FINAL ENGINEERING REPORT

295 Locust Avenue
Tax Map Parcel No 2-2598-46
(includes East 140 Street, Parcel No. 2-2598-74/86)
NYSDEC Site No. C203053
Bronx, New York

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May 2015

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Engineering Certification:

I, Daniel J. Smith, P.E., am currently a registered professional engineer licensed by the State of New York, and I certify that the Remedial Design (RD) was implemented and that all construction activities were completed in substantial conformance with the Department-approved Remedial Action Work Plan (RAWP) except as noted herein. The data submitted to the Department with this Final Engineering Report (FER) demonstrate that the remediation requirements set forth in the RAWP 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 a Site Management Plan (SMP) 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.

Daniel J. Smith, P.E.
NYS PE License No. 073173

STATE OF NEW YORK
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LICENSED PROFESSIONAL ENGINEER

5/9/15

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TAX MAP PARCEL NO 2-2598-46
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BRONX, NEW YORK

1.0 BACKGROUND AND SITE DESCRIPTION

295 Locust Associates, LLC entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) in May 2012 to investigate and remediate an approximate 1.7-acre property located at 295 Locust Avenue in Bronx, New York. The subject property includes a 10,000 square foot parking lot located between 140 East Street and 141 East Street, northeast of the 295 Locust Avenue parcel.

The property was remediated to restricted commercial use and will be used for commercial purposes (e.g., film production studios and related facilities). Residential use will not be applicable at the site.

1.1 Overview of Work Completed

On or about May 23, 2012, the Site was accepted into the NYSDEC Brownfield Cleanup Program (BCP) as Site No. C203053-05-12. The applicant, 295 Locust Associates, LLC, is participating in the BCP as a Volunteer as defined in Environmental Conservation Law (ECL) 27-1405(1)(b).

Under the BCP, the Volunteer has undertaken certain environmental actions, including the installation of a Soil Vapor Intrusion (SVI) mitigation system; Operation, Maintenance and Monitoring (OM&M) of the SVI mitigation system; and, implementation of soil and groundwater remediation. The SVI mitigation system was designed in February 2012 and installed in April and May 2012. The SVI mitigation system has been effectively running since May 2012.

The soil and groundwater remedy for the site is described in the Remedial Action Work Plan (RAWP), dated August 2013, which was approved by the NYSDEC. The Volunteer initiated the soil and groundwater remedy fieldwork on September 26, 2014, and oxidant injection events continued through November 5, 2014. Post-Injection monitoring was completed through April 2015 in general accordance with the approved RAWP.

This document is the Final Engineering Report (FER) describing the remediation implemented by the Volunteer.

1.2 Site Location and Description

The site is located at 295 Locust Avenue in an industrial area of the Port Morris section the County of Bronx, New York and is identified as Block 2598 Lot 46 (building parcel) and Lots 74 and 86 (parking lot) on the Tax Map of the City of New York, Borough and County of the Bronx. The building is situated on an approximately 1.7-acre area bounded by Walnut Avenue (Ross Feiss Blvd) to the northwest, East 140th Street to the northeast, East 139th Street to the southwest, and Locust Avenue to the southeast (see ***Figure 1***). In addition, the Site includes the 10,000 square foot parking lot located between East 140th Street and East 141st Street. The boundaries of the Site, including the parking lot, are fully described in ***Appendix A***: Survey Map, Metes and Bounds.

The Site presently consists of a multi-story building with a footprint of approximately 70,000 square feet (sf). Based upon record drawings of the building, it was constructed with a one-foot thick reinforced concrete structural slab supported by a system of pile caps and concrete grade beams. The floor of the building is situated approximately five feet above the grade of the adjacent street. Ten loading docks leading to exterior rollup doors are present on the southeastern portion of the warehouse building along Locust Avenue. Another loading dock and rollup door opens to East 140th Street. Office space is located in a mezzanine area above the loading docks. The installed SVI mitigation system blowers and main valve manifolds are located in the mezzanine area. The exterior walls of the building are constructed of concrete and sheet metal.

The majority of the concrete slab along the perimeter of the building is underlain by a storm water detention system and sprinkler system recharge trough. The storm water detention system is a water-tight concrete trough that is generally three to four feet deep by six feet wide and collects storm water from the roof via drain pipes which run through the interior perimeter wall of the building. The storm water detention system is reportedly connected to the municipal sewer system at the northern and western corners of the building along Rose Feiss Boulevard (Roux, May 2009). The building's sprinkler system recharge is located along the southeastern portion of the building parallel to East 139th Street, and is constructed of two parallel and water-tight concrete troughs.

The parking lot between East 140th Street and East 141st Street is undeveloped and asphalt paved (Langan, 2015).

Since the BCP work is being completed by a Volunteer who is not the primary occupant at the facility, site access was limited and there were several restrictions on where and when remedial actions could be completed at the site in addition to the physical limitation imposed due to the building construction outlined above. As discussed with NYSDEC, no additional interior floor penetrations were permissible beyond those used in the remedy, as the building has recently been remodeled. Therefore, due to access restrictions it was not possible to install remediation borings or well points inside the building or along the interior perimeter of the building where the storm water and fire water system troughs are integrated into the building structure.

A dry cleaning facility (Modern Tech Dry Cleaners), which is the apparent source of the chlorinated VOCs underlying the Site is located at 874 East 139th Street across the street and to the south of the Site.

1.3 Site History and Ownership

The following information regarding the historical operations conducted on the Site is derived from the Phase II ESA that was prepared by Roux Associates, Inc. (Roux, June 2009) for Locust East 140th Street L.P., a former owner of the Site, and from the East 138th Street Works Site Manufactured Gas Plant History report that was prepared by GEI Consultants, Inc., for Con Ed in connection with the Voluntary Cleanup Application (VCA)[1].

1.3.1 Site Ownership

Based on the above-referenced reports and the information derived from the New York City Department of Finance's Automated City Register Information System, the former owners of record of the Site include:

- 4/23/2015 to present BPA North LLC
- 6/22/2011 to 4/23/2015 295 Locust Associates LLC
- 5/23/2004 to 6/22/2011 Locust East 140th Street L.P.
- 12/21/2001 to 5/23/2004 NYC Industrial Development Agency
- 6/29/1999 to 12/21/2000 Locust East 140th Street L.P.
- 4/5/1996 to 6/29/1999 275 – 295 Locust Ave Realty Corp.
- 1/10/1996 to 4/5/1996 Port Morris Development Corp
- 10/27/1986 to 1/10/1996 Sycamore Hill Corp.
- 6/20/1984 to 10/27/1986 Manhattan Beer Distributors, Inc.,
- 9/3/1963 to 6/20/1984 B.I.M. Realty Company

[1] *The VCP is a predecessor of the current BCP.*

- 7/11/1963 to 9/3/1963 Astra Garage Corp.
- 10/25/1954 to 7/11/1963 Universal Builders Supply Co., Inc.
- 2/1/1952 to 10/25/1954 Julia S. O'Callaghan
- 12/21/1946 to 2/1/1952 Burndy Engineering Co., Inc.
- 6/4/1946 to 12/21/1946 485 E. 133rd St. Corp.
- Prior to 6/4/1946 Con Edison as successor to Central Union Gas Co.

1.3.2 Past Site Operations

The following is a summary of historic site operations as reported by others.

The earliest noted development on the Site was two residences shown on the 1891 Sanborn fire insurance map. By 1908, a portion of the Site was developed with several MGP features including a 2,630,000 cubic foot (cf) gas holder, a water gas purifier house, an oxide storage area, a pit, and a scrubber house used as part of Central Union Gas Company's (a Con Ed predecessor) East 138th Street Works. ***Figure 1*** indicates the approximate locations of the former MGP structures on the Site overlain on the current site layout. The East 138th Street Works was reportedly constructed between 1869 and 1879 and initially produced oven gas using the coal carbonization process. In 1892, the East 138th Street Works was expanded by the addition of Lowe carbureted water gas (CWG) sets. CWG is a form of manufactured gas made from coke/coal and water (as steam) and enriched for candlepower by petroleum products. The CWG was created by passing steam through a bed of incandescent coke or coal, resulting in "blue gas". This was then passed through a chamber containing hot firebrick into which oil was sprayed and the oil volatilized into gaseous hydrocarbons. The resulting mixture of blue gas and gaseous hydrocarbons was then passed through a super heater where the gaseous hydrocarbons were cracked. Wastes generated by the coal carbonization and CWG processes include coal tar, spent lime, and other scrubber materials.

By the 1930s, it appears the MGP facility was decommissioned and aboveground structures were removed. Historical Sanborn fire insurance maps no longer indicated the presence of an MGP facility. Following decommissioning, the northern portion of the Site was developed with a truck storage yard with refueling facilities, including a motor fueling station with storage tanks, until the 1990s. The approximate location of the former fueling station is shown on ***Figure 1***. The southeastern portion of the Site contained three adjoining warehouse-style buildings occupied throughout the 1900s by a variety of facilities including: a motor freight facility, a lumber storage facility, an iron clamp storage facility, a building supplies facility, a refrigerator warehouse, a woodworking facility, a metal storage facility, a tire storage facility, and a furniture manufacturing facility (GEI, 2003). Construction of the existing warehouse building at the Site began in 2000, with demolition of the previous buildings, and was completed in 2002.

1.4 Previous Investigations and Environmental Studies

Several investigations, studies, and work plan / design documents have previously implemented for the Site and surrounding area including:

- *Site Management Plan (SMP)*, TechSolutions Engineering, P.C. (TechSolutions) for Sustainable Development, LLC, April 2015;
- *Subsurface Investigation Report for 901-903 East 140th Street*, Langan Engineering, Environmental, surveying and Landscape Architecture, D.P.C., January 20, 2015;
- *Pilot Test Work Plan – In-Situ Chemical Oxidation (ISCO)*, TechSolutions for Sustainable Development, LLC, January 2014;
- *Remedial Action Work Plan (RAWP)*, TechSolutions for Sustainable Development, LLC, July 2013;
- *Soil Vapor Intrusion Mitigation System: Start-up, Operation, Maintenance and Monitoring Report*, TechSolutions for Sustainable Development, LLC, November 11, 2012;
- *Design Summary Report, Soil Vapor Intrusion Mitigation System*, TechSolutions for Sustainable Development, LLC, February 2012;
- *Remedial Investigation of the 295 Locust Avenue (Block 2598 / Lot 46) Portion of the East 138th Street Works Former MGP Site, Site # V00551, Bronx, New York*, URS Corporation (URS) for Consolidated Edison of New York, Inc. (Con Ed), August 2011;
- *Phase II Environmental Site Assessment: 295 Locust Avenue (Former Distribution Center) and 901-903 East 140th Street (Former Parking Lot) Bronx, New York*, Roux Associates, Inc. (Roux) for Locust East 140th L.P, June, 2009;
- *Phase I Environmental Site Assessment: 295 Locust Avenue (Former Distribution Center) and 901-903 East 140th Street (Former Parking Lot) Bronx, New York* Roux for Locust East 140th L.P., May, 2009;
- *Indoor Air Sampling Summary Letter Report – Murray Feiss Import Corp., Bronx, NY*, Environ International Corp. (Environ), April, 2004;
- *Environmental Review of Murray Feiss Import Corp., Bronx, NY*, Environ, March, 2004;

- *Manufactured Gas Plant History: East 138th Street Works and East 137th Street Station, Bronx, NY*, GEI Consultants, Inc. (GEI) for Con Ed, January, 2003; and,

- *Phase I Environmental Site Assessment (ESA) – Murray Feiss Distribution Center 275-295 Locust Avenue – Bronx, NY*, prepared by Environmental Planning & Management, Inc. (EPM), November 10, 1998.

These documents are incorporated herein by reference.

2.0 REMEDIAL ACTION OBJECTIVES & REMEDY OVERVIEW

In accordance with NYSDEC Department of Environmental Remediation (DER) Guidance document 10 (DER-10), Technical Guidance for Site Investigation and Remediation (May 2010), Remedial Action Objectives (RAOs) were identified and considered the following:

- Applicable Standards, Criteria and Guidance (SCGs), considering the current, intended and reasonably anticipated future use of the site and its surroundings;
- All contaminants exceeding applicable SCGs;
- Environmental media impacted by such contaminants;
- Extent of the impact to the environmental media;
- All actual or potential human exposures and/or environmental impacts resulting from the contaminants in environmental media identified above; and,
- Any site-specific cleanup levels developed.

The RAOs identified in ***Section 2.1*** (inclusive of sub-sections) are applicable at the site.

2.1 Remedial Action Objectives (RAOs)

2.1.1 Groundwater RAOs

The following RAOs apply to groundwater:

- *RAO for Public Health Protection:* (1) Prevent contact with, or inhalation of, volatiles from contaminated groundwater; and,
- *RAO for Environmental Protection:* (1) Restore the groundwater aquifer to pre-disposal / pre-release conditions to the extent practicable; (2) remove the source of ground or surface water contamination to the extent practicable; and, (3) remove VOC contaminant mass from groundwater to the extent practicable.

2.1.2 Soil RAOs

The following RAOs apply to soil:

- *RAO for Public Health Protection:* (1) Prevent ingestion / direct contact with contaminated soil; and, (2) prevent inhalation of, or exposure to, contaminants volatilizing from contaminants in soil.

2.1.3 Soil Vapor RAOs

The following RAOs apply to soil vapor:

- *RAO for Public Health Protection:* (1) Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into the building(s) at the site.

2.1.4 Surface Water and Sediment RAOs

There are no surface waters or sediments located on the Subject Property. Therefore, surface water and sediment RAOs are not applicable.

2.2 Overview of Selected Remedy

The remedy selected for implementation after consideration of appropriate evaluation criteria includes three primary elements:

- In-situ chemical oxidation (ISCO) to address impacted groundwater and saturated soils.
- Maintenance of a soil cap as a soil remedy. The soil cap consists of the concrete floor of the building and other asphalt and concrete surfaces covering the entire exterior of the building within the property boundaries.
- Installation and operation of a sub-slab depressurization system (SSDS) to mitigate sub-slab vapors and prevent intrusion of vapors into structures.

The remedy elements above are also supplemented by a Site Management Plan (SMP) to ensure protection of human health and the environment upon completion of active remediation following submittal of this FER or if the current site uses change warranting additional / different environmental activities. Additional details of the remedy as implemented are provided in ***Section 4*** of this FER.

3.0 INTERIM REMEDIAL MEASURES (IRMS), OPERABLE UNITS (OUS) AND REMEDIAL CONTRACTS

The purpose of this section of the FER is to summarize work performed as interim remedial measures (IRMs), pilot tests, operable units, or under separate remedial construction contracts that were previously documented in individual Construction Completion Reports. This includes IRMs which result in no further remedial action.

3.1 Interim Remedial Measures and Pilot Tests

One IRM and one pilot test were completed at the Site and incorporated into the final remedy. A description of each is provided below:

3.1.1 Sub-Slab Depressurization IRM

There was one IRM completed at the Site that has been incorporated into the final remedy: installation, operation, and maintenance of a soil vapor intrusion mitigation system in the form of a SSDS. The design was completed within the constraints imposed by the property owner as well as the physical limitations of the site (i.e., depth to water and structural elements).

The following is a summary of the SSDS design.

Basis for Design:

The SVI mitigation system was designed to prevent vapors related to historic site activities from entering the facility. Data developed by others indicated the contaminants of concern were primarily chlorinated VOCs and former MGP related chemicals such as BTEX, pentane, and hexane-based compounds. The available soil gas data indicated that the highest levels of concern were located underlying the warehouse section of the facility near the center and western sides of the property. No significant contamination was detected on the eastern side of the site at levels warranting SVI mitigation. As a result, the SVI mitigation design focused on the central and western portions of the facility (complete SSDS drawings are provided in ***Appendix C***).

The SVI mitigation design took into consideration the shallow depth to groundwater and the storm water and fire protection water trough locations (see ***Sheet 2 of Appendix C***). In addition, the building owner restricted trenching in the slab to limited areas along the building centerline where columns leading to the roof were present and where grade beams would not be intersected in order to preserve the structural integrity of the floor slab which is supported by piles. It was determined that an effective SSDS design would encompass a series of SSDS extraction wells placed along the centerline of the building immediately adjacent to the roof columns and pile caps. Five SVI mitigation extraction wells (SVI-1 through SVI-5) were installed as indicated in ***Sheet 2 of Appendix C***. This array of SVI mitigation wells covered over 90% of the area of concern and reduced sub-slab pressure by creating a vacuum that limited movement of contaminated vapors into the structure. All elements of the design were completed in general accordance with the requirements of the New York State Department of Health (NYSDOH) "*Guidance for Evaluating Soil Vapor Intrusion in the State of New York*", October 2006 (as amended).

The operational monitoring data, which are reported to the NYSDEC and NYSDOH on a semi-annual basis, indicates a radius of influence (ROI) of greater than 75 feet.

SVI Well Design:

Five (5) SVI extraction wells were installed to create sub-slab depressurization. The well locations are indicated in ***Sheet 2 of Appendix C*** and the details, including screened intervals and piping to bring the wells to the surface at each location, are provided in ***Sheet 3 of Appendix C***. The screened interval design was critical in this project given that the depth to water is shallow (typically between 10 and 12 feet below grade under the building and only about 4 to 5 feet below grade along the building exterior) and the pile caps and grade beams extend between 2 and 3 feet below the finished floor slab. Therefore, it was necessary to screen the SVI mitigation wells (SVI-1 through SVI-5) from approximately 3 feet to 8 feet below grade to ensure the full radius of influence could be realized without short-circuiting created by pile caps or the elevated water table.

SVI mitigation wells were located approximately 50 feet apart, as indicated on ***Sheet 2 of Appendix C***. This provided a substantial overlap in coverage area along the center of the building and in the areas where soil gas readings have indicated the highest levels of impact. This design also minimized trenching as the wells were all located within 10 feet of the columns leading to the roof which was used to support manifold piping back to the blower systems located on the mezzanine. Each SVI mitigation well was designed to support a minimum extraction rate of 50 cubic feet per minute (cfm) and in actuality higher flows were obtained as head losses in the manifold system were minimized through short piping runs and increasing pipe diameter as the extracted vapors flow toward the SVI system blowers. The SVI mitigation wells were constructed as 2-inch diameter stainless steel wells.

Vapor Monitoring Probes:

The existing vapor monitoring probe network was incorporated into the design. However, review of construction logs for the existing vapor probe design indicated that the depth was not appropriate for proper SVI mitigation system monitoring (i.e., it did not extend below the grade beam depth). Therefore, the TechSolutions design included modification of four (4) of the seven (7) existing vapor monitoring probes to extend to a depth below the grade beams. The remaining existing vapor monitoring probes remained in place to assist in evaluating actual vacuum response as a function of depth and the absence or presence of grade beams near the monitoring probe locations. The locations of the vapor monitoring probes are indicated in ***Sheet 2 of Appendix C*** and the screen and construction details are provided in ***Sheet 3 of Appendix C***. The upgraded vapor monitoring probe locations were selected to ensure monitoring in the following areas:

- One (1) probe in an area that should be under strong vacuum influence in close location to multiple SVI mitigations wells (SVFM-02).
- One (1) probe in an area along the periphery of the anticipated radius of influence of the SVI wells and within an area where elevated soil gas concentrations have been noted by others (SVFM-06).
- One (1) probe along the edge of the SSDS in an area where the anticipated radius of influence will be minimal to help evaluate system effectiveness and determine the actual radius of influence under operations. This probe location also served as confirmation of protection of the loading dock areas along Locust Avenue (SVFM-05).
- One (1) probe located in an area anticipated to be outside or at the extreme periphery of the radius of influence to see if better than anticipated performance is occurring and to evaluate the protectiveness of the system in the corners of the building furthest from SVI mitigation wells (SVFM-1).

In addition, existing vapor monitoring probes SVFM-3, SVFM-4, and H-AA-01 remain for optional future monitoring. H-AA-01 was useful as an indicator of ambient conditions.

<u>Interior and Ceiling Manifold System:</u>

As indicated in ***Sheet 3 of Appendix C***, the piping leaving the wells was 2-inch diameter steel. The piping was notched into the existing floor slab rather than a classical trench design. This was done to minimize cuts all the way through the finished floor and to eliminate any intersections with grade beams or other structural elements. Steel was used as a measure of precaution to provide better integrity than PVC pipe within the floor slab. Upon reaching the columns to the roof, the 2-inch steel piping transitioned to 4-inch steel piping as it emerged from the sub-grade. The 4-inch steel piping was run inside the column to the roof to protect it from accidental damage related to warehouse operations (i.e., forklifts, etc.). A ball valve was provided at each SVI well location to allow flow and vacuum regulation so that the system can be optimized during operation as deemed necessary. The design indicates a transition to PVC piping after the manifold from each well has reached a height of 20 feet above the finished floor to balance costs with protection of equipment. However, PVC piping was unacceptable to the New York City Fire Marshal and CPVC was used instead.

By running piping from individual wells directly up the adjacent roof support columns at the building centerline, the building owner's design restriction to minimize trenching and prevent crossing of grade beams was realized and impacts to the pile cap system were avoided.

In order to minimize roof penetrations, individual laterals from each of the five (5) SVI mitigation wells were individually run to dedicated blower systems (i.e., "homerun" piping with one blower for each SVI) installed on the mezzanine at the east end of the building along Locust Avenue. The ceiling manifold plan is provided in ***Sheet 4 of Appendix C***. This design allowed great operational flexibility and also ensured that in the event of one blower failure, the majority of the building will still be under the influence of the other blower systems to provide an added measure of protection. In addition, the effective ROI was improved due to the additional blower capacity at each SVI well. The roof plan (***Sheet 5 of Appendix C***) indicates the approximate location of the new blower systems and the electrical requirements (completed by others). The complete piping systems as designed are indicated in the piping and instrumentation diagram (***Sheet 6 of Appendix C***).

Blower Systems and Rooftop Piping:

No roof penetrations were required for this project as the effluent from the blower systems exit at the Locust Avenue exterior wall and then were run along the exterior side of the wall up to the roof. All piping and wall penetrations were performed by licensed contractors and the exterior wall repair was completed in strict accordance with architect and wall material manufacturer recommendations to ensure a liquid tight seal.

The five (5) blowers (B-1 through B-5 corresponding to SVI-1 through SVI-5, respectively) were installed on the mezzanine along the Locust Avenue wall (see ***Sheet 4 of Appendix C***). Five (5), Radonaway RP380 Blower systems (B-1 through B-5) were installed. The installation details for the blower systems and the piping and controls necessary are indicated on ***Sheet 3*** and ***Sheet 6 of Appendix C***, respectively.

Each of the five (5) blowers requires a 120VAC, 60Hz receptacle within several feet of the blower. The receptacles were installed by others. Emissions controls were not deemed necessary

The discharge piping exits the exterior wall at Locust Avenue and then extends to the roof top. The discharge piping extends a minimum of three feet above the roofline and was placed away from any fresh air intakes for the building. A rain cap was fitted on the discharge. In addition, since piping leaves the interior of the building and then runs along the exterior, there is the potential for condensate buildup. Low point vents for condensate removal were installed to enable condensate to be collected during the system operation.

3.1.2 ISCO Pilot Test

Treatability testing was completed concurrently with the RAWP development to expedite the project. The treatability test results indicated oxidation with persulfate (e.g., Klozur® from FMC Corporation) was technically feasible. In May 2014, a pilot test was conducted to assess if full-scale treatment was a feasible and cost effective method of treating the groundwater contamination.

The pilot test was conducted in the area of the Site showing the highest levels of chlorinated solvent impacts. The highest concentration of PCE (22,000 µg/L) was detected in (Roux) MWRX-02, close to the dry cleaner operating across East 139th Street. PCE degradation products were detected at their greatest concentrations in MWRX-02 (TCE maximum 3,800 µg/L, dichloroethene [DCE] maximum 37,000 µg/L, and vinyl chloride maximum 6,900 µg/L) and adjacent monitoring well MWMF-04. This area also has impacts from the MGP facility that operated on the 295 Locust Avenue property as well as surrounding properties.

Goals of the Pilot Test

The primary objectives of the pilot test were:

- Determine if the selected oxidant and activator can be effectively delivered to the subsurface at a reasonable rate (i.e., greater than a minimum of 0.5 gallon per minute on average) without an unacceptable groundwater level increase that results in "daylighting" of groundwater and injectants.
- Confirm effectiveness of the injection wells with respect to usability for injections.
- Obtain field data following oxidant and activator injections to verify remedial effectiveness in the short-term and long-term with respect to the ability to degrade contaminants. The focus of this objective was to verify that regional MGP impacts do not adversely impact the ability of ISCO to the degree that it is not a technically- or cost-effective remedy for full-scale implementation.
- Verify the apparent, effective ROI through monitoring at injection points and adjacent wells.

Secondary objectives of the pilot test were to optimize staging areas for full-scale implementation and to identify the best specific procedures for future injection and monitoring.

Pilot Test Injections

The Pilot Test Area A was an approximate 30-foot wide by 70-foot long (2,100 ft^2) area along the north side of East 139th Street between injection wells IW-3 and IW-6 (see ***Figure 2***). The targeted treatment zone was approximately 10 feet thick, from approximately 5 feet below ground surface (bgs) to 15 feet bgs. The persulfate used for pilot testing was sodium persulfate in the form of Klozur® manufactured by FMC Corporation. The pilot test was completed using a dosing of 5 g Klozur®/kg soil ratio, which represents a typical "high dose" application. The Klozur® was injected via four (4) injection wells (IW-3, IW-4, IW-5 and IW-6). The Klozur® was activated using a chelated iron compound (Fe-EDTA).

Results of Pilot Test

To gauge the effectiveness of the persulfate treatment, baseline (pre-treatment) groundwater samples were collected from six (6) monitoring wells in the pilot study area (IW-2, IW-7, MWMF-3, MWMF-4, MWMF-8, and MWRX-2). These wells were then sampled approximately one month after injection and two months after injection. The results of the groundwater sampling are presented in ***Table 1***, which presents the PCE, TCE, c12-DCE, and vinyl chloride results.

The monitoring wells inside the treatment area (MWRX-2 and MWMF-4) showed significant reductions in PCE and TCE levels from the treatment. PCE decreased from 34,700 µg/l to 126 µg/l (a 96% reduction) in MWRX-2. TCE decreased from 5,380 µg/l to 320 µg/l (a 94% reduction) in MWRX-2. In MWMF-4, there was also a significant reduction in PCE which decreased from 636 µg/l to non-detectable levels (<1.8 µg/l), a reduction of 99+%. TCE also decreased from 67.3 µg/l to non-detectable levels (<1.2 µg/l), a reduction of 98%. The chlorinated solvent concentrations in the monitoring wells outside the treatment area exhibited some reduction or stayed stable.

Pilot Test Conclusions and Recommendations

Overall, based on the significant reductions in the chlorinated VOCs within the injection area, the pilot test demonstrated that ISCO using persulfate was an effective treatment technology for the Site. It was recommended that the pilot test be expanded to a full stage injection of the chlorinated VOC-affected area of the Site. That work is discussed in ***Section 4.3***.

4.0 DESCRIPTION OF REMEDIAL ACTIONS PERFORMED

Remedial activities completed at the Site were conducted in general accordance with the NYSDEC-approved RAWP (TechSolutions, August 2013). All deviations from the RAWP are noted below.

- The only deviation from the NYSDEC-approved RAWP relates to portions of the site where the groundwater remedy did not reduce concentrations to Class GA Groundwater Quality Standards. However, significant contaminant mass and concentration reductions were achieved and a SMP has been developed and approved by NYSDEC to address residual concentrations of contaminants.

- Although not a deviation from the NYSDEC-approved RAWP, it should be noted that the optional slant wells discussed in the RAWP were not required and only vertical injection wells were utilized for oxidant and activator delivery and performance monitoring. The elimination of the optional slant wells has no material impact on the work completed at the site.

4.1 Governing Documents

There are multiple governing documents related to the work completed by the Volunteer and documented in this FER. Highlights of these documents are provided below. These documents should be considered incorporated into this FER by reference.

4.1.1 Site Specific Health & Safety Plan (HASP)

All remedial work performed under this Remedial Action was in compliance with governmental requirements, including Site and worker safety requirements mandated by Federal OSHA. The Health and Safety Plan (HASP) was complied with for remedial and invasive work performed at the Site.

4.1.2 Quality Assurance Project Plan (QAPP)

The Quality Assurance Project Plan (QAPP; TechSolutions, July 2013) was included as Appendix F of the RAWP approved by the NYSDEC. The QAPP describes the specific policies, objectives, organization, functional activities, and quality assurance / quality control activities designed to achieve the project data quality objectives. Specifically, the QAPP (and the associated RAWP) addressed the following elements of the overall remediation program at the Site:

- Responsibilities and authorities of the organizations and key personnel involved in the design and construction of the remedy.

- The observations and tests that were used to monitor remedy implementation and the frequency of performance of such activities.

- The sampling activities, sample size, sample locations, testing frequency, acceptance and rejection criteria, and plans for implementing corrective measures as addressed in the plans and specifications.

- Description of the reporting requirements for quality assurance activities including such items as daily summary reports, schedule of data submissions, inspection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation.

4.1.4 Soil/Materials Management Plan (S/MMP)

A formal soil management plan was not required on this project since excavation, handling, storage, transport, and disposal of soils were not included as part of the remedy, except for drill cuttings during installation of monitoring wells and / or oxidant injection wells. Soil handling associated with these activities was completed in accordance with applicable Federal, State, and local laws and regulations.

Materials management related to oxidant injection was completed in accordance with the NYSDEC-Approved RAWP and Pilot Test Work Plan related.

4.1.5 Storm-Water Pollution Prevention Plan (SWPPP)

Since the entire project Site was paved with no exposed vegetation, soil, or sediments, and there was no disturbance of surface covers that would have allowed for contact with subsurface soils that could have realistically led to an erosion or sedimentation concern, therefore, a formal SWPPP was not required for the project. However, the erosion and sediment controls for all remedial construction were performed in general conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control, as applicable.

4.1.6 Community Air Monitoring Plan (CAMP)

A Site-Specific CAMP was developed and included as Appendix E of the NYSDEC-approved RAWP. However, since the remedial action only involved routine drilling and injection operations and the majority of soils encountered were saturated, it was determined that the particulate and dust control measures of the CAMP were not necessary since no visible soil particulates were generated. Drilling fluids were utilized to minimize any dust or particulate generation.

A photoionization detector was used to monitor organic vapor concentrations to ensure protection of public health. No issues associated with organic vapors were encountered during the drilling. It should be noted that the injection activities only involved handling of non-volatile fluids and, therefore, did not pose any type of emissions risks to the surrounding community. Furthermore, mixing of the injection materials was performed inside the building.

4.1.7 Contractors Site Operations Plans (SOPs)

The Remediation Engineer reviewed plans and submittals for this remedial project (i.e., those listed above plus contractor and subcontractor submittals) and confirmed that they were in general compliance with the RAWP. All remedial documents were submitted to NYSDEC and NYSDOH in a timely manner and prior to the start of work.

4.1.8 Community Participation Plan (CPP)

The CPP was developed and approved by the NYSDEC as Appendix D of the RAWP. The Volunteer's agents have implemented the CPP as applicable.

4.2 Remedial Program Elements

This section of the FER outlines the key elements of the remediation program and the entities responsible for its implementation.

4.2.1 Contractors and Consultants

The following entities were the principle technical team members during project implementation:

- Sustainable Development, Inc. (SDI): overall remediation program coordination and liaison with NYSDEC, NYSDOH, and the Volunteer;
- TechSolutions Engineering, P.C.: engineering design, periodic oversight of field construction / remediation activities, and project reporting;
- Recovery Environmental Services, Inc.: remedy implementation, day to day field sampling and construction activities, documentation of field work completed;
- Accutest Laboratories, Inc.: analytical testing and reporting services; and,
- Aquifer Drilling and Testing: well installation and subsurface drilling.

4.2.2 Site Preparation

The following activities were completed as part of Site preparation:

- Mobilization;
- Utility markouts;

- Work Plan development, approvals, and coordination with NYSDEC and NYSDOH; and,

- Acquisition of agency approvals, permits, etc.

Mobilization activities included preliminary meetings on site by the project team to identify existing conditions, coordinate project communications, and ensure that all activities were completed in general accordance with work plans and regulatory approvals. Mobilization on this project was initiated in May 2012 following execution of the BCA by the Volunteer. Additional mobilization activities were completed prior to the start of subsequent phases of work as applicable (e.g., planning meetings were held before starting phases of work, access issues were coordinated, contracts documents were coordinated, etc.).

The driller and the construction team completed utility markouts before all subsurface activities. Any utilities identified were avoided during field work. No utilities were encountered during any of the site activities.

Multiple work plans have been completed and approved by NYSDEC throughout program implementation. These documents have been discussed previously in this FER.

Pre-construction meeting(s) was held with NYSDEC and all contractors prior to the start of various phases of work.

An Underground Injection Control (UIC) application was submitted in February 2014. The USEPA confirmed in an email to SDI, dated March 11, 2014, that a UIC permit by rule is effective for the persulfate injection (UIC ID: 14NY0059902). No additional permits were required for the project; however, the SSDS and associated effluent discharge was installed and operated with NYSDEC approvals.

4.2.3 General Site Controls

Site controls were maintained throughout the project and included the following:

- Site security: site access was strictly limited by the Owner and all work areas were cordoned off during activities. The building was generally locked during operations with access limited to remediation team personnel.

- Job-site records: the project team completed job-site record keeping throughout the field activities. In general, record keeping included sampling records, monitoring records, documentation of oxidant and activator injection events, field screening results, etc.

- Spill response: spill equipment was maintained on-site during oxidant injection activities; however, no spills occurred.

- Erosion and sedimentation controls: although a formal sediment erosion control plan was not required because there were no construction activities that would generate potential erosion or sediment generation and the facility was entirely covered by a concrete cap, care was taken to minimize potential for any erosion or sedimentation (e.g., drill cuttings were immediately drummed and decontamination fluids were contained).
- Equipment decontamination and residual waste management was completed in accordance with approved work plans.
- Groundwater, soil vapor, and indoor air quality screening data were recorded during activities and documented in reports as required by approved work plans.

No significant concerns were noted in relation to any site controls utilized during the remedy implementation.

4.2.4 Nuisance Controls

Since the remedy was only minimally invasive, nuisance controls were only necessary during very limited phases of work – most notably drilling and oxidant injections. During drilling, drilling fluids were utilized to minimize any dust or particulate generation. Reactants for oxidant injections were mixed within the unoccupied interior of the building to ensure protection of the general public and water was available for misting as necessary to prevent dust generation. Trucking and construction vehicles were limited to one or two service vehicles and the drill rig so that noise in the surrounding industrial neighborhood related to the project was generally less than normal noise impacts in the area from daily operations of neighboring business and automobile traffic.

There were no complaints from the public or any other parties at any time throughout project completion.

4.2.5 CAMP Results

CAMP monitoring for VOCs did not indicate any levels of concern during the project.

4.3 Groundwater Remediation - ISCO Implementation

ISCO was considered the most-beneficial remedy for the site because it addressed all contaminants of concern and because of its relatively rapid effectiveness. It did not require semi-permanent equipment nor did it require a large interior well network that could not be installed at the site. Bench and pilot testing demonstrated that ISCO was capable of addressing the contaminants of concern at the Site to meet RAOs under the restrictions and limitations that had to be considered by the Volunteer, as well as the complexities related to the fact that Site is also being remediated by other responsible parties for MGP-related contaminants.

ISCO used chemical oxidation reactions as the remedial mechanism to degrade PCE and its related degradation products (i.e., TCE, DCE, etc.). An oxidant (and activator / catalyst) was injected immediately upgradient of the area with the highest VOC concentrations (MWRX-2) and allowed to flow and distribute through this area of the site with the intent of reducing the mass of chlorinated VOCs. As the oxidant reacted with the contaminants of concern, they were converted to less objectionable contaminants and the total mass of contaminants in the subsurface was reduced.

4.3.1 Oxidant and Activator Selection

ISCO was completed by installing a series of injection wells along the building exterior adjacent to areas of elevated non-MGP contaminant concentrations warranting remediation (see ***Figure 2***). An oxidant, sodium persulfate (i.e., Klozur®) was selected after treatability testing and was injected along with a catalyst (i.e., EDTA) to stimulate the oxidation reactions in-situ. Persulfate oxidation was considered the most appropriate method of ISCO because:

- Persulfate can remediate both the chlorinated VOCs that are the focus of the Volunteer's remediation program as well as the petroleum hydrocarbons that are co-located with the chlorinated VOCs in groundwater.
- Other oxidants (e.g., permanganate) were eliminated from consideration because they were either not effective for all contaminants of concern or considered potentially a safety issue (e.g., Fenton's Reagent) given the fact that contamination is underlying a building and the highly exothermic reaction is a safety concern – especially if there is any free phase LNAPL present in pockets from former MGP site operations.
- Persulfate can be activated by a variety of methods, including iron activation that was used for the Site. Effectiveness was also evaluated during treatability testing using site-specific soil and groundwater.
- Persulfate is commercially available and there are numerous vendors that have a proven track record of successful site implementation with mixed contaminants as are present at the site.

4.3.2 Area of Groundwater Remediation

The area addressed by the remedy is located near the southwest quadrant of the building near the intersection of Walnut Street and East 139th Street with the highest concentrations located along East 139th Street directly across from the neighboring dry cleaner facility (the apparent source). This area of concern also has elevated BTEX concentrations and SVOCs associated with former on-site MGP operations - See ***Figure 2***.

The primary area of concern was not directly accessible with vertical wells installed through the building floor slab nor was the perimeter of the building because of the stormwater and fire protection system troughs. Therefore, the only way to complete the remedy was via installation of new oxidant and activator injection wells along the exterior sidewalk. The injection well layout is indicated in ***Figure 2***.

4.3.3 Oxidant Dosing and Activation

The dosing of oxidant for full-scale injection was based on treatability testing and successful pilot test dosing of 5 g of sodium persulfate per kg of soil to be treated in the remediation area. This dosing used also represents a reasonably high-end oxidant injection concentration considered to be an approximate upper-boundary for cost-effective remediation using persulfate oxidation. Based upon the size of the treatment area, approximately 49,940 pounds of Klozure® sodium persulfate and 4,070 pounds of Fe–EDTA were injected between September 26, 2014 and November 5, 2014. With respect to the dosing rate, a fluid volume of approximately 75% of the effective pore volume in the remediation area was targeted. A 9.6% sodium persulfate concentration was injected based on the dose and volume specified above. The iron-EDTA activator concentration targeted a 150 mg/L *in-situ* concentration after mixing with groundwater in the treatment zone based on guidance by FMC. The injection well locations are shown on ***Figure 2***.

4.3.4 Injection Equipment

A portable injection system with flow control, process instrumentation, mixers, and pumps was utilized for the ISCO application. Gravity injection was also employed in order to minimize localized mounding. All equipment was compatible with the chemicals to be used and the contaminants at the site. Chemicals during injections were stored in temporary tanks within the building for security purposes.

Equipment was staged along the sidewalk or mounted on a truck at East 139th Street during injection events. Power was provided by a portable generator. Water was supplied by the facility personnel.

4.3.5 Underground Injection Control (UIC) Permitting

Prior to the start of injection activities, a UIC permit was applied for and issued by USEPA. The remediation contractor was responsible for permit compliance.

4.3.6 Mixing, Injection, and Process Monitoring

The following general procedure was utilized for mixing injectants to achieve desired dosing requirements and monitoring during injections. Post-injection monitoring is discussed separately in ***Section 4.5***.

- Granular persulfate and activators were mixed into solution at the required concentrations in a mobile injection unit that was located within the building immediately adjacent to the injection points.
- Persulfate and activator solution were injected at each injection well location using a non-pressurized gravity-feed approach. A gravity feed approach was recommended due to the very shallow water table and the need to prevent daylighting of contaminants / injectants and the creating of undesirable preferential migration pathways.
- When initial single well injection monitoring did not indicate an unacceptable rise in the water table, injection was performed at more than one well simultaneously. However, multi-well injection was immediately suspended if the water table rose to within approximately one foot of grade surface.

The dates and volumes of oxidant and activator injected are presented in **Table 2**.

4.3.7 Waste Handling and Disposal

All wastes generated during the remedy implementation were containerized and disposed off-site in accordance with applicable Federal, State and Local regulations. In total, nine (9) drums of non-hazardous investigation-derived wastes were generated and disposed off-site at Clean Earth of New Jersey, Kearney, New Jersey. Waste manifest(s) are provided in ***Appendix D***.

4.3.6 Reporting

Reporting throughout the ISCO phase of the project was completed both formally and informally to document work activities. The following is a summary of the types of reporting completed throughout the project:

- Daily reports (field sheets, screening results, well completion reports, etc.)
- Periodic program level status reports (SDI status reports, formal submission, etc.);

Status reports are submitted to NYSDEC and NYSDOH on a semi-annual basis.

4.4 Contaminated Materials Removal

There was no impacted soil removal completed as part of this remedy as remediation of groundwater and saturated soils was completed *in-situ*. Unsaturated zone soils are being managed via the soil cap system described in ***Section 4.8.1***.

Although physical removal of contaminants was not completed as part of the remedy, the ISCO remedy for groundwater significantly reduced the contaminant mass *in-situ* as discussed further in ***Section 4.5***.

4.5 Remedial Performance Documentation Sampling

Prior to and following oxidant and activator injections, several rounds of groundwater sampling were conducted to evaluate injection effectiveness. Effectiveness sampling events are summarized below:

- May 5, 2014: pre-injection baseline sampling event immediately preceding the start of pilot test injections;
- June 12, 2014: first post-pilot test sampling event (prior to main injections);
- July 23, 2014: second post-pilot test sampling event (prior to main injections);
- August 21, 2014: third post-pilot test sampling event; this event also served as an updated baseline of conditions prior to the start of full-scale injection events in September 2014;
- December 17, 2014: first post-injection sampling event after full-scale remedy implementation between September 2014 and November 2014;
- January 28, 2015: second post-injection sampling event after full-scale implementation; and,
- April 16, 2015: third post-injection sampling event after full-scale implementation (this event was performed at the request of the NYSDEC to evaluate whether rebound had occurred).

Monitoring was completed at eight (8) different monitoring well locations (MWRX-02, MWMF-03, MWMF-04, MWMF-05 [limited sampling], MWMF-06 [limited sampling], MWMF-08, IW-2, and IW-7). Well locations are indicated on ***Figure 2***. All groundwater samples were analyzed for VOCs using Method 8260. Select samples were analyzed for additional parameters including, but not limited to, iron. Sampling was completed in general conformance with the NYSDEC-approved QAPP. Analytical reports are provided electronically as ***Appendix E***. Data Usability Summary Reports (DUSRs) were prepared for all data generated in this remedial performance evaluation program. These DUSRs are included in ***Appendix F***.

The following is a summary of the post-injection, remedial effectiveness monitoring data.

PCE was the primary chlorinated VOC of concern since it was the dry cleaner-related solvent that was the focus of the remedial effort. The percent reduction of PCE is summarized below:

Percent PCE Reduction
Pre-Injection (May 5, 2014) vs. Post-Injection (April 16, 2015)

Well No.	MWRX-02	MWMF-03	MWMF-04	MWMF-08	IW-2*	IW-7*
Pre-Injection (µg/l)	34,700	0.93	636	ND	222	168
Post-Injection (µg/L)	2,880	ND	7.1	ND	161	ND
% Reduction	92%	100%	99%	NA	27%	100%

**Note: The most recent post-injection monitoring event for IW-2 and IW-7 was performed on August 21, 2014.*

The data provided above show a general reduction in the PCE concentration for all the wells monitored. For the well with the highest concentration, MWRX-2, the concentration decrease has shown greater than an order of magnitude decrease in PCE concentrations. As is typical on ISCO projects designed to reduce PCE, there can be an increase in the concentrations of PCE daughter products (most notably TCE, c1,2-DCE and Vinyl chloride) as oxidation proceeds. The only well where this increase was evident was MWRX-02. In all other wells, both PCE and PCE daughter products had significant reductions in concentrations as is discussed further below. Complete percent reduction data for all VOCs are summarized in ***Table 3***.

- **MWRX-2**: Total VOCs increased by 10% but PCE was reduced 92% with corresponding increases in TCE, c1,2-DCE, and vinyl chloride. This was the only monitoring location where there was not a significant reduction in total VOCs. It is likely that the relatively lower percent reduction in contaminants of concern at MWRX-02 is due to the presence of MGP-related impacts since this location is immediately adjacent to the former gas holder at the site. In addition, this location is upgradient of the property and directly downgradient from the off-site dry cleaner which is the apparent source of chlorinated VOCs. As a result, the Volunteer has remediated this location to the extent practicable within its control given MGP-impacts in the area and the proximity to the apparent off-site source of chlorinated VOCs. Residual impacts in this area are to be addressed through engineering controls and implementation of a SMP as addressed later in this report.
- **MWMF-3**: Total VOCs were not reduced in this area but most importantly, all levels of contaminants except for benzene (7.6 µg/l present compared to standard of 2 µg/l) are within regulatory standards.
- **MWMF-4**: PCE and TCE concentrations at this location were reduced by greater than 95% with lesser reductions also noted for secondary chlorinated VOC degradation products. Total VOCs were reduced over 60%, indicating that the majority of residual impacts are either secondary degradation products or MGP-related impacts.
- **MWMF-5:** May 2014 baseline data were not available for this well; therefore, post-injection data were compared to historic data collected by URS to evaluate performance. In general

the distribution of contaminants is consistent with the ISCO being effective. There were significant reductions near MWMF-5 (about 75% total VOC reductions). Most importantly, the key contaminants of concern, including BTEX, had significant reductions: benzene decreased from 5,900 µg/l to 550 µg/l; ethylbenzene from 2,200 µg/l to 272 µg/l, and xylenes from 1,300 µg/l to 174 µg/l. Chlorinated compounds are not a concern at this location.

- **MWMF-6**: In general, all residual concentrations at MWMF-06 were relatively low. BTEX concentrations were reduced significantly (benzene decreased from 110 µg/l in the URS data to 19.7 µg/l in the April 2015 monitoring event). All chlorinated VOC concentrations were at or near NYSDEC regulatory standards and guidelines.
- **MWMF-8:** Chlorinated VOCS are not a significant concern at this location. Only c1,2-DCE was present at any significant levels in the baseline data and it was reduced approximately 44% as a result of the injections. Similarly, vinyl chloride was reduced by about 48%. PCE and TCE were below detection limits at the onset of remediation. This area is evident of a more degraded chlorinated VOC plume locally and may be related to the relatively high petroleum compound concentrations which would have led to anaerobic degradation of the PCE and TCE. BTEX was reduced at percentages in the range of 58% (ethylbenzene) to 68% (toluene).

4.6 Imported Backfill

No imported backfill was used in the completion of this project.

4.7 Contamination Remaining at the Site

As discussed previously, there is contamination remaining at the site above cleanup objectives for both soil and groundwater for the following reasons:

- The ISCO remedy implemented by the Volunteer resulted in significant contaminant mass reduction but did not achieve numerical cleanup objectives. However, the residual contamination mass is being addressed through engineering and institutional controls together with a NYSDEC-approved SMP.

Appendix B indicates the areas of remaining soil contamination and contaminant concentrations based upon the most recent data collected by the responsible party for MGP impacts in 2011. ***Figure 3*** indicates areas of remaining groundwater impacts based upon the January 28, 2015, final groundwater sampling event following remedy implementation by the Volunteer.

4.7.1 Soil Contamination Remaining

Based upon the soil investigation completed by the parties responsible for remediation of MGP impacts in 2011 (URS, 2011), the following is a conservative estimate of residual soil impacts at the site[2].

- Most contaminant exceedances were located in the western portion of the Site although detections were also noted elsewhere (see ***Appendix B and Appendix G***). The primary VOC detections included BTEX compounds associated with former MGP operations and chlorinated VOCs. Chlorinated VOCs are not known MGP feed stocks or residuals and are not typically associated with former MGP sites. Similarly, the BTEX contamination does not appear to be associated with dry cleaning or solvent operations. Historical research of site uses has not revealed any use of chlorinated VOC during operations at the Site.

- Maximum concentrations of chlorinated VOCs (exceeding unrestricted use criteria included:

    - PCE (77 mg/kg in SBMF-04 45.5-46");
    - TCE (8.6 mg/kg in SBMF-23 3.5-4.5");
    - 1,2-Dichloroethane (0.51 mg/kg in SBMF-09 40.5-41.5");
    - cis-1,2-Dichloroethene (70 mg/kg in SBMF-23 3.5-4.5");
    - trans-1,2-Dichloroethene (0.91 mg/kg in SBMF-23 3.5-4.5); and,
    - Vinyl chloride (1.2 mg/kg in SBMF-23 14.2-15").

The chlorinated VOCs are likely attributable to off-site discharges associated with the neighboring dry cleaning establishment and/or other off-site industrial facilities where PCE is / was used. The other chlorinated VOCs are daughter products of PCE and likely formed through reductive dechlorination. In general, chlorinated VOCs were detected most frequently and at the highest concentrations along East 139th Street closer to the mid-block, and within the former gas holder #4, and the western side of the Site.

Maximum concentrations of BTEX compounds exceeding unrestricted use criteria included:

- Benzene (630 mg/kg in SBMF-04 45.5-46");

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[2] *It is likely that the ISCO program and the operation of the SSDS have reduced contaminant concentrations in soil; however, use of the 2011 soil data is considered a conservative approximation of residual impacts that are being addressed by the soil cap and continued SSDS operation.*

- Ethylbenzene (260 mg/kg in SBMF-01 9-10");
- Toluene (1,200 mg/kg in SBMF-04 45.5-46"); and,
- Xylenes (1,900 mg/kg in SBMF-13 5-6").

The BTEX compounds were more widespread than the chlorinated VOCs, with the highest concentrations generally reported within and near the former gas holder #4 at deeper depths where non-aqueous phase liquid (NAPL) was observed. Lower concentrations were generally reported at shallower depths across the entire Site and are likely associated with a regional issue that is outside the scope of the Volunteer's remediation obligations.

There were numerous exceedances in remedial investigation (RI) soil samples for SVOCs, especially PAHs, as compared to Commercial Use Soil Cleanup Objectives (SCOs) for Protection of Public Health in the western portion of the Site and in some areas within the former MGP structures at various depths. In general, there were fewer or no SVOC exceedances in the eastern portion of the Site. Polychlorinated biphenyls (PCBs) were not detected above unrestricted use SCOs. A table showing the maximum concentrations detected in soil samples collected from the main building area along with a designation of whether the data for each parameter exceeds the Commercial Use SCOs is provided in Appendix B (Table 4-2B from the 2012 URS Remedial Investigation report). The exceedances detected in soil samples collected from the parking lot are discussed in Section 4.10 below.

As discussed previously in this FER, soil contamination underlying the building was not remediated due to the presence of the buildings and critical infrastructure, and will be addressed by a soil capping system.

Since contaminated soil and associated soil vapor remains beneath the site after completion of the remedial action, Engineering Controls and Institutional Controls (ECs/ICs) are required to protect human health and the environment. These ECs/ICs are described in the following sections of this FER. Long-term management of these EC/ICs and residual contamination will be performed under the SMP approved by the NYSDEC.

4.7.2 Groundwater Contamination Remaining

As indicated in Table 1, while the ISCO treatment substantially decreased the concentration of the primary chlorinated VOC, it did not decrease the concentration below applicable SCGs in every monitoring well.

Maximum concentrations of chlorinated VOCs exceeding applicable SGCs include:

- PCE (2,880 µg/l in MWRX-2);

- TCE (2,410 µg/l in MWRX-2);
- cis-1,2-Dichloroethene (47,800 µg/l in MWRX-2); and,
- Vinyl chloride (8,730 µg/l in MWRX-2).

Maximum concentrations of BTEX compounds exceeding applicable SGCs are:

- Benzene (6,320 µg/l IW-2);
- Ethylbenzene (1,840 µg/l in IW-2);[3]
- Toluene (11,000 µg/l in IW-2); and,
- Xylenes (5,560 µg/l in IW-2).

The NYSDEC's Remediation Program Regulations related to groundwater protection and control measures describe how to manage sites affected by contaminated groundwater migrating onto a subject property (6 NYCCR Part 375-1.8(d)). Based on the regulations and data, the Volunteer is not responsible for the chlorinated VOC contamination migrating onto the Facility from the dry cleaning facility. The regulations specify the requirements for managing sites where there are both off-site and on-site sources of groundwater contamination:

> (a) Identify a remedy for the site which includes removal, containment or treatment of the on-site sources contributing to the groundwater contamination; and
>
> (b) Include in the remedy actions which eliminate or mitigate on-site environmental or public health exposures, to the extent feasible, resulting from any off-site contamination entering the site.

Although the Remediation Program Regulations do not necessarily require the Volunteer to remediate the chlorinated VOCS, the Volunteer has made a good faith effort by substantially reducing the contaminant mass and installing and operating the SSDS. **Therefore, the Volunteer has met the intent of the NYSDEC Remediation Program Regulations by protecting public health exposures to the extent feasible.**

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[3] *Note: IW-2 was used as an injection point during the remediation program and was not monitored as part of post-remediation sampling. The highest concentrations of BTEX were measured in IW-2 on August 21, 2014 before the final post-injection sampling events. Therefore, the BTEX data are likely much lower than reported for this well.*

4.8 Engineering Controls

Since remaining contaminated soil, associated soil vapor, and groundwater exists beneath the site, ECs are required to protect human health and the environment. The site has ECs consisting of a soil cover system and SSDS, as described in the following subsections.

4.8.1 Soil Cap (Soil Cover System)

In addition to active groundwater remediation via ISCO as outlined in ***Section 4.3***, a soil remedy consisting of maintenance of the existing soil cover coupled with institutional controls and development of the NYSDEC-approved SMP was also employed.

Soil impacts (both MGP and non-MGP contaminants) are present under the existing building. In order to achieve the Soil RAOs for Public Health Protection, two objectives must be met:

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

Maintenance of the existing soil cover system meets both of these objectives when implemented in coordination with operation of the existing SSDS soil vapor mitigation remedy and adherence to the SMP.

Specifically, the soil cover system remedy includes the following:

- The existing concrete floor of the building and the asphalt pavement in the parking lot area serve as the soil remedy cover. The entire floor of the building is concrete (approximately 10-inch thick based upon drawing review and observations during SSDS installation). The existing concrete floor is relatively new and in excellent condition. Expansion joints are not cracking or loose and provide an excellent seal between individual concrete pours. There are no basements. When coupled with the exterior concrete sidewalk system, 100% of the site area is covered with concrete, precluding ingestion or direct contact with contaminated soils. In addition, the asphalt pavement in the parking lot is in good condition.
- The existing concrete floor also provides an excellent vapor barrier on its own; however, the concrete floor system is augmented with a SSDS vapor mitigation system which maintains a pressure differential so that inhalation of, or exposure from, contaminants volatilizing from contaminants in soil is not a completed exposure pathway.

- The cover system will be inspected in accordance with the SMP so that there are no breaches or repairs warranted in order to meet RAOs. Any repairs determined to be needed will be made as soon as practicable in coordination with NYSDEC.

The details of the existing concrete cap are included in the NYSDEC-Approved SSDS design drawing package provided in ***Appendix C***.

Procedures for monitoring and maintaining the soil cap system are provided in the SMP. The SMP also addresses inspection procedures that must occur after any severe weather condition has taken place that may affect on-site systems.

4.8.2 Soil Vapor Mitigation (Sub-Slab Depressurization System)

An existing, NYSDEC and NYSDOH approved SSDS is currently operating at the facility. This system was installed by the Volunteer in July 2012 to meet SVI mitigation requirements in accordance with the BCA. The continued operation of the SSDS in accordance with the approved Soil Vapor Intrusion Operation, Maintenance and Monitoring Plan and SMP is considered the final remedy to meet the Soil Vapor RAOs established for the project. A complete description of the SSDS, which was installed as an IRM, is provided in ***Section 3.3.1*** of this FER.

Procedures for monitoring, operating, and maintaining the SSDS are provided in the SMP and the SVI OM&M Plan. These documents also address inspection procedures that must occur after any severe weather condition occurred that may affect on-site systems.

The NYSDEC and NYSDOH-approved SVI OM&M Plan and the SMP are incorporated in this FER by reference. SSDS drawings are provided in ***Appendix C***.

4.9 Institutional Controls

The site remedy requires that an environmental easement be placed on the property to (1) implement, maintain, and monitor the ECs; (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 commercial and industrial uses only.

An environmental easement for the site was executed by NYSDEC on February 23, 2015. The easement was recorded on April 23, 2015, in the City Register of the City of New York (City Register File No. 2015000136901/Document ID 2015041400629001).

4.10 Supplemental Soil Investigation

As part of a contemplated real estate transaction, a prospective purchaser retained Langan Engineering and Environmental (Langan) to conduct a limited Phase II investigation in the parking lot area northeast of East 140th Street. Langan conducted the investigation on January 5, 2015, which consisted of drilling four soil borings and collecting one sample from each boring for VOC and SVOC analysis using EPA Methods 8260 and 8270. A figure showing the sample locations and the laboratory report are provided in ***Appendix G***. The data do not show any exceedences of the restricted commercial or industrial SCOs for chlorinated VOCs (based on Protection of Public Health). The detections of non-chlorinated VOCs and SVOCs are in the same area as, and consistent with, those previously reported in the RI (e.g., the only commercial or industrial SCO exceedance was for benzo(a)pyrene, which is consistent with earlier soil data from the parking lot area generated by Roux in 2009). These SVOCs are not the responsibility of the Volunteer. Potential exposures to the soil underlying the parking lot are controlled by the soil cover system and soil management procedures set forth in the SMP. No further investigation or remediation related to the presence of non-chlorinated VOCs in the parking lot area is warranted at this time.

TABLES

Table 1
Pilot Test Results Summary

Parameter	Sample Date: Pre-Injection 5/5/2014	Post-Injection 6/12/2014	Post-Injection 7/23/2014	Post-Injection 8/22/2014
IW-2 (Injection Well)				
Tetrachloroethene (PCE)	222	111	296	161
Trichloroethene (TCE)	104	56	122	50.8
cis-1,2-Dichloroethene	12.9	43.6	207	ND
Vinyl chloride	ND	ND	34.6	ND
IW-7 (injection Well)				
Tetrachloroethene (PCE)	168	7.5	13.9	ND
Trichloroethene (TCE)	13.5	ND	15.6	ND
cis-1,2-Dichloroethene	19.9	77.7	19.1	9
Vinyl chloride	12.7	24.3	16.8	ND
MWRX-2 (Monitoring Well)				
Tetrachloroethene (PCE)	34700	4360	3860	126
Trichloroethene (TCE)	5380	1780	2220	320
cis-1,2-Dichloroethene	14100	49900	40600	52800
Vinyl chloride	2900	8510	9410	5090
MWMF-3 (Monitoring Well)				
Tetrachloroethene (PCE)	0.93	6.1	ND	0.54
Trichloroethene (TCE)	1.5	2.9	ND	ND
cis-1,2-Dichloroethene	17.1	16.7	0.8	1.8
Vinyl chloride	2.6	2.5	0.7	ND
MWMF-4 (Monitoring Well)				
Tetrachloroethene (PCE)	636	17.6	ND	ND
Trichloroethene (TCE)	67.3	4.5	ND	ND
cis-1,2-Dichloroethene	477	66.1	16.7	0.9
Vinyl chloride	506	ND	ND	ND
MWMF-8 (Monitoring Well)				
Tetrachloroethene (PCE)	ND	ND	ND	ND
Trichloroethene (TCE)	ND	ND	ND	ND
cis-1,2-Dichloroethene	74.2	103	47.3	39.7
Vinyl chloride	30.9	50.5	49	25.3

Table 2
ISCO Full-Scale Injection Summary

Date of Injection	Mass Klozure® Persulfate Injected (lbs.)	Water Addition for Klozure Solution Makeup (gallons)	Wells Injected	No. Wells with Oxidant Injected	Mass Oxidant Per Well (lbs.)	Volume of Water per Well (gal)	Comments / Iron Addition Notes
09/26/15	1,760	1,600	IW-1 through IW-15	15	117	107	
09/29/15	880	400	IW-1 through IW-5	5	176	80	Also injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-10 through IW-15)
09/30/15	1,760	500	IW-1 through IW-15	15	117	33	
10/01/15	1,760	500	IW-1 through IW-15	15	117	33	
10/02/15	1,760	500	IW-1 through IW-15	15	117	33	
10/02/15	-	-	IW-1 through IW-15	0	0	0	Only injected iron solution. Injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-1 through IW-15)
10/03/15	1,320	500	IW-1 through IW-15	15	88	33	
10/06/15	-	-	IW-1 through IW-15	0	0	0	Only injected iron solution. Injected 800 gallons of water with 440 pounds of iron (equally distributed in wells IW-1 through IW-15)
10/07/15	1,760	500	IW-1 through IW-9	8	220	63	
10/07/15	880	200	IW-10 through IW-15	6	147	33	
10/09/15	2,640	1,200	IW-1 through IW-15	15	176	80	
10/10/15	-	-	IW-1 through IW-15	0	0	0	Only injected iron solution. Injected 1,200 gallons of water with 660 pounds of iron (equally distributed in wells IW-1 through IW-15)
10/13/15	3,520	800	IW-1 through IW-15	15	235	53	
10/14/15	1,760	400	IW-1 through IW-9	9	196	44	Note: slight discrepancy in field log re: individual well dosing but totals were correct. Average per well estimated based upon total injected.
10/14/15	1,490	400	IW-10 through IW-15	6	248	67	Note: slight discrepancy in field log re: individual well dosing but totals were correct. Average per well estimated based upon total injected.
10/15/15	880	400	IW-10 through IW-15	6	147	67	Also injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-1 through IW-9)
10/16/15	2,640	1,200	IW-1 through IW-15	15	176	80	
10/17/15	1,760	800	IW-1 through IW-15	15	117	53	
10/20/15	2,640	1,200	IW-1 through IW-15	15	176	80	
10/21/15	-	-	IW-1 through IW-15	0	0	0	Only injected iron solution. Injected 800 gallons of water with 440 pounds of iron (equally distributed in wells IW-1 through IW-15)
10/22/15	1,760	800	IW-1 through IW-15	15	117	53	
10/23/15	1,760	800	IW-1 through IW-15	15	117	53	
10/24/15	1,760	800	IW-1 through IW-15	15	117	53	Also injected 600 gallons of water with 330 pounds of iron (equally distributed in wells IW-1 through IW-15)

Table 2

ISCO Full-Scale Injection Summary

Date of Injection	Mass Klozure® Persulfate Injected (lbs.)	Water Addition for Klozure Solution Makeup (gallons)	Wells Injected	No. Wells with Oxidant Injected	Mass Oxidant Per Well (lbs.)	Volume of Water per Well (gal)	Comments / Iron Addition Notes
10/27/15	3,520	1,600	IW-1 through IW-15	15	235	107	Also injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-1 through IW-15)
10/28/15	2,640	1,200	IW-10 through IW-15	6	440	200	Also injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-10 through IW-15)
10/29/15	2,640	1,200	IW-10 through IW-15	6	440	200	Also injected 400 gallons of water with 220 pounds of iron solution (equally distributed in wells IW-10 through IW-15). NOTE: wells IW-13 through 15 received majority of injection this day so per well amounts may be slightly off. Totals are correct.
10/30/15	1,760	800	IW-1 through IW-9	9	196	89	
10/31/15	880	400	IW-3 through IW-6	4	220	100	Also injected 200 gallons of water with 110 pounds of iron (equally distributed in wells IW-3 through IW-6)
11/03/15	880	400	IW-1 through IW-9	9	98	44	Discrepancy in individual well logs. Per well estimates assume total was uniformly distributed. Also injected 400 gallons of water with 220 pounds of iron (equally distributed in wells IW-10 through IW-15)
11/04/15	1,430	700	IW-10 through IW-15	6	238	117	Also injected 200 gallons of water with 110 pounds of iron (equally distributed in wells IW-10 through IW-15)
11/05/15	1,210	1,000	IW-1 through IW-9	9	134	111	Also injected 600 gallons of water with 330 pounds of iron (equally distributed in wells IW-10 through IW-15)
TOTALS:	**49,450**	**20,800**					**Totals dissolved iron injected = 3,960 lbs.**

Note: There is a minor discrepancy in the totals from the field logs due to an error in calculation injected per well on a couple of dates in the logs. This has been corrected in this table. The discrepancy was less than 1% of the total oxidant and iron injected and is not significant.

Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	MWRX-2 Pre-Injection 05/05/14		MWRX-2 Post-Injection 06/12/14		MWRX-2 Post-Injection 07/23/14		MWRX-2 Post-Injection 08/21/14		MWRX-2 Post-Injection 12/17/14		MWRX-2 Post-Injection 01/28/15		MWRX-2 Post-Injection 04/16/15		MWRX-2 Percent Reduction (Negative % = Increase in Red)
Parameter	Value	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	
Acetone	50	ND	2500	ND	2000	ND	1000	ND	2000	ND	250	ND	2500	ND	2500	N/A
Benzene	1	136		415		351		213		693		660		430		-216%
Bromochloromethane	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	130	N/A
Bromodichloromethane	50	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Bromoform	50	ND	1000	ND	800	ND	400	ND	800	ND	100	ND	1000	ND	250	N/A
Bromomethane	5	ND	500	ND	400	ND	200	ND	400	ND	50	ND	500	ND	500	N/A
2-Butanone (MEK)	50	ND	2500	ND	2000	ND	1000	ND	2000	ND	250	ND	2500	ND	2500	N/A
Carbon disulfide	NA	ND	500	ND	400	ND	200	ND	400	ND	50	ND	500	ND	500	N/A
Carbon Tetrachloride	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Chlorobenzene	5	ND	250	ND	200	ND	100	ND	200	8.3		ND	250	ND	250	N/A
Chloroethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Chloroform	7	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Chloromethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Cyclohexane	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
1,2-Dibromo-3-chloropropane	5	ND	2500	ND	2000	ND	1000	ND	2000	ND	250	ND	2500	ND	500	N/A
Dibromochloromethane	50	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,2-Dibromoethane	5	ND	500	ND	400	ND	200	ND	400	ND	50	ND	500	ND	250	N/A
1,2-Dichlorobenzene	3	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,3-Dichlorobenzene	3	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,4-Dichlorobenzene	3	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Dichlorodifluoromethane	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	500	N/A
1,1-Dichloroethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,2-Dichloroethane	0.6	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,1-Dichloroethene	5	ND	250	ND	200	ND	100	ND	200	60.5		ND	250	ND	250	N/A
cis-1,2-Dichloroethene	5	14100		49900		40600		52800		32100		40100		47800		-239%
trans-1,2-Dichloroethene	5	ND	250	132		119		135		107		ND	250	ND	250	N/A
1,2-Dichloropropane	1	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
cis-1,3-Dichloropropene	0.4	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
trans-1,3-Dichloropropene	0.4	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Ethylbenzene	5	210		400		374		195		452		459		400		-90%
Freon 113	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
2-Hexanone	50	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
Isopropylbenzene	5	ND	500	ND	400	ND	200	ND	400	21		ND	500	ND	250	N/A
Methyl Acetate	NA	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
Methylcyclohexane	NA	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
Methyl Tert Butyl Ether		ND	250	ND	200	ND	100	ND	200	30.1		ND	250	ND	250	N/A
4-Methyl-2-pentanone(MIBK)	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	1300	N/A
Methylene chloride	5	ND	500	ND	400	ND	200	ND	400	ND	50	ND	500	ND	500	N/A
Styrene	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	250	N/A
1,1,2,2-Tetrachloroethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Tetrachloroethene	5	34700		4360		3860		126		2600		4940		2880		92%
Toluene	5	ND	250	106		95		91.6		78.3		86		80.8 J		Baseline ND
1,2,3-Trichlorobenzene	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	250	N/A
1,2,4-Trichlorobenzene	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	250	N/A
1,1,1-Trichloroethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
1,1,2-Trichloroethane	5	ND	250	ND	200	ND	100	ND	200	ND	25	ND	250	ND	250	N/A
Trichloroethene	5	5380		1780		2220		320		3190		5530		2410		55%
Trichlorofluoromethane	5	ND	1300	ND	1000	ND	500	ND	1000	ND	130	ND	1300	ND	500	N/A
Vinyl chloride	2	2900		8510		9410		5090		8940		8280		8730		-201%
m,p-Xylene	5	114		177		118		118		135		140		139 J		-22%
o-Xylene	5	86.6		168		144		104		192		210		180 J		-108%
Xylene (total)	5	200		345		262		222		326		350		319		-60%
Total VOCs		**57827**		**66293**		**57553**		**59415**		**48933**		**60755**		**63369**		**-10%**

Notes:
1. All results reported in ug/l unless noted.
2. ND = Not Detected above the Reporting Limit (RL)
3. J = Estimated value below the Reporting Limit
4. Reference guideline is NYSDEC Class GA Groundwater Quality Standard / TOGs.

Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	MWMF-3 Pre-Injection 05/05/14	MWMF-3 Post-Injection 06/12/14	MWMF-3 Post-Injection 07/23/14	MWMF-3 Post-Injection 08/21/14	MWMF-3 Post-Injection 12/17/14	MWMF-3 Post-Injection 01/28/15	MWMF-3 Post-Injection 04/16/15	MWMF-3 Percent Reduction (Negative % = Increase in Red)
Parameter	Value	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	
Acetone	50	ND 10	ND 10	ND 10	ND 10	**16.1**	ND 10	ND 10	**N/A**
Benzene	1	**2.1**	**45.2**	**56.8**	ND 1	**16.6**	**7.6**	**14.6**	**-595%**
Bromochloromethane	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 1	**N/A**
Bromodichloromethane	50	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Bromoform	50	ND 4	ND 4	ND 4	ND 4	ND 4	ND 4	ND 1	**N/A**
Bromomethane	5	ND 2	ND 2	ND 2	ND 2	ND 2	ND 2	ND 2	**N/A**
2-Butanone (MEK)	50	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10	**N/A**
Carbon disulfide	NA	ND 2	ND 2	1.7	ND 2	1.8	ND 2	0.25 J	**N/A**
Carbon Tetrachloride	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Chlorobenzene	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Chloroethane	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Chloroform	7	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Chloromethane	5	ND 1	ND 1	**2**	**0.37**	ND 1	ND 1	ND 1	**N/A**
Cyclohexane	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	**N/A**
1,2-Dibromo-3-chloropropane	5	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10	ND 2	**N/A**
Dibromochloromethane	50	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,2-Dibromoethane	5	ND 2	ND 2	ND 2	ND 2	ND 2	ND 2	ND 1	**N/A**
1,2-Dichlorobenzene	3	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,3-Dichlorobenzene	3	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,4-Dichlorobenzene	3	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Dichlorodifluoromethane	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 2	**N/A**
1,1-Dichloroethane	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,2-Dichloroethane	0.6	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,1-Dichloroethene	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
cis-1,2-Dichloroethene	5	**17.1**	**16.7**	0.8	1.8	**1.5**	0.85	ND 1	**100%**
trans-1,2-Dichloroethene	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,2-Dichloropropane	1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
cis-1,3-Dichloropropene	0.4	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	2.5	**N/A**
trans-1,3-Dichloropropene	0.4	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Ethylbenzene	5	ND 1	**16.1**	**97.7**	2	0.52	ND 1	ND 1	**100%**
Freon 113	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	**N/A**
2-Hexanone	50	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	**N/A**
Isopropylbenzene	5	**0.48**	1.6	9.3	ND 2	3.4	3.3	6.2	**-1192%**
Methyl Acetate	NA	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	**N/A**
Methylcyclohexane	NA	ND 5	ND 5	ND 5	**0.35**	ND 5	ND 5	ND 5	**N/A**
Methyl Tert Butyl Ether		ND 1	ND 1	ND 1	ND 1	**0.32**	ND 1	ND 1	**N/A**
4-Methyl-2-pentanone(MIBK)	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	**N/A**
Methylene chloride	5	ND 2	ND 2	ND 2	ND 2	ND 2	ND 2	ND 2	**N/A**
Styrene	5	ND 5	**2.3**	ND 5	**0.64**	ND 5	ND 5	ND 1	**N/A**
1,1,2,2-Tetrachloroethane	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Tetrachloroethene	5	**0.93**	**6.1**	ND 1	0.54	ND 1	ND 1	ND 1	**100%**
Toluene	5	ND 1	**62.6**	**13.1**	4	ND 1	ND 1	ND 1	**100%**
1,2,3-Trichlorobenzene	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 1	**N/A**
1,2,4-Trichlorobenzene	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 1	**N/A**
1,1,1-Trichloroethane	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
1,1,2-Trichloroethane	5	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	ND 1	**N/A**
Trichloroethene	5	**1.5**	**2.9**	ND 1	ND 1	**0.27**	ND 1	0.74 J	**51%**
Trichlorofluoromethane	5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5	ND 2	**N/A**
Vinyl chloride	2	**2.6**	**2.5**	**0.7**	ND 1	**0.76**	**0.39**	1.1	**58%**
m,p-Xylene	5	ND 1	**22.9**	**42**	**9.8**	ND 1	ND 1	ND 1	**N/A**
o-Xylene	5	ND 1	**9**	**35.3**	**4.5**	ND 1	ND 1	ND 1	**N/A**
Xylene (total)	5	ND 1	**31.9**	**77.3**	**14.3**	ND 1	ND 1	ND 1	**N/A**
Total VOCs		**24.7**	**220**	**337**	**38.3**	**41.3**	**12.1**	**25.4**	**-3%**

Notes:
1. All results reported in ug/l unless noted.
2. ND = Not Detected above the Reporting Limit (RL)
3. J = Estimated value below the Reporting Limit
4. Reference guideline is NYSDEC Class GA Groundwater Quality Standard / TOGs.

Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

		MWMF-4							
Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	MWMF-4 Pre-Injection 05/05/14	MWMF-4 Post-Injection 06/12/14	MWMF-4 Post-Injection 07/23/14	MWMF-4 Post-Injection 08/21/14	MWMF-4 Post-Injection 12/17/14	MWMF-4 Post-Injection 01/28/15	MWMF-4 Post-Injection 04/16/15	MWMF-4 Percent Reduction (Negative % = Increase in Red)
Parameter	Value	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	
Acetone	50	ND 250	**261**	**379**	**208**	**759**	**553**	**415**	**Baseline ND**
Benzene	1	**6690**	**343**	**409**	**230**	**40.2**	**64**	**69.9**	**99%**
Bromochloromethane	5	ND 130	**25.1**	**22.7**	**9.9**	**60.5**	**49.4**	**22.3**	**Baseline ND**
Bromodichloromethane	50	ND 25	2.4	1.2	0.84	5.4	3.5	1.5 J	**N/A**
Bromoform	50	ND 100	ND 20	ND 20	ND 4	ND 80	ND 8	ND 5	**5.0**
Bromomethane	5	ND 50	**28.4**	**29.4**	**23.8**	**54.6**	**25.2**	**36.2**	**Baseline ND**
2-Butanone (MEK)	50	ND 250	ND 50	ND 50	ND 10	ND 200	22.2	46.9	**N/A**
Carbon disulfide	NA	ND 50	40.7	48.9	45.9	85.7	36.7	**67.5**	**N/A**
Carbon Tetrachloride	5	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
Chlorobenzene	5	ND 25	ND 5	**2**	0.71	ND 20	0.76	1.4 J	**N/A**
Chloroethane	5	ND 25	**34.6**	**40.2**	**29.9**	**24.5**	**17.6**	**45.3**	**Baseline ND**
Chloroform	7	ND 25	**31.2**	**37.1**	**24.4**	**124**	**105**	**80.0**	**Baseline ND**
Chloromethane	5	ND 25	**1330**	**1430**	**624**	**2470**	**3110**	**2120**	**Baseline ND**
Cyclohexane	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
1,2-Dibromo-3-chloropropane	5	ND 250	ND 50	ND 50	ND 10	ND 200	ND 20	ND 10	**N/A**
Dibromochloromethane	50	ND 25	1.0	ND 5	ND 1	ND 20	0.8	ND **5**	**Below Standard**
1,2-Dibromoethane	5	ND 50	ND 10	ND 10	ND 2	ND 40	ND 4	ND 5	**N/A**
1,2-Dichlorobenzene	3	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
1,3-Dichlorobenzene	3	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
1,4-Dichlorobenzene	3	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
Dichlorodifluoromethane	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 10	**N/A**
1,1-Dichloroethane	5	ND 25	**6**	**6.5**	**4.1**	**14**	**10.5**	**9.7**	**Baseline ND**
1,2-Dichloroethane	0.6	ND 25	**267**	**185**	**147**	**205**	**192**	**158**	**Baseline ND**
1,1-Dichloroethene	5	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**5%**
cis-1,2-Dichloroethene	5	**477**	**66.1**	**16.7**	**538**	ND 20	3.8	**391**	**18%**
trans-1,2-Dichloroethene	5	ND 25	**5.3**	**3.4**	**100**	ND 20	ND 2	**63.8**	**N/A**
1,2-Dichloropropane	1	ND 25	**6.5**	**3.9**	**2.7**	ND 20	**5.3**	**4.2 J**	**Baseline ND**
cis-1,3-Dichloropropene	0.4	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
trans-1,3-Dichloropropene	0.4	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
Ethylbenzene	5	**1560**	ND 5	ND 5	**0.5**	ND 20	ND 2	ND 5	**100%**
Freon 113	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
2-Hexanone	50	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
Isopropylbenzene	5	**92.2**	ND 10	ND 10	ND 2	ND 40	ND 4	ND 5	**100%**
Methyl Acetate	NA	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
Methylcyclohexane	NA	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
Methyl Tert Butyl Ether		**14.4**	**2.6**	**4.1**	**7.5**	ND 20	**1.2**	**5.0**	**65%**
4-Methyl-2-pentanone(MIBK)	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 25	**N/A**
Methylene chloride	5	ND 50	**439**	**352**	**189**	**1390**	**1640**	**700**	**Baseline ND**
Styrene	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 5	**N/A**
1,1,2,2-Tetrachloroethane	5	ND 25	**4.8**	**16.3**	**25.6**	**18.1**	**26.3**	ND 5	**Baseline ND**
Tetrachloroethene	5	**636**	**17.6**	ND 5	**14.6**	ND 20	ND 2	7.1	**99%**
Toluene	5	**210**	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**100%**
1,2,3-Trichlorobenzene	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 5	**N/A**
1,2,4-Trichlorobenzene	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 5	**N/A**
1,1,1-Trichloroethane	5	ND 25	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**N/A**
1,1,2-Trichloroethane	5	ND 25	**37.9**	**57**	**73.1**	**110**	**113**	**102**	**Baseline ND**
Trichloroethene	5	**67.3**	**4.5**	ND 5	**7.0**	ND 20	ND 2	3.0 J	**96%**
Trichlorofluoromethane	5	ND 130	ND 25	ND 25	ND 5	ND 100	ND 10	ND 10	**N/A**
Vinyl chloride	2	**506**	ND 5	ND 5	**11.3**	ND 20	ND 2	**4.2 J**	**99%**
m,p-Xylene	5	**187**	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**100%**
o-Xylene	5	**487**	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**100%**
Xylene (total)	5	**674**	ND 5	ND 5	ND 1	ND 20	ND 2	ND 5	**100%**
Total VOCs		**11601**	**2955**	**3044**	**2318**	**5361**	**5980**	**4354**	**62%**

Notes:
1. All results reported in ug/l unless noted.
2. ND = Not Detected above the Reporting Limit (RL)
3. J = Estimated value below the Reporting Limit
4. Reference guideline is NYSDEC Class GA Groundwater Quality Standard / TOGs.

Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	MWMF-5					
		MWMF-5 Post-Injection 12/17/14		MWMF-5 Post-Injection 01/28/15		MWMF-5 Post-Injection 04/16/15	
Parameter	Value	Result	RL	Result	RL	Result	RL
Acetone	50	**201**		**1360**		**344**	
Benzene	1	**136**		**112**		**550**	
Bromochloromethane	5	**7.7**		ND	50	2.3	
Bromodichloromethane	50	0.69		ND	10	0.28 J	
Bromoform	50	ND	4	ND	40	ND	1
Bromomethane	5	2.3		ND	20	ND	2
2-Butanone (MEK)	50	23.6		ND	100	21.8	
Carbon disulfide	NA	**350**		**331**		**202**	
Carbon Tetrachloride	5	ND	1	ND	10	ND	1
Chlorobenzene	5	**1**		ND	10	0.61 J	
Chloroethane	5	**11.2**		ND	10	4.4	
Chloroform	7	**42.1**		**37.6**		**15.6**	
Chloromethane	5	**491**		**210**		**122**	
Cyclohexane	5	ND	5	ND	50	ND	5
1,2-Dibromo-3-chloropropane	5	ND	10	ND	100	ND	2
Dibromochloromethane	50	ND	1	ND	10	ND	1
1,2-Dibromoethane	5	ND	2	ND	20	ND	1
1,2-Dichlorobenzene	3	ND	1	ND	10	ND	1
1,3-Dichlorobenzene	3	ND	1	ND	10	ND	1
1,4-Dichlorobenzene	3	ND	1	ND	10	ND	1
Dichlorodifluoromethane	5	ND	5	ND	50	ND	2
1,1-Dichloroethane	5	**10.3**		**6.7**		**4.1**	
1,2-Dichloroethane	0.6	**29.5**		**31.5**		**26.6**	
1,1-Dichloroethene	5	ND	1	ND	10	ND	1
cis-1,2-Dichloroethene	5	**46.8**		**7.0**		**41.9**	
trans-1,2-Dichloroethene	5	**2.2**		ND	10	1.4	
1,2-Dichloropropane	1	**11.6**		ND	10	3.8	
cis-1,3-Dichloropropene	0.4	ND	1	ND	10	ND	1
trans-1,3-Dichloropropene	0.4	ND	1	ND	10	ND	1
Ethylbenzene	5	**42.3**		**51.4**		**272**	
Freon 113	5	ND	5	ND	50	v	5
2-Hexanone	50	ND	5	ND	50	ND	5
Isopropylbenzene	5	**5.5**		**7.3**		**20.4**	
Methyl Acetate	NA	ND	5	ND	50	ND	5
Methylcyclohexane	NA	ND	5	ND	50	0.23 J	
Methyl Tert Butyl Ether		**33.2**		**8.8**		**41.3**	
4-Methyl-2-pentanone(MIBK)	5	ND	5	ND	50	ND	5
Methylene chloride	5	**183**		**171**		**89.5**	
Styrene	5	ND	5	ND	50	ND	1
1,1,2,2-Tetrachloroethane	5	**1.2**		ND	10	ND	1
Tetrachloroethene	5	ND	1	ND	10	ND	1
Toluene	5	**3.4**		ND	10	**12.4**	
1,2,3-Trichlorobenzene	5	ND	5	ND	50	ND	1
1,2,4-Trichlorobenzene	5	ND	5	ND	50	ND	1
1,1,1-Trichloroethane	5	0.36		ND	10	ND	1
1,1,2-Trichloroethane	5	**16.3**		**9.1**		**6.1**	
Trichloroethene	5	0.37		ND	10	ND	1
Trichlorofluoromethane	5	ND	5	ND	50	ND	2
Vinyl chloride	2	**28.9**		3.8		**89.1**	
m,p-Xylene	5	4.6		ND	10	**78.3**	
o-Xylene	5	4.8		4.7		**95.8**	
Xylene (total)	5	**9.4**		**7.7**		**174**	
Total VOCs		**1700**		**2360**		**2220**	

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3. J = Estimated value below the Reporting Limit
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Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

		MWMF-6					
Sample ID	**NYSDEC Class GA GW Quality Standard or Guidance Value**	**MWMF-6** **Post-Injection** 12/17/14		**MWMF-6** **Post-Injection** 01/28/15		**MWMF-6** **Post-Injection** 04/16/15	
Parameter	**Value**	**Result**	RL	**Result**	RL	**Result**	RL
Acetone	50	**154**		**45.5**		**18.2**	
Benzene	1	**30.5**		**15.7**		**19.7**	
Bromochloromethane	5	**1.6**		ND	5	ND	1
Bromodichloromethane	50	ND	3	ND	1	ND	1
Bromoform	50	ND	10	ND	4	ND	1
Bromomethane	5	**1.9**		ND	2	ND	2
2-Butanone (MEK)	50	**13.3**		**5.2**		ND	10
Carbon disulfide	NA	**256**		**90.2**		**63.1**	
Carbon Tetrachloride	5	ND	3	ND	1	ND	1
Chlorobenzene	5	**0.99**		**0.9**		**1.1**	
Chloroethane	5	4.8		1.8		1.2	
Chloroform	7	**9.8**		2.9		1.9	
Chloromethane	5	**179**		**40.2**		**17.8**	
Cyclohexane	5	ND	13	ND	5	ND	5
1,2-Dibromo-3-chloropropane	5	ND	25	ND	10	ND	2
Dibromochloromethane	50	ND	3	ND	1	ND	1
1,2-Dibromoethane	5	ND	5	ND	2	ND	1
1,2-Dichlorobenzene	3	ND	3	ND	1	ND	1
1,3-Dichlorobenzene	3	ND	3	ND	1	ND	1
1,4-Dichlorobenzene	3	ND	3	ND	1	ND	1
Dichlorodifluoromethane	5	ND	13	ND	5	ND	2
1,1-Dichloroethane	5	1.6		**0.5**		**0.45**	J
1,2-Dichloroethane	0.6	**9.2**		**3.1**		**2.1**	
1,1-Dichloroethene	5	ND	3	ND	1	ND	1
cis-1,2-Dichloroethene	5	**5.1**		**5.4**		**8.6**	
trans-1,2-Dichloroethene	5	ND	3	ND	1	ND	1
1,2-Dichloropropane	1	ND	3	**0.69**		**0.49**	J
cis-1,3-Dichloropropene	0.4	ND	3	ND	1	ND	1
trans-1,3-Dichloropropene	0.4	ND	3	ND	1	ND	1
Ethylbenzene	5	1.5		0.42		0.62	J
Freon 113	5	ND	13	ND	5	ND	5
2-Hexanone	50	ND	13	ND	5	ND	5
Isopropylbenzene	5	2		0.27		0.26	J
Methyl Acetate	NA	ND	13	ND	5	ND	5
Methylcyclohexane	NA	ND	13	ND	5	ND	5
Methyl Tert Butyl Ether		ND	3	ND	1	ND	1
4-Methyl-2-pentanone(MIBK)	5	ND	13	ND	5	ND	5
Methylene chloride	5	**84.7**		**30.3**		**17.6**	
Styrene	5	ND	13	ND	5	0.61	J
1,1,2,2-Tetrachloroethane	5	ND	3	ND	1	ND	1
Tetrachloroethene	5	ND	3	ND	1	ND	1
Toluene	5	1.5		1.2		1.6	
1,2,3-Trichlorobenzene	5	ND	13	ND	5	v	1
1,2,4-Trichlorobenzene	5	ND	13	ND	5		1
1,1,1-Trichloroethane	5	ND	3	ND	1		1
1,1,2-Trichloroethane	5	**2.5**		**0.88**		0.58	J
Trichloroethene	5	ND	3	ND	1	0.29	J
Trichlorofluoromethane	5	ND	13	ND	5		2
Vinyl chloride	2	1.9		1.6		**5.4**	
m,p-Xylene	5	1.1		0.45		0.76	J
o-Xylene	5	0.94		0.33		0.40	J
Xylene (total)	5	2		0.78		1.2	
Total VOCs		**766**		**248**		**164**	

Notes:
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3. J = Estimated value below the Reporting Limit
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Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	MWMF-8 Pre-Injection 05/05/14	MWMF-8 Post-Injection 06/12/14	MWMF-8 Post-Injection 07/23/14	MWMF-8 Post-Injection 08/21/14	MWMF-8 Post-Injection 12/17/14	MWMF-8 Post-Injection 01/28/15	MWMF-8 Post-Injection 04/16/15	MWMF-8 Percent Reduction (Negative % = Increase in Red)
Parameter	Value	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	Result RL	
Acetone	50	ND 500	ND 200	**76.3**	ND 200	**169**	**93.3**	**59.9**	**Baseline ND**
Benzene	1	**2010**	**3230**	**2780**	**1770**	**1260**	**1420**	**729**	**64%**
Bromochloromethane	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 5	**N/A**
Bromodichloromethane	50	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Bromoform	50	ND 200	ND 80	ND 80	ND 80	ND 80	ND 80	ND 5	**N/A**
Bromomethane	5	ND 100	ND 40	ND 40	ND 40	ND 40	ND 40	ND 10	**N/A**
2-Butanone (MEK)	50	ND 500	ND 200	ND 200	ND 200	ND 200	ND 200	ND 50	**N/A**
Carbon disulfide	NA	ND 100	ND 40	**19**	ND 40	**16.5**	**4.4**	**15.3**	**Baseline ND**
Carbon Tetrachloride	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Chlorobenzene	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Chloroethane	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Chloroform	7	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Chloromethane	5	ND 50	ND 20	**24.1**	ND 20	**29**	ND 20	**12.9**	**N/A**
Cyclohexane	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	4.3 J	**N/A**
1,2-Dibromo-3-chloropropane	5	ND 500	ND 200	ND 200	ND 200	ND 200	ND 200	ND 10	**N/A**
Dibromochloromethane	50	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,2-Dibromoethane	5	ND 100	ND 40	ND 40	ND 40	ND 40	ND 40	ND 5	**N/A**
1,2-Dichlorobenzene	3	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,3-Dichlorobenzene	3	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,4-Dichlorobenzene	3	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Dichlorodifluoromethane	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 10	**N/A**
1,1-Dichloroethane	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,2-Dichloroethane	0.6	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	**17.6**	**N/A**
1,1-Dichloroethene	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
cis-1,2-Dichloroethene	5	**74.2**	**103**	**47.3**	**39.7**	**60.2**	**63.2**	**41.9**	**44%**
trans-1,2-Dichloroethene	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,2-Dichloropropane	1	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
cis-1,3-Dichloropropene	0.4	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
trans-1,3-Dichloropropene	0.4	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Ethylbenzene	5	**3910**	**2780**	**2140**	**2250**	**2090**	**1730**	**1630**	**58%**
Freon 113	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 25	**N/A**
2-Hexanone	50	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 25	**N/A**
Isopropylbenzene	5	**242**	**112**	**116**	**159**	**124**	**108**	**143**	**41%**
Methyl Acetate	NA	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 25	**N/A**
Methylcyclohexane	NA	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	4.3 J	**N/A**
Methyl Tert Butyl Ether		ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
4-Methyl-2-pentanone(MIBK)	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 25	**N/A**
Methylene chloride	5	ND 100	ND 40	ND 40	ND 40	ND 40	ND 40	ND 10	**N/A**
Styrene	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 5	**N/A**
1,1,2,2-Tetrachloroethane	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Tetrachloroethene	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Toluene	5	**596**	**542**	**406**	**220**	**339**	**213**	**192**	**68%**
1,2,3-Trichlorobenzene	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 5	**N/A**
1,2,4-Trichlorobenzene	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 5	**N/A**
1,1,1-Trichloroethane	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
1,1,2-Trichloroethane	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Trichloroethene	5	ND 50	ND 20	ND 20	ND 20	ND 20	ND 20	ND 5	**N/A**
Trichlorofluoromethane	5	ND 250	ND 100	ND 100	ND 100	ND 100	ND 100	ND 10	**N/A**
Vinyl chloride	2	**30.9**	**50.5**	**49**	**25.1**	**17.6**	**27.5**	**16.1**	**48%**
m,p-Xylene	5	**2720**	**1770**	**968**	**609**	**734**	**680**	**887**	**67%**
o-Xylene	5	**1500**	**1060**	**814**	**960**	**758**	**772**	**678**	**55%**
Xylene (total)	5	**4220**	**2840**	**1780**	**1570**	**1490**	**1450**	**1560**	**63%**
Total VOCs		**15303**	**12488**	**9220**	**7603**	**7087**	**6561**	**5991**	**61%**

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Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

Sample ID	NYSDEC Class GA GW Quality Standard or Guidance Value	IW-2 Pre-Injection 05/05/14		IW-2 Post-Injection 06/12/14		IW-2 Post-Injection 07/23/14		IW-2 Post-Injection 08/21/14		IW-2 Post-Injection 12/17/14		IW-2 Post-Injection 01/28/15		IW-2 Percent Reduction (Negative % = Increase in Red)
Parameter	Value	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	
Acetone	50	ND	500	ND	1000	ND	500	ND	500					N/A
Benzene	1	9590		8660		7330		6320						34%
Bromochloromethane	5	ND	250	ND	500	ND	250	ND	250					N/A
Bromodichloromethane	50	ND	50	ND	100	ND	50	ND	50					N/A
Bromoform	50	ND	200	ND	400	ND	200	ND	200					N/A
Bromomethane	5	ND	100	ND	200	ND	100	ND	100					N/A
2-Butanone (MEK)	50	ND	500	ND	1000	ND	500	ND	500					N/A
Carbon disulfide	NA	ND	100	ND	200	ND	100	ND	100					N/A
Carbon Tetrachloride	5	ND	50	ND	100	ND	50	ND	50					N/A
Chlorobenzene	5	ND	50	ND	100	ND	50	ND	50					N/A
Chloroethane	5	ND	50	ND	100	ND	50	ND	50					N/A
Chloroform	7	ND	50	ND	100	ND	50	ND	50					N/A
Chloromethane	5	ND	50	ND	100	ND	50	ND	50					N/A
Cyclohexane	5	ND	250	ND	500	ND	250	ND	250					N/A
1,2-Dibromo-3-chloropropane	5	ND	500	ND	1000	ND	500	ND	500					N/A
Dibromochloromethane	50	ND	50	ND	100	ND	50	ND	50					N/A
1,2-Dibromoethane	5	ND	100	ND	200	ND	100	ND	100					N/A
1,2-Dichlorobenzene	3	ND	50	ND	100	ND	50	ND	50					N/A
1,3-Dichlorobenzene	3	ND	50	ND	100	ND	50	ND	50					N/A
1,4-Dichlorobenzene	3	ND	50	ND	100	ND	50	ND	50					N/A
Dichlorodifluoromethane	5	ND	250	ND	500	ND	250	ND	250					N/A
1,1-Dichloroethane	5	ND	50	ND	100	ND	50	ND	50					N/A
1,2-Dichloroethane	0.6	ND	50	ND	100	ND	50	ND	50					N/A
1,1-Dichloroethene	5	ND	50	ND	100	ND	50	ND	50					N/A
cis-1,2-Dichloroethene	5	12.9		43.6		207		ND	50					100%
trans-1,2-Dichloroethene	5	ND	50	ND	100	ND	50	ND	50					N/A
1,2-Dichloropropane	1	ND	50	ND	100	ND	50	ND	50					N/A
cis-1,3-Dichloropropene	0.4	ND	50	ND	100	ND	50	ND	50					N/A
trans-1,3-Dichloropropene	0.4	ND	50	ND	100	ND	50	ND	50					N/A
Ethylbenzene	5	1840		2210		1900		1840						0%
Freon 113	5	ND	250	ND	500	ND	250	ND	250					N/A
2-Hexanone	50	ND	250	ND	500	ND	250	ND	250					N/A
Isopropylbenzene	5	49.1		58.6		55.8		51.7						-5%
Methyl Acetate	NA	ND	250	ND	500	ND	250	ND	250					N/A
Methylcyclohexane	NA	ND	250	ND	500	ND	250	ND	250					N/A
Methyl Tert Butyl Ether		ND	50	ND	100	ND	50	ND	50					N/A
4-Methyl-2-pentanone(MIBK)	5	ND	250	ND	500	ND	250	ND	250					N/A
Methylene chloride	5	ND	100	ND	200	ND	100	ND	100					N/A
Styrene	5	595		ND	500	ND	250	499						16%
1,1,2,2-Tetrachloroethane	5	ND	50	ND	100	ND	50	ND	50					N/A
Tetrachloroethene	5	222		111		296		161						27%
Toluene	5	17500		11900		12000		11000						37%
1,2,3-Trichlorobenzene	5	ND	250	ND	500	ND	250	ND	250					N/A
1,2,4-Trichlorobenzene	5	ND	250	ND	500	ND	250	ND	250					N/A
1,1,1-Trichloroethane	5	ND	50	ND	100	ND	50	ND	50					N/A
1,1,2-Trichloroethane	5	ND	50	ND	100	ND	50	ND	50					N/A
Trichloroethene	5	104		56.2		122		50.8						51%
Trichlorofluoromethane	5	ND	250	ND	500	ND	250	ND	250					N/A
Vinyl chloride	2	ND	50	ND	100	34.6		ND	50					N/A
m,p-Xylene	5	4680		3330		3750		3890						17%
o-Xylene	5	2040		1420		1700		1670						18%
Xylene (total)	5	6730		4750		5450		5560						17%
Total VOCs		**43363**		**32539**		**32845**		**31043**						**28%**

Notes:
1. All results reported in ug/l unless noted.
2. ND = Not Detected above the Reporting Limit (RL)
3. J = Estimated value below the Reporting Limit
4. Reference guideline is NYSDEC Class GA Groundwater Quality Standard / TOGs.

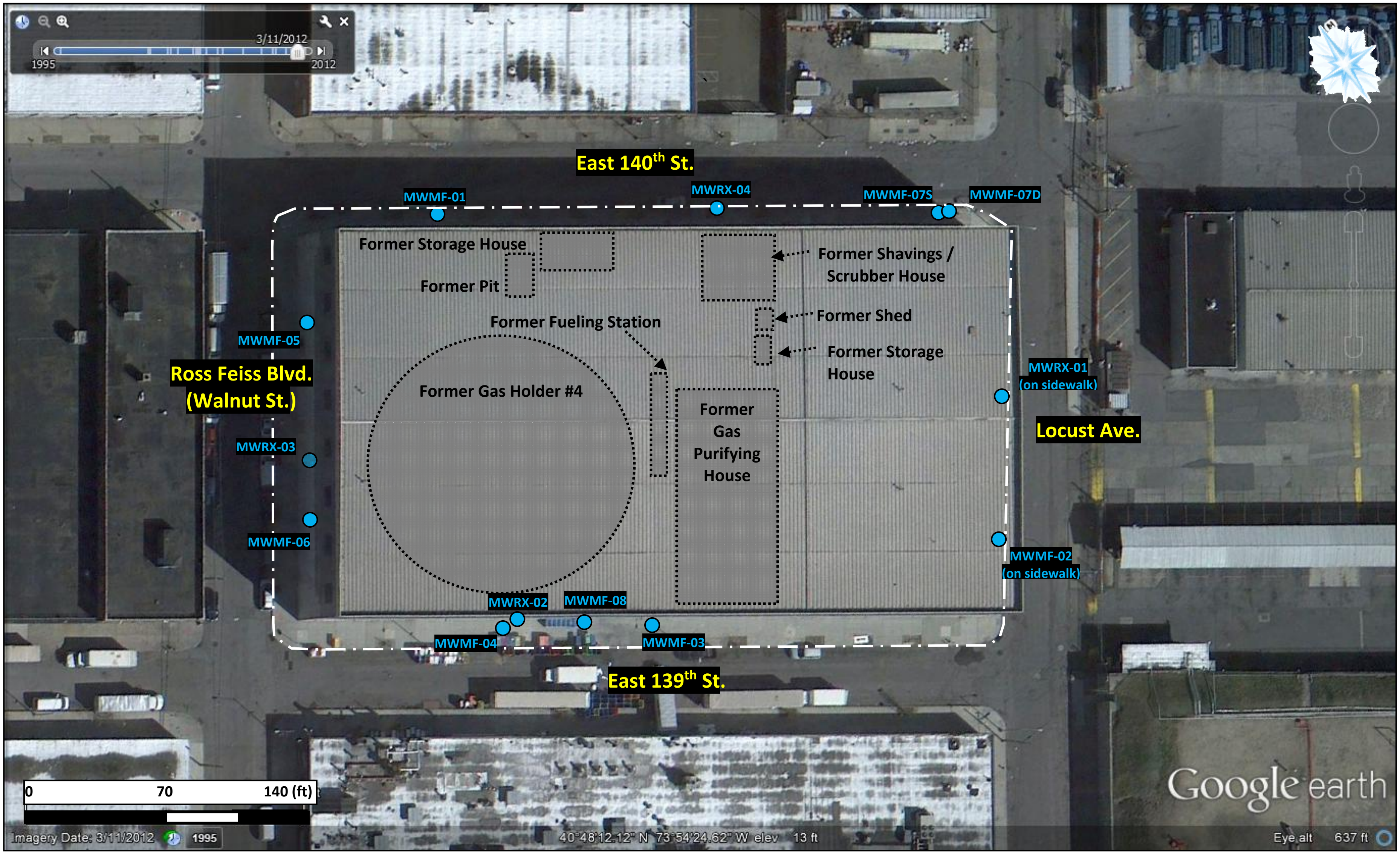
Table 3

Groundwater Sampling Data Summary
Volatile Organic Compounds (VOCs)

		IW-7												
Sample ID	**NYSDEC Class GA GW Quality Standard or Guidance Value**	**IW-7** **Pre-Injection** 05/05/14		**IW-7** **Post-Injection** 06/12/14		**IW-7** **Post-Injection** 07/23/14		**IW-7** **Post-Injection** 08/21/14		**IW-7** **Post-Injection** 12/17/14		**IW-7** **Post-Injection** 01/28/15		**IW-7 Percent Reduction** **(Negative % = Increase in Red)**
Parameter	**Value**	**Result**	RL	**Result**	RL	**Result**	RL	**Result**	RL	**Result**	RL	**Result**	RL	
Acetone	50	ND	100	ND	100	ND	50	ND						**N/A**
Benzene	1	**1370**		**2040**		**1330**		**293**						**79%**
Bromochloromethane	5	ND	50	ND	50	ND	25	ND	5					**N/A**
Bromodichloromethane	50	ND	10	ND	10	ND	5	ND	1					**N/A**
Bromoform	50	ND	40	ND	40	ND	20	ND	4					**N/A**
Bromomethane	5	ND	20	ND	20	ND	10	ND	2					**N/A**
2-Butanone (MEK)	50	ND	100	ND	100	ND	50	ND	10					**N/A**
Carbon disulfide	NA	ND	20	ND	20	ND	10	ND	2					**N/A**
Carbon Tetrachloride	5	ND	10	ND	10	ND	5	ND	1					**N/A**
Chlorobenzene	5	ND	10	ND	10	3.5		**1.3**						**N/A**
Chloroethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
Chloroform	7	ND	10	ND	10	ND	5	ND	1					**N/A**
Chloromethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
Cyclohexane	5	ND	50	ND	50	ND	25	**1.2**						**N/A**
1,2-Dibromo-3-chloropropane	5	ND	100	ND	100	ND	50	ND	10					**N/A**
Dibromochloromethane	50	ND	10	ND	10	ND	5	ND	1					**N/A**
1,2-Dibromoethane	5	ND	20	ND	20	ND	10	ND	2					**N/A**
1,2-Dichlorobenzene	3	ND	10	ND	10	ND	5	ND	1					**N/A**
1,3-Dichlorobenzene	3	ND	10	ND	10	ND	5	ND	1					**N/A**
1,4-Dichlorobenzene	3	ND	10	ND	10	ND	5	ND	1					**N/A**
Dichlorodifluoromethane	5	ND	50	ND	50	ND	25	ND	5					**N/A**
1,1-Dichloroethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
1,2-Dichloroethane	0.6	ND	10	ND	10	ND	5	ND	1					**N/A**
1,1-Dichloroethene	5	ND	10	ND	10	ND	5	ND	1					**N/A**
cis-1,2-Dichloroethene	5	**19.9**		**77.7**		**19.1**		**0.9**						**95%**
trans-1,2-Dichloroethene	5	ND	10	ND	10	ND	5	ND	1					**N/A**
1,2-Dichloropropane	1	ND	10	ND	10	ND	5	ND	1					**N/A**
cis-1,3-Dichloropropene	0.4	ND	10	ND	10	ND	5	ND	1					**N/A**
trans-1,3-Dichloropropene	0.4	ND	10	ND	10	ND	5	ND	1					**N/A**
Ethylbenzene	5	**1260**		**491**		**924**		**199**						**84%**
Freon 113	5	ND	50	ND	50	ND	25	ND	5					**N/A**
2-Hexanone	50	ND	50	ND	50	ND	25	ND	5					**N/A**
Isopropylbenzene	5	**105**		**45.5**		**77.8**		**23.9**						**77%**
Methyl Acetate	NA	ND	50	ND	50	ND	25	ND	5					**N/A**
Methylcyclohexane	NA	ND	50	ND	50	ND	25	**0.76**						**N/A**
Methyl Tert Butyl Ether		**30.8**		**23.4**		**39.4**		**21.6**						**30%**
4-Methyl-2-pentanone(MIBK)	5	ND	50	ND	50	ND	25	ND	5					**N/A**
Methylene chloride	5	ND	20	ND	20	ND	10	ND	2					**N/A**
Styrene	5	ND	50	ND	50	ND	25	ND	5					**N/A**
1,1,2,2-Tetrachloroethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
Tetrachloroethene	5	**168**		**7.5**		**13.9**		ND	1					**100%**
Toluene	5	**65.4**		**19.6**		**35.3**		**12.5**						**81%**
1,2,3-Trichlorobenzene	5	ND	50	ND	50	ND	25	ND	5					**N/A**
1,2,4-Trichlorobenzene	5	ND	50	ND	50	ND	25	ND	5					**N/A**
1,1,1-Trichloroethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
1,1,2-Trichloroethane	5	ND	10	ND	10	ND	5	ND	1					**N/A**
Trichloroethene	5	**13.5**		ND	10	**15.6**		ND	1					**100%**
Trichlorofluoromethane	5	ND	50	ND	50	ND	25	ND	5					**N/A**
Vinyl chloride	2	**12.7**		**24.3**		**16.8**		**1.8**						**86%**
m,p-Xylene	5	**149**		**46.8**		**108**		**40.2**						**73%**
o-Xylene	5	**302**		**99.6**		**218**		**108**						**64%**
Xylene (total)	5	**451**		**146**		**326**		**148**						**67%**
Total VOCs		**3947**		**3021**		**3127**		**852**						**78%**

Notes:
1. All results reported in ug/l unless noted.
2. ND = Not Detected above the Reporting Limit (RL)
3. J = Estimated value below the Reporting Limit
4. Reference guideline is NYSDEC Class GA Groundwater Quality Standard / TOGs.

FIGURES



Existing GW Monitoring Well

Former MGP Infrastructure (some may remain below grade)

Figure 1
Site Plan
295 Locust Avenue, Bronx, NY

(Basemap: Google Earth 2012 Image)

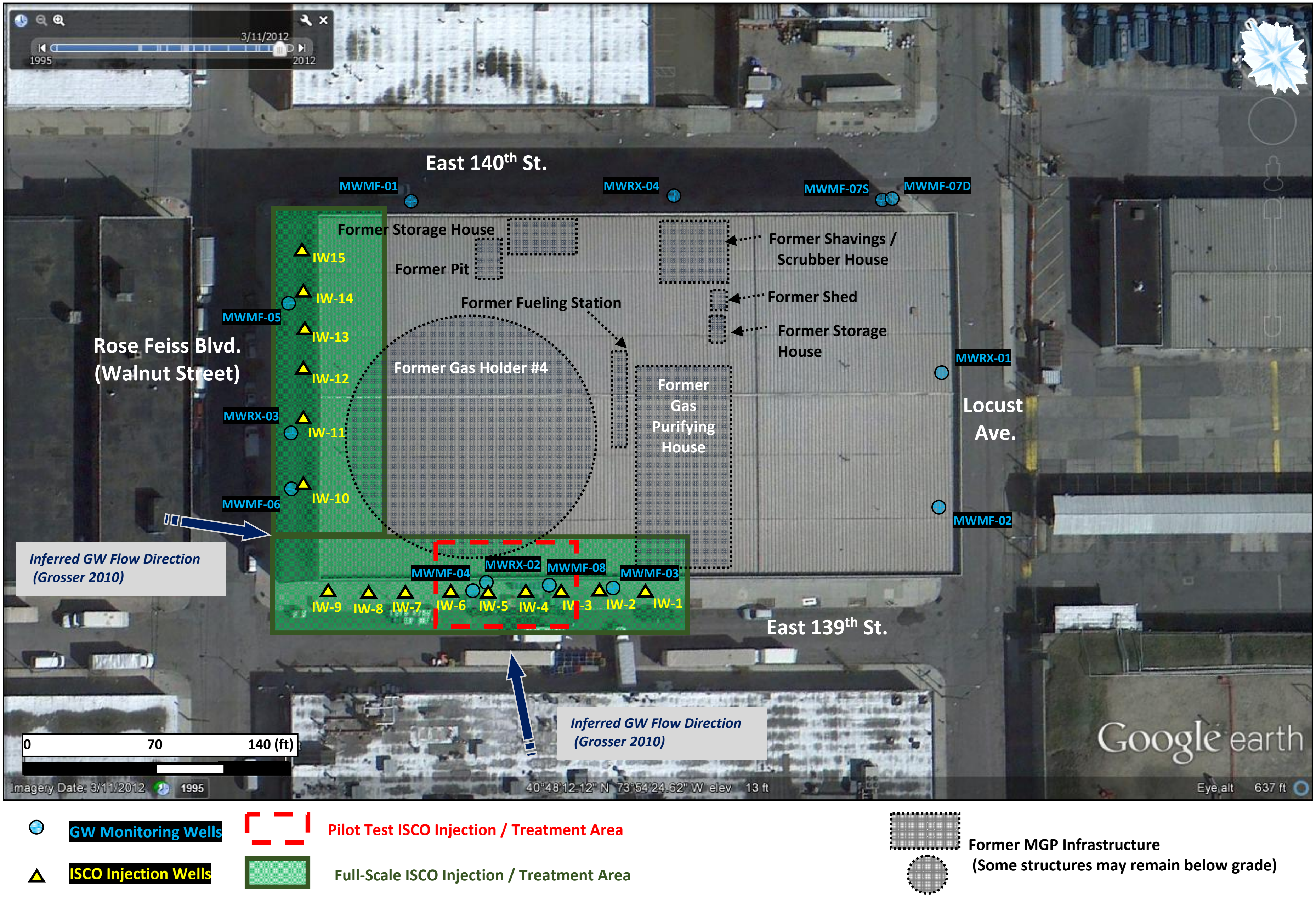
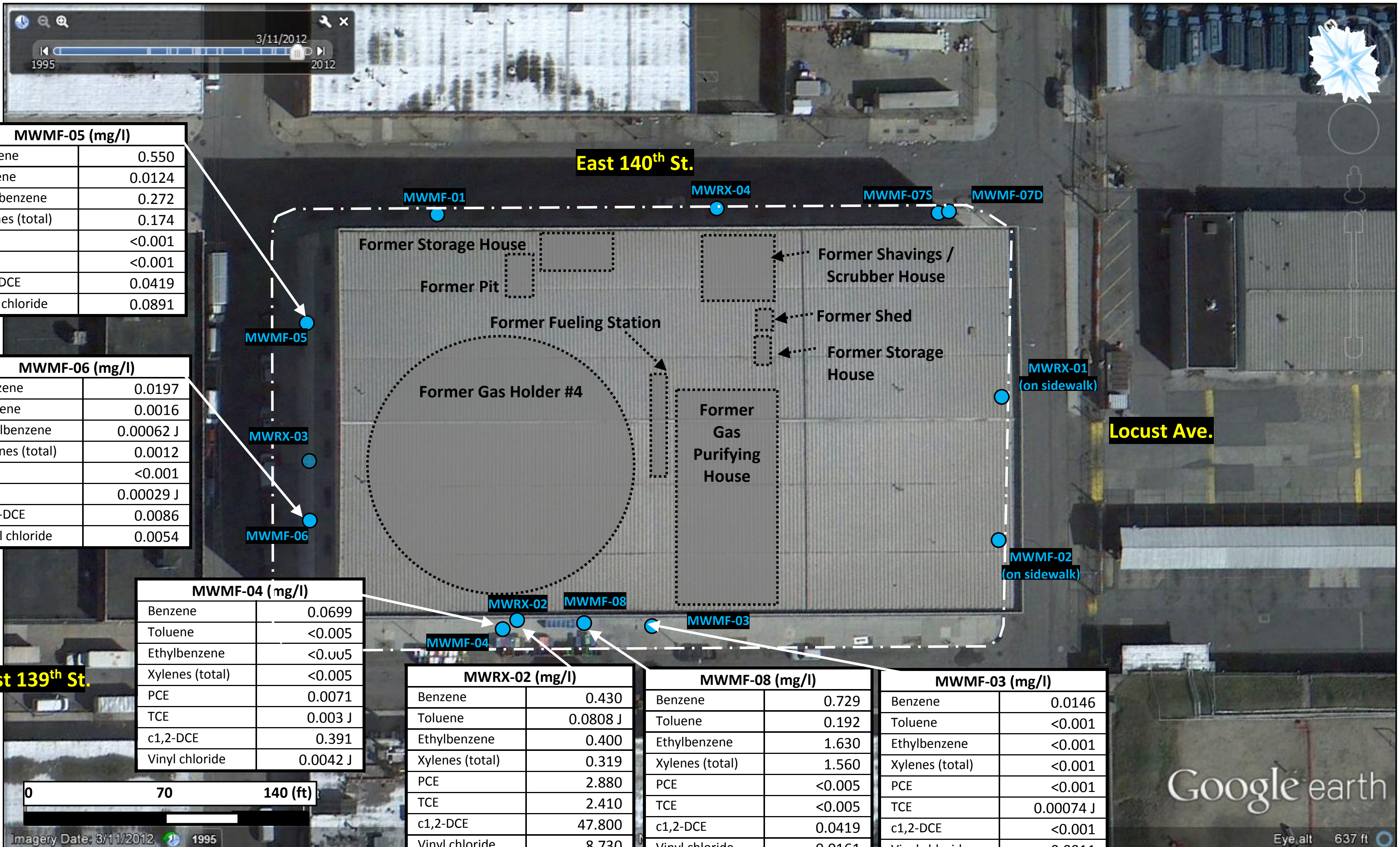


Figure 2

ISCO Injection Locations for Soil & Groundwater Remedy

(Basemap: Google Earth 2012 Image with overlays from reports completed by others)



MWMF-05 (mg/l)	
Benzene	0.550
Toluene	0.0124
Ethylbenzene	0.272
Xylenes (total)	0.174
PCE	<0.001
TCE	<0.001
c1,2-DCE	0.0419
Vinyl chloride	0.0891

MWMF-06 (mg/l)	
Benzene	0.0197
Toluene	0.0016
Ethylbenzene	0.00062 J
Xylenes (total)	0.0012
PCE	<0.001
TCE	0.00029 J
c1,2-DCE	0.0086
Vinyl chloride	0.0054

MWMF-04 (mg/l)	
Benzene	0.0699
Toluene	<0.005
Ethylbenzene	<0.005
Xylenes (total)	<0.005
PCE	0.0071
TCE	0.003 J
c1,2-DCE	0.391
Vinyl chloride	0.0042 J

MWRX-02 (mg/l)	
Benzene	0.430
Toluene	0.0808 J
Ethylbenzene	0.400
Xylenes (total)	0.319
PCE	2.880
TCE	2.410
c1,2-DCE	47.800
Vinyl chloride	8.730

MWMF-08 (mg/l)	
Benzene	0.729
Toluene	0.192
Ethylbenzene	1.630
Xylenes (total)	1.560
PCE	<0.005
TCE	<0.005
c1,2-DCE	0.0419
Vinyl chloride	0.0161

MWMF-03 (mg/l)	
Benzene	0.0146
Toluene	<0.001
Ethylbenzene	<0.001
Xylenes (total)	<0.001
PCE	<0.001
TCE	0.00074 J
c1,2-DCE	<0.001
Vinyl chloride	0.0011

Existing GW Monitoring Well

Former MGP Infrastructure (some may remain below grade)

NOTES
1. Data presented is a summary of contaminants.
2. See analytical reports for a complete listing of all parameters.
3. Only wells included in remediation monitoring program

Figure 3
Groundwater Contamination Remaining at the Site (April 16, 2015)
295 Locust Avenue, Bronx, NY

(Basemap: Google Earth 2012 Image)