FINAL

Work Plan Addendum for the Installation of LGR Monitoring Wells and AOC-65 SVE Enhancement Wells

Prepared for:

Camp Stanley Storage Activity
Boerne, Texas

March 2011

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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
BGS	Below Ground Surface
BS	Bexar Shale
CC	Cow Creek
CSSA	Camp Stanley Storage Area
DIGW	Discrete Interval Groundwater Sample
DQO	Data Quality Objective
GAC	Granular Activated Carbon
ID	Inside Diameter
IDM	Investigation-Derived Media
IH	Interstate Highway
LGR	Lower Glen Rose
MCL	Maximum Contaminant Level
MW	Monitoring well
OD	Outside Diameter
PCE	Tetrachloroethene
PCL	Primary Contaminant Level
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOW	Statement of Work
SIW	Steam Injection Well
SP	Spontaneous Potential
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TD	Total Depth
TPDES	Texas Pollution Discharge Elimination System
UIC	Underground Injection Control
UGR	Upper Glen Rose
USGS	United States Geological Survey
VEW	Vapor Extraction Well
VOC	Volatile Organic Compound
WB	Westbay™-equipped well

SECTION 1
INTRODUCTION

1.1 STATEMENT OF OBJECTIVE

This addendum to the Camp Stanley Storage Activity (CSSA) project work plan (***CSSA Environmental Encyclopedia, Volume 1-1: Work Plans, Parsons, 1996***) describes activities supporting the installation of additional wells to supplement the post-wide groundwater monitoring network, and the expansion of the Soil Vapor Extraction (SVE) system at AOC-65. The field investigations will be documented by two technical memoranda specific to each major task described above. This work is authorized under contract by the United States Army (**<u>Contract No. 2010*1286022*000)</u>**.

1.2 PLANNED ACTIVITIES

This work plan provides a general description of the activities and requirements for completion of two on-post monitoring wells (MWs), five vapor extraction wells (VEWs), and two steam injection wells (SIWs). 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.

Monitoring well construction consists of drilling two Lower Glen Rose (LGR) monitoring wells at on-post locations. These wells will aid in the delineation of volatile organic compound (VOC) contamination within the primary drinking water aquifer for CSSA and the surrounding communities, and may support future activities such as tracer testing to determine groundwater flowpaths and velocities. The proposed drilling locations for these monitoring wells are depicted in **Figure 1.1**.

The workscope also includes the installation of two SIWs and five VEWs to enhance and expand the SVE remediation efforts at AOC-65. The SIWs will be plumbed to the Building 89 boiler to facilitate the injection of steam into the bedrock formation to accelerate the volatilization of VOCs. At the same time, the five new VEWs will be plumbed into the existing SVE system to remove the mobilized VOC vapor plume. **Figure 1.2** represents the location of the proposed SIWs and VEWs at AOC-65.

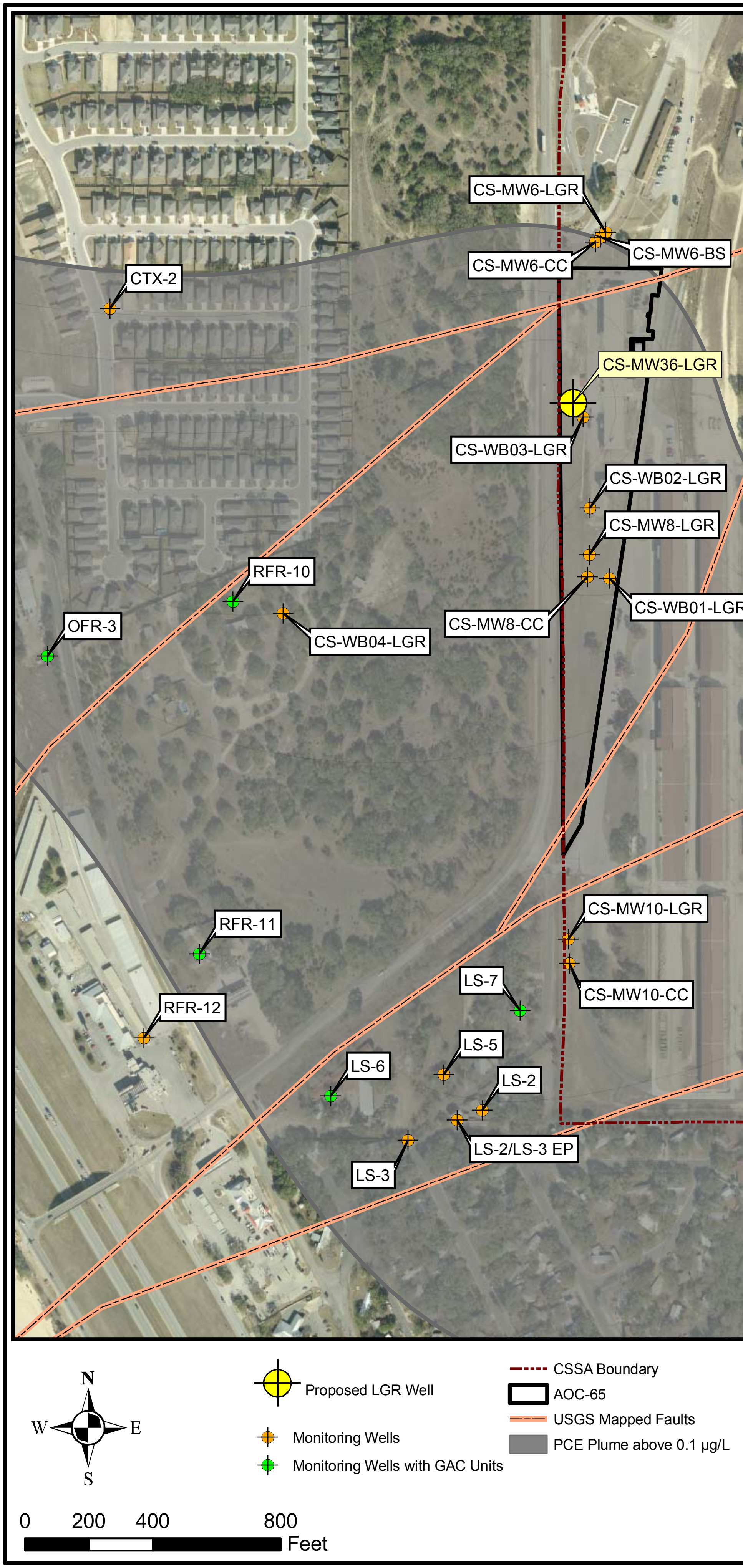

Figure 1.1

Proposed LGR Monitoring Wells

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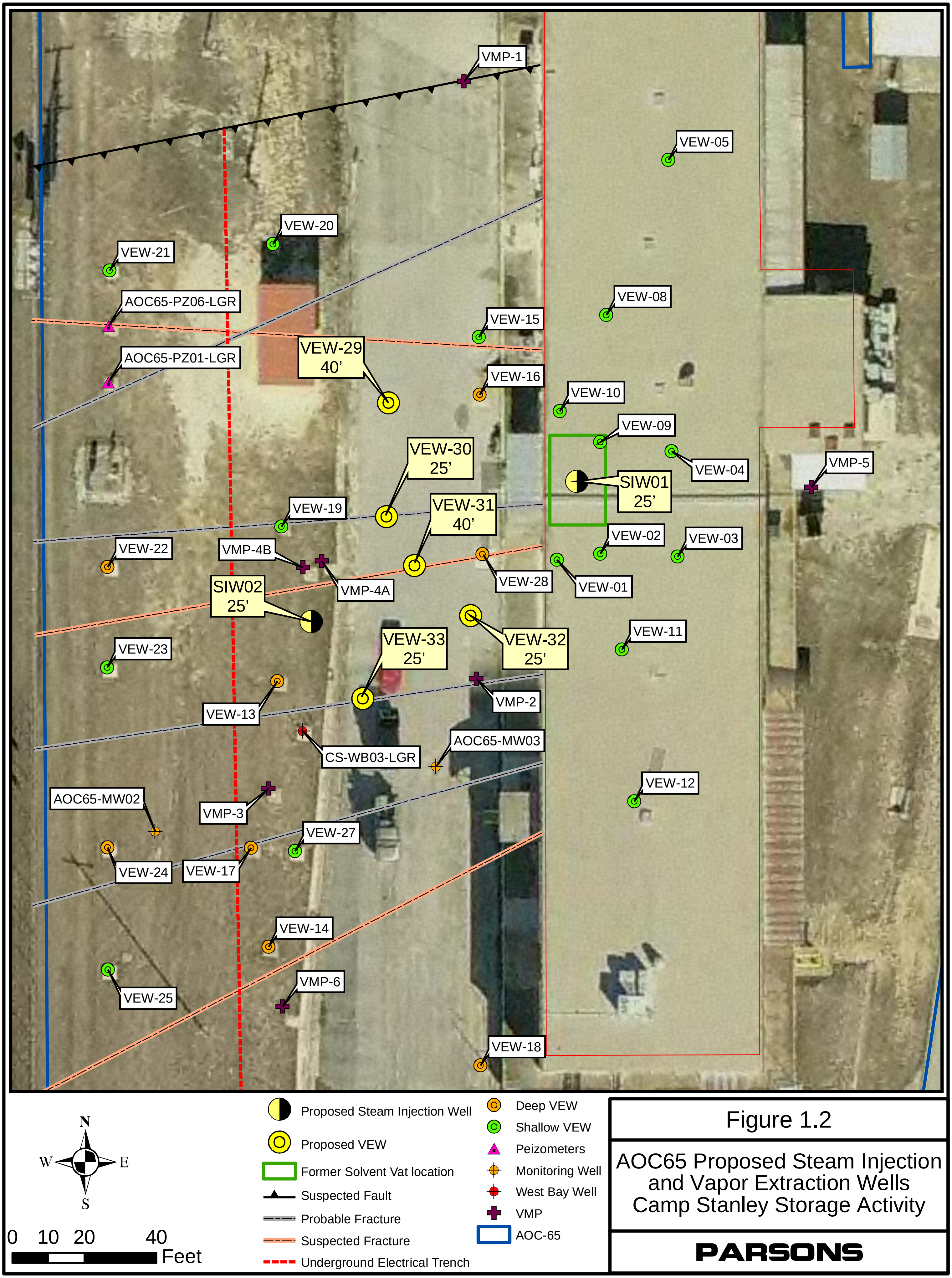

Figure 1.2

AOC65 Proposed Steam Injection and Vapor Extraction Wells
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SECTION 2
MONITORING WELL INSTALLATIONS

2.1 GENERAL

Two LGR wells shall be drilled and installed at two sites within the CSSA facility, one on the west side of AOC-65 and one south, southeast of AOC-65. While actual drilling depths shall be a function of each well's location and land surface elevation, it is estimated that the drilling depths shall be between 350 to 400 feet below ground surface (bgs).

Well CS-MW35-LGR is scheduled to be drilled east of the warehouse section, and southeast of AOC-65 (Building 90). The drilling site is approximately 250 feet northeast of the CSSA Wastewater Treatment Plant. This site has been selected to fill in data gaps between areas of groundwater contamination known to be above the maximum contaminant level (MCL) thresholds for PCE and TCE, and the CSSA southern border, where contaminant concentrations are escalating at off-post well LS-1. The well is also located within significant structural features (faulting) mapped by the USGS, and confirmed by previous drilling at the CS-MW11 well cluster location. Significant volumes of groundwater can be expected to be generated at this drilling location.

Well CS-MW36-LGR is planned to be drilled west of Building 90, in the vicinity of the AOC-65 Weather Station. The intent of this observation well is to monitor the LGR production zone within the aquifer during the upcoming steam injection treatability study. This well will be routinely monitored for changes in condition or contaminant characteristics or concentrations during the study. The physical drilling location is highly constricted by overhead utilities, existing wells, and subsurface remediation system components. The well will be placed in a location that can safely accommodate the drilling rig and ensure the proper clearance from utilities. The electrical service providers are being consulted and appropriate insulating measures will be implemented where recommended.

Declination surveys will be completed within each borehole at 50-foot intervals to ensure the borehole is within 2 degrees of plumb. Discrete Interval Groundwater (DIGW) samples will be collected from the deep wells for vertical profiling of the water column. Geophysical and video surveys will be completed in each borehole by the United States Geological Survey (USGS) prior to the completion of the wells. **Table 2.1** lists the specifics of each drilling location.

Table 2.1
Estimated Quantities of Drilling Requirements

Drilling Location	8" Borehole Depth *(feet)*	Declination Survey *(Every 50')*	4" Well with (Screen) *(feet)*	DIGW Sampling *(Qty)*
MW35-LGR	400	7	350 (25)	3
MW36-LGR	350	8	400 (25)	3
Totals:	750	26	750 (50)	6

2.2 LGR MONITORING WELL INSTALLATIONS

Two LGR monitoring wells (CS-MW35-LGR and CS-MW36-LGR) shall be constructed at predetermined on-post locations to monitor for the presence of contamination in the Middle Trinity Aquifer (**Figure 1.1**). Each single-cased well shall terminate in the LGR portion of the Middle Trinity Aquifer.

2.2.1 Drilling Method

It is anticipated that the actual drilling depths will range between 350 and 400 feet bgs, depending on conditions. The actual drilling depths will be a function of the well's specific location, land surface elevation, and proximity to structural features (faults and subsurface stratigraphy). The final depth shall be determined by the on-site geologist based upon the results of the geophysical and video logs, geological formation contacts, and the presence of structural features. If necessary, drilling footage which exceeds the statement of work (SOW) will be addressed with a scope modification as field conditions warrant.

The completed well will have straight-wall, single-cased design with a nominal diameter of 8 inches. Considering the subsurface material, air rotary drilling with water injection is the preferred method of well borehole advancement. Clean, unchlorinated injection water will be made available from the CSSA water supply system at wells CS-10 and CS-12. The well will be drilled by a licensed well service contractor, and the construction and surface completion will adhere to local and state regulations. The use of "Quickfoam®" is an allowable drilling additive for assisting in cutting removal during the drilling process.

The drilling subcontractor shall use a single shot declination tool to check the plumbness and straightness of the borehole. The declination tool shall be run in the borehole after every 50 feet of advancement. The well shall be plumb within 2 degrees of vertical unless otherwise stated by Parsons and CSSA. The drilling subcontractor will make adequate provisions for the containment, control, and de-foaming of all fluids and solid media exiting the wellhead.

The well will be drilled to the total depth as determined by the on-site geologist. The drilling subcontractor will remove as much sediment as possible by flushing and jetting with the drill stem before exiting the borehole. Once the borehole has been developed, ample time will be given to allow the water column to clear for the video and geophysical logging (see **Section 3.2**). Once the borehole logging inspections have been completed, the on-site geologist will select three intervals to perform DIGW straddle packer testing for VOCs. The DIGW samples will be conducted in accordance with **Section 3.3**.

2.2.2 Well Construction

Once the borehole testing is complete, the monitoring well completion will commence. In general, a single-cased monitoring well shall be constructed with a nominal diameter of 4 inches, consisting of a Schedule 80 polyvinyl chloride (PVC) riser coupled with 25 feet of stainless steel wire-wrapped screen (**Figure 2.1**). The well shall be completed within an open borehole no larger than 8.5 inches in diameter. The diameter of the wells shall allow for the installation of a standard 1.5-inch groundwater bladder pump, which shall be sufficiently sized to pump groundwater at screen interval depth.

The 4-inch inside diameter (ID) PVC casing and 304 stainless steel screen shall be installed within each boring to limit the amount of open borehole to less than 30 feet. The casing and screen shall be centered within the borehole using stainless-steel centralizers at 50-foot intervals. All well casings, screens, and end caps shall be flush-threaded, and shall not require the use of any glues or solvents. All well material shall be certified "clean" by the manufacturer, and shall remain within their original packaging until the time of their downhole installation.

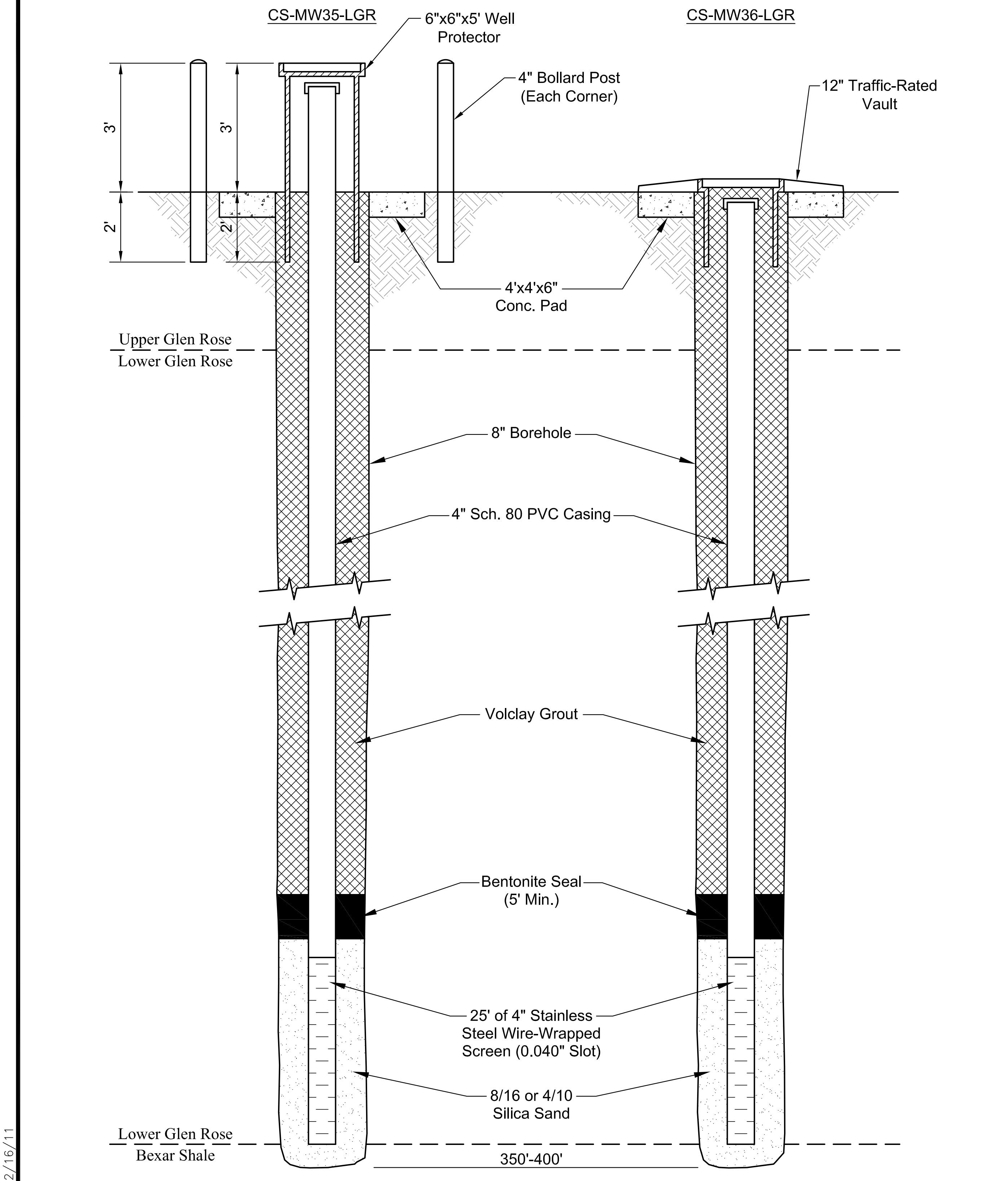

Figure 2.1

Typical Monitoring Well Design

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The well riser shall consist of nominal 4-inch Schedule 80 PVC with flush-threaded joints. The well screen shall be constructed of 304 stainless steel wire-wrapped screen with a slot size of 0.040-inches (40-slot), with no more than a 25-foot intake. The annular space shall be filled with a filter pack from the base of the borehole to a height of 5 feet above the top of the screened interval. The filter pack needs to be sized such that 100 percent retention is maintained by the screen. Commercial sizes of either 8/16 or 4/10 mesh would be acceptable. The filter pack shall be emplaced via tremie pipe from the base of the borehole to the top of the designated screened zone. The height of the filter pack shall be monitored continuously during emplacement using a weighted measuring tape. Prior to the emplacement of the filter pack, the amount of required filter material shall be calculated. Given the well construction parameters (8 inch borehole and 4.5-inch outside diameter [OD] screen), approximately 25.5 pounds of sand shall be required for each foot of the filter pack height. As an example, a filter pack height of 30 feet shall require approximately 765 pounds of silica sand.

A 100 percent sodium bentonite seal with a maximum thickness of 5 feet shall be emplaced within the borehole above the filter pack. The bentonite shall be dropped into the borehole from the surface at a rate sufficient to avoid clumping and bridging, and shall settle through the water column by gravity. The bentonite seal shall be allowed to fully hydrate per the manufacturer's specifications before grouting activities commence.

Beginning with small lifts (less than 250 gallons), a Volclay grout mixture shall be slowly pumped into the annular space using a side-discharge tremie pipe. Past problems with elevated pH resulting from use of Portland grout has prompted the use Volclay in lieu of Portland cement. The volume of grout shall be calculated prior to its emplacement. The slurry shall be injected until grout flows freely at the surface. The annular space shall be checked periodically for settlement, and shall be topped off as needed to no greater than two foot below ground surface. The grout shall be allowed to cure for at least 48 hours prior to well development.

Well CS-MW35-LGR shall be completed with 4-foot square, 6-inch thick concrete pad with a 3-foot high locking well protector and 3-foot bollard posts in accordance with state regulations by the drilling Subcontractor. Both the well protector and bollard posts will extend at least 2 feet below grade, and will be cemented in place and coated with paint consistent with the base protocol. At AOC-65, well CS-MW36-LGR will be completed with a 4-foot square concrete pad and a 12-inch diameter traffic rated flush mount box.

A brass monument will be placed in each monitoring well concrete pad to serve as a permanent benchmark. Monuments will be stamped with each corresponding well's official identification. Each well will be surveyed by a State of Texas registered professional land surveyor. All wells will be secured as soon as possible after drilling with corrosion-resistant locks.

The monitoring wells will be developed by the drilling subcontractor using surging, bailing, and pumping techniques (see **Section 3.4**), Parsons will install QED Well Wizard™ pumps to facilitate incorporation into the groundwater monitoring network.

SECTION 3
BOREHOLE ACTIVITIES

3.1 GENERAL

A total of nine wells shall be drilled and installed at three sites within the CSSA facility. Each of the drilled wells shown in **Table 3.1** will have one or more of the following borehole activities performed.

Table 3.1
Estimated Quantities of Borehole Activities

Drilling Location	DIGW Sampling *(Qty)*	Geophysical Log	Camera Survey (Cam) or Optical Televiewer (OT)
MW35-LGR	3	1*	Cam*
MW36-LGR	3	1*	Cam*
AOC65-SIW-01		1	Cam
AOC65-SIW-02		1	Cam
AOC65-VEW-29		1	Cam
AOC65-VEW-30		1	Cam
AOC65-VEW-31		1	Cam
AOC65-VEW-32		1	Cam
AOC65-VEW-33		1	Cam
Totals:	6	9	9

* To be completed by the USGS under an independent contract with CSSA.

3.2 GEOPHYSICAL AND VIDEO LOGGING

Each borehole drilled under this task order, with the exception of the two LGR wells, will be geophysically logged and video surveyed by Parsons and its Subcontractors. The downhole logging tools will be used to characterize and correlate the geologic/hydrogeologic conditions relative to similar data collected throughout the base in previous efforts. The logging efforts can also help identify significant production zones and will aid in the construction and casing design of the well. Gamma, resistivity, spontaneous potential (SP), and caliper logging shall be conducted. Gross-count natural gamma ray logging shall also be conducted with both short (16") and long (64") resistivity and SP methods to augment identification and correlation of strata or soil/rock types between boreholes, upon the discretion of Parsons geologists. A borehole video camera will be used to inspect and record (analog or digitally) the condition of the well borehole. The USGS will conduct down-hole geophysical testing in the LGR wells and Parsons will be able to use those data to make final well construction determinations.

3.2.1 Electric Logs (Resistivity and Spontaneous Potential)

The resistivity and SP measuring instruments shall be raised toward the surface at a rate no greater than 10 feet per minute. The scales selected for portraying resistivity or SP readings shall be the same at all boreholes. The appropriate scale shall be determined in the field by conducting offset logs prior to the final survey. Scales to be adjusted are the horizontal (millivolts for SP and ohm-meters for resistivity) and vertical (feet). The resistivity logs shall consist of the short-normal (16-inch) and long-normal (64-inch) configurations.

3.2.2 Natural Gamma Ray Logs

Natural gamma ray logging shall be used in conjunction with SP, resistivity, and caliper logs in fluid-filled boreholes.

3.2.3 Caliper Logs

The geophysical subcontractor shall use a borehole caliper to measure the variations in the borehole diameter.

3.2.4 Optical Televiewer

The geophysical subcontractor shall use an Optical televiewer at the well locations to help identify variations in borehole lithology, fractures, cavity dimensions, and orientation of features. In addition to a hard copy report, the data will be made available electronically for viewing and manipulation in software such as WellCAD Reader of equivalent.

3.3 DISCRETE INTERVAL GROUNDWATER SAMPLING

Discrete interval groundwater (DIGW) samples will be collected from selected new boreholes via wireline straddle packer apparatus. Selected boreholes will undergo discrete sampling after thorough cleaning by the drilling subcontractor, but prior to installation of the well material. Discrete sampling intervals will be selected by the site geologist and project task manager based on lithologic and geophysical logs.

In a borehole, a double packer system will be used to straddle either a submersible pump or screened inlet section, based on the yield of the formation at that depth. The packer system's open interval is not expected exceed 12 feet. However, the subcontractor shall be prepared to provide a shorter interval if requested, and be prepared to deploy DIGW sampling packer apparatus in both 6-inch and 8-inch diameter boreholes.

Conditions may warrant collection of discrete groundwater samples as drilling progresses and prior to achieving total depth (TD). Subcontractor shall be prepared to employ a packer system consisting of a single packer set above a submersible electric pump with no check valve. The current bottom depth of the borehole will serve as the lower isolation point for the discrete sample; therefore, this method of sampling would occur as drilling progressed. CSSA shall supply canisters of compressed nitrogen gas for packer inflation. The drilling subcontractor shall be responsible for transporting the nitrogen tanks between the tank storage area and the work sites, and for all related safety issues.

3.4 WELL DEVELOPMENT

All boreholes or wells in which groundwater is encountered will be developed by the Subcontractor using surging, bailing, and pumping techniques. Recovered fluids will be contained for transport to the on-site groundwater treatment plant near well CS-16. Because of the nature of the aquifer, it is anticipated that the VEWs and SIWs will contain groundwater from time to time. If the VEWs are found to contain groundwater following their installation, they will be developed in a manner consistent with a traditional groundwater well.

The monitor well development requirements are:

(1) all newly installed monitor wells shall be developed no sooner than 48 hours after installation to allow for grout curing;
(2) all drilling fluids used during well construction shall be removed during development;
(3) wells shall be developed using surge blocks and bailers or pumps, and wells shall be developed until:
    a. the turbidity remains within a 10 nephelometric turbidity unit range for at least 30 minutes; and
    b. the Contractor is satisfied that all stabilization criteria are met including:
        i. temperature ± 1^{o}C;
        ii. pH ± 0.1 units; and
        iii. electrical conductivity ± 5 percent;
(4) discharge water color and volume shall be documented;
(5) no sediment shall remain in the bottom of the well;
(6) no detergents, soaps, acids, bleaches, or other additives shall be used to develop a well; and
(7) all development equipment shall be decontaminated according to the specifications of this document.

In the interest of time, there is occasion that development activities may progress in stages while the grouting process is occurring. Often, a well requires numerous events to top off settling grout. This process may take place over a period of several days. Development may begin once more than 50 percent of the grout has been emplaced. However, in accordance with the Client's requirements, no development activity shall be engaged within the 48-hour time period after the emplacement of any lifts of grout.

SECTION 4
AOC-65 SVE EXPANSION

4.1 GENERAL

A total of seven wells shall be drilled and installed at AOC-65. This includes two SIWs and five VEWs. The new wells will augment and enhance the recovery of VOCs from the AOC-65 subsurface. While actual drilling depths shall be a function of each well's location and land surface elevation, it is estimated that the drilling depths shall be as follows:

- 25 feet bgs for each steam injection well (Upper or Lower Glen Rose Limestone);
- 25 or 40 feet bgs for each VEW (Upper or Lower Glen Rose Limestone);

Table 4.1 lists the specifics of each drilling location.

Table 4.1
Estimated Quantities of AOC-65 Drilling Requirements

Drilling Location	Continuous Coring	8" Borehole Depth *(feet)*	4" Well with (Screen) *(feet)*	Geophysical Log	Camera Survey and Optical Televiewer
AOC65-SIW-01	0	25	Cased Open Hole	1	Cam
AOC65-SIW-02	25	25	Cased Open Hole	1	Cam
AOC65-VEW-29	40	40	40 (35)	1	Cam
AOC65-VEW-30	25	25	25 (20)	1	Cam
AOC65-VEW-31	40	40	40 (35)	1	Cam
AOC65-VEW-32	25	25	25 (20)	1	Cam
AOC65-VEW-33	25	25	25 (20)	1	Cam
Totals:	180	205	155 (130)	7	7

- ** AOC65-SIW-01 will be completed as a 6-inch open borehole with 10 feet of 10-inch steel surface casing.*

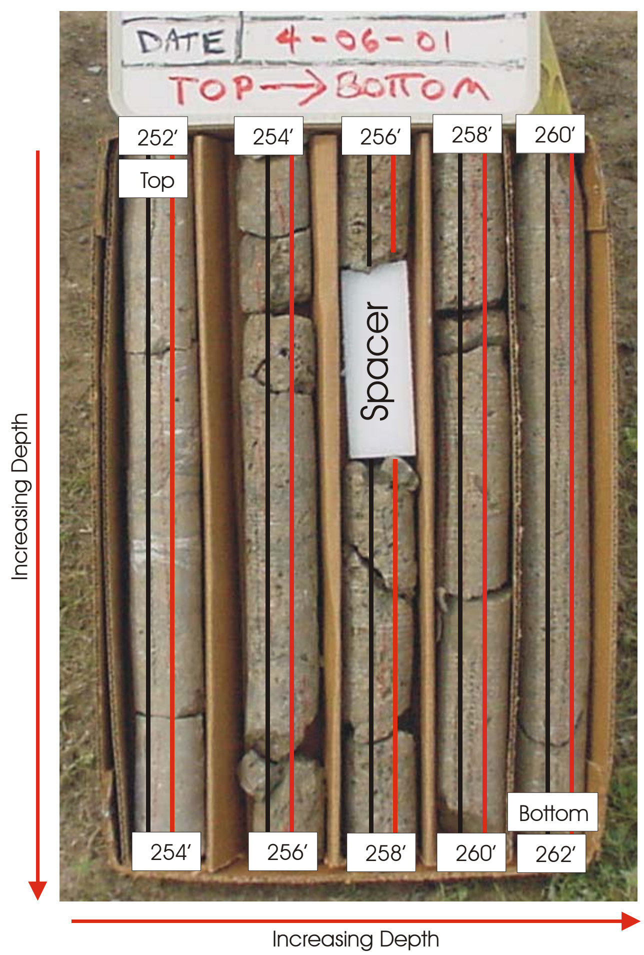
AOC-65 is a known source area for a volatile organic compound (VOC) groundwater contamination plume that has migrated off-post. To address this on-going source area in the underlying fractured bedrock, a soil vapor extraction (SVE) system was installed in 2002. In 2007, the SVE system was upgraded with new extraction wells, vapor monitoring wells, and blowers. The current configuration consists of 29 VEWs connected to four regenerative blowers. Six of these 29 VEWs have been disconnected in order to optimize system efficiency. Monthly screening data indicate significant TVH levels (8.9 to 22 ppm November 2010) in three of the 23 operational VEWs (VEWs 19, 25, and 27), and semi-annual sampling confirms the presence of VOCs in significant quantities in these three VEWs (1,900 to 6,200 ppbv PCE in November 2010). VOC removal rates for VEWs 19, 25, and 27 VEWs are consistently higher than the rest of the VEWs in the system. These three VEWs are generally shallow (TDs between 21 and 25 ft bgs) and are screened from TD to approximately 6 ft bgs. This shallow zone (~5 to 25 ft bgs) will be targeted by all new VEWs; however, two of the new VEWs will be drilled to ~40 ft bgs and screened from TD to 10 ft bgs, in order to provide a monitoring location for the contact between the Upper Glen Rose and Lower Glen Rose.

Geophysical studies completed between November 2001 and January 2002 identified probable and suspected fractures and faults that cross the site at several locations. Two of the best producers (VEWs 27 and 19) are located on or near probable fractures identified from this survey. Fractures in the subsurface provide connections between VEWs, SIWs, and the surface, which may potentially increase the flow at individual VEWs and increase the heat distribution in the subsurface. Locations for new VEWs were selected to take advantage of potential fractures in the subsurface and remain in close proximity to the steam injection wells.

The suspected sources of contamination at AOC-65 include a vat inside of Building 90, and a drainage ditch located west of Building 90. These source areas are the targets for thermal remediation via steam injection. SIW-01 will be installed within the former vat inside Building 90, and SIW-02 will be installed next to the drainage ditch where contaminants were suspected of being released.

4.2 SLIMHOLE DRILLING PROGRAM

Each AOC-65 drilling location (except SIW-01 inside Building 90) will initially be continuously cored using either NXB or NWD4 coring systems. Both coring systems produce 2-inch nominal diameter rock core from a slimhole boring (slimhole) with a nominal 3-inch diameter. Upon retrieval, the core will be immediately screened with a photoionization detector (PID) to identify any potential zones of VOC contamination. Sample intervals will be identified quickly, selected for laboratory analyses, and samples will be obtained as soon as the PID screening is complete.



Every reasonable attempt will be made to recover the correct orientation of the core samples. Each core will be measured for recovery, and an attempt to identify any missing sections will be made with the driller. Where the core is broken and fragmented, an attempt to reposition the correct orientation of the segments will be made before marking the core. While still in the core barrel, the core sample will be marked with a pair of differently colored

(red and black) ceramic marking pencils in a fashion that results in a continuous parallel line down the length of the core. The red marking will be on the right side of the parallel lines when viewing the core from top to bottom. The coloration scheme will allow any piece of core to be correctly oriented in the vertical plane (red on right side). Marked rock cores will be stored in standard core boxes, and missing sections of the core replaced with spacers. Both the core box base and core top will be appropriately-labeled with the well identification, core depth, date, and geologic formation origin. Additionally, the core box base will be sufficiently labeled so the top and bottom of the core are clearly evident. Depths for each 2-foot broken interval should be written on the core box base in a relative position that corresponds with the dividers. Styrofoam spacers will be labeled with the missing interval or sampling information and appropriately positioned within the retrieved core.

CSSA will supply core boxes that will each hold up to 10' of core and Parsons will label them appropriately with date, time, depth, and drilling information relevant to the retained sample. Each section of core will be marked with a corresponding depth, and electronically recorded using a digital camera. The top portion of the core interval starts at the upper left hand corner of the core box, with increasing depth progressing downwards and toward the right, until the lower portion of the core interval is at the lower right hand corner of the core box base (as shown above).

The slimhole will be drilled to the total depth as determined by the on-site geologist. The drilling subcontractor will remove as much sediment as possible by flushing and jetting with the drill stem before exiting the slimhole. Upon completion, video and geophysical logging will be performed (see **Section 3.2**).

4.3 STEAM INJECTION WELL INSTALLATION

To enhance the effectiveness of the AOC-65 SVE remediation system, Parsons will install two open-hole steam injection wells to potentially volatilize and mobilize contaminants to the operational SVE system. In general, the SIWs will be straight-walled, single-cased, open borehole wells constructed with a nominal diameter of 8 inches, with up to 10 feet of 4-inch steel casing.

4.3.1 Drilling Method

Two SIWs will be installed as part of this investigation. One of the wells, SIW-01, will be installed in the former solvent vat inside building 90 and must be drilled using a compact drilling rig capable of clearing 10' overhead obstructions. The second well, SIW-02, will be installed in the grass covered area west of Building 90 (**Figure 1.2**).

Because of the access issues and limited rig size that can be used inside Building 90, the slimhole continuous coring will not occur at SIW-01. Rather, that well will be direct drilled at a 6-inch diameter for the total length of the borehole.

The slimhole boring at SIW-02 will be reamed to its final diameter for the installation of the SIW. The final depth shall be determined by the on-site geologist based upon the results of the geophysical and video logs, geological formation contacts, and the presence of structural features. If necessary, total drilling footage greater than that in the SOW will be addressed with a scope modification as field conditions warrant.

In general, the wells will be an open borehole completion within the consolidated bedrock of the UGR and LGR Limestone. The completed well will have straight-wall, single-cased design with a nominal diameter of either 6 inches (SIW-01) or 8 inches (SIW-02). The steel surface casing will be installed to stabilize the upper portions of the borehole and provide a surface seal meeting all regulatory requirements.

Considering the material to be bored through, air rotary drilling with water injection is the preferred method of well borehole advancement. Clean, unchlorinated injection water will be made available from the CSSA water supply system at wells CS-10 and CS-12. The well will be drilled by a licensed well service contractor, and the construction and surface completion will adhere to local and state regulations. The use of "Quickfoam®" is an allowable drilling additive for assisting in cutting removal during the drilling process. The drilling subcontractor will make adequate provisions for the containment, control, and de-foaming of all fluids and solid media. All necessary measures to control the production of dust during the drilling of SIW-01 will be taken. These precautions include:

- The construction of sheet plastic barriers around the well construction work area;
- The design and implementation of a borehole dust repression system using clean, unchlorinated water from the CSSA supply system;
- The prompt removal of all drill cuttings from the work area utilizing a vacuum truck with hoses or similar.

The wells will be drilled to the total depth as determined by the on-site geologist. The drilling subcontractor will remove as much sediment as possible by flushing and jetting with the drill stem before exiting the borehole. Once the borehole has been developed, ample time will be given to allow the water column to clear for the video and geophysical logging (see **Section 3.2**).

4.3.2 Well Construction

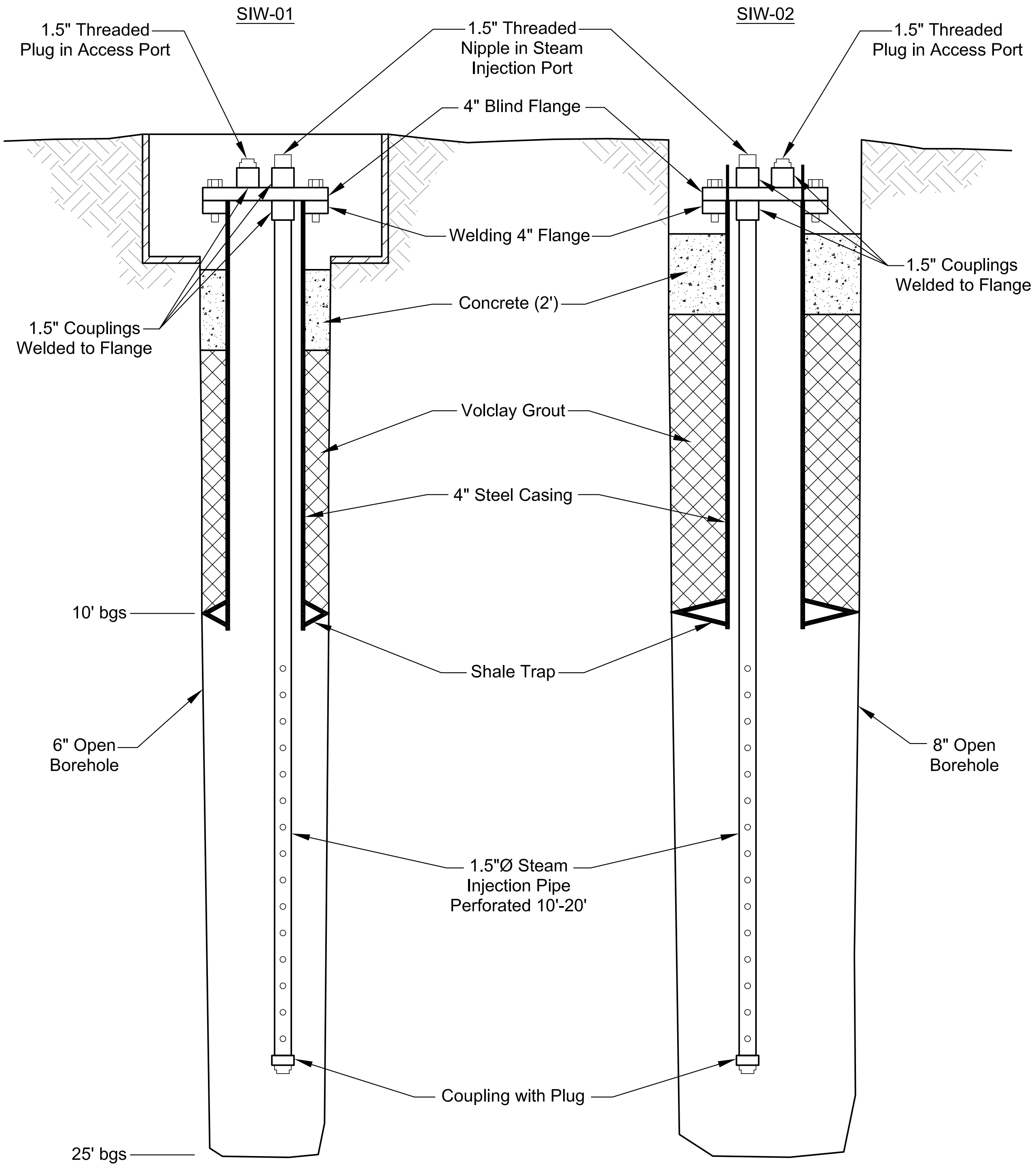
Based on the capabilities of the compact drilling rig, SIW-01 will be constructed within a 6-inch diameter borehole. A 10-foot section of 4-inch diameter low-carbon steel casing shall be suspended and centered within the borehole using two stainless-steel centralizers at top and bottom. Within SIW-02, 10 feet of 4-inch diameter low-carbon steel casing shall be suspended and centered within the 8-inch borehole using stainless-steel centralizers at top and bottom.

The casing material will be decontaminated by the Subcontractor prior to its installation. A shale trap will be affixed to the end of the surface casing to assist cementing of the casing. A Volclay grout mixture shall be slowly pumped into the annular space using a side-discharge tremie pipe. Past problems with elevated pH resulting from use of Portland grout has prompted the use Volclay in lieu of Portland cement. The volume of grout shall be calculated prior to its emplacement. The slurry shall be injected until grout flows freely at the surface. The annular space shall be checked periodically for settlement, and shall be topped off as needed to no greater than two foot below ground surface. The grout shall be allowed to cure for at least 48 hours prior to any development activities. A standard 4-inch flange will be welded to the top of the steel casing to accommodate the steam injection apparatus. The surface casing shall be installed such that the top of casing is 6 inches below grade to facilitate well head construction inside a traffic-rated vault. The wellhead completion for the steam injection well is further addressed in **Section 4.3.3**

4.3.3 Well Head Design and Construction

The SIWs surface completion will be designed to accomplish two primary functions. The first is to incorporate the plumbing necessary to accommodate the pressurized steam, and the second is to allow access for water level measurements or collection of water samples without interfering with the steam injection hardware. This design will be constructed on a 4 inch flange that will form a pressure tight seal on the four-inch steel surface casing.

The steam injection hardware will consist of 20 feet of a 1.5-inch ID perforated steel pipe protruding into the open borehole section of the well. This steel pipe will be connected to the steam source through the surface flange that must also support it. The steam injection plumbing must be offset enough to allow a 1.5-inch access opening into the well. The access opening must be threaded to allow a plug to form a pressure tight seal when not in use. The completed assembly must be set deep enough below ground surface to allow for the connection of a buried steam supply line. Figure 4.1 illustrates the concept of the SIW well design.



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Not to Scale

Figure 4.1

Typical Steam Injection Well Design

Camp Stanley Storage Activity

PARSONS

4.4 VAPOR EXTRACTION WELL INSTALLATION

4.4.1 Drilling Method

Five slimhole borings will be installed and reamed to their final eight-inch diameter for the installation of the 4-inch VEWs. The final depth of each well shall be determined by the on-site geologist based upon the results of the geophysical and video logs, geological formation contacts, and the presence of structural features. If necessary, total drilling footage greater than that in the SOW will be addressed with a scope modification as field conditions warrant.

Considering the material to be bored through, air rotary drilling with water injection is the preferred method of well borehole advancement. Clean, unchlorinated injection water will be made available from the CSSA water supply system at wells CS-10 and CS-12. The well will be drilled by a licensed well service contractor, and the construction and surface completion will adhere to local and state regulations. The use of "Quickfoam®" is an allowable drilling additive for assisting in cutting removal during the drilling process. The drilling subcontractor will make adequate provisions for the containment, control, and de-foaming of all fluids and solid media exiting the wellhead.

The well will be drilled to the total depth as determined by the on-site geologist. The drilling subcontractor will remove as much sediment as possible by flushing and jetting with the drill stem before exiting the borehole. One the borehole has been developed, ample time will be given to allow the water column to clear for the video and geophysical logging (see **Section 3.2**).

4.4.2 Well Construction

Each of the five VEWs shall be constructed with 4-inch diameter, schedule 40 PVC, 0.040 slot screen and 4-inch diameter, schedule 40 PVC riser. Screened interval lengths shall be limited to 25 feet. Each VEW shall be extended flush-mounted and shall be fitted with a below grade piping that connects the VEW to the SVE blower manifold. Each VEW shall be completed per the procedures outlined below. **Table 4.1** includes the proposed well identification number and screened intervals for each of the four VEWs to be installed as part of the SVE system at AOC-65.

The annular space of each VEW shall be filled with number 8/16 silica sand from the base of the borehole to a height of 5 feet above the top of the screened interval. The sand filter pack shall be emplaced via tremie pipe from the base of the borehole to the top of the designated screened zone. The height of the filter pack shall be monitored continuously during emplacement using a weighted measuring device.

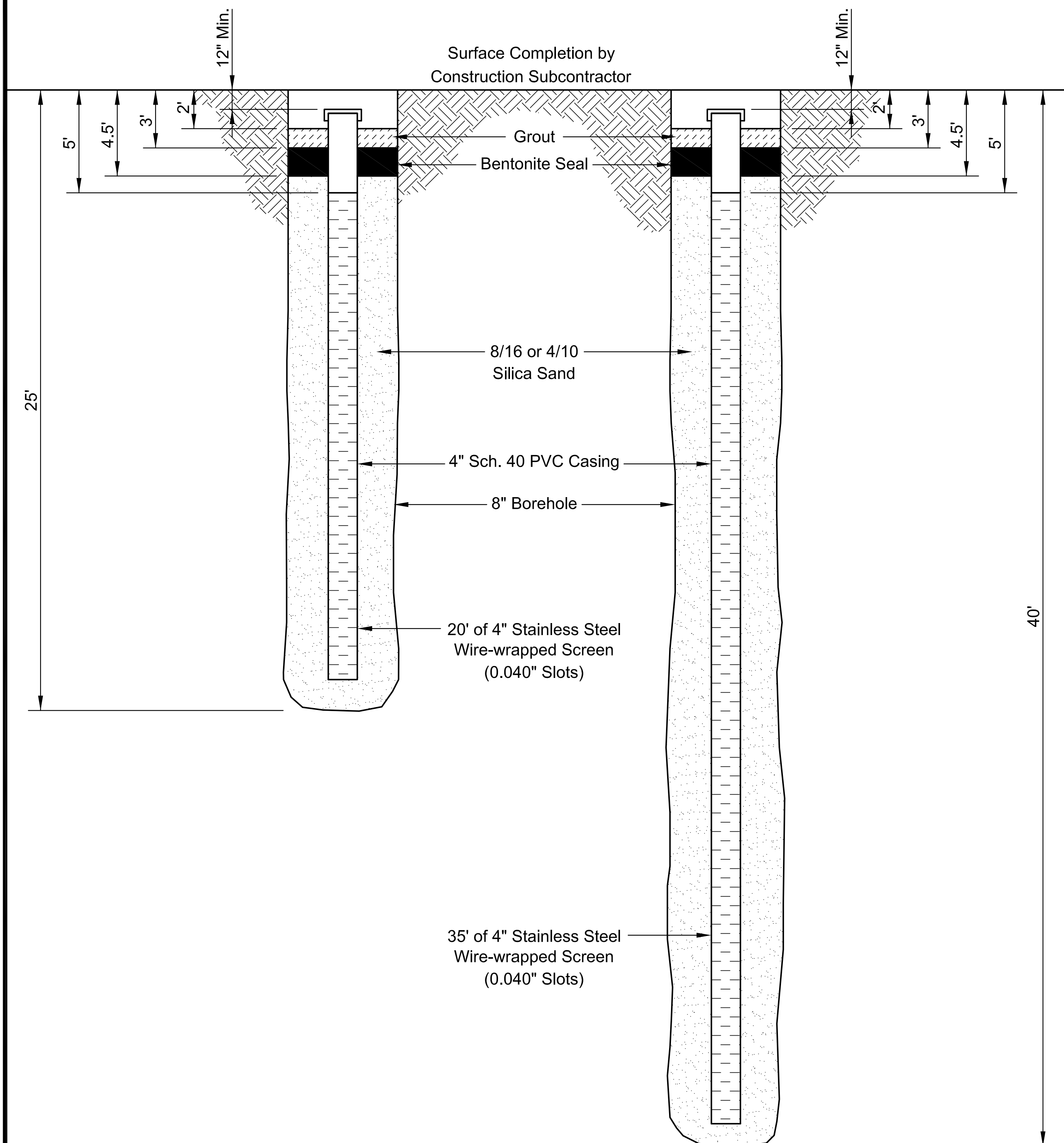
A 100 percent sodium bentonite seal approximately 5 feet thick shall be placed above the filter pack in each borehole. The bentonite shall be dropped into the borehole from the surface at a rate sufficient to avoid clumping and bridging. The bentonite seal shall be fully hydrated per the manufacturer's specifications before grouting activities commence.

Beginning with small lifts, a Volclay® grout mixture will be slowly pumped into the annular space using a side-discharge tremie pipe. The volume of grout shall be calculated prior to emplacement. The slurry shall be injected until grout flows freely at the surface. The annular space shall be checked periodically for settlement, and shall be topped off as needed to no greater than 2 feet bgs. The grout shall be allowed to cure for at least 48 hours prior to well development. The typical VEW well design is illustrated in Figure 4.2.

The surface casing shall be installed such that the top of casing is 6 inches below grade to facilitate the installation of a traffic-rated vault (Section **4.4.3**).

4.4.3 Wellhead Completions

The specifics of the wellhead completions for the SIWs and VEWs will be completed under a separate workplan that details the SVE expansion and steam injection system construction. The final wellhead installation for the SIWs and VEWs will be completed by a Construction Subcontractor, not the Drilling Subcontractor. Upon conclusion of the drilling activities, each SIW and VEW location will be secured with a traffic-rated steel plate until the construction activities commence. At that time, connections to the remediation systems and installation of the traffic-rated vaults will be completed.



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Not to Scale

Figure 4.2

Typical Vapor Extraction Well Design

Camp Stanley Storage Activity

PARSONS

SECTION 5
DECONTAMINATION AND INVESTIGATION-DERIVED MEDIA MANAGEMENT

5.1 GENERAL

This section describes the procedures and requirements for the decontamination of drilling and sampling equipment and the proper management of investigation-derived media (IDM) generated over the course of the environmental investigations.

5.2 DECONTAMINATION PROCEDURES

To prevent sample contamination from the onsite sampling equipment and machinery, decontamination will follow the general procedures outlined in the master CSSA Field Sampling Plan (***CSSA Environmental Encyclopedia, Volume 1.4, Sampling and Analysis Plan***). A decontamination station will be set up at the CSSA Granular Activated Carbon (GAC) Shack (next to well CS-16).

All equipment that may directly or indirectly come into contact with samples will be decontaminated in a designated decontamination area. These include casing, drill bits, drilling rods, auger flights, portions of drill rigs that stand above boreholes, sampling devices, and downhole instruments. In addition, the contractor will take care to prevent the sample from coming into contact with potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure will be used to decontaminate large pieces of equipment such as casing, drill bits, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that comes into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment will be washed with high-pressure hot water and if, necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., are removed. The equipment shall then be rinsed with potable water. The inside surfaces of casing, drill rod, and auger flights will also be washed as described.

The following procedure will be used to decontaminate sampling and drilling devices such as split spoons, core barrels, and bailers that can be hand-manipulated. For sampling and smaller drilling devices, the equipment will be scrubbed with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. Then the equipment will be rinsed with copious quantities of potable water followed by distilled water. The equipment will be air dried on a clean surface or rack, such as Teflon®, stainless steel, or oil-free aluminum elevated at least 2 feet above ground.

Drill rigs, drill pipe and other equipment that does not come into contact with the sample medium will be decontaminated with a steam cleaner before initial use and after each borehole is completed. Drill bits will be decontaminated with a steam cleaner prior to use at each boring or monitoring well location. If hot water cleaning alone is found to be ineffective, the equipment may be scrubbed with laboratory-grade detergent, then rinsed with high-pressure steam. All visible dirt, grime, grease, oil, or loose paint will be scrubbed until it has been removed. When possible, drilling will proceed from the “least” to the “most” contaminated sites.

Casing, centralizers, and well screens will either be certified clean by the manufacturers or will be decontaminated by steam cleaning. Prior to well development, equipment such as pumps or surge blocks will be decontaminated by flushing or pumping laboratory-grade detergent solution, potable water, then distilled water through the internal components in the order listed below. The exterior of the pump inlet hose will be steam cleaned.

Sampling equipment includes augers, continuous-core samplers, hand trowels, bailers, pH meters, conductivity meters, shovels, knives, spatulas, and composition bowls that directly contact samples. The following steps must be followed when decontaminating this equipment:

1. Set up a decontamination area at the site. The decontamination area should progress from “dirty” to “clean” and end with an area for drying decontaminated equipment. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. However, sampling equipment to be used for organic sample collection will not come into contact with plastic after the final rinse, and oil-free aluminum foil must be used.
2. Wash the item thoroughly with soapy, laboratory-grade detergent solution. Use a stiff-bristle brush to dislodge any clinging dirt. Disassemble any items that might trap contaminants internally before washing. Do not reassemble until decontamination is complete, and items are dry.
3. Rinse the item in clear potable water. Rinse water should be replaced as needed, generally when cloudy.
4. Rinse the item with distilled water.
5. Rinse equipment with isopropyl alcohol.
6. After drying, wrap the cleaned item in oil-free aluminum foil for storage at least 2 feet above the ground.
7. After decontamination activities are completed, collect disposable gloves, boots, and clothing. Place contaminated items in proper containers for disposal.

5.3 INVESTIGATION-DERIVED MEDIA MANAGEMENT

Investigation-derived media may include soil cuttings, drilling fluids, purged groundwater, well development water, decontamination fluids (water and other fluids), and disposable personal protective equipment (PPE).

For waste management, the drilling subcontractor may use up to 20-yard, transportable roll-off boxes placed at the drilling location to contain drilling fluids and solid cuttings as necessary. Groundwater generated during drilling activities and well development, as well as decontamination water, will be transported to this roll-off container via vacuum truck for discharge at the SMWU B-3 Bioreactor. All releases into the bioreactor will meet the requirements of the Underground Injection Control (UIC) permit issued to CSSA for the bioreactor operation.

As an alternative, groundwater produced during the investigation can also be treated and discharged from the GAC unit located at the north end of the Inner Cantonment. In accordance with TPDES Permit number WQ0003849000, contaminated water treated through the GAC unit will be discharged at Outfall 002. Likewise, non-contaminated fluids that meet the permit requirements may be directly discharged to ground at Outfall 004. Both outfalls are located at the North Tributary to Salado Creek at the Inner Cantonment fenceline. Two samples per week must be collected and submitted for tetrachloroethene (PCE) and trichloroethene (TCE) analysis for each week of discharge events from each outfall utilized.

The remaining solids, fluids or drill cuttings will be containerized in roll-offs or by plastic sheeting at the wellhead, and managed as appropriate. For those solids and fluids determined non-hazardous by analytical results, CSSA may opt for an alternative recycling or reuse method. Otherwise, solids will be transported for disposal at a Class 2 non-hazardous landfill.

5.3.1 Temporary Storage Containers

Due to drilling in a potentially contaminated portion of the aquifer, generated drilling fluids may have to be contained in multiple 20-yard roll-off boxes. Drilling fluids would be placed directly into the containers at the site and allowed to settle before decantation of the water for processing. Once the solid fraction has sufficiently settled, the liquid fraction of a roll-off container can be characterized for short list VOCs to determine if the water will meet surface discharge requirements (less than MCLs). The liquid fraction of each roll-off is sampled to make the discharge determination.

Once a roll-off container is sampled, the determination to discharge water is based on the analytical results being less than the MCL (or Tier 1 Primary Contaminant Level [PCL]) for a particular compound. The determination of releasing uncontaminated groundwater is made in conjunction (and permission) of the CSSA environmental officer. Discharges to the surface are made to areas that do not have the potential for draining off-post. The roll-off may then be reused to store drilling fluids. Once the roll-off has accumulated approximately 50 percent solids, the container should not be used to store additional fluids until the solid fraction can be characterized and removed from the roll-off.

SECTION 6
SAMPLING REQUIREMENTS

6.1 GENERAL

Analytical samples will be collected from groundwater and IDM waste streams during the course of this task order. The following samples in **Table 6.1** are anticipated to be collected from the following drilling locations:

Table 6.1
Estimated Quantities of Sampling*

Drilling Location	DIGW Samples (VOCs Only)	IDM Sampling for VOCs/Metals (Water)	IDM Sampling for VOCs/Metals (Soil)	March 2010 Quarterly GW Sampling	June 2010 Quarterly GW Sampling
CS-MW35-LGR	3	4	4	1	1
CS-MW36-LGR	3	4	4	1	1
AOC65-SIW-01	-	2	2	1	1
AOC65-SIW-02	-	2	2	1	1
AOC65-VEW-29	-	1	1	1	1
AOC65-VEW-30	-	1	1	1	1
AOC65-VEW-31	-	1	1	1	1
AOC65-VEW-32	-	1	1	1	1
AOC65-VEW-33	-	1	1	1	1
Totals:	6	17	17	9	9

** Quantities do not include QA/QC samples.*

6.2 SAMPLING REQUIREMENTS

The planned sampling activities for this project include groundwater collection and IDM sampling for waste characterization. Depending on the intended use, groundwater samples may either be screening level data (DIGW) or definitive data (quarterly sampling). All IDM samples will be definitive data packages to support waste profiling procedures.

6.2.1 Groundwater Samples

The planned sampling activities for this project include DIGW samples to be collected during drilling activities from new wells associated with the regional groundwater monitoring program (CS-MW35-LGR and CS-MW36-LGR,). These samples will be collected for the CSSA short-list VOCs (1,1-dichloroethene, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride) as screening data only.

Typically, each new well undergoes a one-year quarterly detection monitoring program. For the initial sampling, the full-list VOCs and CSSA metals (arsenic, barium, cadmium, calcium, chromium, copper, lead, iron, magnesium, manganese, mercury, nickel, potassium, sodium, and zinc) are analyzed. The subsequent three quarters are only analyzed for CSSA short list VOCs and cadmium, lead, and nickel. Based upon the findings of the one-year detection period, a sampling schedule will be recommended that is consistent with the current groundwater Data Quality Objectives (DQOs) and Long-Term Monitoring Optimization (LTMO) programs implemented at CSSA. Within the period of performance of this task order, each well will be included in the March and June 2010 quarterly groundwater program. It is likely that the SIWs and VEWs will be typically dry since they are designed to remediate the vadose zone below AOC-65.

Sampling to be conducted will be consistent with sampling and analysis plans previously approved for CSSA investigations. The field team will follow the methods approved in CSSA Quality Assurance Project Plan (QAPP) and the CSSA Sampling and Analysis Plan (SAP). Quality Assurance/Quality Control (QA/QC) sampling and analysis will be performed to meet the requirements in the CSSA QAPP.

6.2.2 IDM Samples

IDM for both soils and fluids may be collected for characterization prior to management activities. Fluids generated during drilling may be containerized in transportable 20-yard roll-off boxes. If analytical results indicate that the IDM is contaminated, it will be transported to the appropriate TPDES permitted outfall treatment system by vacuum truck. The liquid fraction will be treated and discharged in accordance with the TPDES permit. If analytical results indicate that the generated IDM is not contaminated, the material will be reused within CSSA.