OU1 REMEDIAL WORK PLAN
FORMER AIR FORCE PLANT 51
4777 DEWEY AVENUE, GREECE, NEW YORK
DERP-FUDS SITE NO. C02NY057500
NYSDEC SITE NO. V00421

OPERABLE UNIT OU1
AOC1 (FORMER PLATING POND/LAGOON)

Prepared For: 4800 Dewey Avenue, Inc.
80 Steel Street
Rochester, New York 14606

Prepared By: Day Environmental, Inc.
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Rochester, New York 14614

Project No.: 2806S-01

Date: September 29, 2006
Revised Date: February 9, 2007
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Date: 2/9/07

Jeffrey A. Danzinger
Project Manager

Date: 2/9/07

David D. Day, P.E.
President
May 18, 2007

Mr. Louis Atkin
4800 Dewey Avenue Enterprises, Inc.
80 Steel Street
Rochester, NY 14606

Dear Mr. Atkin:

RE: Voluntary Cleanup Project
Former Air Force Plant 51; Site #V00421-8
Operable Unit 1
OU1 Remedial Work Plan; February 9, 2007

The New York State Department of Environmental Conservation (NYSDEC) has completed its review of the February 9, 2007 OU1 Remedial Work Plan (OU1 RWP) prepared by Day Environmental for the Former Air Force Plant 51 site. Based upon the information and representations given in the OU1 RWP and the April 3, 2006 Environmental Site Investigation Report for Operable Unit 1, the OU1 RWP is hereby approved with the following modifications and clarifications.

1. Alternative drilling procedures will be used if the direct-push equipment is not able to achieve the required depths or is otherwise ineffective.

2. If needed, a contingency remedy to protect public health and/or prevent off-site migration could include additional source control and/or migration control at the perimeter of the site. Additionally, NYSDEC may request development and implementation of a contingency remedy at any time if it is determined that the selected remedy cannot achieve the remedial action objectives established for Operable Unit 1.

3. Section 3.4 Institutional Controls: The requirement to evaluate the potential for vapor intrusion into any building to be constructed on the Site will apply to the entire site (not just the area around Operable Unit 1) and will be included in the environmental easement.
4. Section 4.0: The environmental easement will be completed as soon as possible. The draft easement will be submitted to NYSDEC for review by July 9, 2007.

The OU1 RWP consists of this letter and the February 9, 2007 OU1 Remedial Work Plan prepared by Day Environmental, Inc. Please submit nine (9) CDs containing electronic copies of the OU1 RWP (including this letter) by June 25, 2007. Please ensure that the electronic files are in pdf format and that the text of the report is searchable.

Per the OU1 RWP, the remedial design investigation will start by June 25, 2007. Please notify me when the field work has been scheduled.

Thank you for your cooperation in this matter and please contact me at (585) 226-5357 if you have any questions.

Sincerely,

[Signature]

Frank Sowers, P.E.
Project Manager

cc:
Jeff Danzinger (Day Environmental)
David Day (Day Environmental)
David Freeman, Esq.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ........................................................................................................... i

1.0 INTRODUCTION .................................................................................................................. 1
  1.1 Site Background .................................................................................................................. 2
  1.2 Summary of Current Subsurface Conditions ................................................................. 2
  1.3 Project Objectives and Remedial Action Objectives ...................................................... 5

2.0 REMEDIAL DESIGN INVESTIGATION ............................................................................. 7

3.0 REMEDIAL ACTIVITIES .................................................................................................... 11
  3.1 In-Situ Chemical Oxidation of the On-Site Source Area .................................................. 11
      3.1.1 Pilot Phase ................................................................................................................. 12
      3.1.2 Full-Scale Phase ....................................................................................................... 15
      3.1.3 Polishing Phase ........................................................................................................ 17
  3.2 Post-Treatment O&M Groundwater Monitoring ............................................................ 18
  3.3 Remediation-Derived Wastes ......................................................................................... 18
  3.4 Institutional Controls ....................................................................................................... 19
  3.5 Reporting ........................................................................................................................ 19
  3.6 Assessment of Selected Remedy ................................................................................... 20

4.0 PRELIMINARY SCHEDULE ............................................................................................. 25

5.0 HEALTH AND SAFETY .................................................................................................... 26

6.0 QUALITY ASSURANCE/QUALITY CONTROL ................................................................. 27

7.0 REFERENCES .................................................................................................................... 28

8.0 ACRONYMS ....................................................................................................................... 29

FIGURES
Figure AOC1-A  Project Locus Map
Figure AOC1-B  Site Plan
Figure AOC1-C  Previous Test Location Plan
Figure AOC1-D  Cross-Section A-A’
Figure AOC1-E  Cross-Section B-B’
Figure AOC1-F  Potentiometric Overburden Groundwater Contour Map for August 30, 2004
Figure AOC1-G  Total VOCs in Soil
Figure AOC1-H  Total VOCs in Groundwater
Figure AOC1-I  Total VOCs in Groundwater Contour Map
Figure AOC1-J  Proposed Remedial Design Test Locations
Figure AOC1-K  Tentative In-Situ Chemical Oxidation Treatment Areas

APPENDICES
Appendix A  Table 1 (Opinion of Probable Cost of Selected Remedy)
Appendix B  Geo-Cleanse International, Inc. Statement of Qualifications
Appendix C  In-Situ Chemical Oxidation, USEPA August 2006 Engineering Issue
            By S.G. Huling and B.E. Pivetz
EXECUTIVE SUMMARY

This Remedial Work Plan was prepared for the subject property (Site), which consists of an approximate 33.6-acre property (addressed as 4777 Dewey Avenue) located on the west side of Dewey Avenue in the Town of Greece, County of Monroe, New York and is commonly referred to as the former Air Force Plant No. 51 (AFP51). This Remedial Work Plan for Operable Unit OU1 (OU1 Remedial Work Plan) was developed in accordance with the requirements of Voluntary Agreement Index #B8-590-01-02 between the New York State Department of Environmental Conservation (NYSDEC) and 4800 Dewey Avenue, Inc. (4800 Dewey). Operable Unit OU1 is comprised of the following two areas of concern (AOCs):

AOC1 Former Plating Pond/Lagoon: Information indicates that plating rinse wastewater was disposed of into a man-made plating pond/lagoon, which ultimately flowed to Round Pond Creek. Chlorinated volatile organic compounds (VOCs), petroleum-related VOCs, semi-volatile organic compounds (SVOCs), and some metals have been detected in sediment, soil and/or groundwater at, or in proximity to, the former plating pond/lagoon. As an initial remedial action, surface water in the plating pond/lagoon was removed via pumping, and the United States Army Corps of Engineers (USACE) excavated underlying sediments/soils down to the top of the groundwater table in 2000/2001. However, contamination, including dense non-aqueous phase liquid (DNAPL) that predominantly consists of chlorinated VOCs, is still present at AOC1. Under the Voluntary Cleanup Agreement (VCA), the nature and extent of contamination at AOC1 was further delineated, on-going DNAPL monitoring and recovery has been implemented as an interim remedial measure (IRM), and it was determined that further remediation of AOC1 is warranted.

AOC2 Lagoon and Stormwater Outfalls: A discharge point associated with the former plating pond/lagoon is located west of Building #1 just outside the fence of the Site (i.e., approximate property line). The USACE remediated soil and sediments in the discharge ditch downstream of the former plating pond/lagoon, but stopped at the property line. Discharges to the former plating pond/lagoon outfall have been eliminated as a result of the USACE’s remediation efforts. Since there are no more discharges to the former plating pond/lagoon, and since discharges from the stormwater system are being controlled, further work at AOC2 has not been requested by regulatory agencies.

Site Background

The facilities on the Site were generally constructed in the early 1940's. The Department of Defense either owned or leased facilities situated on approximately 44 acres of land located in the Town of Greece, New York, including the Site. These facilities were used for the manufacture of ocean-going ships and cranes during and immediately following World War II, and subsequently for the manufacture of B-52 aircraft parts and Talos ground handling equipment. 4800 Dewey currently owns the Site.

The Site is currently bounded to the north by the Monroe County Shoremont Water Treatment Plant; to the east by Dewey Avenue, with a residential apartment complex beyond; to the west by vacant undeveloped land and New York State/Federal wetlands (containing Round Pond Creek); and to the south by the Ontario State Parkway with residential property beyond.
Remedial Design Investigation

Under this Remedial Work Plan, a remedial design investigation would initially be performed to further evaluate/define the extent of VOC impact to soil and groundwater on the Site in the area generally between existing monitoring well MW1-7 and the former plating pond/lagoon. Additional goals of the remedial design investigation include obtaining information that can be used for the selection and design of the remedial program for this area, and obtaining information that can be used to fill data gaps, if any. The results of the remedial design investigation will be used to design the remedial actions specified herein with concurrence from the NYSDEC.

The proposed remedial design investigation consists of the advancement of nine test borings, the installation of one groundwater monitoring well at one of the test boring locations, and the collection and analysis of soil samples and groundwater samples. A groundwater potentiometric contour map will also be prepared for this area of the Site.

Remedial Activities

The proposed remedy selected to address contamination at operable unit OU1 area of concern AOC1 (former plating pond/lagoon) consists of the following components:

- In-Situ Chemical Oxidation of the On-Site Source Area
- Post-Treatment O&M Groundwater Monitoring
- Institutional Controls

In-situ chemical oxidation will be conducted in subsurface soils and groundwater in the source area (i.e., generally an approximate 100-foot by 140-foot area within, and around, the former plating pond/lagoon location). A remediation contractor will be retained to perform remediation services using hydrogen peroxide with a site-specific formulated catalyst (Fenton’s reagent), and possibly sodium permanganate during a polishing treatment. In-situ chemical oxidation is the process of oxidizing contaminants in the groundwater and soil by injecting water containing high concentrations of an oxidant to the area of contamination. This technology can eliminate (i.e., permanently destroy) many organic contaminants in both saturated and unsaturated environments by changing the organic contaminants into harmless materials, such as water and carbon dioxide.

The chemical oxidation remedial work is divided into a Pilot Phase, a Full-Scale (Primary) Phase, and a Polishing Phase (if deemed necessary). Remedial design plans will be developed and implemented for each phase, and will include: a sampling plan; a health and safety plan; and details concerning injector construction, mixing and application of injectates, process monitoring and performance monitoring. The use of Fenton’s reagent and sodium permanganate will be evaluated separately during the Pilot Phase.

The Pilot Phase will be conducted on just a portion of the source area that requires treatment. The Full-Scale Phase and any Polishing Phase are intended to treat the entire source area. In general, the findings of the Pilot Phase treatment using both the Fenton’s reagent and the sodium permanganate will be used to confirm the use of these chemical oxidation techniques at AOC1 and assist in development of the remedial design plans for the Full-Scale Phase and Polishing Phase (if deemed necessary). It is currently anticipated that Fenton’s reagent would be used during the Full-Scale Phase, and that sodium permanganate would be used during the Polishing Phase (if deemed necessary).
Subsequent to completion of the in-situ chemical oxidation, a post-treatment operation and maintenance (O&M) groundwater monitoring program will be implemented using the AOC1 groundwater monitoring wells that exist at that time in order to evaluate the effectiveness of natural attenuation, the presence and concentration of VOCs, and to determine the extent and potential movement of contamination. This O&M groundwater monitoring will continue for a period of up to five years. Completion of this five-year O&M groundwater monitoring represents a decision point for the remedy. Potential outcomes include closure of the operable unit, further monitoring of the operable unit, additional chemical oxidant injections at the operable unit, or selection and implementation of a contingency remedy.

As part of the remedy, institutional controls will be implemented that include the following elements:

- Development and implementation of a Site Management Plan (SMP) to:
  - Address the characterization, handling, and disposal/re-use of any media (e.g., soil, fill, groundwater) that is disturbed during any future activities at the entire Site;
  - Evaluate the potential for vapor intrusion into any future buildings to be constructed on the Site in the areas of AOC1, including requirements to mitigate such potential vapor intrusions through use of environmental engineering controls or other means;
  - Identify use restrictions for the Site;
  - Include a health and safety plan (HASP) and a community air monitoring plan (CAMP) to assist in reducing potential exposures to Site contaminants.
  - Include an O&M plan to provide specifics on the post-treatment O&M groundwater monitoring program, well/injector maintenance, any future oxidant applications; and
  - Include a reporting plan.

- Annual certification that is intended to validate that the institutional controls (and also engineering controls if required in the future) that are implemented for the Site are unchanged from the previous certification and that no circumstances have occurred that impair the ability of the controls to protect public health and the environment, or constitute a violation or failure to comply with any O&M or SMP for the Site.

- Development and implementation of an environmental easement to require compliance with the SMP and require the property owner to complete and submit to the NYSDEC the annual certification described above. In addition, the NYSDEC will be given a 60-day notice in advance of any “change of use” at the Site.

The results of the in-situ chemical oxidation work, and associated performance monitoring will be provided in an OU1 Remediation/Final Engineering Report (OU1 R/FER) for operable unit OU1. It is anticipated that at least the first two rounds of post-treatment O&M groundwater monitoring will be included in the OU1 remediation report. The SMP and environmental easement will also be included as part of the OU1 R/FER. Annual site management reports (SMRs) will be used to present subsequent post-treatment O&M groundwater monitoring events, annual certification reports, information and requirements set forth in Section 6.4(d) of DER-10 (or current version at the time the SMR is prepared) that pertain to the selected remedy and have not been presented in the OU1 R/FER or previous SMRs, and other pertinent information deemed necessary to evaluate the performance of the remedy.
Monthly progress reports for the Site will also include information pertaining to further development and implementation of the OU1 remedy as the project progresses.

This remedial work plan includes an assessment of the selected remedy, which indicated that the remedy is viable for the conditions that exist at AOC1. The assessment also identifies challenges that are faced with implementing the in-situ chemical oxidation remedy as well as some general information for solutions to those challenges. The remedial design plans will further define the challenges and solutions associated with implementing the in-situ chemical oxidation remedy using Fenton’s reagent and sodium permanganate.

It is anticipated that the design and implementation of the in-situ chemical oxidation activities will take a total of twenty-five or more months to complete. Post-treatment O&M groundwater monitoring could be started within six months after completing the in-situ chemical oxidation activities, and would continue for up to five years. The institutional controls would be completed within approximately two months after completing the in-situ chemical oxidation activities. A FER could be developed within six months after completing the in-situ chemical oxidation activities.

The site-specific HASP dated November 2001, which was included as part of the General Investigation Work Plan dated June 2002 will generally be implemented during performance of the tasks presented in this OU1 Remedial Work Plan. The HASP includes a CAMP. In addition, DAY or the remediation contractor would provide a separate HASP to be implemented during activities that are associated with the in-situ chemical oxidation treatments and performance monitoring events.

The applicable quality assurance/quality control (QA/QC) protocols and procedures included in Section 5.0 of the General Investigation Work Plan dated June 2002 would be implemented during performance of the tasks presented in this OU1 Remedial Work Plan.
1.0 INTRODUCTION

This Remedial Work Plan was prepared for the subject property (Site), which consists of an approximate 33.6-acre property (addressed as 4777 Dewey Avenue) located on the west side of Dewey Avenue in the Town of Greece, County of Monroe, New York and is commonly referred to as the former Air Force Plant No. 51 (AFP51). Figures AOC1-A and AOC1-B depict the location of the Site.

This Remedial Work Plan for Operable Unit OU1 (OU1 Remedial Work Plan) was developed in accordance with the requirements of Voluntary Agreement Index #B8-590-01-02 between the NYSDEC and 4800 Dewey. The NYSDEC document titled “Draft DER-10 Technical Guidance for Site Investigation and Remediation” (NYSDEC DER-10) dated December 2002 was used in the development of this OU1 Remedial Work Plan. The OU1 Remedial Work Plan includes an evaluation of the proposed remedy in relation to factors set forth in 6 New York Codes, Rules and Regulations (NYCRR) 375-1.8 (effective December 14, 2006).

Operable Unit OU1 is comprised of the following two areas of concern (AOCs):

AOC1 (Former Plating Pond/Lagoon): Information indicates that plating rinse wastewater was disposed of into a man-made plating pond/lagoon, which ultimately flowed to Round Pond Creek. Chlorinated VOCs, petroleum-related VOCs, SVOCs, and some metals have been detected in sediment, soil and/or groundwater at, or in proximity to, the former plating pond/lagoon. As an initial remedial action, surface water in the plating pond/lagoon was removed via pumping, and underlying sediments/soils were excavated down to the top of the groundwater table in 2000/2001 by the USACE. However, contamination, including DNAPL that predominantly consists of chlorinated VOCs, is still present at AOC1. As presented in the document titled “Environmental Site Investigation Report; Former Air Force Plant 51; 4777 Dewey Avenue, Greece, New York; DERP-FUDFS Site No. C02NY057500; NYSDEC Site No. V00421; Operable Unit OU1; AOC1 (Former Plating Pond/Lagoon); AOC2 (Lagoon and Stormwater Outfalls)” dated April 3, 2006, environmental work was conducted after the initial remedial action in order to further delineate the nature and extent of contamination at Operable Unit OU1. As part of this work, an IRM was commenced in July 2003 to monitor and recover DNAPL from the former plating pond/lagoon area. Over 180 gallons of DNAPL has been recovered between July 2003 and August 2006. Data limitations have not been identified for AOC1, except for the area in proximity to well MW1-7. As such, this OU1 Remedial Work Plan includes further evaluation of subsurface conditions in the area between well MW1-7 and the former plating pond/lagoon as a remedial design investigation. The results of this remedial design investigation will be used to modify details concerning the selected remedy as deemed necessary. Other areas of contamination that have been identified during investigation of AOC1 (e.g., VOCs in proximity to wells MW1-3, MW1-19 and MW1-21, and contaminants in sediment in a trench drain located inside the northwest portion of Building #1), will be further addressed under other operable units.

AOC2 (Lagoon and Stormwater Outfalls): A discharge point associated with the former plating pond/lagoon is located west of Building #1 just outside the fence of the Site (i.e., approximate property line). The outfall area discharges onto vacant wetland-type land. The USACE remediated soil and sediments in the discharge ditch downstream of the former plating pond/lagoon, but stopped at the property line. Discharges to the former plating pond/lagoon outfall have been eliminated as a result of the USACE’s remediation efforts.
Since there are no more discharges to the former plating pond/lagoon, and since discharges from the stormwater system are being controlled, further work at AOC2 has not been requested by regulatory agencies. However, impacts to the wetlands will be addressed at a later time under Operable Unit OU7, area of concern AOC3 (off-site aquatic life). In addition, the source of contaminants present within the stormwater system is being addressed under Operable Unit OU2, area of concern AOC4 (stormwater system).

This OU1 Remedial Work Plan outlines the scope of work developed to address only contamination that is present at AOC1 (former plating pond/lagoon).

1.1 Site Background

The facilities on the Site were generally constructed in the early 1940's. The Department of Defense either owned or leased facilities situated on approximately 44 acres of land located in the Town of Greece, New York, including the Site. These facilities were used for the manufacture of ocean-going ships and cranes during and immediately following World War II, and subsequently for the manufacture of B-52 aircraft parts and Talos ground handling equipment. Information has not been obtained to suggest radioactive materials were used, stored or disposed of at the Site.

The site was declared excess to the needs of the United States Air Force, and care and custody for the site was transferred to the General Services Administration (GSA). GSA conveyed 40.33 acres fee and 3.66 acres easement to the Monroe County Water Authority (MCWA), which later conveyed 36.63 acres fee and 3.24 acres easement to Dewey Avenue, Inc. 4800 Dewey currently owns the Site.

The Site is currently bounded to the north by the Monroe County Shoremont Water Treatment Plant; to the east by Dewey Avenue, with a residential apartment complex beyond; to the west by vacant undeveloped land and New York State/Federal wetlands (containing Round Pond Creek); and to the south by the Ontario State Parkway with residential property beyond. The Site is zoned as "IL" (light industrial).

1.2 Summary of Current Subsurface Conditions

Test borings were advanced and monitoring wells were installed to evaluate the nature and extent of contaminants at AOC1, and also to monitor and recover DNAPL from AOC1 (refer to Figure AOC1-C).

Fill consisting of reworked soil (e.g., silt, clay, sand and gravel) that occasionally contained trace amounts of concrete, wood or brick is present at portions of AOC1. This fill extended from the ground surface to depths ranging between approximately 4.0 feet and 15.5 feet.

The fill material that was used to backfill the former plating pond/lagoon subsequent to completion of 2000/2001 remedial work conducted by the USACE consisted of silt and/or clay that is intermixed with lesser amounts of sand and gravel from the ground surface to depths ranging between 8 feet and 11.5 feet. This fill is then underlain by a fill material consisting of sand and/or fine gravel that has a thickness ranging between 0.5 foot and two feet. Figures AOC1-D for cross section A-A’ and Figure AOC1-E for cross section B-B’ show this fill in relation to the former plating pond/lagoon as defined in the April 3, 2006 Environmental Site Investigation Report.
At most test locations, the uppermost layer of indigenous soil consists predominantly of silt and/or clay with lesser amounts of sand and gravel. The upper bedrock encountered beneath the overburden deposits in this area of the Site consists of brick red sandstone from the Queenston Formation, Late Ordovician Period, Paleozoic Era (refer to Figures AOC1-D and AOC1-E).

As documented in the April 3, 2006 Environmental Site Investigation Report, the shallow overburden groundwater table in the area of the former plating pond/lagoon generally flows radially outward at relatively low hydraulic gradients. For January 20, 2003, January 28, 2003, April 21, 2003 and April 12, 2004, groundwater in the shallow overburden generally flowed radially outward (i.e., flows west, and east) from the former plating pond/lagoon area and in the vicinity of well MW1-5 north of the former plating pond/lagoon. On August 30, 2004, groundwater in the shallow overburden generally flowed north and west; however, groundwater in proximity to well MW1-5 flowed to the south toward the former plating pond/lagoon (refer to Figure AOC1-F). Groundwater in the deeper overburden/bedrock interface generally flows north and west.

As documented in the April 3, 2006 Environmental Site Investigation Report, the nature and extent of contamination at AOC1 are summarized as follows:

- Contamination detected in subsurface soil or groundwater at AOC1 that appears attributable to historic operations at the Site primarily consists of VOCs, SVOCs and some metals. Total VOC concentrations detected in subsurface soil samples from AOC1 are shown on Figure AOC1-G. The majority of the specific VOCs and SVOCs that were detected at concentrations exceeding standards, criteria and guidance (SCG) values are typically associated with chlorinated solvents or petroleum products.

- Some subsurface soil samples from well locations MW1-7, MW1-8, MW1-9, MW1-10, MW1-12 and MW1-13 (shown on Figures AOC1-C and AOC1-G) contained concentrations of VOCs that exceeded SCG values. Test location MW1-7 is located approximately 140 feet west of the former plating pond/lagoon along the perimeter of the Site, and the other five test locations with exceedances are located within the footprint of the former plating pond/lagoon. Due to the absence of data from the area between well MW1-7 and the former plating pond/lagoon, it is possible that subsurface soil in the area between the former plating pond/lagoon and well MW1-7 may contain VOCs at concentrations exceeding SCGs. Alternatively, it is possible that a separate VOC source exists in proximity to well MW1-7.

VOCs were detected at concentrations exceeding SCG values in groundwater samples from 13 of 17 well locations that were tested (i.e., wells MW1-1, MW1-3 through MW1-10, and MW1-18 through MW1-21 as shown of Figure AOC1-C). Figure AOC1-H shows the total VOC concentrations detected in groundwater samples collected on the dates shown. Figure AOC1-I contours the total VOCs using the highest concentrations of VOCs detected in groundwater samples at any given well during monitoring events between January 2003 and September 2004. As shown from these figures, the highest concentrations of VOCs detected in groundwater were in samples from wells located:

- Within the footprint of the former plating pond/lagoon (wells MW1-8, MW1-9, MW1-10);
- Within the filled-in portion of the former channel north of building #1 (i.e., well MW1-21); and
- In proximity to the northeast corner of Building #1 and a stormwater catch basin (i.e., wells MW1-3 and MW1-19).
[Note: The groundwater quality in proximity to well locations MW1-3, MW1-19 and MW1-21 is not addressed under this OU1 Remedial Work Plan, but will be addressed at a later time under other operable units.]

- DNAPL generally consisting of chlorinated VOCs with lesser concentrations of other VOCs, SVOCs, metals, and polychlorinated biphenyls (PCBs) was encountered at four wells (i.e., MW1-10, MW1-12, MW1-13, and MW1-14 as shown on Figure AOC1-C) within the footprint of the former plating pond/lagoon. In accordance with provisions set forth in the NYSDEC-approved Supplemental Investigation Work Plan OU1-2 dated May 2003, DNAPL has been recovered from the footprint of the former plating pond/lagoon since July 2003, and it is anticipated that this recovery work will continue until this OU1 Remedial Work Plan is implemented. Light non-aqueous phase liquid (LNAPL) has not been encountered at operable unit OU1.

- Potential sources for contamination include the following:
  - Past discharges of degreasers, plating chemicals, etc. to the former plating pond/lagoon from Site operations; and
  - Other potential unknown sources in proximity to well MW1-7.

- The majority of contamination detected is located at, or within, the saturated zone. This may be due in part to the fact that surface water, sediments, and soil were removed down to the top of the apparent groundwater table from the former plating pond/lagoon as part of remedial work conducted by the USACE in 2000/2001. Also, concentrations of contaminants tend to decrease as the distance away from the apparent source areas is increased. The vertical extent of impacted soil within the former plating pond/lagoon was not fully defined; however, analytical laboratory test results for soil samples obtained from deeper overburden/bedrock wells set immediately outside the footprint of the former plating pond/lagoon (i.e., wells MW1-16, MW1-17 and MW1-18) showed VOC concentrations do not exceed recommended soil cleanup objectives (RSCOs) as referenced in the NYSDEC document titled "Division of Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels" (TAGM 4046) dated January 24, 1994, as amended by the NYSDEC's supplemental Tables dated August 22, 2001).

- Analytical laboratory test results for groundwater samples indicate that some VOCs are present in groundwater at concentrations above SCGs in perimeter wells located west, north and east of the former plating pond/lagoon. However, the concentrations of VOCs detected at these perimeter wells are significantly lower than the concentrations of VOCs detected within, or in proximity to, the former plating pond/lagoon.

- Based on the studies performed, the majority of contaminated soils and groundwater exceeding SCGs for VOCs and/or SVOCs at AOC1 generally remain on-site within, and in proximity to, the former plating pond/lagoon.

- Metals were detected in subsurface soil and groundwater samples collected from OU1 locations on the Site. However, the presence of many of these metals may be attributable to naturally occurring conditions. In some instances, occasional elevated concentrations of specific metals (e.g., iron, mercury, zinc, etc.) that were detected in soil or groundwater may be indicative of localized impacts attributable to historic operations at the Site. However, a correlation of metals exceeding SCGs in soil, groundwater and/or DNAPL was not apparent.
In general, it appears that the majority of contamination (e.g., VOCs, SVOCs, metals, PCBs, etc.) discharged to the former plating pond/lagoon was remediated as a result of the 2000/2001 remedial work conducted by the USACE. However, residual contamination primarily consisting of chlorinated VOCs with lesser amounts of other constituents generally remains in subsurface soil below the water table and in the groundwater.

1.3 Project Objectives and Remedial Action Objectives

The primary objective of the proposed scope of work outlined in this OUI Remedial Work Plan is to eliminate or mitigate contamination that exists at area of concern AOC1 (former plating pond/lagoon). As another objective, subsurface conditions would be monitored to evaluate the effectiveness of the remedy. Remedial action objectives (RAOs) for contamination detected in soil and groundwater are provided as follows:

**Soil**

RAOs for public health protection include:
- Prevent ingestion and direct contact with contaminated soil.
- Prevent inhalation of, and exposure to, volatilization of contaminants in soil.

RAOs for environmental protection include:
- Prevent migration of contamination in soil that would result in impacts to surface water or groundwater.
- Prevent impacts to biota via ingestion or direct contact with contaminated soil that would result in toxic conditions or impacts from bioaccumulation through the terrestrial food chain.

**Groundwater**

RAOs for public health protection include:
- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for environmental protection include:
- Remove the source of groundwater contamination. This involves removal/treatment of DNAPL and other grossly contaminated media to the extent deemed feasible while achieving the lower of the Protection of Public Health (Commercial) soil cleanup objectives (SCOs) or Protection of Groundwater SCOs (to the extent deemed feasible) as referenced in Section 375-6 of the NYSDEC document titled “6 NYCRR Part 375, Environmental Remediation Programs” dated December 14, 2006.
- Restore the groundwater aquifer to pre-disposal/pre-release conditions by achieving groundwater standards and guidance values (to the extent deemed feasible) that are referenced in the NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1 document titled "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations" (TOGS 1.1.1) dated June 1998 (as amended by an April 2000 addendum).
- Prevent off-site migration of OU1 contaminants exceeding TOGS 1.1.1 groundwater standards and guidance values
- Prevent the discharge of contaminants to surface water.
2.0 REMEDIAL DESIGN INVESTIGATION

A remedial design investigation would initially be performed to further evaluate/define the extent of VOC impact to soil and groundwater on the Site in the area generally between existing monitoring well MW1-7 and the former plating pond/lagoon. Additional goals of the remedial design investigation include:

- Obtaining information that can be used for the selection and design of the remedial program for the area between MW1-7 and the former plating pond/lagoon. It is assumed that one or more of the remedial elements identified in Section 3 of this work plan will be selected to this area between MW1-7 and the former plating pond/lagoon. A Remedial Work Plan modification will be made if this assumption is incorrect.

- Obtaining information that can be used to fill data gaps, if any, in order to complete the overall remedial design for OU1. If data gaps remain, supplemental Remedial Design Investigation Work Plan(s) will be developed and submitted for NYSDEC approval.

The proposed remedial design investigation consists of the tasks listed below.

Soil Evaluation

Nine test borings will be advanced in the general area between well MW1-7 and the former plating pond/lagoon. It is anticipated that test borings will be advanced to depths up to twenty feet below the ground surface using direct-push drilling and sampling equipment. To the extent practicable, continuous soil samples will be collected from the existing ground surface to the final depth of each test boring. The anticipated locations of these test borings are shown on Figure AOC1-J; however, the actual locations may vary depending upon site conditions encountered and field decisions made with concurrence from the on-site NYSDEC Site representative.

The work completed will be monitored and documented. Monitoring will include visual observations of soil samples (e.g., staining, odors, etc.) as well as screening the headspace on portions of samples with a photoionization detector (PID) for evidence of VOC impact. Other portions of the samples will be collected for possible laboratory analysis.

Up to one soil sample from each test boring (i.e., a total of up to nine soil samples) will be selected and subsequently tested by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified analytical laboratory for target compound list (TCL) VOCs using Analytical Services Protocol (ASP) Method OLM04.2 and target analyte list (TAL) metals using ASP Method ILM04.1. The analytical laboratory test results will be compared to appropriate SCGs that are available at the time of reporting, such as: Soil cleanup objectives (SCOs) for Protection of Public Health (Commercial) SCOs and Protection of Groundwater as referenced in the NYSDEC document titled “6 NYCRR Part 375 Environmental Remediation Program”; dated December 14, 2006.

As part of the quality assurance/quality control for this project, one field blank from soil sampling equipment will be analyzed for TCL VOCs using ASP Method OLM04.2 and TAL Metals using ASP Method ILM04.1, and a matrix spike/matrix spike duplicate (MS/MSD) will also be performed on one of the soil samples.
Groundwater Evaluation

One of the test borings will be converted into a one-inch polyvinyl chloride (PVC) groundwater monitoring well. The anticipated location of the test boring that will be converted to a groundwater monitoring well is shown on the Figure AOC1-J; however, the actual location may vary depending upon actual site conditions encountered and field decisions made with concurrence from the on-site NYSDEC Site representative. The groundwater monitoring well will be constructed of one-inch inner diameter PVC with a ten-foot long 10-slot screen attached to solid riser. It is anticipated that the well screen will be placed from about 5.5 feet and 15.5 feet below the existing ground surface (i.e., similar screened depth interval of existing wells MW1-7, MW1-8 and MW1-11). The annulus around and at least one foot above the screen will be backfilled with a sand pack. A minimum two-foot thick bentonite seal will be placed above the sand pack and the remaining annulus will be filled with cement/bentonite grout. A steel protective casing or curb box will be placed over the monitoring well and sealed in place with concrete.

Approximately one week following installation, the new well will be developed by utilizing either a new dedicated bailer with dedicated cord, or a centrifugal pump and dedicated tubing. No fluids will be added to the well during development. The well development procedure will be as follows:

- Obtain a pre-development static water level reading;
- Calculate water/sediment volume in the well;
- Obtain initial field water quality measurements (e.g., pH, conductance, turbidity, temperature, and PID readings);
- Monitor for the presence of LNAPL or DNAPL;
- Select development method and set up equipment depending on method used;
- Alternate water agitation methods (e.g., moving a bailer or pump tubing up and down inside the screened interval) and water removal methods (e.g., pumping or bailing) in order to suspend and remove solids from the well;
- Obtain field water quality measurements for every one to five gallons of water removed. Record water quantities and rates removed;
- Stop development when water quality criteria are met and at least five well volumes have been removed;
- Obtain post-development water level readings; and
- Document development procedures, measurements, quantities, etc.

Development will continue until the following criteria is achieved:

- Water is clear and free of sediment and turbidity is less than 50 nephelometric turbidity units (NTUs);
- Monitoring parameters have stabilized (i.e., pH is ±0.1 unit; conductance is ±3%, temperature and other parameters are ±10%); and
- A minimum of five well volumes has been removed.

The field measurement data will be presented on Monitoring Well Development Logs.
One groundwater sample will be collected from the new well and also existing wells MW1-6, MW1-7, MW1-8 and MW1-11 (i.e., a total of five well locations). The samples will be collected using low-flow purge and sample techniques with a bladder pump connected to a control box. The low-flow sampling method is ideal for collecting in-line groundwater samples and dissolved oxygen readings. The low-flow purging and sampling procedures to be utilized are outlined below:

- Prior to purging and sampling, static water level measurements will be taken from each well using an oil/water interface meter. The results of this work will be documented in the field.

- In order to minimize the potential re-suspension of solids in the bottom of the well, well depths will not be measured prior to or during low-flow purging and sampling. Well depth information will be obtained from: 1) measurements collected during well development; 2) from well logs; or 3) will be measured after sampling is completed.

- A portable bladder pump connected to new disposable polyethylene tubing will be lowered and positioned at or slightly above the mid-point of the well screen when the screened interval is set in relatively homogeneous material. When the screened interval is set in heterogeneous materials, the pump will be positioned adjacent to the zone of highest hydraulic conductivity (as defined by geologic samples). Care will be taken to install and lower the bladder pump slowly in order to minimize disturbance of the water column.

- The pump will be connected to a control box that is operated on compressed gas (nitrogen, air, etc.) and is capable of varying pumping rates. An in-line flow-through cell attached to a Horiba U-22 water quality meter (or similar equipment) will be connected to the bladder pump effluent tubing to measure water quality data.

- The pump will be started at a pumping rate of 100 ml/min or less (for pumps that can not achieve a flow rate this low, the pump will be started at the lowest pump rate possible). The water level in the well will be measured and the pump rate will be adjusted (i.e., increased or decreased) until the drawdown is stabilized. In order to establish the optimum flow-rate for purging and sampling, the water level in the well will be measured on a periodic basis (i.e., every one or two minutes) using an electronic water level meter or an oil/water interface meter. When the water level in the well has stabilized (i.e., use goal of <0.33 ft of constant drawdown), the water level measurements will be collected less frequently.

- While purging the well at the stabilized water level, water quality indicator parameters will be monitored on a three to five minute basis with a Horiba U-22 water quality meter (or similar equipment). Water quality indicator parameters will be considered stabilized after three consecutive readings for each of the following parameters are generally achieved:

  - pH (+ 0.1);
  - specific conductance (+ 3%);
  - dissolved oxygen (+ 10 %);
  - oxidation-reduction potential (+ 10 mV);
  - temperature (+ 10%); and
  - turbidity (+ 10%, when turbidity is greater than 10 NTUs)
• Following stabilization of the water quality parameters, the flow-through cell will be disconnected and a groundwater sample will be collected from the bladder pump effluent tubing. The pumping rate during sampling will remain at the established purging rate or it may be adjusted downward to minimize aeration, bubble formation, or turbulent filling of sample containers. A pumping rate below 100 ml/min will be used when collecting VOC samples.

• The procedures and equipment used during the purging and groundwater sampling and the field measurement data will be documented in the field and recorded on Monitoring Well Sampling Logs.

• For wells set in low-permeability formations and fractured bedrock (if encountered), alternative purging and sampling techniques from those specified above may become necessary. Any changes in technique shall be presented and approved by the on-site NYSDEC site representative.

The groundwater samples will be submitted to a NYSDOH ELAP-certified analytical laboratory, which will analyze the samples for TCL VOCs using NYSDEC ASP Method OLM04.2, and TAL metals using ASP Method ILM04.1. Natural attenuation and water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, turbidity, nitrate, iron (II), manganese, sulfate, methane, and chloride will also be obtained using a Horiba U-22 water quality meter (or similar equipment) and analytical laboratory testing (i.e., Methods SM3500D, E300IC, SW6010B, and RSK175). The TCL VOCs and TAL metals test results will be compared to groundwater standards and guidance values as referenced in NYSDEC TOGS 1.1.1.

As part of the quality assurance/quality control for this project, one field blank from groundwater sampling equipment will be analyzed for TCL VOCs using ASP Method OLM04.2 and TAL Metals using ASP Method ILM04.1, one trip blank will be analyzed for TCL VOCs using ASP Method OLM04.2, and an MS/MSD will also be performed on one of the groundwater samples.

The locations of the test borings and new well will be surveyed, and the horizontal coordinates (northings and eastings) will be provided in meters using the NAD83UTM Zone 18 (NYTM) coordinate system. The elevation of the new well will be surveyed in feet using the same vertical datum that was used for existing wells. Static water levels will be obtained from each OU1 overburden groundwater monitoring well, including the new well. Groundwater elevations will be calculated, and a potentiometric groundwater contour map for the uppermost water-bearing unit intercepted by these overburden wells will be developed.

The work performed as part of the remedial design investigation will be documented in a data package, which includes: applicable figures; boring logs; a well construction diagram; well sampling logs; analytical laboratory reports and chain-of-custody documentation; and data tables comparing the test results to regulatory SCGs. To the extent deemed necessary, the results of the remedial design investigation will be used to design the remedial actions specified herein with concurrence from the NYSDEC.
3.0 REMEDIAL ACTIVITIES

The proposed remedy selected to address contamination at operable unit OU1 area of concern AOC1 (former plating pond/lagoon) consists of the following components:

- In-Situ Chemical Oxidation of the On-Site Source Area
- Post-Treatment O&M Groundwater Monitoring
- Institutional Controls

A NYSDEC “Transform the Past….Build for the Future” sign will be posted while remedial activities are being performed at the Site. The components of the proposed remedy are further discussed below.

3.1 In-Situ Chemical Oxidation of the On-Site Source Area

In-situ chemical oxidation will be conducted in subsurface soils and groundwater in the source area (i.e., generally an approximate 100-foot by 140-foot area within, and around, the former plating pond/lagoon location). This in-situ remediation is intended to destroy contaminants of concern (e.g., VOCs) within the source area at area of concern AOC1. Geo-Cleanse International, Inc. (GCI), or a comparable remediation contractor, will be retained to perform remediation services using hydrogen peroxide with a site-specific formulated catalyst (Fenton’s reagent) and sodium permanganate. A copy of GCI’s Statement of Qualifications (SOQ) is attached in Appendix B. The SOQ includes technical information (injector construction, chemicals, etc.), performance information on other projects, and safety provisions. Permits required to complete the remedy will be obtained as deemed necessary.

In-situ chemical oxidation is the process of oxidizing contaminants in the groundwater and soil by injecting water containing high concentrations of an oxidant to the area of contamination. This technology can eliminate many organic contaminants in both saturated and unsaturated environments by changing the organic contaminants into harmless materials, such as water and carbon dioxide. A copy of a United States Environmental Protection Agency (USEPA) document titled “In-Situ Chemical Oxidation” dated 2006 by S.G. Huling and B.E Pivetz is included in Appendix C, and this document provides information regarding in-situ chemical oxidation. Some general aspects of chemical oxidation using Fenton’s reagent and sodium permanganate are further discussed below:

Fenton’s Reagent

The Fenton’s reagent reaction \( (H_2O_2 + Fe^{+2} \rightarrow OH^- + OH^- + Fe^{+3}) \) was reported in 1898 by H.J.H Fenton. GCI modified this chemistry for use in its in-situ environmental applications, which has resulted in an aggressive, low pressurized injection of concentrated hydrogen peroxide \( (H_2O_2) \) and ferrous iron \( (Fe^{+2}) \) catalyst that generates the hydroxyl free radical \( (OH^-) \), which is the active oxidizing agent. The hydroxyl free radical is a non-selective oxidant. Oxidation of an organic compound by the hydroxyl free radical is rapid and exothermic (heat-producing) and results in the reduction of contaminants to primarily carbon dioxide and oxygen \( (OH^- + \text{organic contaminant} \rightarrow CO_2 + H_2O) \).
Types of organic contaminants treated using Fenton’s reagent for in-situ chemical oxidation include petroleum hydrocarbons, chlorinated ethanes (e.g., 1,1,1-trichloroethane), chlorinated ethenes (e.g., tetrachloroethene, trichloroethene, dichloroethenes, vinyl chloride), manufactured gas plant wastes (e.g., polycyclic aromatic hydrocarbons), and free phase LNAPL and DNAPL.

Sodium Permanganate

Sodium permanganate (NaMnO₄) is a strong oxidizer, but not as strong as the hydroxyl free radical generated by Fenton’s reagent. The exact chemical reaction is dependent upon the organic contaminants present and the oxidant utilized. The general reaction that occurs between permanganate and an organic contaminant is as follows: NaMnO₄ + Organic Contaminant → CO₂ + MnO₂ + dissolved salts (e.g., Na).

Types of organic contaminants treated using sodium permanganate for in-situ chemical oxidation include chlorinated ethenes (e.g., tetrachloroethene, trichloroethene, dichloroethenes, vinyl chloride). Sodium permanganate does not readily oxidize petroleum hydrocarbons, chlorinated ethanes (e.g., 1,1,1-trichloroethane), LNAPL, or DNAPL.

The chemical oxidation remedial work is divided into a Pilot Phase, a Full-Scale (Primary) Phase, and a Polishing Phase (if deemed necessary). Certain assumptions are made regarding reagent requirements, reagent injection rates, radius of influence of injection points and number of injection points. Some assumptions used include: hardness of groundwater is less than 200 ppm; an average of 293 ppm of chlorinated VOCs is sorbed to saturated soil in the Pilot Phase treatment area; the average concentration of dissolved chlorinated VOCs in groundwater is approximately 558 ppm in the Pilot Phase treatment areas, an average concentration of one ppm of chlorinated VOCs is sorbed to saturated soils in the Full-Scale Phase treatment area, and the average concentration of dissolved chlorinated VOCs in groundwater is 224 ppm in the Full-Scale Phase treatment area. Based on currently available Site data, the preliminary time and dosage estimates account for the presence and destruction of mobile and residual DNAPL during the Pilot Phase treatment, and assumes that DNAPL is not present during the Full-Scale (Primary) Phase treatment or the Polishing Phase treatment (if deemed necessary). The actual amount of chemical oxidants are based on the higher of stoichiometric requirements or minimum volume of oxidant needed to treat within each injector’s radius of influence using the Site data and various assumptions, including those identified above.

GCI has estimated that a total of approximately 139,500 pounds of 50% hydrogen peroxide and 1,840 pounds of 40% sodium permanganate are required for the chemical oxidation. The 50% hydrogen peroxide is a powder that will be mixed with water to create an injectate with a density that is expected to be less than 1.08. The 40% sodium permanganate is a liquid that will be mixed with water to create an injectate with a density that is expected to be less than 1.02. GCI estimates that approximately 4,000 pounds of 50% hydrogen peroxide and site-specific catalyst can be injected per day with one injection vehicle. Further specifics on the remediation program are provided below.

3.1.1 Pilot Phase

A Pilot Phase Remedial Design Plan will be prepared and approved by regulatory agencies before implementing Pilot Phase field activities. This plan will include: a sampling plan; a
health and safety plan; and details concerning injector construction, mixing and application of injectates, process monitoring, and performance monitoring. The Pilot Phase will first evaluate Fenton’s reagent and subsequently evaluate sodium permanganate.

It is anticipated that the Pilot Phase treatment will be conducted over an approximate 50-foot by 50-foot area near former well MW1-10 (refer to Figure AOC1-K). The Pilot Phase treatment will focus on treating contamination present in an approximate ten-foot thick layer that is situated between approximately 8 and 18 feet, or 10 and 20 feet, below the ground surface.

It is currently anticipated that the objectives of the Pilot Phase will include the following:

- Evaluate travel times, distribution patterns (vertical and lateral), treatment effectiveness (vertical and lateral) and persistence of oxidants and reagents.
- Determine whether Full-Scale Phase chemical oxidation application is feasible, or if an alternative remedy should be evaluated.
- Evaluate the need for VOC and DNAPL migration control measures.
- Evaluate the potential for metals mobilization and attenuation in groundwater.
- Evaluate whether multi-level injectors are needed to treat the full vertical extent of the source area, including in the area of more permeable fill within the former plating pond/lagoon that is underlain by less permeable native soil.
- Assess contaminant rebound and determine if multiple injections of Fenton’s reagent or sodium permanganate may be needed to meet the RAOs.
- Document any problems that occur in the field during implementation of the Pilot Phase, and develop associated corrective measures to be used during the Full-Scale Phase.
- Develop injection procedures that are optimized for the Site, such as injection rates pressures, depths, etc.
- Develop monitoring procedures for evaluating performance during the Pilot Phase treatment, and identify appropriate monitoring procedures for the Full-Scale Phase treatment.
- Obtain other data (if necessary) that can be used to design the Full-Scale Phase treatment.

GCI has estimated that nine vertical injectors will be installed within the Pilot Phase treatment area. A subcontractor will be retained to provide direct-push Geoprobe equipment to advance the borings at injector locations. Continuous soil samples will be collected from approximately 30% of the locations during injector installation in order to adjust actual depths and locations where reagents are to be injected. One of these injector locations will be advanced to a depth that will assist in defining the vertical extent of contamination within the former plating pond/lagoon. It is anticipated that the injectors will be screened within depth intervals with the highest field evidence of VOCs (i.e., elevated PID readings, staining, odors, etc) on soil samples that are collected from injectors.

One soil sample and one groundwater sample from three injector locations, and groundwater samples from up to six existing wells within or in proximity to the footprint of the former plating pond/lagoon, will be analyzed by a NYSDOH ELAP-certified analytical laboratory for TCL VOCs using NYSDEC ASP Method OLM04.2 and TAL Metals using ASP Method ILM04.1.
The NYSDEC will be consulted regarding the injector locations and existing monitoring well locations that are selected for sampling. Groundwater samples will be collected using low-flow sampling techniques (described in Section 2.0 of this OU1 Remedial Work Plan) or another technique (i.e., conventional purge and sample with disposable bailer, disposable diffusion bag samplers, etc.) that is acceptable to the NYSDEC. Water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity and turbidity may also be obtained using a Horiba U-22 water quality meter (or similar equipment). The analytical laboratory test results will be compared to appropriate NYSDEC Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values. GCI may arrange for some of the samples to be analyzed for other parameters to assist in formulating a Fenton’s reagent catalyst that is tailored for the Site’s groundwater chemistry.

Each injector will be constructed of 0.75-inch inner-diameter Schedule 80 chlorinated polyvinyl chloride (CPVC) that has 10-slot or 20-slot screened sections connected to a solid riser. It is anticipated that each injector will have a five-foot length of screen; however, screened intervals may be adjusted based on actual field conditions encountered. The necessary connectors will be constructed at or near the ground surface for delivery of the reagents. Further injector construction details are provided in the GCI SOQ that is attached in Appendix B.

Four vent wells will also be installed within the Pilot Phase treatment area. It is anticipated that each well will be installed to a depth that intercepts the top of the uppermost water-bearing zone. These vent wells will be installed using direct-push equipment, and construction details will be provided in the Pilot Phase Remedial Design Plan. The vent wells will be used to relieve gas building-up (if present) during chemical oxidation using Fenton’s reagent and for process monitoring during the Pilot Phase injection work.

Based on current available data, GCI estimates that 27,000 pounds of 50% hydrogen peroxide will be injected along with a site-specific GCI catalyst, which will result in a 3% to 12% actual hydrogen peroxide percentage being injected. Based on currently available data, the preliminary time and dosage estimates account for the presence of some mobile and residual DNAPL during the Pilot Phase treatment. Actual amounts and concentrations of chemical oxidation materials will be refined based on the baseline testing data.

The hydrogen peroxide and catalyst will then be injected over an approximate 10-day period using one injection vehicle. During this Pilot Phase, GCI will conduct a radius of influence test to determine the quantity of oxidant required in order to establish connectivity of oxidant between injectors. This amount will be used as a baseline minimum per injector. Reagents will then be delivered at the other injectors proportionally based on contaminant concentrations throughout the Pilot Phase treatment area. Data and monitoring will be used to target areas where additional treatment is needed. As a result, it is anticipated that injectors will not receive the same amounts of reagents. In addition, it is anticipated that other components of process monitoring (e.g., equipment flow rates; effects on groundwater table; groundwater temperature, pH, etc. at nearby monitoring wells and injector points; etc.) will be completed as part of the Pilot Phase field activities. It is anticipated that the process monitoring will be performed prior to, during and immediately after application of injectates. Further details pertaining to the process monitoring will be provided in the Pilot Phase Remedial Design Plan.

Subsequent to completing performance monitoring associated with the Fenton’s reagent treatment (described below), GCI will return to the Site and complete the second part of the Pilot
Phase by injecting an estimated 306 pounds of sodium permanganate at the same nine injectors previously used to inject the Fenton’s reagent. Actual quantities to be injected may be modified based on the performance monitoring results obtained after the Fenton’s reagent Pilot Phase application. Process monitoring and performance monitoring (described below) will also be completed as part of the Pilot Phase that involves the use of sodium permanganate.

Performance Monitoring of Pilot Phase Treatment

Subsequent to completing each part of the Pilot Phase chemical oxidation treatments, (i.e., first with Fenton’s reagent, and later with sodium permanganate), performance monitoring will be performed to obtain data for use in evaluating the results of the Pilot Phase. Performance monitoring may include, but not be limited to: analysis of soil samples and groundwater samples for TCL VOCs and TAL metals; evaluation of the presence of residual injectate and related chemical reaction products; hydraulic conductivity testing; evaluation of groundwater flow; and collection of water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, and turbidity. The analytical laboratory test results will be compared to applicable NYSDEC Part 375 SCO and TOGS 1.1.1 groundwater standards and guidance values. Further details pertaining to the performance monitoring conducted during evaluation of the Fenton’s reagent application and sodium permanganate application will be provided in the Pilot Phase Remedial Design Plan.

The findings of the Pilot Phase treatment using both the Fenton’s reagent and the sodium permanganate, including their corresponding process monitoring and performance monitoring results, will be provided in a Pilot Phase report. The report will include: a summary of the work performed; figures showing well locations, injector locations, potentiometric groundwater contours, etc.; as-built drawings for the injection system(s); actual dosage rates for each location; an identification and explanation for any deviations from the Pilot Phase Remedial Design Plan; a description of any problems encountered and their resolution; a description of the effectiveness of the remedy including comparisons to RAOs; any waste stream and disposal documentation; selected photographs; boring logs; analytical laboratory data and associated chain-of-custody documentation; tables for baseline and performance monitoring data; and a discussion concerning the data as they relate to the objectives of the Pilot Phase.

3.1.2 Full-Scale Phase

A Full-Scale Phase Remedial Design Plan will be prepared and approved by regulatory agencies before implementing Full-Scale Phase field activities. The findings of the Pilot Phase will be considered when developing the Full-Scale Phase Remedial Design Plan. This plan will also include: a sampling plan; a health and safety plan; and details concerning injector construction, mixing and application of injectates, process monitoring and performance monitoring.

Based on currently available information and data, it is anticipated that Full-Scale Phase in-situ chemical oxidation treatment will be conducted over an approximate 100-foot by 140-foot area within, and in proximity to, the former plating pond/lagoon (refer to Figure AOC1-K). It is currently anticipated that the Full-Scale Phase will generally focus on treating contamination present in an approximate 10-foot thick layer that is situated between approximately 8 and 18 feet, or 10 and 20 feet, below the ground surface. However, the Full-Scale Phase will be designed to treat the full vertical extent of contamination within the defined treatment area to the degree deemed feasible. If necessary, multi-level injections will be completed over the vertical depth interval to be treated. Based on current data, GCI has estimated that 45 Full-Scale Phase
vertical injectors will be installed within the Full-Scale Phase treatment area. It is anticipated that the screened intervals for the injectors will be selected based on field conditions encountered (e.g., intervals with highest field evidence of contamination) and the results of the Pilot Phase treatment. It is anticipated that the injectors installed during the Full-Scale Phase will be constructed of the same materials as described for the Pilot Phase.

A subcontractor will be retained to provide direct-push Geoprobe equipment to advance the borings at injector locations. Continuous soil samples will be collected from approximately 30% of the locations during injector installation in order to adjust actual depths and locations where reagents are to be injected. Two of these injector locations will be advanced to depths that will assist in defining the vertical extent of contamination within the former plating pond/lagoon.

One soil sample and one groundwater sample from fourteen injector locations, and up to six groundwater samples from existing monitoring wells within or in proximity to the footprint of the former plating pond/lagoon, will be analyzed by a NYSDOH ELAP-certified analytical laboratory for TCL VOCs and TAL Metals using NYSDEC ASP Method OLM04.2 to assist in estimating the baseline mass to be treated. The NYSDEC will be consulted regarding the injector locations that are selected for sampling. Groundwater samples will be collected using low-flow sampling techniques (described in Section 2.0 of this OU1 Remedial Work Plan) or another technique that is acceptable to the NYSDEC. Water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, and turbidity may also be obtained using a Horiba U-22 water quality meter (or similar equipment). The analytical laboratory test results will be compared to appropriate NYSDEC Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values.

Twelve additional vent wells will be installed within the Full-Scale Phase treatment area. It is anticipated that each well will be installed to a depth that intercepts the top of the uppermost water-bearing zone; however, information obtained during the Pilot Phase will be used to refine actual depths. These vent wells will be installed using direct-push equipment, and construction details will be provided in the Pilot Phase Remedial Design Plan. These twelve vent wells, and the four vent wells installed as part of the Pilot Phase, will be used to relieve gas building-up (if present) during chemical oxidation using Fenton’s reagent and for process monitoring during the Full-Scale Phase injection work.

Based on current available data, GCI estimates that it will inject 112,500 pounds of 50% hydrogen peroxide along with a site-specific GCI catalyst, which will result in a 3% to 12% actual hydrogen peroxide percentage being injected. Based on currently available data, the preliminary time and dosage estimates assume that DNAPL is treated during the Pilot Phase, and that mobile and residual DNAPL are generally not present during the Full-Scale Phase. Actual amounts and concentrations of chemical oxidation materials will be refined based on the Pilot Phase data, and soil and groundwater data. Reagents will then be delivered at the injectors proportionally based on contaminant concentrations throughout the Full-Scale Phase treatment area. Currently, GCI estimates it will take 29 days to inject the hydrogen peroxide and catalyst using one injection vehicle. Components of the process monitoring used for the Pilot Phase will also be conducted during the Full-Scale Phase.

**Performance Monitoring of Full-Scale Phase Treatment**

Subsequent to completing the Full-Scale Phase chemical oxidation treatment work, performance monitoring will be performed to obtain data for use in evaluating the results of the Full-Scale
Phase. Performance monitoring may include, but not be limited to: analysis of soil samples and groundwater samples for TCL VOCs and TAL metals; evaluation of the presence of residual injectate and related chemical reaction products; hydraulic conductivity testing; evaluation of groundwater flow; and collection of water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, and turbidity. The analytical laboratory test results will be compared to applicable NYSDEC Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values.

The findings of the Full-Scale Phase process monitoring and performance monitoring will be used to assist in evaluating the effectiveness of the treatment and determining if the Polishing Phase treatment is warranted at that time.

### 3.1.3 Polishing Phase

If deemed necessary based on the post Full-Scale Phase treatment performance monitoring results, or based on the post-treatment O&M groundwater monitoring (refer to Section 3.2), GCI will complete a Polishing Phase treatment using sodium permanganate at existing injector locations (i.e., up to nine of the injectors installed during the Pilot Phase treatment, and up to 45 of the injectors installed during the Full-Scale Phase treatment).

A Polishing Phase Remedial Design Plan will be prepared and approved by regulatory agencies before implementing Polishing Phase field activities. The findings of the Pilot Phase and Full-Scale Phase will be considered when developing this Polishing Phase Remedial Design Plan. This plan will also include: a sampling plan; a health and safety plan; and details concerning injector construction, mixing and application of injectates, process monitoring and performance monitoring.

For the purposes of this OU1 Remedial Work Plan, GCI has estimated that approximately 1,532 pounds of 40% sodium permanganate will be injected over a 5-day period by one injection vehicle. The preliminary time and dosage estimates assume mobile and residual DNAPL are not present within the Polishing Phase treatment area based on currently available data. Actual amounts and concentrations of chemical oxidation materials will be refined based on the post Full-Scale Phase treatment performance monitoring data. Reagents will then be delivered at the injectors proportionally based on contaminant concentrations within the Full-Scale Phase treatment area.

#### Performance Monitoring of Polishing Phase Treatment

Subsequent to completing the Polishing Phase chemical oxidation treatment work, performance monitoring will be performed to obtain data for use in evaluating the results of the Polishing Phase. Performance monitoring may include, but not be limited to: analysis of soil samples and groundwater samples for TCL VOCs and TAL metals; evaluation of the presence of residual injectate and related chemical reaction products; hydraulic conductivity testing; evaluation of groundwater flow; and collection of water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, and turbidity. The analytical laboratory test results will be compared to applicable NYSDEC Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values. The analytical laboratory test results will be compared to applicable NYSDEC Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values.
The findings of the Polishing Phase process monitoring and performance monitoring will be used to assist in evaluating the effectiveness of the treatment and determining if further treatments or implementation of a contingency remedy are warranted.

3.2 Post-Treatment O&M Groundwater Monitoring

Subsequent to completion of the in-situ chemical oxidation, a post-treatment operation and maintenance (O&M) groundwater monitoring program will be implemented using the AOC1 groundwater monitoring wells that exist at that time in order to evaluate the effectiveness of natural attenuation, the presence and concentration of VOCs, and to determine the extent and potential movement of contamination. This groundwater monitoring will continue for a period of up to five years. It is assumed that the wells will be sampled on a quarterly basis during the 1st year, and on a bi-annual basis for the 2nd through 5th years. As part of this monitoring program, groundwater will be tested for parameters that evaluate the effectiveness of the remedy, and evaluate natural attenuation and potential movement of any residual constituents.

It is anticipated that during each round of groundwater sampling, samples from up to eight groundwater monitoring wells will be collected using the low-flow sampling protocol described in Section 2.0, or by another technique that is acceptable to the NYSDEC. The specific wells to be sampled, a detailed sampling schedule, and other details for the post-treatment O&M groundwater monitoring will be included in the SMP. The NYSDEC will be consulted regarding the wells that are selected for sampling. A NYSDOH ELAP-certified analytical laboratory will be retained to analyze the groundwater samples collected during each sampling event for TCL VOCs using NYSDEC ASP Method OLM04.2. Water quality parameters such as dissolved oxygen, oxidation-reduction potential, pH, temperature, conductivity, and turbidity may also be obtained using a Horiba U-22 water quality meter (or similar equipment).

With approval from regulatory agencies, the duration and frequency of the groundwater monitoring, the list of parameters to be tested, and the sampling techniques (e.g., switch to use of passive diffusion samplers since only VOCs to be monitored, etc.) may be modified based on observations and the test results of samples collected during previous monitoring events.

Potential outcomes of the post-treatment O&M groundwater monitoring include closure of the operable unit, further monitoring of the operable unit, additional chemical oxidant injections at the operable unit, or selection and implementation of a contingency remedy. The additional chemical oxidant injections or contingency remedy would be intended to address any residual contamination, including DNAPL, that acts as a source of groundwater contamination resulting in off-site migration above SCGs to the extent feasible. A Supplemental Work Plan would be developed and submitted to the regulatory agencies for approval prior to implementation.

3.3 Remediation-Derived Wastes

Remediation-derived wastes (e.g., water removed from wells, decontamination water, general refuse, etc.) will be characterized, transported, and disposed off-site in accordance with applicable regulations.
3.4 Institutional Controls

It is proposed that institutional controls be implemented that include the following elements:

- Development and implementation of a Site Management Plan (SMP) to address the characterization, handling, and disposal/re-use of any media (e.g., soil, fill, groundwater) that is disturbed during any future activities at the Site. Some components of the SMP will apply to the entire Site while other components will be specific to individual operable units. As such, the SMP will be updated as each operable unit is addressed and Site conditions change. The SMP will also evaluate the potential for vapor intrusion into any future buildings to be constructed on the Site in the areas of AOC1, including requirements to mitigate such potential vapor intrusions through use of environmental engineering controls (e.g., sub-slab vapor barrier, sub-slab ventilation system, etc.) or other means. In addition, the SMP will identify use restrictions for the Site (e.g., property development and groundwater use restrictions, etc.). The SMP would also include a HASP and a CAMP to assist in reducing potential exposures to Site contaminants. Other components of the SMP would be an O&M plan to provide specifics on the post-treatment O&M groundwater monitoring program, well/injector maintenance, any future oxidant applications, and a reporting plan.

- Annual certification by the property owner prepared by a professional engineer or environmental professional that is acceptable to the NYSDEC and complies with 6 NYCRR 375-1.8(h)(3) effective December 14, 2006. The certification is intended to validate that the institutional controls (and also engineering controls if required in the future) that are implemented for the Site are unchanged from the previous certification and that no circumstances have occurred that impair the ability of the controls to protect public health and the environment, or constitute a violation or failure to comply with any O&M or SMP for the Site.

- Development and implementation of an environmental easement to require compliance with the SMP; limit use of the Site to general commercial, industrial and passive recreational facilities; restrict use of groundwater as a source of potable water or process water, without necessary water quality treatment as determined by the NYSDOH; and require the property owner to complete and submit to the NYSDEC the annual certification described above. In addition, the NYSDEC will be given a 60-day notice in advance of any “change of use” at the Site.

3.5 Reporting

The results of the in-situ chemical oxidation work, and associated performance monitoring will be provided in an OU1 remediation/final engineering report (OU1 R/FER) for operable unit OU1 that will be signed, sealed and certified by a New York State Professional Engineer in accordance with guidance and regulations applicable at the time the report is prepared. The report will include: a summary of the work performed; figures showing well locations, injector locations, potentiometric groundwater contours, etc.; as-built drawings for the injection system(s); actual dosage rates for each location; approximate quantities and concentration of contaminants removed or treated; an identification and explanation for any deviations from the design plan(s); a description of any problems encountered and their resolution; a description of the effectiveness of the remedy including comparisons to RAOs; any waste stream and disposal documentation; selected photographs; boring logs; analytical laboratory data and associated chain-of-custody documentation; tables for baseline and performance monitoring data; and other pertinent information that is considered appropriate for inclusion. It is anticipated that at least
the first year of post-treatment O&M groundwater monitoring will be included in the OU1 remediation report. The SMP and environmental easement will also be included as part of the OU1 R/FER.

Annual site management reports (SMRs) will be used to present subsequent post-treatment O&M groundwater monitoring events. Post-treatment O&M groundwater monitoring data in each annual SMR will include: applicable groundwater potentiometric maps; well sampling logs; analytical laboratory data and associated chain-of-custody documentation; data tables showing well elevations, static water levels, and calculated water elevations; and data tables showing cumulative groundwater testing results compared to applicable SCGs. Annual SMRs will also include the annual certification report, information and requirements set forth in Section 6.4(d) of DER-10 (or current version at the time the SMR is prepared) that pertain to the selected remedy and have not been presented in the FER or previous SMRs, and other pertinent information deemed necessary to evaluate the performance of the remedy. Details concerning the content of annual SMRs will be identified in the reporting plan section of the SMP.

Monthly progress reports for the Site will also include information pertaining to further development and implementation of the OU1 remedy as the project progresses.

3.6 Assessment of Selected Remedy

Protection of Human Health and the Environment: It is anticipated that the selected remedy (Baseline Groundwater Monitoring, In-Situ Chemical Oxidation of the On-Site Source Area, Post-Treatment Groundwater Monitoring, Institutional Controls) will be protective of human health and the environment under current site conditions and future use as general commercial, industrial and passive recreational facilities. Risks associated with potential human health exposure pathways will be eliminated or adequately controlled. With the exception of restoring the groundwater aquifer to pre-disposal/pre-release conditions, RAOs for soil and groundwater should be adequately addressed by this alternative in relation to protection of public health and the environment. The tasks associated with addressing the RAOs can readily be completed and should satisfy project objectives.

A potential challenge regarding human health and the environment is that artesian conditions are possible with Fenton’s reagent. This could result in safety concerns associated with this condition as well as the potential for contaminated groundwater and/or oxidant to migrate aboveground. Groundwater mounding may likely occur; however, by adjusting injection rates and reagent formulation coupled with other engineering controls, it is anticipated that little or no fluid will come to the surface. GCI will provide a health and safety plan that includes procedures for cleaning up spills of mounded fluid and reagents. Regulatory agency approval of the GCI health and safety plan will be mandatory prior to conducting any in-situ chemical oxidation applications.

Compliance with SCGs: It is anticipated that the selected remedy will result in an 80% to 90% reduction of contamination in soil and groundwater within the area that is treated. It is possible that exceedances of chemical-specific SCGs for soil and/or groundwater may exist subsequent to the chemical oxidation treatment; however, it is anticipated that the selected remedy will provide adequate monitoring of the natural attenuation of residual contamination in order to evaluate compliance trends in relation to chemical-specific SCGs. Location-specific SCGs are met since the institutional controls will be protective of human health and the environment. Action-specific SCGs should also be adequately addressed for this alternative.
Long-Term Effectiveness and Permanence: The long-term risk associated with the contamination will be permanently reduced by the in-situ chemical oxidation remediation and institutional controls that are to be implemented. It is anticipated that the selected remedy will prove to be reliable, and will have the ability to continue to meet RAOs in the future. The in-situ chemical oxidation is effective in the long term and permanently destroys the VOC and petroleum constituents. The long-term effectiveness and permanence of this alternative in relation to residual contaminants will be monitored.

A potential challenge regarding long-term effectiveness for this remedy is that oxygen generated by Fenton’s reagent may become entrapped and interfere with groundwater transport and the delivery of hydrogen peroxide. This may result in poor mass transfer between aqueous, DNAPL and solid phases that could lead to contaminant rebound. However, gas blockage can, and is, controlled through GCI’s use of stabilizers injected with the peroxide. A site-specific catalyst/stabilizer package is designed to prevent the rapid decomposition of the peroxide; thus, preventing gas blockage. The oxygen generated by the Fenton’s reagent reaction will follow the path of least resistance to the surface either through pore spaces or through adjacent injector locations or monitoring wells. As indicated in Sections 3.1.1 and 3.1.2, a venting system (i.e., 16 vent wells) will be installed and utilized by GCO to further relieve gas buildup in the subsurface. The venting system will help to direct the flow of the generated gases to the surface, preventing any potential pore space blockage. This venting system will be incorporated into the current design by coupling the installation of the injectors with the installation of a venting system.

Also, a potential challenge regarding long-term effectiveness for this remedy is that formation of MnO$_2$(s) during permanganate oxidation can lead to permeability reductions, limited mass transfer, and rebound. GCI has indicated that this condition only occurs when large quantities of permanganate are injected. Since this treatment program is designed to use permanganate as a polishing agent and the overall chemical quantities are low, significant permeability reductions associated with formation of MnO$_2$(s) are not anticipated.

Another potential challenge regarding long-term effectiveness for this remedy is that injection of high concentrations of sodium-based oxidants (such as sodium permanganate) in clay-rich environments may be associated with permeability reductions. GCI has indicated that this condition only occurs in certain types of clay and would only present itself if large quantities of sodium permanganate were injected. Since this treatment program is designed to use permanganate as a polishing agent and the overall chemical quantities are low, significant permeability reductions associated with use of sodium permanganate in potentially clay-rich soils at this Site is not anticipated.

Reduction of Toxicity, Mobility and Volume: The in-situ chemical oxidation, natural attenuation and other factors such as advection, dispersion, sorption, diffusion, etc. that are occurring at this Site will result in a significant reduction of contaminant toxicity, mobility, and volume. The in-situ chemical oxidation is anticipated to result in an 80% to 90% reduction of contaminants within the area that is treated.

A potential challenge regarding mobility of contaminants for this remedy is that pressure build-up of oxygen created by Fenton’s reagent could transport contaminated groundwater and DNAPL away from the treatment area and could potentially create artesian conditions at nearby monitoring/recovery wells, etc. However, GCI has indicated that this condition has not been found to occur. During many other projects, sentinel wells in “clean zones” were monitored to
evaluate this condition. Peroxide in the system prevents contaminant migration. If groundwater mounding occurs as a result of the generation of off-gas, this situation is mitigated by GCI via a number of injection controls. Each injector is fitted with a ball-valve capable of withstanding the concentration of the injected reagents and the mild pressures generated as a result of the injection. The ball-valves can either be adjusted to allow the flow of gases only, or fitted with tubing and connected to a vessel designed to collect water or DNAPL. In addition, other measures such as perimeter injection create an oxidative barrier at the perimeter of the treatment area. As such, any material that may migrate from the treatment area would travel through an oxidizing solution.

Also, a potential challenge regarding mobility of contaminants for this remedy is that groundwater displacement during permanganate injection may lead to transport of groundwater and DNAPL away from the treatment area. However, it is estimated that DNAPL destruction will occur during the Fenton’s reagent injection. The permanganate injection will focus on remaining dissolved phase constituents. In addition, permanganate is readily dissolved in groundwater, creating a permanganate solution that will remain reactive in the subsurface for longer periods of time (i.e., greater than three months). This reactive solution will continue to oxidize sorbed and dissolved phase constituents until the permanganate is no longer present. Perimeter injection will also be conducted initially with the permanganate solution.

Another potential challenge regarding mobility of contaminants for this remedy is that excessive heat generated by Fenton’s reagent can result in steam formation, PVC well damage, contaminant volatilization (especially through nearby wells), and DNAPL transport. The exothermic nature of Fenton’s reagent can cause an increase in groundwater temperatures, but will not cause the groundwater to boil. The greatest temperature increases typically occur at the injector locations themselves, as that is where the highest concentrations of oxidant (between 3% and 12%) are delivered. Typical increases in temperature are between approximately 10 to 20° F. Oxidant concentrations are much lower in the monitoring wells (less than 1%); thus, the monitoring wells will experience less exothermic effect. GCI has indicated that the 0.75-inch inner diameter Schedule 80 CPVC injector materials specified for use on this project have been proven to be able to handle the mild pressures and slight temperature increases that can occur as a result of the oxidation reaction.

Another potential challenge regarding mobility of contaminants for this remedy is that chemical oxidation using Fenton’s reagent and permanganate can result in increased concentration and transport of metals. Due to the temporary shift of pH that occurs during a Fenton’s reagent in-situ chemical oxidation treatment program (between 4-6), metal concentrations in groundwater can temporarily increase. This condition is readily remedied once the aquifer returns to ambient conditions. If deemed necessary, GCI can inject caustic reagents once the oxidant has dissipated to return the groundwater pH to ambient conditions; thus, precipitating any dissolved metals. Sodium permanganate also contains trace metals that may slightly increase metals concentrations in groundwater. However, this condition only occurs when large quantities of permanganate are injected. The treatment program for the Site is designed to use permanganate as a polishing agent; thus, the overall chemical quantities are low.

Short-Term Impacts and Effectiveness: The selected remedy will likely result in a slight risk in regard to short-term impacts. It is anticipated that Site remediation workers will have an increased potential to be exposed to Site contamination and treatment chemicals associated with the Fenton’s reagent during the in-situ chemical oxidation work. It is also anticipated that Site
remediation workers will have an increased potential to be exposed to residual Site contamination during long-term groundwater monitoring. Implementation of the SMP and HASP provisions should protect site remediation workers from these short-term risks. It is anticipated that this alternative will not increase short-term risks to occupants of the Site or the surrounding community.

A potential challenge regarding short-term impacts for this remedy is the potential for permanganate to migrate off-site to the wetland or the former ship channel via groundwater transport, migrate along buried storm sewer pipe, or migrate overland from spills/blowback during injection or artesian conditions that could occur during precipitation or snowmelt events. However, GCI has indicated that the potential for any of these situations to occur is low. Permanganate is going to be injected at concentrations between 0.1% and 4%. Upon dissolution into groundwater, permanganate concentrations will be much lower. The permanganate will then be consumed by any remaining contaminant mass, deposited as manganese dioxide, or consumed by background demand.

**Implementability:** The selected remedy can be implemented easily in relation to the current site conditions and anticipated future use as general commercial, industrial and passive recreational facilities. Spatial requirements are limited and would not impede completion of this remedy.

The presence of DNAPL is a potential challenge for implementing this remedy. However, DNAPL monitoring and recovery have been performed at the former plating pond/lagoon since July 30, 2003 as an interim remedial measure. Between July 30, 2003 and December 22, 2004, approximately 162 gallons of DNAPL were removed from recovery wells. Between January 7, 2005 and November 30, 2006, approximately 20 gallons of DNAPL have been removed from recovery wells. This data suggests free-phase DNAPL is being depleted at the former plating pond/lagoon. This DNAPL monitoring and recovery will continue until such time that the NYSDEC consurs that it can be terminated.

A potential challenge regarding implementing this remedy is that acidification of the treatment zone needed for Fenton’s reagent may be difficult if the groundwater is well buffered. During the injector installation phase of both the Pilot Phase and the Full-Scale Phase (primary) in-situ chemical oxidation treatment programs, GCI collects soil cores from the lithologies within, above and below, (as applicable) and tests their buffering capacities. GCI uses the results from these tests to formulate a site-specific catalyst capable of addressing any potential issues associated with soil buffering. Unless the site is in reactive limestone (which is not the case for this Site), the injectate can be formulated to create effective oxidizing conditions. To be effective, only a temporary, slightly acidic (pH ~5) groundwater condition needs to be established in the subsurface.

Another potential challenge regarding implementing this remedy is that hydraulic short-circuiting and preferential pathways can result in uneven dispersion of the oxidant in the treatment area and lower overall treatment effectiveness. This may be of particular concern if injecting near the more permeable interface between native soil and the backfill within the footprint of the former plating pond/lagoon. GCI utilizes several injection methodologies that can overcome these types of situations:

- Injectors are installed on an approximate 15-ft grid, with a radius of 7.5 ft, with a 2.5 ft overlap.
- GCI can inject at multiple injection locations simultaneously, allowing the fluid static pressures to force reagents into less permeable formations.

- GCI can isolate portions of the injection screen using a specialized injection procedure proven to be effective to deliver reagents into adjacent low permeability areas. This technique may prove useful in the area of the former plating pond lagoon that was backfilled with more permeable fill and is underlain by less permeable native soil.

- Off-gas and exothermic reaction can also enhance reagent permeation into tighter lithologies.

In summary, the use of Fenton’s reagent and sodium permanganate for in-situ chemical oxidation at this Site is a desirable remedy for addressing the contamination associated with operable unit OU1. Potential challenges may exist; however, viable solutions have been identified. These solutions will be considered when developing the associated remedial design plans and implementing the remedy for operable unit OU1.

Planned Future Use of the Site: Based on the findings of studies performed to date, it is anticipated that the selected remedy will be acceptable in relation to the current use of the Site, and also the anticipated future use of the Site as general commercial, industrial and passive recreational facilities.

Cost: An opinion of probable costs for the selected remedy is summarized below and presented in more detail in Table 1 included in Appendix A.

- Total Present Worth ........................................................................................................ $ 1,045,096
- Capital/Initial Cost ........................................................................................................ $ 890,400
- O&M/Annual/Closeout Present Worth Cost ................................................................. $ 154,696

The opinion of probable cost that is provided is dependent upon numerous assumptions and factors. As a result, the actual cost associated with the selected remedy may vary from the opinion of probable cost that is provided.

Community Acceptance: It is anticipated that the selected remedy will be acceptable to the community, and that any public comments, concerns or overall perception can be adequately addressed.
4.0 PRELIMINARY SCHEDULE

This preliminary schedule provides an estimate of the amount of time it would take to complete key tasks associated with the OU1 Remedial Work Plan. This preliminary schedule assumes that NYSDEC approval of the OU1 Remedial Work Plan would be obtained in the spring of the year 2007. A detailed schedule can be developed once the OU1 Remedial Work Plan is formally approved by the NYSDEC.

- It is anticipated that the remedial design investigation could be started within one month of NYSDEC approval of the OU1 Remedial Work Plan, and that the remedial design investigation results would be available within three months of the date this task is started.

- Assuming regulatory approval is obtained in the spring of the year 2007, the remedial tasks could be started in the spring of 2007. Development and subsequent NYSDEC approval of the Pilot Phase Remedial Design Plan would take about five months to complete. The Pilot Phase field activities (using both Fenton’s reagent and sodium permanganate) would take four or more months to complete. Development and subsequent NYSDEC approval of a Pilot Phase Report and Full-Scale Phase Remedial Design Plan would take about six months to complete. The Full-Scale Phase field activities would take three or more months to complete. If deemed necessary subsequent to evaluating Full-Scale Phase performance monitoring results, development and subsequent NYSDEC approval of a Polishing Phase Remedial Design Plan would take about five months to complete. It is anticipated that the Polishing Phase would take two or more months to complete. As such, the in-situ chemical oxidation activities would take a total of twenty-five or more months to complete.

- Post-treatment O&M groundwater monitoring could be started within six months after completing the in-situ chemical oxidation activities, and would continue for up to five years.

- Remediation-derived wastes would be disposed as they are generated in accordance with applicable regulations.

- The institutional controls would be completed within approximately two months after completing the in-situ chemical oxidation activities.

- The OU1 R/FER could be developed within six months after completing the in-situ chemical oxidation activities.
5.0 HEALTH AND SAFETY

The site-specific Health and Safety Plan (HASP) dated November 2001, which was included as part of the General Investigation Work Plan dated June 2002 would be implemented during performance of the tasks presented in this OU1 Remedial Work Plan. The HASP includes a community air monitoring program (CAMP). As an exception, the radiation monitoring identified in the HASP would not be conducted since previous monitoring in the OU1 area did not identify radiation measurements of concern. In addition, DAY or GCI (or a similar contractor) would provide a separate HASP to be implemented during activities that are associated with the in-situ chemical oxidation treatments and performance monitoring events.
6.0 QUALITY ASSURANCE/QUALITY CONTROL

The applicable quality assurance/quality control (QA/QC) protocols and procedures included in Section 5.0 of the General Investigation Work Plan dated June 2002 would be implemented during performance of the tasks presented in this OU1 Remedial Work Plan. This includes performing a Data Usability Summary Report (DUSR) on some of the analytical laboratory data that is generated as part of the scope-of-work in this OU1 Remedial Work Plan, to the extent required by the NYSDEC (e.g., post-treatment Full-Scale Phase confirmatory soil samples, and one or more groundwater monitoring events).
7.0 REFERENCES

Project Documents

Voluntary Cleanup Agreement Index #B8-590-01-02 executed by NYSDEC July 13, 2001.


Health and Safety Plan, November 2001

Previous Reports

Former Air Force Plant No. 51, Monroe County, Greece, New York, Interim Removal Action Area 1, Final Completion Report; August 2001; Roy F. Weston, Inc.

Environmental Site Investigation Report; Former Air Force Plant 51; 4777 Dewey Avenue, Greece, New York; DERP-FUDS Site No. C02NY057500; NYSDEC Site No. V00421; Operable Unit OU1; AOC1 (Former Plating Pond/Lagoon); AOC2 (Lagoon and Stormwater Outfalls); April 3, 2006; Day Environmental, Inc.

Regulatory Documents

NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1 document titled "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations" (TOGS 1.1.1) dated June 1998, including April 2000 Addendum Table 1.


NYSDEC 6 NYCRR Part 375 Environmental Remediation Program; revised December 14, 2006.

USEPA August 2006 Engineering Issue, “In-Situ Chemical Oxidation” S.G. Huling and B.E. Pivetz, EPA/600/R-06/072

Other Reference Materials

## 8.0 ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<td>AFP51</td>
<td>Air Force Plant No. 51</td>
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<tr>
<td>AOC</td>
<td>Area of Concern</td>
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<tr>
<td>ASP</td>
<td>Analytical Services Protocol</td>
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<td>CAMP</td>
<td>Community Air Monitoring Program</td>
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<td>CPVC</td>
<td>Chlorinated Polyvinyl Chloride</td>
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<td>DNAPL</td>
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<td>DUSR</td>
<td>Data Usability Summary Report</td>
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FIGURES
NOTES:
1. Monitoring Well MW-1 thru MW-10 are 2" PVC wells installed December 2002.
4. Drawing prepared from Figure C-2 in the general well plan dated June 2002 and site observations by representatives of Day Environmental, Inc. from December 2002 through April 2004.

LEGEND:
- **AOC1** Area Of Concern with Numbered Designation
- **MW-1** Monitoring Well with Designation
- **TL-2** Test Boring with Designation
- **6.3ppb (14-16)** Total VOCs detected in parts per billion (ppb) from depth interval in parentheses
- **ND** Not detected or concentration below reported analytical laboratory detection limit
- **NT** Not tested
NOTES:
1. Monitoring Well MW-1 thru MW-10 are 2" PVC wells installed December 2002.
4. Drawing prepared from Figure CEI-2 in the general work plan dated June 2002 and site observations by representatives of Day Environmental, Inc. from December 2002 through April 2004.

LEGEND
+ CHS-1
Well located identified from a report titled "Former Air Force Plant No. 51, HFOW Investigation, Greece, NY" by Opal Environmental and Energy Services Co., Inc. dated April 2002

AOC1
Area Of Concern with Numbered Designation

MW-1
Monitoring Well with Designation

TS-2
Test Boring with Designation

500 Total VOC Contour Line (ppb) Created by Golden Software, Inc. Surfer® Program

Total TCL VOCs & TICs in Groundwater Contour Map

1' = 50'

BUILDING #1 NORTH

AOC1
Former Planting Pond/Lagoon
NOTES:
1. Monitoring Wells MW1-1 thru MW1-10 are 2" PVC wells installed December 2002.
4. Drawing prepared from Figure G03-2 in the general work plan dated June 2002 and site observations by representatives of Day Environmental, Inc. from December 2002 through April 2004.

LEGEND:
- **AOC1** Area Of Concern with Numbered Designation
- **MW1-1** Existing Monitoring Well with Designation
- **TI-2** Existing Test Boring with Designation
- **AOC4** Proposed Remedial Design Overburden Monitoring Well Location
- **TI-5** Proposed Remedial Design Test Boring Location

**AOC10** Open Channel to Round Pond
NOTES:
1. Monitoring Wells WW1-1 thru WW1-10 are 2" PVC wells installed December 2002.
4. Drawing prepared from Figure CD-2 in the general work plan dated June 2002 and site observations by representatives of Day Environmental, Inc. from December 2002 through April 2004.

LEGEND:
+WW - Monitoring Well with Designation
+AO91 - Area Of Concern with Numbered Designation
+TI - Test Boring with Designation

Full-Scale Treatment Area (140' x 100')
AOC1 Former Filtration Pond/Lagoon
Pilot Treatment Area (50' x 50')
APPENDIX A

Table 1 (Opinion of Probable Cost of Selected Remedy)
### Design-Phase Investigation, In-Situ Chemical Oxidation of Source Area, Post-Treatment Groundwater Monitoring, and Institutional Controls

#### Capital/Initial Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design-Phase Investigation</td>
<td>$20,000</td>
</tr>
<tr>
<td>In-Situ Chemical Oxidation of Source Area</td>
<td></td>
</tr>
<tr>
<td>Pilot Phase</td>
<td>$191,000</td>
</tr>
<tr>
<td>Full-Scale Phase</td>
<td>$400,000</td>
</tr>
<tr>
<td>Polishing Phase</td>
<td>$96,000</td>
</tr>
<tr>
<td>Institutional Controls</td>
<td>$35,000</td>
</tr>
<tr>
<td>20% Contingency</td>
<td>$148,400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$890,400</strong></td>
</tr>
</tbody>
</table>

#### Operation/Maintenance Annual Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 Groundwater Monitoring ($30,000 X 1 yr)</td>
<td>$30,000</td>
</tr>
<tr>
<td>Years 2-5 Groundwater Monitoring ($15,000 X 4 yrs)</td>
<td>$60,000</td>
</tr>
<tr>
<td>Remediation-Derived Waste ($7,000 X 2 Yrs)</td>
<td>$14,000</td>
</tr>
<tr>
<td>Remediation-Derived Waste ($2,000 X 3 Yrs)</td>
<td>$6,000</td>
</tr>
<tr>
<td>20% Contingency</td>
<td>$22,000</td>
</tr>
<tr>
<td><strong>Total Operation/Maintenance Annual Costs</strong></td>
<td><strong>$132,000</strong></td>
</tr>
</tbody>
</table>

#### Closeout Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reports</td>
<td>$35,000</td>
</tr>
<tr>
<td>20% Contingency</td>
<td>$7,000</td>
</tr>
<tr>
<td><strong>Total Closeout Costs</strong></td>
<td><strong>$42,000</strong></td>
</tr>
</tbody>
</table>

#### Present Worth Cost

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/Initial Costs*</td>
<td>$890,400</td>
</tr>
<tr>
<td>Year 1 Groundwater Monitoring Present Worth (F=0.952)*</td>
<td>$34,272</td>
</tr>
<tr>
<td>Years 2-5 Groundwater Monitoring Present Worth (F=4.3295-0.952)*</td>
<td>$60,786</td>
</tr>
<tr>
<td>Years 1-2 Remediation-Derived Waste Present Worth (F=1.8594)*</td>
<td>$15,616</td>
</tr>
<tr>
<td>Years 3-5 Groundwater Monitoring Present Worth (F=4.3295-1.8594)*</td>
<td>$5,928</td>
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<tr>
<td>Closeout Costs (F= 0.9070)*</td>
<td>$38,094</td>
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<tr>
<td><strong>Total Present Worth Cost</strong></td>
<td><strong>$1,045,096</strong></td>
</tr>
</tbody>
</table>

*F = Discount Factor of 5% at the n<sup>th</sup> year of the project

* = Includes 20% contingency