AOC-65 *IN-SITU* CHEMICAL OXIDATION OPERATIONS AND MONITORING PLAN

Prepared for:
Camp Stanley Storage Activity
Boerne, Texas

Prepared By:
Parsons Government Services Group
Austin, Texas

NOVEMBER 2013

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ABBREVIATIONS AND ACRONYMS

AOC	Area of Concern
CSSA	Camp Stanley Storage Activity
CFR	Code of Federal Regulations
DCE	dichloroethene
GAC	granular activated carbon
IIW	ISCO injection well
IRA	Interim Removal Action
ISCO	*in-situ* chemical oxidation
MCL	maximum contaminant level
MW	monitoring well
O&M	operations and monitoring
Parsons	Parsons Government Services Group
PCE	tetrachloroethene
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SVE	soil vapor extraction
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCE	trichloroethene
TSW	treatability study well
UIC	underground injection control
VEW	vapor extraction well
VOC	volatile organic compound
WB	Westbay equipped monitoring well

CHAPTER 1
INTRODUCTION AND SUMMARY OF REMEDIAL DESIGNS

This Operations and Monitoring (O&M) Plan was created as a guide for operating the *in-situ* chemical oxidation (ISCO) injection system equipment and the associated monitoring efforts following ISCO injections at Camp Stanley Storage Activity (CSSA) in Boerne, Texas. An ISCO infiltration gallery and ISCO injection wells were installed to remediate soil, fractured rock and groundwater contamination underneath and around Building 90 and Area of Concern (AOC)-65.

The chemical oxidation process involves increasing the oxidation state of target compounds (i.e., chlorinated solvents) by introducing an oxidant into contaminated media. The targeted compounds are then transformed into by-products that are less harmful than the original compounds. 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.

There are several different oxidants that may be used in *in situ* chemical oxidation applications. Permanganate, Fenton's Reagent, ozone, and persulfate are a few of the more commonly applied chemical oxidants used in environmental remediation applications. Each of these oxidants will oxidize contaminants differently based on the stochiometry of the redox reaction between the oxidant and contaminant. The oxidants differ in type of reaction, speed of reaction, and the persistence of the oxidant.

Persulfate salts have been identified as an appropriate oxidant for application at AOC-65. Persulfate salts (i.e. 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, which is greater than the oxidation potential of permanganate (1.7V). 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: increasing temperatures, photovoltaic activation, addition of general activators like ferrous iron (Fe (II)), copper, silver, manganese, cerium, and cobalt, with base conditions, or with H_2O_2. 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 $\cdot SO_4^-$ may initiate the formation of the hydroxyl radical ($\cdot OH$).

Though there are several types of persulfates (e.g. potassium persulfate, ammonium persulfate, and sodium persulfate), sodium persulfate has been selected for AOC-65. Sodium persulfate has a high solubility, unlike potassium persulfate, and will not leave undesirable reaction products, like ammonia from ammonium persulfate. Because the solubility of sodium persulfate is high, the resulting density of the injection fluid is greater than water. Density-driven transport may allow the injection fluid to be delivered further from the injection site and consequently affect a greater volume of contaminated media. Additionally, activation of sodium persulfate using base conditions (with the addition of sodium hydroxide) is the most effective means to induce the formation of the sulfate radical given the method of application and the site conditions.

In 2012, an interim removal action (IRA) was conducted to remove contaminated materials beneath the concrete-lined drainage swale on the west side of Building 90. Historic uses of tetrachloroethene (PCE) within Building 90 and subsequent releases into the ditch have resulted in long-term dissolved phase PCE and trichloroethene (TCE) contamination in groundwater in the Upper and Lower Glen Rose Formations locally. The 2012 IRA consisted of the excavation of a ~320-foot long, 3.5-foot wide, and between 12- and 15-foot deep trench. The trench was subsequently converted into a series of infiltration galleries to facilitate the application of chemical oxidants for an ISCO treatability study. Prior to the onset of ISCO treatability study activities, soil vapor extraction (SVE) activities were terminated. This SVE system was part of a vapor extraction pilot study in operation at AOC-65 since 2002. Following an initial application of sodium persulfate activated with sodium hydroxide in 2012, four additional ISCO Injection Wells (IIWs) were installed west of the infiltration trench for the 2013 ISCO application.

The objective of conducting thse ISCO injections is to determine the efficacy of ISCO to destroy source contaminants located in the soils and bedrock beneath AOC-65 and ultimately reduce the migration of contaminants to groundwater. The objectives of continued monitoring activities are to gather additional data to allow an evaluation and optimization of the systems' performance. The results of preliminary ISCO O&M activities at the AOC-65 site are examined in the **AOC-65 ISCO Injection Assessment Report**, expected in December 2013.

Although the ISCO injection system installed within AOC-65 is relatively simple, routine monitoring is required to determine efficacy and oxidant requirements for future applications. If significant problems are encountered with the operation of the system, the CSSA Environmental Office at (210) 295-7014 should be notified so repairs can be initiated and coordinated. Additional contact individuals include Parsons Project Manager (Ms. Julie Burdey) at (512) 719-6000 and Parsons Onsite Manager (Ms. Samantha Elliott) at (210) 347-6012.

Site background and current conditions are discussed on Section 2 of this document. Descriptions of the ISCO injection system including layout drawings and schematics are provided in Sections 3. System operation and monitoring is discussed in Section 4 and reporting requirements are included in Section 5 of this plan. Manufacturer's information for ISCO injection and monitoring equipment is included in Appendix A and data collection sheets are included in Appendix B. Appendix C provides photos of the AOC-65 ISCO injection systems pertinent components.

CHAPTER 2
SITE CONDITIONS

2.1 BACKGROUND

Chlorinated solvents, which contain PCE and TCE, 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. Results of the survey included detections of PCE, TCE, cis-1,2-dichloroethene (DCE) and trans-1,2-DCE in the area around Building 90. The detection of DCE indicates that natural degradation of PCE/TCE is occurring in the subsurface. No definitive conclusions were made as to the source of the contamination for AOC-65.

The Final 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 completed in 2002 and included the excavation of soils underlying the pavement and a drainage swale on the west side of the building, lining the drainage swale with concrete to prevent rainwater run-off infiltration, and the installation of a soil vapor extraction (SVE) system.

Pilot testing was initiated at AOC-65 to evaluate the effectiveness of SVE for the removal of VOC contamination 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 2007. These systems, known as the eastern and western AOC-65 SVE system(s), had 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 western portion of the AOC-65 SVE system was expanded in 2007, and the eastern portion was expanded in 2011. The SVE pilot study was terminated in August 2012 due to reduced system efficiency during the operational period of the SVE. Additional details regarding the SVE treatability study at AOC-65 are described in the **2012 Update to AOC-65 Soil Vapor Extraction Operations and Maintenance Assessment Report** (Parsons, 2012).

A second, more intrusive IRA was completed in 2012. This IRA included the excavation a trench (~320-foot long, 3.5-foot wide, and between 12- and 15-foot deep) beneath the concrete-lined drainage swale west of Building 90 (installed following the 2002 IRA) and resulted in the removal of approximately 1,000 CY of bedrock. The trench was subsequently converted into an infiltration gallery with discrete treatment zones to facilitate the application of chemical oxidants for ISCO treatability study. The treatability study was initiated in August 2012, with the first application of ISCO solution via the infiltration gallery. A second application occurred in May 2013, and additional applications of ISCO are anticipated at AOC-65 in the future.

2.2 AOC-65 SITE DELINEATION

Based on the results of the site investigation and groundwater results from nearby discrete interval Westbay wells and monitoring wells (**TO 42 Well Installation Report,**

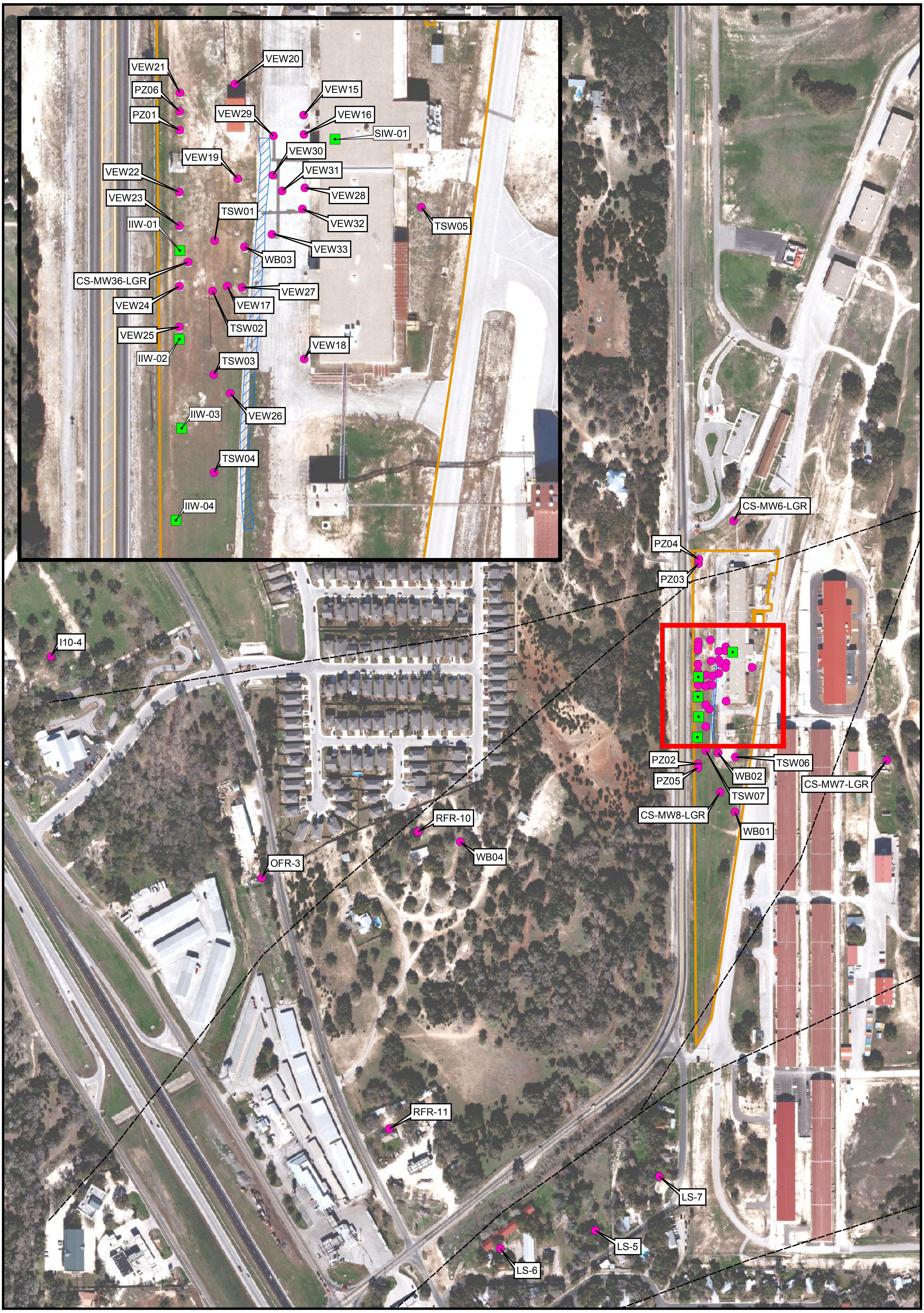
Volume 5-2.3, CSSA Environmental Encyclopedia), the area within AOC-65 containing VOCs that may be successfully treated by ISCO appears to extend immediately around Building 90 in the apparent down gradient direction to the west/southwest. VOC concentrations above the Safe Drinking Water Act (SDWA) Maximum 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). The total volume of the treatment area within AOC-65 is unknown. The location of the AOC-65 ISCO infiltration gallery, ISCO injection wells (IIWs) and Steam Injection Well (SIW) -01, and monitoring wells are shown on **Figure 2.1**.

2.3 UNDERGROUND INJECTION CONTROL PERMITTING

The AOC-65 ISCO injection system operates within a Texas Commission on Environmental Quality (TCEQ) Underground Injection Permit (UIC), Authorization Number 5X2600645.

Requirements associated with this UIC permit include:

- Construction of injection wells or galleries shall meet standards provided in 30 Texas Administrative Code (TAC) §331.132 and as-built construction diagrams or well logs shall be submitted to the UIC Permits Team, Radioactive Materials Division within 30 days of completion;
- Operational and status changes shall be reported to and approved by the UIC Permits Team;
- Closure (plugging) of injection wells shall comply with standards provided in 30 TAC §331.133. Closure reports including injection well monitoring data (injection volumes, pressures, and results) and plugging reports shall be submitted to the UIC Permits Team, Radioactive Materials Division within 60 days of conclusion of injection activities; and
- Injection volumes, pressures, and concentrations of contaminants (including pH and total dissolved solids) in the injected groundwater shall be sampled monthly at the point of reinjection and submitted to the Permits Team, Radioactive Materials Division on a quarterly basis. The concentration of the contaminants in the injectate shall not exceed those in the extracted groundwater or those limits listed in 40 Code of Federal Regulations (CFR) §261.24 Toxicity characteristic table 1 that would deem them hazardous by concentration, whichever is lower.
- Implementation of a groundwater monitoring program for wells near the injection location including sample collection at required locations (see Table 4.1 for list of regulatory required sampling locations) 30, 60, 90 days after ISCO chemicals are injected. Monitoring will continue on a quarterly basis for three quarterly monitoring events following the conclusion of the 90-day monitoring event.



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AOC-65 Boundary
Baseline Sampling Locations
Injection Wells
Infiltration Gallery
USGS Identified Fault

Figure 2.1

ISCO Injection and Groundwater Monitoring Network
Camp Stanley Storage Activity

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CHAPTER 3
SYSTEM DESCRIPTION

3.1 SYSTEM COMPONENTS

There are three main aspects of the ISCO injection system at AOC-65 including the ISCO distribution, mixing and conveyance, and monitoring components. The distribution component includes the infiltration gallery and five injection wells. The monitoring component includes the network of monitoring wells within and surrounding AOC-65 including vapor extraction wells (VEWs), monitoring wells (MWs), and Westbay wells WBs. The mixing and conveyance components included in the ISCO injection system are generally comprised of rented equipment from the selected ISCO chemical supplier and other equipment vendors to be used solely during injection activities. Specifications of major equipment and other pertinent information for the AOC-65 ISCO injection system is provided in **Table 3.1**.

3.2 ISCO DISTRIBUTION COMPONENTS

The ISCO solution and activator is applied to target treatment areas via injection wells and within an infiltration gallery. Locations of the injection wells and infiltration gallery are presented in **Figure 2.1**. Currently, there are five injection wells including ISCO injection well(s) (IIW) -01 through -04 and a modified steam injection well (SIW-01). The IIWs are 8-inch diameter, approximately 125-foot deep, open-borehole completed wells (**Figure 3.1**).

SIW-01 was originally installed to facilitate a steam injection pilot study and is installed within a concrete-lined pit previously used to house a vat for PCE storage for injection of steam into the subsurface. Following the completion of the steam injection study, the well was modified to accept oxidants without damaging well components (**Figure 3.2**).

The infiltration gallery at AOC-65 is installed within a trench that was the byproduct of the IRA efforts at the site conducted in 2012. The IRA trench was 3.5 feet wide, between 12 and 15 feet deep and approximately 320 feet long. The gallery is constructed of alternating layers of 4 ft of ½" gravel and 1 ft of compacted clay with 2"-diameter high density polyethylene perforated injection lines installed within the gravel layers. These injection lines exit the trench at the north end and are fitted with cam-lock style fittings to facilitate connection to the ISCO mixing and conveyance system. The gallery construction effectively creates three separate treatment zones into which ISCO solution can be added independently (**Figure 3.3**). Photographs documenting the excavation of the trench and construction of the infiltration gallery are presented in **Appendix C**.

3.3 ISCO MIXING AND CONVEYANCE EQUIPMENT

Specifications of major equipment used to mix the sodium persulfate and sodium hydroxide and deliver the activated ISCO solution to injection wells and infiltration galleries is provided in **Table 3.1**. Most of the key pieces of equipment used during injection activities are designed and maintained by the chemical supplier and typical equipment rental vendors. Recommended chemical suppliers and equipment rental vendors is included in **Appendix A**.

Table 3.1
AOC-65 ISCO Equipment Specifications

Equipment	***Purpose***	***Source***
4,000 gallon Poly tank	Mix/Contain Sodium Persulfate Solution	Equipment Rental Vendor (Baker Corp.)
16-Inch diaphragm pump	ISCO solution/activator conveyance and injection (trench)	Equipment Rental Vendor (Baker Corp.)
Mixing Skid (LSE1)	Mix Sodium Persulfate 2,204-lb sacks (includes chemical hoses)	Rental - Sodium Persulfate Supplier (FMC)
Forklift	Affix 2,204-lb persulfate sacks to mixing skid hopper	CSSA owned – work order required
Tow-behind Air Compressor	Operate diaphragm pump	Equipment Rental Vendor (United Rentals)
Erdco Vane-style Flow Meters (2) (specific to sodium persulfate)	Gauge application rate of ISCO solution and activator; maintain appropriate mixing ratios	CSSA owned
6,000 gallon tanker trailer For NaOH delivery	Contain activator prior to application	Rental - Sodium hydroxide supplier (RB Products)
Fire hydrant manifold	Supply water to mixing tank	CSSA owned - work order required
250-gallon Poly tank	Convey ISCO solution to IIWs	CSSA owned
65-gallon Poly tank	Convey sodium hydroxide to IIWs	CSSA owned
Dual-axel trailer	Transport smaller poly tanks to IIWs and transport 2,204-lb sacks from storage to site	CSSA owned

Figure 3.1 AOC-65 ISCO Injection Well (IIW) Design

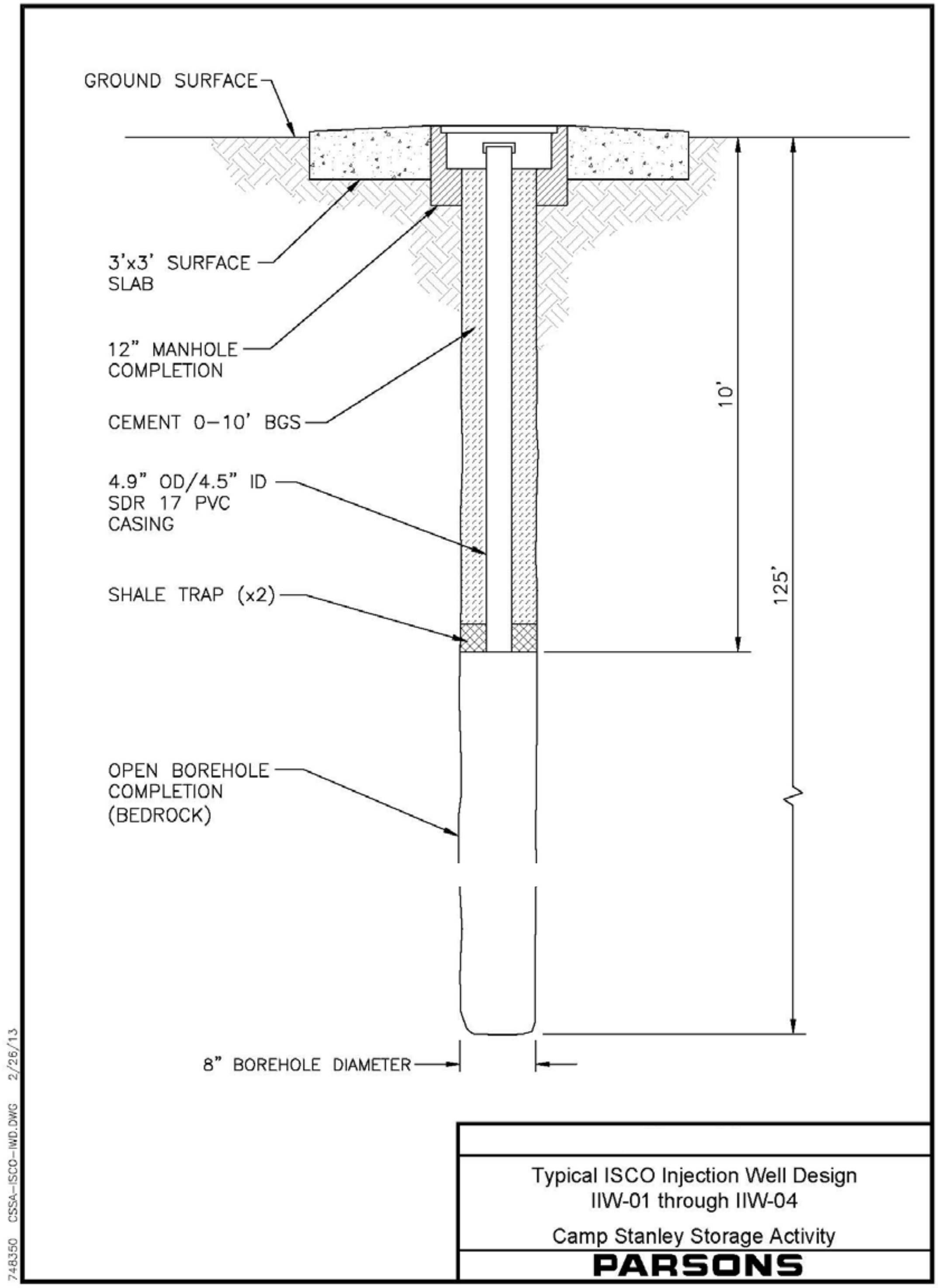
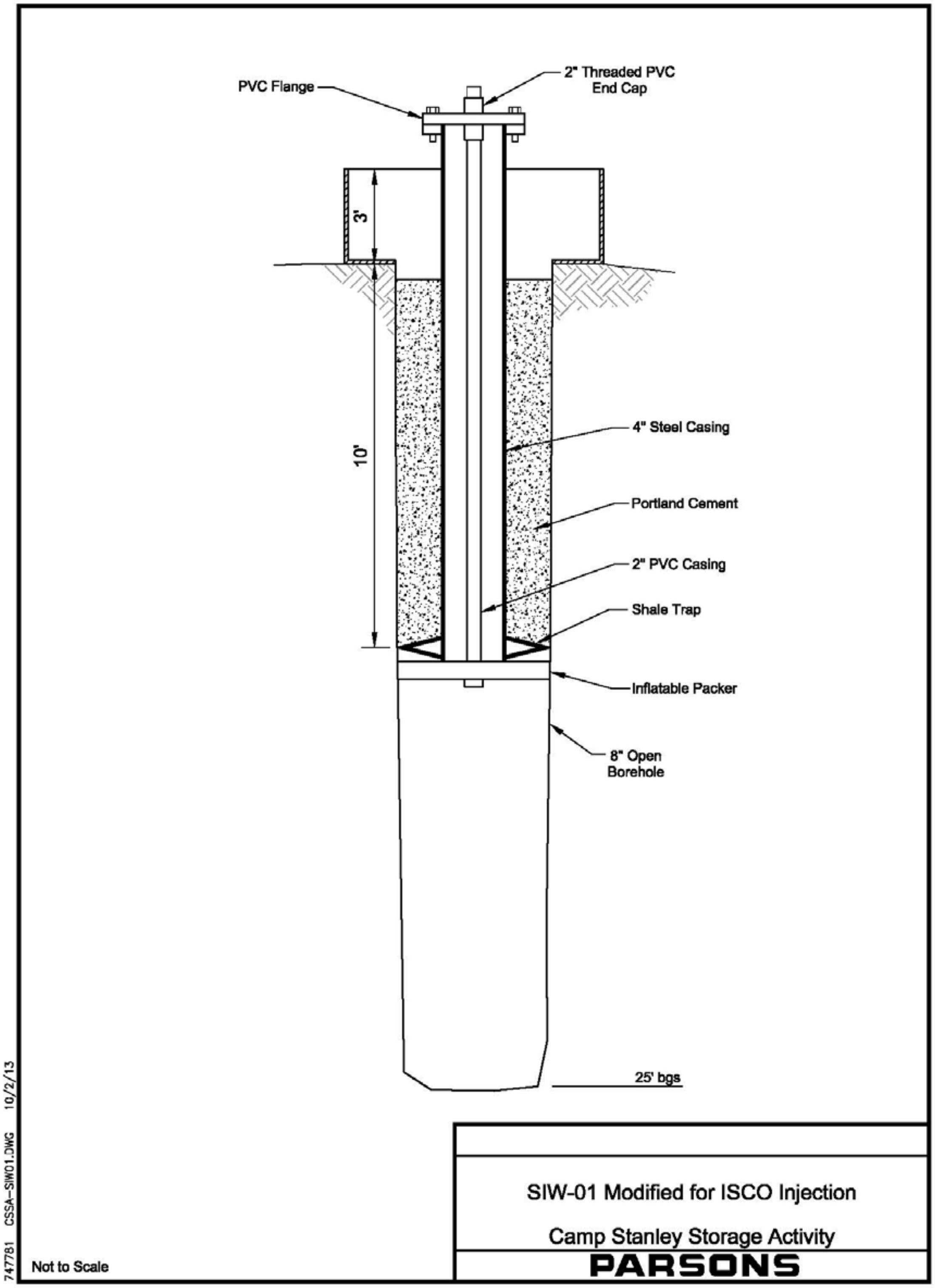


Figure 3.2 AOC-65 SIW-01 Design



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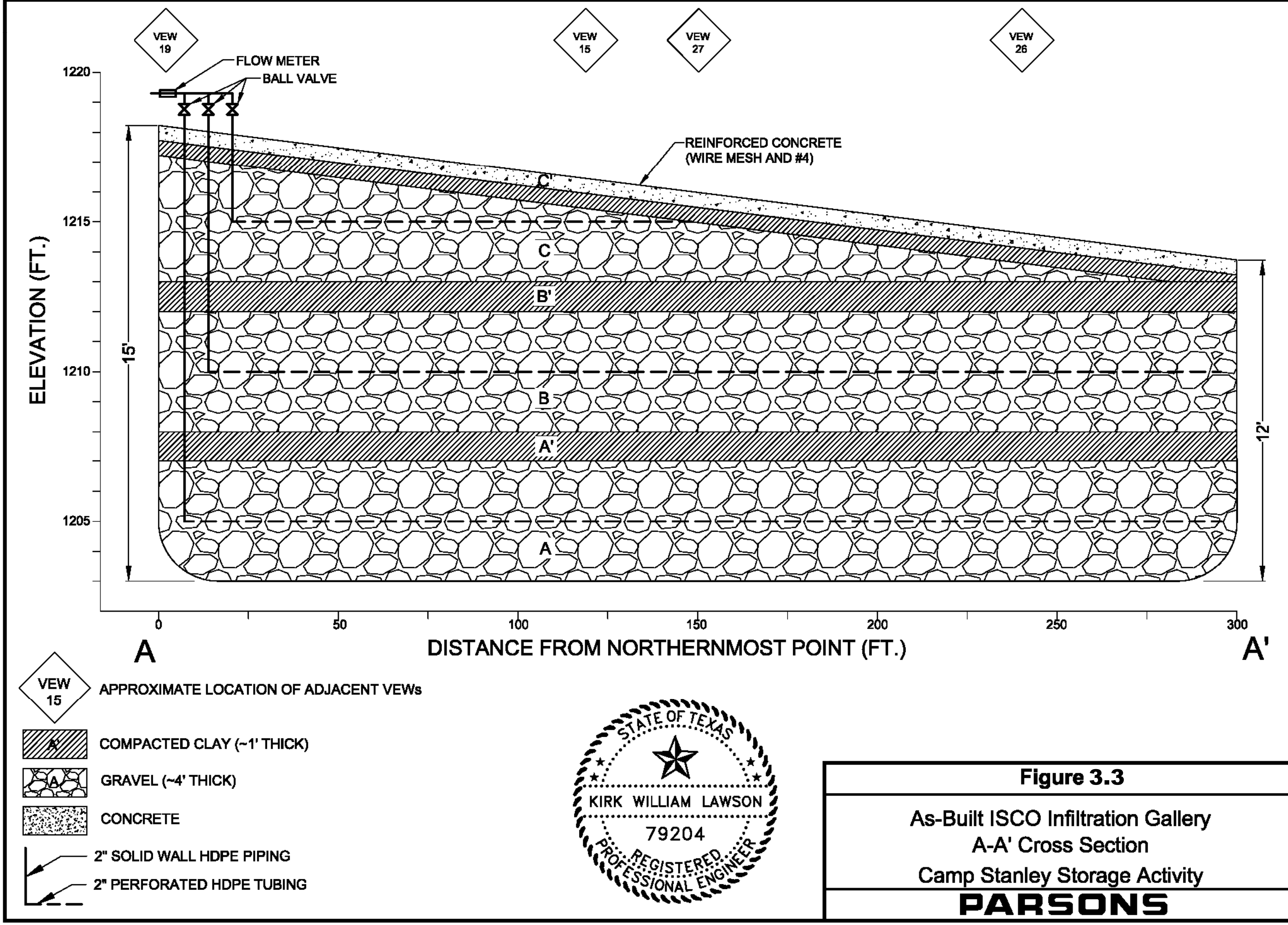

Figure 3.3

As-Built ISCO Infiltration Gallery
A-A' Cross Section
Camp Stanley Storage Activity

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3.4 MONITORING EQUIPMENT

3.4.1 Field Parameter Collection

Field parameters will be collected using a hand-held water quality multi-parameter meter. A YSI-556 (or similar) will be used to collect temperature, pH, conductivity, dissolved oxygen, and oxidation-reduction potential. Field parameters will be collected at shallow monitoring locations provided there is greater than 0.5 feet of saturated thickness within the casing. If insufficient saturated thickness is present, no field parameters will be collected. For deep wells, a bailer will be used to collect a sample for field parameter analysis if no pump is installed, however, if sample collection with a bailer is deemed impracticable due to well design or configuration, no field parameters will be collected. Field parameters will not be collected at WB wells unless samples are being collected for analytical purposes.

3.4.2 Water Level Collection

Water levels will be collected using a standard water level indicator at monitoring wells. Depth to water will be measured from the top of casing, and then used to calculate water table elevations. Pressures will be recorded in WB wells for water level calculation during scheduled sampling events.

3.4.3 Analytical Sample Collection

Samples will be collected with disposable poly bailers, WB equipment or pumps installed (QED or electric submersible) within supply or monitoring wells.

CHAPTER 4
SYSTEMS OPERATION AND MONITORING

The O&M activities that will be performed at the CSSA ISCO injection system includes: injections and performance and regulatory monitoring. These O&M activities are discussed in the following section.

4.1 ISCO INJECTIONS

There are three types of ISCO injection methods used at AOC-65 based on each of the three types of distribution vehicles: IIWs, SIW, or infiltration gallery.

4.1.1 Injection via IIW

ISCO solution application into IIWs will be accomplished using trailer mounted tanks and gravity feeding the oxidant solution and activator independently into each of the four IIWs. A 250-gallon and a 65-gallon poly tank will be used to transport the oxidant solution and activator separately from the ISCO mixing and conveyance system to each injection well location. Injection of the ISCO chemicals will be accomplished via gravity feed from the two tanks. Hoses will be inserted into the well allowing the two chemicals to mix as they are applied within the well. Initial water levels should be collected to determine reasonable volumes of ISCO solution to apply without overfilling the well. No single application of ISCO solution should exceed IIW borehole volume (~300 gallons).

4.1.2 Injection via SIW-01

ISCO solution application into SIW-01 will be accomplished using a 55-gallon drum positioned on the loading dock outside of the Building 90 environmental room. ISCO solution will be pumped, using the diaphragm pump from the mixing and conveyance system, from the mixing tank to the drum. The activator will be added to the ISCO solution in-line using the mixing system eductor. Thus, activated ISCO solution will be contained within the drum prior to SIW-01 injection. A hose running from the drum will be inserted into SIW-01 approximately 10 feet (below the bottom of the steel surface casing). A ball-valve installed at the base of the drum will be used to regulate flow of activated ISCO solution as it is gravity fed into the well to ensure overflowing does not occur. The drum shall be filled no fuller than 75% capacity (~40 gallons) at any given time.

4.1.3 Injection via Infiltration Gallery

ISCO solution application into each of the treatment zones within the infiltration gallery will be accomplished via direct connection to the mixing and conveyance system. ISCO solution will be mixed within a mixing tank and pumped through an eductor where activator will be added before it is injected directly into the selected treatment zone within the infiltration gallery via connection to the injection manifold.

4.2 MONITORING

ISCO treatability study progress monitoring includes baseline and post-injection sampling. Baseline sampling will occur prior to ISCO application events. Post-injection sampling events will occur 30, 60, and 90 days following the onset of ISCO injections and continue on a quarterly basis thereafter. Sampling will be conducted at required regulatory-required monitoring locations as well as performance monitoring locations. 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 (90 days following injections) followed by quarterly events coinciding with groundwater sampling events.

4.2.1 Monitoring Locations

Monitoring locations are presented in **Figure 2.1**. Monitoring locations fall into three categories based on the type and frequency of sampling. Baseline sampling is all inclusive; thus, all available AOC-65 monitoring locations as well as required regulatory monitoring locations are included. Regulatory and performance monitoring locations are identified in **Figure 4.1** include on and off-post monitoring wells, Westbay wells, and private supply wells. Performance monitoring locations include monitoring wells within AOC-65. These three monitoring location categories will be sampled regularly for the various sampling events associated with ISCO injection monitoring, including: baseline sampling locations, regulatory monitoring locations, and optional performance monitoring locations and are presented in **Table 4.1**. For each sampling event, sampling will be conducted at the regulatory required monitoring locations if site conditions allow.

4.2.2 Sample Collection

Several sampling methods are required to obtain samples from the various types of wells included in the ISCO monitoring network. The monitoring network includes monitoring wells with or without QUD pumps installed, WB multi-port monitoring wells, VEWs, piezometers, and water supply wells with submersible electric pumps and GAC filters. Samples will be collected with dedicated disposable poly bailers, WB equipment or installed pumps. Pre and post-GAC samples will be collected at GAC-equipped supply wells.

4.2.3 Sample Analyses

Samples collected will be analyzed for VOCs, Priority Pollutant Metals and anions (sulfate and chloride). The collected samples will be analyzed using USEPA methods SW8260B7470A, SW6010B, and E300.1 for VOCs, metals, and anions, respectively. Specific analytes for the various analytical methods are given in **Table 4.2**.

4.2.4 Sampling Events

Three types of sampling will be conducted during scheduled ISCO monitoring: baseline, regulatory, and performance. Baseline sampling will occur prior to ISCO injections and regulatory and performance monitoring sampling will be conducted 30, 60, and 90 days following the commencement of ISCO injections, then proceed on a quarterly basis.

4.2.4.1 Baseline Sampling

Baseline sampling will include sample collection at every available monitoring location within AOC-65 including: monitoring wells, VEWs, WB wells (all zones), and piezometers as well as, on and off- post monitoring and water supply wells. Samples will be analyzed for VOCs, metals, and anions described in section 4.2.3. Additionally, field parameters may be collected from all monitoring locations within AOC-65 (pH and water levels will be collected from other monitoring locations as available).

4.2.4.2 Regulatory Sampling

Groundwater monitoring associated with the Class V aquifer remediation permit includes monitoring of the LGR within the deepest available zone at Westbay wells -01 through -04 (-LGR09 or -LGR11), at private water supply wells, and within LGR monitoring wells on-post. Required analyses include: VOCs, Priority Pollutant Metals, and sulfate. Pre- and post-GAC samples shall be collected at private supply wells equipped with GAC filtration systems.

4.2.4.3 Performance Sampling

Performance sampling includes the collection of field parameters and groundwater samples for VOC, Priority Pollutant Metals, and sulfate analysis from monitoring locations within AOC-65 (Table 4.1).

4.2.4.4 Conditional Sampling

Although the WB04-UGR01 zone is typically dry, samples collected from this zone are of particular interest due to its proximity to RFR-10 which is the nearest off-post supply well that contains PCE derived from AOC-65. This zone is scheduled to be sampled only during baseline sampling events; however, if zone pressures indicate that water is present at any time during ISCO monitoring efforts, a sample will be collected for VOC analysis. If sufficient water is present for additional analyses, the order of priority will be metals, anions, and then field parameters.

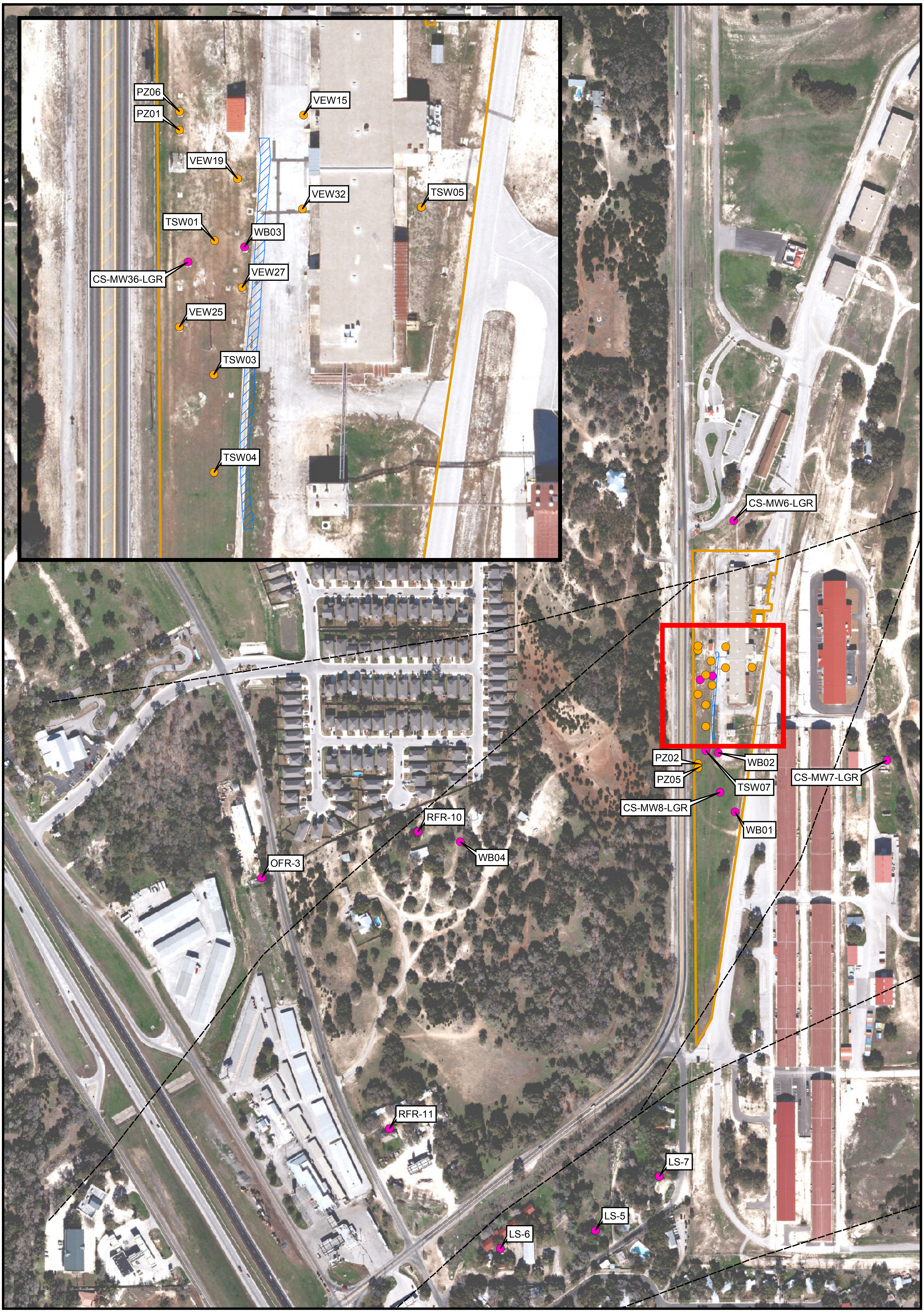
4.2.5 Additional Field Parameter Collection (Performance Monitoring)

Field parameters will be collected using a hand-held water quality multi-parameter meter. A YSI-556 (or similar) will be used to collect temperature, pH, conductivity, dissolved oxygen, and oxidation-reduction potential. Field parameters will be collected at shallow monitoring locations provided there is more than 0.5 feet of saturated thickness within the well. If insufficient saturated thickness is present, no field parameters (other than water level) will be collected. For deep wells, a bailer will be used to collect a sample for field parameter analysis if no pump is installed, however, if sample collection with a bailer is deemed impracticable due to well design or configuration, no field parameters will be collected. Field parameters will not be collected at WB wells unless samples are being collected for analytical purposes.

Water levels will be collected using a standard water level indicator at monitoring wells. Depth to water will be measured from the top of casing, and then used to calculate water table elevations. Pressures will be recorded in WB wells for water level calculation during scheduled sampling events. Performance monitoring will be conducted monthly.

4.3 MONITORING SCHEDULE

The following monitoring schedule is planned for the AOC-65 ISCO system operating at CSSA (**Table 4.3**). The monitoring schedule is based on the ISCO application events, and should be adjusted such that regulatory and performance monitoring occurs 30, 60, 90 days following ISCO injection.



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AOC-65 Boundary
Performance Sampling Locations
Regulatory Sampling Locations
Infiltration Gallery
USGS Identified Fault

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Feet

Figure 4.1

ISCO Performance and Regulatory Sampling Locations
Camp Stanley Storage Activity

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Table 4.1
ISCO Treatability Study Monitoring Location Categories

Off-Post Supply Wells
RFR-10
RFR-11
OFR-3
LS-5
LS-6
LS-7

Off-Post Monitoring Wells
I10-4
WB04 (11 zones)

Westbay Wells	
Zone Breakdown	
Zones:	
UGR-01	
LGR-01	WB01, 02, & 03
LGR-02	LGR-09
LGR-03	UGR-01
LGR-04	LGR-01
LGR-05 (WB01, 02, & 03 only)	
LGR-06	WB04
LGR-07	LGR-11
LGR-08	
LGR-09	
LGR-10 (WB04 only)	
LGR-11 (WB04 only)	

On-Post Monitoring Wells
CS-MW6-LGR
CS-MW7-LGR
CS-MW8-LGR
CS-MW36-LGR
PZ-01
PZ-02
PZ-03
PZ-04
PZ-05
PZ-06
TSW-01
TSW-02
TSW-03
TSW-04
TSW-05
TSW-06
TSW-07
WB01 (9 zones)
WB02 (9 zones)
WB03 (9 zones)

On-Post Vapor Extraction Wells
VEW-15
VEW-16
VEW-17
VEW-18
VEW-19
VEW-20
VEW-21
VEW-22
VEW-23
VEW-24
VEW-25
VEW-26
VEW-27
VEW-28A
VEW-28B
VEW-29
VEW-30
VEW-31
VEW-32
VEW-33

Notes:

1. All wells/WB zones sampled during Baseline sampling event(s).

2. Regulatory required sampling locations.

3. Performance sampling locations.

4. Field parameters may be collected at PZ, TSW, and VEW locations monthly.

Table 4.2
ISCO Treatability Study Analyte List by Analytical Method

Analysis	**Volatile Organic Compounds (short list)**	**Metals**	**Anions**
Method	*SW8260B*	*SW6010B/7470A*	*SW9056*
Analytes	1,1-Dichloroethene *cis*-1,2-Dichloroethene Tetrachloroethene Trichloroethene *trans*-1,2-Dichloroethene Vinyl Chloride	Antimony Arsenic Beryllium Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Thallium Zinc	Chloride Sulfate (as SO_4)

Table 4.3

ISCO Monitoring Schedule

Performance Sampling Event / Regulatory Sampling Event: Month	Year	ISCO Regulatory Monitoring Locations: RFR-10	RFR-11	OFR-3	LS-5	LS-6	LS-7	CS-MW6-LGR	CS-MW7-LGR	CS-MW8-LGR	CS-MW36-LGR	WB01-LGR09	WB02-LGR09	WB03-LGR09	WB04-LGR11
November **December**	2013	GW	GW	GW	GW	GW	GW	PM	PM	PM	GW	PM	PM	PM	PM
February **March**	2014	GW	GW	GW	GW	GW	GW	PM	PM	GW	GW	GW	GW	GW	GW
May **June**	2014	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
August **September**	2014	GW	GW	GW	GW	GW	GW	PM	PM	PM	GW	PM	PM	PM	PM
November **December**	2014	GW	GW	GW	GW	GW	GW	PM	PM	GW	GW	GW	GW	GW	GW
February **March**	2015	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
May **June**	2015	GW	GW	GW	GW	GW	GW	PM	PM	PM	GW	PM	PM	PM	PM
August **September**	2015	GW	GW	GW	GW	GW	GW	PM	PM	GW	GW	GW	GW	GW	GW
November **December**	2015	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
February **March**	2016	GW	GW	GW	GW	GW	GW	PM	PM	PM	GW	PM	PM	PM	PM
May **June**	2016	GW	GW	GW	GW	GW	GW	PM	PM	GW	GW	GW	GW	GW	GW
August **September**	2016	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW

GW	Samples to be collected concurrently with Groundwater Monitoring Program
PM	Samples to be collected during ISCO Performance monitoring sampling

Note: VEWs, TSWs, and PZ will be sampled during Performance Sampling Events and all WB zones will be collected during regulatory monitoring events

CHAPTER 5
REPORTING REQUIREMENTS

5.1 DOCUMENTATION

At the end of the operations and monitoring period, a final ISCO assessment report will be prepared incorporating data from all ISCO injections. This report will include documentation of any new monitoring/injection well installations and infiltration gallery maintenance, analytical data from sampling events, performance monitoring data, and a summary of O&M activities carried out during the operational period.

No Federal or State Agency reporting is required for this project, but the final report will be incorporated into the CSSA Administrative Records (Environmental Encyclopedia).

CHAPTER 6
REFERENCES

Parsons, 2012. AOC-65 SVE Operations & Maintenance Assessment Report, Parsons Infrastructure & Technology Group, Austin, Texas, July 2012.

APPENDIX A

CHEMICAL SUPPLIERS/EQUIPMENT RENTAL VENDORS

Chemical Suppliers:		Contact:
Sodium Persulfate:	FMC Environmental Solutions	609-860-4760
Persulfate Mixing Skid:	FMC Environmental Solutions	email: remediation@fmc.com
Sodium Hydroxide:	RB Products	281-992-3500
Sodium Hydroxide Storage:	RB Products	email: sales@rbproductsinc.com

Equipment Rental Vendors:		Contact:
4,000 gallon Poly tank:	Baker Corp	830-606-7788
18" Diaphragm pump:	Baker Corp	web: www.bakercorp.com
Air Compressor:	United Rental	830-755-9131
		web: www.unitedrentals.com

APPENDIX B

DATA COLLECTION SHEETS

ISCO Sampling AOC-65

Personnel: ______________________ **Permit required samples shaded gray.**

Sampling Event: ______________________

Well ID	TD / pump depth	Water Level ('BTOC)	Sample Date	Sample Time	Temp. (°C)	Cond. (ms/cm^2)	pH	DO	ORP
LS-5	NA								
LS-6	NA								
LS-7	NA								
OFR-3	NA								
RFR-10	NA								
RFR-11	NA								
I10-4	NA								
MW36-LGR	361.5								
MW8-LGR	302								
MW7-LGR	293								
MW6-LGR	314								
VEW-13	41								
VEW-14	61								
VEW-15	13								
VEW-16	41								
VEW-17	52.5								
VEW-18	56								
VEW-19	26								
VEW-20	25.7								
VEW-21	27								
VEW-22	51								
VEW-23	21								
VEW-24	50								
VEW-25	21.5								
VEW-26	50								
VEW-27	21								
VEW-28A	120								
VEW-28B	179								
VEW-29	40								
VEW-30	25								
VEW-31	40								
VEW-32	25								
VEW-33	25								
IIW-01									
IIW-02									
IIW-03									
IIW-04									
PZ-01	132.35								
PZ-02	50.26								
PZ-03	134.2								
PZ-04	43.1								
PZ-05	126.87								
PZ-06	43.64								
TSW-01	40								
TSW-02	40								
TSW-03	40								
TSW-04	40								
TSW-05	40								
TSW-06	51								
TSW-07	40								
AOC65-MW01	31.5								
AOC65-MW02A	18.66								
AOC65-MW02B	31.65								
AOC65-MW03	31.3								

ISCO Sampling AOC-65

Personnel: ______________________ **Permit required samples shaded gray.**

Sampling Event: ______________________

Westbay Zone	Depth	Sample Date	Sample Time	ATM pressure	Outside Pressure	Inside Pressure	Temp. (°C)	Cond. (ms/cm^2)	pH	DO	ORP
WB01-UGR-01	48										
WB01-LGR-01	86										
WB01-LGR-02	113										
WB01-LGR-03	133										
WB01-LGR-04	168										
WB01-LGR-05	196										
WB01-LGR-06	220										
WB01-LGR-07	244										
WB01-LGR-08	280										
WB01-LGR09	300										
WB02-UGR-01	41										
WB02-LGR-01	71										
WB02-LGR-02	100										
WB02-LGR-03	135										
WB02-LGR-04	158										
WB02-LGR-05	187										
WB02-LGR-06	213										
WB02-LGR-07	248										
WB02-LGR-08	287										
WB02-LGR-09	297										
WB03-UGR-01	32										
WB03-LGR-01	63										
WB03-LGR-02	95										
WB03-LGR-03	122										
WB03-LGR-04	139										
WB03-LGR-05	180										
WB03-LGR-06	211										
WB03-LGR-07	240										
WB03-LGR-08	287										
WB03-LGR-09	297										
WB04-UGR-01	47										
WB04-LGR-01	79										
WB04-LGR-02	100										
WB04-LGR-03	130										
WB04-LGR-04	180										
WB04-LGR-06	226										
WB04-LGR-07	256										
WB04-LGR-08	292										
WB04-LGR-09	315										
WB04-LGR-10	335										
WB04-LGR-11	367										

ISCO Sampling AOC-65

Bold = Performance Monitoring Samples
Permit required samples shaded gray.

Personnel: ______________________________

Sampling Event: 30 day 60 day 90 day other: ____________

Well ID	TD / pump depth	Water Level ('BTOC)	Sample Date	Sample Time	Temp. (°C)	Cond. (ms/cm^2)	pH	DO	ORP
LS-5	NA								
LS-6	NA								
LS-7	NA								
OFR-3	NA								
RFR-10	NA								
RFR-11	NA								
MW36-LGR	361.5								
MW8-LGR	302								
MW7-LGR	293								
MW6-LGR	314								
VEW-15	**13**								
VEW-19	**26**								
VEW-25	**21.5**								
VEW-27	**21**								
VEW-32	**25**								
PZ-01	**132.35**								
PZ-02	**50.26**								
PZ-05	**126.87**								
PZ-06	**43.64**								
TSW-01	**40**								
TSW-03	**40**								
TSW-04	**40**								
TSW-05	**40**								
TSW-07	**40**								

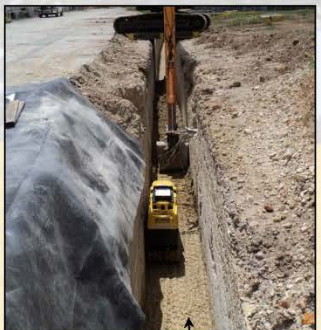
APPENDIX C

INFILTRATION GALLERY CONSTRUCTION PHOTOS

ISCO Infiltration Gallery Construction

Gravel added and leveled.

Injection lines installed.



Injection headers installed.

Clay layer added and compacted.

The HDPE injection lines terminate at the northern portion of the trench where they may be connected to the oxidant/activator mixing and conveyance system.