SUPPLEMENTAL INTERIM REMEDIAL MEASURE (IRM) COMPLETION REPORT

FOR THE

BAY SHORE/BRIGHTWATERS FORMER MANUFACTURED GAS PLANT (MGP) SITE – OPERABLE UNIT NO. 3 BRIGHTWATERS YARD

Submitted by:

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TABLE OF CONTENTS

Chapter **Page**

PROFESSIONAL ENGINEER'S CERTIFICATION PEC-1

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
- 1.1 Interim Remedial Measure Objective 1-1
- 1.2 Interim Remedial Measure Completion Report Organization 1-2

2.0 SITE DESCRIPTION 2-1
- 2.1 Site Background 2-1
  - 2.1.1 Description of Site and Surrounding Areas 2-1
  - 2.1.2 Site History 2-1

3.0 REMEDIAL ACTIVITY SUMMARY 3-1
- 3.1 Significant Remedial Activities 3-1
- 3.2 Status After Initial IRM 3-2

4.0 SUPPLEMENTAL INTERIM REMEDIAL MEASURE WORK SCOPE 4-1
- 4.1 Approved Work Plan Scope 4-1
- 4.2 Work Plan Modifications and Expansions 4-3
  - 4.2.1 Phase I – Source Removal 4-3
  - 4.2.2 Phase II – In-Situ Chemical Oxidation 4-6
  - 4.2.3 Phase III – Enhanced Bioremediation 4-7

5.0 IMPLEMENTATION OF THE PROPOSED SUPPLEMENTAL INTERIM REMEDIAL MEASURE 5-1
- 5.1 Pre-Mobilization Activities 5-2
  - 5.1.1 Phase I – Source Removal 5-2
  - 5.1.2 Phase II – In-Situ Chemical Oxidation 5-3
  - 5.1.3 Phase III – Enhanced Bioremediation 5-4
- 5.2 Mobilization 5-5
  - 5.2.1 Phase I – Source Removal 5-5
  - 5.2.2 Phase II – In-Situ Chemical Oxidation 5-6
  - 5.2.3 Phase III – Enhanced Bioremediation 5-6
- 5.3 Site Preparation 5-6
  - 5.3.1 Phase I – Source Removal 5-6
  - 5.3.2 Phase II – In-Situ Chemical Oxidation 5-7
  - 5.3.3 Phase III – Enhanced Bioremediation 5-7
- 5.4 Phase I Source Removal Activities 5-8
  - 5.4.1 Well Abandonment 5-8

5.4.2 Temporary Sheet Piling Support System 5-8
5.4.3 Temporary Enclosure 5-9
5.4.4 Source Removal Excavation 5-10
5.4.5 Dust and Odor Control 5-11
5.4.6 Transportation and Disposal 5-11
5.4.7 Backfill.... 5-12
5.4.8 Monitoring Well Repair 5-12
5.4.9 Health and Safety Plan 5-13
5.4.10 Air Monitoring 5-13
5.4.11 Site Security 5-13
5.5 Phase II – In-Situ Chemical Oxidation 5-14
5.5.1 Injection Point Installation 5-15
5.5.2 Reagent Preparation and Injection 5-15
5.5.3 Reagent Quantities 5-16
5.5.4 Post-Injection Soil Sampling 5-17
5.5.5 Injection Field Monitoring 5-21
5.5.6 Construction-Derived Wastes 5-21
5.6 Phase III – Enhanced Bioremediation 5-22
5.6.1 Trenching and Inspection and Repair of Existing Oxygen Wells 5-22
5.6.2 Installation of Additional Oxygen Wells 5-22
5.6.3 Tubing Installation and Connection to Oxygen Generator 5-23
5.6.4 Construction -Derived Wastes 5-24
5.7 Groundwater Sampling Program 5-24

6.0 SITE RESTORATION ACTIVITIES 6-1
6.1 Phase I – Source Removal 6-1
6.2 Phase II – In-Situ Chemical Oxidation 6-1
6.3 Phase III – Enhanced Bioremediation 6-1

7.0 CONSTRUCTION COSTS 7-1
7.1 Construction Cost Estimate – All Phases 7-1

8.0 CONSTRUCTION AS-BUILTS 8-1
8.1 Phase I – Source Removal 8-1
8.2 Phase II – In-Situ Chemical Oxidation 8-1
8.3 Phase III – Enhanced Bioremediation 8-1

9.0 MANIFESTS 9-1
9.1 Phase I – Source Removal 9-1

10.0 CONCLUSIONS AND RECOMMENDATIONS 10-1
10.1 Conclusions 10-1
10.2 Recommendations 10-1

LIST OF APPENDICES

Appendix A Figures
- Figure 1 Area Location Map
- Figure 2 Pre-Supplemental IRM Conditions
- Figure 3 Phase I Supplemental IRM Activities
- Figure 4 Phase II Supplemental IRM Activities
- Figure 5 Phase III Supplemental IRM Activities
- Figure 6 OU-3 Groundwater Monitoring Program Well Location Map

Appendix B Tables
- Table B-1 Summary of Post ISCO Soil Sample Analytical Results (4-8 ft. bgs)
- Table B-2 Summary of Post ISCO Soil Sample Analytical Results (8-12 ft. bgs)
- Table B-3 Summary of Post ISCO Soil Sample Analytical Results (16-20 ft. bgs)
- Table B-4 Summary of Post ISCO Soil Sample Analytical Results (QA/QC Blanks)

Appendix C Soil Gas and Groundwater Monitoring Data
Appendix D Manifests/Disposal Documentation
Appendix E Backfill Documentation
Appendix F CAMP Results Summary
Appendix G Well Abandonment Documentation
Appendix H Project Photographs

PROFESSIONAL ENGINEER'S CERTIFICATION

The activities implemented for the Supplemental Interim Remedial Measure were completed in substantial conformance with the NYSDEC approved Work Plan and the Work Plan modifications and expansions indicated in this Report. I have personally examined and am familiar with the attached Supplemental IRM Completion Report. To the best of my knowledge, the contents of the report are accurate, complete and sufficient in documenting the Supplemental Interim Remedial Measure completed for OU-3 Brightwaters Yard in accordance with the NYSDEC approved Work Plan.

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Date

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EXECUTIVE SUMMARY

This Supplemental Interim Remedial Measure (IRM) Completion Report (Report) documents the completion of a three-phased project to further reduce source material and groundwater contamination on and emanating from Operable Unit No. 3 (OU-3) of the Former Bay Shore/Brightwaters Manufactured Gas Plant (MGP) site located in Bay Shore and the Village of Brightwaters, Town of Islip, Suffolk County New York. A map showing the location of OU-3 (Area Location Map) and a Pre-Supplemental Interim Remedial Measure Conditions Plan are provided as Figure 1 and Figure 2 in Appendix A. The activities described in this Report were undertaken as a supplement to the more limited OU-3 IRM conducted in 2001.

The IRM activities have been implemented in accordance with the New York State Department of Environmental Conservation (NYSDEC) approved January 2004 Supplemental IRM Work Plan, the Work Plan modifications and expansions indicated in this Report, and the requirements set forth in the Voluntary Cleanup Agreement with the NYSDEC, Index No. DI-0001-98-11.

The 2001 IRM involved the completion of an in-situ chemical oxidation program within the Brightwaters Yard. In June 2002, KeySpan implemented an IRM Supplemental Investigation Program to identify any remaining contamination within subsurface soils in the Yard. Based on the results of that investigation program, a Supplemental IRM was proposed and implemented to mitigate the following contaminants of concern: benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs), specifically naphthalene, in a groundwater plume beneath the Brightwaters Yard and extending downgradient from the Yard.

The Bay Shore/Brightwaters site operated as a gas plant in 1889 under the ownership of the Mutual Gas and Light Company. The Suffolk Gas and Electric Light Company owned and operated the Former MGP site from 1889 to 1917. In 1918, the Long Island Lighting Company (LILCO) became the legal owner. Gas manufacturing reportedly occurred between 1889 and approximately 1973, when the plant was demolished. The Brightwaters Yard property was used to support gas manufacturing and distribution operations. The Brightwaters Yard is presently used as an active gas construction and maintenance (GC&M) operations base, which includes storage of GC&M equipment and vehicle parking.

The Supplemental IRM activities involved a three-phased approach that addressed remaining contamination associated with the Operable Unit OU-3 source area that resulted in a groundwater plume migrating downgradient of the Brightwaters Yard. The Supplemental IRM approach consisted of excavation of source materials (Phase I) within a temporary enclosure, in-situ chemical oxidation (Phase II), and enhanced bioremediation via injection of oxygen into the aquifer (Phase III). The excavation and in-situ chemical oxidation portions of the work were intended to remove/treat "hot spots" or zones found to contain elevated contaminant levels. The enhanced bioremediation phase was proposed to expedite the natural biodegradation of residual contaminants not destroyed or removed from the IRM area during the previous two, more aggressive, remedial measures.

Phase I of the Supplemental IRM Activities commenced with mobilization on May 6, 2004 and concluded with restoration activities on July 22, 2004. Phase II commenced on October 6, 2004 and concluded on October 13, 2003 with demobilization activities. Post-treatment soil sampling was conducted between November 15 and November 18, 2004. Phase III commenced on November 3, 2004 and the oxygen injection unit was placed into full-scale operation on December 15, 2004. A description of the activities conducted during each phase is presented in Section 5.0.

Based on the results of the Supplemental IRM activities, the following conclusions can be made.

- Phase I of the Supplemental IRM; source area excavation, was successful in achieving the removal of impacted soils and source materials from the IRM area. Approximately 1,500 tons of soils were excavated for off-site transportation and disposal. The Phase I excavation will substantially reduce the area's contribution to the existing groundwater contamination plume;
- Phase II of the Supplemental IRM; in-situ chemical oxidation, involved the injection of a chelated iron complex and stabilized hydrogen peroxide (H_2O_2) at 27 locations within the IRM area. Soil sampling was conducted at each of the 27 locations to confirm the performance of the injections. Phase II was effective in reducing the observed levels of chemical constituents in a majority of the injection locations; and
- Phase III of the Supplemental IRM; oxygen injection, involves the injection of oxygen into 35 wells in order to enhance bioremediation of residual contaminants in soil and groundwater. The oxygen injection unit was successfully installed as planned and is currently operating.

With the completion of all three phases of the Supplemental IRM, including the full-scale operation of the oxygen injection system, bioremediation is expected to enhance the natural attenuation (biodegradation) of contamination not removed or destroyed during the excavation and chemical oxidation processes. Quarterly groundwater monitoring conducted after the completion of the Supplemental IRM activities is expected to reflect these IRM activities. Continued quarterly monitoring of the groundwater in the Yard and immediately downgradient should continue for the next two years in order to assess the effectiveness of these Supplemental IRM activities. At this time, a data review report will be prepared and if appropriate, a recommendation will be made for further remedial action.

This Report is organized into ten sections. Section 1.0, Introduction, provides a regulatory overview of the IRM and states the IRM objectives. Section 2.0, Site Description, describes OU-3 and the surrounding area. Section 3.0, Remedial Investigation Summary, summarizes the previous investigations performed within the IRM area. Section 4.0, Supplemental Interim Remedial Actions, summarizes the scope of the Supplemental IRM. Section 5.0, Implementation of the Proposed Supplemental IRM, presents a comprehensive summary of the supplemental interim remedial actions that were conducted at OU-3. Section 6.0, Site Restoration Activities, describes restoration activities conducted at OU-3. Section 7.0, Construction Costs, describes the approximate construction costs for the IRM activities. Section 8.0, Construction As-Builts, describes the post-IRM surveying activities conducted at OU-3. Section 9.0, Manifests, provides a tabulation of the various wastes generated during implementation of the Supplemental IRM activities. Finally, Section 10.0, Conclusions and Recommendations, presents the findings and conclusions that have been derived from the performance of the Supplemental IRM.

1.0 INTRODUCTION

Paulus, Sokolowski and Sartor Engineering, PC (PS&SPC), on behalf of KeySpan Corporation (KeySpan), has prepared this Supplemental IRM Completion Report (Report), to document the completion of the Supplemental Interim Remedial Measure (IRM), in accordance with DER-10 Technical Guidance for Site Investigation and Remediation (DER-10), at Operable Unit No. 3 (OU-3) located in the Village of Brightwaters, Town of Islip, Suffolk County, New York.

The Supplemental IRM was proposed to the New York Department of Environmental Conservation (NYSDEC) in a work plan entitled, "Work Plan for Supplemental IRM Activities for the Bay Shore/Brightwaters Former MGP Site Operable Unit No. 3 Brightwaters Yard Groundwater Plume (IRM-OU3A)" prepared by TRC Environmental Corporation and dated January 2004 (Supplemental IRM Work Plan). The NYSDEC approved this Work Plan by letter to KeySpan dated March 29, 2004.

The Supplemental IRM was conducted to mitigate the following contaminants of concern: benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs), specifically naphthalene, in a groundwater plume beneath the Brightwaters Yard and extending downgradient from the Yard. An Area Location Map and Pre-Supplemental Interim Remedial Measure Conditions Plan are provided as Figure 1 and Figure 2, respectively. The Figures referenced in this Report are included in Appendix A. The Supplemental IRM activities have been implemented in accordance with the New York State Department of Environmental Conservation (NYSDEC) approved January 2004 Supplemental IRM Work Plan, the Work Plan modifications and expansions indicated in this Report, and the requirements set forth in the Voluntary Cleanup Agreement with the NYSDEC, Index No. DI-0001-98-11.

1.1 Interim Remedial Measure Objective

The completed Supplemental IRM work effort involved a three-phased approach that addressed remaining contamination associated with the Operable Unit No. 3 (OU-3), source area that resulted in a groundwater plume migrating downgradient of the Brightwaters Yard. Phase I of the Supplemental IRM approach consisted of excavation within a temporary enclosure, Phase II consisted of in-situ chemical oxidation (ISCO), and Phase III consisted of enhanced bioremediation via injection of oxygen into the aquifer. The excavation and in-situ chemical oxidation portions of the work were intended to remove "hot spots" or zones found to contain elevated contaminant levels. The enhanced bioremediation phase was proposed to expedite the natural biodegradation of residual contaminants not destroyed or removed from the IRM area during the previous two more aggressive remedial measures.

Using the aforementioned technologies, the objectives of the Supplemental IRM were to:

- Remove significant sources of contamination from the Brightwaters Yard;
- Use in-situ chemical oxidation technology to provide significant reductions in BTEX and PAH concentrations in groundwater underlying and adjacent to the Brightwaters Yard.
- Install and operate an oxygen injection system to facilitate enhanced bioremediation of chemical constituents in soil and groundwater leading to reduced levels downgradient from the Brightwaters Yard; and
- Monitor groundwater and document the success of the Supplemental IRM activities based on the reduction of BTEX and PAH compound concentrations in downgradient groundwater over time.

1.2 Interim Remedial Measure Completion Report Organization

This report is organized in accordance with the following sections:

- Section 1.0 – INTRODUCTION: This section of the Report provides a regulatory overview as well as the objectives of the Supplemental IRM.
- Section 2.0 – SITE DESCRIPTION: This section provides a description of OU-3 and surrounding area.
- Section 3.0 – REMEDIAL ACTIVITIES SUMMARY: This section provides a summary of previous remedial activities performed at OU-3.
- Section 4.0 – SUPPLEMENTAL INTERIM REMEDIAL MEASURE WORK SCOPE: This section summarizes the scope of the Supplemental Interim Remedial Measure including a description of limited modifications and expansions that were made to the Supplemental IRM Work Plan.
- Section 5.0 – IMPLEMENTATION OF THE PROPOSED SUPPLEMENTAL IRM: This section presents a comprehensive summary of the Supplemental IRM that were conducted at OU-3.
- Section 6.0 – SITE RESTORATION ACTIVITIES: This section describes the Post-Supplemental IRM restoration activities conducted at OU-3.
- Section 7.0 – CONSTRUCTION COSTS: This section describes the approximate construction costs for the Supplemental IRM activities conducted at OU-3.

- Section 8.0 – CONSTRUCTION AS-BUILTS: This section describes the Post-Supplemental IRM surveying activities that were conducted at OU-3.

- Section 9.0 – MANIFESTS: A tabulation of the amounts of the various wastes generated during the implementation of the Supplemental IRM activities as well as documentation concerning the off-site disposal of these wastes is provided in this section.

- Section 10.0 – CONCLUSIONS AND RECOMMENDATIONS: This section presents the findings and conclusions that have been derived from the performance of the Supplemental IRM.

2.0 SITE DESCRIPTION

This section provides general information regarding the OU-3 setting and the immediate surrounding area. Also included is a description of the land use and operating history of the IRM area.

2.1 Site Background

Relevant information concerning the historical and present status of OU-3 is provided in this subsection. This information includes a description of the IRM area, a summary of the site/remedial investigations conducted at OU-3, and the results and conclusions obtained from these activities.

2.1.1 Description of Site and Surrounding Areas

OU-3 is located near the south shore of Long Island, approximately 6,000 feet north of the Great South Bay. The surrounding neighborhood is suburban, and land use is mostly commercial and residential, with some light industry. It consists primarily of the KeySpan Brightwaters Yard and is bounded on the east by a small parcel related to the Bay Shore former Manufactured Gas Plant (MGP), small businesses, a residence, and commercial establishments on Clinton Avenue; to the north and west by residences and small commercial businesses; and to the south by the Long Island Railroad (LIRR) Montauk line. The Brightwaters Yard serves as an active gas construction and maintenance (GC&M) operations base, which includes storage of GC&M equipment and vehicle parking equipment.

2.1.2 Site History

The Bay Shore Former MGP commenced operations in 1889 under the ownership of the Mutual Gas and Light Company. The Suffolk Gas and Electric Light Company owned and operated the plant from 1889 to 1917. In 1918, the Long Island Lighting Company (LILCO) became the legal owner and began operating a carbureted water gas plant. Gas manufacturing reportedly occurred between 1889 and approximately 1973, when the plant was demolished.

Please refer to the "Bay Shore/Brightwaters Former Manufactured Gas Plant Site Final Remedial Investigation Report," dated January 2003 and prepared by D&B for more specific details regarding the MGP site history and background, and local geology and hydrogeology.

3.0 REMEDIAL ACTIVITY SUMMARY

A summary of previous remedial activities performed at OU-3 is presented in the following discussions.

3.1 Significant Remedial Activities

The following summarizes the past significant remedial activities conducted at OU-3 and associated with this Supplemental IRM:

- Subsurface Investigations conducted at Brightwaters Yard and associated groundwater plume in June 1997 and in June 1998. Conducted in response to third party spill notification;
- Initiated Quarterly Groundwater Sampling Program for Brightwaters Yard groundwater plume in December of 1998;
- Completed IRM Site Investigation of Brightwaters Yard groundwater plume in August of 1999;
- Installed Oxygen Injection System for the Brightwaters Yard groundwater plume in September 2000. The system has been in service since installation;
- Completed the Brightwaters Yard IRM ISCO Pilot Study in February 2001;
- Completed IRM baseline sampling and the first In-Situ Oxidative Technologies, Inc. (ISOTEC) treatment of Brightwaters Yard groundwater plume source area in May 2001;
- Final Work Plan for the Brightwaters Yard Groundwater Plume Interim Remedial Measure was approved in June 2001;
- Conducted non-aqueous phase liquid (NAPL) removal in Brightwaters Yard groundwater plume source area from June through August 2001;
- Completed ISOTEC post-injection series one sampling event of the Brightwaters Yard in July 2001;
- Completed second ISOTEC treatment of Brightwaters Yard groundwater plume source area in September 2001;
- Completed vadose zone sampling of the ISOTEC injection area for the Brightwaters Yard Groundwater Plume IRM in November 2001;

- Brightwaters Yard Groundwater Plume IRM Supplemental Investigation Work Plan dated June 2002;

- Quarterly Report for the Oxygen Injection System at Brightwaters, NY. Reports began monitoring groundwater data in September of 2000 and the current report contains recent data from April - June of 2002;

- Completed the Brightwaters Yard Groundwater Plume IRM Supplemental Investigation in August 2002;

- Completed a delineation program to refine the limits of the three excavation areas proposed in the Draft IRM Supplemental Investigation Recommendations Report in April 2003;

- Submitted the Final IRM Supplemental Investigation Report for the Brightwaters Yard Groundwater Plume IRM in May 2003; and

- Submitted the Final IRM Supplemental Investigation Recommendations Report to the NYSDEC in May 2003.

Please refer to the Bay Shore/Brightwaters Former Manufactured Gas Plant Site Final Remedial Investigation Report dated January 2003 for more specific details regarding the site history and background.

3.2 Status After Initial IRM

Upon completion of the Initial IRM, the following observations where made after reviewing the supplemental investigation data in conjunction with all previously collected data for the Initial IRM area:

- Soil data from the IRM area and LIRR right-of-way depicted an overall reduction in the contaminants of concern in the 98-99% range. Significant contaminant reduction was achieved, however higher than anticipated baseline conditions were encountered at the beginning of the Initial IRM. Therefore, additional measures were needed to be implemented during the Supplemental IRM to address isolated product trapped within various peat lenses dispersed across the IRM area that could continue to impact groundwater downgradient of the area;

- Groundwater grab samples from this same area indicated an approximate 60% overall destruction of contaminants within the OU-3 groundwater. Four of the eighteen locations monitored actually increased in contaminant concentrations from the baseline-sampling event. Since the groundwater is constantly moving, this data was better utilized to assist in identifying source areas when evaluated in conjunction with certain observed patterns within OU-3.

- Monitoring well sample results from both Brightwaters Yard and immediately downgradient of the Yard varied greatly over the course of the Initial IRM. Historic data for the groundwater plume also depicted the same fluctuations. A relatively consistent downward trend did occur from November 2001 until July 2002. The August 2002 sampling event conducted during the Supplemental Investigation had significantly higher results which may be attributed to the long summer of almost no precipitation followed by several days of rain. Several months of little to no precipitation caused the groundwater table elevation to decrease. The groundwater elevation in the monitoring wells gauged decreased by an average of approximately 1.7 feet over the course of the Initial IRM. Since the majority of contamination on-site is situated along the saturated/unsaturated interface, this drawdown left elevated levels of contamination within the soil matrix without its primary transport mechanism (groundwater flow). Contaminants were trapped in the soil until the groundwater levels rose from a significant precipitation event. This release of contaminants from the soil matrix likely caused the elevated BTEX and naphthalene levels that were observed during the Supplemental IRM Investigation.

In summary, the ISOTEC process had been generally successful in reducing the contaminants of concern in the soil and groundwater during the Initial IRM. However, isolated areas did exist, that required additional investigation and implementation of remedial measures to mitigate the remaining contaminants.

Refer to the Brightwaters Yard IRM Supplemental Investigation Report dated May 2003 for more specific details regarding the most recent soil and groundwater data collected for this operable unit. Refer to the Brightwaters Yard IRM Supplemental Investigation Recommendations Report (the Recommendations Report) also dated May 2003 for the development and description of the supplemental activities detailed in this work plan.

4.0 SUPPLEMENTAL INTERIM REMEDIAL MEASURE WORK SCOPE

The Supplemental IRM was conducted as a three-phased approach to address the remaining contamination associated with the OU-3 source area that resulted in a groundwater plume migrating off-site. Phase I of the Supplemental IRM approach consisted of excavation within a temporary enclosure, Phase II consisted of in-situ chemical oxidation, and Phase III consisted of enhanced bioremediation via injection of oxygen into the aquifer. The excavation and in-situ chemical oxidation portions of the work were intended to remove/treat "hot spots" or zones found to contain elevated contaminant levels. The enhanced bioremediation phase was proposed to expedite the natural biodegradation of residual contaminants not destroyed or removed during the previous two more aggressive remedial measures.

Using the aforementioned technologies, the objectives of the Supplemental IRM were to:

- Remove significant sources of contamination from OU-3;
- Use *in-situ* chemical oxidation technology to provide significant reductions in BTEX and PAH concentrations in groundwater underlying and adjacent to OU-3;
- Install and operate an oxygen injection system to facilitate enhanced bioremediation of chemical constituents in soil and groundwater leading to reduced levels downgradient from the IRM area; and
- Monitor groundwater and document the success of the Supplemental IRM activities based on the reduction of BTEX and PAH compound concentrations in downgradient groundwater over time.

For the purposes of this Supplemental IRM, source contamination was defined as soil observed to be heavily impacted by OU-3 contaminants to the extent of saturation. Minor staining, odors, or elevated air monitoring readings were not considered to be indicative of source material to be removed for the purposes of the Supplemental IRM work. The excavation activities were one part of a three-phase approach to remedy contamination associated with OU-3. The removal of elevated contaminant zones was intended to promote the performance of the second and third phases of the IRM; in-situ chemical oxidation and enhanced bioremediation.

4.1 Approved Work Plan Scope

The scope of work for the Supplemental IRM incorporates the removal of impacted soil, treatment and significant reduction of the concentration of contaminants of concern (COCs) in soil and groundwater utilizing in-situ chemical oxidation (i.e., a patented modified-Fenton's reagent-based technology) as well as groundwater bioremediation via oxygen injection. The scope of the NYSDEC approved Supplemental IRM Work Plan included the performance of the following tasks:

- Mobilization/Demobilization – Bringing materials, supplies, equipment, and personnel to OU-3 and establish safe working conditions for the planned activities; completing a utility search prior to the initiation of any subsurface work activities; constructing temporary facilities to support the Supplemental IRM activities; preparing OU-3 to facilitate the Supplemental IRM activities; demobilizing and restoring OU-3 to Pre-Supplemental IRM conditions;

- Source Material Removal – Excavating Areas A, B and C as identified on Figure 3 to remove soils containing elevated levels of contamination; performing the excavation activities within a temporary enclosure to control anticipated odors and dust from migrating off-site; providing a vapor management system (VMS) to provide negative air pressure within the temporary enclosure and processing the recovered air through an activated carbon system for removal of contaminants and to meet NYSDEC air emission guidance and/or standards;

- ISCO Source Area Treatment – Reducing BTEX and PAH concentrations in soil and groundwater by direct injection of In-Situ Chemical Oxidation reagents in seventeen existing sample locations and seven newly installed locations (Figure 4). These locations were selected for additional treatment based on elevated contaminant concentrations identified in the IRM Supplemental Investigation Report. Post-injection soil sampling was proposed to be conducted approximately thirty days after completion of this injection episode. Groundwater monitoring will continue as part of the existing IRM Quarterly Sampling Program;

- Oxygen Injection System Installation - Implementing an oxygen injection system within the Brightwaters Yard to introduce oxygen into the subsurface to accelerate biodegradation of the residual contaminants. This work effort includes: inspecting and repairing/modifying the pre-existing injection system located on the Yard's southern boundary; installing eighteen new injection wells upgradient of the pre-existing system (Figure 5); establishing a secure hookup to the oxygen generation equipment; and conducting the system startup;

- Oxygen Injection System Post-Construction Operation and Monitoring – Inspecting oxygen injection system components periodically and evaluate performance data to optimize treatment of the groundwater plume;

- Waste Disposal – Removing all construction-related wastes and debris. All wastes were transported and disposed at a properly licensed facility;

- Construction Quality Control/Record keeping - Inspection of Supplemental IRM activities, with thorough documentation of conformance with or modifications from the Supplemental IRM Work Plan; and

- Report Preparation – Project activities and monitoring results are reported in interim submittals and in a final project Completion Report.

4.2 Work Plan Modifications and Expansions

Limited work scope modifications and expansions were made to the field program contained in the approved Supplemental IRM Work Plan, the Site Management Plan (Phase I), the Detailed Operations Plan (Phase II), and the Operations Plan (Phase III). Most of these modifications and expansions were dictated by site conditions encountered during the Supplemental IRM field program. These modifications/expansions to the Supplemental IRM Work Plan were undertaken with the approval of the NYSDEC. The modifications/expansions are discussed in the following subsections.

4.2.1 Phase I – Source Removal

The following modifications/expansions to the approved Supplemental IRM Work Plan and Site Management Plan (SMP) were made during the Phase I Supplemental IRM activities:

- Modification of the temporary enclosure design;
- Modification of the excavation volume in Excavation Areas B and C (as specified in the Supplemental IRM Work Plan) due to the proximity of the existing LIRR Right-of-Way (ROW);
- Modification of the depth of excavation in Excavation Area C (as specified in the Supplemental IRM Work Plan) as per discussions with the NYSDEC and the Suffolk County Department of Health Services (SCDHS);
- Expansion of the Health and Safety Plan (HASP) (as specified in the Supplemental IRM Work Plan) to include remedial work utilizing Level B personal protection equipment (PPE);
- Modification of SMP to supplement the use of transport vehicles with roll-offs containers;
- Modification of the sheeting design as a temporary excavation support system installed around the perimeters of Excavation Areas A, B, and C (as specified in the SMP);

- Modification of the vapor management system (as specified in the SMP) to include extending the intake port of the VMS to the excavation area via flexible ductwork and adding a supplemental mobile vapor management system; and

- Allowance for leaving one sheet in place in the south central area of Excavation Area B.

The modifications to the approved Supplemental IRM Work Plan and SMP are detailed in the following subsections.

4.2.1.1 Modification of the Temporary Enclosure Size

The Supplemental IRM Work Plan specified that the temporary enclosure would have an estimated maximum size of 135 feet by 175 feet, two 14 foot by 14-foot steel bay cargo doors, four personnel doors, and seven observation windows.

In order to accommodate existing facility operations and due to the limited vertical clearance exhibited by the proximity of the existing overhead power lines, a 60 feet by 80 feet sized temporary enclosure was selected to facilitate the excavation work in Excavation Areas A, B, and C. This size enclosure was equipped with a skid system allowing re-location capabilities. This enclosure was initially positioned over Excavation Area B and subsequently towed to Excavation Area C and finally Excavation Area A prior to dismantling and demobilization.

The temporary enclosure utilized for the Phase I Supplemental IRM work was equipped with two 14 foot by 14-foot steel bay cargo doors, two personnel doors and four observation windows. The number of personnel doors and observation windows was reduced due to the smaller size of the selected enclosure.

4.2.1.2 Modification of the Excavation Volumes

Due to the proximity of the LIRR tracks, a five-foot offset from the ROW was established by PS&SPC based on engineering judgment in order to minimize the potential for undermining the LIRR tracks resulting from intrusive activities. In addition, this offset allowed for the placement of the base frame for the temporary enclosure between the sheeting and the existing property fence. Therefore, the excavation volumes were reduced in Excavation Areas B and C.

The Supplemental IRM Work Plan specified that the in-place volume of soils to be excavated from Excavation Areas B, and C were 210 cubic yards and 430 cubic yards, respectively. Due to the mandated 5 foot offset requirement, the in-place volume of soils excavated from Excavation Areas B and C were approximately 170 cubic yards and 418 cubic yards, respectfully.

4.2.1.3 Excavation Area C Depth Modification

During the excavation within Excavation Area C, heavily stained soils were encountered and removed as part of the Phase I Supplemental IRM activities. In addition, air-monitoring equipment indicated elevated VOC levels within the enclosure. As such, the depth of excavation in Excavation Area C (as specified in the Supplemental IRM Work Plan) was modified as per discussions with the NYSDEC and the Suffolk County Department of Health Services (SCDHS). Approximately 5 cubic yards of additional soil was removed from Excavation Area C.

4.2.1.4 Expansion of HASP

Excavation activities commenced in Excavation Area B. During the excavation activities, personal air monitoring in the breathing zone indicated elevated VOC levels that required an upgrade to level B PPE. Work activities were temporary suspended while all personnel designated to work within the temporary enclosure were trained in the proper use of Level B PPE. A Field Change Request to the HASP was prepared which addressed the work performed within the enclosure utilizing Level B PPE.

4.2.1.5 Use of Roll-off Containers

During the excavation activities in Excavation Area B, excavated soils were place within roll-off containers due to space constraints within the enclosure and due to the time constraints imposed by the selected disposal facility. The loading of roll-off containers was performed to allow Williams Environmental Services (WES) flexibility during the work at both Excavation Areas A and B.

4.2.1.6 Modification of the Sheeting Design

The approved SMP called for the temporary excavation support system (i.e., sheeting) to be installed to a depth of 20 and 25 feet below ground surface in Excavation Area A and 25 feet below ground surface in Excavation Areas B and C. Due to obstructions encountered during the installation, the specified penetration depth for some of the individual sheets could not be achieved. In addition, the sheeting joints were not continuous due to the obstructions encountered by the sheeting. Macro Enterprises, Ltd. re-evaluated the sheeting design and determined that the sheeting was adequate to facilitate the proposed excavation. This decision is documented in a letter from Macro Enterprises, Ltd. to PS&SPC and was signed and sealed by a Professional Engineer licensed in the State of New York.

4.2.1.7 Modification of the VMS

As previously indicated, air-monitoring equipment had indicated elevated VOC levels. In addition to the expansion of the HASP, the VMS was also modified. Modifications included extending the intake of the VMS blower (via 30 inch diameter flexible ductwork) to the excavation thus removing VOC levels at the source. In addition, a supplemental mobile vapor management system was utilized within the enclosure. This supplemental mobile system consisted of a 10 horsepower (Hp) blower capable of processing approximately 1,150 cubic feet per minute (CFM), a 550–gallon carbon vessel containing 1600 pounds of activated carbon, flexible 8-inch hosing, and a particulate filter. This supplemental system was used within the enclosure in close proximity to the excavation to remove VOCs prior to them becoming air borne within the enclosure.

4.2.1.8 Sheeting Remaining In-Place

In accordance with approved SMP, all sheeting was to be removed, decontaminated as necessary and removed from the Brightwaters Yard upon completion of the excavation and backfilling activities. All sheeting was removed from the subsurface with the exception of one sheet along the southern central boundary of Excavation Area B. During the removal process, this sheet fractured and separated approximately 5 feet below ground surface (bgs). Since heavy equipment could not be utilized in this area due to the vertical clearance constraints imposed by the overhead electric lines and because intrusive work could not be conducted outside the enclosure, the sheet was left in-place.

4.2.2 Phase II – In-Situ Chemical Oxidation

The following expansion to the approved Supplemental IRM Work Plan and/or Detailed Operations Plan were made during the Phase II Supplemental IRM activities:

- Addition of three supplemental in-situ chemical oxidation points (GVZ-32, GVZ-33 and GVZ-42).

4.2.2.1 Additional In-Situ Chemical Oxidation Points

Based on the visual observations made during the source removal excavation phase of the Supplemental IRM activities (Phase I), three additional points (GVZ-32, GVZ-33 and GVZ-42) were added to the injection program as depicted on Figure 4. These three locations received one round of injection treatment at the 8 to 12-foot bgs interval.

4.2.3 Phase III – Enhanced Bioremediation

The following expansion to the approved Supplemental IRM Work Plan and/or Operations Plan were made during the Phase III Supplemental IRM activities:

- Addition of two wells to address contamination in the area of GVZ-34;
- Addition of one replacement well; and
- Abandonment of one pre-existing well.

4.2.3.1 Addition of Two Supplemental Oxygen Injection Wells

At the request of the NYSDEC, two additional wells (well nos. OX-10A and OX-11A) were added to the enhanced bioremediation program as depicted on Figure 5. These two wells were screened from the 20 to 22-foot bgs interval to address contamination at depth.

4.2.3.2 Addition of One Replacement Well

During trenching activities, pre-existing well no. OX-11 could not be located. A replacement well was installed and designated as well OX-11. During subsequent trenching activities, the pre-existing well no. OX-11 was located and was retained and re-designated as well OX-11B.

4.2.3.3 Abandonment of Pre-Existing Well

The approved SMP included the abandonment of two wells at the eastern end of the pre-existing oxygen injection line. During the inspection and repair of the pre-existing wells, a field determination was made to retain one of the pre-existing wells and to abandon the other. The well selected for abandonment was located at the far eastern end of the pre-existing oxygen injection line near the footprint of the proposed oxygen generator.

5.0 IMPLEMENTATION OF THE PROPOSED SUPPLEMENTAL INTERIM REMEDIAL MEASURE

As previously mentioned, the Supplemental IRM activities consisted of a three-phased approach to address the remaining contamination associated with the OU-3 source area that resulted in a downgradient groundwater plume. Phase I of the Supplemental IRM approach consisted of excavation within a temporary enclosure, Phase II consisted of in-situ chemical oxidation, and Phase III consisted of enhanced bioremediation via injection of oxygen into the aquifer.

Implementation of the proposed remedial activities for Phase I (as described in the Supplemental IRM Work Plan) commenced in May 2004 with mobilization activities and concluded in July 2004 with restoration activities. At various points during the implementation of the project, on-site personnel included a representative of KeySpan, representatives of PS&SPC (i.e., the Construction Oversight Engineer), representatives of the NYSDEC, representatives of WES, Inc (i.e., the selected Contractor), and a representative of Code Environmental Services, Inc. (CODE) (i.e. the selected Transportation and Disposal Contractor).

Implementation of the proposed remedial activities for Phase II (as described in the Supplemental IRM Work Plan) commenced on October 6, 2004 with mobilization activities and concluded on October 13, 2004.with restoration activities. At various points during the implementation of the project, on-site personnel included a representative of KeySpan, representatives of PS&SPC (i.e., the Construction Oversight Engineer), representatives of the NYSDEC, and ISOTEC (i.e., the selected Contractor). Post-injection soil samples were collected between November 15 and November 18, 2004. On-site personnel for the sampling effort included representatives of PS&SPC (collection of soil samples), representatives of KeySpan and representatives of Zebra (direct push drilling contractors).

Implementation of the proposed remedial activities for Phase III (as described in the Supplemental IRM Work Plan) commenced on November 3, 2004 with mobilization activities and the oxygen injection unit was placed into full-scale operation on December 15, 2004. At various points during the implementation of the project, on-site personnel included a representative of KeySpan, representatives of PS&SPC (i.e., the Construction Oversight Engineer), representatives of the NYSDEC, and Fenley & Nicol Environmental Incorporated and Matrix Environmental (i.e., the selected Contractors).

5.1 Pre-Mobilization Activities

5.1.1 Phase I – Source Removal

Prior to mobilization of equipment to the Brightwaters Yard, WES prepared a SMP providing detailed measures, procedures, and operations relating to the completion of the Phase I Supplemental IRM work. The SMP was submitted to the NYSDEC on April 22, 2004. The NYSDEC approved this work plan by letter to KeySpan dated April 23, 2004. The approved SMP included a minimum of the following:

- Description of proposed Supplemental IRM activity implementation (for Phase I) including but not limited to: obtaining necessary permits; site preparation; construction sequence; soil excavation handling and stabilization; odor and dust control; decontamination; soil erosion and sediment control; well abandonment; material staging; backfill, etc;
- Site Layout Plan;
- Construction Quality Control Plan;
- Organization Chart (including list of personnel and subcontractors);
- Vapor Management Design System;
- Project Schedule;
- Temporary Sheet Piling Design; and
- Temporary Enclosure Design.

A HASP was prepared in accordance with 29 CFR 1910 and was included with the Supplemental IRM Work Plan. The HASP, provided to WES, covered site-specific activities associated with the Phase I Supplemental IRM work. WES was given the option of adopting the HASP or preparing their own, with the provision that a WES HASP must either achieve or be more stringent than the requirements of the Supplemental IRM Work Plan HASP. WES elected to prepare their own HASP. The WES HASP was implemented during the Phase I Supplemental IRM work.

The New York Underground Facilities Protective Organization (UFPO) was utilized for utility verification and marking out the locations of subsurface utilities in proximity to Brightwaters Yard. When all subsurface utilities were verified/confirmed, intrusive activities were initiated.

In January 2004, KeySpan conducted an in-situ sampling program to characterize the soils prior to excavation and subsequent off-site disposal. The purpose of the in-situ waste classification activities was to characterize the soils as per the requirements of the selected disposal facility prior to the performance of the Phase I Supplemental IRM activities.

No federal or state permits were required to perform the Supplemental IRM activities. WES procured the necessary permits required for the Phase I Supplemental IRM activities. Based upon the information contained in Article 1 General Provisions of the Village of Brightwaters ordinances and upon discussions between WES and the local building officials, the only local construction permit required was for the electrical connections for the temporary office trailers. Lowell Electrical Contractors Inc., the WES electrical subcontractor, procured these permits and coordinated the inspection of the work.

WES held discussions with the NYSDEC regarding air emissions permits. A representative of the NYSDEC Remedial Action MGP Program informed WES that the Department was familiar with the IRM area and that no air emissions permits were required.

Due to the proximity of the existing LIRR tracks, WES personnel working within the IRM area obtained the necessary LIRR Protective Training. In addition, the LIRR provided KeySpan with flagmen who were stationed next to the tracks when work was performed near the tracks.

5.1.2 Phase II – In-Situ Chemical Oxidation

Prior to mobilization of equipment, ISOTEC prepared a Detailed Operations Work Plan (DOWP) that elaborated ISOTEC's approach for conducting the Phase II Supplemental IRM activities. The DOWP was submitted to the NYSDEC on August 12, 2004. The NYSDEC approved this work plan by letter to KeySpan dated October 5, 2004. The approved DOWP, included discussions of the following:

- ISOTEC's understanding of the characteristics of OU-3 (i.e., remedial background, lithology and hydrogeology and the nature and extent of contamination);
- Project objectives;
- Overview of ISOTEC's modified Fenton's process;
- Treatment locations, intervals and cycles;
- Description of the mobilization and demobilization activities to be conducted as part of the work;
- Utility survey and protection methods;
- LIRR safety training requirements;

- Description of proposed Supplemental IRM activity implementation (for Phase II) including but not limited to: site preparation; utility survey and protection; injection point installation; reagent preparation/injection; injection rates; reagent quantities; injection field monitoring; treatment sampling; decontamination; waste management, etc;
- Injection Process Diagram; and
- Project Schedule.

The aforementioned HASP, included with the Supplemental IRM Work Plan, was provided to ISOTEC for their review and acceptance. As part of the DOWP, ISOTEC adopted the HASP and provided Material Safety Data Sheets and their specific safety procedures for utilizing the ISCO reagents. This supplemental information was included as appendices to the DOWP.

After receiving NYSDEC approval, ISOTEC mobilized all necessary equipment, personnel, and materials for implementation of the Phase II Supplemental IRM. In addition, the New York UFPO was utilized for utility verification and marking out the locations of subsurface utilities in proximity to the IRM area. When all subsurface utilities have been verified/confirmed, intrusive activities were initiated. During the treatment program, steps were taken to ensure that the integrity of the utilities located at or near the treatment area were not disturbed by the field activities. No injection points were installed within 5 feet of the nearest critical utility (i.e. electric line) or identified structure. This clearance was increased/decreased, as necessary, based on the radius of influence information gathered from injection activities.

All members of ISOTEC and Zebra Environmental Services, Inc. (ISOTEC's drilling subcontractor) involved in the work performed within the adjacent LIRR easement attended mandatory training provided by the LIRR. KeySpan procured all necessary permits required to access and perform work within the LIRR easement including coordinating with and scheduling necessary LIRR flagmen and crew workers.

5.1.3 Phase III – Enhanced Bioremediation

Prior to mobilization of equipment, Fenley & Nicol Environmental Incorporated (F&N) prepared an Operations Work Plan providing more detailed measures, procedures, and operations of how the Phase III Supplemental IRM work was performed. The Operations Work Plan was submitted to the NYSDEC on October 19, 2004. The NYSDEC approved the work plan on October 25, 2004. The approved Operations Work Plan included a minimum of the following:

- Description of proposed Supplemental IRM activity implementation (for Phase III) including but not limited to: site preparation; utility survey and protection; injection well abandonment/replacement/rehabilitation; installation and development of new injection wells; trenching and installation of piping; installation and startup of oxygen generator decontamination; waste management, etc;
- System Layout Diagram; and
- Well Specifications.

The aforementioned HASP included with the Supplemental IRM Work Plan was provided to F&N in which they had the opportunity to either adopt the HASP or prepare their own plan that had to either achieve or be more stringent to the requirements of the HASP. F&N adopted the provided HASP and added supplemental MSDS (i.e. for Rusmar foam which was used for odor control) and the HASP was followed during the implementation of the Phase III Supplemental IRM work.

F&N conducted a utility record search in consultation with KeySpan and PS&SPC to verify the locations of any underground utilities in the vicinity of any subsurface excavations, proposed well locations or drilling activities. In accordance with 6 NYCRR Part 53, F&N resolved potential conflicts and procured safe locations for subsurface work to occur.

5.2 Mobilization

5.2.1 Phase I – Source Removal

After receiving NYSDEC approval, WES mobilized all necessary equipment, personnel, and materials to the Brightwaters Yard for implementation of the Phase I Supplemental IRM work in accordance with the approved SMP. All on-site personnel were required to have the requisite 1910.120 Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) Training as well as site-specific training prior to any intrusive activities being performed. Staging areas for materials, construction equipment and excavated material, decontamination areas, and support areas were prepared in accordance with the approved SMP.

The equipment transported to the Brightwaters Yard included construction facility setup (office trailers, security trailer, storage trailers, toilet facilities), a decontamination trailer, excavation equipment, cranes, a VMS, a 60 foot by 80 foot fabric enclosure, New York State Department of Transportation (NYSDOT) specified backfill, soil erosion and sediment control measures, odor and dust control measures, hoses, tanks, drums, and other necessary equipment.

5.2.2 Phase II – In-Situ Chemical Oxidation

After receiving NYSDEC approval, ISOTEC mobilized all necessary equipment, personnel, and materials to the IRM area for implementation of the Phase II Supplemental IRM work in accordance with the approved DOWP. All on-site personnel maintained the requisite 1910.120 OSHA HAZWOPER Training as well as site-specific training prior to any intrusive activities being performed.

The equipment transported to the IRM area included an ISOTEC trailer housing, hoses, tanks, drums, gas powered air compressor and generator, electric mixers and pumps, and pneumatic pumps. The materials transported to the IRM area included hydrogen peroxide at a concentration of 35%-50% and stored in DOT approved containers. Approximately 20-25 drums (55-gallon capacity) of hydrogen peroxide were temporarily staged at the Brightwaters Yard for the Phase II Supplemental IRM work. A catalyst was also transported and stored on-site in dry form until it was required for reagent preparation. A one-inch water line was temporarily installed by ISOTEC from the closest water source (water spigot at the existing building) to the staging area. Zebra's mobilization to the IRM area included a support truck, trailer, direct push (DP) drill rig and compressor.

5.2.3 Phase III – Enhanced Bioremediation

After receiving NYSDEC approval, F&N mobilized all necessary equipment, personnel, and materials to the Site for implementation of the Phase III Supplemental IRM work in accordance with the approved Operations Work Plan.

A GeoProbe drill rig, backhoe, support vehicle, decontamination systems, well construction materials, oxygen delivery piping supplies and PPE were mobilized to the Brightwaters Yard as specified by the approved Operations Work Plan. A designated staging area was established and situated within a perimeter defined by a 48-inch high orange reflective fence. This staging area for mobilization was only used for clean equipment, materials and supplies dedicated to this project.

5.3 Site Preparation

5.3.1 Phase I – Source Removal

Site preparation activities consisted of tasks performed prior to the performance of the Phase I Supplemental IRM work in accordance with the approved SMP. These activities consisted of the installation of soil erosion control measures, minor clearing of vegetation and grading of the work area, relocating existing facility materials, erecting the temporary enclosure equipped with a VMS, staking out and surveying the locations of excavations, establishing needed utilities, and the installation of a pre-fabricated stainless steel decontamination pad. The decontamination pad was equipped with steel grates overlying a 6-inch deep containment basin. This decontamination pad was maintained throughout the duration of the Phase I work.

The IRM area was divided into three primary zones: the exclusion zone, the contamination reduction zone, and the support zone. Zones were established and clearly delineated. The exclusion zone included the areas where active cleanup operations were performed. The exclusion zone was separated from the other zones by a three-foot high, high-visibility fence. The entrance to the contamination reduction zone was made through the decontamination area or vehicle access gate. The contamination reduction zone included the personnel decontamination area and the equipment decontamination pad. Any and all vehicles and equipment leaving the exclusion zone required decontamination on the decontamination pad prior to entering the support zone. The support zone included all other portions of the IRM area not listed above which are used for storage and support functions. Temporary field office facilities, including office trailers, chemical toilets, and parking areas, were established in the support area during site preparation. Temporary utility connections for electricity and telephone will also be established at this time.

5.3.2 Phase II – In-Situ Chemical Oxidation

Site preparation activities consisted of staking out and field identifying the locations of the proposed injection points, establishing needed utilities, construction of a temporary decontamination pad, and staging of materials needed for implementation of the Phase II Supplemental IRM work.

5.3.3 Phase III – Enhanced Bioremediation

A security station adjacent to the staging area was established outside of the work zone. This station had communication equipment and personnel logs, along with copies of this Operations Work Plan, the HASP and the Supplemental IRM Work Plan.

The work zone or exclusion zone was defined by a perimeter 48-inch high reflective orange fence. The fence delineated the work zone and served to restrict access to personnel in accordance with the approved HASP.

A system of communication for all field personnel was established and employed hand signals, flags and/or air horns. The communication system was reviewed at the daily tailgate meeting, at the beginning of the project, and periodically thereafter as needed.

Personnel and equipment decontamination stations were constructed according to the approved HASP and Operations Work Plan. These two separate decontamination stations were located inside the work zone adjacent to the exit for the work zone. Decontamination equipment and supplies were stored in clean 55-gallon drums with removable lids, along with a steam cleaner & generator, water supply (provided by a portable tank on the support vehicle), first aid kits, and plastic liners for the required bermed decontamination stations.

Markers and/or flags were placed in the field to identify existing injection wells to be inspected, repaired or replaced; new injection wells; trenching for oxygen piping service; and, utility services in accordance with the approved Operations Plan.

5.4 Phase I Source Removal Activities

5.4.1 Well Abandonment

Existing monitoring wells, MW-84, MW-86, MW-2S, MW-2I, and MW-2D were located in areas intended to be excavated. As such, these wells were required to be abandoned prior to implementation of the Phase I Supplemental IRM activities. The wells were abandoned by Land, Air, Water Environmental Services (LAWES). The monitoring wells were abandoned in accordance with the NYSDEC Groundwater Monitoring Well Decommissioning Procedure, November 2002.

5.4.2 Temporary Sheet Piling Support System

Macro Enterprises, Ltd. (Macro) installed a temporary excavation support system for each of the three excavation areas at the locations specified in the approved SMP. The system consisted of cantilever sheeting installed to various depths, depending on the depth of excavation. The sheeting was driven in one continuous operation prior to mobilization of the temporary enclosure. The sheet piling design was signed and sealed by a Professional Engineer licensed in the State of New York and was installed by Macro.

A crawler crane was used to unload all materials and equipment at the Brightwaters Yard. Materials and equipment were stored at a minimum distance of ten feet eight inches (10’ 8”) from existing overhead power lines in accordance with KeySpan *Rules for Safe Operation of Cranes, Derricks and Hoisting Equipment Proximate to Energized Power Lines* document. This crane was also used to support the vibratory hammer as well as the sheet piling during driving operations at areas where the crane and/or sheet piles would not foul the overhead power lines. Since the elevation of the lowest point of the overhead lines was approximately 39 feet above the ground surface, the maximum height for equipment or material to be raised was approximately 28 feet above the ground surface.

In areas that were in close proximity to the overhead power lines (i.e. along the southern boundaries of Excavation areas "B" and "C"), an excavator equipped with a vibratory hammer attachment was used to drive all sheeting. The vibratory hammer had mount clamps that enabled it to effectively reduce overhead height restriction and drive sheet piling. Using this low overhead equipment, the minimum distance required by KeySpan of ten feet eight inches was maintained at all times between the overhead power lines and any construction equipment or materials. In addition, to ensure that the minimum required distance was maintained from the overhead lines at all times, the sheet pile lengths installed along the southern boundaries of Excavation Areas "A" and "C" did not exceed 20 feet in length and were not raised more than 2 feet off the ground during installation.

5.4.3 Temporary Enclosure

The temporary enclosure that was utilized for the Phase I Supplemental IRM work consisted of an enclosure that measured 60-feet wide by 80-feet long (measured by maximum width by maximum length) and was manufactured by Summit Structures (Summit). This type of enclosure was selected due to the size of each excavation area, the ease of construction of the enclosure, and the ability to relocate it from one excavation area to the next. The enclosure was constructed of Summit's patented Duraweave FR coated fabric membrane and triple-galvanized ViperSteel frame and was outfitted with a skid system facilitating easier relocation after it was erected. The enclosure could not be relocated using a crane due to the proximity of the existing overhead lines. The temporary enclosure was erected away from the overhead power lines and relocated to each excavation area so that the minimum distance of ten feet eight inches was maintained from the overhead power lines at all times. The enclosure was equipped with one 14 foot by 14 foot electric operated door with steel angle sills, two single personnel doors with hoods, four 2 foot by 2 foot transparent fabric viewing windows, six 400 watt direct lights, and fourteen baseplate earth anchors. The temporary enclosure was designed by a Professional Engineer licensed in the State of New York and was engineered by Summit to comply with all applicable building codes. The specific details of the VMS are outlined in the NYSDEC approved SMP.

The temporary enclosure was initially positioned over Excavation Area B to facilitate the excavation activities. Upon completion of the excavation and backfill activities in Excavation Area B, the enclosure was then relocated to Excavation C by towing the enclosure on its skid system. Upon completion of the excavation and backfill activities in Excavation Area C, the enclosure was relocated and positioned in Excavation Area A where is was then dismantled upon completion of the excavation and backfill activities.

5.4.3.1 Vapor Management System

The temporary enclosure was equipped with a VMS that was capable of providing a minimum of 6 air exchanges per hour based on the interior space of the temporary enclosure, including the depth of the excavation. Negative air pressure was maintained within the enclosure during intrusive work activities. The VMS was designed and manufactured by TIGG Corporation and processed the recovered air from within the enclosure, removed the associated contaminants, and discharged the processed air to the exterior of the enclosure while meeting NYSDEC air emission standards. The VMS consisted of a 20,000 CFM blower that was utilized to remove the air from within the enclosure and convey the air through an NB20 Carbon Absorber filled with 16,000-pounds of vapor phase carbon to remove contaminants. A sample port was located in the outlet ductwork to facilitate the sampling of processed air using a photoionization detector (PID). The outlet ductwork was equipped with a photohelic gauge to measure pressure drop that, together with real time monitoring of the influent and effluent from the VMS, ensured that there was no breakthrough from the carbon vessel. In addition, a Nixtox breakthrough detector was used as an early warning device to ensure compliance with air emission standards. The specific details of the VMS are outlined in the approved SMP.

5.4.4 Source Removal Excavation

Excavation of the contaminated soil was performed using a standard reach 40,000-pound excavator working inside the temporary enclosure. The excavator worked from the existing ground surface and excavated to the full depth at Excavation Areas A, B, and C.

Prior to the commencement of the full-scale excavation activities, WES excavated a test pit in each excavation area to determine the depth to groundwater. This information was used to estimate the amount of unsaturated and saturated soils to be excavated within the particular excavation area. Saturated soils were mixed with unsaturated soils and/or mixed with Quick Lime to reduce moisture content and to meet the acceptance criteria of the approved disposal facility. Quick Lime was added at a ratio of 1% dry weight of soil in 1% increments. Moisture content was measured using a Paint Filter Test in accordance with EPA 9095.

The excavation activities commenced in Excavation Area B located at the eastern end of the IRM area and moved to Excavation Area C and terminated at Excavation Area A located at the northwest part of the IRM area. The excavation activities in each excavation area were completed and backfilled prior to relocating the temporary enclosure and beginning the next excavation area. During excavation activities, any free product that collected in the excavations was subsequently removed using pumps and adsorbent pads and transferred to the temporary storage tank prior to off-site transportation and disposal.

Once the depth to groundwater had been confirmed, WES excavated unsaturated soils down to the groundwater table and stockpiled the soil within the limits of the excavation area for use as a drying agent. Excavation of saturated soils was completed to the required depth and the excavated saturated soils were allowed to dewater via gravity and then mixed with the unsaturated soils to reduce the moisture content.

When necessary, WES performed moisture conditioning of the saturated soils contaminated material in order to obtain the allowable moisture requirement of the disposal facility(s) during excavation activities. Decant waters that were gravity dewatered from excavated soils were directed back into the excavation by sloping the excavation to a deeper point.

5.4.5 Dust and Odor Control

In addition to the temporary enclosure, point source control is the first line of defense in the mitigation of odors and dust from materials handling activities. The primary function of point source control is to minimize the amount of surface area exposed for long periods of time, thereby mitigating the potential for noxious odors and preventing contaminated dust from becoming airborne. WES utilized HydroSeal as necessary to control odors and/or achieve compliance with site action levels during excavation activities inside the temporary enclosure. To this end, HydroSeal was applied to all disturbed areas within the enclosure as necessary. HydroSeal is a lightweight, low-permeable, cellulose cover material that is easily applied and inexpensive to use. It is organic, non-hazardous and biodegradable so it can be disposed of with the impacted soil. Water sprays were utilized to control dust generated by vehicular traffic outside the temporary enclosure.

5.4.6 Transportation and Disposal

All excavated soil that was prepared, as necessary, to meet disposal facility acceptance criteria for moisture content was loaded directly into trucks for subsequent off-site transportation to Clean Earth of Delaware and Casie Protank of Vineland, NJ, disposal facilities licensed to accept and treat the excavated material. Transport vehicles were decontaminated at the decontamination pad and exited the Brightwaters Yard, through the Bay Shore OU-1 West Yard Parcel via a haul road that was created with large diameter road stone (during the West

Parcel IRM activities), and through the North Clinton Avenue gate. The haul route was maintained throughout the duration of the project and the road stone minimized the potential for soil tracking into North Clinton Avenue and for the generation of fugitive dust.

The material load out schedule implemented by WES consisted of loading approximately 10 transport vehicles per day. All transportation and disposal activities were coordinated by Code with assistance from WES. All waste-hauling vehicles were inspected prior to loading and any vehicle that appeared to be in an unacceptable condition for transporting any material were not loaded. Transport vehicles were also inspected for the appropriate placards, vehicle identifications and over-the-road permits for the states in which they traveled. Additionally, transport vehicles and their contents were inspected prior to leaving the Brightwaters Yard to verify that the vehicles were properly lined, decontaminated, covered, placarded and that the load was acceptable for transport and disposal. See Section 9.0 of this Report for a summary of off-site disposal activities.

5.4.7 Backfill

NYSDOT Type 1 coarse aggregate was placed in each excavation below the groundwater table and extended to within 4-feet of the ground surface. A separation geotextile fabric was placed over the coarse aggregate and the balance of the excavation was backfilled to the surface with certified clean fill from an approved source (Tilcon New York, Inc. in Haverstraw, New York). The certified clean fill was placed over the geotextile in 12-inch lifts over the entire depth of the excavation. Each lift was mechanically compacted to a minimum of 90 percent of the modified proctor density. In-place density/moisture tests were performed to document the effectiveness of the compaction efforts. Two-inches of 1-inch crushed stone was installed as a ground surface over all excavation areas. All fill material delivered to the Brightwaters Yard was accompanied by documentation that the fill was certified “clean” from a virgin source or a blend of soils originating from virgin sources not subject to manufacturing operations. Backfill documentation is included in Appendix E.

5.4.8 Monitoring Well Repair

Existing monitoring wells PDMW-2, PDMW-3, MW-16S, MW-16I, and MW-16D were damaged during the Phase I Supplemental IRM activities and required subsequent repair. PDMW-2, PDMW-3, MW-16S and MW-16I were repaired in August 2004 by Fenley and Nicol Environmental Services and MW-16D was abandoned in accordance with the NYSDEC Part 360-2.11 Hydrogeologic Report. Records of well abandonment are included in Appendix G of this Report.

5.4.9 Health and Safety Plan

A HASP was prepared in accordance with 29 CFR 1910 and was included with the Supplemental IRM Work Plan. The HASP, provided to WES, covered activities associated with the Phase I Supplemental IRM work. WES was given the option of adopting the HASP or preparing their own, with the provision that a WES HASP must either achieve or be more stringent than the requirements of the Supplemental IRM Work Plan HASP. WES elected to prepare their own HASP for their reference. The IRM activities were performed pursuant to the requirements contained in the Supplemental IRM Work Plan HASP.

During intrusive Phase I Supplemental IRM activities, PS&SPC performed air-monitoring activities within the work zone and at up-wind and down-wind locations, as necessary. A summary of the results of the Community Air Monitoring Program (CAMP) activities is provided in Appendix F. In addition, a discussion of these monitoring activities is provided in the following subsection.

5.4.10 Air Monitoring

In accordance to the CAMP included with the HASP, a real-time air-monitoring program was established by PS&SPC. The purpose of this monitoring program was to ensure that volatile organic compounds (VOCs) generated from intrusive remedial activities and particulates would not become a concern at OU-3. A PID and MIE DataRam Dustmeter were positioned at a location downwind of the intrusive work area on a stationary tripod monitoring station. In addition, a MIE DataRam Dustmeter was placed upwind of the intrusive work area.

Based on a review of the data, no exceedance of the prescribed 15-minute averages for VOC and particulate emissions were related to the IRM construction activities.

A summary of the dust and PID data monitoring results are presented in Tables F-1 through F-13, which are included in Appendix F.

5.4.11 Site Security

The overall Brightwaters Yard and Bay Shore West parcels are secured by a chain link fence with controlled access points. A safety fence was placed along the northern, eastern and western boundaries of the Phase I work area to separate it from the other portions of the Brightwaters Yard. Access to the IRM area was primarily via an access road from North Clinton Avenue through a lockable gate located on the Bay Shore OU-1 West Parcel.

5.5 Phase II – In-Situ Chemical Oxidation

A total of 27 locations within the Brightwaters Yard as well as the adjacent (south) LIRR easement received treatment via injection of ISOTEC reagents. The locations of the injection points are depicted on Figure 4. The treatment depth intervals and number of treatment cycles proposed at each location are summarized in Table 5-1.

TABLE 5-1

SUMMARY OF PROPOSED ISCO INJECTION PROGRAM

Injection Location Designation	Injection Interval (feet bgs)	Notes
GPS-1	4 to 8 8 to 12	Existing Location
GVZ-4	4 to 8	Existing Location
GVZ-12	4 to 8	Existing Location, Two Treatment Cycles
GVZ-17	4 to 8	Existing Location
GVZ-18	4 to 8	Existing Location, Two Treatment Cycles
GVZ-24	8 to 12	Existing Location, Two Treatment Cycles
GVZ-34	8 to 12 16 to 20	Existing Location, Two Treatment Cycles at the 8 to 12 foot interval
GVZ-35	4 to 8 8 to 12	Existing Location
GVZ-37	4 to 8	Existing Location
GMP-5	4 to 8	Existing Location
GMP-6	4 to 8	Existing Location, Two Treatment Cycles
GMP-7	8 to 12	Existing Location
GMP-10	4 to 8	Existing Location
GMP-11	8 to 12	Existing Location
GMP-12	4 to 8 8 to 12	Existing Location, Two Treatment Cycles at the 8 to 12 foot interval
GMP-16	4 to 8	Existing Location
GMP-17	4 to 8	Existing Location, Two Treatment Cycles
ISO-1	4 to 8	New Location
ISO-2	4 to 8	New Location
ISO-3	4 to 8	New Location

TABLE 5-1

SUMMARY OF PROPOSED ISCO INJECTION PROGRAM

Injection Location Designation	Injection Interval (feet bgs)	Notes
ISO-4	8 to 12	New Location
ISO-5	8 to 12	New Location
ISO-6	8 to 12	New Location
ISO-7	8 to 12	New Location

Based on the visual observations made during the source removal excavation phase of the Supplemental IRM activities (Phase I), three additional points (GVZ-32, GVZ-33 and GVZ-42) were added to the injection program. These three locations received one round of injection treatment at the 8 to 12 foot bgs interval.

The locations of all 27 treatment locations are depicted on Figure 4, included in Appendix A of this Report.

5.5.1 Injection Point Installation

All injection points were installed by Zebra, under the direction of ISOTEC, utilizing DP drilling methodologies. Once installed, the DP points were modified by ISOTEC for reagent injection. Each DP point consisted of a 1 ¼-inch inch inside diameter (ID) stainless steel casing driven into the subsurface via DP methods. The stainless steel casing was equipped with an expandable stainless steel tip. Solid 4-foot sections of the casing were advanced to the desired treatment interval. Once the desired treatment interval was reached, a four-foot section was retracted which exposed a 4-foot stainless steel screen utilized for injection. If an injection point required two treatment intervals, two screen depths were utilized.

5.5.2 Reagent Preparation and Injection

The ISOTEC reagents consisted of a chelated iron complex and stabilized hydrogen peroxide (H_2O_2). The maximum concentration of hydrogen peroxide utilized during the injection processes was 12.5%. The hydrogen peroxide dilution and addition of stabilizers and control agents was performed on-site under the direction of ISOTEC and oversight of KeySpan/PS&SPC. The iron catalyst (Catalyst 4260) was mixed in 55-gallons drums prior to injection.

The reagents were conveyed to the injection points through reinforced tubing. Injection at each point was performed utilizing a wellhead connection consisting of a system of ball valves, fittings and pressure gauges.

5.5.3 Reagent Quantities

A reagent treatment cycle of 165 gallons was proposed for use at OU-3. This proposal was based on previous reagent injection episodes at OU-3. However, due to field conditions encountered during the injection process as well as health and safety considerations (i.e., surfacing of reagents, etc.), the final volumes at each injection point varied. The following summarizes the final injection volumes for each point. It should be noted, due to surfacing of reagents during injection cycles, injection of reagents at a particular point may have been halted and restarted either the same day or on different injection dates. The following Table represents the total amount of hydrogen peroxide and catalyst injected at each location.

TABLE 5-2

SUMMARY OF REAGENT INJECTION VOLUMES

Injection Location Designation	Injection Interval (feet bgs)	Volume of ISOTEC Reagent (Gallons) (Date)
GPS-1	4 to 8 8 to 12	180 (10/11) 180 (10/11)
GVZ-4	4 to 8	120 (10/11) 45 (10/13)
GVZ-12	4 to 8	135 (10/7) 45 (10/8) 90 (10/11) 90 (10/12) Two Treatment Cycles
GVZ-17	4 to 8	180 (10/7)
GVZ-18	4 to 8	180 (10/11) 180 (10/11) 195 (10/13) Two Treatment Cycles
GVZ-24	8 to 12	180 (10/8) 180 (10/11) Two Treatment Cycles
GVZ-34	8 to 12 16 to 20	135 (10/8) 225 (10/12) 180 (10/8) Two Treatment Cycles at the 8 to 12 foot interval
GVZ-35	4 to 8 8 to 12	180 (10/12) 180 (10/8)

GVZ-37	4 to 8	75 (10/8) 105 (10/12)
GMP-5	4 to 8	30 (10/7) 150 (10/11)
GMP-6	4 to 8	135 (10/7) 180 (10/11) 60 (10/13) Two Treatment Cycles
GMP-7	8 to 12	180 (10/7)
GMP-10	4 to 8	180 (10/11)
GMP-11	8 to 12	105 (10/8) 90 (10/12)
GMP-12	4 to 8 8 to 12	360 (10/12) 180 (10/8) Two Treatment Cycles at the 8 to 12 foot interval
GMP-16	4 to 8	180 (10/13)
GMP-17	4 to 8	360 (10/13) Two Treatment Cycles
ISO-1	4 to 8	75 (10/7) 105 (10/11)
ISO-2	4 to 8	180 (10/7)
ISO-3	4 to 8	180 (10/7)
ISO-4	8 to 12	90 (10/7) 90 (10/11)
ISO-5	8 to 12	195 (10/8)
ISO-6	8 to 12	180 (10/12)
ISO-7	8 to 12	180 (10/12)
GVZ-32	8 to 12	180 (10/12)
GVZ-33	8 to 12	180 (10/12)
GVZ-42	8 to 12	180 (10/13)

(1) Total gallons equals the sum of the gallons of hydrogen peroxide and catalyst utilized at each location.

5.5.4 <u>Post-Injection Soil Sampling</u>

As per the January 2004 Supplemental IRM Work Plan, soil samples were collected approximately 30 days after the last ISCO injection to confirm that a significant reduction in contaminant concentrations had occurred as a result of the injections. Soil samples were collected, via DP drilling methods, in the vicinity of the individual injection points and at intervals corresponding with the injection intervals as depicted on Figure 4. The soil samples were submitted to H2M Laboratories, Inc. (a laboratory certified in the State of New York) for BTEX and PAH analysis.

The results of the laboratory analysis of the soil samples has been summarized and are presented as Tables B-1, B-2, B-3 and B-4 included in Appendix B. The analytical results from the post-ISCO soil sampling were compared to the results contained in Table 3-1 of the January 2004 Supplemental IRM Work Plan to determine the effectiveness of the ISCO injections in reducing the known contamination. Table 5-3 summarizes this comparison.

A reduction in BTEX and naphthalene concentrations is indicated for a majority of the comparable ISOTEC injection points. The post-injection data from this Supplemental IRM, as presented in Table 5-3, was compared to the post-injection data presented in Table 3-1 of the January 2004 Supplemental IRM Work Plan. Of the 17 comparable injection point locations, seven are indicated to have lower concentrations for both BTEX and naphthalene on a simple direct comparison basis versus the previous post-injection sampling locations. At five of the locations, the post-injection sample concentrations are indicated to be higher than the previous post-injection samples from the same location. The remaining locations indicated variable results for both BTEX and naphthalene concentrations.

TABLE 5-3

COMPARISON OF SOIL SAMPLE ANALYTICAL RESULTS

Injection Point	Depth Interval (feet bgs)	Table 3-1 of January 2004 Work Plan (ppm)		November 2004 Post-ISCO Sampling (ppm)		Percent Reduction/Increase	
		BTEX	Naphthalene	BTEX	Naphthalene	BTEX	Naphthalene
GPS-1	4 to 8	256	130	360	180	+ 41%	+ 38%
GPS-1	8 to 12	203	35	(1)	(1)	N/A	N/A
GVZ-4	4 to 8	167	47	1,570	200	+ 840%	+ 326%
GVZ-12	4 to 8	576	79	427.3	160	- 26%	+ 103%
GVZ-17	4 to 8	94	6.6	10.3	1.6	- 89%	- 76%
GVZ-18	4 to 8	587	24	97.3	20	- 83%	- 17%
GVZ-24	8 to 12	2,250	120	105.1	4	- 95%	- 97%
GVZ-34	8 to 12	615	32	128.7	31	- 79%	- 3%
GVZ-34	16 to 20	105	32	0.35	0.32	- 99%	- 99%
GVZ-35	4 to 8	24	4.9	308	78	+ 1,183%	+ 1,492%
GVZ-35	8 to 12	27	20	165	41	+ 511%	+ 105%
GVZ-37	4 to 8	287	53	604.2	48	+ 111%	- 9.4%
GMP-5	4 to 8	242	40	180	99	- 26%	+ 148%
GMP-6	4 to 8	913	4.9	279.4	15	- 69%	+ 206%
GMP-7	8 to 12	211	11	0.67	0.26	- 99%	- 98%
GMP-10	4 to 8	403	7.3	47.43	2.8	- 88%	- 62%
GMP-11	8 to 12	50	1.2	477	26	+ 854%	+ 2,067%
GMP-12	4 to 8	260	23	5.6	25	- 98%	+ 9%
GMP-12	8 to 12	1,288	16	6.9	21	- 99%	+ 31%
GMP-16	4 to 8	177	4.1	2,100	80	+ 1,086%	+ 1,851%
GMP-17	4 to 8	1,568	140	1.0	1.3	- 99%	- 99%
ISO-1	4 to 8	N/A	N/A	123.4	7.9	N/A	N/A
ISO-2	4 to 8	N/A	N/A	441.3	9.6	N/A	N/A

TABLE 5-3

COMPARISON OF SOIL SAMPLE ANALYTICAL RESULTS

Injection Point	Depth Interval (feet bgs)	Table 3-1 of January 2004 Work Plan (ppm)		November 2004 Post-ISCO Sampling (ppm)		Percent Reduction/Increase	
		BTEX	Naphthalene	BTEX	Naphthalene	BTEX	Naphthalene
ISO-3	4 to 8	N/A	N/A	22	17	N/A	N/A
ISO-4	8 to 12	N/A	N/A	48.3	0.45	N/A	N/A
ISO-5	8 to 12	N/A	N/A	545	45	N/A	N/A
ISO-6	8 to 12	N/A	N/A	178.68	84	N/A	N/A
ISO-7	8 to 12	N/A	N/A	0.141	0.48	N/A	N/A
GVZ-32	8 to 12	N/A	N/A	0.176	ND@0.38	N/A	N/A
GVZ-33	8 to 12	N/A	N/A	422	47	N/A	N/A
GVZ-42	8 to 12	N/A	N/A	ND@0.012	0.077	N/A	N/A

(1) Soil sample not collected in the field.
ND Not Detected

5.5.5 Injection Field Monitoring

To address the potential for the release of VOCs during the injection process, soil gas monitoring was conducted at three soil vapor monitoring points located downgradient of the ISCO treatment area. Specifically, the monitoring was conducted at existing soil vapor monitoring points SV-02 and SV-03 as well as a new monitoring point (SV-04) installed prior to the performance of the ISCO injections. The locations of the three monitoring points (i.e., SV-02, SV-03 and SV-04) are depicted on Figure 4.

Prior to the performance of the ISCO injection program, baseline soil gas conditions were established by KeySpan. The baseline survey, completed in the fourth quarter of 2004, included the collection of soil gas samples, via Summa Canister, from sampling points installed approximately 10 feet to the east and west of SV-02 and SV-03. The Summa Canisters were submitted to the laboratory for TOC-14A plus naphthalene analysis. In summary, naphthalene, the compound most generally associated with MGP impacts, was not detected in any of the samples. Additionally, a majority of the compounds (44 of the 64 compounds analyzed) were reported as not detected. Twenty compounds were detected above their respective minimum levels of detection in at least one of the soil gas samples.

During the injection process, soil gas concentrations were monitored at SV-02, SV-03 and SV-04. The monitoring was conducted once per day at approximately the mid-point of the working day. Monitoring was performed with a properly calibrated PID. No detectable concentrations of VOCs were noted in any of the three well points during the performance of the injection process.

Post-injection soil gas monitoring was completed on January 7 and March 4, 2005. The results of the baseline and post-injection monitoring events, including the applicable detection limits, are presented in Appendix C.

5.5.6 Construction-Derived Wastes

No soil cuttings were generated during the installation of the injection points. The injection points were installed via direct push installation methodology, which resulted in the compaction and displacement of soils within the borehole.

Soils generated from the performance of the post-ISCO treatment sampling program (i.e., excess soils contained in the sampling sleeves) were returned to the borehole after the sample was collected. Each borehole was completed with a bentonite/cement mixture to replace any resulting headspace.

Wastewaters generated from the decontamination of drilling and injection equipment were collected and containerized in 55-gallon drums. The liquids were then pumped from the drums into a frac tank located on Bay Shore OU-1 for eventual characterization and off-site disposal.

5.6 Phase III – Enhanced Bioremediation

A total of two new injection lines consisting of 18 oxygen injection wells were installed to supplement the pre-existing row of 12 oxygen injection wells previously installed but damaged as a result of Phase I activities. The 2 new rows of wells are located upgradient and parallel to the existing wells and are connected by high-density polyethylene tubing (HDPE) to a newly installed oxygen generator system located on the Brightwaters Yard. The locations of the wells and oxygen generator are depicted on Figure 5.

5.6.1 Trenching and Inspection and Repair of Existing Oxygen Wells

A trench was excavated along the row of pre-existing oxygen injection wells in order to access the wells and allow for the installation of new HDPE tubing. The trench dimensions were approximately 2 feet wide by 3 feet in depth. The 12 pre-existing oxygen injection wells were visually inspected to determine whether repairs and/or upgrades were required. One well located at the eastern end of the trench near the oxygen generator trailer was abandoned in place as per the Operations Plan. The remaining wells were found to be serviceable with minor adjustments.

5.6.2 Installation of Additional Oxygen Wells

To supplement the pre-existing wells, 5 new oxygen injection wells (i.e., well nos. OX-8, OX-9, OX-10A, OX-11 and OX-11A) were installed within the row of pre-existing wells. Two of the newly installed wells (well nos. OX-8 and OX-9) were replacements for wells excavated during Phase I activities. Of the remaining 3 newly installed wells, one (well no. OX-11) was installed as a replacement for a pre-existing well that was subsequently located during extension of the trench. A field determination was made to retain both the newly installed well and the pre-existing well. Each of these three new wells were constructed of one-inch diameter schedule 40 polyvinyl chloride (PVC) and were screened from 18 to 20 feet bgs. The final two new wells (well nos. OX-10A and OX-11A) were installed at the request of the NYSDEC to address contamination at depth and were screened at 20 to 22 feet bgs.

The 18 newly installed upgradient wells were installed in two parallel rows. Seven new wells were installed in the northern-most row (i.e., well nos. OX-26 through OX-32). These wells were screened to depths of 15 to 17 feet bgs.

Eleven new wells were installed along the middle row (i.e., well nos. OX-15 through OX-25) and were screened at depths of 18 to 20 feet bgs.

The new injection wells were installed using a combination of DP and hollow-stem auger methods. The wells were constructed of 1-inch Schedule 40 PVC risers with injection point screens constructed of 1-foot long 1-inch diameter PVC sumps fitted to a 1-inch diameter 1-foot long 0.010 slot PVC screen. The PVC risers are attached to a threaded tee at approximately 2-feet bgs. The tee is fitted with a 1-inch diameter riser to grade. The annular space was filled with #00 Silica Sand to 1-foot above the screen interval. A 2-foot thick bentonite seal was placed above the silica sand with cement bentonite grout to 3-feet bgs and native material to grade. The wellheads are completed with flush mount valve boxes to allow for future servicing of the wells.

Each of the new wells was developed after completion of installation. The wells were developed by alternately surging and pumping for either a maximum of one hour or until the turbidity of the development water registered less than 50 nephelometric turbidity units (NTUs) using a field turbidity meter.

5.6.3 Tubing Installation and Connection to Oxygen Generator

To accommodate the tubing for the 18 additional upgradient wells, 2 2-foot diameter, 3-foot deep trenches were excavated. These trenches were connected to the trench for the pre-existing wells via a trench running in a north-south orientation as depicted on Figure 5. Continuous ½ inch ID, 125 pounds per square inch (psi) HDPE tubing was run from each wellhead connection to the location of the oxygen generating system. The tubing was placed on an approximately 1-foot thick bed of sand within each trench. In addition to the tubing, a telephone line from an existing pole in the Brightwaters Yard was run through the trenches for connection to the oxygen generator unit. The HDPE tubing was secured to each well and grouped in bundles of 10 or less using plastic zip ties. The tubing was run to a pre-existing below grade vault where the individual tubes were connected to the oxygen generator unit. The wells and tubing were pressure tested, and after some minor adjustments, were found to be fully functional.

Upon completion of system testing, each trench was backfilled with excavated non-heavily impacted soils in six-inch lifts and compacted using a vibratory compactor. The lifts were extended to within 6 inches of the final grade and were finished with ¾-inch crushed blue stone to grade.

The oxygen generator unit, provided by Matrix Environmental Technologies, was placed on a pad with a base of ¾-inch crushed stone finished with a 2-inch layer of 3/8-inch crushed stone at the location depicted on Figure 5. The oxygen generator unit has an oxygen production output of 160 standard cubic feet per hour with a capacity for up to 60 injection points. It is equipped with a Sensaphone Model 1104 designed to report system malfunctions so that they may be promptly identified and corrected. The unit is located in an insulated utility trailer and is surrounded by chain link fencing for security purposes.

On December 15, 2004 operation of the oxygen generator system was initiated and the system has been operating continuously since that date.

5.6.4 Construction -Derived Wastes

Cuttings from the installation of the new oxygen injection wells as well excess soils resulting from the placement of the sand bed within the trench excavations were stockpiled on-site for re-use during backfilling of the trenches. Soils that exhibited visual contamination and/or elevated PID readings were segregated, placed on plastic sheeting, sprayed with an odor suppressant foam and covered with plastic sheeting to minimize odor generation and prevent erosion. These excess soils were transferred to on-site roll-offs for eventual off-site disposal. A summary of manifests and Certificates of Destruction will be provided with the Final Supplemental IRM Completion Report

Wastewaters generated from the decontamination of drilling and injection equipment and from well development activities was collected and containerized in 55-gallon drums. The liquids were then pumped from the drums into a frac tank located on Bay Shore OU-1 for eventual characterization and off-site disposal.

5.7 Groundwater Sampling Program

At the request of the NYSDEC, two supplemental side-gradient groundwater-monitoring wells (BBMW-28S and BBMW-28I) were installed in order to monitor for potential groundwater plume migration as a result of implementation of the Supplemental IRM. Figure 6 displays the location of these two wells as well as the remainder of the OU-3 groundwater monitoring wells. The results from the first quarter groundwater-monitoring event (January 2005 to March 2005), including BBMW-28S and BBMW-28I, are presented in Appendix C. Note that data from groundwater sampling in the first quarter of 2005 was reported as non-detect in both BBMW-28S and BBMW-28I. The results from the fourth quarter 2004 OU-3 groundwater-monitoring program are also presented in Appendix C.

The results of the OU-3 groundwater-sampling program are provided to the NYSDEC in the quarterly OU-3 Performance Monitoring Report.

6.0 SITE RESTORATION ACTIVITIES

6.1 Phase I – Source Removal

Excavation areas were backfilled as previously specified in this Report. A final gravel cover of 1 inch crushed stone was placed over areas disturbed during the Supplemental IRM. Facility utilities that were temporary relocated were re-established to pre-remedial conditions.

6.2 Phase II – In-Situ Chemical Oxidation

All injection points were grouted using a bentonite and cement mixture to match pre-disturbance grades. Soil borings installed to collected post-injection soil samples were restored by returning all soils not collected for samples to the borehole. The boreholes were surfaced to match pre-disturbance grades.

6.3 Phase III – Enhanced Bioremediation

Trenches for the oxygen injection tubing were backfilled to grade as previously specified in this Report. The balance of the IRM area was graded and any excess soil was placed in roll-offs for off-site disposal as discussed in Section 5.6.4.

7.0 CONSTRUCTION COSTS

7.1 Construction Cost Estimate – All Phases

Construction costs for the OU-3 Supplemental IRM activities are the sole responsibility of KeySpan Corporation. The actual construction costs, based on invoices submitted to date from WES, PS&SPC, Code Environmental Services (transportation and disposal consultant), H2M Laboratories, Fenley and Nichol Environmental, ISOTEC, Zebra (drilling subcontractor) Matrix Environmental is approximately $1,700,000.00.

8.0 CONSTRUCTION AS-BUILTS

8.1 Phase I – Source Removal

Construction as-built information for the Phase I remedial work is provided in Figure 3.

8.2 Phase II – In-Situ Chemical Oxidation

Construction as-built information for the Phase II remedial work is provided in Figure 4.

8.3 Phase III – Enhanced Bioremediation

Construction as-built information for the Phase III remedial work is provided in Figure 5.

9.0 MANIFESTS

9.1 Phase I – Source Removal

In January 2004, KeySpan conducted an in-situ sampling program to characterize the soils to be excavated, in place, prior to their removal and off-site disposal. The purpose of the in-situ waste classification activities was to characterize the soils as per the requirements of the selected disposal facility prior to the performance of the Phase I Supplemental IRM activities.

Approximately 1,500 tons of soils were excavated during the Phase I Supplemental IRM activities and transported to Clean Earth of New Castle and Casie Protank. As stated previously, the soils generated from Excavation Areas A, B, and C was characterized in-situ prior to excavation as per the requirements of the selected disposal facility. Waste characterization analytical parameters, as well as the frequency of collection of waste characterization samples, were dictated by the disposal facility, Clean Earth of New Castle, ProTank and the NYSDEC. Non-hazardous waste manifests are included in Appendix D.

The following Table summarizes the 56 non-hazardous waste manifests generated during the off-site disposal activities. The Table includes the disposal facility's manifest number as well as tonnage shipped under each manifest.

TABLE 9-1

LIST OF WASTE DISPOSAL MANIFESTS

Manifest Number	Date	Weight (tons)
150251	6/1/04	24.40
150290	6/10/04	23.83
150291	6/10/04	29.60
150292	6/10/04	31.10
150293	6/10/04	29.02
150283	6/11/04	29.10
150286	6/11/04	31.03
150285	6/11/04	32.71
150284	6/11/04	33.23
150287	6/11/04	30.23
150288	6/11/04	29.13
150251	6/16/04	29.95
150252	6/16/04	29.80
150253	6/16/04	30.14
150254	6/16/04	31.29
150255	6/16/04	27.19
150256	6/16/04	32.28
150257	6/16/04	31.76
150258	6/16/04	32.45
150259	6/16/04	29.59
150260	6/16/04	28.75
150263	6/17/04	30.08
150282	6/17/04	26.63
150261	6/17/04	26.14
150266	6/18/04	29.80
150267	6/18/04	27.53
150268	6/18/04	30.18
150269	6/18/04	30.15
150270	6/18/04	32.94
150271	6/24/04	29.99
150272	6/24/04	30.32
150273	6/24/04	26.57
150274	6/24/04	34.07
150275	6/24/04	28.80
150276	6/24/04	29.61
150277	6/24/04	28.95

TABLE 9-1

LIST OF WASTE DISPOSAL MANIFESTS

Manifest Number	Date	Weight (tons)
150278	6/24/04	32.66
150281	6/18/04	24.02
157612	6/24/04	34.14
157613	6/24/04	30.34
157614	7/6/04	3.98
157615	6/25/04	18.12*
157616	6/30/04	20.01*
157617	7/2/04	28.60*
157618	6/25/04	22.28
157619	6/25/04	27.77
157634	7/6/04	9.24*
157635	7/6/04	5.25*
157637	6/30/04	20.39*
157644	7/1/04	22.23*
157645	6/30/04	20.61*
157646	6/30/04	19.79*
157649	6/23/04	22.61*
157650	6/23/04	28.96*
157647	6/28/04	23.31*
157651	7/1/04	24.96*
	TOTAL	**1,507.61**

Note: * = roll-off container was used.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The IRM was implemented in accordance with the approved "Work Plan for Supplemental IRM Activities for the Bay Shore/Brightwaters Former MGP Site Operable Unit No. 3 Brightwaters Yard Groundwater Plume (IRM-OU3A)" prepared by TRC Environmental Corporation and dated January 2004 (Supplemental IRM Work Plan) and the requirements set forth in the Voluntary Cleanup Agreement with the NYSDEC, Index No. DI-0001-98-11.

10.1 Conclusions

Based on the results of the Supplemental IRM activities, the following conclusions can be made.

- Phase I of the Supplemental IRM; source area excavation, was successful in achieving the removal of impacted soils and source materials from the IRM area. Approximately 1,500 tons of soils were excavated for off-site transportation and disposal. The Phase I excavation will substantially reduce the area's contribution to the existing groundwater contamination plume;
- Phase II of the Supplemental IRM; in-situ chemical oxidation, involved the injection of a chelated iron complex and stabilized hydrogen peroxide (H_2O_2) at 27 locations within the IRM area. Soil sampling was conducted at each of the 27 locations to confirm the performance of the injections. Phase II was effective in reducing the observed levels of chemical constituents in a majority of the injection locations; and
- Phase III of the Supplemental IRM; oxygen injection, involves the injection of oxygen into 35 wells in order to enhance bioremediation of residual contaminants in soil and groundwater. The oxygen injection unit was successfully installed as planned and is currently operating.

10.2 Recommendations

Quarterly groundwater monitoring conducted after the completion of the Supplemental IRM activities is expected to reflect the results of these activities. Continued quarterly monitoring of the groundwater in the Yard and immediately downgradient should continue for the next two years in order to assess the effectiveness of these Supplemental IRM activities. At this time, a data review report will be prepared and if appropriate, a recommendation will be made for further remedial action.

APPENDIX A

FIGURES

APPENDIX B

TABLES

APPENDIX C

BASELINE SOIL GAS DATA

APPENDIX D

MANIFESTS/DISPOSAL DOCUMENTATION

APPENDIX E

BACKFILL DOCUMENTATION

APPENDIX F

CAMP SUMMARY RESULTS

APPENDIX G

WELL ABANDONMENT DOCUMENTATION

APPENDIX H

PROJECT PHOTOGRAPHS