanks and storage rooms. This is consistent with Seyfried (1984), who places Warren Chemical's operations at the Site as beginning in 1855. The Site is vacant in the 1915 Sanborn map and the building and structures no longer remain, indicating that operations on Parcel 8 had ceased by this time. On the 1898 map, during Warren's tenure, pumps, tanks, condensers, dryers, steam stills, and storage areas associated with the rendering of coal tar for production of tar paper and asphalt were shown on Site.

The Liquid Carbonic Company, which produced liquefied carbon dioxide for use in soda fountains, occupied the Site from the 1930s until the 1950s. In 1970, the Site was occupied by a metal storage warehouse. Hallen Contractors then occupied the Site from the 1970s until the Site was vacated and all structures demolished in 2001 (AKRF 2005). Currently Parcel 8 is an undeveloped, vacant lot enclosed by a chain-linked fence.

2.3.2 Phase I and Phase II Reports

Phase I reports were not prepared for Parcel 8. Numerous Phase II reports were prepared and are summarized in Section 2.1. The reports consulted include the following:

- AKRF, June 2005., *Supplemental Remedial Investigation Work Plan Parcel 8 and Offsite.* Project Number 10516.

- AKRF, April 2005., *Supplemental Remedial Investigation Report, Queens West Parcel 9.*

- AKRF, June 2005. *Additional Delineation Testing Report,* Queens West Development-Parcel 9, Queens, New York, Project Number 10516.

- AKRF, July 2006. *Off-Site Investigation Report,* Queens West Development-Parcel 9, Queens, New York, Project Number 10516.

- FLS, 2008, *Parcel 8 Supplemental Remedial Investigation Work Plan,* July 2008. Project No. 10011-007-1.

- FLS, 2009. Draft *Parcel 8 remedial Investigation Report,* April 2009. FLS Project No. 10011-007-1.

- TRC Engineers, June 2005. *Operable Units One & Two Remedial Investigation. Report.* Queens West Development – Stage 2, 46-00 5th Street, Long Island City, New York. TRC Project Number 35204-2200-00000.

- TRC Engineers, December 2004. *Supplemental Investigation Report No. 11.* Queens West Development – Stage 2, 46-00 5th Street, Long Island City, New York. TRC Project Number 35204-2010-00000.

2.3.3 Sanborn Maps

The Sanborn Fire Insurance summary included in the July 2008 FLS SRIWP indicated several past uses that are likely sources of the coal tar, petroleum and metals present in soil and groundwater. Included in this report is a review of all available Historic Sanborn Insurance Maps from 1898 to 1996. The maps included the following years: 1898, 1915, 1936, 1947, 1950, 1970, 1977, 1979, 1980, 1985, 1986, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995 and 1996. A Site history obtained from review of the Sanborn maps appears below.

Year	Comments
1898	**Site:** The Site encompasses portions of Block 19, and is bounded by 6th and 7th Streets; the block is bounded to the east by Western Ave. Warren Chemical encompasses the entire Site and includes various structures such as tanks and storage. **Surrounding Properties:** The Site is bounded to the north by 7th Street containing vacant lots and small commercial buildings for N.Y. Mastic Company Work and to the northeast by Cheser Bros Enameled Letters and Signs; to the east by Lawson-Valetine Boiler Works (vacant); to the south by 6th Street and Barber Asphalt Paving, Rail yards and Chase Roberts and Co. Varnish Works; and to the west by the East River. The surrounding properties are predominantly industrial.
1915	**Site:** The Site is vacant. Four structures remain labeled "storage" and all are vacant. **Surrounding Properties:** To the north, N.Y. Mastic Company Work and to the south, Barber Asphalt Paving are no longer present. Additional industrial development occurred on properties to the north and east of the Site. National Varnish Company occupies a property northeast of the Site and Edward Smith Varnish Works, Blau Gas Company of America, and Barber Asphalt occupy properties east of the Site. The Rail yards are shown encompassing the entire block south of the Site. The surrounding properties are predominantly industrial.
1936	**Site:** The Site is occupied by Liquid Carbonic Corp. The buildings associated with the Liquid Carbonic Corp are two large warehouse structures and a smaller storage structure. The surrounding streets have changed names and the Site is now bounded to the north by 47th Rd. (formerly 7th St.), to the south by 48th Ave. (formerly 6th St) and the block bounded to the east by 5th St (formerly Western Ave.) **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1915 Sanborn Map. However, the industrial lot north of the Site is shown occupied by Quimby Corp. and additional factories now occupy properties to the east of the Site. The facilities to the east of the Site are shown as Edward Smith Varnish Works, Harlem Chemical Co., Stanley Barrel Corp., Crest Mfg - Plumber Supplies and Kelly Dry Ginger Ale Corp. The properties south of the Site remain unchanged (Rail yards).

Year	Comments
1947	**Site:** The Site appears unchanged from the 1936 Sanborn Map. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1936 Sanborn Map. However, the properties to the north are shown occupied by Buchman Spark Wheel Mfr., Mfr. of Detergents and Insecticides. The facilities to the east of the Site are shown as Paint and Varnish Works, Chemical Mfg., Refrigeration Equip. Mfr., Crest Mfg - Plumber Supplies and an auto repair shop. The properties south of the Site remain unchanged (Rail yards).
1950	**Site:** The Site appears unchanged from the 1947 Sanborn Map. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1947 Sanborn Map. The properties to the north are shown as occupied by Buchman Spark Wheel Mfr., Mfr. of Detergents and Insecticides. The facilities to the east of the Site are shown as Paint and Varnish Works, Chemical Mfg., Refrigeration Equip. Mfr., Crest Mfg - Plumber Supplies and an auto repair shop. The properties south of the Site remain unchanged (Rail yards).
1970	**Site:** The Site is occupied by a Metal Storage Warehouse and contains three large warehouse type structures and one smaller storage structure. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1950 Sanborn Map. The properties to the north are shown as occupied by Buchman Spark Wheel Mfr., Mfr. of Detergents and Insecticides. The facilities to the east of the Site are shown as Hub Paint Works and Adam Metal Supply. The properties south of the Site remain unchanged (Rail yards).
1977	**Site:** The Site appears unchanged from the 1970 Sanborn map and is occupied by a Metal Storage Warehouse. **Surrounding Properties:** The surrounding properties appear vacant to the east with the exception of the immediate eastern adjacent site shown as Charles Offset Co. Inc. The properties to the north are shown as occupied by Buchman Spark Wheel Mfr., Mfr. of Detergents and Insecticides. The properties south of the Site remain unchanged (Rail yards).
1979	**Site:** The Site appears unchanged from the 1970 Sanborn Map, however the Site is shown as Hallen Contractors. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1977 Sanborn Map.
1980-1989	**Site:** The Site appears unchanged from the 1979 Sanborn Map. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1979 Sanborn Map.
1990-1994	**Site:** The Site appears unchanged from the 1979 Sanborn Map. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1979 Sanborn Map.
1995-1996	**Site:** The Site appears unchanged from the 1979 Sanborn Map. **Surrounding Properties:** The surrounding properties appear generally unchanged from the 1979 Sanborn Map. Charles Offset Co. Inc. borders the site to the east and the properties to the north are shown as occupied by Buchman Spark Wheel Mfr., Mfr. of Detergents and Insecticides. However, the properties to the south are shown as vacant.

All Sanborn Maps available for this Site were reviewed prior to preparation of the RAWP.

2.4 GEOLOGICAL CONDITIONS

LITHOLOGY

Soil boring data collected by AKRF and FLS show that the Site contains historic urban fill, consisting of brown medium to coarse sands intermixed with concrete, brick and ash, from ground surface to predominantly 7 to 13 ft-bg, although it reaches to 19 to 25 ft-bg in a few instances. Underlying the fill are brown medium to coarse sands, silts and clays, to approximately 29 to 35 ft ft-bg, where a heavily consolidated grey silt/till begins. The till lies beneath most of Parcel 8 and typically begins at 28 to 31 ft-bg. The top of bedrock is anticipated to begin at 30 to 35 ft-bg.

A lens of silt and silty clay occurs over approximately 85 percent of Parcel 8, but is not continuous over the entire tract. The silty layer begins at 15 to 18 feet below grade and ends at 18 to 25 feet below grade, although the bottom depth of the unit varies. This unit partially separates an upper surfical groundwater aquifer (approximately 8 to 10 ft-bg to 17 to 24 ft-bg) from a lower groundwater surficial aquifer (approximately 24 ft-bg to 36 ft ft-bg). These lower and upper water-bearing strata were screened as the shallow and deep wells. A geologic cross section is shown in Figure 9 in Appendix A

Of particular importance to non-aqueous phase liquid (NAPL) behavior is the silty clay layer and the increasing bulk density with depth. Bulk density increases from 1.18 g/ml near the water table to 1.57 g/ml near the till layer, an increase of nearly 25 percent. There are several instances where dense non-aqueous phase liquid (DNAPL) is present atop medium to coarse sands, unable to penetrate because of the capillary resistance (SB-26, SB-29, SB-31, SB-32, SB-33, SB-34, SB-35, SB-37, SB-40). NAPL and staining were also observed atop the silty clay lens.

HYDROGEOLOGY

Groundwater occurs in two zones: a shallow zone, extending from the water table at approximately 8 to 10 ft-bg to approximately 17 to 24 ft-bg and a deeper zone, from approximately 24 to 36 ft-bg.

Net groundwater flow in the shallow zone, as expected, is towards the west. Groundwater appears to mound slightly near the center of Parcel 8 and diverges in its westerly flow, with a portion flowing towards the inlets that surround Peninsula Park on the north and south. One component flows northwest toward the Northern Embayment at the end of 47th Road and the other flows southwest towards the Southern Embayment. Groundwater gradients also trend toward the sewer bordering the northern side of Parcel 8 that leads to the 47th Road Outfall. Groundwater in the deeper zone follows the same pattern as the shallow groundwater flow, although there is a greater component of flow towards northwest and there are local deflections in other directions, but the net deep groundwater flow is to the surface water bodies.

The average horizontal hydraulic gradient (based on three rounds of measurements) in the shallow zone is 0.0032 and 0.0035 in the deep zone. While these average gradients are about the same, the gradient measurements were more variable in the deeper zone.

The net vertical hydraulic gradient is downward, from the shallow to the deeper groundwater zone and a downward hydraulic gradient, measured during both low and high tide measurements, was evident in all eight well pairs. The average vertical gradient measured 0.06. The ratio of horizontal to vertical gradient is slightly less than 20 horizontal to 1 vertical.

Hydraulic conductivity, based on slug tests, in the shallow groundwater zone ranged from 3.0 x 10^{-4} cm/sec to 1.7 x 10^{-2} cm/sec and averaged 5.1 x 10^{-3} cm/sec. In the deep groundwater zone this parameter ranged from 2 x 10^{-4} cm/sec to 2.1 x 10^{-3} cm/sec and averaged 8.8 x 10^{-4} cm/sec. On average, hydraulic conductivity in the shallow groundwater zone was approximately 6 times greater than in the deeper zone.

Seepage velocity, using effective porosities for medium and coarse sands of 0.25 to 0.35 ranged from 2.7 x 10^{-6} cm/sec to 2.2 x 10^{-4} cm/sec and averaged 3.4 x 10^{-5} cm/sec in the shallow groundwater zone. In the deeper groundwater zone, seepage velocity ranged from 2.8 x 10^{-6} cm/sec to 2.9 x 10^{-5} cm/sec and averaged 1.1 x 10^{-5} cm/sec. Figure 10 in Appendix A shows the groundwater flow pattern.

2.5 CONTAMINATION CONDITIONS

Contaminant conditions are described in the following sections. Because the Site is small and uniform in contamination, it is regarded as one Area of Concern (AOC).

2.5.1 Conceptual Model of Site Contamination

The majority of on-Site contamination exists between the capillary fringe (approximately 9 ft-bg) to approximately 22 ft-bg beneath the former main operational footprint of Warren Chemical. Some DNAPL exists near the till layer at approximately 30 ft-bg, albeit at a much smaller amount than in the overlying strata.

All of the DNAPL is residual. Numerous attempts to gauge DNAPL accumulation in wells failed to identify measurable NAPL. Visible NAPL occurred in soil borings throughout Parcel 8, mainly in sandy lenses, but the bulk of the contaminant mass is near the contaminant source, the former operational foot print on the southwest and west central part of Parcel 8. This area also corresponds to areas where NAPL thickness is greatest. The DNAPL seems to have remained in the area of the original release, and has not migrated in any direction in any significant quantity.

There is a downward component of groundwater flow and groundwater flows to the west, as expected, but groundwater diverges with a component flowing toward the Northern Embayment (47th Road Inlet) and a component flowing toward the Southern Embayment. Tidal influences, while measurable, do not appear to influence groundwater flow in a way that would affect

contaminant transport. Groundwater along the eastern quarter of Parcel 8 flows eastward toward Center Boulevard.

Dissolved BTEX concentrations are prevalent in both shallow and deep wells, but are, on average, 1.5 times greater in the shallow wells. The highest BTEX groundwater concentrations were identified in the southwest side of Parcel 8. Dissolved naphthalene concentrations are slightly higher in the deeper wells and naphthalene levels are highest along a line running northeast to southwest across Parcel 8, with the highest concentrations predominantly on the southwest and western side of Parcel 8.

The dissolved concentrations of benzene, the most mobile VOC, do not appear to move in the direction of groundwater flow in the shallow zone, although it is difficult to evaluate this on the southwest side because the Site boundary is close to the higher concentrations. Dissolved benzene in the deeper groundwater zone appears to move toward the northwest, based on the decreasing concentration gradient in this direction. However, benzene was not detected in any surface water sample.

Soils on Parcel 8 are impacted by PAHs from the surface to depth. The shallow surface soils contain some debris and PAHs from a combination of the historic waste and the fill that was brought in to grade the land for development. The surface soil also contains a few scattered areas of metals and PCB contamination. Subsequent to Warren Chemical, historic Site operations resulted in scattered small-scale solvent spills that did not impact groundwater or result in elevated soil gas concentrations.

2.5.2 Description of Areas of Concern

Due to the limited size of the Site (0.73 acres) and the prevalence of soil and groundwater impacts across the Site, all of Parcel 8 is considered an AOC. The RI did uncover a number of scattered soil "Hot Spot" areas. Hot Spots are those soil locations where copper, barium, or arsenic, and PCBs exceeded the Commercial Use SCOs in soils below 4 ft-bg.

2.5.3 Identification of Standards, Criteria and Guidance

- **6 NYCRR Part 375-6 Commercial Use Soil Cleanup Objectives (SCOs)**

  These are the SCOs driving Site cleanup. Track 4 cleanup standards are proposed, with Commercial Use SCOs being the principal SCOs. The exception is the contaminants in soil that are also found in groundwater in concentrations exceeding the ambient water quality standards identified below. For those contaminants, the protection of groundwater SCOs will apply. The upper 4+ feet of soil, plus Hot Spots and grossly contaminated soil below that depth to the water table will be excavated, and soils below the water table will be chemically treated. Subsequently, at least two feet of fill, meeting the requirements of Part 375-6.7(d)(1) (the more stringent of the Protection of Groundwater or Protection of Public Health SCOs for Commercial Use), and/or asphalt paving or concrete, will be placed over the entire Site. As such, the Site will be effectively capped and there will be no complete exposure pathways.

The following lists the remedial action standards, criteria and guidance affecting Site cleanup and the applicability of each.

- Remove all soil on Parcel 8 from grade to 4 ft-bg. This aspect of the remedial action will remove a significant portion of Site soils that exceed the Commercial Use SCOs. Bottom and sidewall post-excavation samples will be collected to identify any residual concentrations for future site management.
- Remove Hot Spot areas that exceed the Commercial Use SCOs for copper, barium, or arsenic, and PCBs to the depth of the water table and/or the maximum depth possible without sheeting or shoring. Bottom and sidewall post-excavation samples will be collected to identify any residual concentrations for future site management The size of Hot Spot area excavations will be field determined by endpoint sampling (Refer to Figure 4).
- Remove grossly contaminated soils to the water table and/or the maximum depth possible without sheeting or shoring. While not part of the Part 375-6 Commercial Use SCOs, removal of gross contamination is one of the most preferred measures listed under the hierarchy of source removal and control measures in ECL Section 27-1415.5(a). The size of grossly contaminated soils excavations will be field determined by visual observations (Refer to Figure 4)
- Allow soils from below 4 ft-bg, or, where applicable, below the depth of Hot Spot and grossly contaminated soil excavation, to remain in place. Soils that may remain in place are primarily urban fill containing SVOCs. As noted above, a minimum of 2 or more feet of approved fill (meeting the more stringent of the Groundwater Protection and Protection of Public Health Commercial Use requirements of Part 375-6.7(d)(1)), concrete or asphalt pavement will be placed over all residual soils.
- Treat the interval from the water table (10 ft-bg) to approximately 22 ft-bg, the treatment interval, using surfactant enhanced *in situ* chemical oxidation with a clean-up goal of 90 percent contaminant source mass reduction.

6 NYCRR Parts 700-706 - Water Quality Standards

- **NYSDEC Ambient Water Quality Standards and Guidance Values – TOGS 1.1.1**

  The TOGS ambient water quality standards and guidance values apply to groundwater cleanup on Parcel 8 because these are the sole standards and guidance used to assess groundwater quality and monitor remediation of contaminated sites.

- **NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation – May 2020**

  This document provided the guidance for the RIR and the RAWP.

- 40 CFR Part 144 - Underground Injection Control Program

- Technical Guidance for Screening Contaminated Sediments (January 1999)

- NYSDEC Draft Brownfield Cleanup Program Guide – May 2004;

  The remedial plan presented in this RAWP is consistent with this guidance.

- New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan

  The generic community air monitoring guidelines will be followed during the excavation phases of Site remediation.

- NYS Waste Transporter Permits – 6 NYCRR Part 364;

  Any waste removed from the Site will be managed in a manner that complies with all applicable waste management, handling, and transport regulations.

- NYS Solid Waste Management Requirements – 6 NYCRR Part 360 and Part 364;

  Any waste removed from the Site will be managed in a manner that complies with all applicable waste management, handling, and transport regulations.

2.5.4 Soil/Fill Contamination

This section summarizes the soil sampling analytical results for the Site.

Summary of Soil/Fill Data

VOCs

Soil boring analytical results indicated a single location (SB-29 at 13-15 ft-bg) where the benzene concentration (115,000 ug/kg) exceeded the Commercial Use SCO of 44,000 ug/kg. None of the analytical results for ethylbenzene or toluene in soil exceeded their respective SCOs and only one total xylene result, [QW-SB-15B (16-18') Dup], at 520,000 ug/kg, exceeded the SCO of 500,000 ug/kg. Chlorinated compounds were predominantly ND and in the few instances where they were detected, concentrations were below their respective SCOs.

SVOCs

SVOCs were reported at concentrations above the SCOs in several soil borings at varying depths. The SVOCs reported above the SCOs are the polycyclic aromatic hydrocarbons (PAHs), which are combustion products and typical components of historic urban fill, but are also components of products such as fuel oils, and coal tars.

PAHs above the SCOs were reported in all samples collected from the 2 to 4 ft-bg depth interval, which consists of historic urban fill.
In general, the highest elevated concentrations of PAHs were in soils exhibiting visual indications of NAPL contamination. Soil samples containing elevated concentrations of PAHs largely consisted of medium to coarse sands collected from the depth interval of approximately 12 to 31 ft-bg, within the saturated zone. In particular, soil samples SB-29 (13-15 ft), SB-29 (19-

20 ft), SB-35 (18-20 ft), MW-22 (12-13 ft), MW-22 (17.5-18.5 ft), SB-26 (13-14.5 ft), and SB-26 (19-21 ft), which exhibited visual indications of coal tar, were reported as containing the highest concentrations of PAHs.

Metals

Below 2 ft bg, arsenic exceeded the SCO of 16 mg/kg in four locations: SB-40 (2-4'), 17.5 mg/kg; SB-35 (2-4'), 17.8 mg/kg; MW-22 (12-13'), 24 mg/kg; and QW-SB-7 (7-9'), 19.5 mg/kg. Below 2 ft-bg, copper exceeded the SCO of 270 mg/kg in one location: SB36 (2-4'), at 325 mg/kg. All other toxic metal results were below the SCOs.

PCBs

Total PCB concentrations at depths beneath 2 ft-bg, exceeded the Commercial use SCO of 1,000 ug/kg at one location, SB-31 (2-4') at 55,100 ug/kg.

Pesticides

All pesticide results were below the Commercial Use SCOs.

Appendix J of the RIR provided in Appendix A provides a ranked tabulation of contaminant compounds in soils and fill on Parcel 8.

Comparison of Soil/Fill with SCGs

Refer to Section 2.5.4.1 for a discussion of the analytical results compared to the SCGs. Table A-1 and Figures 7 and 8 in Appendix A show exceedances from Track 1 Unrestricted SCOs for all soil/urban fill at the Site. ~~Figure [x] is a spider map that shows the location and summarizes exceedances from Track 1 Unrestricted SCOs for all soil/fill.~~

2.5.5 On-Site and Off-Site Groundwater Contamination

This section summarizes the groundwater analytical results for the Site. A groundwater flow contour map is presented in Figure 10 in Appendix A.

Summary of Groundwater Data

VOCs

BTEX exceeded the Class GA criteria in groundwater at all but two locations, at MW-10 on the northwest corner, and MW-20 in the northwest quadrant (Figure 10, Appendix A), where benzene was below detection levels. The highest benzene concentrations were detected in well cluster MW-16(S)/MW-9 where benzene was detected at 5,050 µg/L and 1,210 µg/L, respectively, and in well cluster MW-14(S)/MW-22(D), where benzene measured 3,720 µg/L and 1,020 µg/L. BTEX concentrations are highest between approximately 18 and 24 feet below grade. Table 8B in Appendix A summarizes the concentrations of BTEX compounds in

groundwater. VOCs in groundwater above TOGS Class GA AWQS are summarized in the following table.

Summary of VOCs in Groundwater above TOGS Class GA AWQS, ug/L

Sample	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW20(S)	Nd	1.2	11.2	27.7	nd
MW17(S)	8.2	1.1	34.6	39.2	nd
MW19(D)	29.4	50.2	1,050	1,610	nd
MW15(D)	40.2	8.5	675	679	nd
MW13(S)	64.5	46.2	402	730	nd
MW23(S)	140	31.2	714	916	nd
MW12(D)	157	50.4	617	568	17.9
MW11(D)	163	445	1,340	2,380	37.1
MW18(D)	215	23.2	587	569	2.2
MW21(S)	441	115	531	2,310	nd
MW22(D)	1,010	254	1,050	1,720	2.3
MW9 (Deep)	1,210	14,000	1,280	5,120	nd
MW14(S)	3,720	6,150	3,150	11,100	nd
MW16(S)	5,050	9,690	1,260	5,220	nd
MW7R (Deep)	5,120	671	904	2,510	nd
TOGS GA AWQS*	1	5	5	5	10

nd – Below detection limits; * or guidance value

SVOCs

Acenaphthene concentrations ranged from 1 µg/L to 405 µg/L with a median concentration of 227 µg/L. Acenaphthene exceeded the TOGS Class GA criterion of 20 µg/L in all samples except in MW-10. Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(g,h,i)perylene exceeded their TOGS Class GA criterion of 0.002 µg/L in four wells (MW-14[S], MW-16[S], MW-20[S], and MW-23[S]). Chrysene and benzo(a) anthracene each exceeded their TOGS Class GA criterion of 0.002 µg/L in six and eight wells, respectively. Naphthalene concentrations ranged from ND to 17,300 µg/L in MW-11 (D). SVOCs in groundwater above TOGS Class GA AWQS are summarized in the following table.

Summary of SVOCs in Groundwater above TOGS Class GA AWQS, ug/L

Sample	Acenap-hthene	Benzo a anthra-cene	Benzo a pyrene	Benzo-b fluoran-thene	Benzo k-fluorant hene	Chry-sene	Fluor-anthe ne	Fluor-ene	Indeno cd-pyrene	Naph-thalene	Phena n-threne	Pyre-ene
MW7R	89	0.53	Nd	nd	nd	nd	5	44.9	nd	nd	51.2	3.3
MW17(S)	173	0.68	Nd	nd	nd	0.65	10.7	51.3	nd	387	77.1	6.5
MW15(D)	388	0.41	Nd	nd	nd	nd	5.6	47.1	nd	nd	62.8	3.2
MW12(D)	405	nd	Nd	nd	nd	nd	7.2	85.8	nd	nd	99.3	3.6
MW22(D)	127	nd	Nd	nd	nd	nd	2.0	65.7	nd	12,900	36.1	0.91
MW21(S)	173	0.75	Nd	nd	nd	0.65	7.5	80.5	nd	9,400	72.7	5
MW9	166	nd	Nd	nd	nd	nd	3.0	47.4	nd	6,640	38.1	1.2
MW11(D)	383	nd	Nd	nd	nd	nd	6.5	139	nd	17,300	85.3	3.7
MW13(S)	248	nd	Nd	nd	nd	nd	4.8	71	nd	10,300	56.4	2.9
MW18(D)	206	nd	Nd	nd	nd	nd	5.0	40.1	nd	5,640	60.3	2.3
MW23(S)	334	6.8	5.6	4.5	3.7	7.1	34.9	130	2.8	nd	192	27.8
MW20(S)	45.5	27	22.2	15.2	15.7	27.3	62.5	38.6	9.7	486	128	53.1
MW19(D)	299	0.44	Nd	nd	nd	nd	4.5	128	nd	11,200	74.6	3
MW16(S)	155	6.5	5.8	3.6	3	5.5	20.9	84.6	2.7	12,500	92.7	18.1
MW14(S)	187	5	3.7	2.7	2.7	4.4	21.3	81	1.8	12,700	95.2	17.2
TOGS GA AWQS*	20	0.002	nd	0.002	0.002	0.002	50	50	0.002	10	50	50

nd – Below detection limits; * or guidance value

Metals

Arsenic concentrations in onsite wells were below the TOGS criterion of 25 µg/L. However, in offsite well MW 8, arsenic concentrations measured 160 µg/L and 164 µg/L in the unfiltered and filtered samples, respectively. Lead exceeded the TOGS criterion of 25 µg/L in two samples: MW-20(S) and MW-14(S). Lead exceeded the TOGS criterion of 25 µg/L in two samples: MW-20(S), 27.9 µg/L and MW-14(S), 66 µg/L. Manganese exceeded 300 µg/L in several wells.

Comparison of Groundwater with SCGs

Refer to Section 2.5.5.1 for a discussion of the analytical results compared to the SCGs. ~~A table that indicates exceedances from GA groundwater standards in monitor wells prior to the remedy is shown in Table [x]. A spider map that indicates the location(s) of and summarizes exceedances from GA groundwater standards prior to the remedy is shown in Figure [x].~~

2.5.6 Summary of On-Site and Off-Site Soil Vapor Contamination

The results of the soil gas survey conducted as part of the RI indicated that the body of contaminant mass is located in the southeast corner, arcing from the southeast corner to southwest corner and along the western boundary of Parcel 8. The soil gas results are consistent with the results of the soil samples collected from borings.

Benzene concentrations ranged from ND (in two of the 11 samples) to 37.4 parts per billion volume (ppbv) (119.3 ug/m^3). Toluene was detected in 10 of the 11 samples at concentrations ranging from ND to 21.2 ppbv (79.9 ug/m^3). Naphthalene was detected in 2 out of 11 samples, up to a concentration of 3 ppbv (15.7 ug/m^3).

Tetrachloroethylene (PCE) was detected in all samples at concentrations ranging from 1.1 ppbv (7.5 ug/m^3) to 31.9 ppbv (216.3 ug/m^3). It should be noted that PCE concentrations in groundwater at all monitoring well locations were below detection limits. Trichloroethene (TCE) was detected at two locations at concentrations ranging from ND to 5.4 ppbv (29 ug/m^3). Methylene chloride was detected in one sample at a concentration of 4 ppbv (13.9 ug/m^3) .

2.5.6.1 Comparison of Soil Vapor with SCGs

There are no New York State standards for soil gas but the New York State Department of Health (NYSDOH) has developed indoor air guidelines for three of the compounds (methylene chloride, tetrachloroethylene, and trichloroethene) detected in the sub-slab soil gas.

For PCE, all but two samples, I01S (16.1 ppbv, 109.2 ug/m^3) and F04S (31.9 ppbv, 216.4 ug/m^3), were below the NYSDOH PCE indoor air guideline of 14.7 ppbv (99.7 ug/m^3). For TCE, at two locations, G04S (5.4 ppbv, 29 ug/m^3) and H02S (1.1 ppbv, 5.9 ug/m^3), the concentrations were only slightly above the NYSDOH trichloroethene indoor air guideline of 1 ppbv (5.4 ug/m^3). Methylene chloride was below the NYSDOH indoor air guideline of 17.7 ppbv (61.4 ug/m^3). The sole detection most likely represents a potential lab contaminant.

A table of soil vapor data collected prior to the remedy is shown in Table 10, Appendix A. Figure 2, Appendix A, shows the soil gas sampling locations. ~~A spider map that indicates the location(s) of and summarizes soil vapor data prior to the remedy is shown in Figure [x].~~ As a precautionary measure, engineering controls (Section 6) will be included in construction of any structures to be occupied, ensuring that any residual contamination that could yield soil gas will never have a complete exposure pathway to receptors.

2.5.7 Surface Water Sampling

Acetone was detected in surface water collected from the 47th Road Outfall, but was below detection levels in all Parcel 8 wells. Benzene, while detected in all the wells along the northern boundary of Parcel 8, was ND in the outfall sample. The same pattern holds for toluene, ethylbenzene, and total xylenes. Since these are the most soluble components, and groundwater flows toward the sewer line, the inference is that groundwater from Parcel 8 is not having a

material adverse impact on local surface water. Surface water results are included in Table 9, Appendix A. Figure 2, Appendix A, shows the surface water sampling locations.

2.5.8 Sediment Sampling

The sediment samples were collected in the embayment south of Peninsula Park, as shown on Figure 2, Appendix A. Most (90 percent) VOC concentrations were below detection levels (ND). Concentrations of VOCs with measurable concentrations (25 of 252 samples) were comparatively low, ranging from 1.7 ug/kg to 1,250 ug/kg.

PAH concentrations ranged from ND to 136,000 ug/kg. PAH concentrations were generally higher in the 0 – 2-foot interval. This is likely the result of continuous PAH loading from the many combined sewer outfalls along the East River.

Dieldrin, 4,4' DDD, 4,4' DDE, and 4,4' DDT were the most commonly detected pesticides. Concentrations were generally low, ranging from approximately 9 ug/kg to 87 ug/kg.

PCBs were detected at comparatively low levels in all samples, ranging from ND to 2.1 mg/kg.

Individual metals exhibit a comparatively small spread over their respective concentration ranges. The highest concentration of copper was 384 mg/kg and lead was detected at a maximum concentration of 369 mg/kg.

A comparison of the concentrations of VOCs, PAHs, metals, and PCBs in sediment with those of nearby sediment and Parcel 8 compounds demonstrates that contamination from Parcel 8 appears to have no discernable impact on sediment contaminant levels.

Sediment results are included in Table 17, Appendix A.

2.6 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS

2.6.1 Qualitative Human Health Exposure Assessment

The following exposure assessment follows the guidelines of Appendix 3B of the *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2002). NYSDEC and NYSDOH consider an exposure pathway complete and exposure possible when all five of the following criteria exist. If any criterion fails to exist, then there is no exposure pathway. The exposure criteria are as follows:

1. Contaminant source
2. Contaminant release and transport mechanism
3. Point of exposure
4. Route of exposure
5. Receptor population

This qualitative exposure assessment analyzes conditions at the Site in its current state, prior to remediation, as well as conditions following implementation of this RAWP and construction of planned redevelopment activities.

Soil Gas

Under current Site conditions, there is no complete exposure pathway for soil gas. Concentrations of soil gas were below detection limits at the surface of the Site, and ambient air sampling over the Site reflects background ambient air quality. Exposure pathways to the public or trespassers are incomplete because there is no transport and release mechanism and because there is a negligible source of soil gas. Regardless, as a precautionary measure, engineering controls (Section 6) will be included in construction of any structures to be occupied, ensuring that any residual contamination that could yield soil gas will never have a complete exposure pathway to receptors.

Surface Soil (0 – 0.25 feet)

Most PAH compounds in surface soil are below the Commercial Use SCOs. All but one PCB sample result was below the Commercial Use SCO and all metals results except for one mercury result were below the Commercial Use SCOs. All BTEX compounds were below the Commercial Use SCOs in surface soils.[3]

The surface soil represents a low level source of mercury, zinc, and PAHs. The point of exposure is the surrounding area (park, sidewalk, street). The route of exposure is inhalation and dermal contact via fugitive dust. The Site is nearly level and slightly depressed from the surrounding area, so erosion of surface soils to the surrounding area is not a concern.

The potential release and transport mechanisms are wind and airborne transport during dry periods. The surface of Parcel 8 is mostly covered with gravel, compact base material, and vegetation, but there are some bare areas. The bare soil is mostly hard-packed and does not easily yield dust; nevertheless, Parcel 8 is on the East River and this is a windy area. Overall, currently, there is intermittent and low level potential exposure to receptor populations of PAHs and some metals from surface soils.

This exposure pathway will be eliminated in the development scenario as all surface soils to a depth of four feet will be removed and the area covered with approved clean fill and engineering controls described below.

Subsurface Soil

Subsurface soils, those greater than 0.25 feet below grade, contain metals, one area of elevated PCBs, VOCs, and ubiquitous PAHs that exceed the Commercial Use SCOs. Under current Site conditions, these compounds are beneath the surface and isolated from contact with the public

[3] All PCB samples, except for one sample with results modestly over the Restricted Residential SCO, were well below this criterion. All metals results except for some mercury and most zinc samples were below the Unrestricted Residential or Restricted Residential SCOs, and all BTEX results were below the Restricted Residential SCOs in surface soils.

and trespassers because of the overlying soil, gravel, and partial pavement. Other than excavation, there is no release mechanism for exposure, so this is an incomplete exposure pathway, other than for Site remediation workers who will be protected through implementation of a remediation HASP.

This exposure pathway will remain incomplete in the development scenario as contaminated subsurface soils will be removed and/or treated with *in situ* remediation and the area covered with a minimum of two feet of approved clean fill and engineering controls described below.

Surface Water
There is no surface water on Site and groundwater discharges to surface water are within background levels.

Groundwater
Groundwater at the Site contains concentrations of BTEX, SVOCs, and some metals exceeding the TOGS Class GA criteria. Depth to groundwater is approximately 7 to 10 feet below grade and there are no supply wells within six miles of the Site. The area is served by a public water supply that receives its water via aqueducts from upstate reservoirs. Drinking water is monitored regularly at local sampling points. Consequently, the exposure pathway is incomplete for this medium in the current state and in the development scenario.

Significant Receptors in Surrounding Area
The environmental receptors in the vicinity are the park adjacent to Parcel 8 and the East River. A review of the New York City Department of Environmental Protection (NYCDEP) website indicates that the one groundwater well operating in Queens is not in the vicinity of Parcel 8.

The human health receptors in the area are schools, a daycare center, parks and residences. There is one elementary school (PS 78) located within 300 feet of the Site, a daycare (Little Ones) located approximately 300 feet southeast of Parcel 8 in a multi-family building, and a third school located within 0.5 miles northeast of Parcel 8. Multi-family buildings surround the Site to the north, east and southeast, including the 35-story residential building on Parcel 9, directly across Center Boulevard to the east and several new high-rise residential buildings within the southern portion of Stage 2 of the QWD. The area further east includes park, residential and commercial development. Industrial and manufacturing developments are located northeast and southeast of Parcel 8. A map including the surrounding land uses and sensitive receptors in included as Figure 4, Appendix A.

2.6.2 Fish & Wildlife Remedial Impact Analysis

The results of the sediment sampling were compared to the contaminant levels found in adjacent sediments that were sampled as part of an investigation for the adjacent Queens West Development Stage 2 site. The results of this investigation were reported in the *Lands Under Water Report* (LUW) by Environ Corp. 2008 that found "In general, constituent concentrations in surface sediment samples were determined not to pose an ecological concern or were determined not to be elevated, relative to background and regional concentrations."

The *Lands Under Water Report* also concluded that "Given the multiple lines of evidence, the sampling data do not provide evidence of contamination in surface water or sediments in the East River from the Site [QWD Stage 2] that would warrant further action." The report's analysis and conclusions were accepted by NYSDEC, and on that basis, the VCP site Volunteers, East Coast Entities 3, LLC, East Coast Entities 4, LLC, TRC Companies, Inc. and TRC Engineers, Inc. received a Release and Covenant Not to Sue and the site Volunteer Queens West Development Corporation received a letter of No Further Action, both issued by NYSDEC on January 26, 2009.

Since the same general QWDC Stage 2 findings apply to sediments in the Southern Embayment, and because the Southern Embayment borders the same location as evaluated in the LUW report, the conclusions are the same. Appendix L in Appendix A contains the LUW report.

2.7 INTERIM REMEDIAL MEASURES

The interim remedial measures completed to date include the following:

- In June 2008, the construction and demolition (C&D) pile that covered approximately two-thirds of the Site was removed and an IRM completion report was submitted to the Department.

- A 1,000-gallon fuel oil UST on the southern side of the Parcel 8 was closed in place by filling with concrete in December 2007. The ancillary piping was removed at the time.

2.8 REMEDIAL ACTION OBJECTIVES

Based on the results of the Remedial Investigation, the following Remedial Action Objectives (RAOs) have been identified for this Site.

2.8.1 Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater containing contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles emanating from contaminated groundwater.
- The cleanup objectives for groundwater are the TOGS Class GA AWQS and/or achievement of asymptotic levels for VOCs and naphthalene during the proposed eight quarters of post-remedial monitoring.

RAOs for Environmental Protection

- Restore groundwater aquifer, to the extent practicable, to pre-disposal/pre-release conditions and/or to a level commensurate with Site use.
- Prevent the discharge of contaminants to surface water.
- Prevent further off-site migration of contaminated groundwater.
- Remove the source of ground or surface water contamination.

2.8.2 Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of, or exposure to, contaminants volatilizing from contaminated soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- ~~Prevent impacts to biota due to ingestion/direct contact with contaminated soil that would cause toxicity or bioaccumulation through the terrestrial food chain~~.

2.8.3 Surface Water

There is no surface water on Site, so the RAWP does not address this medium.

~~RAOs for Public Health Protection~~

- ~~Prevent ingestion of contaminated water.~~
- ~~Prevent contact or inhalation of contaminants from impacted water bodies.~~
- ~~Prevent surface water contamination that may result in fish advisories.~~

~~RAOs for Environmental Protection~~

- ~~Restore surface water to ambient water quality standards for each contaminant of concern.~~

~~Prevent impacts to biota due to ingestion/direct contact with contaminated surface water that would cause toxicity or bioaccumulation through the marine or aquatic food chain.~~

2.8.4 Sediment

There are no material adverse impacts to sediment stemming from Parcel 8, so the RAWP does not address this medium.

~~RAOs for Public Health Protection~~

- ~~Prevent direct contact with contaminated sediments.~~
- ~~Prevent surface water contamination that may result in fish advisories.~~

~~RAOs for Environmental Protection~~

- ~~Prevent release(s) of contaminant(s) from sediments that would result in surface water levels in excess of (ambient water quality criteria).~~
- ~~Prevent impacts to biota due to ingestion/direct contact with contaminated sediments that would cause toxicity or bioaccumulation through the marine or aquatic food chain.~~

3.0 DESCRIPTION OF REMEDIAL ACTION PLAN

3.1 EVALUATION OF REMEDIAL ALTERNATIVES

The primary purposes of soil and groundwater remediation on the Site are to:

- eliminate sorbed NAPL and dissolved VOCs and SVOCs in a timely and cost effective manner to achieve the remedial action objectives, and
- remove shallow soils with metals and PCBs above regulatory cleanup objectives.

Selection of the potential remedies for consideration involved selecting a range of remedial alternatives and methodologies that could be used to address the contaminants of concern at the Site, taking into account issues such as the urban nature of the area, population density, the change in setting from industrial to residential and commercial, limited space for remedial equipment, current land use, proximity to schools and daycare, and aesthetics. Remedies requiring excavation as a component of a more complex remediation were eliminated. For example, incineration or recycling soil for beneficial re-use and the like were omitted because they depend on excavation, which is considered. After weighing these considerations, the pool of available remedies was narrowed down to the following for evaluation using the alternatives selection factors set forth in 6 NYCRR Part 375-1.8(f):

- Alternative 1 - No Action/Monitored Natural Attenuation
- Alternative 2 - Track 1 Unrestricted Use: Source Removal – Shallow and Deep Excavation
- Alternative 3 - Track 4 Restricted Commercial Use: Groundwater Extraction and Treatment, Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls
- Alternative 4 - Track 4 Restricted Commercial Use: In situ Treatment using Oxygen-Enhanced Biodegradation (OEB), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls
- Alternative 5 - Track 4 Restricted Commercial Use: In situ Treatment using Air Sparging (AS)/Soil Vapor Extraction (SVE), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls
- Alternative 6 - Track 4 Restricted Commercial Use: In situ Treatment using Conventional *In-Situ* Chemical Oxidation (CISCO), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls
- Alternative 7 – Track 4 Restricted Commercial Use: In situ Treatment using Surfactant Enhanced In Situ Chemical Oxidation (S-ISCO™) Using Primawave™ Injection Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

Table 1 presents a summary and side-by-side comparison of each remedial alternative according to the selection factors of 6 NYCRR Part 375-1.8(f).

- Protection of human health and the environment;

- Compliance with standards, criteria, and guidelines (SCGs);
- Short-term effectiveness and impacts;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of contaminated material;
- Implementability;
- Cost effectiveness;
- Community Acceptance; and
- Land use.

The following text is a general discussion of the pros and cons of the candidate remedies. The text presents additional information and information particular to the Site and setting used in evaluating the remedial alternatives. All remedial alternatives except the No Action alternative and Track 1 Cleanup are Track 4 Remedies which include shallow soil excavation, Hot Spot and grossly contaminated soil removal, and institutional and engineering controls. A detailed discussion of the selected remedial alternative is provided in Section 3.3.

Alternative 1 - No Action/Monitored Natural Attenuation

If no action is taken, then the mass of contamination would remain essentially unchanged, most likely for an indeterminate period. The bulk of the contamination occurs as a residual mass of heavy SVOC and VOC compounds strongly affixed to the soil matrix in the form of NAPL. The contaminant mass will continue to slowly dissolve into groundwater, leaving a dissolved plume of elevated BTEX compounds that is likely to remain for many decades. Natural attenuation will degrade the dissolved VOCs slowly over time and already limits the extent of their migration, but VOCs will remain elevated in groundwater. The SVOC portion will likely remain for much longer and natural attenuation will act more slowly on these compounds. In their present buried state, these contaminants pose little risk to the public or potential Site users. Nonetheless, Site workers could be exposed to subsurface contaminants while performing invasive work and exposed to surface contaminants via dermal exposure inhalation of vapors and particulates. Surface contamination could reach the public via inhalation of airborne particulates. Dermal contact between Site workers and contaminated groundwater is another potential exposure pathway.

Allowing this contamination to remain in place on a Site slated for potential redevelopment is not consistent with Part 375 because the Site has been identified as a significant threat and no action would leave a large mass of source contamination – although deep – within a densely populated area. Considering these factors, the no action alternative was rejected.

Alternative 2 - Track 1 Cleanup (Source Removal – Shallow and Deep Excavation)

Track 1 cleanup could likely be achieved through source removal by means of excavation of all on-Site contamination down to bedrock (approximately 30 ft-bg). Source removal is very effective in removing contaminant mass, but it is complicated by Site and local conditions, the depth of the main contaminant mass, potential community exposure during remediation, traffic issues and other practical considerations.

The Site is within an increasingly heavily populated area that has a daycare facility and elementary school within approximately one-half block and residential complexes on the north and east sides. Public parks abut Parcel 8 on the west and south. More residential units and park areas are under development in the area with near term completion expected.

Excavating the bulk of the source contamination, which lies below the water table to bedrock at approximately 30 feet, would require sheeting and shoring to stabilize the sides of the excavation. Installation of sheeting generates abundant noise and diesel emissions and this preliminary task would be complicated, prolonged and potentially prevented by large debris in the subsurface. Large debris pieces such as concrete, stone, wood timbers, and metal were identified in some of the test pits excavated during the RI. This debris would likely serve as obstructions to sheet piles that would delay or prevent their installation.

Assuming sheeting can be installed, excavation would have to occur within a negative pressure enclosure. The enclosure would have to be ventilated and the emissions put through charcoal canisters. The blowers and charcoal canisters are large, very noisy, and require space. The emissions must be vented to the outside. The blowers would likely require space beyond Parcel 8, such as along the streets and/or in the parks, thus limiting or restricting access to the surrounding areas for an extended period to remove the large volume of soil. Even under an enclosure, odors associated with excavation and off-site transportation of deep source material are likely to remain a community issue.

Deep excavation would also require dewatering with treatment of the fluid prior to discharge either to the East River or to the New York City sanitary sewer system. The treatment system would require additional space, and has the potential to generate odors.

It is estimated that more than 35,000 cy of soil would have to be removed from a limited work space. This would require that more than 2,100 truckloads of soil be removed in front of the daycare and schools and near the parks and residential buildings, exposing the public near the Site, as well as along the entire route to a disposal facility, to additional vehicle emissions and particulates for an estimated period of eight to 12 months or more. Community complaints are likely to be frequent with excavation.

Deep excavation of source contamination—assuming no complications— would likely cost on the order of 11 million to 12 million dollars. Deep excavation has major adverse impacts to the community because of the noise, odors, trucks, emissions, and construction activity performed so close to receptor populations across the street. Considering these factors, the excavation alternative was rejected.

Alternative 3 - Groundwater Extraction and Treatment, Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

Groundwater extraction and treatment is expected to have no material remedial effect on the type and volume of contaminants on Parcel 8 regardless of duration. It is therefore not considered a viable remedy.

Groundwater extraction and treatment is an ineffective option for remediating on-Site soils and groundwater because there is a large mass of dense, non-polar contamination strongly sorbed onto the soil. With this type of contaminant, groundwater extraction will only remove the dissolved portion and leave the principal portion attached to the soil virtually untouched. This means that only an extremely small amount of the contaminant, the dissolved portion (fraction of a percent), will be removed and the rest will remain, and that even after decades of groundwater withdrawal this remedy will not reduce the volume or toxicity of the contaminant.

Additionally, it is not a realistic option due to the costs associated with long term continued operation and maintenance. Anticipated costs for installation and operation for 30 years are approximately 11 million dollars. This alternative was therefore rejected.

Alternative 4 - In situ Treatment using Oxygen-Enhanced Biodegradation (OEB), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

Bioremediation is a practical and cost-effective method to remove hydrocarbons from soil and groundwater. Studies by the United States Geological Survey (USGS) have shown that naturally present microorganisms actively consume certain hydrocarbon-derived compounds and transform them into harmless carbon dioxide (CO_2) and water (H_2O). These studies have shown that the rate of these bio-transformations can be greatly increased by the addition of oxygen, which acts as the primary electron acceptor, and nutrients such as nitrates and sulfates, which act as the secondary electron acceptors. However, bio-transformation occurs principally in aqueous solution and the bulk of the contaminant mass at the Site occurs as residual NAPL that is not dissolved. Also, if OEB were used at the Site, most of the oxygen would not contact the contamination because it would instead follow preferential pathways. This means that the vast majority of contaminant mass would be unavailable for bio-transformation and that remediation using this approach would take an indeterminate amount of time (reasonably expected to far exceed most of the other options analyzed) and require a significant amount of oxygen to supply and fuel bacterial consumption, which would likely require constant oxygen injections. For these reasons, OEB was rejected as a remedial alternative.

Alternative 5 - In situ Treatment using Air Sparging (AS)/Soil Vapor Extraction (SVE), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

In-situ AS can potentially enhance groundwater remediation by two mechanisms: 1) volatilization of strippable hydrocarbons in the aquifer and capillary fringe, and 2) enhanced biodegradation of non-strippable hydrocarbons in the aquifer and capillary fringe.

In-situ AS is a proven technology and is well suited for sites requiring concurrent operation with a SVE system and a relatively high proportion of volatile organic compounds. However, due to the large NAPL mass on Parcel 8 and because the mass contains a very large portion of high molecular weight SVOCs below the water table, an AS/SVE remedy would be of extended duration. In practical terms, AS/SVE would have to operate indefinitely because it would be incapable of removing the sorbed NAPL that is the mass of the contamination. For these reasons, AS/SVE was rejected as a remedial alternative.

Alternative 6 - In situ Treatment using Conventional *In-Situ* Chemical Oxidation (CISCO), Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

In-situ chemical oxidation remediation is a process that employs a chemical agent and typically a catalyst to break down contaminants into carbon dioxide and water. The oxidant is injected into the ground via wells and/or well points. Conventional chemical oxidation is efficient and effective, but it has three technical limitations for this site. One is that chemical oxidation occurs only when the contaminant is in aqueous solution. The second is that unstable liquid fronts and variable permeability lead to inefficient injection and distribution of the oxidant. In many cases, the oxidant does not achieve contact with a large portion of the contaminant mass because of uneven placement (fingering). The third is that the oxidation reaction occurs primarily at the macro-scale level, not at the pore-scale level. The first limitation can be overcome by injecting a surfactant to dissolve the NAPL into aqueous solution (S-ISCO). The second can be partially offset by greatly increasing the number of injection points, but does not completely address the uneven placement and fingering. The third limitation cannot be overcome by conventional means. As a result of these limitations conventional oxidation was rejected as a remedial alternative.

Alternative 7 - In situ Treatment using Surfactant Enhanced In Situ Chemical Oxidation (S-ISCO™) Using Primawave™ Injection, Shallow Excavation, Hot Spot Soil Removal, and Institutional Controls

S-ISCO™ using Primawave™ technology is similar to conventional *in situ* chemical oxidation but with two important differences. The first is that a plant-based surfactant is introduced concurrent with the oxidant to dissolve the NAPL into aqueous solution. This is a key factor because it makes the contaminant mass available for oxidation (a surfactant can be and is used effectively with conventional *in situ* chemical oxidation.) The second factor is that injection using Primawave™ technology provides much greater oxidant coverage by generating an even dispersion front that reduces fingering and promotes pore-scale application of the oxidant. This is accomplished through the generation of porosity dilation waves to open soil pores and drive fluids through them. Application of the surfactant and oxidant in this manner overcomes fingering, covers more of the contaminant mass, and achieves much closer contact between the contaminant and oxidant to affect more complete oxidation and an optimum result from the oxidant. This means that Primawave™ will disperse the surfactant and oxidant at the pore-scale level and create a gradient between contaminant and oxidant such that the oxidant “seeks out” the contamination. Combined, these technologies have the potential to greatly enhance remediation.

3.2 SELECTION OF THE PREFERRED REMEDY

Remedial Alternative 7 is the preferred remedy for the Site. The key elements of the preferred remedy are as follows:

1. Removal of the top four feet of soil sitewide
2. Hot Spot removal (to approximately 5 feet below the original grade) and removal of UST(s)
3. Removal of grossly contaminated soils to the depth of the water table (8-10 ft bg) and/or the maximum depth possible without sheeting or shoring
4. In situ chemical oxidation of the principal zone of contaminant mass, over the entire Site from the water table to approximately 22 ft bg using a natural, citrus-based surfactant to dissolve the NAPL for oxidation utilizing sodium persulfate.
5. Removal of UST and relict piping.
6. Installation of a composite cover system consisting of, at a minimum, two feet of NYSDEC-approved fill and/or six inches of asphalt paving or concrete.
7. Recording of an Environmental Easement describing any limitations on Site use, including implementation of a Site Management Plan.
8. Implementation of a Site Management Plan that will: (i) require installation of an active sub-slab depressurization system and vapor barrier for any occupied buildings constructed on the Site, (ii) detail procedures for future maintenance of engineering controls and management of any residual Site contamination and (iii) address procedures for future ORCA application for groundwater treatment, if necessary, including monitoring parameters.

The chosen remedy will result in attainment of the Commercial Use SCOs for all shallow soils on the Site and the majority of the deeper soils, while minimizing the risk of community exposure to contaminants and nuisance disturbances during remedial work. The main risk of exposure to contaminants and nuisance disturbances to the surrounding community will be associated with off-Site transportation of the shallow excavated soils. The logistics of implementing the S-ISCO™ remedy are limited to deliveries, mixing, short-term storage, and injection over an approximately two to four-month period.

3.2.1 Zoning

The preferred remedy occurs entirely beneath grade and will not have any effect on existing zoning designations.

3.2.2 Applicable comprehensive community master plans or land use plans

The preferred remedy should not have any effect on community master plans or land use because land use will not change as a result of the remedy.

3.2.3 Surrounding property uses

The surrounding property use is a mixture of high-rise residential, retail and light commercial, and state parks. The preferred remedy will not have any adverse effect on surrounding property use. In fact, the preferred remedy will maintain the viability for current use of the parks, whereas a large excavation may impair their accessibility for as much as a year.

3.2.4 Citizen participation

In accordance with the approved Citizen Participation Plan, Appendix J, a fact sheet describing the remedy was distributed and the RAWP was made available for public comment and review. No public comments were received during the public comment period. Given the minimal community disruption and nuisance issues associated with this type of remedy (S-ISCO™), significant objections to the remedy are not anticipated.

3.2.5 Environmental justice concerns

The remedy does not pose any known environmental justice concerns.

3.2.6 Land use designations

The proposed remedy is compatible with the proposed use of the Site as a public library and park ranger headquarters.

3.2.7 Population growth patterns

Population growth in the vicinity of the Site is expected to increase due to the expanding number of residential units being built. The preferred remedy should have no effect on population growth.

3.2.8 Accessibility to existing infrastructure

All infrastructure required for implementing the preferred remedy is readily available. The remedy will not impact the existing infrastructure.

3.2.9 Proximity to cultural resources

The preferred remedy will have no adverse effect on nearby cultural resources.

3.2.10 Proximity to natural resources

The preferred remedy will have no adverse effect on nearby natural resources.

3.2.11 Off-Site groundwater impacts

The preferred remedy is expected to improve off-Site groundwater quality. Monitoring and, if necessary, hydraulic control will be conducted during implementation of the remedy to ensure that surfactant application does not result in off-site migration of contaminants.

3.2.12 Proximity to floodplains

As the preferred remedy relies primarily on an *in-situ* method, it should have no bearing on potential impacts to a floodplain. Removal of the upper 4 feet of soil Site-wide, with localized removal of Hot Spots and gross contamination, will temporarily alter minor drainage characteristics within the floodplain, but these will be addressed in future construction.

3.2.13 Geography and geology of the Site

The preferred remedy should not permanently alter the geography or geology of the Site in any way. The remedy would result in short-term subsurface changes to soil physical and chemical properties.

3.2.14 Current Institutional Controls

There are no existing institutional controls for the Site.

3.3 SUMMARY OF SELECTED REMEDIAL ACTIONS

The selected remedy is consistent with a Track 4 cleanup with restricted commercial use and consists of the following key components:

1. Excavation of the top four feet of soil over the entire area of the Site. The shallow soil excavation will proceed in the open without an enclosure, although odor suppressant foam will be on hand[4] and will be utilized as needed. Removal of the closed-in-place UST and any ancillary piping will also be completed at this time.

2. Hot Spots of metals and PCBs identified during the RI, as well as grossly contaminated soil observed during soil excavation of the top four feet of soil, will be removed to a depth where endpoint sample meets the Commercial Use SCOs, or to the depth of the water table and/or the maximum depth possible without sheeting or shoring. Soil removal identified in remedial components 1 and 2 will remove approximately 3 percent of the total organic contaminant mass from the Site. The remedial performance goals for shallow soil removal are the Part 375 commercial use SCOs.

[4] Generally limited faint odors were observed while test pit sampling at some locations; odors were not an issue during excavation to locate the UST.

Hot Spot areas, depicted on Figure 4, include the following:

Location	Parameter	Max. concentration (mg/kg)	Commercial Use SCO (mg/kg)
MW-19/SB-36	Copper	325	270
MW-19/SB-36	Barium	678	400
SB-35	Arsenic	17.8	16
SB-40	Arsenic	17.5	16
SB-31	PCBs	55.1	1

Soils which are not grossly contaminated below approximately 4 ft-bg, and below Hot Spot excavation areas will remain in place.

Excavation (components 1 and 2) will be completed in lifts or strips so that the existing soil cover will remain in place and minimize exposure of subsurface soils. Only a small portion will be excavated at a time. The strips will be approximately 10 to 20 feet wide with a length that will accommodate "load and go" removal of soils into trucks. Alternatively, no more than a 60-foot by 60-foot excavation (3,600 ft^2) will be made in any one day so as to accommodate up to 30 trucks per day. In this manner, only soil that can be removed from the site without stockpiling will be excavated. Post excavation samples will be collected for expedited turn around and the results forwarded to the Department for review. If accepted, clean cover will be placed over the excavation to grade and the next strip will begin. The process will continue until excavation is complete.

3. Screening for indications of gross contamination (by visual means, odor, and monitoring with PID) of all excavated soil during any intrusive Site work.
4. Appropriate off-Site disposal of all material removed from the Site in accordance with all Federal, State and local rules and regulations for handling, transport, and disposal
5. Collection and analysis of end-point samples subsequent to removal of shallow soil, Hot Spots and gross contamination. Endpoint samples will be collected at 4 ft-bg, and along the Site sidewalls and analyzed for VOCs, SVOCs, metals, PCBs, and pesticides/herbicides. In the areas of Hot Spot and gross contamination excavation, endpoint samples will be collected at the bottom of the Hot Spot and/or gross contamination excavation and along the sidewalls of each excavation in accordance with the procedures in DER-10, and similarly analyzed.
6. Import of materials to be used for backfill and cover in compliance with: (1) Part 375-6.7(d) and~~chemical limits and other specifications included in Table [x],~~ (2) all Federal, State and local rules and regulations for handling and transport of material;
7. Installation of a demarcation barrier at 4 ft-bg between the residual soil and approved fill material. Hot Spot and gross contamination excavations will be filled to 4 ft-bg with soils meeting Part 375-6.7(d) prior to installation of the demarcation barrier.
8. Installation of a composite cover system consisting of, at a minimum, 2 feet of clean soil and/or 6 inches of asphalt or concrete.

9. S-ISCO™ will address the bulk of the contaminant source mass. The greater part of the mass occurs from approximately 10 ft-bg to 22 ft-bg, (i.e., the treatment zone) and encompasses about 67 percent of the contaminant mass (67,000 pounds). Additional S-ISCO™ treatment will address deep contamination atop the till layer near the southwest corner of Parcel 8. The combination of these remedial approaches has a goal of reducing the net organic contaminant mass across the Site by approximately 75 to 80 percent.
10. All activities associated with the remedial action, including permitting requirements, will be conducted in accordance with the applicable Federal, State and local rules and regulations.
11. Recording of an Environmental Easement requiring implementation of engineering and institutional controls described in a Department-approved Site Management Plan to manage residual contamination.

    Publication of a Site Management Plan for long term management of residual contamination, as required by the Environmental Easement, that will: (i) require installation of an active sub-slab depressurization system and vapor barrier for any occupied buildings constructed on the Site, (ii) detail procedures for future maintenance of engineering controls and management of any residual Site contamination and (iii) address procedures for future ORCA application for groundwater treatment, if necessary, including number and location of downgradient monitoring/treatment wells and monitoring parameters.The work sequencing of the remedial elements is as follows:

    - In situ subsurface remediation. This phase needs to occur first because injection wells need to be installed and the existing surface soil acts as necessary overburden to well installation and performance. The existing monitoring wells also need to remain in place for monitoring. This phase is expected to begin in the summer.
    - Removal of 4 feet of soil over the entire Site and post-excavation sampling. This needs to be done in the cold weather to minimize the potential for odor generation.
    - Removal of Hot Spot areas and grossly contaminated soil and post-excavation sampling and addition of approved fill up to 4 ft-bg. This needs to be done in the cold weather.
    - Install demarcation barrier.
    - Backfill with approved cover material which meets the requirements of Part 375-6.7(d)..

    Remedial activities will be performed at the Site in accordance with this NYSDEC-approved RAWP. All deviations from the RAWP will be promptly reported to NYSDEC for approval and fully explained in the FER.

3.4 IN SITU REMEDIATION OF SOURCE CONTAMINATION

The objective of the selected remedy is shallow soil removal Hot Spot and gross contamination excavation and removal combined with S-ISCO™ *in situ* treatment to destroy the bulk of residual organic contaminant source mass. Within the treatment zone, between the water table (8 to 10 ft-bg) and 22 ft-bg, lies the principal body of contaminant mass. All

of the contamination within this interval (and on all of Parcel 8) is residual (i.e., not free-product NAPL, but immobilized within the soil pores in the form of a NAPL that, under normal conditions, is unable to flow but continues to adversely impact groundwater), and nearly all of it is below the water table. The estimated 67,000 pounds[5] of contaminant within the treatment zone originated primarily from coal tar and accounts for most of the impacts to soils and groundwater across Parcel 8. Oxidation of this contaminant mass is fundamental to effectively remediating the Site.

The *in situ* chemical oxidation portion of the remedy has five components: 1) Pre-treatment sampling to establish a baseline; 2) Pilot Test; 3) full-scale S-ISCO™ Treatment; 4) post-treatment sampling to determine the degree of mass reduction; and 5) monitoring of the treatment to track the long-term effectiveness of the remedy.

Because of the nature and extent of contamination and because *in situ* chemical oxidation occurs exclusively in the subsurface and depends on chemical reactions, several means will be employed to evaluate whether the remedial goals have been attained, including pre- and post-remedial sampling of soil and groundwater and comparison of the pre- and post-treatment results.

Treating the residual is crucial because the overwhelming mass/volume of contamination is in this form. Residual contamination on a site-wide basis is largely inaccessible to other (i.e., non-surfactant enhanced) *in situ* treatment methods.

To effectively treat residual contamination, one has to be able to get into the soil pores with a material that will destroy the contamination, but first, the NAPL has to be dissolved so that the oxidant can work, and the oxidant has to be distributed into the pores evenly so that all the contamination is treated and rebound does not occur. Fingering and preferential pathways have to be overcome and the location of the contaminant mass has to be known and the distribution understood. The Rem-Metrik process will be used to overcome these challenges, optimize remediation, and measure its effectiveness. Rem-Metrik measures treatment of contamination at the pore scale level where residual contamination occurs. This is accomplished using Rem-Metrik to identify and quantify the distribution of NAPL in conjunction with Primawave™, a process that opens pore spaces and dispenses chemical amendments at the pore scale level and VeruTEK's S-ISCO™ surfactant enhanced oxidant. To this end the Rem-Metrik process will be used to establish treatment benchmarks and quantify performance of the *in situ* treatment.

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[5] This estimate was derived by FLS employing the method by Gallagher et al. 1995, which uses contouring depth intervals using average concentrations in each interval to arrive at the estimate. A separate, independent mass estimate was also completed by VeruTEK with the same data but a different approach using linear interpolation between adjacent data points to estimate soil concentrations at 1-foot intervals along the soil columns to arrive at an average concentration for the soil column over Parcel 8, which in turn was used to estimate the total contaminant mass. This approach estimated 47,000 pounds of contaminant in the treatment zone. Considering the variability in the ground and the inherent uncertainty in these methodologies, this estimate is very close to that developed by FLS. Subsequent sampling in areas around Parcel 8 refined the estimate downward from 67,000 lbs to 53,600 lbs.

Rem-Metrik measures the contaminant mass, identifies its location and distribution, establishes remediation benchmarks, and quantifies performance of *in situ* treatment. Rem-Metrik pinpoints where treatment should occur to be most effective and cost efficient and, most important, when remediation is complete. Primawave™ evenly distributes VeruTEK's S-ISCO™ surfactant and the oxidant (persulfate) throughout the soil matrix—at the pore scale level—where it can contact the NAPL blobs and ganglia, dissolve the NAPL, and then destroy the NAPL. VeruTEK's surfactant enhanced *in situ* chemical oxidation (S-ISCO™) "uses a patent-pending surfactant-cosolvent mixture, VeruSOL™, which enables aqueous phase oxidant reactions to destroy solubilized NAPLs." Once NAPL constituents are dissolved in the aqueous phase using VeruSOL™, the oxidant can destroy the contaminants and reduce contamination (www.verutek.com).

Rem-Metrik is a patent pending process (US Patent Application No. 12/437,824 and International Patent Application No. PCT/US09/43434) that serves to accurately quantify subsurface contamination and measure the effectiveness of treatment. It incorporates Wavefront Technology Solutions, Inc's. Primawave™ (or Powerwave™) process to open up the pore space, increasing permeability to enhance NAPL mobilization or to deliver treatment chemicals, such as VeruTEK's S-ISCO™ process, uniformly throughout the contaminated media.

Using a more sophisticated mass/volume-base approach, Rem-Metrik establishes realistic pre-treatment baseline (benchmark) conditions and post-treatment measurements as a means of obtaining scientifically-based measurements to quantify the degree of remediation. This method yields an objective means of gauging when cleanup is complete that is more accurate than conventional end-point sampling.

Primawave™ will dispense oxidant evenly at the pore scale level where it will treat most NAPL almost immediately and get close enough so that the oxidant establishes a gradient with any remaining contamination such that it "seeks out" the remaining contamination.

3.4.1 Pre-treatment and Post-treatment Sampling

Soils

Establishing pre-treatment baseline conditions is fundamental to measuring the effectiveness of the remedy and assessing whether additional treatment is warranted. In order to evaluate S-ISCO™ treatment, pre and post-treatment soil samples will be collected for TCL VOC and SVOCs. TPH samples will also be collected.

One-hundred fourteen (114) randomly selected soil samples from the 10 ft-bg to 22 ft-bg treatment interval will be collected, using simple random sampling (SRS). Parcel 8 will be divided into 28 grid cells (approximately 35 feet by 35 feet per grid cell). One randomly located soil boring will be advanced using direct push sampling in each grid cell. Figure 5 shows the randomly located soil boring locations. Within each boring, four randomly selected 6-inch-long soil samples will be collected from a potential total of twenty-four samples (a 12-foot-long sample core contains twenty-four 6-inch samples). Samples

collected for SVOC and TPH analyses will be homogenized before being placed in the sampling jars. VOC samples will be collected from representative locations on the 6-inch-long sample core and placed directly into the sample container without mixing. The 6-inch sample core will be visually inspected. Equal soil volumes will be taken from different places on the core so as to measure any discernable variation. The sample cores will be logged and photographed.

Using the concentrations or summary statistics obtained from the proposed 114 SRS's will ensure that sampling yields an estimate with a 95 percent confidence interval and a margin of error of 900 mg/kg[6,7].

Subsequent to implementation of the remedy, the same number of soil samples will be collected using the identical soil sampling protocol (different randomly selected locations in each grid cell and different randomly selected depth intervals) as was used for the pre-remediation samples. In addition, several sampling cores will be advanced adjacent to the pre-treatment sampling locations, and the cores will be photographed for visual comparison.

Groundwater

Pre- and post-treatment sampling of TCL VOCs and SVOCs across Parcel 8 will be conducted to measure the change in dissolved concentrations. Each round of groundwater sampling will encompass all the wells on Parcel 8 plus the upgradient wells in Center Boulevard and the downgradient wells in Peninsula Park. Two rounds of pre-treatment groundwater sampling will be completed, separated by approximately one month.

The same measurement protocol will be instituted four weeks following treatment and again at 8 to 10 weeks following treatment to assess effectiveness, and then quarterly for two years following the end of treatment. Table 2 summarizes the sampling and monitoring frequency.

3.4.2 S-ISCO™ Treatment

The objective of the treatment phase of the remedy is to destroy contaminant source mass in place by chemical oxidation. DNAPL and other soil-bound contaminants will be

[6] The variation in the soil samples is so great that a greater confidence level and narrower margin of error would require an impossible number of samples. The methodology used to establish the number of pre- and post-treatment samples may be found in Moore, D.S and McCabe, G.P., *Introduction to the Practice of Statistics*, 2003.

[7] Simple random sampling is proposed because it will yield unbiased estimates of the contaminant concentrations. Soil concentrations typically, and on Parcel 8 especially, have very high variability and it is improbable that sampling next to the original sampling locations will result in reliable before/after results. Only by random selection of sample locations will sampling yield estimates with a quantifiable degree of certainly.

mobilized to the aqueous phase through a combination of surfactant injected with the oxidant and Primawave™ technology. The oxidant is expected to remain viable in the ground for 30 to 60 days.

Based on the bench scale testing (Attachment 1) conducted on Parcel 8 field samples completed by VeruTEK, surfactant-enhanced alkaline-activated persulfate resulted in 96 to >99 percent destruction of the contamination in soil collected from Parcel 8. The DNAPL was dissolved into water using VeruSOL-3™, which is a mixture of U.S. FDA Generally Recognized as Safe (GRAS) plant-based surfactants and co-solvents.

Successful treatment should leave no residue in the soil except for carbon dioxide, water, sodium, and sulfate, the last two of which are naturally occurring and found on Site. Some amount of plant-based citrus terpenes from the surfactant should also remain. These are innocuous compounds derived from squeezing citrus rinds. There will be a likely increase in alkalinity for approximately two months before the soil's natural buffering capacity restores the soil pH to normal levels.

VeruSOL-3™, sodium persulfate, and activator (catalyst) NaOH, will be mixed in polyethylene containers on-Site and injected through Excitation wells using Wavefront Technology Solutions, Inc's. Primawave™ technology via Wavefront's Sidewinder™ tool (or upgraded equivalent). Catalyzed hydrogen peroxide may be similarly injected near the water table, if necessary (at concentrations of no more than 2 to 6 percent). The injection wells will be constructed of 2-inch-diameter, schedule 80, 40-slot (or larger), PVC with well screens positioned through the treatment interval. The screens will be a maximum of 6 feet in length. Each injection well will occur in a cluster, with an upper well, generally screened in the 10-to 16-foot interval, and a lower well, generally screened in the 16-to 22-foot interval. Where necessary, screen interval adjustments will be made based on the data collected from soil borings installed during the RI. Table 3 presents the actual screened intervals based on Site stratigraphy. These intervals were selected to optimize the injection and appropriately target the contamination mass in the area of that specific well. The injection well clusters will be placed 10 to 30+ feet apart depending on the results of the pilot test discussed in Section 3.4.3. The wells will be removed following successful completion of treatment in accordance with DER-10, and with Department approval.

Excitation wells, wells from which porosity dilation waves will propagate to apply treatment chemicals, will be positioned over the most heavily contaminated portion of the Site to allow more oxidant mass to be injected where the mass of contaminant is greatest. The wells will be supplemented by several direct-push injection points in the most heavily contaminated southwest part of the Site, at the approximate 25-to 30-foot interval, to target contamination directly above the till layer. Proposed injection well and direct push locations are provided in Figure 5. These locations are subject to change based on pilot test results.

Direct push injection (Excitation) points will also introduce the oxidant on the Site area that contains less contaminant mass, the northeast and eastern portion of Parcel 8, as shown on Figure 5. Oxidant injection into wells and direct push points may occur

concurrently, since, for the most part, separate equipment and operating crews are utilized. The following table provides information regarding the surfactant and oxidant that will be used. As indicated, the spacing of the injection points and the duration of the injection process will be determined in the course of the pilot test discussed in Section 3.4.3. The injection volume is approximate and will be refined during the pilot test (See Section 3.4.3).

Material	Approx. Conc., g/L	Est. Total Mass, kg	Approx. Gallons Injected	Injection Point Spacing	Total Est. Injection Time, days
Sodium Persulfate	25 - 100	128,627	761,600	Aprrox. 30-ft radii	120
Catalyzed Hydrogen Peroxide	TBD	TBD	TBD	TBD	TBD
VeruSOL-3™	5 - 20	6,000	317,000	--	--
Activator, NaOH	20	2,400	127,000	--	--

VeruSOL-3™ and the activator will be injected simultaneously with the oxidant, so the total estimated injected volume is 317,600 gallons.

Use of catalyzed hydrogen peroxide is listed as a potential option only for use near the water table if needed. It is not likely to be used.

As opposed to conventional injection, Primawave™ operates by generating porosity dilation pressure waves that open soil pores and drive fluid more uniformly through the subsurface, maximizing contact of the oxidant with the contaminant mass. This difference allows Primawave™ to overcome the principal limitation of conventional injection: unstable injection fronts that lead to fingering and uneven placement of the treatment amendments. Primawave™ "harnesses highly accelerated fluid pressure pulses to move fluids, contaminants, or treatment amendments through saturated porous or elastic media (soil or rock). The process creates subsurface pressure waves of high amplitude and low frequency. . . . The pressure pulses are unique because they open pores, increase pore interconnectivity. . . . The pressure pulses are capable of dispensing and dispersing fluids, thereby improving approaches such as *in situ* chemical oxidation" (Panter 2008). Use of this technology will reduce the number of injection points, increase effectiveness by increasing contact of the treatment chemicals and soil and decrease treatment duration.

The deep and shallow Excitation well couplets will also serve as wells for hydraulic control to ensure that surfactant does not transport dissolved NAPL off Site. In addition, a 4-inch-diameter well with a 12-foot-long well screen will be installed through the treatment interval in the center of the Site as an additional means of preventing dissolved NAPL from moving off Site by creating a hydraulic gradient towards the center of Parcel 8.

Injection monitoring will provide advance notice of potential off-Site contaminant migration. If this occurs, then submersible pumps will be installed into the wells as necessary to promote hydraulic control. Potential wells for this purpose include: MW-9, MW-16(S), MW-15(D), MW-20(S), MW-19(D), MW-10, MW-14(S), and MW-22(D). Any pumped water will be discharged to the city sanitary sewer, pursuant to NYCDEP Bureau of Wastewater Treatment Standard Use Ordinance, Limitations for Effluent to

Sanitary or Combined Sewers. A sanitary sewer discharge permit will be obtained from NYCDEP before any discharge to the sewer is required as a contingency measure, if required. The permit will determine whether pre-treatment is required before discharging to the sewer. Based on the results of groundwater sampling on Parcel 8, it is anticipated that discharged groundwater will require pre-treatment.

3.4.3 Pilot Test

A proposed Pilot Study work plan was submitted to the Department on June 9, 2009 and was approved on September 10, 2009. A copy of the Pilot Study Work Plan is included as Attachment 1. The objective of the Pilot Study was to measure critical performance parameters:

- Treatment radius of influence (ROI). This information will influence the injection well layout and the treatment time.
- Injection rate and volume (min., max., sustainable)
- Treatment effectiveness, by means of measuring the change in groundwater concentrations following the pilot test and pre and post-pilot test treatment soil results and analyzed for the constituents of concern.

Results of the Pilot Study were submitted to NYSDEC and NYSDOH in a report dated July 12, 2010 (see Appendix [P]). The results support the full scale implementation of the proposed remedy.

3.4.4 Monitoring

Monitoring is crucial because it provides information regarding the mass and flow rates of the injected chemicals, where chemicals are traveling and the nature of their reactions in the subsurface. It is an important component to the success and documentation of treatment and will guide additional treatment if warranted by indicating the approximate amount and location of residual contamination. Therefore, monitoring will take place in three phases to accurately measure treatment effectiveness:

1. Pre-injection Monitoring
2. Injection-Phase Monitoring
3. Post-injection Monitoring

Pre-injection Monitoring

Pre-injection monitoring will include the soil and groundwater sampling described in Section 3.4.1. and in the Pilot Test in Section 3.4.2. This phase will also include performance monitoring (i.e., monitoring the baseline conditions that will also be measured during treatment). Performance monitoring includes sampling the existing monitoring wells for temperature, pressure, turbidity, pH, ORP dissolved oxygen (DO), specific conductance, and interfacial tension (IFT) using instruments and laboratory

analyses for baseline conditions. Pre-injection monitoring will also provide baseline data for assessing whether the surfactant has mobilized dissolved contaminant to the point where it could move off Site. Table 2 summarizes the monitoring, analysis, and frequency of Pre-injection Monitoring.

Injection-Phase Soil, Groundwater and Soil Gas Monitoring

Injection monitoring will include performance monitoring and process monitoring. Process monitoring includes measuring flow rate, persulfate concentrations, and IFT. Injection monitoring is ongoing during injection and will provide advance notice of potential offsite migration. Table 2 summarizes the monitoring, analysis, and frequency of Injection Monitoring. As previously noted, hydraulic control during remedy implementation will be provided on an as-needed basis by the deep and shallow injection well-couplets and a 4-inch-diameter well installed in the center of the Site. Taken together, the injection monitoring and hydraulic control provided by the well couplets and 4-inch-diameter well will ensure that surfactant does not adversely transport dissolved NAPL off Site.

Soil Gas Monitoring

In addition to monitoring the injection, the potential for releases and migration of soil gas in response to pulsing will also be monitored.[8] Prior to commencing full-scale remediation, four pressure monitoring points will be installed in the street in front of the nearest school (in the City Lights building located at the southeastern corner of Center Boulevard and 48th Avenue) to establish baseline conditions prior to *in situ* treatment. The monitoring points will consist of steel tubing with a retractable 3-inch-long screen that will be installed above the capillary fringe at approximately 5 to 8 ft-bg and the annulus sealed with clay and/or bentonite. The tops will be flush-mounted in the road or sidewalk. The points will be installed by driving the sample probe to 5 to 8 ft-bg using a direct push rig and the intake shaft attached to a length of dedicated Teflon or polyethylene tubing. A manometer will collect background subsurface pressure readings for baseline conditions. It will be placed on the measuring point and maintained there until the pressure measurements stabilize and/or representative conditions are otherwise reasonably ascertained. This decision will be based on field conditions.

Three SUMMA canisters for TO+15 plus naphthalene will also be collected from three of the four monitoring points in the street in front of the nearest school to establish baseline conditions prior to *in situ* treatment. The samples will be collected by using the same procedure prescribed in the RIR except that a helium tracer test will not be conducted. A minimum of one soil gas volume will be purged from the borehole before collecting the

[8] There is very low likelihood of this happening. Primawave^{TM} operates only in the saturated zone because it requires an incompressible material, water, to transmit mechanical energy. Soil gas is compressible. Because gas is compressible, the porosity dilation waves produced by Primawave^{TM} stop when they reach unsaturated media and have no more capacity to disperse fluids such as soil gas.

sample according to NYSDOH requirements. With the vacuum maintained, the sample will then be collected by attaching the tubing to the dedicated SUMMA canister flow controller set to a sampling rate of 0.2 liters/minute or less. The SUMMA canisters will be shipped to Accutest in Dayton, New Jersey for analysis. Accutest is an ELAP-certified laboratory.

Three days after *in situ* treatment begins, and every other day thereafter, the pressure measuring points will be monitored using a manometer to assess whether there is a change in soil gas pressure due to treatment. If the measurements indicate a positive response, the Department will be notified and the monitoring frequency modified so as to track potential soil gas pressure changes. Up to four (one at each point) additional SUMMA canisters for TO+15 plus naphthalene may be collected at the monitoring points using same sampling protocol as in the baseline sampling. Based on the pressure monitoring results and/or additional SUMMA canister analysis, the results will be forwarded to the Department for a decision whether to continue soil gas monitoring or take other actions.

Additional soil gas monitoring for pressure will take place around the Parcel 8 perimeter, two points on each of the north, west, and south sides only, to monitor soil gas pressures during treatment. Monitoring will follow the same procedure employed in sampling near the school. One sampling episode will occur before treatment begins and a second will take place one week after treatment begins. Based on the monitoring, the results will be forwarded to the Department for a decision whether to continue soil gas monitoring or take other actions.

Post-Injection Monitoring

Post-treatment monitoring includes soil and groundwater sampling as described in Item 3.4.1 and performance monitoring as described in Table 2. Post-injection monitoring will enable comparison of pre-treatment and post-treatment results to assess the treatment effectiveness.

3.5 REMEDIAL OBJECTIVES

This RAWP contemplates a Commercial Use Track 4 cleanup. This level of cleanup is appropriate for the proposed Site use as a public library and park/or headquarters. Successful implementation of the proposed remedy and the appropriate engineering and institutional controls will ensure that there is no contact with any remaining contamination. Any remaining contaminants will be immobile, relatively insoluble and isolated from contact with the public. Table 4 summarizes the proposed SCOs and groundwater cleanup objectives.

Soils

The entire Site will be excavated to 4 ft-bg and Hot Spot and gross contamination areas will be excavated to the maximum depth possible with no sheeting or shoring. The Part 375-6.8 Commercial Use SCOs will guide delineation and removal of Hot Spots. Any grossly

contaminated soil encountered during removal of the upper 4 feet and in Hot Spot areas will be also be removed.

Sidewall post-excavation samples will be collected to identify any residual concentrations above the Commercial Use SCOs that may need to be addressed in future Site management.

Within the treatment zone (water table to 22 ft-bg), the cleanup goal is removal of 90 percent of the contaminant mass. Nonetheless, within the treatment zone, the contamination will be dosed with surfactant and oxidant sufficient to remove 100 percent of the organic contaminant. The results of the bench-scale studies indicated destruction of the contaminant mass approaching 100 percent. Any residual contamination above Commercial Use SCOs will be addressed in the SMP

Groundwater

The cleanup objectives for groundwater are the TOGS Class GA AWQS and/or achievement of asymptotic levels for VOCs and naphthalene during the proposed four quarters of post-remedial monitoring.

4.0 REMEDIAL ACTION PROGRAM

4.1 GOVERNING DOCUMENTS

4.1.1 Site Specific Health & Safety Plan (HASP)

A Site Specific HASP has been created for the Site and is included in Appendix E.

All remedial work performed under this plan will be in full compliance with governmental requirements, including Site and worker safety requirements mandated by Federal OSHA.

The Volunteer and associated parties preparing the remedial documents submitted to the State and those performing the construction work, are completely responsible for the preparation of an appropriate Health and Safety Plan and for the appropriate performance of work according to that plan and applicable laws.

The Health and Safety Plan (HASP) and requirements defined in this Remedial Action Work Plan pertain to all remedial and invasive work performed at the Site until the issuance of a Certificate of Completion.

The Site Safety Coordinator will be Jesse Mausner. A resume will be provided to NYSDEC prior to the start of remediation.

Confined space entry will comply with all OSHA requirements to address the potential risk posed by combustible and toxic gasses.

4.1.2 Quality Assurance Project Plan (QAPP)

A Quality Assurance Project Plan (QAPP) has been created for the Site to address quality control and quality assurance procedures for all Site sampling including post excavation endpoint sampling and is included in Appendix F.

4.1.3 Construction Quality Assurance Plan (CQAP)

No construction is planned for remediation of Parcel 8. The QAPP, Section 4.1.2, specifies the procedures to address quality control.

4.1.4 Soil/Materials Management Plan (SoMP)

The Soil/Materials Management Plan (SoMP) includes plans for managing all soils/materials that are disturbed at the Site. The SoMP, which describes procedures for excavation, handling, storage, transport and disposal, is included in Appendix G.

4.1.5 Storm-Water Pollution Prevention Plan (SWPPP)

The Storm Water Pollution Prevention Plan (SWPPP) addresses the requirements of the NYSDEC SPDES General Permit for Storm water Discharges from Construction Activity (GP-0-08-001 including physical methods to control and/or divert surface water flows and to limit the potential for erosion and migration of Site soils, via wind or water. This plan is included in Appendix H.

The erosion and sediment controls will be in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control.

4.1.6 Community Air Monitoring Plan (CAMP)

The purpose of the CAMP is to protect downwind receptors (e.g., residences, businesses, schools, nearby workers, and the public) from potential airborne contaminants released as a direct result of the Remedial Action (RA) being performed at the Site. This plan is presented in Appendix I.

4.1.7 Contractors Site Operations Plan (SOP)

The Remedial Engineer has reviewed all plans and submittals for this remedial project (including those listed above and contractor and sub-contractor document submittals) and confirms that they are in compliance with this RAWP. The Remedial Engineer is responsible to ensure that all later document submittals for this remedial project, including contractor and sub-contractor document submittals, are in compliance with this RAWP. All remedial documents will be submitted to NYSDEC and NYSDOH in a timely manner and prior to the start of work.

~~A detailed remedial construction design document will be submitted to NYSDEC for approval in [date].~~

4.1.8 Citizen Participation Plan

The Citizen Participation Plan (CPP) provides members of the affected and interested public with information about how NYSDEC will inform and involve them during the investigation and remediation of the Site identified above. The approved CPP for this project is attached in Appendix J.

A certification of mailing will be sent by the Volunteer to the NYSDEC project manager following the distribution of all Fact Sheets and notices that includes: (1) certification that the Fact Sheets were mailed, (2) the date they were mailed; (3) a copy of the Fact Sheet, (4) a list of recipients (contact list); and (5) a statement that the repository was inspected on (specific date) and that it contained all of applicable project documents.

No changes will be made to the approved Fact Sheets authorized for release by NYSDEC without written consent of the NYSDEC. No other information, such as brochures and flyers, will be included with the Fact Sheet mailing.

The approved Citizen Participation Plan for this project is attached in Appendix J.
Document repositories have been established at the following locations and contain all applicable project documents:

Queens Borough Public Library
Court Square Branch
2501 Jackson Avenue
Long Island City, New York 11101
(718) 937-2790
Mon 12-7; Tue 1-6; Wed 10-6; Thurs 12-6; Fri 12-6; Sat 10-5:30; Sun closed

NYSDEC Region 2 Office
47-40 21st Street
Long Island City, NY 11101
Call in advance – (718) 482-6405
Mon. to Fri. 9 a.m. to 4 p.m.

Community Board No. 2 Office
43-22 50th Street - Second Floor
Woodside, New York 11377
(call in advance) (718) 533-8773
Mon. to Fri. 9 a.m. to 5 p.m.

4.2 GENERAL REMEDIAL CONSTRUCTION INFORMATION

4.2.1 Project Organization

An organization chart is included in Table 5. Resumes of key personnel involved in the Remedial Action are included in Appendix K.

4.2.2 Remedial Engineer

The Remedial Engineer for this project will be Arnold F. Fleming, P.E. The Remedial Engineer is a registered professional engineer licensed by the State of New York. The Remedial Engineer will have primary direct responsibility for implementation of the remedial program for the Parcel 8 Site (NYSDEC BCA Index No. W2-1059-05-0 Site No. C241087). The Remedial Engineer will certify in the Final Engineering Report that the remedial activities were observed by qualified environmental professionals under his supervision and that the remediation requirements set forth in the Remedial Action Work Plan and any other relevant provisions of ECL 27-1419 have been achieved in full conformance with that Plan. Other Remedial Engineer certification requirements are listed later in this RAWP.

The Remedial Engineer will coordinate the work of other contractors and subcontractors involved in all aspects of remedial construction, including soil excavation, stockpiling, characterization, removal and disposal, air monitoring, emergency spill response services, import

of back fill material, and management of waste transport and disposal. The Remedial Engineer will be responsible for all appropriate communication with NYSDEC and NYSDOH.

The Remedial Engineer will review all pre-remedial plans submitted by contractors for compliance with this Remedial Action Work Plan and will certify compliance in the Final Remediation Report.

The Remedial Engineer will provide the certifications listed in Section 10.1 in the Final Engineering Report.

4.2.3 Remedial Action Construction Schedule

A general remedial action schedule is included in Figure 6.

4.2.4 Work Hours

The hours for operation of remedial construction will conform to the New York City Department of Buildings construction code requirements or according to specific variances issued by that agency. DEC will be notified by the Applicant of any variances issued by the Department of Buildings. NYSDEC reserves the right to deny alternate remedial construction hours.

4.2.5 Site Security

The Site is encircled by a construction fence and all gates will be secured at the conclusion of each work day. Additional Site security will be provided by the Site construction manager as necessary. Only properly trained personnel will be allowed on site during the remedial activities. A log book will be maintained for all site visitors.

4.2.6 Traffic Control

All work will be on Parcel 8. No road or lane closures are anticipated. Truck routes for hauling excavated soil will be adhered to as described in Section 5.4.4.

4.2.7 Contingency Plan

A contingency plan for the discovery of underground storage tanks (USTs) or other previously unidentified contaminant sources during on-Site remedial activities is included in Section 5.4.11.

4.2.8 Worker Training and Monitoring

OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER), site safety training and medical monitoring for Site will be conducted in accordance with the Site specific HASP which is included in Appendix E.

4.2.9 Agency Approvals

The Applicant has addressed all SEQRA requirements for this Site. All permits or government approvals required for remedial construction have been, or will be, obtained prior to the start of remedial construction.

The planned end use for the Site is in conformance with the current zoning for the property as determined by New York City Department of Planning. A Certificate of Completion will not be issued for the project unless conformance with zoning designation is demonstrated.

A complete list of all local, regional and national governmental permits, certificates or other approvals or authorizations required to perform the remedial and development work is attached in Table 6. This list includes a citation of the law, statute or code to be complied with, the originating agency, and a contact name and phone number in that agency. This list will be updated in the Final Engineering Report.

4.2.10 NYSDEC BCP Signage

A project sign will be erected at the main entrance to the Site prior to the start of any remedial activities. The sign will indicate that the project is being performed under the New York State Brownfield Cleanup Program. The sign will meet the detailed specifications provided by the NYSDEC Project Manager and contained in Appendix L.

4.2.11 Pre-Construction Meeting with NYSDEC

A meeting will be held with the Department prior to beginning remediation. The meeting will include, at a minimum, the Remedial Engineer, any field staff employed by the Remedial Engineer, the remedial contractor, and the NYSDEC and NYSDOH Project Managers.

4.2.12 Emergency Contact Information

An emergency contact sheet with names and phone numbers is included in Table 7. That document will define the specific project contacts for use by NYSDEC and NYSDOH in the case of a day or night emergency.

4.2.13 Remedial Action Costs

The total estimated cost of the Remedial Action appears in Table 1. An itemized and detailed summary of estimated costs for all remedial activity is attached as Appendix M. This will be revised based on actual costs and submitted as an Appendix to the Final Engineering Report.

4.3 SITE PREPARATION

4.3.1 Mobilization

Site mobilization will involve the staging of equipment and material to perform the remediation. Mobilization will occur pursuant to the schedule included in Figure 7. Equipment includes 1,000-gallon HDPE tanks, storage trailers, injection mixers and pumps, an equipment enclosure, a generator, carboys of sodium hydroxide, bags of sodium persulfate, and drums of surfactant.

4.3.2 Erosion and Sedimentation Controls

Erosion and sedimentation controls will be instituted in accordance with the SWPPP which is included in Appendix H.

4.3.3 Stabilized Construction Entrance(s)

A pad of gravel will be placed at the point of entry and exit for construction traffic onto the Site, which will be determined by the Contractor prior to beginning work on-Site. A Stabilized Construction Exit/Decontamination Pad (SCE/DP) will be established at all Site exits. At a minimum this SCE/DP will consist of large diameter gravel underlain by filter cloth. This temporary measure will be used to prevent the tracking of contaminated soil outside the work area onto adjacent pavements and public streets. Trucks leaving the Site with excavated soil will be inspected for soil and brushed off. A truck wash with a provision for fluid capture will be added prior to excavation activities and any truck wash water collected for disposal.

4.3.4 Utility Marker and Easements Layout

The Volunteer and its contractors are solely responsible for the identification of utilities that might be affected by work under the RAWP and implementation of all required, appropriate, or necessary health and safety measures during performance of work under this RAWP. The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this RAWP. The Volunteer and its contractors must obtain any local, State or Federal permits or approvals pertinent to such work that may be required to perform work under this RAWP. Approval of this RAWP by NYSDEC does not constitute satisfaction of these requirements.

The presence of utilities and easements on the Site has been investigated by the Remedial Engineer. It has been determined that no risk or impediment to the planned work under this Remedial Action Work Plan is posed by utilities or easements on the Site.

4.3.5 Sheeting and Shoring

Sheeting and/or shoring will not be required for implementation of the selected remedy.

~~Appropriate management of structural stability of on-Site or off-Site structures during on-Site activities include excavation is the sole responsibility of the Applicant and its contractors. The Applicant and its contractors are solely responsible for safe execution of all invasive and~~

~~other work performed under this Plan. The Applicant and its contractors must obtain any local, State or Federal permits or approvals that may be required to perform work under this Plan. Further, the Applicant and its contractors are solely responsible for the implementation of all required, appropriate, or necessary health and safety measures during performance of work under the approved Plan.~~

4.3.6 Equipment and Material Staging

Equipment and material will be safely staged on-Site in a manner to be determined by the Site superintendent.

4.3.7 Decontamination Area

A temporary decontamination pad will be constructed before the stabilized construction exit to decontaminate trucks and other vehicles/equipment leaving the Site. The decontamination pad will be constructed using a 60-mil high density polyethylene (HDPE) liner with perimeter berms, sloped to a low-lying sump to contain any liquids. The decontamination pad will be sized to accommodate the largest construction vehicle used. All decontamination material will be collected and properly disposed of off- site.

4.3.8 Site Fencing

The Site is currently and will be continuously encircled with solid plywood and/or screened chain link fencing to prevent trespassing onto the Site.

4.3.9 Demobilization

Demobilization from the Site will be managed by the Site construction manager, and, at a minimum, will include the following:

- Restoration of areas that may have been disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas, temporary water management area[s], and access area);
- Removal of temporary access areas (whether on-Site or off-Site);
- Removal of sediment and erosion control measures and disposal of materials in accordance with acceptable rules and regulations;
- Equipment decontamination;
- General refuse disposal.

4.4 REPORTING

This section outlines the reporting requirements for the site. All daily and monthly Reports will be included in the Final Engineering Report.

4.4.1 Daily Reports

Daily reports will be submitted to NYSDEC and NYSDOH Project Managers by the end of each day following the reporting period and will include:

- An update of progress made during the reporting period;
- Locations of work and quantities of material imported and exported from the Site;
- References to alpha-numeric map for Site activities;
- A summary of any and all complaints with relevant details (names, phone numbers);
- A summary of CAMP finding, including excursions;
- An explanation of notable Site conditions.

Daily reports are not intended to be the mode of communication for notification to the NYSDEC of emergencies (accident, spill), requests for changes to the RAWP or other sensitive or time critical information. However, such conditions must also be included in the daily reports. Emergency conditions and changes to the RAWP will be addressed directly to NYSDEC Project Manager via personal communication.

Daily Reports will include a description of daily activities keyed to an alpha-numeric map for the Site that identifies work areas. These reports will include a summary of air sampling results, odor and dust problems and corrective actions, and all complaints received from the public.

The NYSDEC assigned project number will appear on all reports.

4.4.2 Monthly Reports

Monthly reports will be submitted to NYSDEC and NYSDOH Project Managers within one week following the end of the month of the reporting period and will include:

- Activities relative to the Site during the previous reporting period and those anticipated for the next reporting period, including a quantitative presentation of work performed (i.e. tons of material exported and imported, etc.);
- Description of approved activity modifications, including changes of work scope and/or schedule;
- Sampling results received following internal data review and validation, as applicable; and,
- An update of the remedial schedule including the percentage of project completion, unresolved delays encountered or anticipated that may affect the future schedule, and efforts made to mitigate such delays.

4.4.3 Other Reporting

Photographs will be taken of all remedial activities and submitted to NYSDEC in digital (JPEG) format. Photos will illustrate all remedial program elements and will be of acceptable quality. Representative photos of the Site prior to any Remedial Actions will be provided. Representative

photos will be provided of each contaminant source, source area and Site structures before, during and after remediation. Photos will be submitted to NYSDEC on CD or other acceptable electronic media and will be sent to NYSDEC's Project Manager (2 copies) and to NYSDOH's Project Manager (1 copy). CD's will have a label and a general file inventory structure that separates photos into directories and sub-directories according to logical Remedial Action components. A photo log keyed to photo file ID numbers will be prepared to provide explanation for all representative photos. For larger and longer projects, photos should be submitted on a monthly basis or another agreed upon time interval.

Job-site record keeping for all remedial work will be appropriately documented. These records will be maintained on-Site at all times during the project and be available for inspection by NYSDEC and NYSDOH staff.

4.4.4 Complaint Management Plan

Complaints received from the public will be immediately reported to the RE's project manager and immediate corrections will be attempted. The NYSDEC project manager will be notified that day regarding the nature of the complaint and any actions taken. The complainant will also be given the NYSDEC project manager's contact information for any follow up. A written log of complaints and corrective actions, if any, will be maintained by the Remedial Engineer or his representative.

4.4.5 Deviations from the Remedial Action Work Plan

During the implementation of the RAWP, any deviation from the RAWP will be noted and immediately brought to the attention of the RE. The RE or his representative will contact the NYSDEC Project Manager and determine if the deviation necessitates a formal RAWP modification and NYSDEC approval. If no formal RAWP modification is required, the deviation will be noted in the Site reports and explained in the FER.

5.0 REMEDIAL ACTION: MATERIAL REMOVAL FROM SITE

Soil will generally be removed by excavating using front end loaders and loading directly into trucks for off-Site removal and transportation to a licensed disposal facility.

5.1 SOIL CLEANUP OBJECTIVES

The Soil Cleanup Objectives for this Site are listed in Table 4.

Soil and materials management on-Site and off-Site will be conducted in accordance with the Soil Management Plan as described below.

~~UST closures will, at a minimum, conform to criteria defined in DER-10.~~

5.2 REMEDIAL PERFORMANCE EVALUATION (POST EXCAVATION END POINT SAMPLING)

5.2.1 End-Point Sampling Frequency

Subsequent to removal of the top four feet of soil and any hot spots, endpoint samples will be collected in accordance with DER-10 section 5.4(b)(5), at a rate of one sample for every 900 ft^2 of bottom area and one sample for every 30 linear feet of sidewall.

5.2.2 Methodology

Bottom samples will be collected from the first six inches of remaining soil. Sidewall samples will be collected from the face of the sidewall. Both samples will be collected from the locations that appear to have the most remaining contamination. Refer to Section 3.4 and Table 4 for the sampling parameters.

5.2.3 QA/QC

Excavation endpoint sampling will be subject to the QA/QC requirements included in the QAPP which is included in Appendix E.

5.2.4 DUSR

All excavation endpoint sampling data analytical reports will undergo a third party review of the analyses conducted. The third party (New Environmental Horizons, Inc.) will produce a Data Usability Summary Report (DUSR) which will be submitted to the NYSDEC. The DUSR will be included as an appendix in the FER.

5.2.5 Reporting of End-Point Data in FER

Chemical labs used for all end-point sample results and contingency sampling will be NYSDOH ELAP certified.

End point sampling, including bottom and side-wall sampling, will be performed in accordance with DER-10 sample frequency requirements. Side-wall samples will be collected a minimum of every 30 linear feet. Bottom samples will be collected at a rate of one for every 900 ft^2. The FER will provide a tabular and map summary of all end-point sample results and exceedances of SCOs.

5.3 ESTIMATED MATERIAL REMOVAL QUANTITIES

The estimated quantity of soil/fill to be removed from the Site is 4,800 cubic yards. The estimated quantity of soil to be imported into the Site for backfill and cover soil is 2,400 cubic yards. No soil/fill is expected to be reused/relocated on Site.

5.4 SOIL/MATERIALS MANAGEMENT PLAN

5.4.1 Soil Screening Methods

Visual, olfactory and PID soil screening and assessment will be performed by a qualified environmental professional during all remedial and development excavations into known or potentially contaminated material (Residual Contamination Zone). Soil screening will be performed regardless of when the invasive work is done and will include all excavation and invasive work performed during the remedy and during development phase, such as excavations for foundations and utility work, prior to issuance of the COC.

All primary contaminant sources (including but not limited to tanks and hotspots) identified during Site Characterization, Remedial Investigation, and Remedial Action will be surveyed by a surveyor licensed to practice in the State of New York. This information will be provided on maps in the Final Engineering Report.

Screening will be performed by qualified environmental professionals. Resumes will be provided for all personnel responsible for field screening (i.e. those representing the Remedial Engineer) of invasive work for unknown contaminant sources during remediation and development work.

5.4.2 Stockpile Methods

Limited space precludes stockpiling for any extended period. The only stockpiling that may occur is for a day or two prior to removal by truck. The Site is at a lower elevation than the surrounding area, so runoff will not be an issue. Any soil stockpiled overnight will be placed on and covered with plastic sheeting and the ends weighted down to secure the cover. Odor suppressant material will be applied to the stockpiled soil prior to covering. A nearby hydrant serves as a readily available source of water to control dust.

In the case of soil stockpiling on-Site, the following precautions will be taken:

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Soil stockpiles will be continuously encircled with silt fences. Hay bales will be used as needed near catch basins, surface waters and other discharge points in accordance with the SWPPP.

~~A dedicated water truck equipped with a water cannon will be available on-Site for dust control.~~

5.4.3 Materials Excavation and Load Out

The Remedial Engineer or a qualified environmental professional under his supervision will oversee all invasive work and the excavation and load-out of all excavated material.

The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the Site has been investigated by the Remedial Engineer. It has been determined that no risk or impediment to the planned work under this Remedial Action Work Plan is posed by utilities or easements on the Site.

Loaded vehicles leaving the Site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

~~A truck wash will be operated on-Site.~~ The Remedial Engineer will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the Site until the remedial construction is complete.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-Site sediment tracking.

The Remedial Engineer will be responsible for ensuring that all egress points for truck and equipment transport from the Site will be clean of dirt and other materials derived from the Site during Site remediation and development. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

The Volunteer and associated parties preparing the remedial documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all invasive work, the structural integrity of excavations, and for structures that may be affected by excavations (such as building foundations and bridge footings).

The Remedial Engineer will ensure that Site development activities will not interfere with, or otherwise impair or compromise, remedial activities proposed in this Remedial Action Work Plan.

Each hotspot ~~and structure to be remediated (USTs, vaults and associated piping, transformers, etc.)~~ will be removed and end-point remedial performance sampling completed before excavations related to Site development commence proximal to the hotspot or structure.

Development-related grading cuts and fills will not be performed without NYSDEC approval and will not interfere with, or otherwise impair or compromise, the performance of remediation required by this plan.

Mechanical processing of historical fill and contaminated soil on-Site is prohibited.

All primary contaminant sources (including but not limited to tanks and hotspots) identified during Site Characterization, Remedial Investigation, and Remedial Action will be surveyed by a surveyor licensed to practice in the State of New York. The survey information will be shown on maps to be reported in the Final Engineering Report.

5.4.4 Materials Transport Off-Site

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Truck transport routes are in accordance with the New York City Department of Transportation (DOT) truck map, which is included in Appendix N. All trucks loaded with Site materials will exit the vicinity of the Site using only these approved truck routes.

Proposed in-bound and out-bound truck routes to the Site are shown in Figure 1 of Appendix N. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during Site remediation and development.

Queuing of trucks will be performed on-Site in order to minimize off-Site disturbance.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

All trucks will be washed prior to leaving the Site. Trucks leaving the Site with excavated soil will be inspected for soil and brushed off. If needed, a truck wash will be added.

5.5.5 Materials Disposal Off-Site

The disposal location will be established at a later date and will be reported to the NYSDEC Project Manager. The total quantity of material expected to be disposed off-Site is 4,800 tons. Of this, the majority is expected to consist of non-hazardous historic urban fill containing SVOCs and PAHs. A small quantity, on the order of one to three tons will be removed as TSCA PCB hazardous waste. There is a possibility that an even smaller volume of soil will be removed as hazardous waste for lead in soils. Some portion of the material contains large concrete, stone, and metal pieces. These will be handled as construction and demolition (C & D) material.

All soil/fill/solid waste excavated and removed from the Site will be treated as contaminated and regulated material and will be disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this Site is proposed for unregulated disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to NYSDEC's Project Manager. Unregulated off-Site management of materials from this Site is prohibited without formal NYSDEC approval.

Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

The following documentation will be obtained and reported by the Remedial Engineer for each disposal location used in this project to fully demonstrate and document that the disposal of material derived from the Site conforms with all applicable laws: (1) a letter from the Remedial Engineer or BCP Applicant to the receiving facility describing the material to be disposed and requesting formal written acceptance of the material. This letter will state that material to be disposed is contaminated material generated at an environmental remediation Site in New York State. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a summary of all chemical data for the material being transported (including Site Characterization data); and (2) a letter from all receiving facilities stating it is in receipt of the correspondence (above) and is approved to accept the material. These documents will be included in the FER.

Non-hazardous historic fill and contaminated soils taken off-Site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2

Historical fill and contaminated soils from the Site are prohibited from being disposed at Part 360-16 Registration Facilities (also known as Soil Recycling Facilities).

Soils that are contaminated but non-hazardous and are being removed from the Site are considered by the Division of Solid & Hazardous Materials (DSHM) in NYSDEC to be Construction and Demolition (C & D) materials with contamination not typical of virgin soils. These soils may be sent to a permitted Part 360 landfill. They may be sent to a permitted C/D processing facility without permit modifications only upon prior notification of NYSDEC Region 2 DSHM. This material is prohibited from being sent or redirected to a Part 360-16 Registration Facility. In this case, as dictated by DSHM, special procedures will include, at a minimum, a letter to the C & D facility that provides a detailed explanation that the material is derived from a DER remediation Site, that the soil material is contaminated and that it must not

be redirected to on-Site or off-Site Soil Recycling Facilities. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a summary of all chemical data for the material being transported.

The Final Engineering Report will include an accounting of the destination of all material removed from the Site during this Remedial Action, including excavated soil, contaminated soil, historic fill, solid waste, and hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. This information will also be presented in a tabular form in the FER.

Bill of Lading system or equivalent will be used for off-Site movement of non-hazardous wastes and contaminated soils. This information will be reported in the Final Engineering Report.
Hazardous wastes derived from on-Site will be stored, transported, and disposed of in full compliance with applicable local, State, and Federal regulations.

Appropriately licensed haulers will be used for material removed from this Site and will be in full compliance with all applicable local, State and Federal regulations.

Waste characterization will be performed for off-Site disposal in a manner suitable to the receiving facility and in conformance with applicable permits. Sampling and analytical methods, sampling frequency, analytical results and QA/QC will be reported in the FER. All data available for soil/material to be disposed at a given facility must be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

5.4.6 Materials Reuse On-Site

Refer to Section 5.4.9.

~~Chemical criteria for on-Site reuse of material has been approved by NYSDEC. This criteria is listed in Table [x]. The Remedial Engineer will ensure that procedures defined for materials reuse in this RAWP are followed and that unacceptable material will not remain on-Site.~~

~~Acceptable demolition material proposed for reuse on-Site, if any, will be sampled for asbestos.~~

Concrete crushing or processing on-Site is prohibited.

Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site is prohibited for reuse on-Site.

Contaminated on-Site material, including historic fill and contaminated soil, removed for grading or other purposes will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines. This will be expressed in the final Site Management Plan.

5.4.7 Fluids Management

All liquids to be removed from the Site, including dewatering fluids, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Liquids

discharged into the New York City sewer system will be addressed through approval by NYCDEP.

Dewatered fluids will not be recharged back to the land surface or subsurface of the Site. Dewatering fluids will be managed off-Site.

Discharge of water generated during remedial construction to surface waters (i.e. a local pond, stream or river) is prohibited without a SPDES permit.

5.4.8 Demarcation

After the completion of soil removal and any other invasive remedial activities and prior to backfilling, a land survey will be performed by a New York State licensed surveyor. The survey will define the top elevation of residual contaminated soils. A physical demarcation layer, consisting of orange snow fencing material or equivalent material will be placed on this surface to provide a visual reference. This demarcation layer will constitute the top of the 'Residuals Management Zone', the zone that requires adherence to special conditions for disturbance of contaminated residual soils defined in the Site Management Plan. The survey will measure the grade covered by the demarcation layer before the placement of cover soils, pavement and sub-soils, structures, or other materials. This survey and the demarcation layer placed on this grade surface will constitute the physical and written record of the upper surface of the 'Residuals Management Zone' in the Site Management Plan. A map showing the survey results will be included in the Final Remediation Report and the Site Management Plan.

5.4.9 Backfill from Off-Site Sources

Imported backfill may be necessary for Site stabilization. The preferred backfill material will be the RCA material stored on Stage 3 of the QWD property that was previously approved by NYSDEC for use within the QWD areas.[9] Otherwise, clean compactable soil, which meets applicable building codes, will be used. A certificate detailing the chemical sampling data and source will be sent to NYSDEC for approval. In the event that soil backfill is required the following procedure will be followed:

All imported soils, except for RCA material currently stored on Stage 3 that was previously approved by NYSDEC for use within the QWD sites, will be sampled to ensure that they meet the requirements of Part 375-6.7(d)(1) (the more stringent of the Protection of Groundwater or Protection of Public Health SCOs for Commercial Use), or are otherwise approved by NYSDEC.

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[9] The re-use of RCA that originated on other QWD sites was approved for sites C241095 (formerly known as V00505D) and C241096 (formerly known as V00505C) in the TRC January 2008 Remedial Action Work Plan for those Queens West Development – Stage 2 sites: "Recycled concrete aggregate that originated from other portions of the Queens West Development property and that meets 'exempt fill' requirements under 6 NYCRR 375-6.7(d)(1)(ii)(b) may be imported to the BCP Site from other portions of the QWD properties. . . ."

The use of RCA as backfill on Parcel 8 was also approved by NYSDEC in the December 2007 Parcel 8 *Interim Remedial Measures Plan.*

Confirmatory samples will be collected at the frequency described in DER-10 table 5.4 and analyzed for VOCs, SVOCs, Metals, Pesticides, PCBs. The results of this sampling will be forwarded to NYSDEC for approval prior to import. Non-compliant soils will not be imported onto the Site without prior approval by NYSDEC.

After approval, imported soil (if necessary) that is not directly emplaced will be stored onsite on clean polyethylene sheeting away from all deleterious substances. The stockpile will be covered with clean polyethylene sheeting. The location, volume, and condition of this stockpile will be noted in the weekly reports.

All materials proposed for import onto the Site will be approved by the Remedial Engineer and will be in compliance with provisions in this RAWP prior to receipt at the Site.

Material from industrial sites, spill sites, other environmental remediation sites or other potentially contaminated sites will not be imported to the Site.

The Final Engineering Report will include the following certification by the Remedial Engineer: "I certify that all import of soils from off-Site, including source evaluation, approval and sampling, has been performed in a manner that is consistent with the methodology defined in the Remedial Action Work Plan".

All imported soils, except previously approved RCA from Stage 3, will meet NYSDEC approved backfill or cover soil quality objectives for this Site. ~~These NYSDEC approved backfill or cover soil quality objectives are the lower of the protection of groundwater or the protection of public health soil cleanup objectives for [site specific use] as set forth in Table 375-6.8(b) of 6 NYCRR Part 375.~~

Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Nothing in this Remedial Action Work Plan should be construed as an approval for this purpose.

Solid waste will not be imported onto the Site.

Trucks entering the Site with imported soils will be securely covered with tight fitting covers.

5.4.10 Stormwater Pollution Prevention

The SWPPP addresses the requirements of New York State Storm Water Management Regulations including physical methods to control and/or divert surface water flows and to limit the potential for erosion and migration of Site soils, via wind or water. This plan is included in Appendix H.

Barriers will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the RAWP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters

Silt fencing will be installed around the entire perimeter of the remedial construction area.

5.4.11 Contingency Plan

If USTs or other previously unidentified contaminant sources are found during on-Site remedial excavation or development related construction, sampling will be performed on product, sediment and surrounding soils, etc. Chemical analytical work will be for full scan parameters (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs). These analyses will not be limited to STARS parameters where tanks are identified without prior approval by NYSDEC. Analyses will not be otherwise limited without NYSDEC approval.

Identification of unknown or unexpected contaminated media identified by screening during invasive Site work will be promptly communicated by phone to NYSDEC's Project Manager. These findings will be also included in daily and periodic electronic media reports.

In the event that the remedial plan does not meet the objective of reduction of organic contaminant mass of 90 percent in the treatment zone and groundwater standards are not met after the remedial period is complete, downgradient wells will be installed along the western side of the Site as part of the long term monitoring plan to monitor if contaminated groundwater is leaving the site. If a plume of contaminated groundwater is observed, treatment of the groundwater using ORCA® will be applied to these wells as required by the Department. The number and location of these monitoring/treatment wells will be approved by the Department and presented in the SMP.

5.4.12 Community Air Monitoring Plan

The CAMP was developed using the NYSDOH Generic Community Air Monitoring Plan and is included in Appendix I.

The purpose of the CAMP is to protect downwind receptors (e.g., residences, businesses, schools, nearby workers, and the public) from potential airborne contaminants released as a direct result of the Remedial Action (RA) being performed at the Site. The CAMP helps to confirm that the RA does not spread airborne contamination off-site by providing real-time

monitoring protocols for VOCs and particulates (i.e., dust) at the downwind Site perimeter while the RA is in progress. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. CAMP monitoring stations will be adjusted so as to always be in the upwind and downwind locations. Exceedances observed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers on the day of the occurrence and included in the daily and monthly reports.

A map showing the location of fixed and mobile sampling stations is shown in Figure [x] of Appendix I.

5.4.13 Odor, Dust and Nuisance Control Plan

The Final Engineering Report will include the following certification by the Remedial Engineer: "I certify that all invasive work during the remediation and all invasive development work were conducted in accordance with dust and odor suppression methodology defined in the Remedial Action Work Plan."

5.4.13.1 Odor Control Plan

This odor control plan is capable of controlling emissions of nuisance odors off-Site. Specific odor control methods to be used on a routine basis will include (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-Site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of all other complaints about the project. Implementation of all odor controls, including the halt of work, will be the responsibility of the Applicant's Remedial Engineer, who is responsible for certifying the Final Engineering Report.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-Site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

Excavation will take place only in the winter months or when the weather is cold so as to minimize odors. Additionally, odor control foam and spray (Ecosorb) will be on hand to control any odors should they arise. As a final contingency, an enclosure will be available that can be erected within three days should the need arise. In the event significant odor conditions arise that cannot be adequately managed with foam and spray, excavation will cease until the enclosure is erected and all enclosure air systems are operational. The size and type of enclosure will depend on amount of excavation to be completed inside the enclosure. Details will be provided to the Department at the time, if necessary.

5.4.13.2 Dust Control Plan

Contractor will supply a laborer designated for truck inspection and decontamination. Truck washing will occur during the all excavation and load-out of material.

A dust suppression plan that addresses dust management during invasive on-Site work will include, at a minimum, the items listed below, as applicable:

- Dust suppression will be achieved through the use of a dedicated fire hydrant line for road wetting.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-Site roads will be limited in total area to minimize the area required for water truck sprinkling.

5.4.13.3 Other Nuisances

The Site is a bare open space. No other nuisances are reasonably foreseen. Any unforeseen nuisances that arise will be dealt with on a case-by-case basis.

~~A plan for rodent control will be developed and utilized by the contractor prior to and during Site clearing and Site grubbing, and during all remedial work.~~

A plan will be developed and utilized by the contractor for all remedial work and will conform, at a minimum, to NYCDEP noise control standards.

6.0 RESIDUAL CONTAMINATION TO REMAIN ON-SITE

Since residual contaminated soil and groundwater/soil vapor will likely exist beneath the Site after the remedy is complete, Engineering and Institutional Controls (ECs and ICs) are required to protect human health and the environment. These ECs and ICs are described hereafter. Long-term management of EC/ICs and of residual contamination will be executed under a Site specific Site Management Plan (SMP) that will be developed and included in the FER.

ECs will be implemented to protect public health and the environment by appropriately managing residual contamination. The Controlled Property (the Site) will have two primary EC systems. These are: (1) a sub-slab depressurization system and vapor barrier, and minimum one-foot-thick concrete slab will be incorporated in the construction of any structures that will be occupied and (2) any remaining residually contaminated soils will be covered with the composite cover system described in Section 7.1. The FER will report residual contamination on the Site in tabular and map form. This will include presentation of exceedances of both Track 1 and Track 4 SCOs. ~~This will include presentation of exceedances of both Track 1 and Track 4 sites.~~

7.0 ENGINEERING CONTROLS: COMPOSITE COVER SYSTEM

7.1 COMPOSITE COVER SYSTEM

The entire site will be covered with a minimum of 2 feet of NYSDEC-approved fill, with an additional cover of concrete building slab or asphalt paving on some areas. This will prevent exposure to residually contaminated soils.

Exposure to residual contaminated soils will be prevented by an engineered composite cover system that will be built on the Site. This composite cover system will be comprised of concrete building slabs and concrete covered sidewalks.

~~Exposure to residual contaminated soils will be prevented by an engineered, composite cover system that will be built on the Site . This composite cover system will be comprised of a vapor barrier, asphalt covered roads, concrete covered sidewalks, and concrete building slabs.~~

A Soil Management Plan will be included in the Site Management Plan and will outline the procedures to be followed in the event that the composite cover system and underlying residual contamination are disturbed after the Remedial Action is complete.

~~A diagram showing the design detail for each cover type is shown in Figure [x].~~

~~A map showing the aerial distribution of each of the cover types to be built at the Site is included in Figure [x].~~

Maintenance of this composite cover system will be described in the Site Management Plan in the FER.

8.0 ENGINEERING CONTROLS: TREATMENT SYSTEMS

The Site Management Plan will detail the specifications for a proposed soil vapor barrier and SSDS once building plans are finalized.

8.1 Criteria for Completion of Remediation/Termination of Remedial Systems

8.1.1 Sub-slab Depressurization System (SSDS)

The SSDS will not be discontinued without written approval by NYSDEC and NYSDOH. A proposal to discontinue the active SSDS may be submitted by the property owner based on confirmatory data that justifies such request. Systems will remain in place and operational until permission to discontinue use is granted in writing by NYSDEC and NYSDOH.

8.1.2 Composite Cover System

The composite cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in perpetuity.

9.0 INSTITUTIONAL CONTROLS

After the remedy is complete, the Site will likely have residual contamination remaining in place. Engineering Controls (ECs) for the residual contamination have been incorporated into the remedy to render the overall Site remedy protective of public health and the environment. Two elements have been designed to ensure continual and proper management of residual contamination in perpetuity: an Environmental Easement and a Site Management Plan. These elements are described in this Section. A Site-specific Environmental Easement will be recorded with Queens County to provide an enforceable means of ensuring the continual and proper management of residual contamination and protection of public health and the environment in perpetuity or until released in writing by NYSDEC. It requires that the grantor of the Environmental Easement and the grantor's successors and assigns adhere to all Engineering and Institutional Controls (ECs/ICs) placed on this Site by this NYSDEC-approved remedy. ICs provide restrictions on Site usage and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. The Site Management Plan (SMP) describes appropriate methods and procedures to ensure compliance with all ECs and ICs that are required by the Environmental Easement. Once the SMP has been approved by the NYSDEC, compliance with the SMP is required by the grantor of the Environmental Easement and grantor's successors and assigns.

9.1 ENVIRONMENTAL EASEMENT

An Environmental Easement, as defined in Article 71 Title 36 of the Environmental Conservation Law, is required when residual contamination is left on-Site after the Remedial Action is complete. As part of this remedy, an Environmental Easement approved by NYSDEC will be filed and recorded with the Queens County Register's Office. The Environmental Easement will be submitted as part of the Final Remediation Report.

The Environmental Easement renders the Site a Controlled Property. The Environmental Easement must be recorded with the Queens County Register's Office before the Certificate of Completion can be issued by NYSDEC. A series of Institutional Controls are required under this remedy to implement, maintain and monitor these Engineering Control systems, prevent future exposure to residual contamination by controlling disturbances of the subsurface soil and restricting the use of the Site to Commercial use(s) only. These Institutional Controls are requirements or restrictions placed on the Site that are listed in, and required by, the Environmental Easement. Institutional Controls can, generally, be subdivided between controls that support Engineering Controls, and those that place general restrictions on Site usage or other requirements. Institutional Controls in both of these groups are closely integrated with the Site Management Plan, which provides all of the methods and procedures to be followed to comply with this remedy.

The Institutional Controls that support Engineering Controls are:

- Compliance with the Environmental Easement by the Grantee and the Grantee's successors and adherence of all elements of the SMP is required;

- All Engineering Controls must be operated and maintained as specified in the SMP;
- A soil vapor mitigation system consisting of a sub-slab depressurization system under all occupied building structures must be inspected, certified, operated and maintained as required by the SMP;
- All Engineering Controls on the Controlled Property, including the composite cover system and SSDS, must be inspected and certified at a frequency and in a manner defined in the SMP;
- Groundwater and soil vapor monitoring must be performed as defined in the SMP;
- Data and information pertinent to Site Management for the Controlled Property must be reported at the frequency and in a manner defined in the SMP;
- On-Site environmental monitoring devices, including but not limited to, groundwater monitoring wells and soil vapor probes, must be protected and replaced as necessary to ensure proper functioning in the manner specified in the SMP;
- Engineering Controls may not be discontinued without an amendment or extinguishment of the Environmental Easement.
- ~~A composite cover system consisting of asphalt covered roads, concrete covered sidewalks, and concrete building slabs must be inspected, certified and maintained as required in the SMP~~;

Adherence to these Institutional Controls for the Site is mandated by the Environmental Easement and will be implemented under the Site Management Plan (discussed in the next section). The Controlled Property (Site) will also have a series of Institutional Controls in the form of Site restrictions and requirements. The Site restrictions that apply to the Controlled Property are:

- Vegetable gardens and farming on the Controlled Property are prohibited;
- Use of groundwater underlying the Controlled Property is prohibited without treatment rendering it safe for intended purpose;
- All future activities on the Controlled Property that will disturb residual contaminated material are prohibited unless they are conducted in accordance with the soil management provisions in the Site Management Plan;
- The Controlled Property may be used for restricted commercial use only, provided the long-term Engineering and Institutional Controls included in the Site Management Plan are employed;
- The Controlled Property may not be used for a higher level of use, such as restricted residential use without an amendment or extinguishment of this Environmental Easement;
- Grantor agrees to submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC;

and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or an alternate period of time that NYSDEC may allow. This annual statement must be certified by an expert that the NYSDEC finds acceptable.

9.2 SITE MANAGEMENT PLAN

Site Management is the last phase of remediation and begins with the approval of the Final Engineering Report and issuance of the Certificate of Completion (COC) for the Remedial Action. The Site Management Plan is submitted as part of the FER but will be written in a manner that allows its removal and use as a complete and independent document. Site Management continues in perpetuity or until released in writing by NYSDEC. The property owner is responsible to ensure that all Site Management responsibilities defined in the Environmental Easement and the Site Management Plan are performed.

The SMP is intended to provide a detailed description of the procedures required to manage residual contamination left in place at the Site following completion of the Remedial Action in accordance with the BCA with the NYSDEC. This includes: (1) development, implementation, and management of all Engineering and Institutional Controls; (2) development and implementation of monitoring systems and a Monitoring Plan; (3) development of a plan to operate and maintain any treatment, collection, containment, or recovery systems (including, where appropriate, preparation of an Operation and Maintenance Manual); (4) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communication of Site information to NYSDEC; and (5) defining criteria for termination of treatment system operation.

To address these needs, the SMP will include four plans: (1) an Engineering and Institutional Control Plan for implementation and management of EC/ICs; (2) a Monitoring Plan for implementation of Site Monitoring; (3) an Operation and Maintenance Plan for implementation of remedial collection, containment, treatment, and recovery systems; and (4) a Site Management Reporting Plan for submittal of data, information, recommendations, and certifications to NYSDEC. The SMP will be prepared in accordance with the requirements of ~~in~~ NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 and the guidelines provided by NYSDEC. The Monitoring plan will include a provision for installation of contingency chemical application/injection wells on the downgradient side of Parcel 8 for future chemical, ORCA, application to address off-Site migration of contaminated groundwater in the event that the remediation goals are not realized.

Site management activities, reporting, and EC/IC certification will be scheduled on a certification period basis. The certification period will be annually. The Site Management Plan will be based on a calendar year and will be due for submission to NYSDEC by March 1 of the year following the reporting period.

The Site Management Plan in the Final Remediation Report will include a monitoring plan for groundwater at the down-gradient Site perimeter to evaluate Site-wide performance of the remedy. ~~Appropriately placed groundwater monitor wells will also be installed immediately down-gradient of all volatile organic carbon remediation areas for the purpose of evaluation of the effectiveness of the remedy that is implemented.~~ The results of two year's worth of quarterly groundwater monitoring will be reviewed to assess whether monitoring may cease or be reduced, with Department approval.

No exclusions for handling of residual contaminated soils will be provided in the Site Management Plan (SMP). All handling of residual contaminated material will be subject to provisions contained in the SMP.

10.0 FINAL ENGINEERING REPORT

A Final Engineering Report (FER) and Certificate of Completion (COC) will be submitted to NYSDEC following implementation of the Remedial Action defined in this RAWP. The FER provides the documentation that the remedial work required under this RAWP has been completed and has been performed in compliance with this plan. The FER will provide, as applicable, a comprehensive account of the locations and characteristics of all material removed from the Site ~~including the surveyed map(s) of all sources.~~ The Final Engineering Report will include as-built drawings for all constructed elements, certifications, manifests, bills of lading as well as the complete Site Management Plan (formerly the Operation and Maintenance Plan). The FER will provide a description of the changes in the Remedial Action from the elements provided in the RAWP and associated design documents. The FER will provide a tabular summary of all performance evaluation sampling results and all material characterization results and other sampling and chemical analysis performed as part of the Remedial Action. The FER will provide test results demonstrating that all mitigation and remedial systems are functioning properly. The FER will be prepared in conformance with DER-10.

Where determined to be necessary by NYSDEC, a Financial Assurance Plan will be required to ensure the sufficiency of revenue to perform long-term operations, maintenance and monitoring tasks defined in the Site Management Plan and Environmental Easement. This determination will be made by NYSDEC in the context of the Final Engineering Report review.

The Final Remediation Report will include written and photographic documentation of all remedial work performed under this remedy.

The FER will include an itemized tabular description of actual costs incurred during all aspects of the Remedial Action.

The FER will provide a thorough summary of all residual contamination left on the Site after the remedy is complete. Residual contamination includes all contamination that exceeds the Track 1 Unrestricted Use SCO in 6NYCRR Part 375-6. A table that shows exceedances from Track 1 Unrestricted SCOs for all soil/fill remaining at the Site after the Remedial Action and a map that shows the location and summarizes exceedances from Track 1 Unrestricted SCOs for all soil/fill remaining at the Site after the Remedial Action will be included in the FER.

The FER will provide a thorough summary of all residual contamination that exceeds the SCOs defined for the Site in the RAWP and must provide an explanation for why the material was not removed as part of the Remedial Action. A table that shows residual contamination in excess of Site SCOs and a map that shows residual contamination in excess of Site SCOs will be included in the FER.

The Final Engineering Report will include an accounting of the destination of all material removed from the Site, including excavated contaminated soil, historic fill, solid waste, hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. It will provide an accounting of the origin and chemical quality of all material imported onto the Site.

Before approval of a FER and issuance of a Certificate of Completion, all project reports must be submitted in digital form on electronic media (PDF).

10.1 CERTIFICATIONS

The following certification will appear in front of the Executive Summary of the Final Engineering Report. The certification will be signed by the Remedial Engineer, Arnold F. Fleming, who is a Professional Engineer registered in New York State This certification will be appropriately signed and stamped. The certification will include the following statements:

I, Arnold F. Fleming, am currently a registered professional engineer licensed by the State of New York. I had primary direct responsibility for implementation of the remedial program for Parcel 8 Site (NYSDEC BCA Index No. W2-1059-05-03, Site No. C241087).

I certify that this Final Engineering Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that the Site description presented in this FER is identical to the Site descriptions presented in the Environmental Easement, the Site Management Plan, and the Brownfield Cleanup Agreement for Parcel 8 and related amendments.

I certify that the Remedial Action Work Plan dated [month day year] and Stipulations [if any] in a letter dated [month day year] and approved by the NYSDEC were implemented and that all requirements in those documents have been substantively complied with.

I certify that the remedial activities were observed by qualified environmental professionals under my supervision and that the remediation requirements set forth in the Remedial Action Work Plan and any other relevant provisions of ECL 27-1419 have been achieved.

I certify that all use restrictions, Institutional Controls, Engineering Controls, and all operation and maintenance requirements applicable to the Site are contained in an Environmental Easement created and recorded pursuant ECL 71-3605 and that all affected local governments, as defined in ECL 71-3603, have been notified that such easement has been recorded. A Site Management Plan has been submitted by the Applicant for the continual and proper operation, maintenance, and monitoring of all Engineering Controls employed at the Site, including the proper maintenance of all remaining monitoring wells, and that such plan has been approved by the NYSDEC.

I certify that the export of all contaminated soil, fill, water or other material from the property was performed in accordance with the Remedial Action Work Plan, and were taken to facilities licensed to accept this material in full compliance with all Federal, State and local laws.

I certify that all import of soils from off-Site, including source approval and sampling, has been performed in a manner that is consistent with the methodology defined in the Remedial Action Work Plan.

I certify that all invasive work during the remediation and all invasive development work were conducted in accordance with dust and odor suppression methodology and soil screening methodology defined in the Remedial Action Work Plan.

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

11.0 SCHEDULE

A remedial action schedule is included in Figure 6. The schedule may be revised after the pilot test results are analyzed and prior to the start of remediation and construction. Major planned deviations will be submitted to the NYSDEC Project Manager for review and approval. All other schedule deviations will be reported to the NYSDEC during the execution of the RAWP.