DRAFT LCP OU-2
REMEDIAL DESIGN REPORT

Prepared For:

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In Association with:

ERFS

Environmental Remediation & Financial Services, LLC

OCTOBER 2012

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REVIEWED AND APPROVED BY:

Project Manager: _____ 10-15-2012
Date

Technical Manager: _____ 10-12-2012
Date

October 2012

CERTIFICATION STATEMENT

LCP OU-2 REMEDIAL DESIGN REPORT

I, the undersigned, on behalf of Honeywell, certify that I am and at all pertinent times hereinafter mentioned was a Professional Engineer licensed or otherwise authorized under Article 145 of the Education Law of the State of New York to practice engineering; that I am the person who had primary direct responsibility for the performance of the work performed to complete the Design Report, and that activities described in this report were performed in accordance with the Remedial Design Work Plan dated May 2011.

10/17/2012

David Babcock, P.E. Date
New York State Professional Engineer
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Unauthorized alteration or addition to this engineering document is a violation of Section 7209. Provision 2 of the New York State Education Law

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ACRONYMS

bgs	Below ground surface
CAMP	Community Air Monitoring Plan
CPOI	Chemical parameter of interest
CQAP	Construction Quality Assurance Plan
cy	Cubic yards
ERFS	Environmental Remediation & Financial Services, LLC
FS	Feasibility study
ft	Foot
GPR	Ground penetrating radar
INSOTEC	In situ Oxidative Technologies, Inc.
ISCO	In situ chemical oxidation
LCP OU-2	Linden Chemical and Plastics Operating Unit 2
LNAPL	Light non-aqueous phase liquid
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
ND	Non-detect
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PVC	Polyvinyl chloride
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
ROD	Record of Decision
SCO	NYSDEC Soil Cleanup Objectives
SMP	Site Management Plan
SVOC	Semi-volatile organic compound
USEPA	US Environmental Protection Agency
VOC	Volatile organic compound

EXECUTIVE SUMMARY

The remediation of Linden Chemical and Plastics Operable Unit 2 (LCP OU-2) is part of the continuing effort to restore the overall former LCP site, which is located in an industrial area on Gerelock Road in the Town of Geddes, The 20-acre site consists of two OUs. The LCP OU-2 site, the subject of this design, was formerly a hydrogen peroxide plant.

A Record of Decision (ROD) outlining the selected remedy for LCP OU-2 was issued in April 2010. The ROD included several remedial activities to address contamination in the LCP OU-2 soils and groundwater. This report describes design elements that are necessary for the implementation of the remedy, including the following:

- *In situ* chemical oxidation to permanently treat site soil and groundwater chemical parameters of interest at multiple depths to meet target New York State Department of Environmental Conservation (NYSDEC) Part 375 standards
- Excavation and offsite disposal of approximately 3,100 cubic yards (cy) of shallow soils from around the former building footprints
- Installation of 1 ft. of clean gravel cap and demarcation layer following remediation

The ROD also included the development of a site management plan (SMP) and an environmental easement for the property, including provisions for managing the redevelopment and reuse of the site to be consistent with the established remedial goals. The SMP and environmental easement will be finalized following completion of the remedial activities described herein.

Honeywell has conducted activities that support the design of the selected remedy and support and supplement data collected during the Remedial Investigation (Parsons 2004). These pre-design activities included bench-scale and full-scale pilot studies, additional soil and groundwater sampling, and removal of shallow soils as part of the remedy for the LCP OU-1 site.

This design report has been developed in consideration of the NYSDEC Green Remediation and the US Environmental Protection Agency (USEPA) Region 2 Clean and Green policies.

SECTION 1

INTRODUCTION

1.1 PURPOSE

This report presents the design for the LCP OU-2 Remedial Action. It continues the work being performed under the LCP OU-2 ROD (ROD; Index #D7-0001-01-03) (NYSDEC, 2010) and builds on the following previous submittals:

- Remedial Investigation (RI) (Parsons, 2004)
- Feasibility Study (FS) (Parsons, 2009)
- Remedial Design Work Plan (RDWP) (Parsons, 2011b)

This report includes plans and specifications for:

- Removing approximately 3,100 cy of soil from the unsaturated shallow zone and backfilling the removal area
- Implementing ISCO technology to remediate saturated soils and groundwater in place
- Installing additional monitoring wells and erosion controls during construction
- Restoring surfaces and constructing a final cover
- Providing a description of the content of a SMP

1.2 SITE DESCRIPTION AND BACKGROUND

The former LCP site is located 2 miles northwest of the City of Syracuse, in the Town of Geddes, Onondaga County, New York (see Figure 1.1). The approximately 20-acre site is located in an industrial area on Gerelock Road (formerly called Belle Isle Road), west of Bridge Street (Route 297), and south of the New York State Fairgrounds and an active railroad right-of-way.

The former LCP site consists of two OUs. The OU-2 site, the subject of this design, is a 1.7-acre area in the eastern portion of the site where a former hydrogen peroxide plant was located. LCP OU-2 is located north of the West Flume, south of the New York State Fairgrounds, east of an area of OU-1 called the brine mud area, and west of the former NAKOH Chemical facility. The manufactured hydrogen peroxide at LCP OU-2 used hydrogen gas generated as a byproduct of the chlor-alkali facility located on OU-1. This process included the use of xylene to manufacture hydrogen peroxide. The contaminated soil and groundwater at OU-2 resulted from spills and/or leaks of production chemicals that occurred while the hydrogen peroxide facility was in operation.

The other operable unit for the LCP site is OU-1. NYSDEC issued a ROD for OU-1 in 2000. All of the remedial work at OU-1 was completed by 2008, with the exception of the final cap that will be placed once remediation of Ninemile Creek is complete. Remediation of OU-1 included some work on OU-2. The two buildings formerly located on OU-2, a hydrogen

peroxide plant process building and a hydrogen compressor building, and associated tanks and containers were demolished and/or removed in 2001. In addition, the OU-2 underground sewers and utilities were removed, and surface soil was excavated to depths between 1 and 3 ft. as part of the OU-1 remedial action. Following excavation and regrading, the OU-2 site was covered with approximately 6 inches of clean gravel in August 2005.

1.3 REMEDIAL OBJECTIVES

The LCP OU-2 remedial objectives, as presented in the ROD (NYSDEC 2010), are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals in soil
- Exposures of persons at or around the site to VOCs, SVOCs, and metals in groundwater
- Environmental exposures of flora or fauna to VOCs, SVOCs, and metals in soil
- Contaminant releases from soil into groundwater that may create exceedances of groundwater quality standards

Further, the remediation goals for the site include attaining to the extent practicable:

- Ambient groundwater quality objectives meeting 6 NYCRR Part 703-3 Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (http://www.dec.ny.gov/regs/4590.html)
- Soil quality objectives meeting 6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives (SCOs) (http://www.dec.ny.gov/regs/15507.html)

Remediation objectives for ethylbenzene and xylene, the primary contaminants found at the OU-2 site, are summarized below:

Chemical Compound	Groundwater Cleanup Objective (Class GA)	SCO (Part 375 Protection of Groundwater)
Ethylbenzene	5 µg/L	1,000 µg/kg
Xylene	5 µg/L	1,600 µg/kg

µg/L – micrograms per liter
µg/kg – micrograms per kilogram

1.4 SELECTED RESPONSE ACTION

The following selected response actions for OU-2 are presented in the ROD (NYSDEC 2010):

1. A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.

2. Chemical oxidant(s) and catalyst(s) would be injected into the subsurface to address site remedial action objectives. In addition to the injection of chemical oxidants below the water table, supplemental chemical oxidation treatment of vadose zone soils would be conducted (e.g., direct application of chemical oxidants to the surface soil and/or land farming). Emission and/or odor controls would be implemented as required during remedy construction. Monitoring would be required to ensure that adverse effects to the aquifer or the West Flume would not occur during remediation. Monitoring would also be employed throughout the remedial action to assess the performance and demonstrate the effectiveness of the remedy. In addition, the *in situ* chemical oxidation technology would be extended onto the NAKOH Chemical property to address the NMW-2 (northwest) area.
3. Construction of a soil cover over the site to prevent exposure to contaminated soils. The 1-ft. thick cover would consist of clean soil or crushed stone underlain by a demarcation layer to delineate the cover soil from the subsurface soil. Clean soil is soil that is tested and meets the Division of Environmental Remediation's criteria for backfill or local site background. A cover would also prevent migration, via storm water runoff, of any remaining site contaminants from entering the West Flume.
4. Imposition of an institutional control in the form of an environmental easement that would require (a) limiting the use and development of the property to commercial use, which would also permit industrial use; (b) compliance with the approved Site Management Plan; (c) restricting the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by New York State Department of Health (NYSDOH); and (d) Honeywell to complete and submit to the Department a periodic certification of institutional and engineering controls.
5. Development of a SMP which would include the following institutional and engineering controls: (a) management of the final cover system to restrict excavation below the soil covers demarcation layer. Excavated soil would be tested, properly handled to protect the health and safety of workers and the nearby community, and would be properly managed in a manner acceptable to the Department; (b) continued evaluation of the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified; (c) monitoring of groundwater; (d) identification of any use restrictions on the site; (e) fencing or other means to control site access; and (f) provisions for the continued proper operation and maintenance of the components of the remedy.
6. For remediation of the off-site NAKOH Chemical property, soil would be excavated to the commercial soil cleanup objective for mercury (2.8 parts per million). Soil would be consolidated at the LCP OU No. 1 Site, within the cap and slurry wall system. Clean soil would replace the excavated soil. The NAKOH Chemical property is currently zoned industrial, and the reasonable anticipated future land use for the property and its surroundings is industrial or commercial.
7. Honeywell would provide a periodic certification of institutional and engineering controls, prepared and submitted by a professional engineer or such other expert acceptable to the Department, until the Department notifies the property owner in

writing that this certification is no longer needed. This submittal would: (a) contain certification that the institutional controls and engineering controls put in place are still in place and are either unchanged from the previous certification or are compliant with Department-approved modifications; (b) allow the Department access to the site; and (c) state that nothing has occurred that would impair the ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the Site Management Plan unless otherwise approved by the Department.

8. The operation of the components of the remedy would continue until the remedial objectives have been achieved, or until the Department determines that continued operation is technically impracticable or not feasible.
9. Since the remedy results in untreated hazardous waste remaining at the site, a long-term monitoring program would be instituted. Inspection and, if necessary, repair of the cover would be conducted to ensure the cover prevents human contact with subsurface soils. This program would allow the effectiveness of the cover to be monitored and would be a component of the long-term management for the site.

Components of the remedy for the OU-2 site addressed in this design document are summarized on Figure 1.2 and include all items listed above, with the exception of Item 6, which was addressed in the *LCP Bridge Street OU-2 Site NAKOH Proposed Soil Removal Work Plan* (Parsons 2011a). The work plan was approved by NYSDEC, and the removals are being conducted as part of the Geddes Brook / Nine Mile Creek Remediation.

SECTION 2

PRE-DESIGN INVESTIGATIONS

The remedy specified in the LCP OU-2 ROD, (NYSDEC and USEPA 2010) includes vadose zone remediation. The ROD states that, in addition to the planned ISCO of the saturated zone, "supplemental treatment of vadose zone soils may be necessary. Vadose zone treatment would be evaluated as part of the Remedial Design."

Additional sampling was conducted in early 2012 to provide additional information needed to determine the type and extent of remedy appropriate for vadose zone. This sampling was conducted under a NYSDEC-approved work plan (Parsons 2012). The sampling also served to provide additional information for upcoming remediation of underlying saturated soils. Data generated as part of this investigation were submitted to NYSDEC in May 2012.

2.1 PILOT TESTING

As part of the site FS, chemical oxidation pilot studies were performed on behalf of Honeywell at the LCP OU-2 site between 2005 and 2007 to further assess remedial technologies that were being considered for the site.

The first pilot study was completed in August 2005 by Environmental Remediation & Financial Services, LLC (ERFS) and involved both propagation testing and chemical oxidation bench-scale oxidant screening tests. The second pilot test took place between October 2006 and March 2007 and was completed by In-Situ Oxidative Technologies, Inc. (ISOTEC). For the *in situ* injection process, ISOTEC used stabilized hydrogen peroxide (Fenton's Reagent) and a complexed iron catalyst at a neutral pH to treat both the saturated and vadose zones in a small targeted area of the site. This reagent was used because it was shown to be effective in the treatment of the site chemical parameters of interest (CPOIs) in bench-scale testing. Summary reports from these pilot studies are included with the FS Report (Parsons 2009).

2.2 2012 SHALLOW SOIL INVESTIGATION

Shallow soils are defined as soils reaching from the surface to approximately 7 ft. below ground surface (bgs) (depending on groundwater level fluctuations) and are in the vadose (unsaturated) soil zone. The shallow site soils were characterized in RI sampling performed from 2002 through 2004. High VOC concentrations were detected in the shallow soils in portions of the site (Figure 2.1). Removal of the shallow soils was planned as part of the OU-1 remedy as discussed in Section 1.2. Portions of the upper 1 to 3 ft. of soil (approximately 6,200 cy) were excavated from OU-2 from late 2004 through June 2005. The original excavation was to include the upper 3 ft. of soils at OU-2; however, some sections of the site were found to contain light non-aqueous phase liquid (LNAPL), which is less dense than water. Consistent with discussions with NYSDEC, areas containing significant LNAPL were not excavated. Accordingly, 3 ft. were removed over approximately 50 percent (western half) of OU-2, and 1 to 2 ft. were removed from the remaining areas.

Because LNAPL was found during the 2004-2005 work, additional shallow soil sampling was performed in 2012. Direct push samples were collected at 21 locations within the northeast portion of the site to a depth of 6 ft. to characterize and better delineate areas of high VOC concentrations and the presence of LNAPL. High concentrations of xylene and ethylbenzene were detected around and within the footprint of the former peroxide building, shown on Figure 2.2. Samples were also analyzed for ignitability, reactivity, and corrosivity, and were found to have none of these characteristics.

2.3 2012 DEEP SOIL CHARACTERIZATION

The OU-2 soils above bedrock consist of four types of soils as follows from top to bottom: (1) 3 to 7 vertical ft. of fill; (2) 1 to 6 ft. of less permeable clay/clayey-silt; (3) approximately 35 ft. of silty-sand with intermittent lenses of clayey silt; and (4) glacial till. Borings completed at OU-1 in 2002 encountered Vernon Shale bedrock at depths of 51 to 78 ft. Depth to the water table is generally 4 to 7 ft. bgs.

Based on 2004-2005 sampling results, subsurface soils at OU-2 are impacted primarily from 3 to 20 ft. bgs as shown in Figure 2.1. Previous construction activity at the site may have breached the layer of clay/clayey silt allowing CPOIs to migrate further downward than they would naturally. VOCs detected in OU-2 subsurface soil are primarily xylenes and ethylbenzene. On average, xylenes make up 85 to 95 percent of the VOCs in site subsurface soils, and ethylbenzene makes up the remaining 5 to 15 percent. These two VOCs were detected in soil above NYSDEC Part 375 SCOs for protection of groundwater (NYSDEC 2006) as deep as 20 to 25 ft. bgs.

2.4 2012 BASELINE GROUNDWATER QUALITY

Groundwater has previously been sampled during the RI, pilot studies, and the pre-design investigation. Site monitoring wells were sampled for the 2003 and 2004 sampling events, and the results are shown on Figure 2.3. Effects on local groundwater from impacted subsurface soils are particularly evident in groundwater analyzed from monitoring wells PMW-1S, PMW-2S, PMW-3S, and NMW-2S. Xylene and ethylbenzene are the only VOCs observed in groundwater at OU-2 above New York State Class GA groundwater quality standards. Xylenes make up approximately 90 percent of the VOCs detected in affected site groundwater, and ethylbenzene makes up the remaining 10 percent. The 2012 sampling concentrated on the wells that were highly impacted in the previous events. Results of this sampling showed little changes in groundwater quality or movement when compared to previous sampling events. Groundwater contours for the deeper groundwater zone are presented on Figure 2.4. Deep groundwater at OU-2 appears to flow south toward the West Flume with low hydraulic gradients.

SECTION 3

DESIGN ELEMENTS

3.1 GENERAL SITE WORK

The scope of work for the shallow soils at OU-2 includes removal and temporary staging of the existing gravel layer, excavation of impacted soil to the groundwater table, backfilling the excavation with a foot of sand/gravel to support the installation of ISCO injection laterals, and backfill of the remaining excavation with structural fill to existing grade. Following completion of excavation and backfill activities, multiple rounds of ISCO will be conducted to address impacted deep soils and groundwater. Following completion of ISCO activities, a final cap will then be installed over the entire OU-2 site to provide a long-term barrier to exposure to shallow soils. The site work is detailed in the following sections.

3.1.1 On-site Utilities

As part of the previous remedial activities performed at the OU-2 site, many of the previously existing sewers and utilities were removed from the OU-2 site. However, additional active and inactive utilities may still exist on-site. Before beginning intrusive work, Parsons will contact Dig Safely New York to locate and mark underground utilities. In addition, Parsons will hire a private utility marking company to use ground penetrating radar (GPR) as an additional precautionary measure to identify underground utilities.

If necessary, active utility lines found at the OU-2 site will be terminated, re-routed, or protected during the remediation effort. In addition, if necessary, any inactive utilities found will be removed, plugged or grouted in place.

3.1.2 Site Preparation and Control

Site preparation will include the tasks described below.

- Temporary facilities: Temporary facilities, such as trailers, utilities, decontamination pad(s), and staging areas will be installed, as required. Existing gravel roads will be used to access the perimeter of work areas. No additional access roads are anticipated for this effort. Parsons has contracted with ERFS to conduct ISCO at the OU-2 site. ERFS will construct temporary facilities to support ISCO activities. A typical layout of this equipment and facilities anticipated during ISCO at the OU-2 site is shown on Figure 3.1 These facilities are discussed further in Appendix A.
- Clearing: The site has already been cleared of existing buildings and brush. No additional clearing activities are anticipated.
- Cultural resource investigations were conducted in preparation for previous remedial activities conducted at the OU-1 and OU-2 sites. Since there were no findings of historical or pre-contact importance during the investigation for OU-2, no further evaluations related to cultural resources will be conducted prior to initiation of remedial activities at OU-2.

3.2 SHALLOW SOILS

The selected remedy, as presented in the ROD (NYSDEC 2010), included treatment of shallow soils to address contamination. Following further consideration of treatment options for shallow soils and discussions with NYSDEC, it was determined that chemical treatment would not be effective for reaching remedial goals in shallow soils. In addition, biological treatment would be undermined by ISCO activities addressing deeper contamination, as oxidation would destroy any existing microbial activity it encounters. Therefore, the designed remedy for shallow soils will consist of excavation and offsite disposal of shallow soils exceeding the SCOs, followed by backfill and restoration.

3.2.1 Stormwater Management/ Erosion Control

Since the shallow soil excavation activities will result in a disturbance of less than one acre, neither an NYSDEC State Pollutant Discharge Elimination System stormwater general permit nor a USEPA National Pollutant Discharge Elimination System storm water general permit will be required.

Although state and federal permits will not be required, stormwater management and erosion control are still required to prevent site run off. These controls will consist of silt fencing and similar elements to prevent significant soil erosion. Stormwater from upgradient locations will be routed temporarily away from exposed materials and excavations using silt fencing. No on-site stockpiling of excavated material is planned prior to transport to the offsite disposal facility. Any precipitation coming into contact with exposed material within the excavation area will be retained on-site and allowed to drain into the subsurface. The stormwater and erosion control structures (silt fencing) will be temporary and maintained and inspected for the duration of the excavation work. These structures will be removed once surface work in each portion of the site is complete.

3.2.2 Gravel Removal/ Staging/ Reuse

During part of the OU-1 remediation between 2004 and2005, 1 to 3 ft. of surface soils were removed from OU-2. Off-site clean gravel was imported to those cover soils that were originally anticipated to be removed but were left in place due to LNAPL presence.

To the extent practicable, this gravel will be removed and stockpiled on-site for reuse following completion of the removal activities. Gravel will be inspected for signs of staining. Stained gravel and gravel in direct contact with underlying soils will be removed and disposed of offsite with excavated soils.

3.2.3 Soil Excavation

Shallow soils exceeding Part 375 criteria noted in Section 1.3 for VOCs/SVOCs will be removed from the site as shown on Drawing C-002 included in Appendix B. The estimated total volume of material to be removed is approximately 3,100 cy, as shown on Drawing C-002.

The excavation limits shown on Drawing C-002 are based on pre-design sampling. In general, the shallow soils will be removed to just above the groundwater table. The excavation sidewalls will be excavated at a 2:1 slope, as shown in excavation detail on Drawing C-006.

Groundwater in the site varies from approximately 3 ft. bgs to approximately 7 ft. bgs. Nearby monitoring wells will be gauged prior to excavation activities to determine the groundwater elevation at the time construction activities begin. Parsons will field-direct activities to remove soils to approximately 6 inches above this elevation to avoid accumulating groundwater in the open excavation. Based on field observations, the removal may extend deeper, should heavily stained soils be encountered close to the planned excavation elevation.

Concrete foundations and piers are anticipated to be encountered during excavation within the footprint of the former building foundations. To the extent necessary to facilitate soil removal, concrete will be removed and taken with excavated soil to an offsite disposal facility. The concrete elements removed from the excavation area will be broken down to the extent required for acceptance at the disposal facility. Existing concrete foundation structures not inhibiting soil removal will be left in place.

Existing groundwater monitoring well PMW-2S, which falls in the footprint of the shallow soil removal area, will be mechanically removed to the extent practical as part of this excavation. The well is installed to an approximate depth of 16 ft. bgs, and does not penetrate a confining subsurface layer. Following completion of the removal and backfill, this well will be reinstalled, as discussed in Section 3.3.4.1

3.2.4 Transportation and Disposal

Because of the potential for volatilization of site contaminants, excavated soil will be loaded directly into waiting vehicles for transportation off-site to an approved disposal facility. Prior to departure, trucks will be tarped, and tires will be dry-brushed as necessary to remove visible soil. In addition, odor/vapor controls will be applied as needed and are described in Section 3.2.7.

As part of the 2012 Pre-Design Investigation, shallow soils have been sampled and characterized for off-site disposal. Based on the results of this sampling, it has been determined that the materials can be disposed of as non-hazardous waste. Due to the volume of material to be taken off-site, it is anticipated that an additional five characterization samples will be required for off-site disposal. The planned off-site disposal facility for excavated soils is High Acres Landfill, located in Fairport, New York, approximately 70 miles from the site.

The excavated material also will include construction debris from building foundations, anticipated to consist of concrete and steel rebar. This debris will be removed, broken up as required, and disposed of with the removed soil.

3.2.5 Confirmatory Sampling

Following excavation, side wall post-excavation soil samples will be collected in accordance with the Construction Quality Assurance Plan (CQAP), included as Appendix C. One composite sample will be collected for every 30 ft. of sidewall. Since ISCO will address underlying soils, no samples will be collected on the bottom of the excavation. Samples will be submitted and analyzed for SCOs, as summarized in Table 1.

3.2.6 Backfill/ Final Grade

Following completion of the soil excavation, injection laterals for chemical oxidant addition will be installed as shown in Drawing C-003 (Appendix B), to facilitate the injection and distribution of chemicals during the ISCO treatments. These laterals will be installed in an 18-inch thick gravel layer (see detail on Drawing C-006) to further facilitate oxidant/reagent distribution. To the extent practicable, on-site stockpiled surface gravel will be used for this gravel layer.

Following installation of injection laterals, the remaining excavation area will be backfilled with structural fill obtained from a source demonstrated to meet NYSDEC requirements for backfill or local site background.

The remedy for the entire OU-2 site also calls for the placement of a cover consisting of soil or crushed stone to prevent contact with soils remaining onsite. A 1-ft. layer of gravel will be installed following completion of ISCO activities. The finish grade and site restoration plan for the site are shown on Drawing C-004. A demarcation layer (Tencate Mirafi orange delineation nonwoven geotextile or approved equal) will be placed beneath the 1-ft. layer of gravel to delineate the on-site soils remaining in place following achieving cleanup Part 375 criteria noted in Section 1.3. Backfill materials will be sampled and analyzed per the CQAP to verify that they meet the NYSDEC criteria for backfill or local site background. The excavation/backfill and injection trench details are shown on Drawing C-006.

3.2.7 Odor Control

Site soils are impacted with high concentrations of xylenes and ethylbenzene. Disturbing these soils during excavation has the potential to release these contaminants into the work zone. To address this potential impact, measures to cover or mitigate emissions will be maintained on-site while excavation activities are ongoing. Countermeasures will include, but will not necessarily be limited to water sprays, tarps, and foaming agents. If necessary, additional countermeasures will be identified and implemented to mitigate potential. Countermeasures will be applied as needed during the excavation process, onto soils contained in trucks leaving the sites, and on the open excavation at the end of each day as needed based on air monitoring results.

Air quality monitoring will be conducted around the site perimeter to ensure the removal activities are not impacting air quality. Community air monitoring will be in accordance with NYDOH's Generic Community Air Monitoring Plan (CAMP), included as Appendix D.

3.3 DEEP SOIL/ GROUNDWATER

3.3.1 *In-Situ* Chemical Oxidation

The selected remedy as outlined in the ROD includes the injection of oxidizing chemicals into the subsurface to address organic chemicals found in the deep soils and groundwater. The oxidizing reaction breaks down contaminants found onsite, such as xylene and ethylbenzene, into environmentally benign byproducts. Injections will take place over the course of approximately one year to bring contaminant levels in soil and groundwater down to site cleanup objectives.

ISCO activities will take place primarily on the OU-2 property, although it will extend onto the adjacent NAKOH property in two areas, as shown in Figure 1.2.

3.3.2 Summary of ERFS SOW

ERFS will perform ISCO activities at LCP OU-2 using several different delivery mechanisms to obtain the necessary oxidant/reagent distribution needed to bring soil and groundwater concentrations down to the cleanup objectives. These mechanisms include direct push injections, lateral injection piping, polyvinyl chloride (PVC) injection wells, and, if necessary, propagation (creating high permeability flow paths in the subsurface to aid in the distribution of oxidants). Oxidizers to be used onsite will include catalyzed hydrogen peroxide and activated sodium persulfate (as warranted). Hydrogen peroxide is a cost-effective oxidizer that reacts quickly with any organic material it encounters. Persulfate is longer-lived in the subsurface and can thereby have a larger radius of influence. Both hydrogen peroxide and persulfate have been effectively applied at many other sites in the United States with similar cleanup objectives.

To treat LCP OU-2 soils and groundwater, ERFS has divided the site into sub-areas and will tailor the remedial approach for each sub-area based on the contaminant distribution, subsurface conditions, other considerations (e.g., proximity to the West Flume), and based on the reaction of the subsurface to ongoing treatments. These site sub-areas as now defined are shown in Drawing C-005 (see Appendix B). ISCO parameters such as injection point-spacing, injection flowrate, and oxidant selection will be adjusted as needed during ISCO implementation. Additional details pertaining to the ISCO activities are included in the work plan for ISCO Treatment of OU-2 prepared by ERFS (see Appendix A).

3.3.3 Remedy Performance Monitoring (Soil and Groundwater)

In general, groundwater sampling and analysis will be used to gauge and guide ISCO activities. Once groundwater data indicate that site contaminants have been treated to groundwater quality objectives, soil sampling will be conducted as final verification. Based on the results of soil sampling, individual sub-areas will be cleared or additional injection will be conducted. As part of this sampling program, several new groundwater monitoring wells will be installed to supplement existing monitoring wells.

3.3.3.1 Additional Pre-ISCO Monitoring

Additional groundwater monitoring will be conducted following shallow soil excavation activities and no more than one month prior to planned initiation of ISCO activities, as described below.

3.3.3.1.1 Baseline Groundwater Monitoring

After completion of the shallow soil excavation described in Section 3.2, monitoring well PMW-2S (which will be removed during the shallow excavation) will be replaced. The remaining wells will also be assessed for damage that may have occurred during the shallow soil removals. Any damaged wells will be repaired and/or replaced depending on the specific condition and reparability. Additionally, four intermediate depth wells will be installed and

screened between 15 to 25 ft. bgs to supplement existing monitoring wells and provide additional groundwater data. As shown on Drawing C-005, the new wells will be installed in proximity to PMW-6S, the new PMW-2S, PMW-3S and D, and to the east of PMW-4S near PGP-11.

Replacement and new monitoring wells will consist of 2-inch PVC casings with 10-slot screens. A screen length of 10 ft. will be used for these wells. Well construction details are shown in Drawing C-006.

After additional monitoring well installation and development and before initiating chemical oxidation, one round of low-flow groundwater samples will be collected and analyzed as described in the CQAP (see Appendix C). Data from these wells will also be used to evaluate remedy effectiveness in the interim and final stages of the ISCO injections.

3.3.3.1.2 Soil Monitoring

There are soil analytical results from previous sampling events for at least one location in each sub-area depicted in Drawing C-005. These will be used for baseline purposes and will be compared to soil sample results collected after completion of remedial activities. No additional soil samples will be collected prior to ISCO activities.

3.3.3.2 Interim Progress Monitoring

Following the first two ISCO injections, one additional round of groundwater samples will be collected utilizing low-flow techniques to evaluate effectiveness of the remedy to date and to focus further ISCO injections to areas with elevated groundwater results. Any monitoring wells that were non-detect (ND) for VOCs based on prior monitoring results will not be included during this interim sampling event. Samples will be collected and analyzed as described in Section 3.3.4.1. Additional interim groundwater sampling events will be conducted as necessary depending on the first interim sample results and evaluation of the remedy to date. Results will be used to determine where additional ISCO events may be required.

3.3.3.3 Pre-Final Sampling

3.3.3.3.1 Groundwater

A round of groundwater sampling will be completed following completion of ISCO injections. Results from this round of samples will be compared to prior results and to the groundwater objectives summarized in Section 1.3. Based on the sample results, Honeywell and the NYSDEC will determine the necessity for additional injections and groundwater sample collection. Groundwater samples will be collected as described in Section 3.3.4.1.1. Should results of the interim progress monitoring show sufficient reduction in contaminants to warrant initiation of the final soil sampling round, this pre-final groundwater sampling may not be necessary.

Final groundwater sampling will be repeated, to allow the sampling to account for any potential rebounding period (transfer of contaminant from adsorbed-to-soil phase to dissolved phase) following the final ISCO event. The length of this period will be determined in consultation with NYSDEC, and will be based on data collected during ISCO progress monitoring sampling events.

3.3.3.3.2 Soils

Once the groundwater sampling results indicate groundwater objectives have been reached to the extent practicable, soil samples will be collected for comparison to prior results and Part 375 SCOs. Soils samples will be collected using direct push methods from two sample locations within each of the 10 sub-areas, as shown on Drawing C-005. Soil samples will be collected and analyzed on 5-ft. intervals to a depth of 25 ft. and in accordance with sampling procedures included in the CQAP (see Appendix C). The 0- to 5-ft. interval will not be analyzed because soil exceeding cleanup objectives in this interval will have been removed. Soil sampling locations will be determined in the field, in consultation with NYSDEC.

3.3.4 West Flume / Aquifer / Barrier Wall Monitoring

As required by the ROD, monitoring will be conducted to ensure that adverse effects to the aquifer or the West Flume do not occur during remediation. This monitoring will be accomplished primarily though the groundwater monitoring program described in Section 3.3.3. In addition, visual monitoring of the West Flume will be conducted during ISCO activities for evidence of impacts (e.g., foaming from oxidation, formation of oily sheen). Evidence of any impacts found will be assessed to determine their origin. Any effects tied to ISCO at OU-2 will prompt a modification to the ISCO process. In addition, while ISCO activities are taking place in the southern portion of the site, monitoring will be conducted to monitor the barrier wall on OU-1. This monitoring will be done by monitoring groundwater at existing OU-1 well PZ-3B (mid depth), for changes in pH. Any changes in pH may be an indication that the oxidation reaction is in close proximity to the well. Evidence of this condition will prompt further evaluation to determine if the ISCO activities should be modified.

3.3.5 Evaluation of Final Sampling Results

Following receipt and validation of final soil and groundwater data, Honeywell and NYSDEC will assess the data to determine whether each of the sampling grid areas, as shown on Drawing C-005, has demonstrated an acceptable level of contaminant reduction. If needed, additional focused injection events will be completed followed by focused resampling as warranted.

3.4 ENVIRONMENTAL EASEMENT

As part of the selected remedy as outlined in the ROD, an Environmental Easement will be obtained for the LCP OU-2 site, which will accomplish the following:

- Limit the use and development of the property to commercial and/or industrial use
- Restrict the use of groundwater onsite for drinking purposes
- Require compliance with an approved SMP
- Require Honeywell to complete and submit to the Department a periodic certification of institutional and engineering controls

Following completion of the site remedial activities, Honeywell will submit the Environmental Easement for NYSDEC's review in accordance with Article 71, Title 36 of the New York State Environmental Conservation Law.

3.5 SITE MANAGEMENT PLAN

As part of the selected remedy as outlined in the ROD, an SMP will be prepared to maintain the measures in place to eliminate contact potential with site soils which remain on site and to monitor future redevelopment and/or reuse of the site. The SMP will be submitted for NYSDEC approval following completion of the onsite remedial activities, in conjunction with the submittal of the Final Engineering Report. The SMP will subsequently be linked to the Environmental Easement to assure implementation by any future property owner. The content of the SMP is described in the following sections.

3.5.1 Management of Final Cover

Periodic monitoring of the cover will be performed once the final cover is placed. The SMP will define the frequency of these inspections. Each inspection will include a visual observation that the gravel layer is intact and that the demarcation layer is undisturbed. Any significant erosion or damage to the gravel layer will be repaired. Weed growth will be controlled as needed.

Any future redevelopment activities that require the disturbance of this gravel layer will require coordination with NYSDEC. Testing of soil excavated below the site's demarcation layer will be required, and management of excavation spoils will require NYSDEC approval.

3.5.2 Site Access Control

LCP OU-2 is currently accessed through a site road from the LCP OU-1 site. This access road crosses the West Flume, and access is currently restricted by a locking gate. The SMP will address the installation of a new site perimeter fence to restrict site access. Proper signage will be posted on the fence to clarify site redevelopment restrictions and the presence of the demarcation layer. The condition of the site perimeter fence will be inspected periodically, and any damage will be repaired.

3.5.3 Groundwater Monitoring

Groundwater sampling may be required to monitor groundwater conditions following completion of the remedial activities. The SMP will outline the extent and frequency of the monitoring activities, which will be determined based on the results of on-site ISCO activities.

3.5.4 Redevelopment Monitoring

The SMP will outline plans for the monitoring and inspection of redevelopment at the LCP OU-2 site for adherence to site use restrictions and to evaluate/mitigate potential vapor intrusion into any future buildings constructed on-site.

SECTION 4

SCHEDULE

Remedial activities for LCP OU-2 are scheduled to begin in winter 2012/2013 with the removal of shallow soils. Removal of shallow soils and backfill activities are expected to take one to two months. Following completion of the excavation and backfill activities, ERFS will mobilize to the site for the completion of ISCO activities. ISCO is expected to take up to two years to reach site goals.

SECTION 5

REFERENCES

New York State Department of Environmental Conservation. 2010b. Record of Decision. LCP Chemical Operable Unit No. 2. April 2010.

New York State Department of Environmental Conservation. 2010c. Order on Consent and Administrative Settlement (Index # D7-0001-01-03). Signed December 30, 2010.

Parsons, 2004. Final Remedial Investigation Report for LCP OU-2. Prepared for Honeywell, Inc. September 2004.

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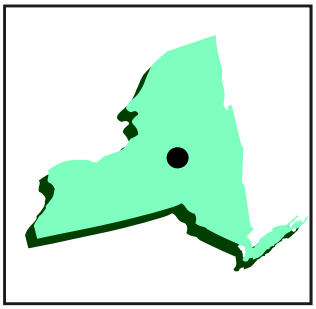
Parsons, 2011a. Final Remedial Design Work Plan LCP Bridge Street Operable Unit 2. Prepared for Honeywell, Inc. May 2011.

Parsons, 2011b. Final LCP Bridge Street OU-2 Site NAKOH Proposed Soil Removal Workplan. Prepared for Honeywell, Inc. July 2011.

Parsons, 2012. LCP OU-2 Supplemental Sampling Data and Additional Sampling Workplan. Prepared for Honeywell, Inc. January, 2012.

FIGURES



New York
Syracuse West Quadrangle

N

LATITUDE: N40° 42' 51"
LONGITUDE: W74° 06' 07"

FIGURE 1.1

Honeywell

TOWN OF GEDDES,
NEW YORK

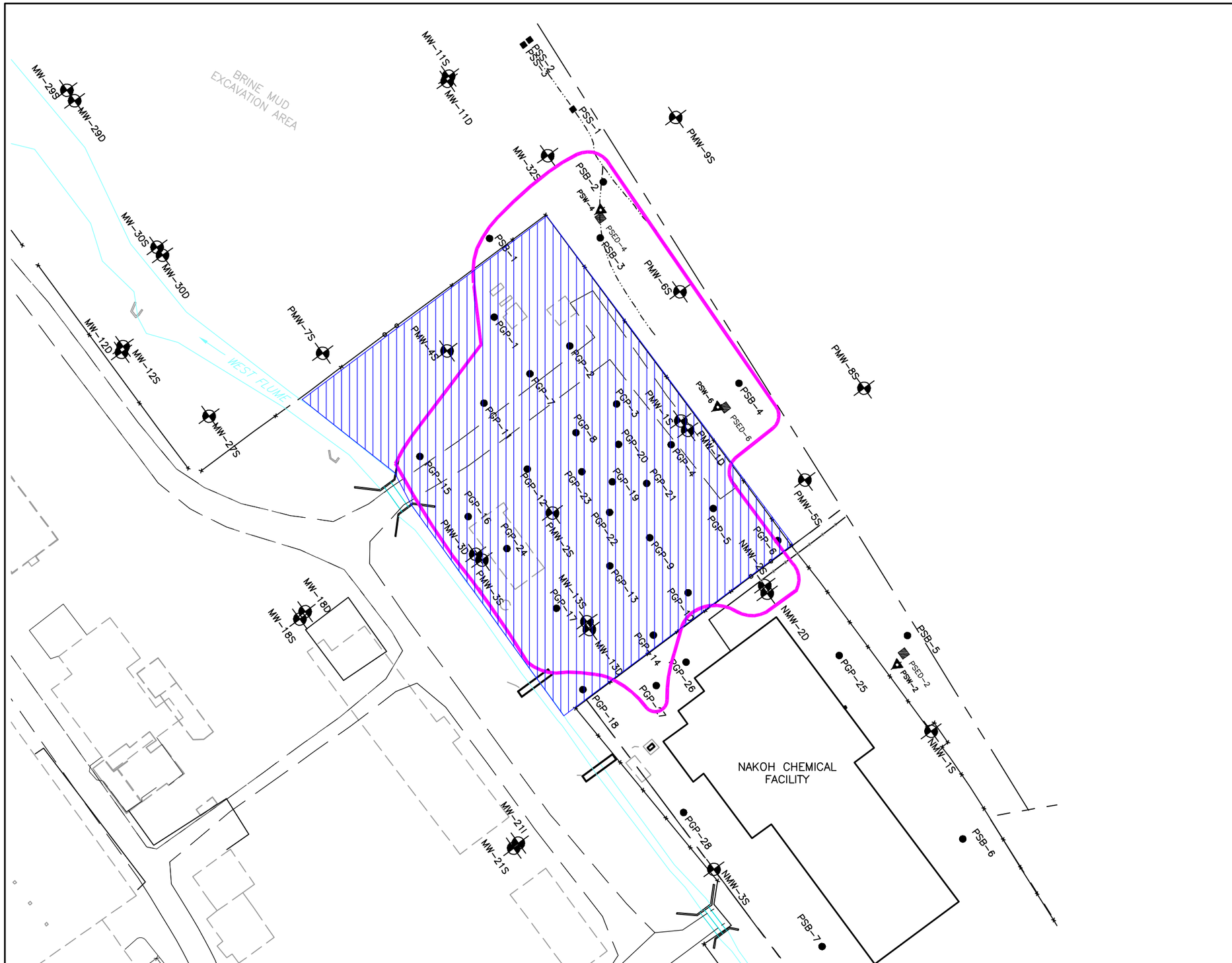
LCP BRIDGE STREET OU-2

SITE LOCATION MAP

PARSONS

290 ELWOOD DAVIS ROAD, SUITE 312, Liverpool, New York 13088* Ph: (315) 451-9560

P:\Honeywell – Syr\444170\cad\dec submittal\44170SLM-design.ppt



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PLOT DATE: 6/28/2012 1:17 PM PLOTTED BY: RUSSO, JILL

LEGEND

- FENCE
- DIRT ROADS
- PAVED ROADS
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LIMITS OF IN-SITU CHEMICAL OXIDATION (ALTERNATIVE 4)
- APPROXIMATE LIMITS OF SOIL COVER ON LCP OU-2 PROPERTY
- MONITORING WELL LOCATIONS
- SOIL BORING LOCATIONS

NOTES:

LIMITS OF REMEDIATION ARE BASED ON DATA FROM THE REMEDIAL INVESTIGATION AND ARE SUBJECT TO REVISION DURING DESIGN AND IMPLEMENTATION.

MAP SOURCE: C.T. MALE ASSOCIATES, P.C. DATED 12/03.

80 40 0 80 160

SCALE: 1"=80'

FIGURE 1.2

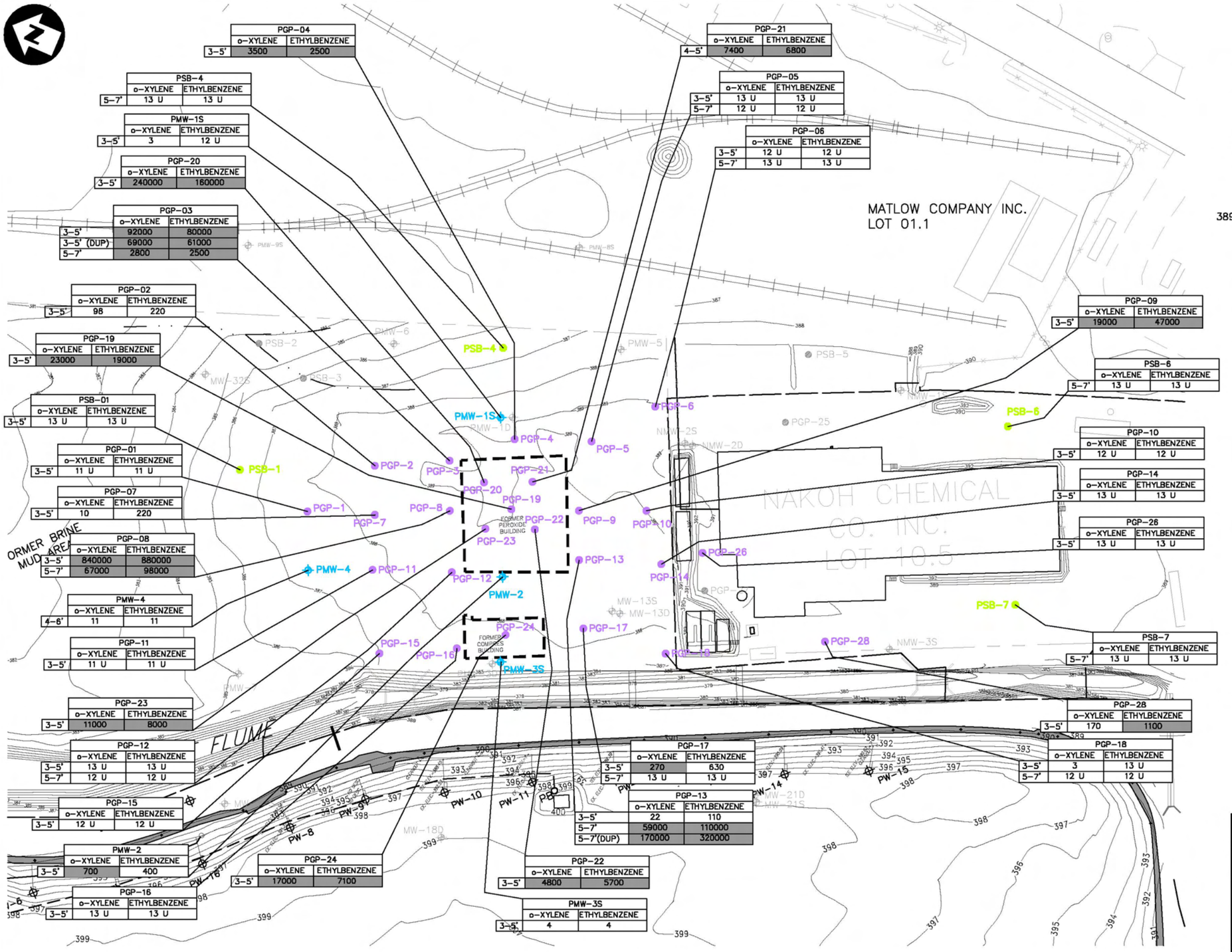
Honeywell

TOWN OF GEDDES, NEW YORK

REMEDIAL DESIGN SUMMARY

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560



LEGEND

- FENCE
- FORMER STRUCTURES
- DIRT ROADS
- EXISTING STRUCTURES
- FORMER PROCESS SEWER
- APPROXIMATE PROPERTY LINE
- 389 — GROUND SURFACE CONTOUR ELEVATIONS (IN FEET ABOVE MEAN SEA LEVEL)
- MONITORING WELL LOCATIONS
- PGP — GEOPROBE BORING LOCATIONS
- PSB — SOIL BORING LOCATIONS
- NMW-1 — MONITORING WELL AT NAKOH CHEMICAL

	LOCATION ID	
	o-XYLENE	ETHYLBENZENE
SAMPLE DEPTH IN FEET	RESULTS IN ug/Kg	RESULTS IN ug/Kg

U – NOT DETECTED

DATA THAT EXCEEDS PART 375 (o-XYLENE OVER PART 375:17) (ETHYLBENZENE OVER PART 375:16)

80 40 0 80 160

SCALE: 1"=80'

FIGURE 2.1

Honeywell

TOWN OF GEDDES, NEW YORK

SHALLOW SOIL SAMPLE LOCATION AND RESULTS (PRE 2012)

PARSONS

301 PLAINFIELD ROAD * STE 350 * SYRACUSE, NY 13212 * 315-451-9560
OFFICES IN PRINCIPAL CITIES

FILE NAME: P:\HONEYWELL -SYR\446893 – LCP OU-2 REMEDIAL DESIGN\10.0 TECHNICAL CATEGORIES\10.2 CAD\DESIGN\REPORT FIGURES\SK446893-SK002.DWG
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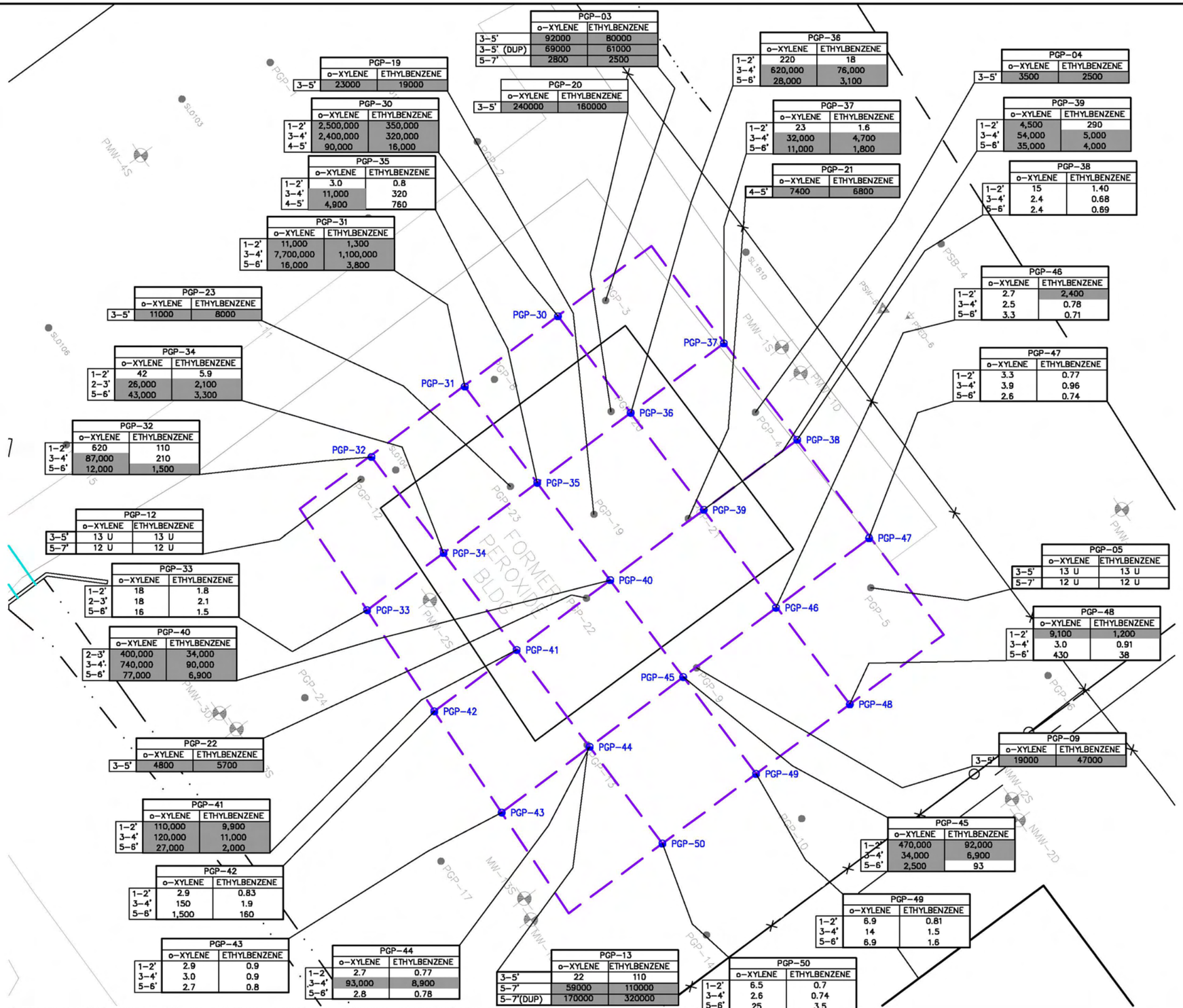

PGP-03	o-XYLENE	ETHYLBENZENE
3-5'	92000	80000
3-5' (DUP)	69000	81000
5-7'	2800	2500

PGP-20	o-XYLENE	ETHYLBENZENE
3-5'	240000	160000

PGP-19	o-XYLENE	ETHYLBENZENE
3-5'	23000	19000

PGP-30	o-XYLENE	ETHYLBENZENE
1-2'	2,500,000	350,000
3-4'	2,400,000	320,000
4-5'	90,000	16,000

PGP-35	o-XYLENE	ETHYLBENZENE
1-2'	3.0	0.8
3-4'	11,000	320
4-5'	4,900	760

PGP-31	o-XYLENE	ETHYLBENZENE
1-2'	11,000	1,300
3-4'	7,700,000	1,100,000
5-6'	16,000	3,800

PGP-23	o-XYLENE	ETHYLBENZENE
3-5'	11000	8000

PGP-34	o-XYLENE	ETHYLBENZENE
1-2'	42	5.9
2-3'	26,000	2,100
5-6'	43,000	3,300

PGP-32	o-XYLENE	ETHYLBENZENE
1-2'	620	110
3-4'	87,000	210
5-6'	12,000	1,500

PGP-12	o-XYLENE	ETHYLBENZENE
3-5'	13 U	13 U
5-7'	12 U	12 U

PGP-33	o-XYLENE	ETHYLBENZENE
1-2'	18	1.8
2-3'	18	2.1
5-6'	16	1.5

PGP-40	o-XYLENE	ETHYLBENZENE
2-3'	400,000	34,000
3-4'	740,000	90,000
5-6'	77,000	6,900

PGP-22	o-XYLENE	ETHYLBENZENE
3-5'	4800	5700

PGP-41	o-XYLENE	ETHYLBENZENE
1-2'	110,000	9,900
3-4'	120,000	11,000
5-6'	27,000	2,000

PGP-42	o-XYLENE	ETHYLBENZENE
1-2'	2.9	0.83
3-4'	150	1.9
5-6'	1,500	160

PGP-43	o-XYLENE	ETHYLBENZENE
1-2'	2.9	0.9
3-4'	3.0	0.9
5-6'	2.7	0.8

PGP-44	o-XYLENE	ETHYLBENZENE
1-2	2.7	0.77
3-4'	93,000	8,900
5-6'	2.8	0.78

PGP-13	o-XYLENE	ETHYLBENZENE
3-5'	22	110
5-7'	59000	110000
5-7'(DUP)	170000	320000

PGP-50	o-XYLENE	ETHYLBENZENE
1-2'	6.5	0.7
3-4'	2.6	0.74
5-6'	25	3.5

PGP-36	o-XYLENE	ETHYLBENZENE
1-2'	220	18
3-4'	620,000	76,000
5-6'	28,000	3,100

PGP-37	o-XYLENE	ETHYLBENZENE
1-2'	23	1.6
3-4'	32,000	4,700
5-6'	11,000	1,800

PGP-21	o-XYLENE	ETHYLBENZENE
4-5'	7400	6800

PGP-04	o-XYLENE	ETHYLBENZENE
3-5'	3500	2500

PGP-39	o-XYLENE	ETHYLBENZENE
1-2'	4,500	290
3-4'	54,000	5,000
5-6'	35,000	4,000

PGP-38	o-XYLENE	ETHYLBENZENE
1-2'	15	1.40
3-4'	2.4	0.68
5-6'	2.4	0.69

PGP-46	o-XYLENE	ETHYLBENZENE
1-2'	2.7	2,400
3-4'	2.5	0.78
5-6'	3.3	0.71

PGP-47	o-XYLENE	ETHYLBENZENE
1-2'	3.3	0.77
3-4'	3.9	0.96
5-6'	2.6	0.74

PGP-05	o-XYLENE	ETHYLBENZENE
3-5'	13 U	13 U
5-7'	12 U	12 U

PGP-48	o-XYLENE	ETHYLBENZENE
1-2'	9,100	1,200
3-4'	3.0	0.91
5-6'	430	38

PGP-09	o-XYLENE	ETHYLBENZENE
3-5'	19000	47000

PGP-45	o-XYLENE	ETHYLBENZENE
1-2'	470,000	92,000
3-4'	34,000	6,900
5-6'	2,500	93

PGP-49	o-XYLENE	ETHYLBENZENE
1-2'	6.9	0.81
3-4'	14	1.5
5-6'	6.9	1.6

LEGEND

- FENCE
- FORMER STRUCTURES
- APPROXIMATE PROPERTY LINE
- MONITORING WELL LOCATIONS
- SURFACE WATER SAMPLE LOCATIONS
- WEST FLUME SEDIMENT SAMPLE LOCATIONS
- SHALLOW SOIL SAMPLE LOCATIONS
- GEOPROBE BORING LOCATIONS
- SOIL BORING LOCATIONS
- NMW-1 MONITORING WELL AT NAKOH CHEMICAL
- SL0105 LCP OU1 RI SAMPLE (OCTOBER 1995)
- SOIL BORING LOCATIONS (2012)

	LOCATION ID	
	o-XYLENE	ETHYLBENZENE
SAMPLE DEPTH IN FEET	RESULTS IN ug/Kg	RESULTS IN ug/Kg

U – NOT DETECTED

DATA THAT EXCEEDS PART 375 (o-XYLENE OVER PART 375:17) (ETHYLBENZENE OVER PART 375:16)

30 15 0 30 60

SCALE: 1"=30'

MAP SOURCE: C.T. MALE ASSOCIATES, P.C.

FIGURE 2.2

Honeywell

TOWN OF GEDDES, NEW YORK

SHALLOW SOIL SAMPLE LOCATION AND RESULTS (2012)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212, PHONE: 315-451-9560

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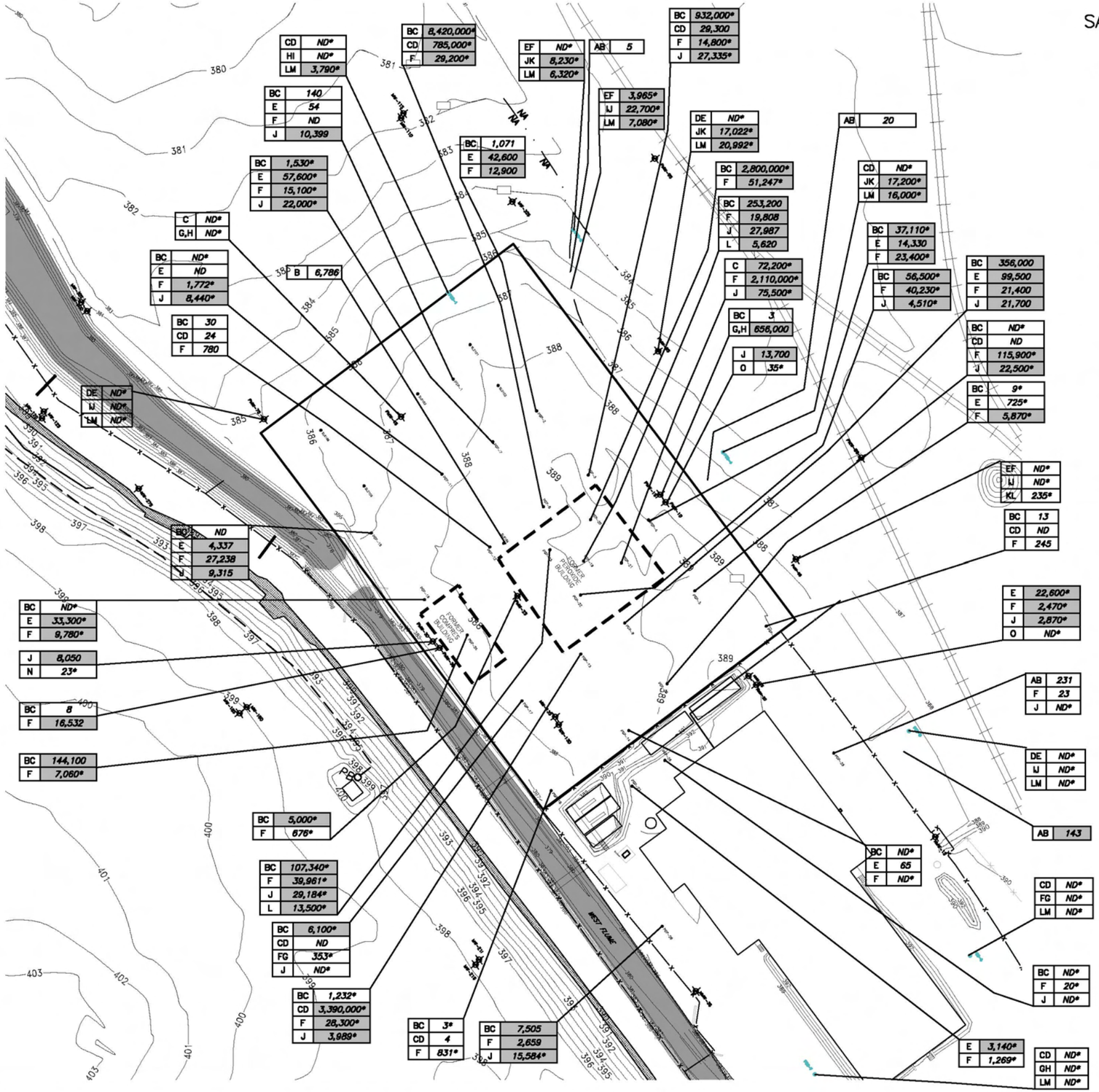

SAMPLE DEPTH RANGE KEY (FEET BELOW GROUND SURFACE)

B	2'–4'
C	4'–6'
D	6'–8'
E	8'–10'
F	10'–12'
G	12'–14'
H	14'–16'
I	16'–18'
J	18'–20'
K	20'–22'
L	22'–24'
M	24'–26'
N	26'–28'
O	28'–30'
P	30'–32'
Q	32'–34'
R	34'–36'
S	36'–38'
T	38'–40'
U	40'–42'
V	42'–44'
AB	1'–3'
BC	3'–5'
CD	5'–7'
DE	7'–9'
EF	9'–11'
FG	11'–13'
GH	13'–15'
HI	15'–17'
IJ	17'–19'
JK	19'–21'
KL	21'–23'
LM	23'–25'

LEGEND

- TANKS
- FENCE
- FORMER STRUCTURES
- DIRT ROADS
- PAVED ROADS
- APPROXIMATE PROPERTY LINE
- MONITORING WELL LOCATIONS
- SURFACE WATER SAMPLE LOCATIONS
- WEST FLUME SEDIMENT SAMPLE LOCATIONS
- SHALLOW SOIL SAMPLE LOCATIONS
- GEOPROBE BORING LOCATIONS
- SOIL BORING LOCATIONS
- NMW–1 MONITORING WELL AT NAKOH CHEMICAL
- SL0105 LCP OU1 RI SAMPLE (OCTOBER 1995)
- ONE OR MORE VOC'S OR TOTAL VOC CONCENTRATION ABOVE STATEWIDE NYSDEC TAGM 4046 OBJECTIVES.

NA	NOT ANALYZED
ND	NOT DETECTED
28	TOTAL VOC CONCENTRATION (ug/kg)
235*	TOTAL BTEX CONCENTRATION (ug/kg)

80 40 0 80 160

SCALE: 1"=80'

MAP SOURCE: C.T. MALE ASSOCIATES, P.C.

FIGURE 2.3

Honeywell TOWN OF GEDDES, NEW YORK

TOTAL VOCs IN SUBSURFACE SOILS (ug/kg)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212, PHONE: 315–451–9560

FILE NAME: P:\HONEYWELL –SYR\446893 – LCP OU–2 REMEDIAL DESIGN\10.0 TECHNICAL CATEGORIES\10.2 CAD\DESIGN\REPORT FIGURES\SK446893–SK004.DWG
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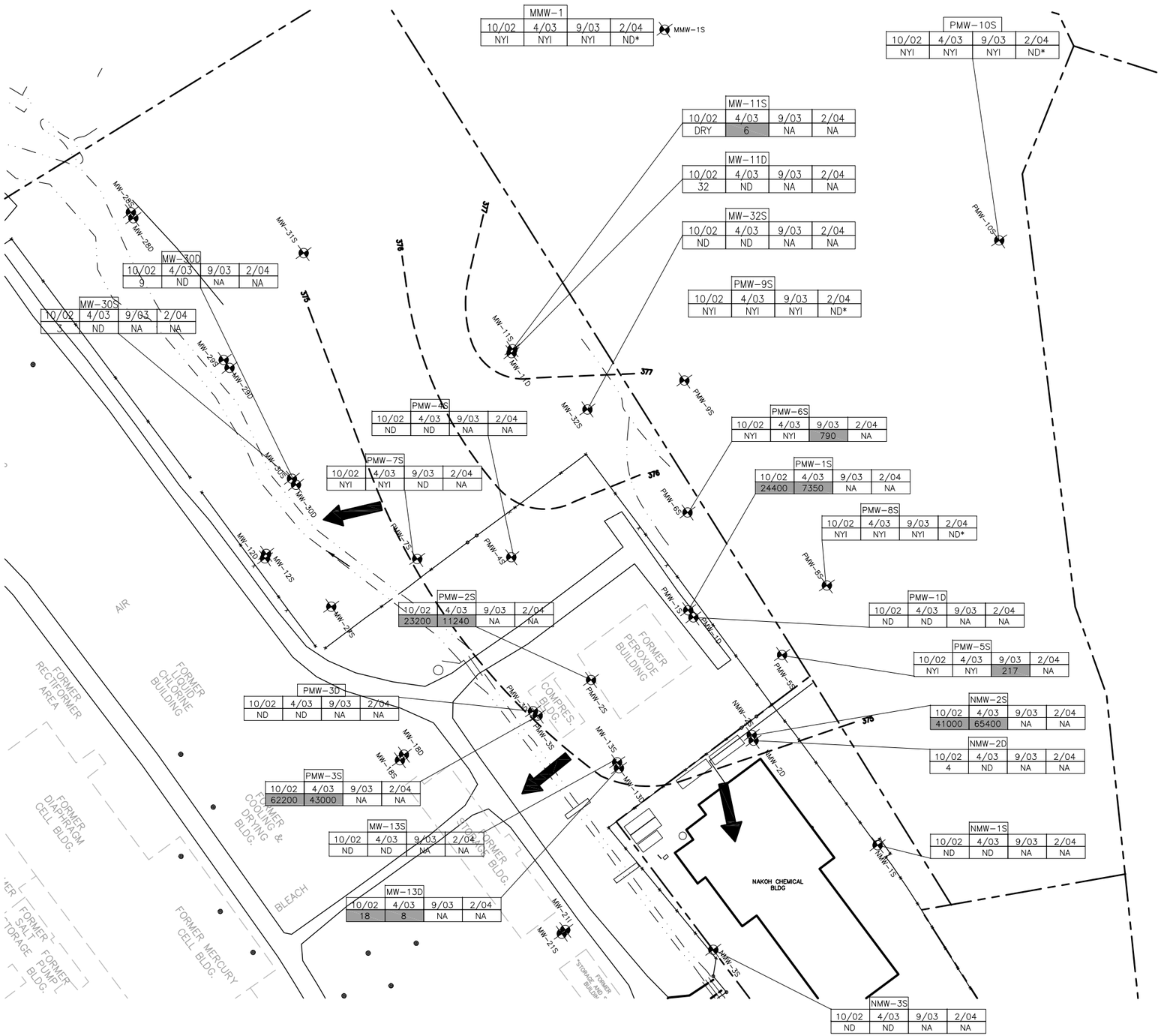

LEGEND

- FENCE
- DIRT ROADS
- PAVED ROADS
- APPROXIMATE PROPERTY LINE
- TANKS
- PMW-11S — MONITORING WELLS
- NMW-3 — MONITORING WELL AT NAKOH CHEMICAL
- XYLENES OR ETHYLBENZENES EXCEED NYSDEC CLASS GA GROUNDWATER STANDARDS OR GUIDANCE VALUES

MW-11D		
10/02	4/03	9/03
32	ND	NA

GROUNDWATER SAMPLE RESULTS IN ug/L

APPROXIMATE GROUNDWATER FLOW DIRECTION

NYI — NOT YET INSTALLED
NA — NOT ANALYZED
ND — NOT DETECTED
* — ANALYZED FOR BTEX

MAP SOURCE: C.T. MALE ASSOCIATES, P.C.

80 40 0 80 160

SCALE: 1"=80'

FIGURE 2.4

Honeywell TOWN OF GEDDES, NEW YORK

TOTAL VOCs IN GROUNDWATER (PRE 2012) (ug/L)

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\446893 - LCP OU-2 REMEDIAL DESIGN\10.0 TECHNICAL CATEGORIES\10.2 CAD\DESIGN\REPORT FIGURES\SK446893-SK005.DWG
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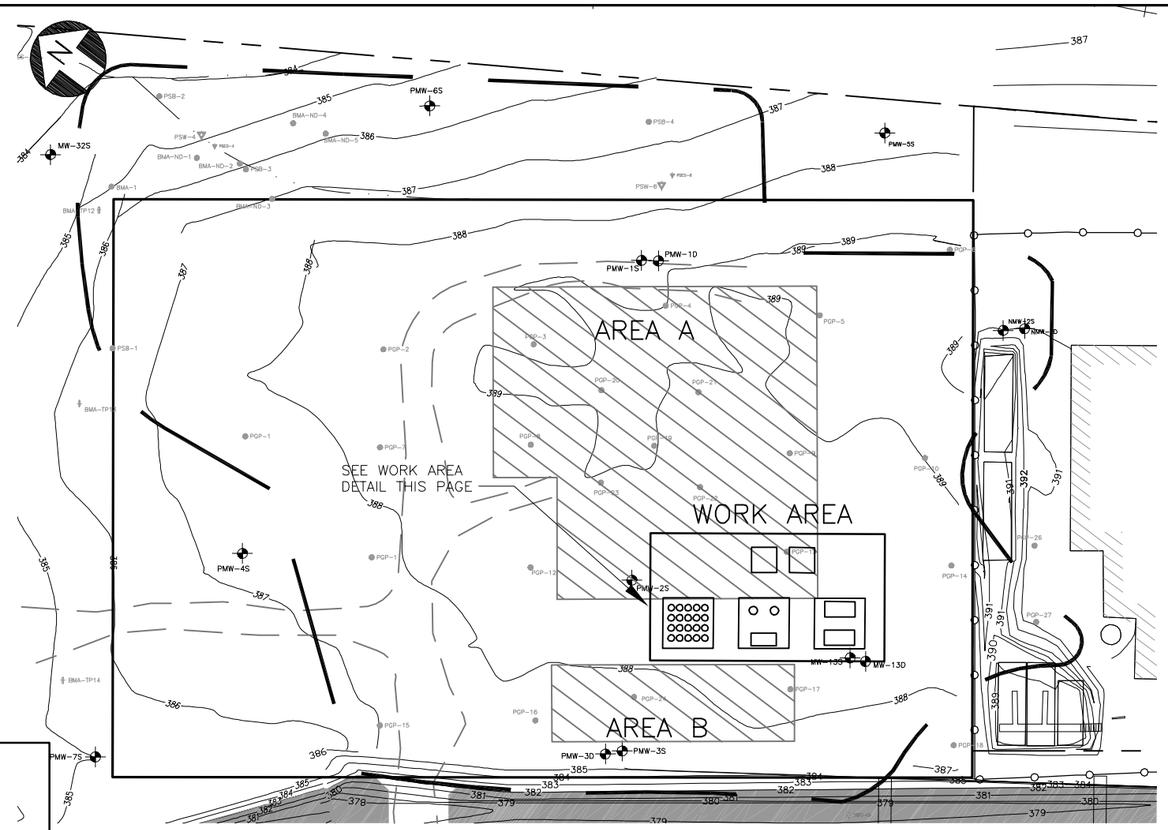
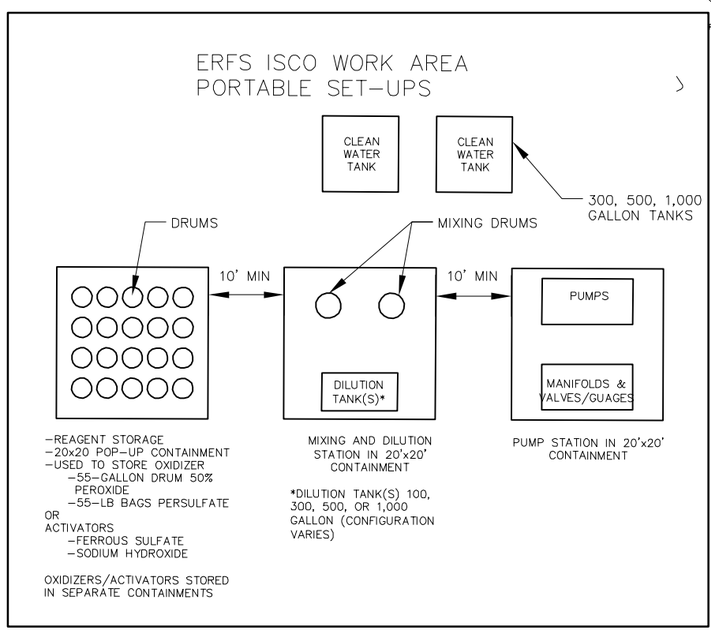


SITE LAYOUT

1"–60'



WORK AREA

1"–20'

LEGEND:

- DIRT ROADS
- PAVED ROADS
- APPROXIMATE PROPERTY LINE
- FORMER STRUCTURES
- EXISTING CHAIN LINK FENCE
- RAILROAD
- SILT FENCE
- AREAS TO BE EXCAVATED TO GROUNDWATER
- TARGET ISCO TREATMENT AREA

NOTE:

1. LAYOUT AND LOCATION OF WORK AREA WILL VARY THROUGH TREATMENT.

20 10 0 20 40

SCALE: 1"=20'

60 30 0 60 120

SCALE: 1"=60'

FIGURE 3.1

Honeywell

TOWN OF GEDDES, NEW YORK

TYPICAL ISCO LAYOUT

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315–451–9560

FILE NAME: P:\HONEYWELL –SYR\446893 – LCP OU–2 REMEDIAL DESIGN\10.0 TECHNICAL CATEGORIES\10.2 CAD\DESIGN\REPORT FIGURES\SK446893–SK006.DWG
PLOT DATE: 7/10/2012 2:48 PM PLOTTED BY: RUSSO, JILL

APPENDIX A

ISCO WORK PLAN

FINAL

WORK PLAN
FOR
ISCO TREATMENT OF OU-2

LCP-OU2 Remediation Project
Subcontract No. 446893-30001.00

Prepared For:

PARSONS

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September 2012

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EXECUTIVE SUMMARY

Environmental Remediation and Financial Services, LLC (ERFS) has been subcontracted by Parsons Engineering of New York, Inc. (Parsons) to prepare this work plan for implementing in situ chemical oxidation (ISCO) of saturated soil and groundwater at the OU2 site. ERFS has experience at the OU2 site and at many other Honeywell sites and other Superfund sites delivering ISCO services. The ERFS project team is highly qualified with experience at implementing thousands of injection events over the past 10 to 15 years.

Parsons will excavate unsaturated soil (refer to Parsons Design Report for details) and install horizontal, slotted PVC piping (injection laterals, or laterals) in the bottom of the excavation prior to backfilling. These laterals will be used throughout the treatment program to deliver reagents into upper saturated soils. Access points to the laterals will be finished as stick up pipes. The stick up riser pipes will be avoided during additional site activities to prevent damage from vehicles and equipment. Drilling in the area will avoid the laterals by sighting the line between risers, in conjunction with site maps, to avoid drilling in those locations.

ERFS will utilize catalyzed hydrogen peroxide delivered through direct push rods and injection nozzles for the first treatment event, followed by PVC well installation via direct push drilling. The second event would utilize these PVC wells to deliver another round of catalyzed hydrogen peroxide. Subsequent events are estimated to be of smaller scale as the treatment area shrinks and contaminant concentrations are lowered. The injection laterals installed during the Parsons soil excavation will also be used to deliver reagents as needed during the treatment program – more widely used during initial events and on a more focused basis in later events. ERFS estimates that a third and possibly fourth or more polishing events may be needed and may use hydrogen peroxide and/or activated sodium persulfate for these treatments. ERFS will evaluate progress and install optional propagations, if needed, to supplement the PVC well field to assist with reagent distribution. ERFS will utilize high-pH activated persulfate in the area along the OU1 subsurface bentonite slurry wall, outside the 50-ft buffer zone, to minimize chemical-structural impacts to that wall.

ERFS plans to execute the project in a stepwise fashion. The full ~80,000 square feet (sf) treatment area will be divided into ~10,000 sf sub-areas with one or more sub-areas being treated at a time (e.g. multiple treatment crews may be used during part of the project). ERFS will begin by treating downgradient areas first then progressing upgradient to complete one site-wide treatment event. By treating downgradient areas first, ERFS will create a downgradient zone with oxidizing conditions to break down contaminants that may migrate with the groundwater gradient over the course of treatment. Treatment events will be followed by stabilization periods to allow reagents to react fully before executing follow-on injections. Treatment of sub-areas in rotation will continue until field monitoring data indicate that groundwater sampling is necessary to gauge remediation progress. As laboratory analysis results indicate that sub-areas may be at or near goals,

soil sampling will be employed to determine if treatment is still needed in those sub-areas. The treatment scope and frequency are expected to decline over time as the remediation progresses and the sub-areas requiring treatment shrink.

The Parsons Design Report provides details on monitoring locations, methods, and frequency. Prior to initiating treatment, Parsons will collect baseline groundwater samples from shallow and deep monitoring wells as described in the Parsons Design Report. Historical soil data will be used for baseline data. ERFS will monitor multiple groundwater and vapor head-space parameters during treatment to make real-time adjustments to the treatment process during injection events. Parsons will sample key wells during interim monitoring to gauge groundwater cleanup progress. Once interim groundwater samples demonstrate sufficient progress, Parsons will collect soil samples from key boring locations. As these data indicate that remediation goals may have been attained, then the baseline groundwater sampling will be repeated.

Total project duration is estimated to be 24 months or less following the initial mobilization for treatment. This time period will allow for multiple rounds of treatment across the site, allow for waiting periods between treatment and sampling events, allow for laboratory analytical turnaround time and project team review, and allow time to adjust treatments to focus on polishing at stubborn areas. Substantial contaminant concentration reductions are expected in the first 12 months with polishing and monitoring in the next 12 months.

1.0 INTRODUCTION

ERFS has been subcontracted by Parsons to provide remediation services at the LCP Bridge Street site, Operable Unit 2 (OU2) in Syracuse, New York. More specifically, the work involves an in situ remediation approach for treating volatile organic compounds (VOC), primarily xylene and ethylbenzene, and semivolatile organic compounds (SVOC) including 2-Ethylanthraquinone (2-EAQ) in saturated soil and groundwater within the site property boundaries. Treatment goals are to achieve the New York State Department of Environmental Conservation's (NYSDEC) Ambient Groundwater Quality Standards (Class GA) and NYSDEC Part 375 Soil Standards.

2.0 SPILL CONTROL,

2.1 Spill Control

ERFS will follow spill prevention steps and precautions detailed in Appendix B that will address materials storage, staging, secondary containment, handling, mixing, and dilution procedures and requirements. Exhibits 2-1 and 2-2 below depict typical field set-ups for secure staging and storage of treatment chemicals.

Adequate countermeasure materials (absorbents, neutralizers, dilution water) will be maintained on site during the work and all ERFS personnel and subcontractors will understand their responsibilities to control or mitigate a reagent spill, including notifications.

Exhibit 2-1 ERFS Preparing Reagents at Honeywell's ConductorLab Site

Exhibit 2-2 ERFS Secured Reagent Storage in Field Erected Containments

3.0 TREATMENT TECHNOLOGY EVALUATION AND SELECTION

Multiple proven technologies are available for in situ treatment of chlorinated solvents in groundwater. Several approaches are possible at the OU2 site; however, many of these techniques may not be cost-effective or meet the project schedule. The discussion that follows presents an evaluation of the site contaminants of concern, in situ treatment methods, in situ chemical oxidizers that may be appropriate for VOC treatment, methods for delivering selected reagents to the locations and depth intervals where significant VOC reside, and finally, a presentation of the selected approach and rationale.

3.1 Contaminants of Concern

VOC compounds such as xylene and ethylbenzene have been found in soil and groundwater as a result of past industrial activities at the OU2 site. These two compounds make up the vast majority of the contaminants impacting the site, with xylene in the largest proportion. Other VOC and semivolatile compounds have been detected above their respective cleanup goals but in localized areas and at concentrations only slightly above cleanup goals. All of these compounds can be treated in situ by employing in situ chemical oxidation (ISCO) as demonstrated in bench and pilot tests previously executed at the site. Site cleanup objectives are presented in the LCP OU-2 Design submittal.

3.2 Remedial Approach – Reagent Delivery

ERFS has considered reagent delivery using direct push (DP) driven injection nozzles, fixed PVC wells, injection laterals and propagations (sand-filled hydraulic fractures described below). These delivery techniques will be used individually or in combinations to deliver sufficient treatment reagents to the areas and intervals above cleanup goals. Given the site setting (discussed in Section 4.0 below), all of these techniques can be implemented at the site and should be effective given the site soils and estimated hydraulic conductivity.

Further, ERFS plans on segmenting the treatment area into multiple, smaller, sub-areas to facilitate treatment technique refinements from sub-area to sub-area. The size, shape, and designation of sub-areas are presented on Parsons Drawing C006. Following the excavation and backfill of shallow, unsaturated soils by Parsons, ISCO treatment will proceed starting at the farthest down gradient end of the plume (sub-area 1) then working back toward the center of the plume and then on to the upgradient side.

Sub-Areas are summarized as follows:

Sub-Area	**Depth Interval**	**Remarks**
1 through 5	Approximately 6 ft bgs to ~24 ft bgs	These 5 sub-areas represents majority of contaminant mass. These sub-areas in total cover the plume situated downgradient of the former building where the deepest contamination is found. This ~1 acre area was then divided into ~8,000 sf sub-areas for easier remediation management.
6, 8, and 9	Approximately 6 ft bgs to ~20 ft bgs	Area on upgradient side of former building has been equally divided and forms an "L" Shape around Former Peroxide Building
7	Approximately 6 ft bgs to ~20 ft bgs	Separated as unique area that is on NaKOH property portion of plume
10	Approximately 6 ft bgs to ~20 ft bgs	Will act as buffer zone between major treatment areas and the West Flume and the OU1 slurry wall. A 15 ft wide buffer zone along the West Flume will be maintained while injecting in this sub-area.

Using a segmented approach, ERFS will begin treatment at selected sub-areas to confirm reagent distribution, injection point spacing, and injection rates and pressures. Subsequent sub-areas will undergo treatment using the information gathered during treatment of the initial sub-areas, making the overall project more efficient and productive.

ERFS has found that actively re-circulating groundwater within the treatment zone has been very effective at other Superfund sites and at other Honeywell treatment sites. As groundwater is extracted at treatment area wells while reagents are being added in more remote positions in the treatment area, then reagents will be drawn toward the extraction points. By shifting injection and extraction point locations, this effect is spread across the treatment area. The difference in water elevation at the extraction – injection points helps drive the reagent flow in preferential directions allowing better mixing and reagent contact with contamination.

ERFS will incorporate some amount of re-circulating groundwater during all injection events to promote distribution and good reagent mixing. Groundwater will be extracted from target monitoring wells within an active sub-area during each injection event and the recovered groundwater will be used for reagent mixing and re-injected in that same sub-area. ERFS has been successful with this "drag and draw" approach at the Honeywell Conductorlab site in Groton Mass, the Besley site in Greenfield, Mass, the KMSS

Superfund site in New Jersey, and at gas station sites in New York. Although VOC concentrations are high in groundwater relative to the treatment goals, those concentrations are small compared to the amount of oxidizing reagent that will be present in the mixing tanks. For example, if total VOC concentration in the extracted water is 1,000 ug/L and the oxidizer concentration is 5% (or 50,000 mg/L, or 50,000,000 ug/L), then the oxidizer will be present at 50,000 times greater than the contaminants. Therefore, total VOC concentrations will be greatly reduced by mixing with reagents in the mixing tanks without lowering oxidizer concentrations significantly. Further, total VOCs in groundwater are not concentrated enough, nor will tank residence time be long enough, to result in noticeable (e.g. visual indications such as bubbling or foaming, or temperature increases, etc) reactions in the mixing tanks.

ERFS will conduct the first injection event using direct push drilling and injection techniques. The specification sheet for the injection tooling from the Geoprobe Company is included as Appendix A. Direct push injection will allow rapid application of a large reagent volume so that significant contaminant reduction can be realized early in the project. Further, direct injection will disturb subsurface soils and groundwater such that good mixing is promoted leading to better treatment. This is especially important at the OU2 site since soil data indicate that a significant contaminant mass resides within low permeability soils from 10 to 15-20 ft bgs. This approach also allows flexibility to treat various depths at one location without the need for multiple screened well points. Direct push injection will be accomplished using injection nozzles from Geoprobe, not modified DP screens as was used in the pilot test, so that higher flow rates and better oxidant contact can be attained. Injection flow rates are anticipated to range from 1 gpm to 20 gpm or more depending on the location and depth of injection.

The basis for injection volumes and number of injection points is provided in Appendix C – Calculations. ERFS estimates that a total of ~20 direct push injection points will be used in the first injection event in each sub-area of approximately 8,000 square feet (150 to 200 locations will be needed for the total treatment area). Parsons Design Report Drawing C-006 illustrates the general approach for the proposed DP points. A higher injection point density (more points with smaller spacing) and a larger reagent injected volume per point will be used in areas that are more highly contaminated than others, as is indicated in the site investigation data (e.g. pre-design, baseline, and interim sampling results all serve as the basis of treatment decision making as the project progresses). A total of 150,000 to 200,000 gallons of reagents are anticipated for injection during the first event. Injection point total depth will also vary since some areas are contaminated to deeper depths than others.

As the first injection event is being completed, ERFS will install ~15 PVC injection wells in each ~8,000 square feet sub-area, or ~150 PVC injection wells sitewide. Wells will be installed via direct push installation methods to minimize soil cuttings generation. As with the DP injection locations, PVC wells will be spaced closer together in areas of higher residual contamination. The second and subsequent injections will utilize these PVC wells and, if needed, the injection laterals that are to be installed in conjunction with excavation

of the unsaturated soils. Parsons Design Report Drawing C-003 illustrates approximate locations for injection wells and laterals. This approach is described in more detail in Section 4.0. Typical PVC injection well and injection lateral construction are illustrated in the Parsons Design Report.

If needed to supplement the reagent delivery approach described above, ERFS will install Propagations in selected areas and depths at the site to enhance reagent distribution. The need for Propagations will be determined based on field monitoring data and laboratory analysis data once PVC wells have been installed and used for injection. Propagations are replacements for inefficient wells. Propagation placement will be optimized by noting locations and depth intervals during the initial injection event that may benefit from Propagation placement. Propagations are installed by: (1) driving a 2-in steel pipe to the targeted depth; (2) cutting a soil notch at the bottom of the 2-in pipe; (3) charging the 2-in pipe and notch with a sand-guar mixture; (4) increasing sand-guar pressure to 'propagate' the notch outwards, creating a disk consisting of guar mixed with drilling sand and measuring up to 40 feet across and approximately 2 cm in average thickness. This can create a plane of coarse sand approximately 1,000 square feet to infiltrate reagents into the subsurface independent of geological limitations. Final structure of a Propagation can be mapped using transits, sonics and down hole probes. Propagations are filled like bladders at low pressure and are used to feed reagents into the groundwater and / or soil. The Propagations can also be converted to piezometers or recovery wells in the future.

Propagations were utilized during pilot testing at the OU2 site. It was observed during the active injection phase of the site pilot testing that reagents transited over 50 ft from one side of the Propagation area to the other, illustrating their effectiveness in distributing reagents. ERFS estimates that three to four Propagations may be needed in each of the ~8,000 square feet sub-areas, or 25 to 30 for the full site treatment area.

3.3 Reagent Selection

ERFS has experience applying a range of chemical treatment reagents that will be effective on the OU2 contaminants, including activated sodium persulfate and catalyzed hydrogen peroxide in various formulations and applications. These oxidizers will effectively treat the residual contaminants at the site. ERFS intends to use both hydrogen peroxide and sodium persulfate as oxidizers at the site.

Catalyzed hydrogen peroxide is not as long lived in the subsurface; however, it is very cost-effective when treating a large contaminant mass. As indicated in historical reports, the residual contaminant mass within OU2 is significant and will drive the oxidant demand at the early stages of treatment. ERFS will utilize low cost oxidizer blends for the initial treatment steps and, as contaminant mass is reduced, shift tactics to utilizing a more pervasive oxidant like persulfate. Since ERFS will apply an iron catalyst with the peroxide, iron catalyst residual can serve to initiate persulfate during subsequent treatments along with iron or other initiators added with the persulfate. Alternatively, all three

reagents (iron catalyst, peroxide, and persulfate) can be simultaneously applied at the site to affect multiple radical generation pathways.

ERFS recognizes that treatment in areas near the West Flume and OU1 slurry wall must avoid interaction with the West Flume and the OU1 slurry wall. This can be done in two ways: (1) maintaining a treatment 'buffer zone' along the slurry wall; and (2) using reagents that will not lower pH near the slurry wall. ERFS will use both methods for treatment near the slurry wall. Propagations will not be used in sub-area 10 which is adjacent to the slurry wall. Since any type of in situ remediation is limited by the effective treatment radius, ERFS will typically determine that radius empirically in the field. For the OU-2 site, ERFS will maintain a buffer zone that is 125% larger than that radius away from the West Flume, or at a minimum 15 ft away, whichever is longer, during injections of catalyzed hydrogen peroxide. In addition, ERFS will use a high-pH (10 s.u.) initiated persulfate blend in areas at this 15 ft buffer along the slurry wall to avoid acid degradation of the wall. As stated in the LCP OU-2 Design submittal, monitoring along the slurry wall will be conducted. If the results of this monitoring indicate the ISCO activities are potentially leading to impacts on the wall, ISCO activities will be modified.

Sodium persulfate is a strong oxidizer and can be activated by high pH, peroxide, and by the presence of dissolved iron in the system. Several of the wells within the treatment area exhibit elevated pH (possible result of the former caustic production operations on site), and persulfate could be activated via high pH simply by adding it to groundwater in some locations. Persulfate is also moderately long-lived in the subsurface and can therefore travel significant distances in situ before completely reacting, making it very effective at low permeability sites (FMC 2008). This feature may be beneficial at the OU2 site given the relatively low permeability of the soils in the treatment area.

Therefore, ERFS intends to begin treatment with diluted hydrogen peroxide (4% to 8%) catalyzed with ferrous sulfate (2% to 5.5%), closely monitor the remedial progress, and then polish the treatment area with additional peroxide treatments with iron-activated persulfate. Ferrous sulfate is a readily available, low cost catalyst suitable for use with both peroxide and persulfate. ERFS will avoid strong reactions that can be associated with catalyzed peroxide treatments (as observed during pilot testing when 12% peroxide was injected) by using diluted mixtures, controlling application rates (1 to 20 gpm), and allowing all catalyst-oxidant mixing to occur in the subsurface. By simply scaling back the peroxide concentration, reagent surfacing and oxidizer waste due to unproductive side reactions can be greatly minimized.

None of these remedial options requires significant dilution water and injected volumes are expected to fall within roughly 5% to 10% of the treatment area pore volume during any one injection event; therefore, contaminant concentration dilution and/or contaminant plume migration is minimized. ERFS will also avoid periods longer than several hours of increased hydrostatic head at injection areas, which will further reduce the potential for contaminant migration from the treatment area. Further, the technique of removing groundwater in the target area while injecting will also minimize reagent migration out of

the focus area. Reaction byproducts of the selected oxidants, catalyst, and initiators, do not form listed contaminants or hazardous residuals.

4.0 REMEDIAL ACTION IMPLEMENTATION

4.1 Site Setting Description & Assumptions

Prior work efforts at the OU2 site and the site investigation history are summarized in the Parsons Design Report. The following section presents only a brief summary of information that pertains to this ISCO work plan. Additional site background details are found in previous reports.

- Soil and groundwater contamination at the site stem from historical manufacturing operations that utilized the primary contaminants. All process equipment and utilities, including sewers, were removed from the site. Some building foundations remain.
- Water is not available at the site but ERFS will bring in water as needed using a water truck supplied from a nearby hydrant.
- Site soils are described as clay, silt, and fine sand with some areas of gravel.
- Depth to groundwater is approximately 6-8 ft bgs. Groundwater flow direction is to the north-northwest.

4.2 Permitting and Notifications

Pursuant to the requirements of the USEPA underground injection control (UIC) program (40 CFR Part 144), ERFS will provide notification to NYSDEC for the installation of Class V injection wells in conjunction with the planned groundwater remediation project. Notification to EPA must be completed at least 30-days prior to installation of injection wells. A copy of the blank notification form is included as Appendix D.

In addition, Parsons/Honeywell/ERFS will contact local fire prevention officials to determine what notification and inspection requirements may apply to the use and temporary storage of hazardous chemicals at the LCP-OU2 site.

4.3 Remedial Approach Implementation

ERFS has designated sub-areas within the total treatment area footprint to illustrate the treatment sequencing. ERFS will initiate treatment at one or two sub-areas and then progress to additional sub-areas working from down gradient to upgradient, working in rough numerical order of the sub-areas. Once treatment of one or more sub-areas is underway and near completion, a decision will be made to work on sub-areas in parallel with multiple work crews.

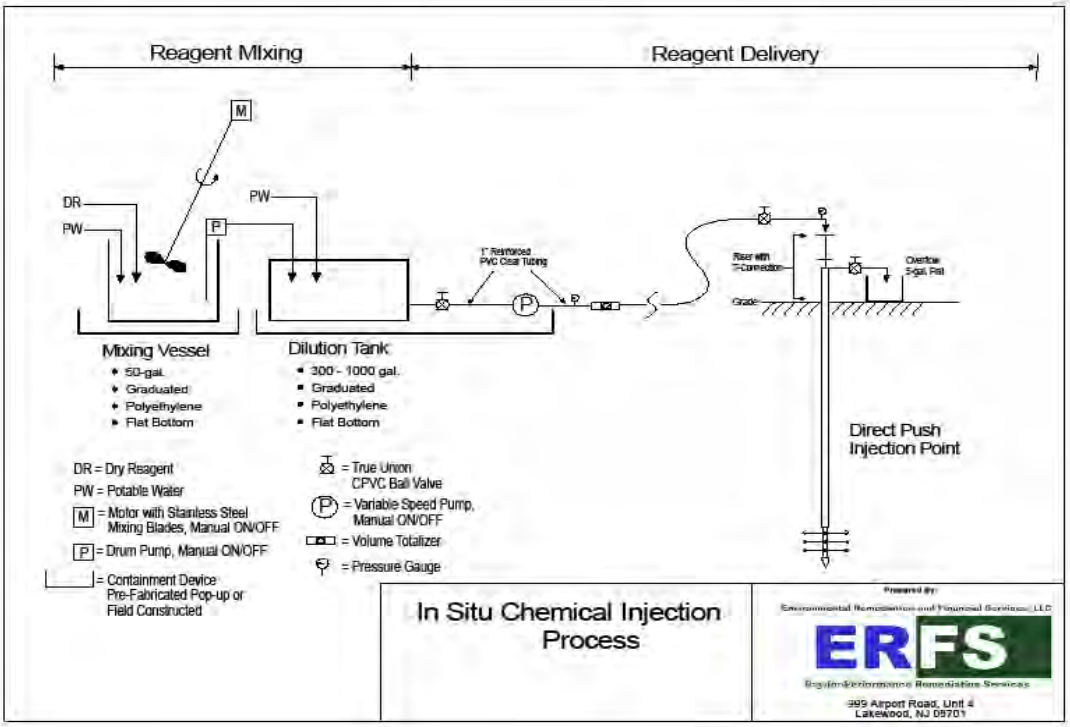
Each work crew (2-3 ERFS field technicians, mixing equipment, reagents, and support vehicle plus a geoprobe rig and operator) will focus on a sub-area, complete the injection quantities and volumes for that sub-area, and then move on to the next sub-area.

Reagents will be delivered to the site periodically to avoid storing large quantities of concentrated oxidizer at any one time. Approximately 20 to 25 drums (55-gal plastic) of 50% hydrogen peroxide will be delivered for each active sub-area. Iron sulfate catalyst will be delivered in 50-lb bags (15 to 30 per sub-area) and stored in a separate location to avoid accidental mixing with oxidizer. Sodium persulfate will be delivered as a dry powder in 50-lb bags. All chemicals will be segregated into individual pop-up containments to avoid mixing or contact among the reagents.

The work station will consist of 50-gal, 100-gal, 300-gal, and 500-gal plastic tanks for mixing and dilution of reagents. Exhibit 3-1 below depicts a typical chemical mixing and dilution field station. Once mixed, reagents are then supplied through reinforced flexible hose, pump(s), and quick connects to the well head situated at the geoprobe rig or fixed PVC well or propagation for injection into the targeted intervals and locations. Exhibit 3-2 provides a process schematic of the reagent delivery system. Reagent handling precautions are detailed in the ERFS project HASP. Generally, mixing operations and handling of all concentrated (e.g. as-delivered concentrations) reagents requires combinations of protective clothing and equipment such as tyvec work suits, rubber gloves, face shields, partial respirator and eye goggles (or full-faced respirator).

Exhibit 3-1 ERFS Chemical Mixing Field Station Example

Exhibit 3-2 ERFS Reagent Delivery Schematic



The first injection event will be completed using direct push (DP) drilling injections. After the first event and installation of PVC injection wells, ERFS will utilize the PVC injection wells and the laterals (in the former soil excavation area) for reagent delivery. As field data and subsequent laboratory data are reviewed, ERFS may conduct additional DP injections in combination with utilizing fixed PVC injection wells and injection laterals. In some locations, ERFS will install the optional Propagations.

Injection events will promote good mixing and distribution of reagents in the treatment area by extracting groundwater during treatment from treatment area monitoring wells. Extracted groundwater will be used as dilution water and mixed with reagents on-site to minimize waste generation. Direct push injections allow flexibility for injecting into multiple locations and to deliver sufficient volumes of reagents focused into targeted intervals where contaminants reside. No soil cuttings will be generated as part of the direct push injections.

Initially, the injection laterals placed in the unsaturated soil excavation area will be used extensively to provide wide area treatment of the upper water table. ERFS anticipates that fewer laterals will be used as the project progresses and injection in certain areas becomes unnecessary.

ERFS estimates that two to three or more treatment events will be required in series to achieve goals. For the second and subsequent treatments ERFS anticipates that treatment volumes will diminish as amenable areas show rapid improvement and stubborn areas

require more treatment. Reagent types and formulations will be evaluated and re-designed as needed for each treatment event.

Calculations are provided in Appendix C and form the basis for ERFS' proposed treatment. In summary, ERFS proposes the following treatment approach for saturated soil and groundwater:

- Event 1 – Inject via DP and laterals. If all sub-areas are treated, ERFS estimates 150 to 200 DP locations will be needed. Total treatment interval will be in accordance with the contamination depths which vary by sub-area. Injections will be staggered at two to four foot vertical intervals starting from the bottom and then raising the injection nozzle stepwise. An estimated 150,000 gallons of hydrogen peroxide (4% to 8%) and 30,000 to 40,000 gallons of ferrous sulfate (2% to 5%) solutions will be injected via the DP borings and the laterals (~5% of the pore volume). As a sub-area treatment is completed, PVC wells will be installed via DP methods. An estimated 150 PVC wells will be installed site wide.
- Event 2 – Inject via PVC wells and laterals. If all sub-areas are treated, ERFS estimates that 150,000 gallons of hydrogen peroxide (4% to 8%) and 30,000 to 40,000 gallons ferrous sulfate (2% to 5%) solutions will be injected into PVC vertical and lateral points.
- Event 3 – Evaluate if Propagations are needed and install prior to this event in appropriate locations. Under this optional task, ERFS estimates that up to 30 Propagations may be installed. While 30 Propagations are estimated for this optional work, fewer may be installed. Since VOC reduction will result from Events 1 and 2, and some wells / areas will not require treatment, less reagent volume will be needed in Event 3. ERFS estimates that 75,000 gallons of 5% activated (using iron in the mix tank) persulfate plus 30,000 to 45,000 gallons of low concentration (2% - 5%) hydrogen peroxide activator will be applied in Event 3.
- Polishing events – Based on field data, observations, and on laboratory data, polishing treatment events will be needed to drive stubborn areas toward remediation goals. Based on ERFS experience at similar sites, polishing events are estimated to be of similar scope to Event 3 described above. Up to 3 to 6 polishing events may be needed to meet goals across all sub-areas.

4.4 Project Conclusion

At the conclusion of continuous field events, ERFS will de-mobilize all equipment, reagents and materials from the site. Some equipment, such as rinsed and empty tanks and hoses, or inert materials such as PVC piping/screening and filter sand may be stored on site between field events. ERFS will remove trash after each event. Empty reagent drums will be picked up for recycling as deliveries are made with remaining empty drums to be picked up at event completion.

Once project goals are achieved and data has been accepted all remaining materials will be removed. PVC injection wells will be removed and the well holes allowed to collapse. Grout will be tremmied into any well holes remaining open. Propagations will be filled with grout and stick up pipes removed to below grade.

4.5 Periodic and Final Reporting

ERFS will provide progress updates consisting of a cover summary memo with attachments to include field logs, updated draft maps, and photographs of site activities. A final report detailing the work completed with back up documentation will be submitted following project completion and data receipt. Refer to the Parsons Design Report for reporting schedules.

4.6 Remediation Schedule and Milestones

ERFS anticipates that the first injection will require five weeks onsite to complete using two injection crews operating in parallel. After a three to four week stabilization period, interim groundwater samples would be collected by Parsons (refer to Parsons Design Report for sampling schedule, locations, and analyses).

Following receipt and review of data, ERFS will implement the second treatment, requiring approximately five weeks onsite. Following a four week stabilization period, key wells will be sampled for VOCs and confirm the approach for Treatment Event 3.

Polishing Treatment Event 3 will require three weeks on site to complete. Following a longer stabilization period of two to three months (persulfate persists longer in the subsurface), ERFS will again sample key wells and confirm cleanup status.

Total project duration is estimated to be 24 months or less following the initial mobilization for treatment. This time period will allow for multiple rounds of treatment across the site, allow for waiting periods between treatment and sampling events, allow for laboratory analytical turnaround time and project team review, and allow time to adjust treatments to focus on polishing at stubborn areas. Substantial contaminant concentration reductions are expected in the first 12 months with polishing and monitoring in the next 12 months.

5.0 Monitoring

Monitoring will consist of baseline, interim, and final sampling of selected monitoring wells and soil borings for VOCs to evaluate treatment effectiveness and remediation progress. Existing soil boring data will be utilized for soil baseline conditions. Refer to the Parsons Design Report for details regarding soil and groundwater sampling locations, frequency, and analyses.

ERFS will monitor treatment area monitoring wells for field parameters during treatment events to gauge the progress of reagent distribution and extent of oxidizing reactions. ERFS field monitoring results will be utilized for trend analysis to develop a qualitative determination of reagent distribution. These parameters include dissolved oxygen, oxidation reduction potential, pH, temperature, depth to water, specific conductance, iron, and oxidizer in groundwater samples using both hand held instruments and down hole probes / data loggers as well as analyte-specific field test kits (iron, peroxide, and persulfate). Vapor head space in treatment area wells will be monitored for oxygen, carbon dioxide, lower explosive limit, and PID readings using hand held instruments. Field readings will be recorded in daily logs.

APPENDIX A

DP Injection Tool Cut Sheet

Geoprobe® Accessories

>> Tools Menu

View Product Video

Pressure Activated Injection Probe

The Pressure-Activated Injection Probe allows for either top-down or bottom-up injection of remediation materials when using any Geoprobe® grout or injection machine. The probe allows materials to be injected laterally into the subsurface. Unlike conventional injection methods, this probe ensures accurate placement of the material into the intended injection interval. A key feature of this probe is that it acts as a backflow preventer, keeping injection material IN the ground and not ON the ground! The probe is available for use with 1.5 in. probe rods (21479) and with 1.25 in. probe rods (18735).

Pressure Activated Injection Probe

For use with:

- Geoprobe® Grout & Injection Machines

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APPENDIX B

Spill Prevention and Control Plan

In-Situ Chemical Oxidation Services
LCP - OU2 Site
Syracuse, NY

Environmental Remediation and Financial Services, LLC
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June 2012

1.0 INTRODUCTION

This *Spill Prevention and Control Plan* has been developed by Environmental Remediation and Financial Services, LLC (ERFS) specifically for implementation of in-situ remediation services to be provided by ERFS in conjunction with the following project:

Project Name:	In-Situ Chemical Oxidation Services LCP - OU2 Site Syracuse, NY
Client Name:	Parsons
Phone:	315-484-3217 (mobile) 315-552-9688 (office direct)
Project Manager:	Thomas Drachenberg, PE
Secondary Contact:	Matthew Vetter
Phone:	315-552-9742 office direct

2.0 SITE DESCRIPTION AND GENERAL ASSESSMENT

The LCP – OU2 site (OU2) consists of approximately 80,000 square feet (sf) of vacant land. Former buildings, slabs, and known utilities will have been removed prior to executing the ISCO treatments.

Unintended releases of treatment reagents could be in the form of concentrated or diluted reagents. Releases could occur by way of spills of raw materials (highest potential during handling operations such as off-loading deliveries and mixing / dilution operations) or spills, leaks, or short circuiting of diluted reagents during injections.

Depending on the location and amount of reagent release, areas that could be affected include (refer to Parsons Figures):

- Potential storm drains at the NAKOH building (sub-area G);
- The West Flume (sub-area J). The West Flume is an earthen drainage channel that varies in depth, but is on average at ~5 ft below surrounding grade;
- Downgradient, down-slope areas to the north and northeast (within and beyond sub-areas A, B, C, and D – make note of the topography and what appears to be a drainage swale between OU2 and the rail lines to the northeast)

3.0 SPILL PREVENTION AND CONTROL

Spill prevention and control measures have been developed based upon the anticipated volumes of chemicals to be stored and staged at the site and upon the batch volumes of

mixtures to be prepared during treatment operations. Table 1 below summarizes the estimated theoretical volumes and rates of release for potential spill events during these operations.

Table 1 - Estimated Potential Spill Volumes and Rates:

Potential Event	Material Released	Volume Released	Spill Rate
Complete failure of valve or connection to a dilution tank	10% (maximum concentration) solution of hydrogen peroxide or 5% (maximum concentration) solution of ferrous sulfate (low pH)	300 to 500 gallons	50 gallons per minute
Overflow of dilution tanks	10% (maximum concentration) solution of hydrogen peroxide or 5% (maximum concentration) solution of ferrous sulfate (low pH)	50 to 100 gallons	10 gallons per minute
Failure of delivery component: hose, pump or valve.	10% (maximum concentration) solution of hydrogen peroxide or 5% (maximum concentration) solution of ferrous sulfate (low pH)	20 to 30 gallons	5-10 gallons per minute
Tip-over of mixing vessel	25% solution of hydrogen peroxide or sulfuric acid	20 to 30 gallons	Instantaneous
Overflow of mixing vessel during mixing	25% solution of hydrogen peroxide or sulfuric acid	1-2 gallons	1-2 gallons per event
Puncture or tip-over of storage drum	50% hydrogen peroxide or 98% sulfuric acid	55 gallons	5-10 gallons per minute
Reagent surfacing	<10% (maximum concentration) solution of hydrogen peroxide or <5% (maximum concentration) solution of ferrous sulfate (low pH)	100 gallons per injection point max	10 gallons per minute

At each treatment area, mixing, dilution and pumping equipment will be placed or staged in secondary containment devices, capable of holding at least 110% of the entire volume of material being staged. Similar secondary containment will be provided within treatment areas

for temporary (i.e., during daily work hours) storage of treatment chemicals in their original containers.

- **Drum handling requirements:** Treatment chemicals will be delivered to the site by the chemical supplier in a lift-gate-equipped truck. Drums or carboys (i.e., containers) will be inspected and bungs checked for tightness prior to handling. Containers will be set on the ground and moved into secondary containment devices using drum dollies. For daily operations, containers will be loaded onto an ERFS service truck using drum dollies and lift-gate and driven to treatment areas for dilution and application. Prior to any handling, bungs will be checked for tightness.
- **Drum storage secondary containment:** Pre-fabricated, 10-foot by 10-foot (or similar), pop-up secondary containment devices will be used to store drums and carboys at the site. Spill pallets may also be used to store or stage one or two drums or carboys. Containment devices will be used both at storage and treatment areas.
- **Signage:** Storage areas will be marked with appropriate NFPA and DOT signage for the materials being stored.
- **Segregation of Incompatible Reagents:** __X_ yes _____ no
- **Mixing and Dilution Operations:** Locate area for mixing and dilution operations on level ground. Create an exclusion zone with physical and visual barriers that can be secured from vehicular and pedestrian traffic. Set-up secondary containment device(s) within the exclusion zone to stage treatment chemical and to house all mixing and dilution equipment and operations.
- **Surfacing Containment:** Any material that has been injected and then surfaces will be diked with sand to stop surface runoff. Once diked, the material will be recovered with wet vacuums or reabsorbed into the subsurface.
- **Footage of containment dike required:** Around injection surfacing points – estimated at approximately 5 to 10 linear feet per each location. Around storm water drains – approximately 15 to 20 feet each. Total estimate – approximately 100 feet or approximately 20 sand bags.
- **Recovered liquid storage requirements:** 100 gallons maximum. Any recovered reagents will be re-used for injection at the site.
- **Number of Wet Vacuums:** _2 / Power cord: 200_ feet
- **pH meter:** Yes __X__ No_____
- **Reagent neutralizers:** Water for hydrogen peroxide or ferrous sulfate solutions. Bicarbonate of soda.

Description of where a spill would go: Prior to mobilization, all areas to be used for storage and staging of treatment chemicals will be inspected for drains, storm-water catchments and drainage features, slopes and subsurface utility structures. Potential receptors will be identified and, if necessary, additional preventative measures will be incorporated into this Spill Prevention and Control Plan.

Spills originating from storage or mixing & dilution areas will be contained within secondary containment facilities. Recovery operations would be implemented immediately.

Spills from surfacing events are expected to infiltrate back into the ground.

Spills onto paved surfaces will be contained with dikes using sand to prevent runoff toward storm water catchment basins.

Describe actions that would be taken in the event of a spill:

Treatment chemicals will be delivered to the Site by the Chemical Supplier in DOT-approved plastic drums (55-gallon) or carboys (15 gallons). Containers will be sealed at all times during handling and transportation. Only when containers are located within secondary containment will they be opened for transfer of contents. Similarly, all pumps, mixing vessels and dilution tanks will also be located within secondary containment devices. Any spills involving concentrated reagents would likely occur within the secondary containment and involve less than 10-gallons. In the event of such a spill involving concentrated hydrogen peroxide, the substance will be diluted with potable water and retrieved using wet vacuums. Diluted hydrogen peroxide would be added to dilution tanks for further dilution and used for subsurface injection. In the event of a spill involving acidic reagents (ferrous sulfate), the material will be neutralized with bicarbonate of soda. Residual material would be containerized for off-site disposal.

Any dilute liquid reagent that enters the secondary containment will be recovered with wet vacuums for use during injection. If dilute liquid reagent is spilled outside of the secondary containment, it will be bermed with sand to prevent surface runoff and allowed to infiltrate into the subsurface. If necessary, the dilute reagent can be further diluted with water. Sand will be flushed with water and left on-site.

4.0 SPILL NOTIFICATION

During the course of the project, ERFS will record all incidents involving spills or releases of treatment chemicals. Section 6.0 of this indicates the information to be recorded for each incident. In addition, ERFS will provide notification as soon as possible according to the following list:

Contact List

Client Name: Parsons
Phone: 315-484-3217 (mobile)
315-552-9688 (office direct)
Project Manager: Thomas Drachenberg, PE

Note: If the spill volume exceeds the reportable quantity (see Table 2 below) for the specific chemical notification shall be made to:

U.S. Coast Guard, National Response Center 800-424-8802

Table 2: Reportable Quantities

Reagent	Reportable Quantity
Hydrogen Peroxide (<52%)	NA
Sulfuric Acid (formed upon dissolving ferrous sulfate in water)	1,000 lbs.

5.0 FACILITY INSPECTIONS

Upon mobilization to the Site and set-up of storage areas and work areas, periodic inspections of facilities and equipment will be conducted as summarized in Table 3 below:

Table 3 – Periodic Inspections

Facilities	Frequency	Look For
Chemical Storage	Upon set-up and daily thereafter	Evidence of leaking drums. Inspect secondary containment device – test integrity as needed.
Mixing and Dilution Tanks	Daily	Leaks, drips, loose fittings & connections,
Injection Points, monitoring points, former soil borings, and other subsurface penetrations	Continuously during injection	Surfacing issues around and in the vicinity of injection points. Pay close attention to preferential flow paths, utility corridors, or old sampling locations that might not have been abandoned properly that might surface in remote locations.
Spill Control Equipment	Daily	Adequate supply of sand bags, water, shovels, brooms. Test functionality of wet vacuums.
Storm Drains and Drainage Features	Continuously during injection	Evidence of surfacing flows

Any evidence of a release or spill shall be addressed immediately and be recorded and /or reported pursuant to Sections 6.0 and 4.0 of this Spill Prevention and Control Plan.

6.0 RECORD KEEPING OF SPILLS OR RELEASES

Record Keeper: ERFS Safety Officer

Date	Type of Incident	Cause	How it was Cleaned Up
Reagents	**Volume Released**	**Notifications**	**Operating Changes Required**

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7.0 EMPLOYEE TRAINING

Training Coordinator: Patrick Boska

Prior to participating in any work at this Site, all ERFS field personnel will acknowledge their review and understanding of the Spill Prevention and Control Plan for the OU2 ISCO project by their signature.

Signature of Employee	Employee Name	Date

ERFS APPROVAL

I certify that I have personally examined and am familiar with the information submitted in this document and that, based on my inquiry of those individuals responsible for obtaining this information, the information submitted is true, accurate and complete.

Signature *Mark Vigneri*	Mark Vigneri President & CEO	Date 6/10/10
Signature *Ron Adams*	Ron Adams Exec VP, Program Mgr	Date 6/10/10
Signature *David Spader*	David Spader Project Manager	Date 6/10/10
Signature *Patrick Boska*	Patrick Boska Site Safety Officer	Date 6/10/10

APPENDIX C
Design Basis and Calculations

A) Treatment volume – soil and groundwater

Basis: Plumes, sizes, and depth intervals shown in Exhibit 4-1

Treatment Volume	= Area x Depth x porosity x unit conversions
1) Unsat'd Soil	= 20,000 sf x 6 ft / 27 = ~4,500 tons
2) Saturated Soil	= [80,000 sf x 14 ft] + [45,000 sf x 6 ft] = 1.39 M CF = 51,481 CY = 56 M kg
3) Groundwater	= 1.39 M CF x 0.3 x 7.5 = 3,127,500 gal = 11.84 M Liters

B) Contaminant Mass

1) Saturated Soil

Basis: Table 2.6 of the Parsons FS, "Chemical Mass Estimates from EVS Output" (ERFS recognizes that Table 2.6 presents contaminant mass over what appears to be an impacted volume much larger than the RFP treatment area. Using these mass estimates should result in a conservatively high mass estimate and related oxidant mass requirement)

Xylene	= 2,230 lbs = 1 M g
Ethylbenzene	= 370 lbs = 168,000 g
Total Soil VOC	= 1.17 M g = 11,037 g-moles (MW=106 g/mole for both)

2) Groundwater

Basis: Parsons Fig 1.15, Average of 2002, 2003, 2004 groundwater sampling results for most contaminated wells is approximately 40,000 ug/L total VOC (mostly xylene with some ethylbenzene)

Total VOC (assume as all xylene)	= 40,000ug/L x 11.84M L x g/1M ug = 473,600 g = 4,462 g-mole

C) Oxidizer Mass Needed Based on Contaminant Mass

Total VOC = 15,499 g-moles

Stoichiometry for C8 aromatic compound oxidation – 9 moles peroxide needed for each mole of xylene or ethylbenzene.

Efficiency for typical injection is 10%

Peroxide needed	= 15,499 g-moles x 9 (stoich) x 10 (efficiency factor)
	= 1,394,910 g-moles
	= 47,426,940 g of peroxide (100% strength)
	= 94,853,880 g at 50% strength
	= 208,929 lbs 50%
	= 22,982 gal 50%
	= 229,820 gal 5% (avg. injection concentration)

**229,820 gallons of oxidizer represents 7% of the treatment area pore volume which falls in the rule-of-thumb range of 5% to 10% of the pore volume needed to achieve adequate distribution and contact with impacted media while avoiding excessive treatment, mounding, and forced plume migration.*

D) Reagent Volume Based on Estimated Soil Oxidant Demand

Basis: Soil oxidant demand (SOD) is typically in the 0.5 to 1.0 g of oxidant per kg of soil matrix. Based on review of site documents, bench test results, and pilot test results, ERFS estimates that SOD is at 0.75 g/kg

SOD	= 56 M kg x 0.75 g/kg
	= 42 M g oxidizer
	= 92,511 lb at 100%
	= 185,022 lb at 50%
	= 20,352 gal at 50%
	= 203,520 gal at 5%

**Results from both C and D above check and agree within 12% of each other, therefore, ~200,000 to 250,000 gal of 5% peroxide (or equivalent) is a good estimate and basis of the reagent needed for the initial rounds of site treatment.*

E) Injection Point Spacing and Number of Points

Basis 1: Based on soil types and estimated hydraulic conductivity, ERFS estimates an ROI of 15 ft and a 20% overlap needed.

Number of points needed = 80,000 sf x 1.2 / [15 x 15 x 3.14]
= 136 points

Basis 2: Phase 3 Pilot Recommendations – based on field observed ROI using the pilot test techniques, recommendations were to place points on 25 ft centers (or an ROI of 12.5 ft without overlap). Pilot test also observed large area coverage where injection points linked up to propagations.

Number of points needed = 80,000 sf / [12.5 x 12.5 x 3.14]
= 163 points

Avg of the two results above = (136 + 163) / 2 = 150 points

**Number of DP points could rise by 20% to 30% depending on localized short-circuits, heavy contamination, etc., so estimate should be in the 150 – 200 points range.*

F) Reagent Volume Based on Pilot Test Results

Phase 3 Pilot Test concluded that site remediation required 50 gallons of 12% hydrogen peroxide (plus catalyst) at two intervals per location, or 100 gals of 12% per location. Also concluded that injection locations should be spaced on ~25 ft centers (~500 sf of treatment per location), which would result in ~160 locations for 80,000 sf treatment area. Report estimated that two to four treatment events would be needed.

Basis: 100 gal of 12% hydrogen peroxide into 160 locations for 4 events

Peroxide amount: = 100 gal x 160 x 4
= 64,000 gal 12%
= 15,360 gal 50%
= 153,600 gal 5% peroxide or equivalent

**Above estimate for the full four treatments approximately checks with results of estimates in items C and D. ERFS recommends using the results of items C and D above for the injection volumes for the first two events, or 150,000 gallons each for the first two events. This is based on the 50% treatment results observed during pilot testing (meaning too little oxidizer was injected).*

<u>Summary & Conclusions</u>

ERFS recommends injecting 150,000 gallons of 5% peroxide with a proportional catalyst solution of 2% to 6% ferrous sulfate heptahydrate solution into 150 - 200 injection locations for each of the first two treatment events (Event One = DP event followed by fixed PVC well installs; Event Two = PVC well injection event). Injection points are