FINAL ENGINEERING REPORT

for

FORMER WILLOW SERVICE STATION (18-02 LLC)
18-02 27TH AVENUE
ASTORIA, NEW YORK

NYSDEC VCP No: V00613
Reference Spill # 9416654

Prepared For

18-02 LLC

JANUARY 2009
(Revised March 2009)
(Revised May 2009)
(Revised October 2009)

Prepared By

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1.0 INTRODUCTION

1.1 Purpose

This Final Engineering Report ("FER") has been prepared by ESPL Environmental Consultants Corp. ("ESPL") in accordance with the terms of the Voluntary Cleanup Agreement ("VCA"), Index # W2-0949-03-02 for the Former Willow Service Station, Site ID# V00613 ("the Site"), entered into between by 1802 LLC and R&R General Supply Company ("the Owners") and New York State Department of Environmental Conservation ("NYSDEC") dated July 30, 2003; and requirements for submittal of regulatory documents as identified in the 6 NYCRR Part 375, Subpart 375-1.6(c). (Refer: Appendix A - VCA).

The purpose of the FER is to document compliance with technical and statutory requirements and to provide a consolidated record of remedial activities that have taken place, in accordance with the NYSDEC approved Schedule and Remedial Action Work Plan ("RAWP"), dated December 2007 (Refer: Appendix B - RAWP), and during implementation of the selected corrective measures and remedial actions for the Site.

1.2 Scope

This FER has been prepared after the determination that the selected remedy as per the approved RAWP is fully functional and operational at the site. The FER is submitted to NYSDEC and New York State Department of Health ("NYSDOH") for approval in accordance with NYSDEC requirements. The FER also documents remedial activities performed subsequent to the approved RAWP.

2.0 PROJECT BACKGROUND

The Site is located at 1802 27th Avenue, Astoria, New York, in a mixed residential /commercial area and was used as a gasoline retail facility and an auto repair shop. The location of the site is shown on the United States Geologic Surveys (USGS) 7.5-minute Quadrangle Map (Refer: Appendix C - Figure 1) and relevant site features are shown on site location map (Refer: Appendix C - Figure 2).

The site is bounded to the north by 27thAvenue, to the south and east by private residences and to the west by a woodworking and furniture finishing facility, a wholesale food distributor and apartment buildings. Residents and businesses in the vicinity of the site utilize public water. The site is geographically located at latitude 40.772700 and longitude 73.927400. The subject site is listed in the tax map as follows:

Building No.	Zone	Block/Lot	Usage/Structure
18-02 27th Avenue	C2-1 /R-5	541 / 7	4 Stories 17 units residential 1 unit commercial - R&R General Supply Basement - R&R General Supply storage

2.1 Site History

The site was previously used as the Willow Service Station; a retail fuel filling station and automotive repair garage; and had been in operation for over 30 years.

A tank-field with a total of six (6) 550 gallon underground storage tanks (USTs) was located directly north of the building. A second tank-field containing three (3) 550 gallon diesel USTs was located south of the building. One (1) 2000 gallon gasoline UST was located northeast of the building. In 1994, a leak was discovered in one of the tanks located in the north tank field, and was reported to NYSDEC. Consequently, NYSDEC assigned spill # 94-16654 to the site. The tanks in the north tank field were pressure tested and one of the tanks failed the tank tightness test. The failed tank was subsequently abandoned in place. The six (6) 550-gallon USTs in the first tank-field were excavated and removed from site in December 1999. (Refer: Appendix C - Figure 3).

The present owner, 1802 LLC, acquired the site in 2002 and demolished existing structures in early 2003 followed by construction of a four story commercial/residential building with a basement. The basement and ground floor are devoted solely to hardware storage. There is an on-site outdoor parking lot in the north–northwest corner of the site.

The current use and occupancy of the building is as follows:

Floor	Use	Status
Basement	Retail store storage, refuse room	Occupied
1st Floor	Commercial Retail store/R&R General Supply	Occupied
Mezzanine	R&R General Supply Offices & administration	Occupied
3rd Floor	6 units Residential Apt.	Occupied
4th Floor	6 units Residential Apt.	Occupied
Penthouse	5 units Residential Apt.	Occupied

2.2 Site Boundaries

The following description provides site boundary information for the subject site (Refer: Appendix C - Figure 4):

All that certain plot, piece or parcel of land, situate, lying and being at Long Island City, in the Borough and County of Queens, City and State of New York, bounded and described as follows:

BEGINNING at a point formed by the intersection of the southwesterly side of 27th Avenue with the easterly side of 18th Street;

RUNNING THENCE southeasterly along the southwesterly side of 27th Avenue at an interior angle of 63 degrees 20 minutes 20 seconds with the easterly side of 18th street, 159.58 feet (Tax Map), 160.83 feet (Actual) to a point;

THENCE southwesterly on a course forming an exterior angle of 68 degrees 55 minutes 8 seconds with the southwesterly side of 27th Avenue, a distance of 23.7 feet (Tax Map), 23.99 feet (Actual);

THENCE westerly on a course forming an interior angle with the last course of 99 degrees 2 minutes 48 seconds being parallel with Astoria Boulevard, a distance of 11 feet;

THENCE southerly on a course forming an exterior angle with Astoria Boulevard of 90 degrees 34 minutes 00 seconds, a distance of 39.86 feet to the northerly side of Astoria Boulevard;

THENCE westerly along the northerly side of Astoria Boulevard, 108.43 feet (Deed), 108.47 (Actual);

THENCE northerly on a course forming an interior angle with Astoria Boulevard of 86 degrees 32 minutes 00 seconds, a distance of 60 feet;

THENCE westerly on a course forming an exterior angle of 90 degrees 21 minutes 00 seconds with the last course, a distance of 24.98 feet to the easterly side of 18th Street.

2.3 Previous Investigations

As a part of the site's extensive construction activities in 2004, a total of 298 tons of contaminated soil, together with all the remaining USTs and scrap metal, were removed and disposed of at an approved and duly licensed disposal facility. During the excavation, additional underground storage tanks were discovered and removed. A Petroleum Bulk Storage

Application was filed with NYSDEC Since all USTs were removed in past, the sources of contamination no longer existed. It was confirmed from the residual soil and groundwater sampling results that BTEX/MTBE were the predominant contaminants remained beneath the site.

Contaminated groundwater was detected in the shallow aquifer 13 to 19 feet below grade. The observed direction of site groundwater flow was generally in northwest. A hydraulic gradient of 0.0056 ft/ft was determined from well monitoring data. This value is consistent with a predominantly silty lithology and yields a pore water velocity of 0.0012 ft/day.

The current site owner entered into a VCA with NYSDEC in July of 2003, immediately upon site acquisition. The site is duly listed on NYSDEC's Voluntary Cleanup database. The contemplated use of the site contained in the VCA is restricted commercial (excluding day care, child care, and medical care uses). Also, construction of a 4-story commercial/residential building (hardware storage in the basement and first floor and 3 stories of apartments) began concurrently with soil remediation (excavation, screening, removal) in 2004. Pre-construction soil and groundwater sampling indicated that Volatile Organic Compounds (VOCs) (BTEX, MTBE), and Semi-Volatile Organic Compounds (SVOCs) (Acenaphthene, Naphthalene, Pyrene, Fluoranthene, and Phenanthrene) were present in the soil and groundwater at levels exceeding the NYSDEC TAGM # 4046 Recommended Soil Cleanup Objectives and NYSDEC TOGS 111 Division of Water Ambient water quality standards and guidance values and groundwater effluent limitations.

Remediation of soil from the site, via excavation and removal to a permitted off-site recycling facility for proper disposal was completed. A total of 4,450 cubic yards of soil (6,027 tons) was removed. 84 tons of clean soils were disposed at Evergreen Recycling of Corona, NY, and 2,303 tons of contaminated soils were disposed at Clean Earth of Philadelphia, and 3,640 tons of contaminated soils were disposed at Clean Earth of Carteret, NJ (Refer: Appendix C - Figure 5 for Former Soil Excavation Area). Post-excavation confirmatory or end-point soil samples were collected.

The excavation area was backfilled with clean material consisted of recycled concrete and stone with an average thickness of 7 inches to 8 inches in the excavated area and behind site shoring.

Piping for a Sub-Slab Depressurization system (SSDS) was installed beneath the basement floor slab during the building's construction and it was deemed necessary to remove residual soil vapors that may exist beneath the basement floor.

2.4 Remedial Action Work Plan (RAWP)

Due to the presence of subsurface contamination observed from the previous on-site field investigations for groundwater, soil vapor, and indoor air quality; and off-site investigation for groundwater and soil vapor, NYSDEC required additional remedial investigations for the site in 2006 and 2007.

The contemplated use contained in the Voluntary Cleanup Agreement was restricted commercial (excluding day care, child care, and medical care uses). The following remediation evaluations were therefore based on providing cleanup sufficient to allow for the contemplated use of the site as commercial (since the first floor of the building is used for the commercial purpose).

Subsequently, to address the remedial action objectives, a RAWP was submitted in December 2007 with following criteria:

- Prevent human ingestion of groundwater containing contaminant concentrations above the applicable standards.
- Prevent human ingestion and dermal contact with contaminants in soil.
- Prevent inhalation of VOCs volatilizing from subsurface soil to indoor air.

The major Standards, Criteria and Guidelines (SCGs) identified in the RAWP were:

- 6 NYCRR Part 375 residential Soil Cleanup Objectives (SCOs).
- 6 NYCRR Part 703 standards for groundwater.
- Air Guideline Values and outdoor background air quality for off-site, outdoor air quality, per NYSDOH soil vapor intrusion guidance (October 2006).
- Air Guideline Values and indoor background air quality for on-site, indoor air quality, per NYSDOH soil vapor intrusion guidance (October 2006).
- Air Guide 1 – Guidelines for the Control of Toxic Ambient Air Contaminants (relevant to discharges associated with treatment).
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Waste (relevant to residuals generated during treatment).
- NYSDEC solid and hazardous waste regulations for transportation and disposal of contaminated soils and treatment residuals.
- NYSDEC requirements for Deed Restrictions.

The RAWP was approved by NYSDEC in February 2008 (Refer: Appendix B) with the following recommended remedial action for the site:

2.4.1 On-Site Remedial Actions

Implementing the SSDS was recommended by NYSDEC, along with indoor and outdoor air monitoring for removing the trapped indoor air VOC contaminants beneath the slab. In addition, the existing free product recovery and monitoring of groundwater beneath the building was recommended to continue, as per the site management plan referred in Section 13 below.

A Deed Restriction, restricting sub-slab groundwater use and soil contact was proposed. The SSDS operation was required by NYSDEC. Site maintenance for the SSDS and monitoring activities would be required, including annual certification of the operations and activities performed.

The soil and groundwater SCGs would not be met; however, the slab and the deed restriction would act to preclude soil and groundwater contact so that the soil and groundwater Remedial Action Objectives could be met. Implementation of the SSDS would meet the Remedial Action Objective related inhalation of VOCs volatilizing from sub-slab soil to indoor air.

2.4.2 Off-Site Remedial Actions

No off-site action for soils was recommended as the contaminant levels were below the Part 375 residential SCGs.

In-situ groundwater treatment by bioremediation using an oxygen release compound at some locations and chemical oxidation in others was recommended as a means of meeting the groundwater standards.

These remedial actions were proposed to meet the Remedial Action Objectives and should meet the SCGs. There was no guarantee that treatment will meet the groundwater standards but it was expected that at least significant contaminant reduction should occur.

Groundwater treatment was required to provide a long-term, permanent solution, and to reduce the volume and toxicity of groundwater contaminants.

2.4.3 Institutional Controls

One institutional control was proposed in the RAWP – a Deed Restriction against extracting and using groundwater beneath the

building slab for any purpose and precluding contact with on-site soils. This would include continued operation of the SSDS and implementation of the Site Management Plan.

Remedial activities performed from the submission of RAWP in December 2007 to the report preparation date are elaborated in this FER along with any relevant information that is necessary for the submission of the report to NYSDEC.

3.0 SITE HYDROGEOLOGY

Based on available site information, the site is underlain by brown silty sand, with some silty clay intercalations. Groundwater at the site is presently under unconfined conditions, although the presence of silty clay intercalations may cause local confinement and vertical variation in hydraulic heads. Groundwater was located at depths ranging from 15 feet to approximately 24 feet below grade. The groundwater flow direction is observed to be essentially to the southwest.

4.0 ON-GOING REMEDIAL ACTIVITIES

The recommended remedial actions and description of activities completed pursuant to the approved remedial action work plan (RAWP) were as follows:

4.1 On-Site Groundwater Remediation

As described in Section 2.4.1 above on-site remediation consisted of implementing the sub-slab depressurization system, along with the indoor and outdoor air monitoring. The SSDS was required to keep VOC contamination beneath the building from contaminating the indoor air:

4.1.1 SSDS System

The pilot testing and installation of various SSDS system components were conducted on several dates in April and July 2008, in accordance with the specifications outlined in the SSDS Work Plan approved by NYSDEC on July 25, 2008 (Refer: Appendix F), with some deviations that will be discussed in Section 5.1.2 below.

As per the approved Work plan for the SSDS Activation various system components were installed at site in July 2008 (Refer: Appendix C - Figure 6 and Refer: Appendix D - Photographs). The basement floor was inspected to be free from any visible cracks and openings and no additional sealing in the basement area was

required. The details of system installation and start-up, and indoor/outdoor air testing are described in the Final Report of SSDS Activation (Refer: Appendix G).

On August 14, 2008, the SSDS was successfully activated. Pressure testing and system balancing were performed.

Post-activation air quality and effluent air sampling (Refer: Appendix C - Figure 7) were conducted in order to determine the presence or absence of contaminants in indoor air that may be related to the previously documented contamination at the Site; to document the effectiveness of the SSDS; and to determine the need (if any) for treatment of the SSDS effluent air (refer Sections 5.1.2 and 7.4 below).

4.1.2 Product Recovery and Groundwater Monitoring

The existing free product recovery and monitoring of groundwater beneath the building was continued by pumping/bailing out free products from monitoring wells and storing in a 275-gallon AST, on-site, in the basement (Refer: Appendix E - Table 1 for the survey of groundwater depth of monitoring wells).

Summary tables of analytical results for on-site and off-site Monitoring wells (pre and post-well decommissioning and new off-site wells, (Refer: Appendix C - Figures 8, 9, & 10) for the quarterly periods, September 2007 to November 2008, are presented in Appendix E - Tables 2 to 6.

4.2 Off-site Groundwater Remediation

Off-site, In-situ groundwater treatment by bioremediation, using an oxygen release compound at some locations and chemical oxidation in others was recommended in the approved RAWP for Area A and Area B.

During July 21 to 24, 2008, two (2), 2-inch PVC monitoring wells (labeled as MW-18 (OS) and MW-19 (OS) due to off-site locations) were installed to a depth of 30-feet below grade (fbg) with the use of 3.5-inch drive casing (Refer: Appendix C - Figure 10 and Appendix D - Photographs), The wells were constructed with 10-feet of 2-inch schedule 40 PVC screen, 20-feet of 2-inch schedule 40 PVC risers and were completed at the surface with a 6-inch flush mount set in concrete.

Subsequent to the monitoring wells installation, 1,080 pounds of RegenOx® and 500 pounds of ORC-A®, mixed with approximately 1,500 gallons of water were injected at area "A" from depths 20-30 fbg at eight (8) locations (Refer: Appendix C - Figure 11).

Following the injection at area "A", 800 pounds of ORC-A®, mixed with approximately 1,500 gallons of water were injected at area "B" from depths 20-30 fbg at sixteen (16) locations (Refer: Appendix C - Figure 11).

4.3 Submission of Progress Reports

The work progress for the site was reported to NYSDEC for each of the preceding months from December 2007 to date. The monthly reports described all the activities performed during the reporting at the site. In addition, quarterly progress reports were submitted to NYSDEC, reporting all the activities performed and presenting analytical data collected for the groundwater samples taken from all the operational monitoring wells at the site.

Each monthly and quarterly progress report for the site was also circulated to the recipients described in Section 11.0.

5.0 MODIFICATIONS TO APPROVED RAWP

For the better performance of the systems to be installed at the site and to meet the remedial action objectives, following modifications to the approved on-site and off-site remedial action was considered necessary:

5.1 On-site Groundwater Remediation

5.1.1 Well Decommissioning

On April 15, 2008 a request for decommissioning of on-site monitoring wells, MW-1, 3, 4, 5, 6, 8, 9, and 16 was submitted to NYSDEC. A review of the SSDS revealed that these wells do not serve any purpose for groundwater quality determination and negatively impact the vacuum required under the slab and can short circuit the system. This request was approved by NYSDEC in a letter dated May 13, 2008 (Refer: Appendix H). The wells were appropriately closed and sealed in order to increase the efficiency of the SSDS by closing vapor migration pathways and potential points of SSDS pressure leakage (Refer: Appendix C - Figure 12 and Appendix D - Photographs).

5.1.2 Sub-Slab Depressurization System

The following alterations were made to the SSDS Work Plan approved by NYSDEC on July 25, 2008 (Refer: Appendix F and G, Appendix C - Figure 6, and Appendix D - Photographs).

- To alleviate the potential for tampering with the system fan, the fan was installed at the rooftop of the building, rather than at ground level.

- No carbon vessel was installed at the rooftop discharge point due to difficulty in transporting a vessel to the rooftop (the roof top is only accessible by ladder). Effluent air sampling was therefore conducted without prior carbon treatment, assuming that carbon treatment would only be installed, if necessary, given the air sampling results.

- No permanent pressure monitoring points were installed in the basement. Instead, temporary monitoring points were created through the basement slab in order to collect the system pressure data.

- Ball valves were incorporated into the design of the system and installed on each branch of system piping within the boiler room of the basement to better control the pressure required for effective system operation.

5.2 Off-site Groundwater Remediation

An analysis to modify the quantities of RegenOx® and ORCA® as reported to NYSDEC in the approved RAWP was required to improve the efficiency and prolonging the effectiveness of the selected groundwater treatment at the site. NYSDEC approved the requested modifications on July 10, 2008 and are as follows (Refer: Appendix I)

5.2.1 RAWP Chemical Quantities and Number of Injection Points

In the RAWP, the original number of injection points and chemical quantities were based on information available from Regenesis, the supplier of formulations for in-situ treatment of soil and groundwater hydrocarbon contamination: *RegenOx™* for chemical oxidation of higher (part per million) levels of hydrocarbons in groundwater around OSDP-2, and *Oxygen Release Compound Advanced Formulation (ORCA™)* for bioremediation of lower (part per billion) levels of hydrocarbons in groundwater around OSDP-3 to 6.

5.2.2 Different Amounts of Each Chemical

Regenesis revised the calculations for higher chemical requirements compared to the estimates in the RAWP, based on their experience for the contaminant levels and subsurface

formation; and proposed chemical addition rates on the basis of vertical foot of injection (13.5 lb. RegenOx™/vertical foot and 6.25 lb. ORCA™/vertical foot).

5.2.3 To use ORCA™ where RegenOx™ was proposed

Regenesis recommended also using ORCA™ where RegenOx™ was proposed so that after chemical oxidation of the higher levels of contamination, the lower levels of residual contamination would be further reduced by bioremediation.

5.2.4 To reduce the number of Injection Points for ORCA™

Regenesis proposed that, because ORCA™ would persist in the subsurface for approximately one year and would be somewhat more mobile after injection than RegenOx™, half of the original injection points would be sufficient (i.e., 16 injection points instead of 32).

To summarize following modifications were approved prior to implementing the off-site groundwater remediation at the site:

- The number of injection points were reduced from 40 to 24
- The quantities of products to be injected were increased as below:
  - *Area "A" – Blend of RegenOx® and ORCA®*
    1,080 pounds of RegenOx® / 500 pounds of ORCA® were injected using 8 injection points, 5 ft by 5 ft, 20 to 30 fbg.
  - *Area "B" – ORCA®*
    800 pounds of ORCA® were injected using 16 injection points, 10 ft by 10 ft, 20 to 30 fbg.

6.0 REMEDIAL ACTIONS TAKEN AT SITE

6.1 Well Decommissioning

Monitoring wells MW-1, 3, 4, 5, 6, 8, 9, and 16 were decommissioned in July 2008 by using cement/bentonite grout as per NYSDEC approved Well Decommissioning Plan. (Refer: Appendix H and Appendix C - Figure 12).

6.2 On-site Groundwater Remediation

The existing free product recovery and monitoring of groundwater beneath the building continued. In November 2005, 188-gallon of product/water mixture was disposed off-site to Clean Water of New York, as non-hazardous liquid waste and since then approximately 181-gal. product/water mixture has been recovered (for the periods November 2005 to June 2007 and May 2008 until now) and stored in a 275-gal. recovery tank at the site.

A total of 46.0 gallons of product/water mixture (since May 2008) was pumped and/or manually bailed out from monitoring wells MW-13, 14 and/or 17. Product recovery through active bailer system was noted to be effective and approximately 85% of the free product was recovered from May 2008 to date. Upon the recovery tank being full, the mixture of product/water will be pumped empty and the contents will be transported to an approved recycling facility for disposal.

Summary of Free Product Recovered / Removed (On-site Monitoring Wells)

Date	Product Recovery*
May-08	10.00
June-08	5.00
July-08	17.00
August-08	2.50
September-08	3.00
October-08	3.50
November-08	2.00
December-08	3.00
Total **	46.00

* from Monitoring wells MW-13, 14 and/or 17, cumulatively
** = By passive-bailing, product mixed water and stored manually in an AST at site
Approx. Product/Water recovered in the ratio of 85% (or 39.1 gal. product) : 15% (or 6.9 gal. water)

6.3 Off-site Groundwater Remediation

Installation of two (2) off-site monitoring wells and injection of chemical oxidation and oxygen release compounds in the vicinity of OSDP-2 (Area A) and OSDP-4 (Area B) was completed and described in Section 4.2 above.

6.3.1 RegenOx™ *In Situ* Chemical Oxidation Application by using Direct-Push Injection Method:

As recommended by Regenesis preparation of work area for the application of Direct Push Injection Method was performed as follows:

(1) Prior to the installation of RegenOx™, surface and overhead impediments as well as the location of all underground structures were identified. A utility mark-out was called for the site.

(2) Locations of all the Injection Points were pre-marked prior to the installation.

(3) A Geoprobe® (6620DT), direct-push, track mounted, remote-probe unit capable of working in the areas of limited access was set-up for each injection point and the manufacturer standard operating procedures (SOP) were followed for the direct push equipment.

(4) A 1.5-inch O.D./0.625-inch I.D drive rods were used for the site and rods were advanced by driving through the surface pavement. The drive rod assembly was pushed to the desired depth of 20-30 fbg or till Geoprobe® refusal.

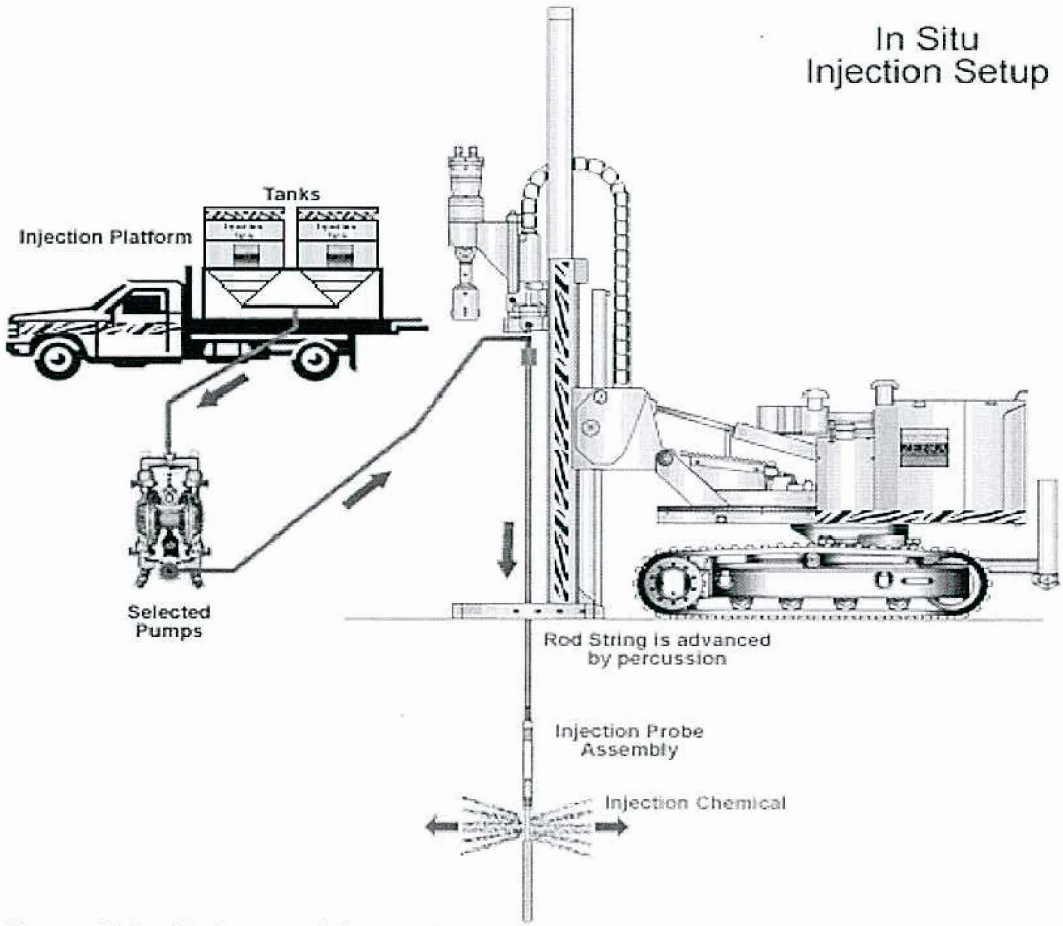
(5) The pre-determined quantities of RegenOx™ and/or ORC-A® were mixed into a 55 gallon drum. The pre-measured quantities of RegenOx™ and/or ORC-A® were added to the pre-measured volume of water to make the desired target % oxidant in solution. The mixture of the water and oxidants were uniformly mixed with a power drill and paint stirrer until the chemical were dissolved in the water, until a homogenous mixture was formed. After mixing the RegenOx™ mixture was immediately injected into the subsurface through the inject point.

(6) The injection process was continuously monitored for the requisite pump pressure to detect changes in aquifer back-pressures and for any indications of aquifer refusal. If aquifer acceptance appeared to be low, as indicated by high back-pressure, a care was observed to allow sufficient time for the aquifer to equilibrate prior to removing the drive rod.

(7) Upon completion of the injection process, each injection points were appropriately sealed using sand, bentonite and/or cement as per the manufacturer recommendation.

(8) The drive rod assembly was cleaned, as necessary, once removed from the injection point and quick set concrete was used to provide a good surface seal with minimal set up time. A proper borehole and surface seal assured that the RegenOx™ remains properly placed and prevented contaminant migration from the subsurface.

(9) A proprietary Rupe pump, model GP 20/1500, especially for soil remediation/injection to inject "thick" viscous chemicals, was used for the delivery of slurry of water/chemical oxidants. All moving parts and hoses were flushed and cleaned with clean water at the end of the day.



(Source: Zebra Environmental Corp., NY)

6.4 Sub-Slab Depressurization System

As per the approved Work plan for the SSDS Activation, various system components of the system were installed at site in July 2008. The details of system installation and start-up, and indoor/outdoor air testing are presented as the Final Report of SSDS Activation. (Refer: Appendix G)

7.0 OBSERVATIONS AND RECOMMENDATIONS

7.1 Well Decommissioning

The decommissioning of monitoring wells, MW-1, 3, 4, 5, 6, 8, 9, and 16 was necessary for the effective SSDS activation. The vacuum observed, as noted in Section 6.4, was sufficient for the effective SSDS operation.

7.2 Groundwater Remediation (On-Site)

The product recovery from monitoring wells, MW-13, 14 and/or 17 has revealed that lesser quantities of free products were being pumped/bailed-out from these wells due to effective removal of free-product from the wells. In addition, as described in Section 5.2, in-situ chemical oxidation treatment required for the off-site groundwater remediation may have been effective in reducing the quantities of free product from these wells. This may have been possible due to the chemicals applied for off-site remediation, being distributed beyond a radius of 10 to 30 feet from the injection points and influencing some wells on the property. A comparison of the quarterly analytical data for MW-13, 14 and 17, before and after the chemical injection, indicated a possible influence from the chemical injections even though this wells were beyond 30 feet. Also, at MW-13 there was a decreasing trend prior to injection, then an increase right after injection, then decreases. (Refer: Appendix E - Tables 7 to 10 for the summary of groundwater analytical data of the remaining wells).

7.3 Groundwater Remediation (Off-Site)

Installation of two (2) off-site monitoring wells was completed and off-site in-situ groundwater treatment by bioremediation using an oxygen release compound at some locations and chemical oxidation in others was successful as recommended in the approved revisions for the selected remedy.

The treatment was effective in driving the contaminants to the aqueous phase and initiating oxidation at the water/product interface. A minimal rebound was observed due to desorption of contaminants from residual petroleum bound within the subsurface, following injection of chemicals. However, the rate of desorption appeared relatively slow and may be due to the contaminants binding tightly to the soil.

Alternatively, once the oxidants start depleting, the dissolved phase contaminant concentrations may rebound to greater concentrations than they were present originally. This can be due to the chemical oxidation process can often reduce the fraction of organic carbon bound to the mineral content of the soils, and thereby reducing the adsorption

capacity. In addition, the elevation of pH can affect the solubility and chemical behavior of the contaminant, resulting in a greater partitioning of contaminant in the aqueous phase, occurring post- treatment than before.

Also, due to the application of oxygen release compounds, oxygen will be released for a period of 9-12 months and will enhance in-situ, aerobic biodegradation. If a rebound is observed, degradation will continue, due to the presence of source of oxygen form these compounds. Noticeable changes in the volatile organics observed, for the existing monitoring wells on-site and off-site, suggested that the chemicals used to address residual contamination were beneficial in keeping it from migrating off-site.

This is very encouraging and indicates that the chemical oxidation application is effective in inducing significant amounts of sorbed mass to move into the aqueous phase where oxidation process can proceed (Refer: Appendix E -Table 11 for the summary of groundwater analytical data of the remaining wells).

Continuous monitoring of the groundwater quality will be required to further evaluate on-going in-situ groundwater treatment by bioremediation, using oxygen release compounds as well as need for additional applications depending on the observation made during the future groundwater sampling.

7.4 Sub-Slab Depressurization System

The SSDS has been installed in accordance with the Work Plan approved by the NYSDEC. The system was successfully installed and observed to be properly operational.

Post-activation pressure testing indicated that the system was effective at creating and maintaining adequate negative pressure below the entire footprint of the building. Post-activation effluent air sampling indicated that the system was effective in removing vapors likely to be associated with the gasoline contamination. However, VOC concentrations in the effluent air do not suggest the need for treatment prior to emission or an air emissions permit (Refer: Appendix G). No further SSDS installation or testing is recommended; however, system effluent air will be monitored every nine-months and will coincide with the groundwater remediation to determine if continued operation of the SSDS is necessary.

Post-activation air quality sampling indicated the presence of several VOCs within the building, however, many of the detected compounds were not observed in the SSDS effluent air sample. As the system has been documented functioning properly, it is likely that the VOCs detected in the indoor air were the result of VOC-containing products stored and

used throughout the basement of the building. With respect to previously documented gasoline contamination at the Site, no further investigation of indoor air is recommended.

The operations and maintenance of the SSDS will be required until the groundwater meets the groundwater standards (Part 703.5) or until the Department determines that it is no longer required at the site.

8.0 ENGINEERING AND INSTITUTIONAL CONTROLS

8.1 Engineering Controls

Detailed monitoring of engineering controls for the site will be addressed in Section 13, Site Management Plan, below (Refer: Appendix J - Site Management Plan). A synopsis of engineering controls for the site will be as follows:

- Depending on the groundwater quality observed during periodic sampling and analysis, one additional round of off-site in-situ groundwater treatment, using chemical oxidation and bioremediation, was recommended in approved RAWP. Additional treatment, as deemed necessary, based on the results of groundwater sampling will be considered in consultation with NYSDEC.

- However, if significant contaminant reduction has been achieved with the first round of injection and additional reduction has been attained by a second round of injection, but not down to the groundwater standards, the Department will be petitioned for a variance from the groundwater standards.

- Continue existing on-site free product recovery from existing monitoring wells containing free product, coinciding with groundwater sampling events. Existing wells MW-13, 14 and 17 have contained free product and will be inspected at the time of groundwater monitoring (quarterly during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements) and its condition noted. Maintenance required for the proper functioning will be performed.

- Continue implementing and operating the on-site SSDS with periodic inspections (quarterly for the first year and subsequently every 9 months or as determined by NYSDEC) of the piping, fans, etc. will be performed. Inspection of the vacuum pressure at each of the collection riser locations will be performed to ensure that a

negative pressure exists and sub-slab vapor is being collected. Maintenance required for the system to function properly will be performed.

- The basement floor will be inspected for cracks and openings, especially at walls and penetrations. Floor openings will be caulked and sealed and the existing sump will be closed, to minimize any sub-slab volatile organic compounds from entering into the basement. Sealing of the floor openings and sump will be inspected during the system inspection, and maintained accordingly.

- Collect vapor samples on the SSDS influent (quarterly for the first year and subsequently every 9 months or as determined by NYSDEC).

- No new openings of the sidewalk for trees or planters will be proposed, which would increase the potential for sub-soil vapors to enter the atmosphere.

8.2 Institutional Controls (Deed Restrictions)

An Institutional control for the site will include a Deed Restriction, restricting access to on-site groundwater as required by NYSDEC. The annual report described in Section 12.0 will include a certification that the institutional controls are in effect and effective.

9.0 COST ESTIMATE FOR IMPLEMENTATION OF INSTITUTIONAL AND ENGINEERING CONTROLS

Estimated Costs of Remedial Action implementation for the Site were calculated in November 2007 for 17 wells, however, 8 wells were decommissioned and 2 off-site wells were installed in July 2008, and are revised for 11 wells as follows:

A. Institutional Control (Deed Restrictions - restriction against use of groundwater and contact with soils beneath the building)

The estimated one-time cost for the legal submission:	$5,000
Sub-total	**$5,000**

B. Engineering Controls Costs (Annual Operation Monitoring & Maintenance Costs)

- **Groundwater Sampling and Analysis, Free Product Removal**

Groundwater sampling and analysis Estimated for every quarter during the first year i.e. equivalent to 4 events/year), & per event:	
11 samples @ $300 =	$3,300
Sampling labor and reporting, 12 hours @ $80 =	$960
Sub-Total, per event:	$4,260
Free product removal performed while sampling groundwater; assume per year for disposal	$500
Sub-total (First year)	$17,540
*2nd injection if necessary	$6,450
Estimated every 9-month there after for the second year, subject to NYSDEC determination of frequency & requirements) i.e. Equivalent to 1.3 event/year), & per event:	
11 samples @ $300 =	$3,300
Sampling labor and reporting, 12 hours @ $80 =	$960
Sub-Total, per event:	$4,260
Sub-total (Second year)	$5,538
Free product removal performed while sampling groundwater; assume per year for disposal	$500
Sub-Total	**$30,028**

- **Outdoor Air Sampling**

One sample @ $1,000 =	$1,000
Sub-Total	**$1,000**

- **SSDS**

Periodic inspections (24 hours @ $75)	$1,800
Air discharge analysis (1 @ $1000)	$1,000
Electric power (2 kW @ $0.14/kW-hr)	$2,450
Vacuum blower maintenance (1 @ $1,000)	$1,000
Sub-total	**$6,250**

TOTAL, ANNUAL OM&M $ 31,028 - $ 37,278

C. TOTAL PRESENT VALUE COST

The total present value cost would depend on how long groundwater monitoring and operation of the SSDS will be required. These activities would be performed until NYSDEC determines that they are no longer required. 1802 LLC can petition NYSDEC to reduce or eliminate OM&M requirements if data show consistent improvements of the results.

Assuming these activities will be required for two (2) years, the total present value cost would be approximately $62,056 – 74,556.

10.0 DEED RESTRICTIONS

A copy of the Deed Restrictions or Covenants and Restrictions recorded with the New York City Department of Finance, Office of the City Register, on September 24, 2009 is presented as Appendix K.

11.0 CITIZEN PARTICIPATION (CP)

The CP is a mechanism to promote the trust and involve communication between the community, government, public interest groups, the private parties and other citizens involved and to keep them aware of the cleanup.

The CP Plan included submission of all relevant project documents to the repositories at Long Island Division - Queens Library; as well as the following recipients, upon review of the documents and approval by NYSDEC:

(1) Mr. James Drumm, Environmental Engineer
New York State Department of Environmental Conservation (NYSDEC)
Division of Environmental Remediation
Remedial Bureau B, Section B
625 Broadway, 12th Floor
Albany, NY 12233-7016

(2) Long Island Division - Queens Library
89-11 Merrick Boulevard
Jamaica, NY 11432

(3) Mr. Christopher M. Doroski
New York State Department of Health (NYSDOH)
Bureau of Environmental Exposure Investigation
Flannigan Square
547 River Street Rm 300
Troy, NY 12180-2216

(4) Ms. Alali M. Tamuno - NYSDEC
Office of General Council
100 Hillside Avenue, Suite 1W
White Plains, NY 10603-2860

(5) Mr. Thomas Kunkel - NYSDEC Region 2
1 Hunters Point Plaza
4740 21st Street
Long Island City, NY 11101

(6) Mr. Gary Litwin - NYSDOH
Bureau of Environmental Exposure Investigation
Flannigan Square 547 River Street
Troy, NY 12180

(7) Mr. Robin Gordon
Long Island General Supply Co., Inc.
12-22 Astoria Boulevard
Long Island City, NY 11102

(8) John V. Soderberg, P.E., Esq.
207 Hallock Road, Suite 212
Stony Brook, NY 11790

12.0 ANNUAL REPORTING AND CERTIFICATION

Reporting to the Department will include:

(a) Interim Reports

Every quarter during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements, a report on the amount of free product recovered and results of groundwater monitoring within one month after performing the sampling will be submitted. These reports will also contain inspection and maintenance information related to the monitoring wells and passive free product collection system.

(b) Annual Certification Reports

An annual certification shall be submitted by 1802 LLC to the Department, including certification by a New York State licensed Professional Engineer, that the engineering and institutional controls required for the remedy are still in place, have not been altered, and are still effective. It will certify that the Site Management Plan has been followed, or note any deviations with explanations. In addition, it will contain a compilation of all the monitoring, inspection, and maintenance activities performed during the

year, i.e., related to the off-site groundwater, on-site groundwater monitoring and free product recovery, the SSDS, and indoor and outdoor air quality.

The first annual certification report will be submitted by the first day of the month following the start of the anniversary of the implementation of remedial actions. This annual certification will then be submitted annually until 1802 LLC receives notice or approval from the Department that Site Management activities are no longer required at the site.

(c) Other Voluntary Cleanup Agreement Reporting

1802 LLC shall notify the Department immediately upon the discovery of any upset, interruption, or termination of one or more controls without the prior approval of NYSDEC.

13.0 SITE MANAGEMENT PLAN

A stand-alone Site Management Plan (Refer: Appendix J), submitted along with the RAWP, was updated as follows. Any subsequent deviations, necessary for the project, compared to that with the submitted RAWP and/or with this report, will be presented to NYSDEC prior to implementation at the site.

The Site Management Plan was developed in accordance with the requirements of Draft DER-10 Technical Guidance for Site Investigation and Remediation (December 2002), Section 6, and included a description of the site management activities and implementation; institutional and engineering controls oversight; conditions under which treatment operations can be ceased; site closeout; and contingency plan, health and safety plan, site exposure assessment, and quality assurance project plan. It was prepared as a stand-alone manual that can be implemented by individuals unfamiliar with the site.

Following site management activities, will address the engineering controls for the site.

13.1 Operation and Maintenance Activities

The following activities will require an on-going operation and monitoring at the site.

13.1.1 On-site Groundwater Monitoring

(a) Continue existing on-site free product recovery from existing monitoring wells containing free product, coinciding with groundwater sampling events

Existing wells MW 13, 14, and/or 17 have been observe to contain free product and will be inspected at the time of groundwater monitoring event (every quarter during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements), the free product collection system as described below will be inspected and its condition noted. Maintenance required for it to function properly will be performed.

The existing free product collection system comprises of a portable air operated diaphragm pump and compressor system to remove free floating products observed (if any) during the groundwater monitoring event. The product/water mixture will be pumped into a plastic container and emptied manually into a 275-gallon storage tank placed in the basement. Alternatively, PVC disposable bailers may also be used for free product removal.

(b) *Implement and operate an on-site SSDS*

Quarterly inspections will be performed to observe operations of the system during the first year (and subsequently every nine months subject to NYSDEC determination of frequency and requirements). In addition, an effluent air sample on the will be collected and analyzed using EPA method TO-15 parameters, every 9 months.

(c) *Seal the basement floor openings, existing sump and maintenance of the on-site SSDS*

The basement floor will be inspected for cracks and openings, especially at walls and penetrations. Floor openings (if any observed) will be caulked and sealed and the existing sump, if required, will be closed, to minimize any sub-slab volatile organic compounds from entering into the basement.
Quarterly inspections of the piping, fans, etc. and vacuum pressure at each of the collection riser locations will be performed during the first year (and subsequently increased to every nine months subject to NYSDEC determination of frequency and requirements) to ensure that a negative pressure exists and sub-slab vapor is being collected. Maintenance required for the system to function properly will be performed.

Sealing of the floor openings, cracks, and sump (if closed) will be inspected during the periodic SSDS inspection, and maintained accordingly.

13.1.2 Off-Site Groundwater Monitoring

(a) *Implement off-site in-situ groundwater treatment, using chemical oxidation and bioremediation and continue existing groundwater monitoring:*

The goal of treatment was to achieve the Part 703 groundwater standards. However, if significant contaminant reduction has been achieved with the first round of injection and additional reduction has been attained by a second round of injection, but not down to the groundwater standards, a request will be made to the Department for a variance from the groundwater standards.

13.2 Monitoring Activities

(a) *Monitor presence of free product in on-site groundwater monitoring wells*

This will consist of inspecting the passive collection system for the presence of free product during groundwater sampling events (every quarter during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements).

(b) *Monitor on-site groundwater quality*

This will consist of sampling the nine (9) existing monitoring wells for STARS 8021 volatile compounds and 8270 semi-volatile compounds during groundwater sampling events (every quarter during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements).

(c) *Monitor performance of the on-site SSDS*

This will consist of:

An effluent air quality sample will be collected (every nine months) using EPA Method TO-15 parameters. Monitoring of outdoor air quality will determine if sub-slab ventilation is effective in reducing indoor air contaminants and air quality results will be used in determining the effectiveness of the SSDS.

(d) Monitor effectiveness of off-site in-situ groundwater treatment

This will consist of monitoring of the two groundwater monitoring wells installed to measure remediation progress (every quarterly during the first year and every 9 months there after, subject to NYSDEC determination of frequency and requirements). Samples will be analyzed for STARS 8021 volatile compounds and 8270 semi-volatile compounds. The need for additional reagent injection will be determined based on the monitoring results. The overall contaminant reduction vs. the Part 703 groundwater standards will be considered in deciding the need for additional treatment. Significant contaminant reduction would provide more protectiveness than current conditions.

14.0 CHANGE OF USE

It is proposed not to change the present use at the property, as described in Section 2.1 above, and the contemplated use contained in the Voluntary Cleanup Agreement will continued to be restricted commercial (excluding day care, child care, and medical care uses).

15.0 FINANCIAL ASSURANCE

The VCA contains no specific requirements for providing financial assurance for continuing remedial activities at the site. However, the need for financial assurance shall be confirmed with NYSDEC and, if it is necessary the criteria set forth in 6 NYCRR PART 375: Environmental Remediation Programs, subdivision 375-1.11(c) will apply.

16.0 PROJECT CLOSE-OUT

Site closeout will be implemented when all remediation for the site will be complete and the Department will make a determination that the engineering and institutional controls are no longer necessary and no longer has any oversight responsibility for the site and the site has been cleaned to NYSDEC's pre-approved commercial use criteria.

17.0 CERTIFICATIONS

The FER is prepared, stamped and signed by an individual licensed or otherwise authorized in accordance with article145 of the education law to practice the profession of Engineering:

"I certify under the penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

"I certify that the Remedial Design was implemented and that all construction activities were completed in substantial conformance with the Department-approved Remedial Design and were personally witnessed by me or a person under my direct supervision."

Date: 11/06/09 Signature: Ray Kahn

Ray Kahn, P.E.
NYS Professional Engineer License # 075099-1
Director of Environmental Technology
ESPL Environmental Consultants Corp.