

Work Plan for AOC-65 ISCO Treatability Study



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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
bgs	Below ground surface
CSSA	Camp Stanley Storage Area
CY	Cubic Yard
DCE	Dichloroethene
GAC	Granular Activated Carbon
HDPE	High Density Polyethylene
ISCO	<i>In-Situ</i> Chemical Oxidation
IRA	Interim Removal Action
KDT	Klozur Oxidant Demand Test
PCE	Tetrachloroethene
SOD	Soil Oxidant Demand
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TSW	Treatability Study Well
VEW	Vapor Extraction Well
VOC	Volatile Organic Compound

SECTION 1 INTRODUCTION

1.1 STATEMENT OF OBJECTIVE

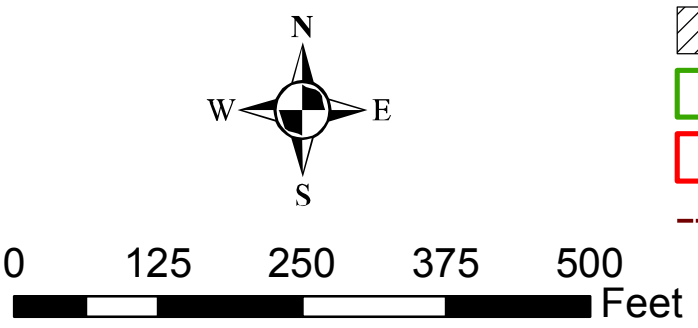
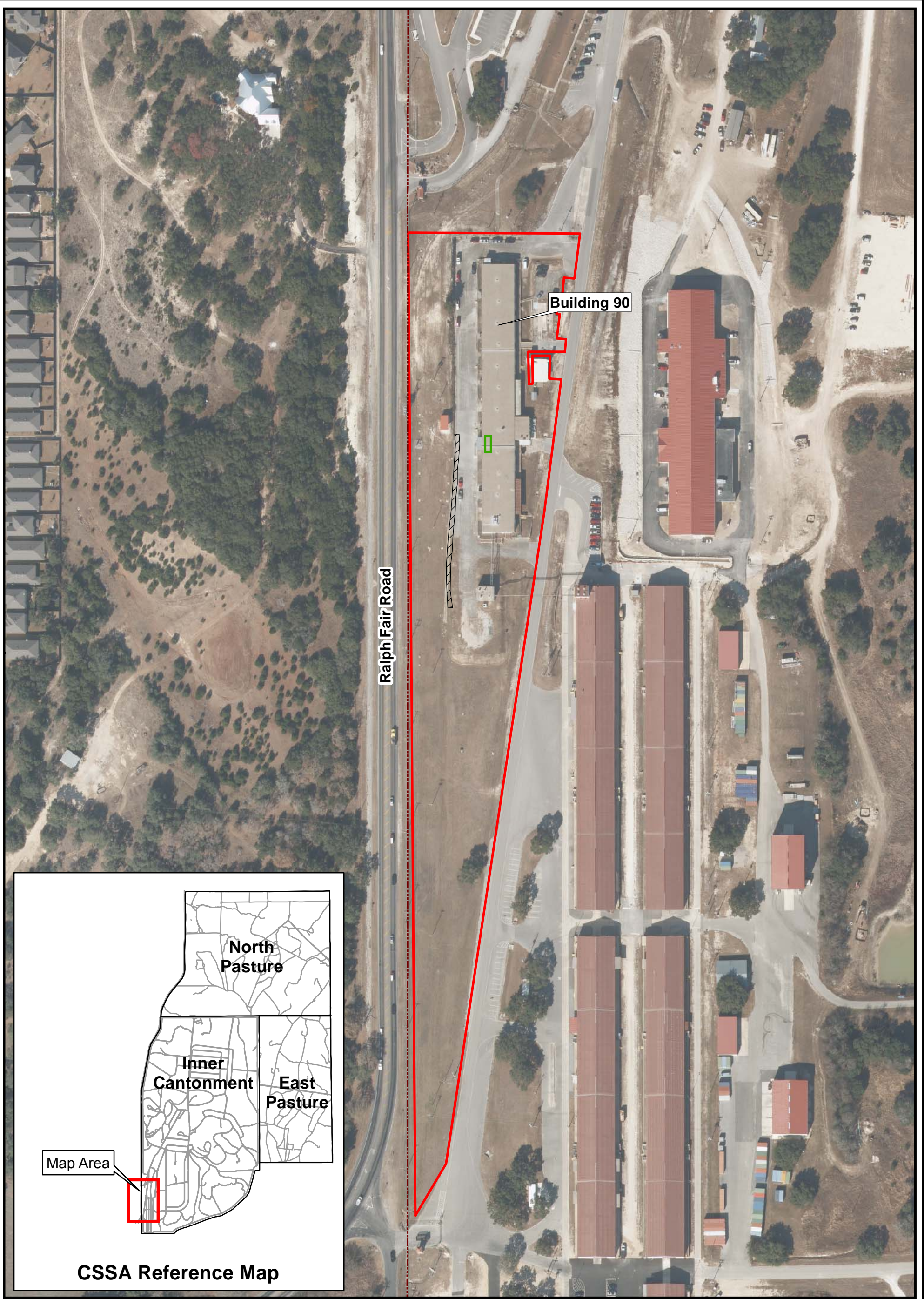
This work plan is for a pilot-scale treatability study of the use of *in-situ* chemical oxidation (ISCO) to treat solvent contamination in groundwater at Area of Concern-65 (AOC-65). This document serves as both an addendum to the existing CSSA *Work Plan*, February, 1996 (see CSSA Environmental Encyclopedia (www.stanley.army.mil), Volume 1-1) and work plan addenda contained therein, and an addendum to the existing CSSA *Field Sampling Plan*, February, 1996 (see CSSA Environmental Encyclopedia, Volume 1-4) and sampling and analysis plan addenda contained therein. Results of the proposed ISCO treatability study will be documented in a treatability study report.

1.2 BACKGROUND

AOC-65, located along the western fence line within the Inner Cantonment at Camp Stanley Storage Activity (CSSA) (**Figure 1.1**), has been identified as the source of vapor phase and dissolved phase (Plume 2) chlorinated solvent contamination. Chlorinated solvents, which contain volatile organic compounds (VOCs), were used in Building 90 for more than 30 years. Chlorinated solvent usage at CSSA was eliminated in 1995 and replaced with a citrus-based cleaning solvent. Source characterization of the Building 90 vicinity (main portion of AOC-65) included a 2001 soil gas survey which entailed collection and analyses of 319 soil gas samples. Around and inside Building 90, tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and trans-1,2-DCE were detected. The detection of DCE indicates that natural degradation of PCE/TCE is occurring in the subsurface.

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report for AOC-65 was completed in September 2002 (Parsons, 2002b). An interim removal action (IRA) was also initiated in 2001 and included excavation of ~1,300 cubic yards (CY) of soils underlying the pavement and drainage swale on the west side of the building as well as, lining the drainage swale with concrete to prevent rainwater run-off infiltration. A second IRA was performed in early 2012, whereby the soil and bedrock beneath the concrete-lined drainage swale (location of the 2001 IRA) were excavated to a depth of approximately 15 feet.

Pilot testing of a soil vapor extraction system (SVE) was initiated at AOC-65 to evaluate the effectiveness of VOC contamination removal from the vadose zone. SVE was demonstrated to be an effective method for source removal in surface formations at CSSA during the earlier pilot and treatability study at SWMU B-3. Two SVE systems were installed at AOC-65 in late 2002. These systems, known as the eastern and western AOC-65 SVE system(s), have the primary objectives of removing VOC contaminants from the soils, fractured limestone, and groundwater around AOC-65 and to decrease the migration of contaminants from the site. The system was optimized in 2006 and was idle until operations resumed in 2007. The system remained on from April 2007 through July 2012, and during the final four years of operation removed approximately 10 gallons of PCE. Due to system inefficiencies, both the SVE systems were shut down and ultimately dismantled.







-  Trench
-  Former Solvent Vat location
-  AOC-65
-  CSSA Boundary

Figure 1.1
AOC-65
Site Map
Camp Stanley Storage Activity

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A pilot-scale ISCO treatability study was conducted in August 2012. Prior to the 2012 pilot study, seven treatability study wells (TSWs) were installed within AOC-65 to monitor the progress of the treatment front associated with application and activation of sodium persulfate in shallow groundwater. For this treatability study, four new ISCO Injection Wells (IIWs), will be installed. IIW design is provided in **Figure 1.2**. These wells will be installed within AOC-65, along the fenceline west of the trench and will be used to create an ISCO treatment barrier for chlorinated solvents potentially mobilized when ISCO solution is injected into the infiltration galleries within the trench. The location of the AOC-65 vapor extraction wells (VEWs), TSWs, IIWs and the trench associated with the most recent interim removal action are shown on **Figure 1.3**.

VOC concentrations above the Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) for groundwater have been encountered at depths as deep as 300 feet below grade and at significantly higher levels in monitoring wells screened near the surface (upper 50 feet). Additionally, groundwater monitoring of seven off-post wells west and southwest of AOC-65 have detected PCE and TCE historically. Water from six of these wells is treated via granular activated carbon (GAC) filtration systems. During ISCO application, these six wells with GACs and one additional off-post well will be monitored as described in **Section 4**.

The bedrock beneath a drainage ditch west of Building 90 is suspected as a continuing source of dissolved and vapor phase contamination. The 2012 IRA resulted in the excavation of a trench 3.5' wide, between 12' and 15' deep and greater than 300' long. The trench has been backfilled with alternating layers of ½"-sized quartz gravel and clay with perforated high density polyethylene (HDPE) tubing installed within the gravel layers creating three discreet zones. The overall effect of the backfilled trench is that of an infiltration gallery with the ability to apply an ISCO solution at any of the three zones independently or simultaneously to treat the surrounding bedrock and destroy contamination contained therein. It is anticipated that applying the ISCO solution in an infiltration gallery rather than injecting it in a well allows the solution to follow the same preferred paths, both laterally and vertically, that the contaminants used, while a well may or may not intersect one or any of the preferred flow paths. An infiltration gallery is a conduit of permeable material (gravel) into which the chemical oxidant solution can be added so that it slowly drains to the subsurface. To enhance the possibility that both lateral and vertical paths are taken when an ISCO solution is added, the infiltration gallery has been divided with layers of impermeable clay, thus only the basal gravel layer is anticipated to drain vertically, and successive gravel layers are anticipated to drain laterally through the fractures and conduits in the walls of the trench. Perforated injection lines laid in each of the successive gravel layers provide the means to inject the chemical oxidant and the catalyzer to activate the oxidant. The infiltration gallery design is presented in **Figure 1.4**.

1.3 PLANNED ACTIVITIES

Existing work plans and quality control plans for current and previous CSSA task orders fulfilled by Parsons remain in effect and are available in the *CSSA Environmental Encyclopedia, Volume 1, Work Plans*. General activities to be conducted will follow the provisions of those prior documents, as applicable. General descriptions of site history, geology, and hydrogeology are also found therein. The following paragraphs describe the planned field activities and procedures to be completed.

GROUND SURFACE

3'x3' SURFACE SLAB

12" MANHOLE COMPLETION

CEMENT 0-10' BGS

4.9" OD/4.5" ID SDR 17 PVC CASING

SHALE TRAP (x2)

OPEN BOREHOLE COMPLETION (BEDROCK)

8" BOREHOLE DIAMETER

10'

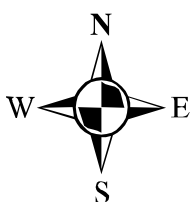
125'

Figure 1.2

Typical ISCO Injection Well Design
IIW-01 through IIW-04

Camp Stanley Storage Activity

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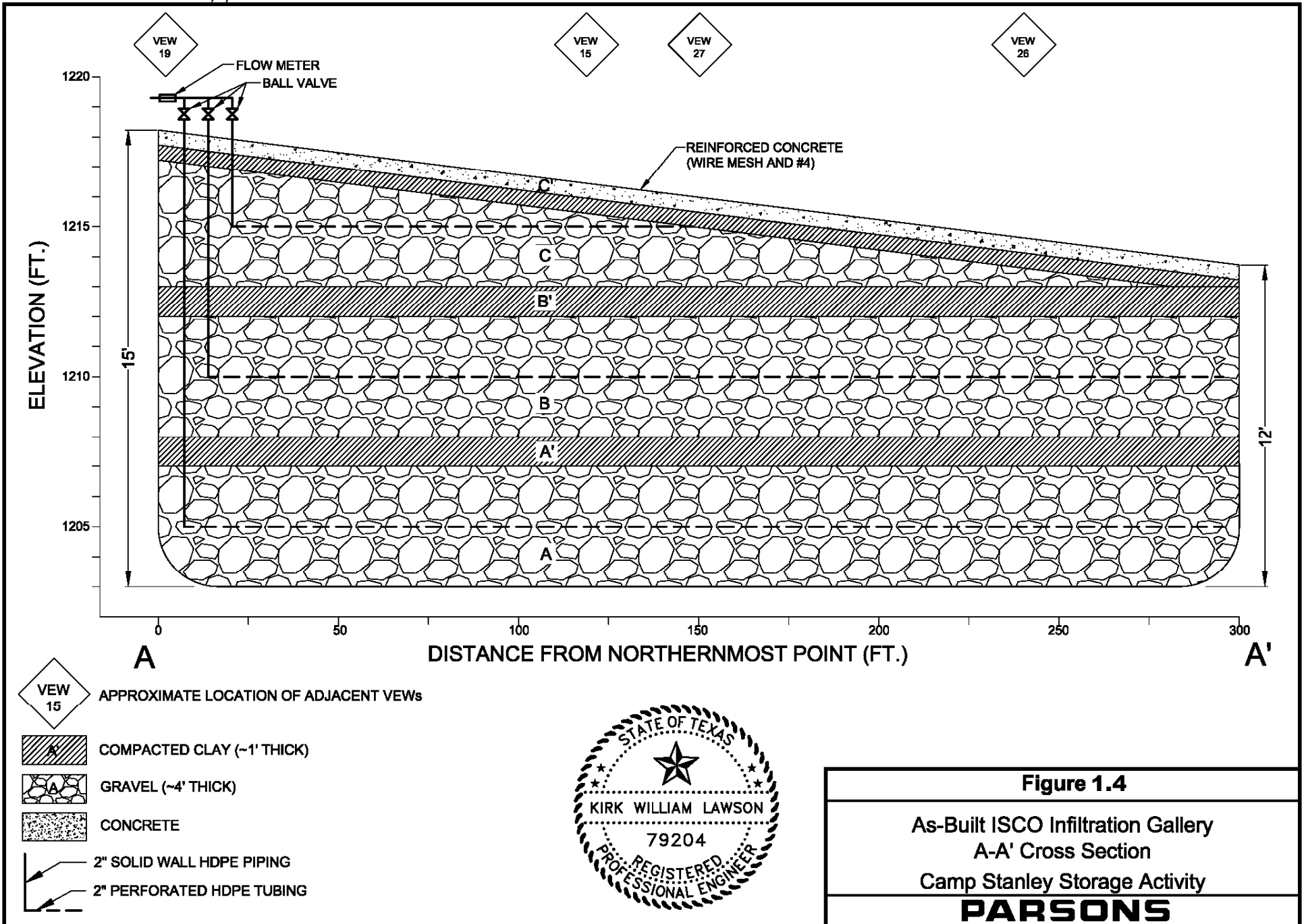
0 25 50 100 Feet

-  Monitoring Well
-  VEWs
-  Peizometers
-  Steam Injection Well
-  Treatability Study Well
-  West Bay - Multipoint Monitoring Well
-  IIWs
-  Trench
-  AOC-65 Vat

Figure 1.3

AOC-65 Monitoring
Overview Map
Camp Stanley Storage Activity

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This work plan provides a general description of the activities and procedures required for the completion of a treatability study at AOC-65 to determine the pilot-scale efficacy of ISCO as a remedial option for VOCs in soils and groundwater. Specifically, the proposed treatability study includes the following activities:

- Equipment set up,
- Mixing sodium persulfate solution,
- Injection of ISCO solution (oxidant and activator) in:
 - IIW-01 through IIW-04,
 - Each zone within the infiltration gallery,
 - SIW-01, and
- Monitoring
 - Groundwater sampling for reaction byproducts and changes in geochemistry
 - On-post wells,
 - Off-post wells
 - Field parameter collection of on- and off-post wells.

Quick-connect hose fittings will be installed to the injection gallery HDPE surface lines to facilitate injection hose connections. Hose with similar quick-connect fittings will be used to transport the oxidant and activator from their respective transport containers to the selected injection well or infiltration zone within the trench. A 200-gallon poly tank will be used to transport the ISCO solution from the mixing tank to each of the IIWs. Injection into these IIWs will occur via gravity feed. An air-operated dual-diaphragm pump will be used to transport the oxidant from the mixing/storage tank to the trench. The activator will be dosed into the injection stream via Venturi effect prior to injection.

1.4 HEALTH AND SAFETY

Work will be performed in modified Level D. Dust masks are required during Klozur persulfate mixing activities. Additionally, access to emergency showers and eyewash stations is required during all ISCO solution injection activities, and is provided in Building 90.

SECTION 2 INJECTION EQUIPMENT

2.1 GENERAL

To facilitate the injection of ISCO solutions into injection wells and the infiltration gallery within AOC-65, a skid mounted mixing hopper with circulation pump (provided by FMC), an air-powered dual-diaphragm pump, a ~4,900 gallon storage tank and a 200 gallon transport tank will be used. The dual-diaphragm pump utilizes compressed air to pump injection fluids to either the infiltration gallery thus a gas-operated air compressor capable of 100 cfm at 100 psig is required. A forklift will be required to off-load and position injection equipment and position the loaded super sack jig atop the mixing hopper. Anticipated equipment used include:

- Hopper Mixing Skid
- 4,000-gallon Mixing Tank (Rain for Rent)
- Air-powered Dual Diaphragm Pump (Rain for Rent)
- 200-gallon Poly transport tank affixed to a trailer
- Air-compressor (100 cfm @ 100 psig)
- 480-Volt power
- Water Supply – hydrant within AOC-65
- 1.5” chemical resistant hoses w/ quick-connection fittings (200’ total)
- Forklift

2.2 MAKE-UP WATER

Approximately 27,000 gallons of make-up water will be required for the treatability study. Make-up water will be obtained from CSSA’s water system. A fire hydrant located within AOC-65 will be utilized to provide water for the treatability study. Due to the proximity of the hydrant to the injection site no transport will be required. The water from the fire suppression line is however chlorinated. Water samples from the distribution system indicate a range of chlorine concentrations (between 0.7 and 2.0 ppm). FMC indicates that at these concentrations the additional persulfate demand generated by the presence of chlorine is negligible. An air gap will be maintained while filling the mixing tank to ensure no ISCO chemicals enter the water distribution system.

2.3 EQUIPMENT STAGING

A planned equipment staging map (**Figure 2.1**) is designed to allow sufficient access to all equipment required to complete all injection activities. Additionally, Building 90 access will be required to ensure access to emergency shower and eyewash stations.

2.4 PRE-INJECTION WELL INSTALLATION

Prior to initiating injection activities, four additional wells will be installed along the western fenceline at AOC-65, ISCO Injection Wells (IIWs). These open borehole wells will be filled with ISCO solution prior to injecting within the infiltration galleries within the trench. ISCO fluids added to these IIWs may create a protective ISCO barrier such that chlorinated solvents mobilized during the primary ISCO injections within the trench have an additional opportunity to be destroyed before migrating off post.

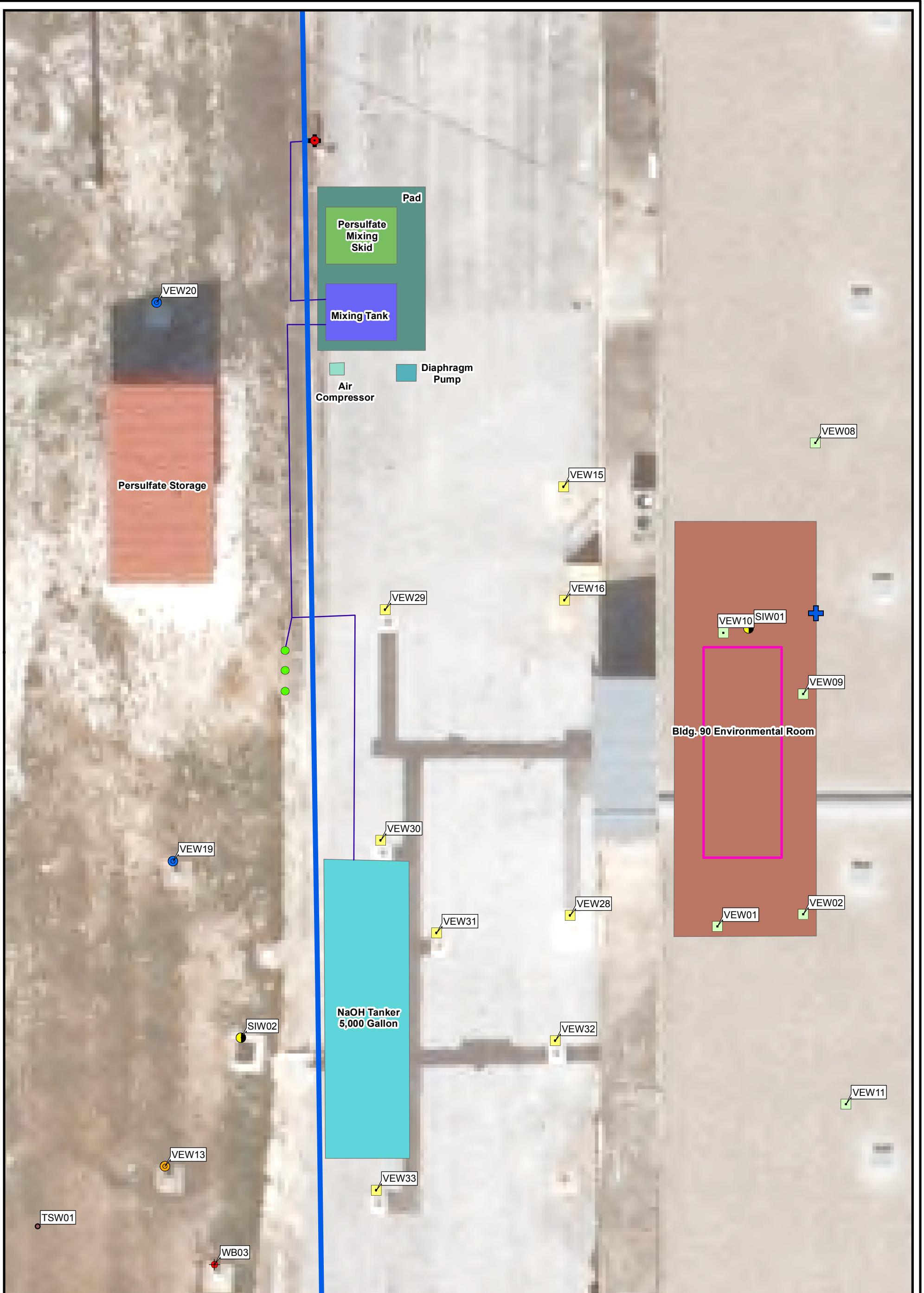


Figure 2.1

AOC-65 ISCO Trench
 Equipment Staging Map 2
 Camp Stanley Storage Activity

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- + Emergency Shower/Eyewash
- Infiltration Gallery Injection Lines
- AOC-65 Vat
- 6 inch Water Line
- + Fire Hydrant

0 5 10 20 30 40 Feet

SECTION 3 ISCO SOLUTION

3.1 GENERAL

The chemical oxidation process involves increasing the oxidation state of a substance (i.e., chlorinated solvents) by introducing an oxidant into contaminated soils. The targeted compounds are then transformed into new species that are less harmful than the originals. Oxidation of the substance may occur by the addition of an oxygen atom, the removal of a hydrogen atom, and/or the removal of electrons without the removal of a proton from the target compound.

In situ chemical oxidation (ISCO) requires the injection of an oxidant into the subsurface so that a redox reaction between the oxidant and the target compound takes place, oxidizing the compound into benign compounds. Oxidants may catalyze in a number of ways to increase their oxidation potential, and thus reduce targeted compounds more quickly and completely. Typical methods of catalysis include: temperature increase, addition of a general activator, photo activation, and with base conditions.

3.2 OXIDANT SELECTION

Sodium persulfate has been selected as the chemical oxidant for use at AOC-65 for several reasons. First, sodium persulfate is more stable than many other oxidants used in ISCO applications, like ozone and hydrogen peroxide, yet has a relatively high oxidation potential (2.1 V). Similarly, the sulfate radical is more stable than the hydroxyl radical upon catalysis. Sodium persulfate has a high solubility, and the densities of injection fluids are greater than water which allows for more effective vertical transport of oxidants in fractures or within the porous media. The reaction rate for persulfate is generally slow, up to a few weeks. The slow reaction rate/long persistence of persulfate also allows for greater dispersal and thus, affects a greater volume of contaminated media. Finally, sodium persulfate is less likely than some oxidants to leave undesirable reaction products or precipitate solids reducing permeability and contact with contaminants and foul the formation.

Klozur® is a form of sodium persulfate used in environmental applications manufactured by FMC. Klozur® persulfate activation chemistries are used to convert Klozur® Persulfate into the persulfate radical. General information regarding the properties of Klozur is provided in its specific material safety data sheet (MSDS) (**Appendix A**).

3.3 ACTIVATOR SELECTION

Sodium persulfate in aqueous solutions dissociate to form the persulfate anion $S_2O_8^{2-}$. By itself, the persulfate anion is capable of degrading many types of contaminants, and has an oxidation potential of 2.1V. Persulfate can be catalyzed to form the sulfate radical ($\cdot SO_4^-$), which has an even greater oxidation potential (2.6V). The catalysis of persulfate may be accomplished in a number of ways including: increased temperatures, photo (UV) activation, addition of general activators like ferrous iron (Fe (II)), copper, silver, manganese, cerium, and cobalt, with base conditions, or with H_2O_2 .

The preferred method of catalysis at AOC-65 is with base conditions. To achieve the base conditions required (pH 10 or greater); a 25% sodium hydroxide solution will be added to the

oxidant. In addition to having a greater oxidation potential, the sulfate radical also can degrade a wider array of contaminants, the reaction rates are much quicker, and the formation of $\cdot\text{SO}_4^-$ may initiate the formation of the hydroxyl radical ($\cdot\text{OH}$). General information regarding the properties of 25% sodium hydroxide is provided in its associated MSDS, included in **Appendix A**. The potential to mobilize naturally occurring metals exists when subsurface pH conditions are increased. During bench-scale testing, arsenic, barium, chromium, copper, lead, nickel, and zinc concentrations rose to near or above MCLs as a pH of 11 was achieved during the activation of persulfate. It is anticipated that as the oxidation reactions cease, and pH returns to more neutral conditions (pH \sim 7), soluble forms of these metals will return to an immobilized state.

3.4 BENCH-SCALE TEST RESULTS

Klozur activated persulfate is a strong oxidant capable of mineralizing a wide range of contaminants, including chlorinated solvents. Chemical oxidants do not target specific compounds, rather will mineralize not only the contaminant of concern, but oxidize soil organics, reduced metals, and other organic species present. Additionally, activated persulfate will undergo auto-decomposition as a function of temperature, concentration, and activation method. Quantification of the demand upon the activated persulfate from these components is necessary to develop appropriate persulfate dosing requirements for treatability testing and field applications.

A series of Klozur soil-oxidant demand tests (KDTs) were performed by FMC Environmental Solutions using soil samples correlative to soils at AOC-65, though uncontaminated; to determine the oxidant demand likely to be encountered in the subsurface utilizing high pH as the activation method. Specifics of these tests and individual results are provided in a **SOD Technical Memorandum**; however, an average soil-oxidant demand (SOD) of 0.49 g Klozur/kg soil was ultimately determined. This SOD must first be overcome before activated oxidants will oxidize contaminants of concern.

Based on the bench-scale test results, FMC recommended the use of between 10 and 20% Klozur persulfate solution. High pH persulfate activation using a 25% sodium hydroxide solution is also recommended.

3.5 OXIDANT/ACTIVATOR DOSAGE

Dosage requirements are based on the natural SOD, concentration of the target compound(s) in groundwater and soils, activation chemistry (high pH) and treatment volume. The bench-scale test determined a natural SOD of 0.49 g Klozur/kg soil. Concentrations of PCE in groundwater samples from CS-WB03-UGR01 (located \sim 10' west of the trench) have been as high as 30,000 $\mu\text{g}/\text{l}$ (March 2008) and most recently \sim 7,000 $\mu\text{g}/\text{l}$ (October 2012). Waste characterization samples collected during the IRA effort indicate PCE concentrations in soils as high as 0.32 mg/kg.

3.5.1 Oxidant Mixture

To achieve the recommended 20% persulfate solution, Klozur persulfate will be mixed with water at a rate of 1.9 lbs per 1 gallon. Dust masks shall be worn while operating or making adjustments to the mixing skid. Approximately 55,000 lbs of Klozur persulfate will be used during the ISCO treatability study which will require 26,400 gallons of water, thus the mixing and injection of the persulfate solution will be conducted in batches. Batches will consist of two

sacks of Klozur persulfate (4,400lbs total) and 2,112 gallons of water generating 2,310 gallons of 20% persulfate solution.

3.5.2 Activator

A 25% sodium hydroxide solution will be used to activate the persulfate. The activator is anticipated to arrive pre-mixed; therefore, no mixing will be required.

3.5.3 ISCO Solution Dosage

Typical 25% NaOH dosage for persulfate is 12.7 gallons per 100 lbs of persulfate to neutralize acid generation, for a total of 6,985 gallons. An additional 30% of this volume is required to overcome the soil buffering capacity of the soils and bedrock, or 2,095.5 gallons. The total volume of 25% NaOH required to activate 28,875 gallons of 20% sodium persulfate is 9,080.5 gallons, which equals 1 gallon NaOH per 3.18 gallons persulfate solution by volume. Flow meters located on the inlet lines from the persulfate mixing tank and the additive line will be used to ensure the 3.19:1 ratio is maintained during injections.

3.5.4 Additional Sodium Hydroxide Injection

Monitoring of field parameters including pH will be conducted following injections within the infiltration gallery. Subsequent to injection, dramatic changes in pH are expected in VEWs and monitoring wells surrounding the trench and SIW-01. Should the observed pH drop below 10.5 following ISCO application, additional activator shall be injected.

3.6 OXIDANT/ACTIVATOR INJECTIONS

Once a batch of the oxidant solution has been mixed, injections will commence immediately and will continue daily until the entire batch has been injected. Injections will occur in batches of ~2,300 gallons each. Approximately 29,000 gallons of Klozur persulfate (12.5 batches) will be injected. Injections will begin with the IIWs to ensure that the ISCO curtain is in place prior to the main gallery injections. ISCO solution may be transported to the IIWs via a 200-gallon transport tank and gravity fed into the wells concurrently with sodium hydroxide. Injections in the infiltration gallery will begin in the lowest zone, followed by the middle and upper zones, then SIW-01. Estimated injection volumes for each location are given in **Table 3.1**.

Table 3.1 Klozur Persulfate Injection Volume per Location

Injection Location	Gallons of 20% Persulfate Solution	Gallons of 25% Sodium Hydroxide	Gallons of activated persulfate solution
Trench - Lower Zone	9,200	2,850	12,050
Trench - Middle Zone	12,250	3,800	16,050
Trench - Upper Zone	6,150	2,000	8,150
SIW-01	100	35	135
IIW-01	300	100	400
IIW-02	300	100	400
IIW-03	300	100	400
IIW-04	300	100	400
Total	28,900	9,085	37,985

The injection volume for each trench zone is based on the capacity of the zone and degree of fracturing (as determined by a fracture analysis). The middle zone of the infiltration gallery is the largest of the three zones and the majority of identified fractures are located adjacent to this zone. The lowest zone is slightly smaller than the middle zone, and relatively few fractures were identified that intercept this zone. The upper zone, which extends approximately half the length of the trench, is much smaller than either the lower or middle zones, and thereby can accommodate a much smaller volume of injected ISCO solution. Injection wells IIW-01 through IIW-04 are 8-inch diameter, 125-foot deep open boreholes with 10 feet of surface casing. SIW-01 is a 25-foot deep, 8-inch diameter borehole. Steel casing is emplaced to 10 feet below ground surface (bgs). This steel casing has been effectively isolated from the rest of the borehole via the emplacement of shale traps below the casing, thus ensuring that the casing will not become the target of the activated persulfate solution.

Addition of the 25% sodium hydroxide solution will occur simultaneous with Klozur injections. The sodium hydroxide will be introduced into the Klozur solution via an additive line located on the pump skid. Totalizers located on the Klozur solution and additive lines will be used to monitor rates of addition and ball valves will be used to modify the addition rates to ensure the proper dosage (~3 gallons Klozur to 1 gallon Sodium Hydroxide) is maintained.

Following the completion of all injections, field parameters will be collected from selected VEWs and TSWs. Should the observed pH values from VEWs and TSWs nearest the injection locations (infiltration gallery or SIW-01) be lower than 10.5, additional sodium hydroxide will be injected. The volumes of additional sodium hydroxide are relative to the volume of ISCO solution injected at each location and provided in **Table 3.2**. Zones that have had the greatest volume of ISCO solution injected will require more sodium hydroxide to neutralize the acid generated from the reduction of the persulfate.

Table 3.2 Additional Sodium Hydroxide Injection Volumes

Injection Location	Additional Sodium Hydroxide (gal)
Trench - Lower Zone	1,000
Trench - Middle Zone	1,350
Trench - Upper Zone	550
Total	2,900

SECTION 4 MONITORING

4.1 GENERAL

Monitoring the progress of the ISCO injections will include background and post-injection sampling. Sampling will be conducted at on and off-post wells (MWs and VEWs) 30, 60, and 120 days following the completion of persulfate injections. In addition to groundwater sampling, field testing for persulfate and collection of field parameters, including pH may be completed at on-post wells and VEWs weekly during the first month, then monthly until the last scheduled sampling event (120 days following injections).

4.2 MONITORING POINTS

Samples will be collected for VOC, total dissolved solids, sulfate and metals analysis 30, 60, and 120 days following ISCO injections at 7 off-post wells and selected on-post wells. Field parameters will be collected from the TSWs and at additional on-post monitoring locations including VEWs, WBs (various zones), PZs, and MWs. Samples may be collected from these additional monitoring points for VOC, metals and sulfate analysis to determine the extent of ISCO influence.

Table 4.1 Monitoring Locations

Off-Post Wells	On-Post Wells	*Additional On-Post Monitoring Locations
LS-5	CS-MW6	VEWs (15, 19, 25, 27, and 32)
LS-6	CS-MW7	CS-WB-01 (UGR-01, LGR-01)
LS-7	CS-MW8	CS-WB-02 (UGR-01, LGR-01)
OFR-3	CS-MW36	CS-WB-03 (UGR-01, LGR-01)
RFR-10	CS-WB01-LGR09	TSWs (01, 03, 04, 05, and 07)
RFR-11	CS-WB02-LGR09	PZs (01, 02, 05, and 06)
CS-WB04-LGR11	CS-WB03-LGR09	

* Additional on-post monitoring locations will be monitored for field parameters (pH and water levels) and sampled for VOC, metals, and sulfate analyses and may be field tested for persulfate.

Samples will be collected from the pre-GAC and post-GAC sample ports (if applicable) at off-post wells. All background sampling locations are provided in **Figure 4.1**, and post-injection sampling locations are provided in **Figure 4.2**.

4.3 SAMPLING PROCEDURES

Samples will be collected for VOC, metals and sulfate analysis 30, 60, and 120 days following ISCO injections at 7 off-post wells and selected on-post wells. At the off-post wells samples will be collected from both pre- and post-GAC sample ports at supply wells. At on-post locations (TSWs, VEWs, MWs, WBs, and PZs) samples will be collected using disposable

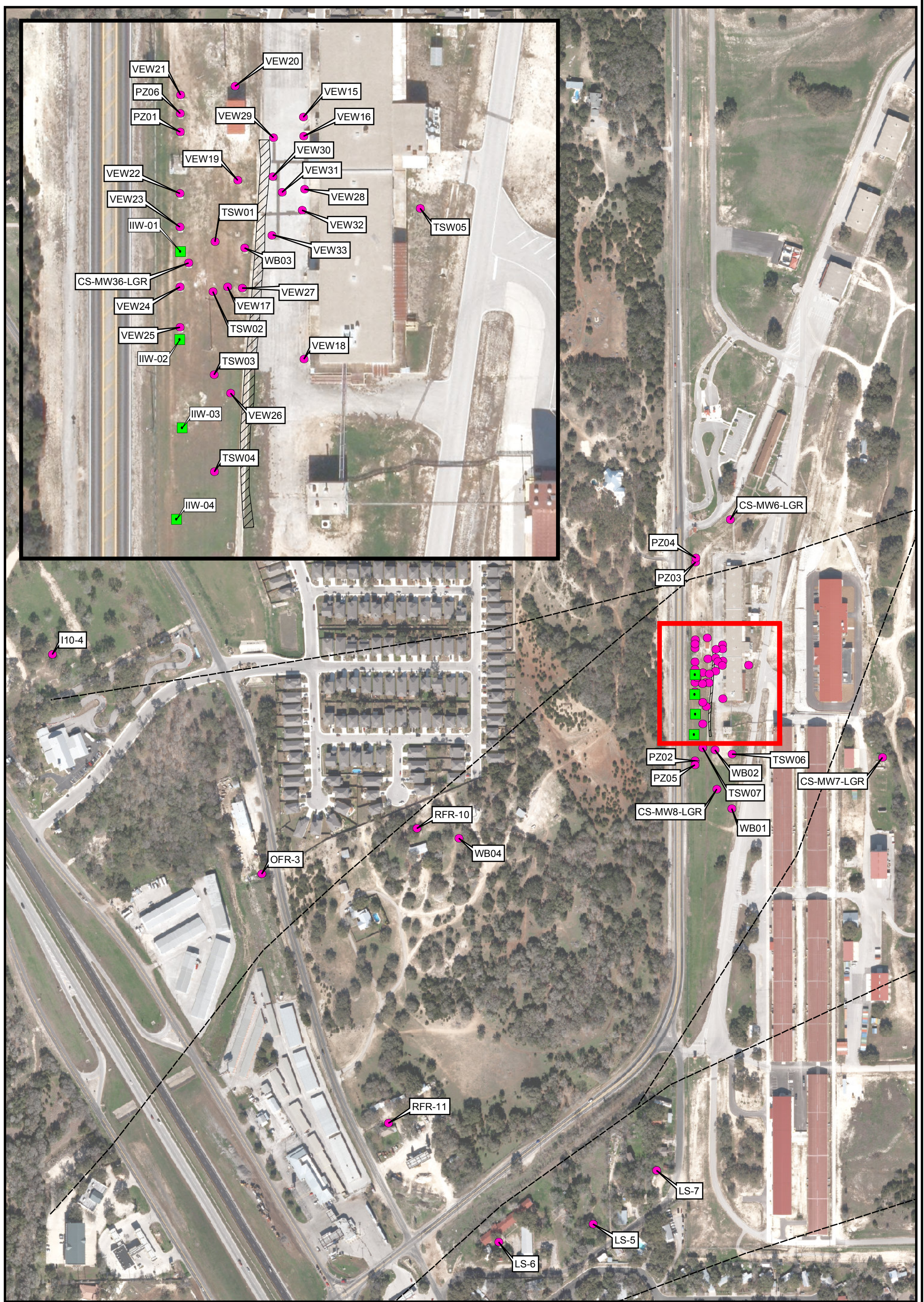
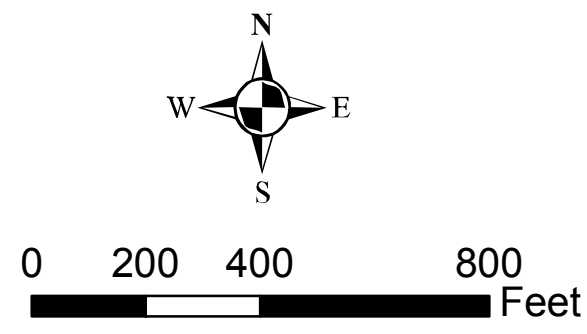


Figure 4.1
 AOC-65 ISCO
 Baseline Sampling Locations
 Camp Stanley Storage Activity

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- Baseline Sampling Locations
- IIWs
- ▨ Trench
- Faults

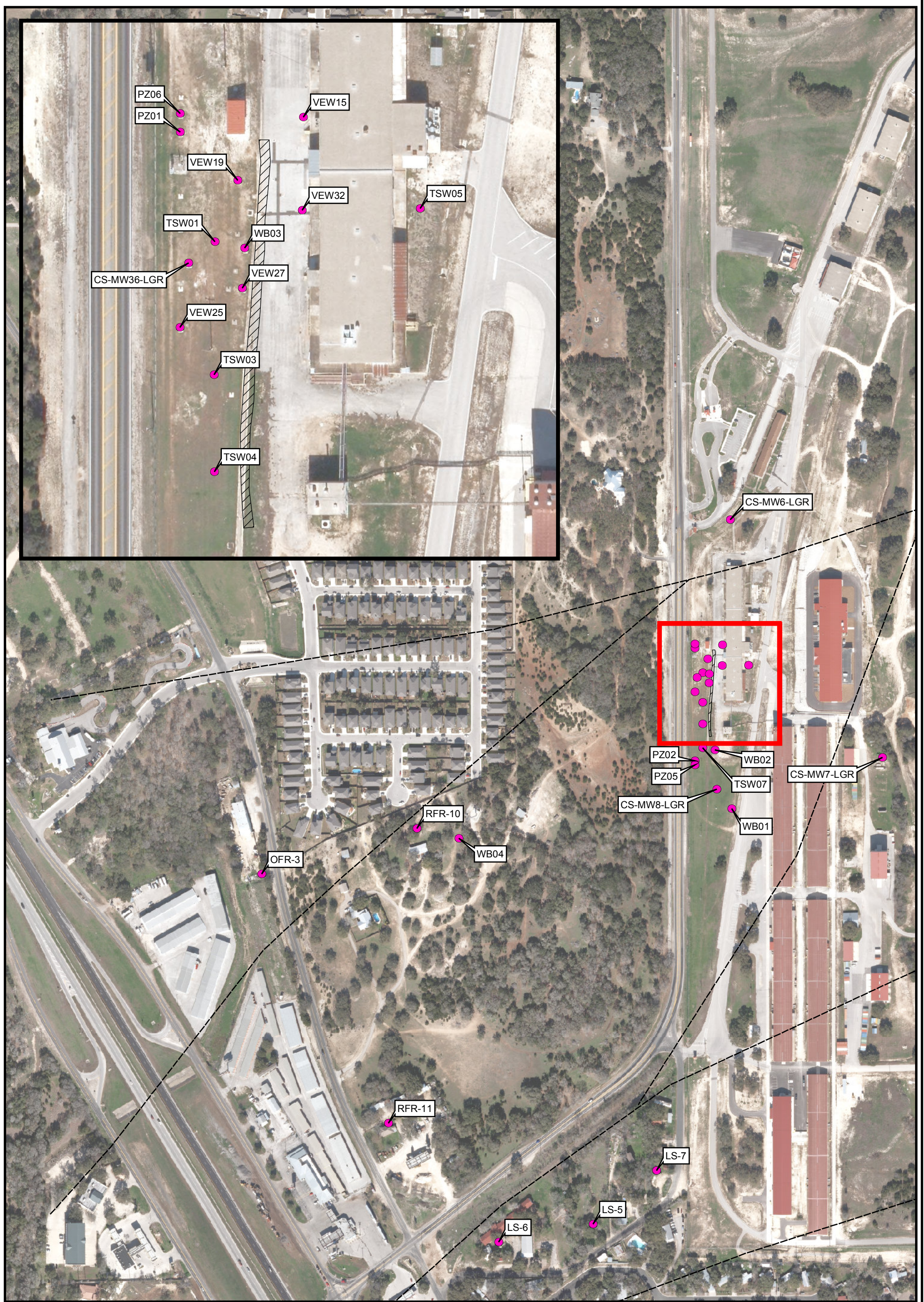


Figure 4.2

AOC-65 ISCO
 Post-Injection Sampling Locations
 Camp Stanley Storage Activity

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bailers, Westbay sampling equipment, or compressed nitrogen for monitoring wells. All samples will be shipped to APPL, assuming standard turn-around times (3 weeks) and as screening data. No field duplicates will be required. However, the lab should be made aware that samples have the potential to harm equipment. The reaction rate for sodium persulfate activated with sodium hydroxide is generally slow, up to a few weeks, thus, samples containing injection fluids may still be reacting upon arrival at the lab (applicable only for samples collected 30 days following ISCO injection).

Field parameters will be collected from the TSWs on-post wells and at additional on-post monitoring locations including VEWs, TSWs, and PZs. A hand-held water quality meter (YSI 560) with a 50-foot probe lead will be used to collect field parameters in monitoring locations with at least 1 foot of water. It may be necessary to use disposable bailers to collect a sample from deeper VEWs, TSWs, and PZs to analyze with the YSI.

Additionally, field test kits may be utilized to screen for persulfate at on-post monitoring locations. Persulfate screening will be conducted as needed to identify the movement of injected ISCO solution within groundwater within AOC-65.

Appendix A

Klozur/Sodium Hydroxide MSDS

MATERIAL SAFETY DATA SHEET

Sodium Persulfate



MSDS Ref. No.: 7775-27-1
Date Approved: 06/01/2009
Revision No.: 13

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200 and Canada's Workplace Hazardous Materials Information System (WHMIS) requirements.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sodium Persulfate

SYNONYMS: Sodium Peroxydisulfate; Disodium Peroxydisulfate

GENERAL USE: Polymerization initiator. Etchant and cleaner in manufacture of printed circuit boards. Booster in hair bleaching formulations in cosmetics. Secondary oil recovery systems as a polymerization initiator and a gel breaker.

MANUFACTURER

FMC CORPORATION
FMC Peroxygens
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)
msdsinfo@fmc.com (Email - General Information)

EMERGENCY TELEPHONE NUMBERS

(303) 595-9048 (Medical - U.S. - Call Collect)

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A. & Canada)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Xn-O; R8-R22-R36/37/38-R42/43

4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested. For gastric lavage or emesis induction, consider the possible aggravation of esophageal injury, and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m ³ (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H ₂ O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

with incompatible materials can result in a material decomposition or other uncontrolled reactions.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Use of persulfates in chemical reactions requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Ref. ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Ref. ICG/T-79.029]

DERMAL LD₅₀: > 10 g/kg [FMC Ref. ICG/T-79.029]

ORAL LD₅₀: 895 mg/kg (rat) [FMC Ref. ICG/T-79.029]

INHALATION LC₅₀: 5.1 mg/l (rat) [FMC Ref. I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Ref. ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

CARCINOGENICITY:

NTP: Not listed
IARC: Not listed
OSHA: Not listed
OTHER: ACGIH: Not listed

12. ECOLOGICAL INFORMATION**ECOTOXICOLOGICAL INFORMATION:**

Bluegill sunfish, 96-hour LC₅₀ = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC₅₀ = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC₅₀ = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC₅₀ = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

14. TRANSPORT INFORMATION**U.S. DEPARTMENT OF TRANSPORTATION (DOT)**

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME: Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME: Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):

Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):

Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):

The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:

None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):

There are no ingredients in this product, which are subject to Section 313 reporting requirements.

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):

Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

All components are listed or exempt.

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):

Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Hazard Classification / Division: C
D2A
D2B

Domestic Substance List: All components are listed or exempt.

INTERNATIONAL LISTINGS

Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed
New Zealand: Listed

HAZARD AND RISK PHRASE DESCRIPTIONS:

EC Symbols: Xn (Harmful)
O (Oxidizer)

EC Risk Phrases: R8 (Contact with combustible material may cause fire)
R22 (Harmful if swallowed.)
R36/37/38 (Irritating to eyes, respiratory system and skin.)
R42/43 (May cause sensitization by inhalation or by skin contact.)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:

4 = Severe
 3 = Serious
 2 = Moderate
 1 = Slight
 0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA (National Fire Protection Association)

Degree of Hazard Code:

4 = Extreme
 3 = High
 2 = Moderate
 1 = Slight
 0 = Insignificant

REVISION SUMMARY:

This MSDS replaces Revision #12, dated April 30, 2006.

Changes in information are as follows:

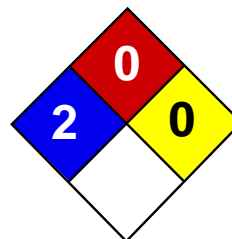
Section 1 (Product and Company Identification)
 Section 3 (Composition / Information on Ingredients)
 Section 15 (Regulatory Information)
 Section 16 (Other Information)

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Health	2
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet

Sodium Hydroxide, 25% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Hydroxide, 25%

Catalog Codes: SLS4210

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Sodium hydroxide; Water

CI#: Not applicable.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hydroxide	1310-73-2	25
Water	7732-18-5	75

Toxicological Data on Ingredients: Sodium hydroxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant), of eye contact (irritant), of ingestion. Hazardous in case of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Non-corrosive for skin. Non-irritant for skin. Non-sensitizer for skin. Non-permeator by skin. Non-irritating to the eyes. Non-hazardous in case of ingestion. Non-hazardous in case of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe

skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Finish by rinsing thoroughly with running water to avoid a possible infection. Cold water may be used.

Skin Contact:

If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:

Corrosive liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep container dry. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as acids.

Storage:

Alkalis may be stored in heavy duty gauge steel containers. Corrosive materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

Sodium hydroxide CEIL: 2 (mg/m3) from ACGIH [1995] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Odorless.

Taste: Alkaline. Bitter. (Strong.)

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Basic.

Boiling Point: The lowest known value is 100°C (212°F) (Water).

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.15 (Water = 1)

Vapor Pressure: The highest known value is 17.535 mm of Hg (@ 20°C) (Water).

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Extremely reactive or incompatible with acids.

Corrosivity:

Highly corrosive in presence of aluminum. Slightly corrosive to corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:

Very hazardous in case of skin contact (corrosive, irritant), of ingestion. Hazardous in case of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 8: Corrosive liquid.

Identification: : Sodium hydroxide, solution (Sodium hydroxide) : UN1824 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Pennsylvania RTK: Sodium hydroxide Massachusetts RTK: Sodium hydroxide TSCA 8(b) inventory: Sodium hydroxide; Water

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):

CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC): R35- Causes severe burns.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:05 PM

Last Updated: 11/01/2010 12:00 PM

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