FINAL REMEDIATION REPORT

CONSTRUCTION CONTRACT NO.: D004478

WEST SIDE CORPORATION SITE OU NO. 1
JAMAICA

SITE NO. 2-41-026
QUEENS (C), NY

Prepared for:
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
625 Broadway, Albany, New York

Denise M. Sheehan, Commissioner

DIVISION OF ENVIRONMENTAL REMEDIATION

URS Corporation
77 Goodell Street
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November 2006

STATE SUPERFUND WORK ASSIGNMENT D004440-10
REMEDIAL CONSTRUCTION CONTRACT NO. D004478

FINAL REMEDIATION CERTIFICATION REPORT

FOR

WEST SIDE CORPORATION SITE OU No. 1

SITE No. 2-41-026

JAMAICA, QUEENS, NEW YORK

SUBMITTED BY:

URS CORPORATION
77 GOODELL STREET
BUFFALO, NEW YORK 14203

OCTOBER 2006

CERTIFICATION
OF
CONSTRUCTION QUALITY ASSURANCE

AT

WEST SIDE CORPORATION SITE OU NO. 1
REMEDIAL ACTION CONSTRUCTION
JAMAICA, QUEENS, NEW YORK
CONTRACT NO. D004478

URS Corporation's (URS's) personnel provided oversight of the remedial action construction at the West Side Corporation Site OU No. 1 according to generally accepted practices. Based on field observations made by on-site personnel, field and laboratory test data, and data provided by the Contractor and its subcontractors, my professional opinion is that the remedial action construction at the site has been performed in substantial conformance with the July 2000 Record of Decision (ROD), September 2002 Explanation of Significant Differences (ESD), and New York State Department of Environmental Conservation (NYSDEC)-approved Contract Documents (D004478) through Separable Part C and as stated in this report.

Management of the soil vapor extraction and treatment system following remedial construction are on-going work activities are not covered by this certification.

P.E. 11.30.06
Signature

STATE OF NEW YORK
URS CORPORATION NEW YORK
No 095
LICENSED PROFESSIONAL ENGINEERS

NOVEMBER 2006

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ACRONYMS AND ABBREVIATIONS

AST	aboveground storage tank
bgs	below ground surface
BQA	Brooklyn Queens Aquifer
C&D	construction & demolition
CAC	Citizens Advisory Committee
CADD	computer-aided drafting and design
CPP	Community Protection Plan
DNAPL	dense non-aqueous phase liquid
DUSR	Data Usability Summary Report
EEO	Equal Employment Opportunity
ERH	electrical resistance heating
ESD	Explanation of Significant Difference
HASP	Health and Safety Plan
LS	lump sum
M/WBE	minority/woman-owned business enterprise
NTP	notice to proceed
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOL	New York State Department of Labor
O&M	operation & maintenance
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCE	perchloroethylene (tetrachloroethylene)

PCO	potential change order
PCU	power control unit
PID	photoionization detector
ppb	parts per billion
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
PRAP	Proposed Remedial Action Plan
PVC	polyvinyl chloride
QA/QC	Quality Assurance / Quality Control
RFI	Request for Information
RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision
scfm	standard cubic feet per minute
SSD	sub-slab depressurization
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TCL	target compound list
TMP	temperature monitoring point (probe)
UC	unit cost
URS	URS Corporation
UST	underground storage tank
VOC	volatile organic compound

FINAL REMEDIATION REPORT
WEST SITE CORPORATION SITE OU No. 1
NYSDEC SITE NO. 2-41-026
CONTRACT NO. D004478

1.0 INTRODUCTION

This report documents the remedial activities completed under New York State Department of Environmental Conservation (NYSDEC) Contract No. D004478 at the West Side Corporation OU No. 1 Site. URS Corporation (URS) provided construction engineering and oversight services under NYSDEC Work Assignment Nos. D003825-54 and D004440-10.

This report was prepared in accordance with the *Project Management Work Plan and Budget for Construction Management and O&M* (URS, 2003). As required under Subtask 2.5A of that plan, this report evaluates and certifies the work performed by the Contractor, verifies that the work was constructed in accordance with the Contract Documents, and includes a description of all variations from the Contract Documents. Only the period of construction at the site is discussed in this report; the six-month SVE site management period will be described in the *Final Engineering Report - Operations & Maintenance*, submitted under separate cover.

1.1 Remedial Construction Contractor and Subcontractors

The Remedial Action was performed under one contract, awarded by the NYSDEC to the approved low bidder of Clayton Group Services, Inc. (Clayton), from Edison, New Jersey, for an amount of $3,848,902.00 in late December 2004. During the course of the project, Clayton became part of the Bureau Veritas company. For consistency, only the name "Clayton" has been used in this report.

Clayton utilized several subcontactors over the course of the project. Uniform Contracting Questionnaires (UCQs) were submitted to the NYSDEC for approval of all subcontracts with a potential value of more than $10,000. Subcontractors and sub-subcontractors utilized by Clayton included:

Thermal Remediation Systems (TRS)	Supplied, constructed, and operated the ERH system
AWT	Pavement saw-cutting and trench work, including installation of SVE system piping, trenches and wellhead boxes.
Freehold Carting Inc.	Waste hauler for the soil rolloffs.
Land, Air, Water Environmental Services (LAWES)	Installation of exploratory soil borings, and installation of the new site monitoring wells.
J&L Drilling	Drilling and installation of the ERH electrodes.
Aurora Electric	Primary electrical subcontractor.
Verde Inc.	Subcontractor to Aurora for the installation of the electric poles.
Hellmann Electric	Subcontractor to Aurora for the installation of overhead cables and cable fittings on the poles.
All Mechanical Corp.	Installed the gas supply line for the Catox unit and tie-in to the sewer system.
Balkan Plumbing	Subcontractor to All Mechanical. Made the connection to the sewer at the street.

Perrotto Engineering	Subcontractor to All Mechanical. Expediter for the permit to connect to the gas system.
Environmental Waste Minimization, Inc. (EWMI)	Installation of protective bollards and other concrete work.
Lifetime Concrete, Inc.	Provided the concrete pad for the new gas service.
All Guard Fencing	Installed fencing around the ERH area, Catox system, and around the gas supply
Chemtech Laboratories	Laboratory analytical for air, water, and soil samples.
Princeton Analytical Laboratories	Laboratory analysis of air samples.
J.E. Gasho, Inc.	Supplied and constructed the components and housing for the SVE system.
Hi-Temp	Supplied the catox system.
Spata Security	Provided security services.
GE Capital	Supplied the office trailers.

1.2 Site Description and Background

1.2.1 Site Description

The 4.5-acre West Side Corporation Site is located at 107-10 180th Street in Jamaica, Queens in a mixed commercial/residential area. The West Side Corporation property was used as a storage and distribution center for chemicals used in the dry cleaning industry from approximately 1969 to 1990. The depth to groundwater around the site is generally 10-15 feet below the ground surface. The facility is currently leased by a bus company (Atlantic Express) and is used for servicing, storage, and dispatch of a high volume of school buses.

Up until 1982, several groundwater production wells (formally owned and operated by the Jamaica Water Supply Company) were located to the north, west, and southwest of the site. These wells were used to supplement the local public water drinking system during periods of high demand, particularly during summer months. As part of the Brooklyn-Queens Aquifer (BQA) Feasibility Study, the New York City Department of Environmental Protection (NYCDEP) is planning to restart several groundwater production wells located downgradient of the site to address flooding problems from a rising water table and to potentially provide a future source of potable water. The New York State Department of Environmental Conservation (NYSDEC) and NYCDEP have been working together to ensure that the BQA project is compatible with the remediation of the West Side Corporation site.

1.2.2 Operational/Disposal History

The Site was used for the manufacture and distribution of ceramic pipes and fittings until 1969. From about 1969 to 1992, the Site was used as a storage and distribution center for laundromat supplies, hangers, plastic garment bags, and most notably dry cleaning chemicals including large quantities of perchloroethylene (also known as tetrachloroethylene, perc or PCE). The property was operated as the West Side Corporation.

Five 10,000-gallon aboveground storage tanks (ASTs) were located outside the southeast portion of the Site building and were used for the storage of PCE. These tanks were filled via truck tankers and via railroad tanker cars. Railroad tracks were located between the building and the ASTs. The piping from the ASTs extended into the southern portion of the building where PCE was dispensed into 55-gallon drums for distribution to dry-cleaning establishments. Apparently, improper handling of the chemicals has resulted in the disposal of hazardous wastes, primarily PCE, at the site, some of which were released or have migrated in groundwater from the site to surrounding areas, including the properties to the south and east. A total of three separate source areas have been identified at the site. Source Area 1 is the largest and most highly contaminated area. This was the location of the former ASTs at the site. Source Areas 2 and 3 are smaller areas towards the north, one on each side of the main building at the site.

Several underground storage tanks (USTs) were reportedly located around the Site building. These tanks were reported to contain diesel and gasoline fuel for delivery and Site vehicles.

Historical data indicate that contaminated groundwater from the site was drawn toward the former Jamaica Water Supply Company wells when they were in operation. Analytical data from that time is not available but current and historical information suggests that the concentration of PCE that may have been introduced to the water distribution system was likely low due to dilution.

1.2.3 Remedial History

The Site was first listed in the Registry in August 1997, on the basis of information contained in a subsurface investigation report provided to the Department by the New York City Corporation Counsel. The report was prepared by EEA, Inc., apparently for a potential purchaser. Groundwater was found to contain up to 50,000 parts per billion (ppb) of PCE and soil up to 3,100 parts per million (ppm) of PCE according to the report prepared by EEA.

The current owner(s) of the site declined to undertake the remediation of the site. Therefore, a Remedial Investigation/Feasibility Study (RI/FS) was initiated by the Department in July 1998 under the New York State Superfund Program.

During the investigation of Operable Unit No. 1 (on-site), it was determined that groundwater contamination extends downgradient (the direction of groundwater flow) of the site to the south-southwest. The concentrations of PCE were as high as 5,900 parts per million (ppm) in shallow soils and as high as 7,100 ppm in deep soils in the area where the storage tanks were located. The concentration of PCE in shallow groundwater in that area was detected at a maximum of 210,000 parts per billion (ppb). Concentrations decreased in the direction of groundwater flow (south-southwest). The depth to groundwater around the Site is generally 10-15 feet below the ground surface. A Proposed Remedial Action Plan (PRAP) for Operable Unit No. 1 was released for public comment in February 2000 and a Record of Decision (ROD) was signed on July 31, 2000. The ROD-specified groundwater extraction and treatment, hydraulic containment, soil vapor extraction and treatment, and chemical oxidation for soils in the highly contaminated source area for the on-site remedy. The Department will also seek to impose restrictions on the use of the site to ensure the long-term effectiveness of the on-site remedy. To define the extent of off-site contamination and develop a remedy, Operable Unit No. 2 (off-site) was established.

On July 31, 2000, the Department signed a Record of Decision (ROD) which selected a remedy to cleanup the soil and groundwater on the Site itself (OU-1). The ROD specified groundwater extraction and treatment, hydraulic containment, soil vapor extraction and treatment, and chemical oxidation for soils in the highly contaminated source area for the on-site remedy. The Department was also to impose restrictions on the use of the site to ensure the long-term effectiveness of the on-site remedy.

One component of the remedy for OU-1 was to perform a pilot-scale study to assess the effectiveness of chemical oxidization in the Source Area No. 1. During the fall of 2001, URS performed a pilot-scale study as part of the remedial design. Although some reduction in contamination was noted, the Department concluded that the reduction was not great enough to move ahead with the full-scale application of the chemical oxidation. URS was asked to evaluate other technologies that could be used in Source Area No. 1. URS completed this evaluation during May/June 2002 and recommended using a technology called electrical resistive heating (ERH). In September 2002, an Explanation of Significant Differences (ESD) was issued by the Department revising the OU-1 remedy to incorporate the ERH technology.

A second ROD was signed in February 2002 that addresses contaminated groundwater that has moved from the site to the south-southwest ("Operable Unit No. 2, OU-2"). Any residual DNAPL and contaminated groundwater is expected to be captured by the OU-2 (off-site) groundwater extraction system and/or subject to natural attenuation. A chronology of NYSDEC administrative actions for this site is listed below:

1. November 1995 - Site discovery and lengthy negotiations with PRP

2. August 1997 - Class 2 designation

3. March 1998 - Referral to the State Superfund for investigation/remediation

4. March 2000 - Remedy proposed for on-site soils and groundwater (OU-1)

5. July 2000 - ROD signed for OU-1

6. February 2002 - ROD signed for OU-2 (off-site groundwater)

7. September 2002 - Explanation of Significant Differences (ESD) issued for OU-1

1.3 Description of the Remedial Action

The remedial action to address OU-1 consisted to two separate systems. First an ERH system was installed and operated to reduce contamination specifically in the source area. Second, a soil vapor extraction and treatment (SVE) system was installed to reduce contaminant concentrations throughout the entire contaminated area of the site. Clayton completed construction of the remedial action, which consisted of the following major components:

- Preparation and implementation of necessary plans including: Work Plan, Sampling and Analysis Plan, Quality Assurance / Quality Control (QA/QC) Plan, Contingency Plan, Health and Safety Plan, and Surface Water Management Plan.

- Installation and operation of a sub-slab depressurization system in the break room of the Atlantic Bus building.

- Installation of subsurface structures and components required for electrical resistance heating including electrodes/vapor recovery wells, temperature monitoring points and additional groundwater monitoring wells.

- Construction of the aboveground ERH treatment system, including the power control units, blowers, condensers, cooling tower, etc.

- Installation of the piping to connect the ERH electrodes/vapor recovery wells to the treatment system.

- Installation and connection of electric lines from the ConEd transformers to the power control units.

- Construction of a discharge line from the ERH treatment system to the sanitary sewer system on 180th Street.

- Installation of a catalytic oxidation air treatment system, including the installation and connection of natural gas lines.

- Construction and installation of secure system housing, utilities, fences, bollards, and other appurtenances as required.

- Installation of all temporary and permanent utilities as needed to complete the work.

- Startup and operation of the ERH system

- Collection of post remediation confirmatory soil samples from the ERH remediation area.

- Decommissioning and removal of the ERH system and aboveground components.
- Installation of subsurface structures and components required for soil vapor extraction, including soil vapor extraction wells, vacuum monitoring points, and piping.
- Construction and connection of a soil vapor extraction treatment system.
- Startup and testing of the SVE system.
- Repair and restoration of all disturbed areas of the site.

1.4 Pre-Construction Meeting

On January 11, 2005, a pre-construction meeting was held at the New York City Department of Environmental Protection (NYCDEP) offices on 180th Street, directly adjacent to the project site in Queens, NY. In attendance were representatives of NYSDEC, NYCDEP, Clayton, URS, TRS, Helen Neuhaus & Associates, Malcolm Pirnie, and ConEd. Items of discussion included the following: the responsibilities of project participants and lines of communication; Minority/Women-Owned Business Enterprise (M/WBE) and Equal Employment Opportunity (EEO) goals; contract time; progress schedules; working hours; approval of subcontractors; maintenance of as-built drawings; submittal requirements; changes in the work; payments; completion of the work and final acceptance; dispute resolution; project plans; community meetings; site security; certified payrolls; health and safety; Atlantic Bus operations; and community concerns. At the meeting, a Notice-to-proceed date of January 10, 2005 was mutually established.

2.0 SUMMARY OF REMEDIAL WORK

URS maintained a resident engineer/inspector on site during all construction activities. Signed daily inspection reports, including photographs of site, were prepared to document the Contractor's daily efforts and the progress of construction during the construction period. The remedial construction was performed in accordance with the Contract Documents, including one addendum issued during the bid process.

This section summarizes the remedial construction activities at the site, including a description of all variations from the original Contract Documents. Accompanying this report are copies of the project Record Drawings maintained by the Contractor during the course of construction, as well as copies of the daily inspection reports, change orders, and all other information relevant to documenting the Contractor's efforts at the site.

2.1 Narrative Description of Construction

This narrative covers the "construction period," defined for the purpose of this report as the period involving work by the general contractor, Clayton. Section VI of the Contract Documents divide the work into four separable parts of completion, Parts A through D, to be completed sequentially. The Parts are defined as follows:

- Part A – Construct the ERH system, complete system startup, and achieve operation at the target temperatures, and install a sub-slab depressurization (SSD) system.
- Part B – Operate the ERH system at steady-state conditions, collect post-remediation soil samples, and decommission the ERH system.
- Part C – Construct, test and start up a Soil Vapor Extraction (SVE) system.
- Part D – Operate, monitor and maintain the SVE system operation for a six month period. Turn the system over to the NYSDEC after the operating period.

The following paragraphs contain a general description of the construction activities on a monthly basis from NYSDEC Notification of Apparent Low Bidder through Part C Substantial Completion. In addition to a summarization of construction activities, significant discussions or decisions relevant to subsequent construction issues also are presented.

November 2004 (Apparent Low Bidder Letter) through January 2005 (Preconstruction Meeting)

- Contractor submits draft Work Plans including Health and Safety (HASP), Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), Schedule and Community Protection Plan (CPP).

- Preconstruction meeting was held on January 11, 2005 to establish administrative procedures over the course of the contract. Established that Con Edison would do the complete installation of the concrete pads / transformers for the new electric services.

- Clayton seeks permission to rearrange the specific pay items under the parts of completion to be consistent with their labor and materials and their performance bonds. Notice to Proceed date was mutually established as January 10, 2005.

Preconstruction Meeting through the end of January 2005

- Engineer notes work tasks that were scheduled to begin but have not yet started, including site preparation, system construction, subsurface depressurization system construction, and electrical work.

- Engineer notes various non-intrusive work tasks that should not be affected by delays in the approval of the CPP and HASP. This includes survey, hiring an electrician, coordination of service entrance locations with Con Edison, and utility connections for site offices.

- One office trailer is mobilized to the site.

- Engineer/NYSDEC agreed to allow Clayton to tie-in to the Atlantic Express electric supply to save Clayton time and effort required for a separate service installation.

February 2005

- The coordination with various parties to secure permits for gas connection, plumbing connection, and street opening was discussed.
- Clayton revised the CPP and HASP to address comments from the community review panel. A PCO for additional time and costs to address comments on these plans is approved.
- Clayton's electrician mobilized to the site. Electric service installed for the office trailer.
- The laptop computer for the field office is delivered.
- Contractor requests permission to install their own well in the ERH area for monitoring purposes.
- New field team leader (Allen Attenborough) begins work at the site for Clayton.
- Clayton submitted a fifth version of the CPP for review.

March 2005

- An electric submeter was installed on the power connection from Atlantic Express to the construction office trailers.
- Additional revisions to CPP and HASP were submitted
- Clayton mobilizes a Health and Safety Officer to the site. Generally no other personnel are onsite at this time.
- Onsite utility markout survey was conducted at the end of the month.

- An access gate was installed for personnel to get to the site from the offices located on the adjacent property.

- Outdoor piping for the SSD system was installed.

April 2005

- Two project signs were installed

- The pavement was sawcut for the outline of electrical trench. Subcontractors began installing the electrical trench and conduit.

- Con Edison installed transformer pads and conduit from pads.

- Contractor proposed using the existing sewer connection at Atlantic Express instead of making their own connection.

May 2005

- Installed buried conduit at the electric service entrances. Poured concrete for the electrical trenches.

- Con Edison delivered the transformers for the power supply.

- Abandoned the existing chemical oxidation sleeves and specified monitoring wells

- Drilling at the site for various structures including: 6 exploratory soil borings; temperature monitoring points (TMPs) for the ERH system, SVE wells

- Installed the trenches and piping for the SVE extraction wells and for the condensate line connection to the sewer; installed 8" SVE main line and sewer discharge line in trench across the driveway, installed SVE aboveground pipe over the loading dock roof and on the building wall

- Began assembly of ERH electrical parts and installation / construction of the electrodes

- Investigated an unknown buried tank and drywell uncovered at electrical trench; collected and analyzed Geoprobe® samples around the tank.

- SSD system was started and performance testing conducted.

June 2005

- Drilling, including the installation of new monitoring wells, SVE wells, vacuum monitoring points, and ERH recovery well/electrodes.

- Survey of the new monitoring wells, SVE wells, and vacuum monitoring points.

- Continued installing SVE piping and ERH piping as well as the sewer discharge line in the driveway.

- ERH equipment was delivered to the site including the power control units (PCU's), blower, and cooling tower

- Con Edison connected their transformers to power lines

- Collected samples from the soil storage rolloffs for disposal characterization.

- Started restoration and asphalt repavement of pipe trenches

July 2005

- Continued installation of the ERH electrodes, the ERH piping, and the sewer discharge line. Installed trenches for the buried electrodes and TMP located in front of the second Atlantic Express garage door.

- Installed surface casings for electrodes and began assembly of the electrodes.

- Installed concrete pads for the sheds to house the electrical switchgear and meter; electrical switchgear cabinets were delivered; the newly installed transformers were sampled and tested for PCBs.

- Repaved the condensate line trench
- Removed an abandoned fuel tank uncovered in driveway in the path of the condensate line.
- Sampled and analyzed additional rolloffs of soil for waste characterization.

August 2005

- Shipped several soil rolloffs offsite for disposal
- Developed monitoring wells
- Surveyed well elevations
- Installed road boxes and hatches for the buried ERH electrodes, backfilled and paved the area
- Continued installation of the TMPs for the ERH system.
- Continued installing SVE piping and connection to the Catox unit
- Installed the SVE wells located inside of the bus garage. Trenched and installed piping under the floor to these wells and to the TMP located inside the bus garage.
- Paved the trench for the condensate discharge line from tank removal area to the cleanout
- Road and sidewalk opened for sewer connection but work stopped because of improper permit.
- Began installing SVE wellhead boxes and covers; connecting SVE piping and valves to the extraction wells

September 2005

- Electric poles delivered, began installation of power poles; installed the CT (electric switchgear) cabinets; started construction of electrical switchgear enclosure sheds; overhead cable sets arrived onsite; pulled underground feeder cables through the conduits to the PCUs for the ERH system.

- Continued SVE wellhead box installations and piping tie-ins.

- Installed fencing around the ERH area, installed the first set of bollards at the corners of the fence for protection.

- CATOX unit installation begins.

- Shipped several soil rolloffs offsite for disposal.

- Restored and repaved the SVE piping trenches.

- Collected a round of samples from the monitoring wells.

October 2005

- Continued construction of the switchgear shed; continued ERH electrical feed hookup; vandalism/theft of copper conductor cables and repair of damage; installed guy wires and cable mounting hardware on the power poles; installed overhead triplex power cable on the power poles.

- Started site cleanup- disassembled the decontamination station, demobilized the emergency foam machine offsite.

- Continued installing SVE wellhead boxes, valves, and piping tie-ins. Continued trenching and piping to SVE extraction wells. Re-installed SVE extraction well EW-14 in new location (away from drainage structures). Continued restoring and repaving SVE trench areas.

- Installed conduit and electrical wire to supply the CATOX unit; installed protective fencing around the unit; completed CATOX exhaust stack installation.

- Sampled additional soil rolloffs for disposal characterization and shipped additional rolloffs offsite

November 2005

- Con Edison installed cables between transformer secondary side and switchgear cabinets and connected meter wiring. Installed the electric meters. Replaced the south service transformer for a second time, due to a water leak. Turned on the power to the transformers at the end of the month.

- Electrician continued work on PCU feeder cables, making connections between the overhead cables and the underground section; completed splices to repair cable vandalized in October. Installed 600 Amp fuses in the switchgear and connected telephone service to the PCU units.

- Installed wall brackets and piping for the gas line supply to the Catox unit. Pressure tested the piping sections. Installed a concrete pad (extension of existing) at the new gas service location next to the existing service, installed fencing at the location. Installed the new gas connection (regulator and tie-in).

- Completed various ERH system plumbing and electrical connections including control and sensor fittings, backflow preventer, etc.

- Installed the thermocouples in the TMPs.

- Surveyed various SVE well locations and pipe inlet elevations.

December 2005

- Waste soil rolloff was shipped offsite.

- Installed testing taps on vacuum monitor points for the SVE system.

- Debugging the ERH system and preparing for startup. Tying the control of the Catox unit into the controls for the ERH system.

- NYC Department of Buildings inspected and approved the gas connection.

- Contractor and Engineer met with the NYCDEP to resolve outstanding permit issues regarding connection to the sewer system.

- Installed additional traffic bollards around the ERH area, the Catox unit, at the gas service connection, the SVE trailer future location, and the power pole where the service goes from abovegrade to underground.

- Debugging and repairing the Catox unit

- Complete ERH system and Catox started and running on December 22, 2005.

- Clayton begins system operation and collection of influent and effluent samples

<u>January 2006</u>

- Operation of the ERH system continued. Because the sewer connection was not yet complete, the system was operating with a temporary holding tank for the collection of condensate as requested by Clayton. ERH system shutdown on January 14 because of a full condensate holding tank. The ERH system was restarted on January 17 after a 4,000 gallon holding tank was brought onsite; the full condensate tank was drained into the new holding tank

- Sewer connection was attempted with standard 6-inch diameter pipe, but stopped before tying into sewer; the 6-inch pipe was unnecessarily removed because of lack of communication between Contractor and subs. On January 24, the sewer line was connected and then inspected by a NYCDEP inspector. A sewer trap was installed at the end of the month.

- In early to mid-January, it became apparent that the specified temperature goals were going to be difficult to meet, apparently due to the unusual convective movement of the

water through the treatment area. On January 16, the ERH subcontractor reconfigured the electrode connections to energize the upper electrodes, and additionally disconnected the perimeter electrodes in an attempt to concentrate the energy into a smaller area. This was requested by the Contractor and authorized by the Engineer and Department, even though the operation of the lower electrodes did not achieve the originally specified temperature goals. On January 25, the electrodes were reconfigured to operate the upper electrodes only. January 30, 2006 was determined to be the date of Part A Substantial Completion. Section 3.0 of this report further discusses the temperature goals and the convection issue.

- The traffic bollards surrounding the ERH fence were covered with plastic pipe sleeves because they were developing voltages above the safety threshold specified in the HASP. The system voltage was increased once the bollards were covered.

- TMP's were grouted by the ERH subcontractor to prevent inaccurate temperature readings due to convection within the TMP pipe

- Contractor modified the SSD system to include a drain at the "drop leg" low point because the piping had filled with water.

- 180th Street was re-paved over the sewer connection cutout.

<u>February 2006</u>

- Operation of the ERH system continued with occasional maintenance adjustments and reconfiguration of electrodes.

- Contractor repaired the sidewalk where the sewer connection was made.

<u>March 2006</u>

- Operation of the ERH system continued with occasional maintenance adjustments and reconfiguration of electrodes.

- A break in pipe for the condensate discharge to the sewer was repaired.

- Problems with the Catox unit were resolved by cleaning of a screen and making changes to the Catox maintenance procedures.

April 2006

- Operation of the ERH system continued with occasional maintenance adjustments and reconfiguration of electrodes. The ERH system electrodes were shut down on April 25 based on direction by the Engineer. The blowers and Catox system continued operation.

- Contractor repaired a leak in the condensate piping. The leak was captured in the secondary containment area.

- Certificate of Part A Substantial Completion (Appendix R) is issued to the Contractor. The date of completion is determined to be January 30, 2006.

May 2006

- Operation of the ERH system blowers and Catox unit continued.

- Contractor collected post-remediation soil samples via geoprobe.

- Data usability summary reports (DUSR) were prepared by Engineer and the Contractor for the post remediation soil samples. Data was deemed acceptable by the Engineer and decommissioning of the ERH system was authorized on May 25, 2006 via e-mail. This was followed with a written letter confirming the shut-down date was sent on June 8, 2006 (see Appendix S).

- Part A Final Completion (Appendix R) is issued to the Contractor. The date of completion is determined to be March 1, 2006.

June 2006

- Electrician made the electrical connections required for the operation of the SVE system. Two of the three power feed cables at the north service entrance and all cables at the south service were disconnected from the power within the switchgear cabinets. The

remaining cable set at the north entrance was cut at the top of pole near the SVE system and connected to the new SVE masthead.

- Contractor replaced a damaged cover at EW-14 cover and repaired settlement occurring at EW-15 by filling in the depression with concrete.

- Phone and electric service at the site trailers was disconnected and security service was discontinued.

- The ERH system was dismantled. All major components and most remaining pallets of material (steel shot and graphite) were removed from the site. PVC piping from the ERH system and remaining steel shot (damaged bags) were staged for salvage or disposal.

- The last office trailer was removed from the DEP property.

- All ERH area fencing was removed, with the posts cut off flush with grade. Bollards were removed by pulling from the ground, backfilling holes with crushed stone and capping flush to grade with 6 to 8-inches of concrete. All ERH electrodes were cut off several inches below grade and temporarily capped.

- Rolled fence fabric and posts as well as the folded plastic secondary containment for the condensate tank have been staged at the DEP property for pickup and use by NYSDEC.

- Electrical and piping connections to the SVE system have been completed and the system has been "bump" tested for functionality.

<u>August 2006</u>

- Minor repairs made to aboveground piping; other preparations as necessary for the startup of the SVE system.

<u>September 2006</u>

- Contractor collected quarterly round of groundwater samples.

- Operation of the SVE system began on September 6, 2006.

2.2 Submittals

The approved shop drawings document many of the minor details of the construction. Those details are not discussed in this report.

The required shop drawings were received from Clayton, and reviewed by URS, in a timely manner. All the required shop drawings were ultimately approved by URS.

2.3 Contract Modifications

The following section discusses significant variations (administrative agreements, field clarifications, proposed change orders, approved substitutions, etc.) from the Contract Documents for each of the major areas of construction at the site. Only proposed change orders or field orders that affected the construction or operation of the facilities are described in this section. Requests for Information (RFIs)/Field Clarifications as well as the Proposed Change Orders (PCOs) have been included as Appendices A and B respectively.

PCOs that were agreed upon by the Contractor and the Engineer have been incorporated into change orders. To date, two change orders have been prepared under this contract. The value of Change Order No. 1, dated September 2, 2005, was $18,725.30. It was accompanied by a contract extension of 63 calendar days. The value of Change Order No. 2, dated September 5, 2006, was $71,970.29. It was accompanied by a 197-day contract extension. Copies of the executed change orders are included in Appendix P. The new contract price for the general contract is $3,939,597.59, an increase of $90,695.59 over the original contract price of $3,848,902.00.

2.3.1 Modifications to the ERH System

Several change order items were issued in association with the construction, installation, and operation of the ERH system.

- The Contract Documents designated an area to be fenced and treated using ERH. It was assumed that all of the electrodes and other ERH equipment could be installed aboveground within the fenced area. After construction began, Atlantic Express, a bus company that rents the site, expressed concerns that they could not lose access to two of their garage bays. After negotiation with Atlantic, it was agreed that the north extent of the fenced area would be moved to allow access to one of the two blocked bays. To accomplish this, four of the electrodes, and two of the TMPs were redesigned and constructed as below grade structures. (Change Order No. 2)

- As construction began at the site, Atlantic Express had concerns about the extent and location of the area that would be fenced and used for ERH equipment staging. The contractor had laid out the fenced area as specified in the original Contract Documents. However, Atlantic Express had installed a new aboveground bus fueling station at the site subsequent to the preparation of the Contract Documents. Atlantic was concerned that two lanes of bus traffic around the fueling station could not be maintained without impacting other bus traffic. The Contractor was requested to redesign the layout of their equipment in order to fit the ERH and SVE systems into a different and somewhat smaller footprint. (Change Order No. 2)

- During drilling for installation of the ERH electrodes, there were numerous difficulties at the shallow depths due to large concrete obstructions and other debris that led to refusal of the drilling equipment. The importance of keeping the electrode grid spaced evenly limited the flexibility in the placement of the electrodes, in addition to the fact that the obstructions seemed to be widespread and refusal was encountered at numerous locations. Consequently, each of the electrode locations was pre-excavated with a backhoe through the shallow depths. The electrodes were drilled to depth after the debris layer was removed. (Change Order No. 2)

- After installing the fence around the ERH area, bus operators were accidentally hitting the fence due the limited space at the site, the constant bus traffic, and the extremely tight parking. A change was issued to install a total of four bollards around the treatment area. While these bollards protected the corners of the fence, they did not prevent busses from hitting the sections of fence between the bollards, especially when snow and ice made the conditions at the site more hazardous. This became a concern not so much for the protection of the fence, but due to the proximity of the electrodes and piping to the fence, there was a possibility of a bus damaging the equipment and/or causing a potential release of steam and hot vapors to the community. Due to these safety concerns, a change was issued to install bollards a minimum of every 5 feet along the fence. A third change related to the bollards was issued when routine monitoring of the ERH area showed that the voltage measured at the bollards was increasing and that they could present an electrical hazard. Insulated PVC covers were installed over all of the bollards to provide protection to site personnel. A fourth change associated with the bollards was required when it was determined that costs for removal and disposal of the bollards following ERH treatment had not been included in the previous PCOs. (Change Order No. 2)

- A significant change was associated with the operation of the ERH system, and the achievement of temperature goals. This change is discussed in Section 3.0 along with the discussion of the results from the ERH treatment. (Change Order No. 2)

2.3.2 Modifications to the SVE System

Changes to the SVE system were relatively minimal and included only one actual change to the system as originally specified. The other changes were in response to specific conditions encountered at the site.

- Due to concerns with potential tampering and security issues with the SVE system, it was determined that the system control panel, located on the outside of the trailer (although within a fenced area) should be covered with a “dead-face” panel, where the controls and system operation are not visible to the outside. (Change Order No. 2)

- During the installation of the well box for SVE extraction well EW-14, a previously unidentified drywell was encountered directly adjacent to the extraction well. Due to the likelihood that the drywell would limit the influence and effectiveness of the extraction well, well EW-14 was moved to a new location and re-drilled. A pipe was encountered at the second location, requiring that the well box be modified in order to fit into the location. (Change Order No. 2)

- A second change order item was required for extraction well EW-14 when it was determined that the original well box modifications were not sufficient. The lid to the wellbox became uneven with the surrounding area, and eventually was damaged by a snowplow at the site. The existing well box was cut down, and a new lid was recast onto the box. (Change Order No. 2)

- Due to obstacles for the drill rig inside the bus garage (typically overhead pipes or supports), it was necessary to relocate some of the structures for the SVE system. These included EW-5 and EW-10. Each of these was offset from their originally proposed locations by approximately 5 feet. Additionally, extraction well EW-5 could only be advanced to a depth of 8 feet instead of the 10 feet required by the Contract Documents. The screened portion of this well is therefore two feet shorter than specified. (Field Clarification #19)

2.3.3 Modifications to the Site Preparation and Other Work

This section outlines the changes in work not specifically related to either the ERH or SVE systems. As with those systems, most of the contract changes were due to unexpected site conditions encountered during the course of the work. They are outlined in this section.

- A local citizens community group, the Brooklyn Queens Aquifer Citizens Advisory Committee (CAC), is active in the neighborhood and was initially concerned about the remedial work at this site. The CAC includes a Scientific Review Panel that reviewed and commented on the Contractor's plans for the site, especially the Community Protection Plan and the Health and Safety Plan. The review by the committees, as well

the efforts of the Contractor to respond to their comments in a timely manner, delayed intrusive work at the site in addition to the cost of producing several additional iterations of these documents. Additionally, the Contractor was requested to attend one of the CAC's monthly meetings to become familiar with the committee and to discuss their concerns. (Change Order No. 1)

- The NYSDEC requested that the Contractor collect and analyze groundwater samples from a total of 21 offsite monitoring wells. These samples were to document the offsite groundwater contaminant concentrations prior to the startup of the ERH remediation system, since these wells had not recently been sampled. (Change Order No. 2)

- During the installation of electrical conduit from the NYCDEP site to the West Side site, a previously unknown underground storage tank (UST) and a dry well were discovered by the excavation subcontractor. The UST appeared to have been previously filled with sand and closed in place. However, because these two structures were not identified during previous site investigations, sampling was conducted to determine whether either of these two structures were possibly source areas requiring additional information. The results of the samples indicated that the structures could remain in place, and the electrical conduit was rerouted around them. (Change Order No. 1)

- A second unknown UST was encountered in the main driveway during the construction of the discharge line connecting to the sewer system. This tank was located in the direct path where the line was to be constructed. Because the UST was not in use, but had not been closed, the Contractor was requested to excavate, sample, and remove the tank, and to prepare a tank closure report. (Change Order No. 2)

- A third set of electrical cables were installed from both the North and South ConEd transformers to the electrical disconnects for the ERH system. The additional cable was required due to the distance between the two points, and the fact that the voltage drop would be too high with only two cables. (Change Order No. 2)

- The SSD system installed in the break room of Atlantic Express was originally installed with a small, dedicated blower. The Contract Documents specified that once the SVE system was operational, the SSD should be disconnected from the small blower and

reconnected to the SVE system. However, because the SVE system eventually will be removed at some time in the future, and the SSD system is expected to remain in operation for safety purposes, it was determined that it would be most beneficial to keep the two systems separated. (Field Clarification)

- The quantities of soil for offsite disposal, both hazardous and non-hazardous, increased over the original bid quantities. This was in part due to the fact that much of the excavated soil contained fill and debris that made it unsuitable for backfill at the site. Additionally, based on analysis of the first rolloffs of contaminated soil for disposal, it was determined that additional samples would be required for accurate characterization of the soil. After negotiations with the Contractor, it was agreed that one sample should be collected form each rolloff before disposal. (Change Order No. 2)

2.3.4 Modifications to the Schedule for Substantial Completion

As described in Section 2.1, the Contract Documents, *Section VI – Agreement, Separable Parts of the Work*, this contract was divided into four parts of completion. However, due to the large dollar amount and lengthy duration of the contract work, it was not possible for the Contractor to obtain one single bond to cover all of the work at the site. As a result, the Contractor obtained four individual bonds, one for each part of the work. To simplify the release of the bonds, the Contractor attempted to reorder the pay items included under each part into a more chronological order. There was no change to the Contract Cost or Time associated with this modification. Change Order No. 2, located in Appendix O, includes further details on the specific pay items included under each part of completion.

2.4 Final Quantities and Costs

Final quantities for many of the bid items differed from that estimated in the original contract bid form. The most significant contract deduction occurred from liquidated damages that were assessed by the NYSDEC for a delay of 195 days in completing the work required. Additional deductions resulted from those items associated with the restart of the ERH system that was not

required. Most of the additions to the contract, as outlined above, were due to unexpected conditions encountered at the site during the work. Table 2-1 summarizes both the original and actual bid quantities and costs. Note that many of the "Actual" quantities are only projected, especially for those items associated with operation of the SVE system, which is on-going.

2.5 Disposal of Contaminated Soil

Both hazardous and non-hazardous soil was generated from the construction activities at the site. Construction activities that generated soil included trenching for the installation of the SVE lines, power line conduits, and discharge connection to the sewer; drilling of the ERH electrodes, SVE wells, and vapor monitoring points; excavation for installation of the SVE well boxes; and excavation associated with the removal of two USTs. All excavated soil was stockpiled in rolloff boxes for waste profiling and disposal. A total of 32 rolloffs and other containers were used during the excavation. Several different disposal facilities were utilized over the course of the contract due to a variety of factors such as cost, scheduling availability, and willingness to accept the waste. The disposal facilities utilized were:

Environmental Soil Management, Inc. of New York

304 Towpath Road

Fort Edward, NY 12828

Casie Protank

3209 North Mill Road

Vineland, NY 08360

CWM Chemical Services, LLC

1550 Balmer Road

Model City, NY 14107

The Environmental Quality Company (EQ)

Michigan Disposal Waste Treatment Plant

49350 N. I-94 Service Drive

Belleville, Michigan 48111

Cycle Chem, Inc.

217 South First Street

Elizabeth, NJ 07206

Table 2-2 summarizes the disposal of the waste to the various facilities. Waste manifests and other information have been included as Appendix G to this report.

Table 2-1
Comparison of Bid Quantities and Costs to Actual Quantities and Costs

Item No.	Description	Estimated Bid Quantity	Actual Quantity (1)	Units	Unit Price	Cost @ Estimated Bid Quantity	Cost @ Actual Quantity	Change Order No. 1 Costs (2)	Change Order No. 2 Costs (2)
UC-1	Offsite disposal of non-hazardous soil	64	202	Ton	$ 118.25	$ 7,568.00	$ 23,886.50		
UC-2	Offsite disposal of hazardous soil	10	65	Ton	$ 306.38	$ 3,063.80	$ 19,914.70		
UC-3	Soil vapor extraction well	16	16	Each	$ 2,868.54	$ 45,896.64	$ 45,896.64		
UC-4	Additional soil vapor extraction well	2	1	Each	$ 2,868.54	$ 5,737.08	$ 2,868.54		
UC-5	Vacuum monitoring point	10	10	Each	$ 745.94	$ 7,459.40	$ 7,459.40		
UC-6	4-inch diameter below grade SVE pipe	700	789.5	LF	$ 207.68	$ 145,376.00	$ 163,963.36		
UC-7	4-inch diameter above grade SVE pipe	230	208	LF	$ 92.28	$ 21,224.40	$ 19,194.24		
UC-8	6-inch diameter above grade SVE pipe	530	321	LF	$ 112.28	$ 59,508.40	$ 36,041.88		
UC-9	8-inch diameter above grade SVE pipe	100	88	LF	$ 122.06	$ 12,206.00	$ 10,741.28		
UC-10	SVE system steady state operation following startup	6	6	Month	$ 1,200.00	$ 7,200.00	$ 7,200.00		
UC-11	Temperature monitoring point	13	13	Each	$ 2,926.04	$ 38,038.52	$ 38,038.52		
UC-12	Shallow groundwater monitoring well	4	4	Each	$ 2,938.54	$ 11,754.16	$ 11,754.16		
UC-13	Intermediate groundwater monitoring well	4	4	Each	$ 2,983.54	$ 11,934.16	$ 11,934.16		
UC-14	Deep groundwater monitoring well installed to clay layer	2	2	Each	$ 3,078.54	$ 6,157.08	$ 6,157.08		
UC-15	ERH system steady-state operation Phase 1	91	91	Calendar Day	$ 2,937.96	$ 267,354.36	$ 267,354.36		$ (64,151.36)
UC-16	Electricity allowance for ERH steady State Operation Phase One	1	1	Each	$ 190,860.00	$ 190,860.00	$ 190,860.00		
UC-17	ERH system standby phase	30	30	Calendar Day	$ 978.25	$ 29,347.50	$ 29,347.50		
UC-18	Aqueous Phase Carbon for Startup & Steady-State Operation Phase One	4000	0	Pound	$ 4.19	$ 16,760.00	$ -		
UC-19	Fencing	500	256	LF	$ 38.92	$ 19,460.00	$ 9,963.52		

Table 2-1
Comparison of Bid Quantities and Costs to Actual Quantities and Costs

Item No.	Description	Estimated Bid Quantity	Actual Quantity (1)	Units	Unit Price	Cost @ Estimated Bid Quantity	Cost @ Actual Quantity	Change Order No. 1 Costs (2)	Change Order No. 2 Costs (2)
UC-20	Health and Safety	185	198	Person per Work Day	$ 100.00	$ 18,500.00	$ 19,800.00		
UC-21	Post Remediation Soil Sampling	25	25	Each	$ 952.94	$ 23,823.50	$ 23,823.50		
UC-22	SVE Extraction Well Sampling During Startup	32	32	Each	$ 170.00	$ 5,440.00	$ 5,440.00		
UC-23	SVE Extraction Well Sampling During Operation	96	96	Each	$ 170.00	$ 16,320.00	$ 16,320.00		
UC-24	SVE Catalytic Oxidizer Inlet Sampling During Startup	2	2	Each	$ 170.00	$ 340.00	$ 340.00		
UC-25	SVE Catalytic Oxidizer Inlet Sampling During Operation	6	6	Each	$ 170.00	$ 1,020.00	$ 1,020.00		
UC-26	SVE Catalytic Oxidizer Outlet Sampling During Startup	30	30	Each	$ 170.00	$ 5,100.00	$ 5,100.00		
UC-27	SVE Catalytic Oxidizer Outlet Sampling During Operation	6	6	Each	$ 170.00	$ 1,020.00	$ 1,020.00		
UC-28	ERH Condensed Vapor Sampling During Startup	32	12	Each	$ 170.00	$ 5,440.00	$ 2,040.00		
UC-29	ERH Condensate Vapor Sampling During Steady State Op'n Phase One	13	32	Each	$ 170.00	$ 2,210.00	$ 5,440.00		
UC-30	ERH Condensate Sampling During Startup	32	1	Each	$ 170.00	$ 5,440.00	$ 170.00		
UC-31	ERH Condensate Sampling During Steady-State Operation Phase One	13	14	Each	$ 170.00	$ 2,210.00	$ 2,380.00		
UC-32	ERH Discharge Sampling During Startup	9	1	Each	$ 170.00	$ 1,530.00	$ 170.00		
UC-33	ERH Discharge Sampling During Steady-State Operation Phase One	13	3	Each	$ 170.00	$ 2,210.00	$ 510.00		
UC-34	ERH Catalytic Oxidizer Outlet Sampling During Startup	32	12	Each	$ 170.00	$ 5,440.00	$ 2,040.00		
UC-35	ERH Catalytic Oxidizer Outlet Sampling During Steady-State Op'n Phase One	7	31	Each	$ 170.00	$ 1,190.00	$ 5,270.00		
UC-36	Groundwater Sampling	134	155	Each	$ 170.00	$ 22,780.00	$ 26,350.00		
UC-37	Soil Borings	6	6	Each	$ 785.00	$ 4,710.00	$ 4,710.00		
UC-38	ERH System Steady-State Operation Phase 2	63	0	Calendar Day	$ 2,997.10	$ 188,817.30	$ -		

Table 2-1
Comparison of Bid Quantities and Costs to Actual Quantities and Costs

Item No.	Description	Estimated Bid Quantity	Actual Quantity (1)	Units	Unit Price	Cost @ Estimated Bid Quantity	Cost @ Actual Quantity	Change Order No. 1 Costs (2)	Change Order No. 2 Costs (2)
UC-39	Electricity Allowance for ERH Steady-State Operation - Phase 2	1	0	Each	$ 132,100.00	$ 132,100.00	$ -		
UC-40	Aqueous Phase Carbon Restart and Steady-State Operation Phase 2	3000	0	Pound	$ 3.12	$ 9,360.00	$ -		
UC-41	ERH Condensed Vapor Sampling During Restart	32	0	Each	$ 170.00	$ 5,440.00	$ -		
UC-42	ERH Condensed Vapor Sampling During Steady-State Op'n Phase 2	8	0	Each	$ 170.00	$ 1,360.00	$ -		
UC-43	ERH Condensate Sampling During Restart	32	0	Each	$ 170.00	$ 5,440.00	$ -		
UC-44	ERH Condensate Sampling During Steady-State Operation Phase Two	8	0	Each	$ 170.00	$ 1,360.00	$ -		
UC-45	ERH Discharge Sampling During Restart	9	0	Each	$ 170.00	$ 1,530.00	$ -		
UC-46	ERH Discharge Sampling During Steady-State Operation Phase Two	8	0	Each	$ 170.00	$ 1,360.00	$ -		
UC-47	ERH Catalytic Oxidizer Outlet Sampling During Restart	32	0	Each	$ 170.00	$ 5,440.00	$ -		
UC-48	ERH Catalytic Oxidizer Outlet Sampling During Steady-State Op'n Phase Two	4	0	Each	$ 170.00	$ 680.00	$ -		
UC-49	SVE Catalytic Oxidizer Outlet HCl Sampling During Startup	15	0	Each	$ 170.00	$ 2,550.00	$ -		
UC-50	SVE Catalytic Oxidizer Outlet HCl Sampling During Operation	26	0	Each	$ 170.00	$ 4,420.00	$ -		
UC-51	ERH Catalytic Oxidizer Outlet HCl Sampling During Startup	32	16	Each	$ 170.00	$ 5,440.00	$ 2,720.00		
UC-52	ERH Catalytic Oxidizer HCl Sampling During Steady-State Op'n Phase One	13	4	Each	$ 170.00	$ 2,210.00	$ 680.00		
UC-53	ERH Catalytic Oxidizer Outlet HCl Sampling During Restart	32	0	Each	$ 170.00	$ 5,440.00	$ -		
UC-54	ERH Catalytic Oxidizer HCl Sampling During Steady-State Op'n Phase Two	8	0	Each	$ 170.00	$ 1,360.00	$ -		
LS-1	General	1	1	LS	$ 169,446.90	$ 169,446.90	$ 169,446.90		
LS-2	Site Preparation	1	1	LS	$ 169,446.90	$ 169,446.90	$ 169,446.90	$ 8,080.75	$ 25,488.67
LS-3	Site Facilities and Services	1	1	LS	$ 169,446.90	$ 169,446.90	$ 169,446.90	$ 5,108.85	

Table 2-1
Comparison of Bid Quantities and Costs to Actual Quantities and Costs

Item No.	Description	Estimated Bid Quantity	Actual Quantity (1)	Units	Unit Price	Cost @ Estimated Bid Quantity	Cost @ Actual Quantity	Change Order No. 1 Costs (2)	Change Order No. 2 Costs (2)
LS-4	Site Restoration	1	1	LS	$ 17,608.50	$ 17,608.50	$ 17,608.50		
LS-5	Soil Vapor Extraction System Installation and Startup Operation	1	1	LS	$ 91,160.00	$ 91,160.00	$ 91,160.00		$ 5,460.66
LS-6	Electrical Resistance Heating System	1	1	LS	$ 232,200.00	$ 232,200.00	$ 232,200.00		$ 52,692.33
LS-7	Electrode/Vapor Recovery Well Installation	1	1	LS	$ 394,525.00	$ 394,525.00	$ 394,525.00		$ 49,643.08
LS-8	Electrical Resistance Heating System Piping	1	1	LS	$ 49,450.00	$ 49,450.00	$ 49,450.00		
LS-9	Electrical Resistance Heating Startup	1	1	LS	$ 349,375.00	$ 349,375.00	$ 349,375.00		
LS-10	Electrical Resistance Heating System Restart	1	0	LS	$ 175,225.00	$ 175,225.00	$ -		
LS-11	Decommission Electrical Resistance Heating System	1	1	LS	$ 83,850.00	$ 83,850.00	$ 83,850.00		$ 12,509.15
LS-12	Sewer Discharge Connection	1	1	LS	$ 10,900.50	$ 10,900.50	$ 10,900.50		$ 14,101.00
LS-13	Electrical	1	1	LS	$ 505,250.00	$ 505,250.00	$ 505,250.00		$ 75,600.00
LS-14	Utility Allowance	1	0.08507	LS	$ 5,000.00	$ 5,000.00	$ 425.35		
LS-15	Subsurface Depressurization System	1	1	LS	$ 20,081.00	$ 20,081.00	$ 20,081.00		
LS-16	New Item - UST & Dry Well Sampling			LS				$ 5,535.70	
	Liquidated Damages								$ (156,000.00)
Totals						**$ 3,848,902.00**	**$ 3,291,085.39**	**$ 18,725.30**	**$ 15,343.53**
Final Contract Cost (Actual + Change Orders)							**$ 3,325,154.22**		

Notes:
1. "Actual Quantity" represents the projected actual quantity at the end of the contract. Costs for ERH-related items generally are correct, and costs for SVE-related items are estimated.
2. Costs associated with a change on quantity are already included in the "Actual Quantity" column and therefore not shown here.

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Table 2-2
Summary of Waste Disposal

Date Rolloff Removed	Estimated Weight (Ton)	Classification	Disposal Facility
8/4/2005	15.63	Non-Haz	ESM
8/4/2005	16.50	Non-Haz	ESM
8/11/2005	18.23	Non-Haz	Casie
8/11/2005	19.41	Non-Haz	Casie
8/12/2005	24.18	Non-Haz	Casie
8/12/2005	22.85	Non-Haz	Casie
8/12/2005	25.43	Non-Haz	Casie
8/12/2005	29.78	Non-Haz	Casie
8/15/2005	25.15	Non-Haz	Casie
8/15/2005	25.90	Non-Haz	Casie
8/15/2005	23.72	Non-Haz	Casie
8/15/2005	-	Non-Haz	Casie
8/16/2005	27.27	Non-Haz	Casie
8/16/2005	23.94	Non-Haz	Casie
8/16/2005	24.41	Non-Haz	Casie
8/16/2005	19.21	Non-Haz	Casie
8/17/2005	25.39	Non-Haz	Casie
8/17/2005	28.38	Non-Haz	Casie
8/18/2005	25.67	Non-Haz	Casie
8/18/2005	17.59	Non-Haz	Casie
8/19/2005	26.26	Non-Haz	Casie
9/8/2005	15.48	Haz	Model City
9/12/2005	12.45	Haz	Model City
9/9/2005	24.13	Haz	Model City
9/13/2005	12.53	Haz	Model City
9/21/2005	23.90	Non-Haz	Casie
10/21/2005	11.23	Haz	EQ
10/21/2005	-	Non-Haz	EQ
12/5/2005	22.82	Non-Haz	Casie
12/5/2005	-	Non-Haz	
12/16/2005	18.37	Non-Haz	Casie
12/16/2005	10.50	Non-Haz	Casie
3/28/2006	6 cy	Non-Haz	Cycle Chem
3/29/2006	6 cy	Non-Haz	Cycle Chem
Total Hazardous	75.82		
Total Non-Hazardous	540.48		

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3.0 SUMMARY AND RESULTS OF ERH SYSTEM OPERATIONS

3.1 Introduction

ERH is the technology used to remove the PCE from the saturated zone. In this section, the conduct of the ERH treatment is described. ERH works by passing electric current to electrodes installed into the saturated zone. The groundwater acts as a conductor to allow current to pass from one electrode to another. Since the groundwater is merely an adequate conductor, it provides resistance to the current (causing voltage to drop with distance) and energy is released in the form of heat. This phenomenon is exploited to raise the temperature of the groundwater and thus volatilize the VOCs in the saturated zone. Volatilized VOCs are captured once they rise to the vadose zone through a vapor recovery system consisting of vapor recovery wells, vacuum blowers and offgas treatment through catalytic oxidation.

3.2 Specified ERH Operation

The Contract Documents did not specify the number of electrodes to be installed. Rather a minimum amount of electrode power input was mandated (800 KW) and temperature goals were set. The Contract Documents divided ERH operation into three parts: Startup, Phase 1 Operation, and Phase 2 Operation.

During Startup, the ERH system was required to bring the treatment zone, defined as a square 60 feet by 60 feet and a depth of 55 feet below ground surface (bgs) to the boiling temperature. The target boiling temperature was specified through consideration of the elevation of the boiling temperature due to the hydrostatic pressure of the water column, and consideration of the depression of the boiling temperature due to the presence of two separate liquid phases (water and free-phase PCE). The Contact Documents required for the lower 15 feet (40 to 55 feet bgs) of the saturated zone to be heated to the specified temperature prior to heating the upper zone, as this lower zone was deemed to be free of PCE as dense non-aqueous phase liquid (DNAPL). Heating this lower zone was to first provide a safety zone should free-phase PCE present as ganglia higher up in the water column

sink during treatment – it would fall to this lower heated zone and volatilize rather than sink as DNAPL.

The Contract Documents specified Phase 1 operation to be steady state operation at the calculated boiling temperatures throughout the treatment zone. Phase 2 operation was to be identical to Phase 1 operation, but was to be implemented optionally, only if confirmatory sampling indicated that further treatment was warranted.

3.3 Performance Criteria Revised by PCO 27

The operation of the ERH treatment did not follow the specified course of action. The heated water behaved differently than documented in previous implementations of this technology. In a typical soil horizon, the vertical hydraulic conductivity is much less than the horizontal hydraulic conductivity. Typically, a rule of thumb is that the ratio of vertical to horizontal permeabilities is about 10:1. The reduced vertical permeability typically prevents heated water from rising as it is heated (heated water is less dense than cold water, and thus rises). The heat balance performed during the design did not anticipate significant convective heat loss. This issue was discussed with the different ERH vendors during design, they indicated that heat loss was primarily conductive rather than convective.

At the West Side site, however, the sand was apparently unusually uniform. While no vertical hydraulic conductivities were measured, it is suspected that the vertical permeability was much greater than found commonly. This facilitated the rising of heated water. This has three main impacts on the operation of the ERH system.

1. First, because the water within the treatment zone was rising (and dispersing laterally along the top of the water table), cold water flowed into its wake. This prevented achieving the proscribed temperature goals. On the macro scale, the amount of water rising to the top and then dispersing horizontally caused a much greater percentage of the 800 KW of delivered power to be lost outside the treatment zone via convection. These losses, coupled with conductive heat losses and heats of vaporization meant that

not enough power was available to complete the accumulation of heat during the startup phase, and boiling temperatures were not achievable throughout the treatment zone. On the smaller scale, the heating that did occur was not uniform (although current was presumably uniform throughout the depths). The lower zone was cooler as cold water rushed in to replace the heated water rising to the top. Boiling temperatures were achieved at the surface, but not at depths.

2. Second, the fact that boiling temperatures were not achieved throughout the treatment zone meant that any DNAPL ganglia present in the treatment zone could not be presumed to be automatically treated. An advantage of ERH over chemical treatments such as oxidation is that no contact between treatment reagents and contaminants is required. So long as the heat reaches the contaminants and boiling temperature is achieved, the PCE would volatilize regardless of whether it was dissolved or in the free phase. Without achieving boiling temperatures, transition to the vapor phase could not be guaranteed. This was a potential negative impact of the unexpected convection

3. Third, the unexpected convection provided a positive benefit. If ERH were operated without convection (as originally envisioned), the volatilized VOCs would need to migrate upward as small bubbles until they reached the vadose zone, where they would be collected. This would be a rate-limiting step and could extend the time needed to reach cleanup. With the upward convection, however, dissolved PCE was transported to the surface where boiling temperatures were achieved. When the dissolved contamination reached the surface, it was quickly volatilized and then captured by the vapor recovery system.

While it was not clear during operation whether the potential negative implications of the second impact described above would overshadow the positive implications of the third impact, it was important from a contractual point of view to resolve the issues raised by the first impact as soon as the convective phenomenon was observed. Separable Part A of the contract was defined by several criteria linked to payment items. Most prominent of these payment items was the lump sum payment item LS-9 which was not defined as complete until boiling temperatures were achieved

throughout the treatment area. It was clear that because of the unexpected convection that had developed, the temperature goals would never be met. According to the contract, the contractor would thus never complete Separable Part A nor receive full payment for LS-9.

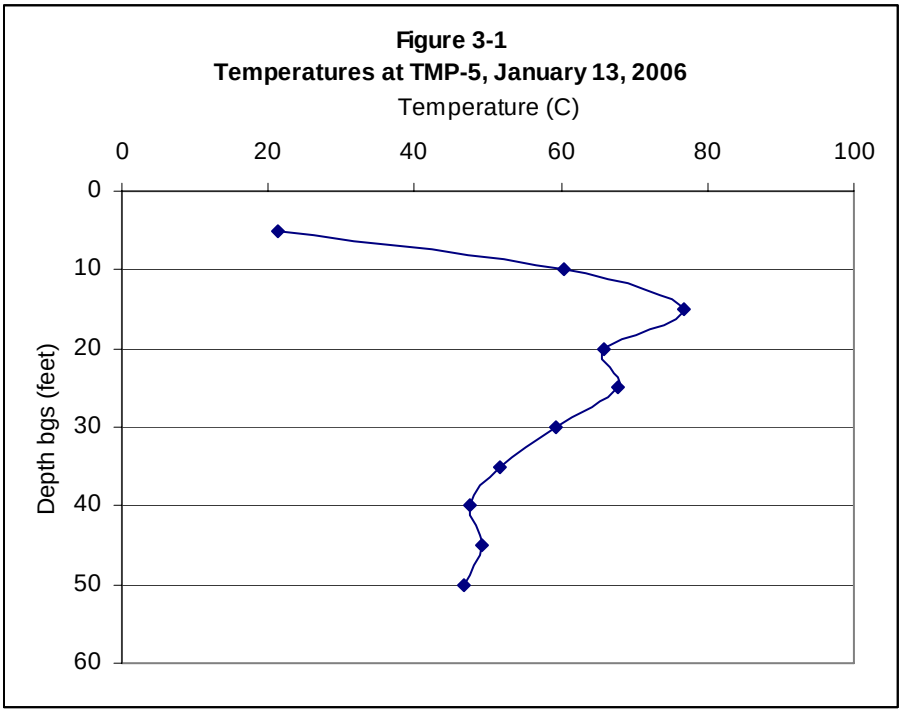
Therefore, URS and NYSDEC entered into negotiations with the contractor over a potential change order (PCO) for the temperature performance goals outlined in the specifications and required for Separable Part A completion and LS-9 payment. Changed conditions are routinely required to approve a PCO; however, no changed conditions were encountered, only unanticipated behavior. However, without an approved PCO, the contractor would have been inclined to cease operation in an effort to prevent increased financial losses that would result from inability to complete Separable Part A pursuant to the contract. Because PCE was being removed (as discussed below), URS and NYSDEC wanted the contractor to continue operation and thus agreed to approve a PCO that put in place alternate performance goals for LS-9 and hence Separable Part A. The alternate performance goal was to achieve steady state operation, as defined by the temperature measurements. URS's review of the trends of temperature over time concluded that steady state was achieved on January 30, 2006, approximately 35 days after initial electrode energizing. This alternate performance criterion was established in PCO 27.

PCO 27 also altered the performance goals and the contract price for the steady state operation of the ERH system upon meeting the LS-9 startup goal. Originally, steady state operation, reimbursed through payment item UC-15, required the maintenance of the temperature goals established in the specifications. Since that was not achievable, PCO 27 modified the performance requirements for payment of UC-15 to require (instead of the temperature goals) that at a minimum 600 KW of power be introduced to the subsurface and that the contractor make an effort to put all available power (800+ KW) into the ground. Additionally, in order to increase the power density (and thus reduce the cooling influence of the inflowing cool water), the contractor was allowed, through PCO 27, to focus the power on subset portions of the treatment area, with the requirement that a minimum of twelve electrodes be energized at any one time. Empirically, this approach was found to provide short-term increases in the rate of PCE recovery.

3.4 Detailed ERH Operational Summary

ERH electrodes were initially energized in testing mode on December 20, 2005, using only low voltages to check the system. Full voltage operation began on or about December 27, 2005. In accordance with the specifications, only the lower portion of the electrodes (depths 40 to 55 feet bgs) were energized at the start.

By the second week of January 2006, it became apparent that the unexpected convection was developing. This was manifested by the measurement of higher temperatures at depths above 40 feet bgs than below 40 feet bgs, as shown in Figure 3-1 (TMP-5 is the temperature monitoring point in the center of the treatment area).



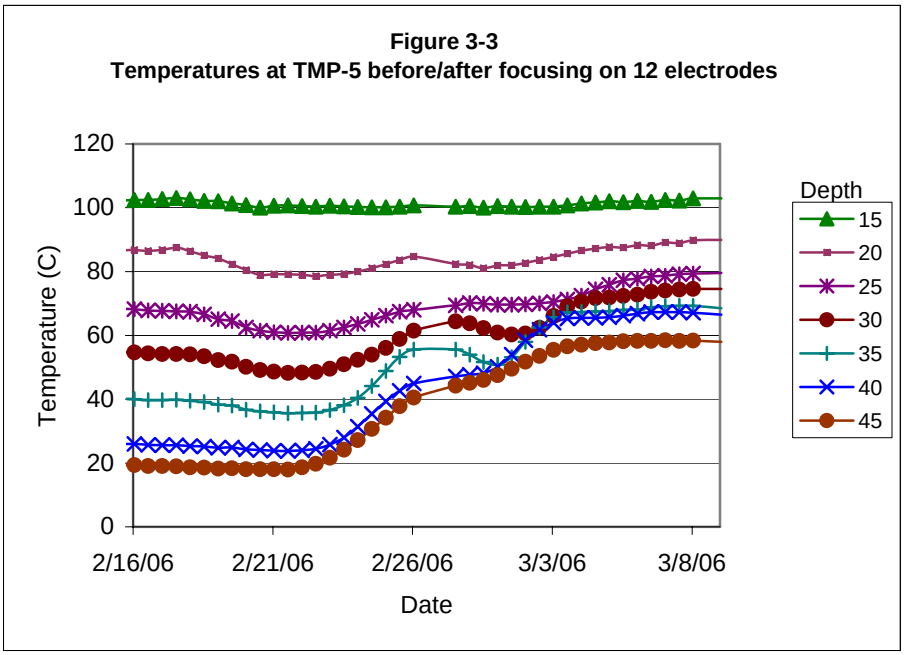
A conference call with URS and the contractor was held on January 18, 2006 to discuss this. At that conference call, it was mutually decided that it made no sense to continue to energize just the lower electrodes since achieving boiling temperatures there before heating the upper zone was not

physically possible due to the convection. Therefore, URS approved energizing the upper electrodes prior to meeting boiling temperatures in the lower electrodes. Additionally, to increase the power density delivered to the core of the treatment area, the perimeter electrodes were de-energized. These electrodes had been installed outside the specified 60 x 60 foot treatment area. The contractor had requested these changes in the initial version of PCO 27. While PCO 27 was revised twice before it was accepted, URS gave verbal permission for these changes in operation during the January 18, 2006 conference call. The arrangement of the electrodes and TMPs is shown on Figure 3-2. After removing the perimeter electrodes from the power supplies, electrodes E-6, E-7, E-8, E-9, E-11, E-12, E-13, E-15, E-16, E-17, E-18, E-20, E-21, E-22, E-24, E-25, E-26, and E-27 remained energized.

On January 25, with convection still present following the energizing of both the upper and lower electrodes, the contractor requested, and URS accepted, the de-energization of the lower electrodes. Since the zone below 40 feet was below the zone of high contamination targeted for treatment, URS agreed that it would be better to focus all available energy into the target area in an effort to meet target temperatures throughout this zone.

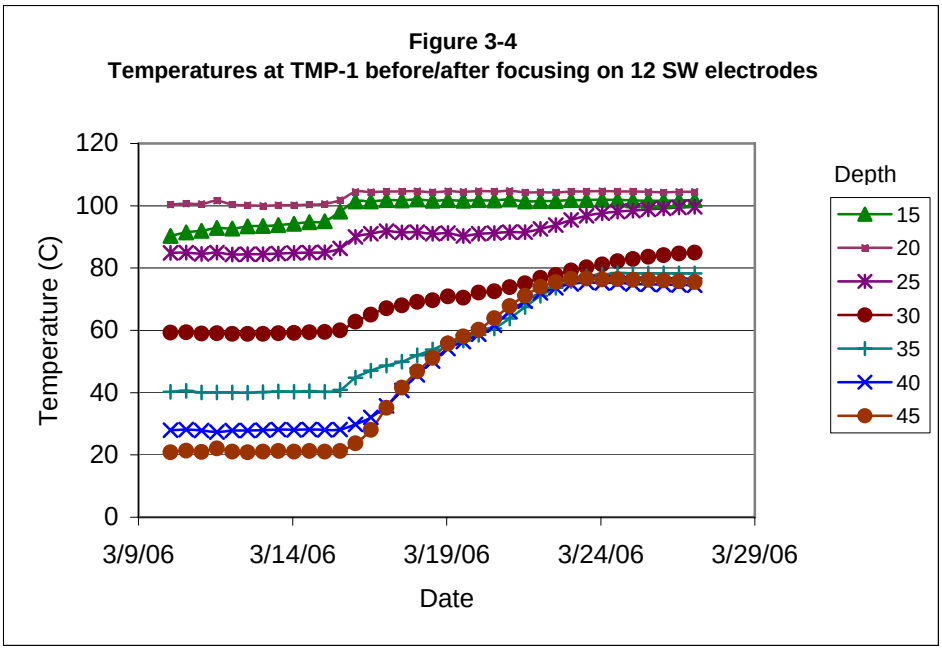
On February 6, 2006 it became apparent that steady state had been reached, and the original temperature goals would not be met. The contractor submitted a revised PCO 27 asking for changes in the performance goals for payment item LS-9. While the PCO was not approved at that time, permission was granted to start focusing the power to yet higher power densities through energizing just 12 electrodes at a time rather than the 18 electrodes wholly within the 60 x 60 foot target area.

The contractor implemented the more-focused/higher-power-density operation approach starting February 21, 2006, applying power only to the 12 most central electrodes (E-7, E-8, E-11, E-12, E-13, E-16, E-17, E-20, E-21, E-22, E-25, and E-26). This provided markedly increased temperatures within the area where the energy was focused, as shown on Figure 3-3.



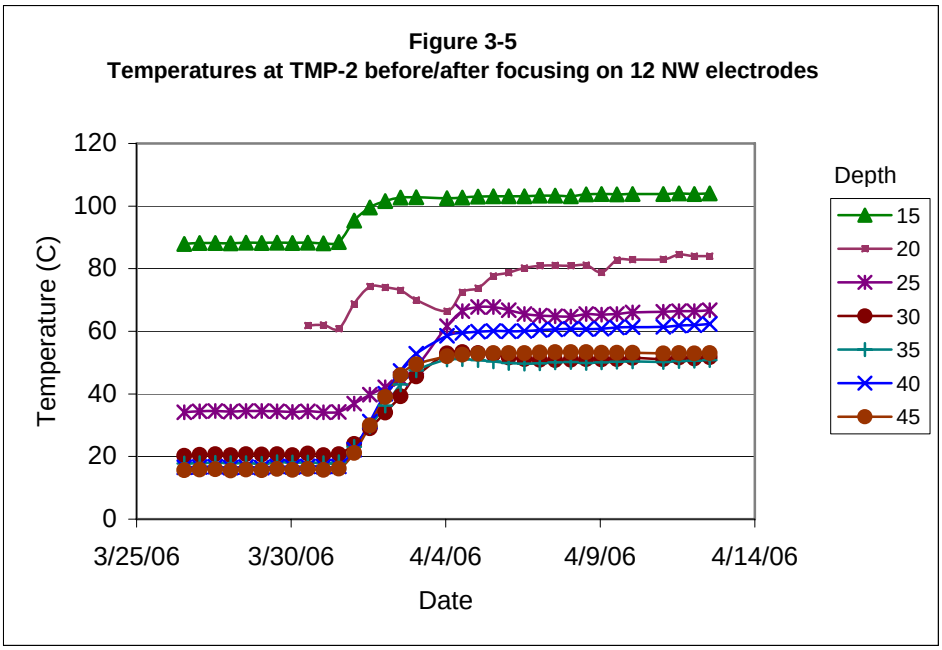
The increase in temperature in the localized area was accompanied by an increase in the recovery rate of PCE (discussed below). This application of power to the 12 most central electrodes continued for about three weeks until the increase in PCE removal rates dropped off.

On March 15, 2006, the contractor shifted the focused power input to the following 12 electrodes: E-1, E-2, E-3, E-6, E-7, E-10, E-11, E-12, E-15, E-16, E-19, and E-20. This was the southwest quadrant of the target zone. This resulted in an increase in this zone, which is best characterized by TMP-1, as shown in Figure 3-4.



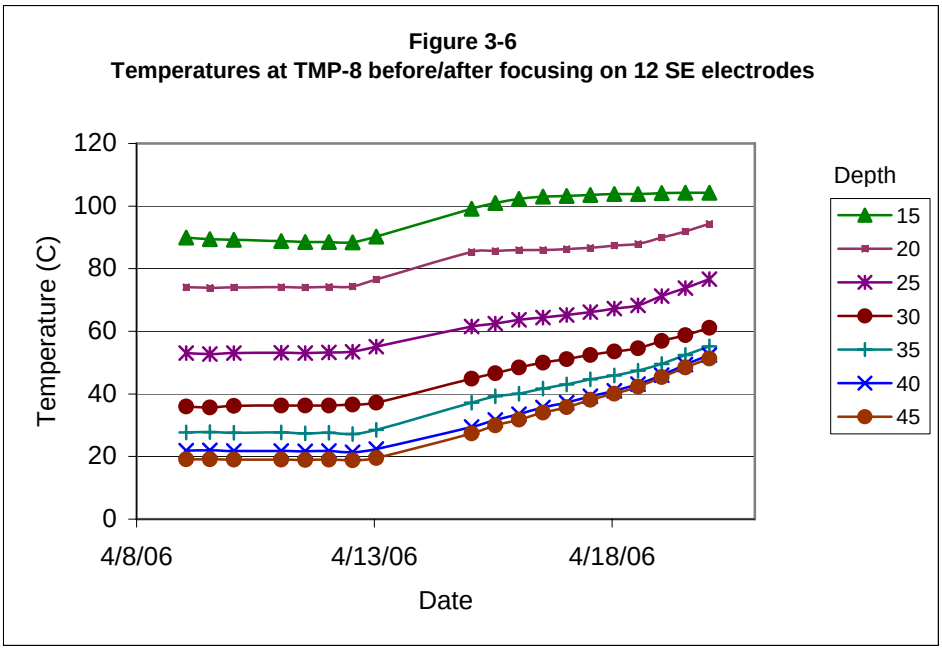
The increase in temperature in the localized area was accompanied by an increase in the recovery rate of PCE (discussed below). This application of power to the 12 southwest electrodes continued for about two weeks until the increase in PCE removal rates dropped off.

On March 31, 2006, the contractor shifted the focused power input to the following 12 electrodes: E-3, E-4, E-5, E-7, E-8, E-9, E-12, E-13, E-14, E-16, E-17, and E-18. This was the northwest quadrant of the target zone. This resulted in an increase in this zone, which is best characterized by TMP-2, as shown in Figure 3-5.



The increase in PCE removal that resulted from the switch to the NW electrodes was less than the switch to the SW electrodes, but was allowed to run for two weeks as with the previous focus area.

On April 12, 2006, the contractor shifted the focused power input to the following 12 electrodes: E-15, E-16, E-17, E-19, E-20, E-21, E-24, E-25, E-26, E-28, E-29, and E-30. This was the southeast quadrant of the target zone. This resulted in an increase in this zone, which is best characterized by TMP-8, as shown in Figure 3-6.



Although a temperature increase was observed after this electrode shift, no increase in PCE removal rates was observed, so no other shifts in focused power were pursued.

PCE removal rates were calculated by measuring the PCE concentration in the extracted gas stream before it entered the catalytic oxidizer (only a very small percentage of the PCE ended up in the condensate that was discharged to the sanitary sewer after treatment with activated carbon. These concentrations multiplied by the gas flow rate provide the mass removal rate.

Since both the gas concentration measurements and the flow rate measurements are point-in-time measurements, URS calculated the PCE removal rate through looking at the readings of the flow totalizer measuring the cumulative volume of gas removing. By graphing the cumulative gas volume removed vs. time, fitting the data to a fourth-order polynomial equation, and then integrating the equation, a more representative flow rate was calculated that would be unaffected by localized variations in the instantaneous flow rate measurements. The rate of PCE removal calculated this was is shown as a function of time on Figure 3-7.

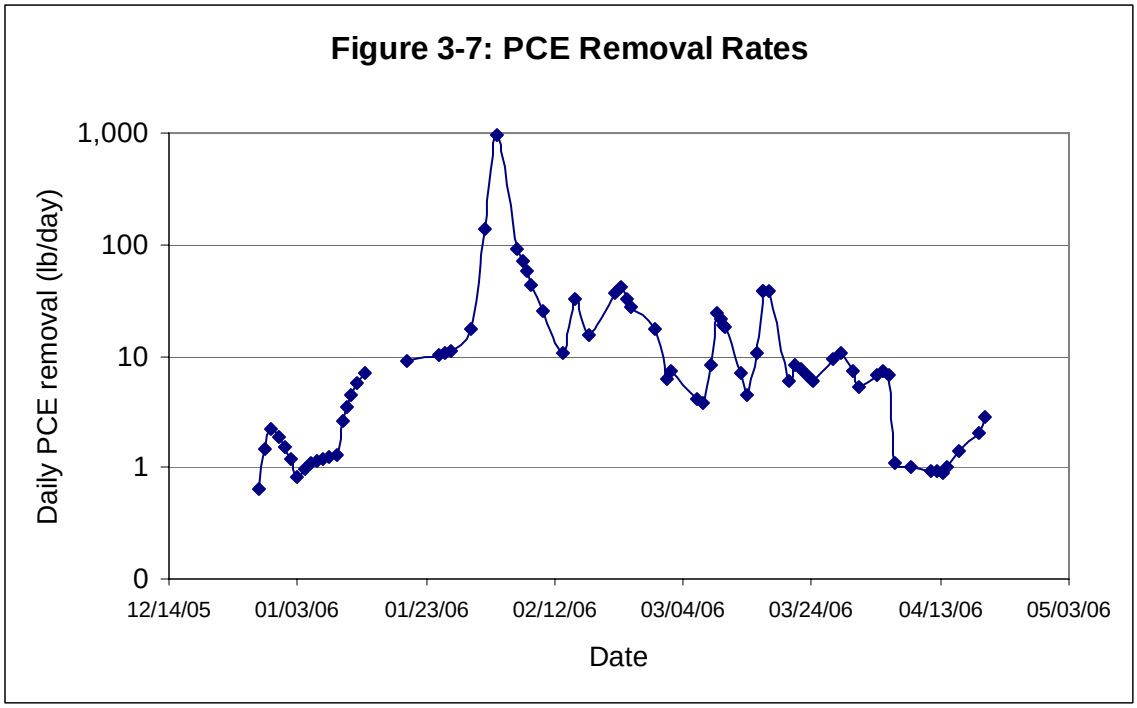
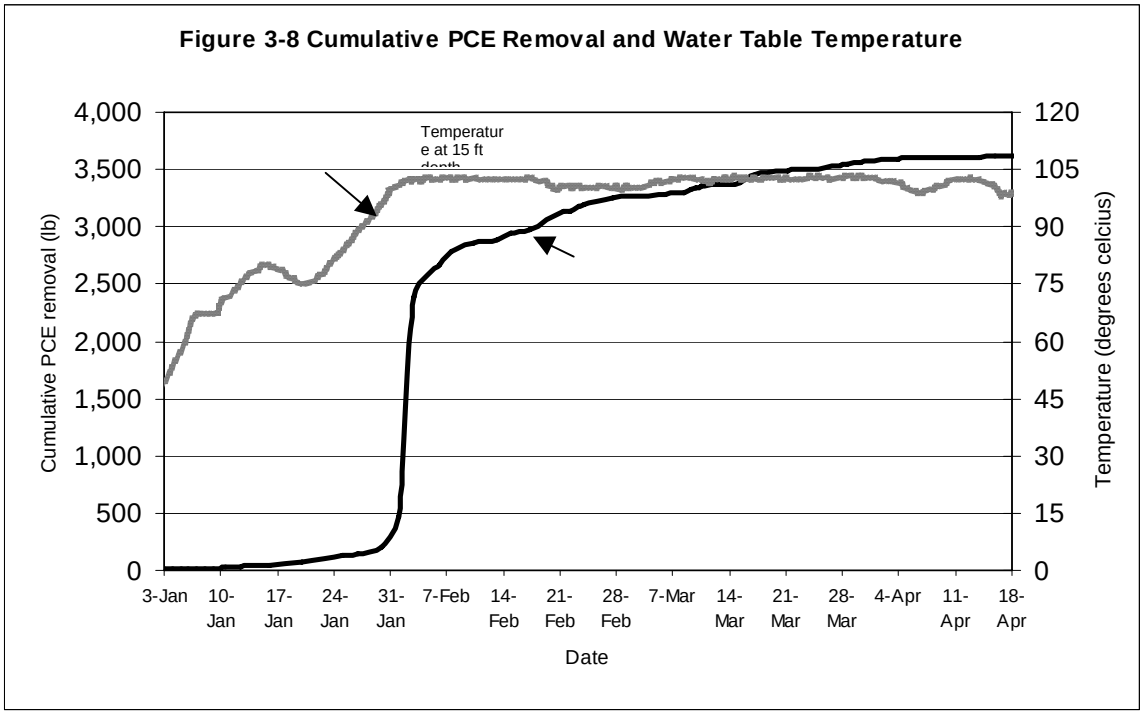
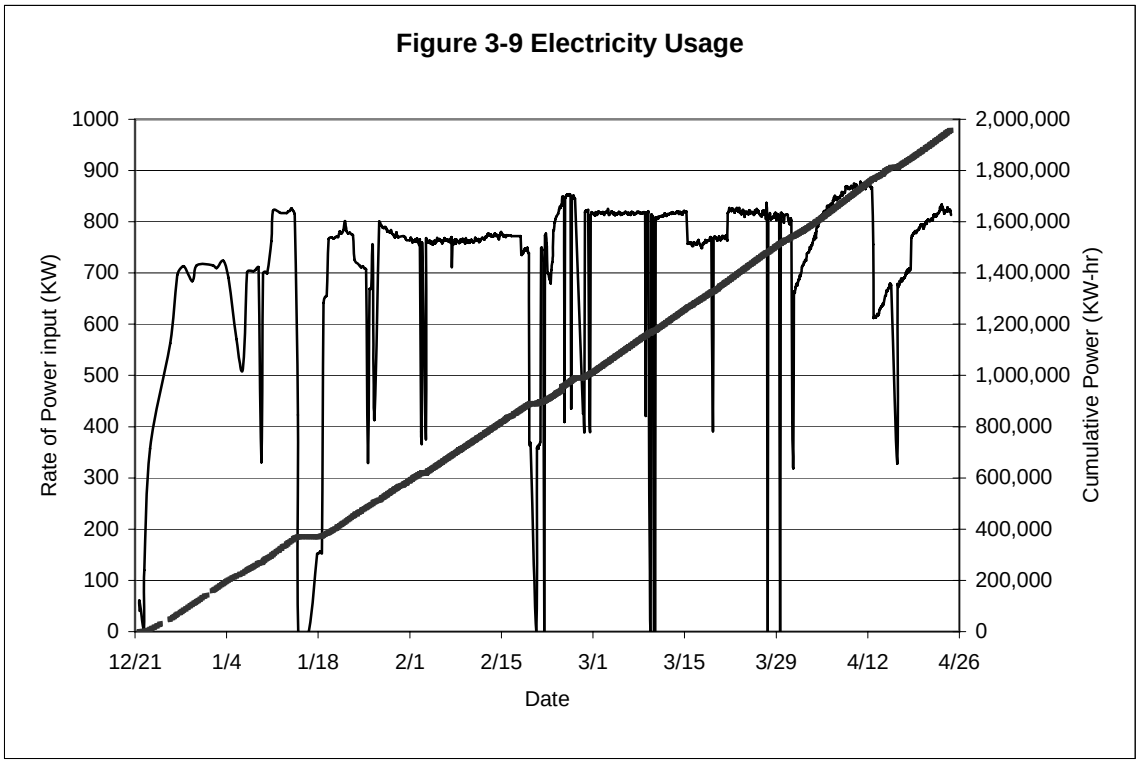


Figure 3-7 shows that a major peak in the removal rate February 3, 2006. As shown on Figure 3-8, which graphs the cumulative amount of PCE removed superimposed with the temperature near the surface of the water table as a function of time, this peak corresponds to the achievement of boiling temperatures at the surface of the water table.

The three minor peaks between February 21, 2006 and March 21, 2006 correspond to the efforts to focus the power input in the center, the northwest and the southwest portions of the treatment zone, respectively. The system was shut down on April 24 after the removal rate had dropped significantly.



The average power input over the course of the project, including the startup period, was approximately 700 KW, with a total of just under 2,000,000 KW-hr put into the ground. Figure 3-9 shows the rate of power input during the project, as well as the cumulative amount of power used for restive heating.



On May 10, 2006, the contractor collected confirmatory soil samples to evaluate the effectiveness of the remedial action. Twenty-five samples were collected from the eight locations shown on Figure 3-10. At each of the locations shown on figure 3-10, a sample was collected each of the following depth intervals: 14-18 feet, 26-30 feet, and 38-42 feet. The 25th sample was collected at location PR-4 at the 51 to 55 foot depth interval. The samples were collected by direct-push techniques. The acetate sample sleeves were cooled in an ice bath prior to removal and placement in the sample containers to minimize the chance of VOC release during sampling. None of the samples contained any PCE, except a detection at 10 μg/kg at the 38-42 foot depth interval at location PR-2.

4.0 SVE SYSTEM INSTALLATION

4.1 Introduction

The SVE system was designed to extract and treat contaminated soil vapor from the unsaturated zone in the three separate source areas at the site. Volatilized VOCs are captured through a system a vapor extraction wells located throughout the three source areas. The extraction and treatment system consists of vacuum blowers, a condensate separator, and offgas treatment through catalytic oxidation. A sub-slab depressurization (SSD) system also was installed in the break room. This system is similar to the SVE, but remains a separate and independent system.

4.2 System Construction and Installation

4.2.1 Vapor Extraction Wells

A total of 16 vapor extraction wells were installed at the site. Ten of the extraction wells are located in Source Area 1, the same source area where ERH remediation of the saturated zone was conducted. Three of the ten wells at Source Area 1 were installed within the bus garage. Due to the apparent success of the ERH, no additional SVE wells were installed within the actual ERH treatment area, a contingency that had been included as part of the Contract Documents. Three extraction wells were installed in Source Area 2, and three wells were installed at Source Area 3. One of these wells is located on the adjacent NYCDEP property. A total of six vapor monitoring points also were installed throughout the three source areas. Boring logs and installation information for all wells are located in Appendix F.

Although there were some minor changes to the location and construction of the three wells inside the bus garage due to obstructions with the drilling equipment and refusal at one well (see Section 2.3.2), all wells generally were installed as directed by the Contract Documents.

4.2.2 Treatment System

The major components of the SVE system are a 55-gallon moisture separator and three regenerative blowers installed in parallel, each capable of 250 cfm at a vacuum of 50 inches of water column. The entire SVE system is housed in a trailer. The system was constructed at an off-site location and then mobilized to the site afterward. URS conducted an inspection and testing of the SVE trailer on January 18, 2006, at the fabrication shop, prior to its mobilization to the site. Minor system problems were identified and corrected.

4.3 System Operation

There are two phases of operation for the SVE system. The first phase is the startup and performance testing, which started on September 6, 2006, and is anticipated to last for a period of one month. During this phase, the system will be monitored more frequently, and include a shorter turn around time for sample results. The system will be managed by the Contractor to meet all of the performance objectives identified for the system in Section 11301 of the Contract Documents, i.e., that the system extracts a minimum of 750 scfm of soil vapor, and that the system can sustain a vacuum of 40 inches of water column at each extraction well. Completion of the startup and testing phase comprises the majority of Part C Substantial Completion.

Following completion of the startup and performance testing, the Contractor will be responsible for operating the SVE system for a total of six additional months (until April 2007). During this period, the Contractor will be responsible for all system operation and monitoring, as well as sampling and any system maintenance that may be required. Completion of the six month operating period (as well as turn over of the SVE system to the NYSDEC), and restoration of the site, comprises the majority of Part D Substantial Completion. Following completion of Part D, URS will prepare a Final Engineering Report to evaluate and summarize operation of the SVE system during the testing (1 month) and operation (6 months) by the Contractor. The Final Engineering Report will be prepared as a supplement to this Final Remediation Report.

4.4 Sub-Slab Depressurization System

The SSD system was installed in a breakroom used by the bus drivers for Atlantic Express. Historical data showed unacceptable concentrations of contaminants in the air of this room. To minimize contaminants that my be migrating up from beneath the slab for of the room, the SSD system was installed. The SSD consists of two penetrations through the concrete slab floor, connected via piping to a small blower mounted on the outside of the building. Collected vapors are discharge to a vent located above the roof line of the building.

Construction of the SSD system was completed by Clayton in May 2005. Smoke testing was conducted on May 19, 2005. The smoke test verified that the system was able to maintain a vacuum beneath the floor slab. The SSD system was later modified to include a valve and discharge line at the low point in the piping system. This line extends through the concrete floor and is used to periodically drain the condensate from the system.

On February 7, 2006, Clayton collected air samples concurrently from the breakroom as well as ambient samples of the outside air. The concentration of PCE in the breakroom was determined to be approximately 631 $\mu g/m^3$ (93 ppbv), which although acceptable based on OSHA standards, is not acceptable based on NYSDOH limitations. The Engineer determined that the SSD system was installed correctly, and therefore Clayton was not responsible for the elevated PCE concentrations. NYSDEC is proceeding with additional mitigation measures in the form of a ventilation system for the breakroom. The existing SSD system will remain in place and continue to maintain the negative pressure gradient under the floor slab. The ventilation system is not intended to provide positive pressure in the room, but simply to help circulate fresh air into the space and flush out any PCE vapors. This modification is being done by URS outside of the construction contract with Clayton.

APPENDIX A

RFIS AND RESPONSES

APPENDIX B

PCOS AND RESPONSES

APPENDIX C

POST-REMEDIATION SOIL CONFIRMATION SAMPLE RESULTS

(INCLUDING DUSR)

APPENDIX D

GROUNDWATER MONITORING LOCATIONS AND SAMPLE RESULTS

APPENDIX E

CATOX EFFLUENT AIR SAMPLES

TREATED CONDENSATE SAMPLES

APPENDIX F

WELL CONSTRUCTION LOGS

BORING LOGS

APPENDIX G

WASTE MANIFESTS

APPENDIX H

PROJECT MEETING MINUTES

APPENDIX I

DAILY AIR MONITORING REPORTS

APPENDIX J

PROJECT SITE SIGN-IN SHEETS

APPENDIX K

PERMITS

APPENDIX L

UST CLOSURE REPORT

APPENDIX M

RECORD DRAWINGS

APPENDIX N

ENGINEER'S DAILY INSPECTION REPORTS

APPENDIX O

CHANGE ORDERS

APPENDIX P

CONTRACT DOCUMENTS AND ADDENDA

APPENDIX Q

NYSDEC NOTICE TO PROCEED LETTER

APPENDIX R

NYSDEC PART A SUBSTANTIAL / FINAL COMPLETION LETTERS

APPENDIX S

MISCELLANEOUS LETTERS