Review Avenue Development Site (RAD) II

LONG ISLAND CITY, QUEENS, NEW YORK

Final Engineering Report

Brownfield Cleanup Program (BCP) Site Number:
#C241005

Prepared by:

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511 Congress Street, Suite 200

Portland, Maine 04112

and

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200 American Metro Boulevard – Suite 113

Hamilton, New Jersey 08619

December 2015

CERTIFICATIONS

I, **Brent C. O'Dell**, am currently a registered professional engineer licensed by the State of New York, I had primary direct responsibility for implementation of the remedial program activities, and I certify that the **Remedial Action Work Plan** was implemented and that all construction activities were completed in substantial conformance with the Department-approved **Remedial Action Work Plan**.

I certify that the data submitted to the Department with this Final Engineering Report demonstrates that the remediation requirements set forth in the **Remedial Action Work Plan** and in all applicable statutes and regulations have been or will be achieved in accordance with the time frames, if any, established in for the remedy.

I certify that all use restrictions, Institutional Controls, Engineering Controls, and/or any 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.

I certify that a Site Management Plan has been submitted 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 Department.

I certify that all documents generated in support of this report have been submitted in accordance with the DER's electronic submission protocols and have been accepted by the Department.

I certify that all data generated in support of this report have been submitted in accordance with the Department's electronic data deliverable and have been accepted by the Department.

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, Brent C O'Dell, of MACTEC Engineering & Consulting, P.C., am certifying as Owner's Designated Site Representative for the site.

069876	6/7/16	
NYS Professional Engineer #	Date	Signature

Note: include PE stamp

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LIST OF ACRONYMS

AS	Air Sparging
ASP	Analytical Services Protocol
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CAMP	Community Air Monitoring Plan
C/D	Construction and Demolition
CFR	Code of Federal Regulation
CLP	Contract Laboratory Program
COC	Certificate of Completion
CO_2	Carbon Dioxide
CP	Commissioner Policy
DER	Division of Environmental Remediation
EC	Engineering Control
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
ERP	Environmental Restoration Program
GHG	Green House Gas
GWE&T	Groundwater Extraction and Treatment
HASP	Health and Safety Plan
IC	Institutional Control
LNAPL	Light Non-Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules and Regulations
O&M	Operations and Maintenance
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration

OU	Operable Unit
PID	Photoionization Detector
PRP	Potentially Responsible Party
PRR	Periodic Review Report
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAD II	Review Avenue Development II Property
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RP	Remedial Party
RSO	Remedial System Optimization
SAC	State Assistance Contract
SCG	Standards, Criteria and Guidelines
SCO	Soil Cleanup Objective
SMP	Soil Management Plan
SOP	Standard Operating Procedures
SOW	Statement of Work
SPDES	State Pollutant Discharge Elimination System
SSD	Sub-slab Depressurization
SVE	Soil Vapor Extraction
SVI	Soil Vapor Intrusion
SVMS	Soil Vapor Mitigation System
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
USEPA	United States Environmental Protection Agency

UST	Underground Storage Tank
VCA	Voluntary Cleanup Agreement
VCP	Voluntary Cleanup Program
VER	Vacuum Enhanced Recovery

FINAL ENGINEERING REPORT

1.0 BACKGROUND AND SITE DESCRIPTION

Cresswood Environmental Consultants, LLC (Volunteer) retained Golder Associates, Inc. (Golder) to prepare a Remedial Action Work Plan (RAWP) to satisfy the requirements of the New York State Department of Environmental Conservation (NYSDCEC) for the Review Avenue Development (RAD) I and RAD II properties located on Review Avenue in Long Island City, New York, dated February 9, 2007. The RAWP was prepared in accordance with the DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2010) and Subpart 375.3 Brownfield Cleanup Program (BCP) Regulations (NYSDEC, 2006a) and submitted in November 2011. Cresswood Environmental Consultants, LLC entered into two Brownfield Cleanup Agreements (BCA) C241089 and C241005 dated June 6, 2005, with the NYSDEC to participate in the Brownfield's Cleanup Program for the RAD I and RAD II Sites respectively.

The RAD I Site and the RAD II Site are adjacent to each other and have the same physical setting. The RAD Sites had been investigated concurrently since the early 1980's, but were entered into separate BCA and assigned different BCP numbers. The remedy selected by the NYSDEC for the RAD II Site is in the Record of Decision (ROD) issued by the NYSDEC in February 2007. A Decision Document is to be issued by the NYSDEC for the RAD I Site and a separate FER will be provided to address the requirements of that Decision Document. The remainder of this document will focus on the requirements of the ROD for the RAD II Site.

The RAD II Site is approximately 1.8 acres in size, is identified as Block 312 and Lot 69 on the Long Island City Tax Map and is located in a highly industrialized part of Long Island City, County of Queens, New York. Figure 1 presents a site location map. Zoning in this area is designated as heavy manufacturing. All of the structures that previously existed on the RAD II Site were demolished since the property was abandoned in 1981. Much of the RAD II Site was reportedly covered by asphalt or concrete during its operation; large portions of the RAD II Site have since been covered with surficial urban fill and debris. Figure 2 presents a site layout map for the RAD II Site.

The RAD II Site is separated from the RAD I property by a right of way, Preston Street, which runs from Review Avenue to the Long Island Railroad. The address of the RAD II Site is 37 - 80 Review Avenue.

The RAD II Site is bounded by Review Avenue to the northeast, the Southern Line of the Long Island Railroad to the southwest, the Former Phoenix Beverage property to the southeast (37-88 Review Avenue), and the RAD I property (37-30 Review Avenue) to the northwest (see Figure 2). To the northeast of Review Avenue is the Calvary Cemetery and

to the southwest of the Long Island Railroad is the South Capasso property and the Former Peerless Oil property. The boundaries of the RAD II Site are shown on Figure 2.

RAD II has been historically used for a variety of industrial purposes since the late 19th century. Available information indicates that at one time the Site was owned by American Agricultural Chemical Company ("American Agricultural"). In 1931, American Agricultural transferred the southern part of the Site to Triplex Oil. In 1938, American Agricultural transferred the northern part of the Site to Triplex Oil. Triplex Oil used the property for the refining of used crank case oil for approximately 40 years. From 1972 until 1980, the facility was operated by several parties including Russell Mahler and Mahler-owned companies. In 1980 Quanta Resources, Inc. acquired the property, and used the property for the re-refining of used crankcase oil and other liquid recycling before filing for bankruptcy on October 6, 1981. The property was abandoned in November 1981.There were structures on the Site (buildings, tanks, containment areas, concrete pads, sumps, vaults, debris piles, and foundation structures), which were demolished and removed in 2008 as part of an interim remedial action. Angel Aerial Corporation is currently leasing the Site for parking of equipment and vehicles. The source of LNAPL beneath the Site is a function of historic on-site operations.

2.0 SUMMARY OF SITE REMEDY

2.1 Remedial Action Objectives

The remediation goals for the RAD II Site, as stipulated by the ROD dated February 9, 2007, are to eliminate or reduce to the extent practicable:

- The presence of LNAPL as a potential source of soil, groundwater and soil gas contamination;
- Potential for further migration of LNAPL that could result in soil, groundwater or soil gas contamination;
- Exposures of persons at or around the site to VOCs or exceedances of the lower explosive level (LEL) in soil vapor;
- The potential for ingestion/direct contact with contaminated soil; and
- The release of contaminants from the urban soil and LNAPL into groundwater that may create exceedances of groundwater quality standards over time.

In addition, the remediation goals for the RAD II Site are to meet to the extent practicable:

- Ambient groundwater quality standards; and
- Standards, Criteria, Goals (SCGs) for soil to the extent practicable.

2.1.1 Groundwater

Remedial Action Objectives (RAOs) for Public Health Protection

- Restrict the use of untreated groundwater beneath the Site as a potable water source.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for Environmental Protection

- LNAPL recovery to the extent practicable, to remove the source of groundwater contamination and restore groundwater quality to the extent practicable.
- Prevent the discharge of contaminants to surface water.

2.1.2 Soil

RAOs for Public Health Protection

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

RAOs for Environmental Protection

- Prevent migration of contaminants from LNAPL and soil that could result in groundwater contamination.

- Prevent impacts to biota from ingestion or direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.
- Prevent impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain.

2.1.3 Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from the potential for, soil vapor intrusion into buildings at the Site.

2.2 Description of Selected Remedy

The RAD II Site was remediated in accordance with the remedy selected by the NYSDEC in the ROD dated February 9, 2007. The factors considered during the selection of the remedy are those listed in 6NYCRR 375-1.8. The following are the components of the selected remedy as presented in the ROD:

1. A remedial design program has been implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.
2. “Construction of an area wide LNAPL recovery system using a combination of single-phase, vacuum enhanced recovery and localized soil heating methods.”
3. The buildings and tanks on site have been demolished, removed, and the demolition debris properly disposed.
4. The site has been covered by a paving system at least 6 inches in thickness. A 2-foot soil cover will be constructed over all vegetated areas (if any) to prevent exposure to contaminated soils

5. A site management plan has been developed to: (a) address residual contaminated soils that may remain on site or off site during future redevelopment. The plan requires soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (b) evaluate the potential for vapor intrusion for any buildings developed on the Quanta Resources site, including provision for mitigation of any impacts where warranted; (c) identify any use restrictions; and (d) provide for the operation and maintenance of the components of the remedy.

6. Imposition of an institutional control in the form of an environmental easement that (a) requires compliance with the approved site management plan; (b) limits the use and development of the property to commercial or industrial uses only; (c) restricts the use of groundwater as a source of potable water, without necessary water quality treatment as determined by NYSDOH; and (d) requires the property owner to complete and submit to the NYSDEC periodic certifications.

7. Periodic submittals will be provided by the property owner that verify that the institution and engineering controls are still in place, allow NYSDEC access to the site and certify nothing has occurred that will impair ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the site management plan.

8. Since the remedy may result in some untreated hazardous waste remaining at the Quanta Resources site, a long term monitoring program will be instituted. This program will allow the effectiveness of the area wide LNAPL recovery system to be monitored and will be a component of the operation, maintenance, and monitoring for the property.

9. An investigation of the potential for soil vapor intrusion off-site has been completed.

The buildings and tanks on the RAD II Site have been demolished, removed, and the debris properly disposed as presented in the Construction Completion Report – Progress

Submittal, Demolition Documentation dated September 30, 2011 located in Appendix G. The other components of the selected remedy are the preparation of an Environmental Easement and periodic submittals, which are components addressed in the Site Management Plan (SMP). The remedies selected for the RAD II Site are listed below by media:

LNAPL

The remedy for LNAPL beneath the RAD II Site is recovery using single-phase skimmer pumps and vacuum enhanced (VER) recovery methods at locations where higher viscosity LNAPL is present. A long term monitoring program to monitor the effectiveness of the LNAPL recovery system has been implemented.

Soil

The remedy for the soil at the RAD II Site was to cover residual contamination in soil and urban fill using materials consistent with the development of the RAD II Site (i.e. 6 inch paving system.

Groundwater

The remedy for groundwater was the establishment of an institutional control that restricts the use of untreated groundwater beneath the RAD II Site as a source of potable water.

Soil Vapor

The results of soil vapor investigations on the RAD II Site did not identify a threat for migration of soil vapor laterally from the limits of the LNAPL beneath the RAD II Site.

Listed below were the primary elements of the selected remedy:

- Operation of a LNAPL recovery system;
- Installation of a paving system cap at least 6 inches thick to be protective of human health by restricting direct contact with compounds that exceed the soil objectives for restricted use (found in Subpart 375.6 Remedial Program Soil Cleanup Objectives NYSDEC(b));
- Establishment of an institutional control that restricts the use of untreated groundwater beneath the RAD II Site as a source of potable water;

- The execution and recording of an Environmental Easement to restrict land use and prevent future exposure to any contamination remaining at the RAD II Site;
- Development and implementation of a SMP for long term management of remaining contamination as required by the Environmental Easement, which includes plans for the following: (1) ECs and ICs, (2) monitoring, (3) operation and maintenance, and (4) reporting; and
- Periodic certification of the EC's and IC's listed above.

3.0 INTERIM REMEDIAL MEASURES, OPERABLE UNITS AND REMEDIAL CONTRACTS

The selected remedy for the RAD II Site was performed in multiple phases to adequately address specific site characteristics.

- In 1982 the NYCDEP and NYSDEC completed an Emergency Removal Action to address immediate risks posed by the site due to the various waste materials left behind in tanks and related structures. Over 500,000 gallons of oil/water liquids and approximately 900 cubic yards of solids were removed from the site some of which were impacted with PCBs, chlorinated solvents, heavy metals and/or cyanide.
- Following the removal action, an environmental investigation was conducted and the results presented in a report published in January 1983.
- In 1983 Site classification changed to Class 3.
- A Phase I Investigation was conducted in 1984. Site classification was changed to a Class 2a
- A Phase II Investigation was conducted by NYSDEC and a report was published in May 1990. Site classification was changed to Class 2.
- 1988 through 1990 – investigatory work was conducted
- As a result of the Phase II Investigation, an RI Investigation was initiated to define the nature and extent of contamination

- RI report was submitted to NYSDEC in June 2005
- February 2007 – A Record of Decision was published by the NYSDEC
- In 2008 an IRM was implemented. Which involved demolition and removal of the remaining building and 14 remaining empty and decontaminated steel ASTs along with debris piles, below grade foundations, concrete pads, sumps and vaults
- In 2008 a VER LNAPL Recovery Pilot Study was completed by Golder Associates, Inc.
- A RAWP was completed in November 2011 by Golder Associates, Inc.
- A Pre-Design Investigation (PDI), including an LNPAL recovery pilot study, was conducted by Amec Environment & Infrastructure with a PDI report was published in June, 2013.
- LNAPL Recovery System Construction and site capping commenced with well drilling activities during the fall of 2014. In the spring and summer of 2015, the LNAPL recovery system construction the site capping system was constructed. LNAPL Recovery partial commissioning and skimmer pump operation was implemented in August, 2015 with full system commissioning and VER system implementation occurring in November 2015 by Amec Foster Wheeler.

4.0 DESCRIPTION OF REMEDIAL ACTIONS PERFORMED

Remedial activities completed at the RAD II Site were conducted in general conformance with the NYSDEC-approved RAWP and ROD.The changes to the proposed remedy were designed to make the remedy more effective and environmentally sustainable. The major differences are described below.

1. Soil heating (Thermal enhancements) to the proposed product recovery area on RAD II were determined to be ineffective and potentially detrimental (with regards to soil vapor concerns) to LNAPL Recovery.
2. Stormwater controls were found not to be required, as the proposed cover system was determined to be consistent with historical surface cover at the site. No net increase in stormwater flow would result from the paved cap.
3. Vacuum enhanced recovery (VER), employed in the higher viscosity LNAPL areas of the site was modified by eliminating the drop tube and replacing with a 2 phase extraction line approach for utilization of in well, top loading Total Fluids Pumps and separate Soil Vapor Extraction Lines. This modification, increases vacuum enhancement while simultaneously decreasing energy consumption, improving the oil/water separation process and decreasing the size of the treatment system required.
4. The product recovery treatment system will not include storage of TSCA wastes. Additional sampling has found PCB levels to be below 50ppm in all but one recovery well, TF-6D. This well will be managed separately from the full scale system until sample data reveals PCB levels below 50ppm at this location.
5. Chemical treatment was found to be necessary to avoid the potential of biological fouling and emulsification during system operations.

4.1 Governing Documents

4.1.1 Site Specific Health & Safety Plan (HASP)

All remedial work performed under this Remedial Action was in full compliance with governmental requirements, including Site and worker safety requirements mandated by Federal Occupational Safety and Health Administration (OSHA).

A Health and Safety Plan (HASP) was compiled for all remedial and invasive work performed at the Site. The HASP used for the RAD II Site is provided in in Appendix G of the SMP.

4.1.2 Quality Assurance Project Plan (QAPP)

The QAPP provided a framework of procedures, functional activities, and organization to be used during the execution of environmental work at the RAD II Site. The procedures and criteria outlined in the QAPP described the level of performance required to achieve the project objectives.

The objectives of the QAPP were as follows:

- Provide a consistent framework for collecting samples and generating analytical data throughout the project;
- Identify detection limit and quality control (QC) goals for analytical methodologies used to generate chemistry data;
- Set forth review procedures used to demonstrate that the analytical systems are achieving project objectives;
- Set forth record-keeping procedures for field activities, sample collection and handling, and analytical data reporting;
- Provide for generation and documentation of data of known and acceptable quality; and,
- Set forth procedures that limit the effect of non-laboratory activities on analytical data.

The QAPP assured the documentation of RAD II Site activities so that field and analytical measurements could be verified. Quality assurance (QA) activities included the use of a management system to produce valid data in support of the program and a system of checks and reports that monitored the attainment of data quality objectives (DQOs). This management system included plans that allowed for the traceability, completeness, and

security of field and analytical documents, procedures, and the evaluation of data quality relative to DQOs. QC included specific technical activities performed by field or laboratory personnel to demonstrate that system performance was maintained within established criteria. QC activities were included within this QA system to document precision, accuracy, and comparability of results. The QAPP for the RAD II Site is in Appendix F of the SMP.

4.1.3 Community Air Monitoring Plan (CAMP)

A Community Air Monitoring Plan (CAMP) was prepared for the RAD II Site because there is remaining contamination in soil. The CAMP required real-time monitoring for volatile and semi-volatile organic compounds (VOCs and SVOCs) and particulates (i.e., dust) at the downwind perimeter of the RAD II Site when investigation and remediation activities were in progress. The CAMP was not intended for use in establishing action levels for worker respiratory protection. Rather, its intent was to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and onsite workers not directly involved with invasive activities) from a potential airborne contaminant. The action levels in the CAMP required increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helped to confirm that work activities did not spread contamination off-site through the air.

This generic CAMP will also be sufficient to cover the area of the Site for any future invasive activities. Because of the small size of the Site and the Site's conditions, a separate site-specific CAMP or supplement should not be required. Reliance on this CAMP will not preclude simple, common-sense measures to keep VOC, dust, and odors at a minimum around possible future invasive work areas. The CAMP is in Appendix L of the SMP.

4.1.4 Community Participation Plan

The purpose of the Citizen Participation Plan (CP Plan) for the Site was to provide information that would promote and facilitate citizen participation as required in the legislation that created the Brownfields Cleanup Program (BCP). Environmental investigations and remediation were conducted on the RAD II Site to characterize and remove organic constituents identified in the subsurface that were associated with the previous uses of the Site.

The objectives of the CP Plan were as follows:

1. Inform the public of planned and/or ongoing actions, the nature of environmental conditions, responses under consideration, and progress;
2. Create opportunities for the public to provide information, opinions and perspectives on the Site's technical decisions;
3. Ensure open communication among the public, the project staff, and state/local decision makers throughout the remedial progress; and
4. Coordinate public outreach efforts within the involved governmental agencies to best serve the public.

Opportunities for public participation were provided when notices announcing investigative and remedial activities were published in the Environmental Notice Bulletin. Opportunities for public participation were provided when Fact Sheets were distributed that discussed the proposed plans for investigation or remediation.

A Site Contact List which included the names of persons required by the BCP is included below and in the SMP. This list will be updated as necessary to include the names of any parties that identify themselves to the Site's owner or NYSDEC as interested in being on the list.

Company	Title	Name	Address	Office Phone	Mobile Phone	Email
Cresswood Environmental	Owner	David Kushner	Paradigm Capital Group 380 Lexington Avenue 2020 New York, New York 10168	212-661-0858	NA	kush@paradigmcf.com
de maximis	de maximis Project Coordinator	Craig Coslett	1550 Pond Road #120 Allentown, PA 18014	610-435-1151	610-360-7539	ccoslett@demaximis.com
MACTEC	MACTEC Program Director	William Weber	511 Congress Street #200 Portland, ME 04101	207-828-3530	207-289-4213	William.Weber@amecfw.com
MACTEC	MACTEC Project Manager, Engineer of Record (EOR)	Brent O'Dell	200 American Metro Blvd #113 Hamilton, NJ 08619	609-631-2915	908-285-1769	Brent.Odell@amecfw.com
MACTE	MACTEC Health and Safety Officer	Cindy Sundquist	511 Congress Street #200 Portland, ME 04101	207-828-3309	207-650-7593	Cynthia.Sundquist@amecfw.com
MACTEC	MACTEC OMM Manager	Kinjal Shah	200 American Metro Blvd #113 Hamilton, NJ 08619	609-689-2829	732-986-7432	Kinjal.Shah@amecfw.com
MACTEC	MACTEC	Dan Berkowitz	285 Davidson Avenue, Suite 405	732-302-9500	848-702-9743	Daniel.Berkowitz@amecfw.com

Company	Title	Name	Address	Office Phone	Mobile Phone	Email
	OM&M Technical Support		Somerset, New Jersey 08873			
MACTEC	MACTEC Engineering Lead	Tim Kessler	200 American Metro Blvd #113 Hamilton, NJ 08619	609-631-2927	215-704-6592	Timothy.Kessler@amecfw.com
MACTEC	MACTEC System OM&M Manager	Vincent Whelan	200 American Metro Blvd #113 Hamilton, NJ 08619	609-689-2832	609-815-6175	Vincent.Whelan@amecfw.com
MACTEC	MACTEC OM&M Senior Technician	Joe Lewandowski	751 Arbor Way #180 Blue Bell, PA 19422	610-341-0491	610-203-3484	Joseph.Lewandowski@amecfw.com
MACTEC	MACTEC OM&M Technician	Dan Berkowitz	285 Davidson Ave #405 Somerset, NJ 08873	732-302-9500	848-702-9743	Daniel.Berkowitz@amecfw.com

A public document repository was also established at which copies of documents and other information pertaining to the investigation and remediation of the Site, including technical data and reports submitted to the NYSDEC have been placed. The information was kept current and included reports, data, maps and other information gathered during the various stages of investigative and remedial activities at the Site. Fact Sheets were also available at the repository. The repository for the Site is listed below:

Queens Borough Public Library
Sunnyside Branch
4306 Greenpoint Avenue
Long Island City, New York 11104
(718) 784-3033
Hours: Monday- 9:00 am - 8:00 pm,
Tuesday 1:00pm – 6:00pm
Wednesday and Friday 10:00am – 6:00pm
Thursday 12:00pm – 8:00pm
Saturday 10:00 – 5:30
Sunday CLOSED

In addition, complete project records are also kept at the following location:

NYSDEC Region 4 Office
625 Broadway
Albany, New York 12233-0001
Telephone: (518) 402-8545
Hours: Monday-Friday 9:00 am – 3:00 pm

By appointment only, contact Brian Davidson, Remediation Manager, 518-402-9790, brian.davidson@dec.ny.gov

4.1.5 Excavation Plan

The NYSDEC was notified at least 15 days prior to the start of any excavation/soil disturbance activity for remediation or development on the RAD II Site, including grading, trenching, and drilling, where potential remaining contamination was expected to be encountered. The initial notification was made to:

Brian Davidson, Remediation Manager, 518-402-9790,
brian.davidson@dec.ny.gov
Regional Hazardous Waste Remediation Engineer
NYSDEC Region 4 Office
625 Broadway
Albany, New York 12233-0001

This notification included the following:

- A detailed remedial design and description of the work to be performed, including the location and areal extent, plans for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;
- A summary of environmental conditions anticipated in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work;
- A summary of the applicable components of this Excavation Plan;,
- A statement that the work will be performed in compliance with this Excavation Plan and 29 Code of Federal Regulations (CFR) 1910.120;
- A copy of the contractor's health and safety plan (HASP), in electronic format, if it differs from the HASP provided for the Site;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill.

4.1.5.1 Soil Screening Methods

Soil screening was performed by a Qualified Environmental Professional (QEP), Professional Engineer, or designated representative during all remediation and development excavations/soil disturbance activities within known or potentially contaminated material (potential remaining contamination). Soil screening was performed regardless of when the invasive work was done and included all excavation and invasive work performed during remediation, development, utility installation and/or repair in or immediately adjacent to the Site, such as excavations for foundations and utility work. Personnel potentially exposed to contaminated soil were required to have personal protective equipment and the appropriate Hazardous Waste Operations and Emergency Response (HAZWOPER) training under 29 CFR 1910.120.

Soil from drill cuttings, excavation, or grading were segregated based on previous environmental data and screening results 1) soil that requires off-site disposal, 2) soil that requires testing, 3) soil that can be returned to the subsurface, and 4) soil that can be used as cover soil. Soil impacted with LNAPL or from a depth of 15 feet below ground surface (bgs) or greater was segregated and managed as Non-TSCA, Non RCRA Hazardous Petroleum Contaminated Remediation Waste </= 50 mg/kg and disposed off-site at a soil recycling facility. Excess soil obtained from the RAD II Site at a depth < 15 ft or otherwise not visually impacted with saturated LNAPL was reused on the Site beneath the final cap.

4.1.5.2 Stockpile Methods

Soil stockpiles were continuously encircled with erosion and sediment controls, such as a berm and/or silt fence. Hay bales and other erosion and sediment controls were used as needed near catch basins, surface waters and other discharge points.

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

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

4.1.5.3 Materials Excavation and Load Out

Other than drill cuttings, no excavated soils were shipped off the RAD II property during the construction of the cap system and LNAPL recovery system. Excavation and load out of petroleum impacted soils, and disposal of recovered oil and water waste did occur during an Emergency Removal Action in 1982. A QEP, Professional Engineer or person under their direct supervision provided oversight of invasive work and the excavation and re-use of on-site soils generated during the installation of the LNAPL recovery system. The

owner of the property and their contractors were responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the RAD II Site were investigated by the QEP or Professional Engineer. It was determined from this investigation what risks or impediments to the planned work under this plan w posed by utilities or easements on the Site.

The QEP, Professional Engineer or designated representative was responsible for ensuring that all excavation equipment was cleaned of residual soils before leaving the RAD II Site until the activities performed under this section are complete.

Locations where vehicles enter or exit the RAD II Site were inspected daily for evidence of off-site soil tracking.

The QEP, Professional Engineer, or designated representative was responsible for ensuring that all egress points for truck and equipment transport from the RAD II Site are clean of soil and other materials derived from the Site during intrusive excavation activities. Cleaning of the adjacent streets were performed as needed to maintain a clean condition, with respect to soil and other materials derived from the RAD II Site.

4.1.5.4 Materials Disposal Off-Site

Other than drill cuttings, no excavated soils were shipped off the RAD II property during the construction of the cap system and LNAPL recovery system. The NYCDEP and NYSDEC completed an Emergency Removal Action in 1982 which included excavation and disposal of contaminated soils and LNAPL. During the installation of the LNAPL recovery system, all excavated soils and drill cuttings removed from the RAD II property at a depth shallower than 15 feet bgs were reused onsite as fill material beneath the cap. All drill cuttings removed via recovery well and monitoring well drilling activities at a depth deeper than 15 feet bgs was characterized and managed as solid waste in accordance with the permit requirements of the disposal facility. LNAPL was separated and recovered from well development water generated during the installation of the LNAPL recovery wells during the fall of 2014 and winter of 2015. The LNAPL was disposed of off-site by Cycle Chem Corporation during the spring of 2015.Off-site disposal locations for drill cuttings deeper than 15 feet were shipped offsite in 17H open top DOT shippable drums and disposed of by Cycle Chem Corporation at 217 South First Street in Elizabethtown, New Jersey. Actual disposal quantities and associated documentation is provided in Appendix D. This documentation includes waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

4.1.6 Materials Reuse On-Site

Chemical criteria for onsite reuse of soil and other material were approved by NYSDEC. The QEP, Professional Engineer or their designated representative, ensured that procedures defined for soil and other material reuse were followed and that unacceptable soil and other material did not remain onsite. Contaminated onsite material, including historic fill and contaminated soil, that was acceptable for re-use onsite was placed below impervious/cap surface, and was not reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

4.1.7 Cover System Restoration

As existing site paving was in extremely poor condition, and in accordance with the ROD, a new 6" paving system was installed over the entire RAD II property to ensure the site was properly capped.

4.1.8 Backfill from Off-Site Sources

All soil and other material proposed for import onto the RAD II Site was approved by the QEP, Professional Engineer or designated representative and was in compliance with provisions prior to receipt at the RAD II Site.

Soil and other material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites was not imported to the RAD I or II Site.

All imported soil met the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that met 'exempt' fill requirements under 6 NYCRR Part 360, but did not meet backfill or cover soil objectives for the RAD II Site, was not be imported onto the Site without prior approval by NYSDEC. Solid waste was not imported onto the RAD II Site.

Trucks entering the RAD II Site with imported soil were securely covered with the appropriate covers. Imported soil was stockpiled separately from excavated soil and other material and covered to prevent dust releases.

4.1.9 Stormwater Pollution Prevention

Barriers and hay bale checks were installed in accordance with the Erosion and Sediment Control Plan (ESCP) and inspected once a week as well as after each storm event. The results of inspections were recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs were made immediately.

Accumulated sediments were removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor were repaired immediately with appropriate backfill material.

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

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

Silt fencing or hay bales were installed around the perimeter of a construction area.

4.1.10 Contingency Plan

No previously unidentified contaminant sources were found during remediation or development related construction, excavation activities.

4.1.11 Storm-Water Pollution Prevention Plan (SWPPP)

Amec Foster Wheeler prepared a site specific Erosion and Sediment Control Plan (ESCP) and submitted to the New York State Department of Environmental Conservation (NYSDEC) Region 2 offices on June 18, 2014. The ESCP was submitted for NYSDEC's information and review only as a permit is not required since the site remediation is being performed under the Brownfield Cleanup Program (BCP), however, the substantive requirements of NYSDEC for ESCP permits were followed. No comments were received from NYSDEC Region 2. The erosion and sediment controls for all remedial construction were performed in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control and the site-specific ESCP.

4.1.12 Contractors Site Operations Plans (SOPs)

The Remediation Engineer reviewed all plans and submittals for this remedial project (i.e. those listed above plus contractor and subcontractor submittals) and confirmed that they were in compliance with the RAWP. Except as otherwise noted herein. All remedial documents were submitted to NYSDEC and NYSDOH in a timely manner and prior to the start of work. The Remediation Engineer oversaw site oversight personnel, reviewed contractor work plans, drawings and specification and ensured that the site and drilling contractors adhered to the design plans and specifications.

4.2 Remedial Program Elements

4.2.1 Contractors and Consultants

A Listing of the contractors who performed work on the RAD II is listed as follows:

- Site Work Contractor – Transit Corp., Yonkers, NY
- Well Drilling and Development – Aquifer Drilling and Testing, Inc., Mineola, NY
- Surveyor – Geod Corporation, Newfoundland, NJ
- Subsurface Survey – Delta Geophysics
- Contaminated Environmental Media Disposal/Recycling Services – Cycle Chem, Inc., Elizabeth, NJ

4.2.2 Site Preparation

Prior to mobilization, a pre-construction meeting was held between Amec Foster Wheeler, de maximis, and the contractor on March 11, 2015. An NYC Building Department PW-1 and building permit was obtained for the installation of the Equipment Enclosures and sewer connection and a separate PW-1 and building permit was also obtained for the installation of the Above Ground Storage Tanks. An air permit to construct was not required for the discharge of extracted soil vapor following vapor phase treatment. Public subsurface utility notifications and mark-outs were completed as well as the implementation of multiple private subsurface surveys to identify additional known and unknown utilities prior to intrusive activities. Limited areas were cleared and grubbed in advance of intrusive activities. These areas included the south-central and southeastern portions of the RAD II site.

Documentation of agency and non-agency permit approvals are provided under Appendix F.

4.2.3 General Site Controls

The RAD II site is bounded by a fence and two gates. The site is manned and guarded 24 hours a day, 7 days per week. A separated 90 ft by 90 ft treatment compound has been delineated and further secured by additional fencing, within the site perimeter fencing, and serves as the location of the packaged treatment equipment and LNAPL Storage Tanks. Refer to Excavation Plan described above for additional site control details.

4.2.4 Nuisance Controls

Nuisance controls for dust, odor, and excavation equipment decontamination are described above in the site Excavation Plan.

4.2.5 CAMP Results

Monitoring results indicate that no exceedances of offsite dust concentrations or VOCs have occurred. Action levels were triggered for on-site dust levels and proper water spray controls were implemented to mitigate the issue. Summary of CAMP implementation and findings are provided in a summary sheet under Appendix D.

4.2.6 Reporting

Daily and Weekly Construction Summaries are prepared by the Site Engineer's Construction Manager and submitted to the PRP Group's Project Manager on a weekly basis. Digital Photo logs are also updated on a weekly basis and made available to the Project Manager on a monthly basis.

Daily and Weekly Construction Summary reports have been provided electronically in full in Appendix D; Digital Photo Logs have been provided electronically in full in Appendix E.

4.3 Contaminated Materials and Reuse

Contaminated materials removed from the RAD II site include the following:

- A total of 11 fifty-five (55) gallon drums of LNAPL generated from PDI Pilot Testing activities as well as separated from well development water, were disposed of offsite.
- Drill cuttings from > 15 feet below ground surface generated from recovery well drilling activities. 103 fifty-five (55) gallon drums of drill cuttings were accumulated and disposed of offsite.

Table 1 shows the total quantities of each category of material removed from the site and the disposal locations. Results from Table-3 were used to characterize the disposal waste.

As-builts provided under Appendix A indicates the location of the recovery wells where the above waste was generated. Appendix D includes the waste disposal documentation for this material.

All excavated soils generated from installation of subsurface process piping on the RAD II property was re-used on site and placed beneath the Asphalt Cap. Soils from trenching activities on the RAD I Property (as a result of installing the LNAPL extraction system pursuant to the ROD were collected and disposed of at Cycle Chem, Inc.'s Lewisberry PA facility.

4.4 Remedial Performance/Documentation Sampling

Current completed remedial construction activities have not included any remediation of soil and groundwater contamination, end point sampling has not been performed. An asphalt paving system Cap has been completed, as described in Section 4.7 and LNAPL Recovery and Treatment Systems have been installed as described in Section 4.8 as an Engineering Control. The remedial performance of the LNAPL Recovery and Treatment Systems will be measured in accordance with the procedures outlined in the OM&M Plan provided with the SMP.

4.5 Imported Backfill

Imported fill was provided from the following offsite sources:

- Excavated soils generated from the installation of sub-grade piping on the adjacent RAD 1site (used to achieve final grades for the Cap System);
- Virgin 3/8 inch Clean Stone from Evergreen Recycling (used for underground pipe and sleeve bedding);
- Recycled Common Fill from Evergreen Recycling (used to achieve final grades for the Cap system); and
- Recycled Dense Graded Aggregate from Evergreen Recycling (used for the asphalt Cap System sub-base.

A table of all sources of imported backfill with quantities for each source is shown in Table 2. Analytical results for backfill, in comparison to allowable levels, are provided in Appendix D.

4.6 Contamination Remaining at the Site

4.6.1 LNAPL

Most of the contamination associated with the RAD II Site is contained in the LNAPL, which occurs on the groundwater table and the vadose zone throughout much of the RAD

II Site. The ROD requires that the LNAPL recovery system operate until the remedial action objectives have been achieved or until it is determined that the continued operation of the LNAPL recovery system is technically infeasible or impracticable. During the operation of the LNAPL recovery system, the performance of the system will be evaluated periodically to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. When LNAPL recovery has been terminated, sorbed LNAPL will remain as residual contamination within the soil of the vadose zone.

4.6.2 Groundwater

Most of the contamination associated with the RAD II Site is contained in the LNAPL, which occurs on the groundwater table and the vadose zone throughout much of the Site. The ROD requires that the LNAPL recovery system operate until the remedial action objectives have been achieved or until it is determined that the continued operation of the LNAPL recovery system is technically impracticable. During the operation of the LNAPL recovery system, the performance of the system will be evaluated periodically to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. Groundwater sampling has generally indicated the concentrations of LNAPL constituents in groundwater beneath the RAD II Site do not exceed the groundwater quality standards applicable to ambient groundwater. The need for continuing groundwater monitoring after substantial completion of LNAPL recovery will be evaluated during the recovery period. See Section 2.3 of the SMP.

4.6.3 Soil Vapor

The Results of soil vapor investigations on the RAD II Site have not identified a threat for migration of soil vapor laterally from the limits of the LNAPL.

Since contaminated soil and petroleum light non-aqueous phase liquid (LNAPL) remains on the groundwater beneath the site and is a potential source of ongoing soil, groundwater and soil gas contamination after completion of the Remedial Action, Institutional and Engineering Controls are required to protect human health and the environment. These Engineering and Institutional Controls (ECs/ICs) are described in the following sections. Long-term management of these EC/ICs and residual contamination will be performed under the Site Management Plan (SMP) approved by the NYSDEC.

4.7 Cap System

Exposure to remaining contamination in soil/fill at the site is prevented by a soil cover system placed over the site. This cover system consists of a minimum of a 12" pavement system comprised of 6 inches of Dense Graded Aggregate (DGA) and 6" of Bituminous Asphalt Pavement in accordance with the detail provided in the approved RAWP. Concrete foundations for treatment system enclosures and a concrete slab for LNAPL storage tanks also prevent exposure to remaining contamination in the soil/fill at the site. A final environmental easement is referenced in the SMP to address future excavations that might encounter LNAPL impacted soils. Drawing C-507 in Appendix A shows the as-built cross sections for each remedial cover type used and built on the site.

4.8 Other Engineering Controls

Since LNAPL continues to be present at the Site, Engineering Controls (EC) are required to protect human health and the environment. The site Engineering Controls are described in the following subsections.

4.8.1 Vacuum Enhanced Total Fluids LNAPL Recovery System

The installed LNAPL recovery system designed for the higher viscosity LNAPL portion of the Site will enhance LNAPL recovery via both hydraulic and pneumatic gradient enhancement. System details have been outlined below as follows:

- ***Vacuum Enhanced Total Fluids LNAPL Recovery System –*** The LNAPL recovery system for the higher viscosity area consists of enhancing product recovery via both hydraulic and pneumatic enhancement a total of 30 Vacuum Enhanced/Total Fluids (VER/TF) Recovery Wells arranged in 7 zones. Ten (10) of the VER/TF Recovery Wells are located on RAD 1 while twenty (20) are located on RAD II. Six zones (labeled TF-1 through TF-6) consist of four (4) recovery wells each (labeled A through D), while the seventh zone (labeled TF-7) consists of six (6) recovery wells labeled A through F). Zones TF-1 through 5 are located on RAD II. Hydraulic and vacuum enhancement is accomplished by installing top loading TF pneumatic pumps in each of the 20 VER/TF RAD II recovery wells as well as by applying a vacuum to the vadose zone via separate vapor extraction lines tied into each recovery well's casing.

In addition to routing vapor extraction lines to each well head, compressed air supply lines and groundwater/LNAPL discharge lines have also been routed to each well head as required to power the pneumatic pumps and transport extracted groundwater and LNAPL product from each well back to the treatment facility in dedicated transport lines from each zone. Each VER/TF Recovery Well zone is specially piped, manifolded and equipped with automatic controls to allow for the enhanced recovery in each zone to be turned ON and OFF or pulsed at any desired frequency and duration. The recovery well system can also monitored and controlled by the system operator remotely via a cellular modem/ Human Machine Interface (HMI) system. Record drawings provided in Appendix A shows the location of each of the 20 VER/TF Recovery Wells which have been located in the higher viscosity LNAPL portion of the RAD II site.

- ***VER/TF and Skimmer LNAPL Recovery Wells*** - Each recovery well is constructed with 15 feet of 0.020 inch Slot, 4 inch diameter V-Wire continuous slot PVC screen and 4 inch diameter Sch 40 PVC casing to a total installed depth of approximately 25 to 30 ft below ground surface. The V-Wire Screen was utilized to improve well efficiency and capture radius of influence. In the VER/TF wells, top of screen elevations were set to provide approximately 5 ft of open screen above groundwater/top of product elevation to allow for substantial pneumatic connectivity to the vadose zone as required to generate adequate vacuum influence.

- ***Skimmer LNAPL Recovery Wells*** - Each recovery well is constructed with 15 feet of 4" diameter standard V-Wire continuous slot PVC screen and 4" Sch 40 PVC casing to a total installed depth of approximately 25 to 30 ft below ground surface to maximize efficiency and radius of influence. Top of screen elevations were set to provide approximately 5 ft of open screen above groundwater elevation to allow for adequate vacuum influence to the vadose zone.

- ***Total Fluids Pumps –*** Twenty (20) top loading pneumatic total fluids (TF) pumps have been installed at each of the 4" VER/TF RAD II recovery wells. The recovery well heads were modified to accept the pumps as well as the compressed air and liquid discharge lines and the vapor extraction line. The TF pumps are automatic, variable capacity pumps which will maintain pumping level at the pump's top inlet, thereby allowing for extraction of both LNAPL and groundwater. A flow rate of 1.5 gpm to 3 gpm is anticipated from each well at a total extracted flow rate of up to 25 gpm when 2 to 3 zones are active. Compressed air supply piping has also been arranged five (5) separate manifolds such that 4 pumps are supplied by compressed when its supply solenoid control valve is energized as determined by the control system timer or manual operator initiation (local or remote).

- ***Vacuum Enhancement System –*** Vapor extraction piping has been routed to each recovery well such that the recovery wells can also be vacuum enhanced. The vapor extraction piping has also been arranged in 5 separate manifolds such that the vapor extraction flow from each manifold serves 4 wells in each zone. The zone manifold line is connected to a source of vacuum when it's respective Motor Operated Valve (MOV) is opened as determined by the control system timer or manual operator initiation (local or remote). A 30 HP low/medium vacuum blower with a flow rate capability of 750 scfm (@ 5" Hg inlet vac.) has been utilized to apply vacuum at one (1) to four (4) recovery well zones simultaneously. As such, with approximately 5 ft of open screen, a flow rate of up to 44 scfm per well @ 1" Hg casing vacuum can be achieved for a total extracted flow rate of 176 to 704 scfm.

- ***Field Piping –*** Trenching and Piping systems for the VER/TF and Skimmer wells were installed utilizing 1 or more 4" and 6" corrugated HDPE pipe sleeves depending on the pipe trench segment. A Pipe Trench Segment Identification Table provided on the Record Drawings indicates the size, type and quantity of sleeves installed in each segment. The VER/TF associated pipe sleeves also include 4" diameter sch. 40 PVC SVE zone piping which are also listed on the

above referenced Table. The 4 inch and 6 inch diameter sleeves are utilized to carry compressed air hose, total fluids discharge hose and skimmer pump product discharge hose. The sleeves allow for future replacement in the event of failure or degradation in the future. The sleeves and SVE zone lines are bedded in 3/8" clean, compacted virgin stone with a minimum of 6 inches of cover above, below and on each side. The SVE zone lines also have been configured with low point drains, accessible from grade via an 8 inch manhole cover, and also are configured to drain directly into select recovery wells in the event of excessive moisture accumulation in these lines. Suitable excavated soils were used as backfill above the bedding stone to the pavement system subgrade elevation. All compressed air and liquid hose joints are located in recovery well vaults or the hose vaults for ready inspection of pipe integrity. All sleeves carrying total fluids or LNAPL have been installed with a 36 inch minimum burial depth as required for freeze protection. Sleeves with air-lines and 4" SVE zone lines have been installed with a minimum of 24 inch burial depth as required for traffic loading protection. Compressed air hose sizes range ½" ID to 1" ID, while TF and LNAPL lines range from ½" ID to 2" ID. Approximately 2,200 linear feet of pipe trenching has been installed on the RAD II site as required for both the Vacuum Enhanced Total Fluids Recovery System and the Single Phase LNAPL Recovery System described below in Section 4.8.2.

- ***Recovery Well Vaults –*** Recovery well vaults are constructed using 24 inch square and 30 inch square by 24 inch deep steel, open bottom vaults with H-20 traffic rated, hinged and lockable diamond plate steel lids. The vault frames are locked into 12 inch thick concrete pads with an outside dimension of 5 ft X 5 ft and 5-1/2 ft X 5-1/2 ft depending on weather the vault is 24 inch square or 30 inch square, respectively. The concrete pads dissipate traffic wheel loading such that the load applied to the subsurface soils is within the allowable soil bearing capacity. A 30 inch square hose vault has also been provided,

constructed per the above recovery well vault description, to allow for junction of air lines and TF discharge lines a one critical location.

- ***Phasing Plan*** **-** The 20 RAD II VER/TF recovery wells will be operated in multiple modes of operation in order to maximize product recovery, minimize energy consumption and to avoid exceeding the limitations of the oil/water separation and groundwater treatment processes. The modes of operation are summarized as follows:

    - ***Skimmer Mode*** **–** skimmer pumps have initially been installed and operated in the VER/TF wells until such time that initial product thicknesses in recovery wells have been reduced from multiple feet to </= 1 ft and/or LNAPL production rate (gallons per day or week) has diminished by >/= 75%.

    - ***Hydraulic Enhancement mode*** **–** Following the skimming or single phase LNAPL recovery mode of operation, pneumatic TF pumps will be installed in the VER/TF wells and set at a pumping level configured for approximately 6” to 12” of piezometric draw-down (or as required to keep total extracted groundwater production </= 25 gpm). This mode of operation will continue until product thicknesses in recovery wells have been reduced from multiple feet to < 1 ft and/or LNAPL production rate (gallons per day or week) has diminished by >/= 75%. As compared to the prior mode of operation.

    - ***Vacuum and Hydraulic Enhancement (VER) mode*** **–** Following operation of the TF pumps without Vacuum enhancement, the vacuum blower will also be operated to achieve approximately 1” Hg casing vacuum at each of the VER wells. Upon further significant diminishment of product thicknesses and LNAPL production rate, additional operational variables can be adjusted, including zone pulsing schedules, piezometric draw down and

applied casing vacuum levels as required to maximize LNAPL production rates and minimize energy consumption and operational costs per gallon of LNAPL recovered. Operation will continue until such time that maximum extent practical recovery goals can be achieved as outlined in the approved RAWP.

Procedures for monitoring, operating and maintaining the Vacuum Enhanced Total Fluids LNAPL Recovery System are provided in the Operation and Maintenance & Monitoring Manual Plan (OM&M) in Section 4 of the Site Management Plan (SMP). The Monitoring OM&M Manual Plan also addresses inspection procedures that must occur after any severe weather condition has taken place that may affect on-site ECs.

4.8.2 Single Phase LNAPL Recovery System

The installed Single Phase LNAPL Recovery system is utilized to recover LNAPL from the lower viscosity area of the RAD II site. The system consists of a total of 38 Skimmer Recovery Wells outfitted with pneumatically operated skimmer pumps. 23 Skimmer wells are located on RAD I while 15 skimmer wells are located on RAD II. See Appendix A for the location of each Skimmer Recovery Well (S1A through 1E, S2A through 2D and S-3A through 3E). Each skimmer pump is configured with a specific gravity skimmer intake and a pneumatic cycle timer that controls the pumping rate of each skimmer pump. The specific gravity skimmers are designed to sink in product with a specific gravity of less than approximately < 0.95 and float on water such that they can remove LNAPL down to a thickness of approx. 1/4". The skimmer float has a vertical range of travel of 24" to accommodate fluctuations in groundwater elevation. The skimmer pumps have a maximum rated capacity of up to 160 gallons per day. The operator will adjust the pumping rate of each skimmer pump over time to avoid significantly exceeding the LNAPL recovery yield from each of the skimmer wells. By doing this, the rate of LNAPL recovery will be maximized while avoiding unnecessary pump wear and wasting compressed air and energy.

Procedures for monitoring, operating and maintaining the Single Phase LNAPL Recovery System are provided in the OM&M Manual in Section 4 of the Site Management Plan (SMP). The OM&M Manual also addresses inspection procedures that must occur after any severe weather condition has taken place that may affect on-site ECs.

4.8.3 Packaged SVE and Groundwater Treatment System

The Packaged SVE and Groundwater Treatment System with LNAPL product storage tanks, have been installed in the Northeast Portion of the RAD II site in a secure 90 ft by

90 ft treatment system compound. The treatment system is built to serve a total of 68 recovery wells located on both the RAD I and RAD II sites. The RAD II site consists of a total of 35 wells, composed of 20 VER/TF wells and 15 Skimmer Wells. The treatment equipment is housed in two (2) steel, 40-foot long, insulated shipping containers (Sea-Boxes) hereafter referred to as Treatment Equipment Enclosures. All equipment was pre-plumbed, wired and inspected at an off-site location. The Treatment Equipment containers were installed on concrete piers and spread footings. Two (2), 6,000 gallon, above ground, secondarily contained storage tanks were installed on a single 8" thick concrete pad. Two (2) Vapor-phase activated carbon and one (1) Vapor-phase Potassium Permanganate filtration have been located outside of the treatment equipment enclosures on the asphalt pavement cap system. Equipment is sized based on a vapor flow of up to 750 scfm @ 5" Hg Vac. and an instantaneous liquid flow rate of 25 gpm from 5 to 15 VER/TF recovery wells at a time. A process flow diagram for the treatment process is presented in Appendix A. The following treatment equipment components have been provided:

- ***SVE Inlet Manifold –*** A seven (7) position manifold serves each of the seven (7) VER/TF Zones (2 zones on RAD I, 5 zones on RAD II). Each position includes: flow meter; manual gate valve, motor operated valve (MOV), vacuum gauge; Schedule 80 PVC Pipe and fittings.

- ***Vapor- Liquid Separator –*** 150 gallon steel vessel with: low (pump on), high (pump off), and high-high (alarm) switches; progressive cavity transfer pump, skid mounted.

- ***Vacuum Blower –*** One, 30 HP skid mounted regenerative blower with inlet filters, dilution valve, silencers, vacuum relief valve, capable of 750 SCFM @ 5"Hg Inlet vacuum.

- ***Heat Exchanger –*** Static Air to Air, 750 scfm, complete with temperature indicator and high temperature switch. Provides approximately 20 deg. Delta Temperature drop of SVE blower discharge air as required for efficient vapor phase treatment.

- ***Vapor Phase Carbon Treatment Vessels –*** Two (2) vessels each containing 2,000 lbs of virgin vapor phase activated carbon for VOC removal. Vessels are

complete with 6" inlet and outlet connections and provide 4.5 ft of bed depth and 16 ft2 of cross sectional area.

- ***Vapor Phase Potassium Permanganate Treatment Vessel –*** 2,160 lbs of 6% potassium permanganate impregnated media for Vinyl Chloride removal. Vessel complete with 6" inlet and outlet connections and provides 36 FT3 of media, 2.2 ft of bed depth and 16 ft2 of cross sectional area.

- ***2 Stage Oil/Water Separation System –*** 25 gpm, gravity feed. Stage 1: 500 gallon 304SS pre-separation and equalization tank with rotary skimmer and upstream Biocide Injection; post gross separation emulsion breaking reagent injection; Stage 2: 540 gallon 304SS coalescing pack gravity separator complete with rotary skimmer, belt skimmer, 120 gallon product storage chamber and 150 gallon effluent tank. Complete with effluent transfer pump level switch controls, and product discharge pump level switch controls.

- ***Effluent Transfer Pump –*** 1-1/2 HP, 30 gpm nominal centrifugal pump w/ 1-1/4" Inlet and 1" outlet connections with SS wetted components and housing.

- ***Product Discharge Pump –*** ½ HP, 4.8 gpm rotary gear pump w/ ¼" Inlet & Outlet connections, with bronze body and gear construction.

- ***Bag Filters –*** 4 6.7 inch diameter X 30 inch deep bag filters with SS housings and 2 inch connections. Complete with eyebolt lids, manifold and interconnects for 2 parallel trains of 2 filters in series, pressure gauges and high pressure alarm switch.

- ***Liquid Phase Carbon Treatment Vessels –*** 2-1,000 lb units, manifold and valves, interconnection hoses, pressure gauges, roof hatch directly over vessels to facilitate carbon change.

- ***Air Compressor –*** Rotary screw 20 HP, 88 cfm @ 125 psig, with integral after-cooler and refrigerated dryer. Complete with local control panel, remote alarm integration with system HMI, particulate filter, coalescing filter, pressure

regulator, gauges, automatic condensate drain system, and 3-way solenoid valve for quick pneumatic pump shutdown.

- ***Compressed Air Supply Manifold –*** A Seven (7) position manifold serves each of the seven (7) VER/TF Zones (2 zones on RAD I, 5 zones on RAD II). Each position includes: manual ball valve; pressure gauge; pressure regulator, solenoid valve. Schedule 40 carbon steel pipe and fittings.

- ***Main Control Panel*** - PLC controlled logic with 16 Inputs & Outputs, color touch screen graphical Human Machine Interface (HMI), remote monitoring and control via wireless modem, email notification alarms.

- ***Electrical –*** NEC Class I, Div 2 Hazardous Location wiring provided in the Groundwater Treatment System and the Soil Vapor Extraction Rooms.

- ***HVAC –*** Electric Unit Heaters and ventilation fans provided in both equipment enclosures complete with thermostat controls.

- ***Non-TSCA LNAPL Storage Tanks –*** Two (2) 6,000 gallon, single-wall steel with secondary containment dike, New York City waste-oil labeled. Complete with 90% and 95% high level alarm and overfill prevention system; local mechanical tank gauge, normal and emergency venting system to meet fire code requirements, access stair and platform for vacuum tanker truck hose connection.

Procedures for monitoring, operating and maintaining the Packaged SVE and Groundwater Treatment System are provided in the OM&M Manual in Section 4 of the Site Management Plan (SMP). The OM&M Manual also addresses inspection procedures that must occur after any severe weather condition has taken place that may affect on-site ECs.

4.9 Institutional Controls

The site remedy requires that an environmental easement be placed on the property to (1) implement, maintain and monitor the Engineering Controls; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; and, (3) limit the use and development of the site to surface (IE parking) uses only.

The environmental easement for the RAD II Site was executed by the Department on May 2, 2015, and filed with the Queens Borough Clerk on October 21, 2015. The County Recording Identifier number for this filing is 2015111000994001. A copy of the easement and proof of filing is provided in Appendix D of the Site Management Plan.

4.10 Deviations from the Remedial Action Work Plan

No significant deviations from the remedies prescribed by the ROD or RAWP have occurred. The general intent for each remedy component as described in the RAWP has been maintained. Engineering details, however, have changed in order to improve upon remedial effectiveness, decrease energy consumption, decrease O&M costs and ensure sewer discharge compliance.

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