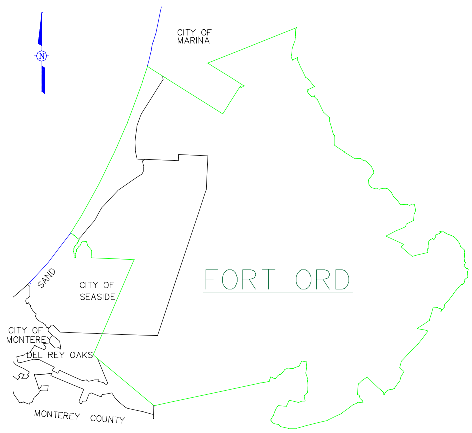
Appendix A
Final Work Plan and Sampling and Analysis Plan
Pilot Soil Vapor Extraction and Treatment
Operable Unit Carbon Tetrachloride Plume
Former Fort Ord, California

Associated Field Work Variances

FINAL WORK PLAN AND
SAMPLING AND ANALYSIS PLAN
PILOT SOIL VAPOR EXTRACTION AND TREATMENT
OPERABLE UNIT CARBON TETRACHLORIDE PLUME
FORMER FORT ORD, CALIFORNIA
MARCH 2004
REVISION 0



TOTAL ENVIRONMENTAL RESTORATION CONTRACT
DACW05-96-D-0011

Submitted to:

Department of the Army
Corps of Engineers, Sacramento
1325 "J" Street
Sacramento, California 95814-2922

Submitted by:

Shaw Environmental, Inc.
#4 All Pro Lane
P.O. Box 1698
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Presidio of Monterey

U.S. ARMY CORPS
OF ENGINEERS

Shaw™ Shaw Environmental, Inc.

FINAL WORK PLAN
and
SAMPLING AND ANALYSIS PLAN

PILOT SOIL VAPOR EXTRACTION AND TREATMENT OPERABLE UNIT CARBON TETRACHLORIDE PLUME

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PILOT SOIL VAPOR EXTRACTION AND TREATMENT OPERABLE UNIT CARBON TETRACHLORIDE PLUME

FORMER FORT ORD, MARINA, CALIFORNIA

TOTAL ENVIRONMENTAL RESTORATION CONTRACT DACW05-96-D-0011

Revision 0

March 2004

Approved by: _____Signature on File__________ Date: _____________
John Pietz, PE
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List of Acronyms and Abbreviations

%	percent
AHA	activity hazard analysis
AR/COC	Analysis Request/Chain of Custody
ARAR	Applicable, Relevant and Appropriate Requirements
Army	U.S. Department of the Army
BACT	Best Available Control Technology
BCT	Base Realignment and Closure (BRAC) Cleanup Team
BRAC	Base Realignment and Closure
bgs	below ground surface
CDQMP	Chemical Data Quality Management Plan
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
CT	Carbon tetrachloride
CTAC	carcinogenic air contaminants
CTP	Carbon tetrachloride plume
DQO	data quality objective (s)
EPA	Environmental Protection Agency
ft	feet
GAC	granular activated carbon
HDPE	high-density polyethylene
hp	horsepower
HS	Health and Safety
in	inch
ins.Hg	inches.mercury
IT	IT Corporation
KW	kilowatt
lb	pound
lbs/day	pounds per day
LFG	landfill gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
NOx	nitric oxide
NPL	National Priority List
O&M	operation and maintenance
OU	Operable Unit
OU2	Operable Unit 2
PCE	Perchloroethylene
PCQCP	Program Contractor Quality Control Plan
PEL	permissible exposure limit
PG&E	Pacific Gas and Electric
ppbv	parts per billion by volume
PQL	practical quantitation limits

List of Acronyms and Abbreviations (continued)

PVC	Polyvinyl Chloride
QC	quality control
RI/FS	Remedial Investigation/Feasibility Study
ROI	radius-of-influence
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SQP/SOP	Standard Quality Procedures/Standard Operating Procedures
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVE	Soil Vapor Extraction
TAC	toxic air contaminant
TAT	turn-around-time
TCE	trichloroethene
TERC	Total Environmental Restoration Contract
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound
w.c.	water column

1.0 Introduction

This work plan describes the design and installation of a pilot soil vapor extraction and treatment system (pilot SVE system) to remediate vadose zone soils in a suspected source area for the Operable Unit Carbon Tetrachloride Plume (OU CTP) at former Fort Ord, Marina, California. This work plan was prepared for the U.S. Department of the Army (Army) by Shaw Environmental, Inc. (Shaw, formerly IT Corporation) under the Total Environmental Restoration Contract (TERC) II No. DACW05-96-D-0011.

Analytical results from soil gas and groundwater samples collected in what is now the Preston Park housing area, in the vicinity of Lexington Court and Ready Court, suggest that a source of carbon tetrachloride (CT) may be present in the vadose zone soils in this area. The CT in the soils is suspected to be a continuing source of groundwater contamination and has the potential for vapor intrusion into nearby residential housing. As described in this work plan, the Army will install three new soil vapor extraction wells and convert two existing monitoring wells in this area to extraction wells. The extraction wells will be tied in via pipeline to a vapor treatment system installed in an unused garage at Lexington Court. The treatment system will use granulated activated carbon (GAC) to remove CT and other volatile organic compounds (VOCs) from the extracted soil vapor. Twelve new nested monitoring probes, plus three existing shallow probes, will be used to monitor system performance.

This work plan only addresses implementation of the proposed pilot SVE system. The results of the pilot SVE system will provide data for the OU CTP Remedial Investigation/ Feasibility Study (RI/FS) on the effectiveness of this remedial technology for source control of the CT groundwater plume and mitigation of potential vapor intrusion into the nearby housing area.

1.1 Site Location and History

Ford Ord is a former military installation that comprises approximately 46 square miles in northwestern Monterey County, California (Figure 1-1). Monterey Bay and the Santa Lucia Range form the western and southern boundaries of Fort Ord, respectively. The cities of Marina and Seaside are northwest and southwest of Fort Ord, respectively.

Fort Ord served as a training and staging facility for infantry troops from its opening in 1917 until its closure in 1993. In 1990, Fort Ord was placed on the U.S. Environmental Protection Agency (EPA) National Priority List (NPL), primarily due to VOCs found in groundwater beneath the Fort Ord Operable Unit 2 (OU2) Landfill.

The suspected source area for the OU CTP is located in the northern portion of former Fort Ord, generally south of the city of Marina and north of Imjin Parkway (Figure 1-1). The pilot SVE system will be conducted within the area in which the CT concentration in the soil gas exceeds 20 parts per billion by volume (ppbv) (Figure 1-2).

1.2 Summary of Previous Investigations

Appendix A provides a summary of investigations conducted to date. These investigations have defined an area of soil gas contaminated with CT. Concentrations have been found to be higher in proximity to the water table than at shallow depths. Based on these investigations it appears that soil gas may be a source for continuing groundwater contamination, and possibly a source for indoor air contamination.

1.3 Pilot Soil Vapor Extraction and Treatment System Work Plan Organization

This work plan is organized into the following sections and appendixes:

- Section 1.0 provides an introduction, location and history of OU CTP
- Section 2.0 presents the objectives and benefits of the pilot soil vapor extraction and treatment system
- Section 3.0 describes the regulatory requirements
- Section 4.0 presents the construction work plan for the extraction system
- Section 5.0 presents the construction work plan for the treatment system
- Section 6.0 describes the start-up operations
- Section 7.0 provides a Sampling and Analysis Plan (SAP)
- Section 8.0 describes safety and health requirements
- Section 9.0 discusses contractor quality control and presents the project organization
- Section 10.0 presents the list of references
- Appendix A provides a summary of previous investigations
- Appendix B presents an analysis of soil gas permeability based on tests conducted the landfill gas system at the OU2 Landfill
- Appendix C presents results of air flow modeling used to design extraction well spacing
- Appendix D provides Construction Specifications
- Appendix E provides Activity Hazard Analyses (AHA)
- Appendix F provides Vendor Submittals

All Appendices are included on a compact disk.

2.0 Pilot Soil Vapor Extraction Objectives and System Overview

This section provides the objectives for the pilot SVE system and a general description of the proposed components.

2.1 Objectives

The objectives for the pilot SVE system were developed jointly by the Army, Mactec and Shaw, following the Technical Project Planning (TPP) process developed by USACE (1998).

2.1.1 Evaluate Site Information and Data

A CT soil vapor plume has been identified and delineated using subsurface probes (see Figure 1-2 and Appendix A). The soil vapor plume is located in a residential area in the vicinity of Lexington Court and Ready Court. The soil vapor plume presents a continuing source of groundwater contamination and a potential vapor intrusion problem into the nearby housing .

The primary chemical of concern is CT. Three other VOCs have been detected in the OU CTP groundwater plume and in the soil gas in the study area: chloroform, perchloroethylene (PCE), and trichloroethylene (TCE).

2.1.2 Identify and Document Project Objectives

The Army directed U.S. Army Corps of Engineers (USACE), Mactec and Shaw to design a mitigation that will:

- Provide source control for the CT groundwater plume, and
- Alleviate the potential for vapor intrusion into the nearby housing area

It was agreed that there is currently no specific cleanup level. However, it is anticipated that a cleanup level will be determined after an evaluation of the pilot test data. Shaw will implement a pilot test that will provide data for the RI/FS. The RI/FS schedule requires approximately 3 months of test data by June 2004.

Design guidance includes:

- Existing data from the landfill gas pilot test will be used for design of the extraction well spacing
- The presumptive treatment method is GAC
- A well field will be designed to vent the soils capture area within the existing 20 ppb CT soil vapor contour, with focus on the 80 ppb contour. It was acknowledged that the existing 20 ppb contour does not "close" to the north. For present purposes it will be

assumed that the 20 ppb contour can be extrapolated to close following the trend of the 80 ppb contour. This issue will be resolved by monitoring during pilot testing.

- Piping should be buried for security
- Depth to groundwater in the general vicinity is approximately 100 feet (ft). The vadose zone thickness matches the depth to water.
- Mactec will determine if a target cleanup level for the deep soil vapor can be back-calculated based on a soil gas concentration equivalent to the groundwater cleanup level
- Mactec will determine if a target cleanup level for the shallow soil vapor can be back-calculated from the acceptable risk in the housing.

2.1.3 Identify Stakeholder Perspectives

Various stakeholders include regulators, primarily the Base Realignment and Closure (BRAC) Cleanup Team (BCT), the Army, and the public:

- Impacts to adjacent residents and property should be minimized during construction and operations, e.g. by installing the treatment system in one of the empty houses on Lexington Court. This will provide security and reduce noise.
- The Army will prepare a fact sheet and public notifications. Community relations will not be addressed further in this work plan.
- There is no proven risk to residents in the housing. Concentrations within the houses or beneath the slab have not been determined. With conservative assumptions, the risk may fall in the 10^{-5} to 10^{-6} range, requiring further evaluation. The TPP agreed that an accelerated mitigation is preferable to extended air monitoring and evaluation. (Subsequently the Army has proposed to conduct indoor monitoring at 6277 Lexington Court. This is addressed in a separate sampling and analysis SAP (Shaw 2004).
- The plan will be presented to the BCT for comment prior to preparation of the work plan. This was done at the December 2003 BCT meeting.

2.1.4 Define Probable Remedies

The mitigation will include two main remedy components, the extraction system and the treatment system.

The current proposed extraction system will consist of extraction wells distributed to vent soils within the 20 ppb CT contour. The system will be designed with existing data. Soil venting will be verified using a combination of existing and new monitoring probes at various depths.

The proposed system will use GAC. This method is efficient for removal of CT and the 3 other compounds detected in the soil vapor. The system will be installed in Lexington Court.

Effectiveness of removal will be verified with pre- and post-treatment sampling of the treatment system, and by monitoring soil vapor concentrations. Normal analytical methods will be adequate, and will be defined in the work plan.

2.1.5 Identify Executable Stages to Site Closeout

The following stages in the development of the pilot test were identified:

- Design and work plan using existing data
- Procure and install wells, probes, pipeline and equipment
- 3 month pilot test and evaluation for the RI/FS

At the end of 3 months the effectiveness of the mitigation will be evaluated. If the system is efficiently removing CT, operation will continue at the discretion of the Army until either: a) cleanup levels have been attained, or b) removal of CT is low and continued operation is not cost effective.

2.1.6 Recognize Site Constraints and Dependencies

Design of the pilot test must take into account the existing housing and potential impacts to residents.

Permits are not required for the pilot test. Discharge will be designed to be in compliance with Monterey Bay Unified Air Pollution Control District (MBUAPCD) Regulation II (New Sources) and Regulation X (Toxic Air Contaminants) - Rule 207 and Rule 1000.

2.1.7 Data gaps

It was agreed that the test can be designed with existing data. Existing soil vapor concentrations have been defined (Appendix A). Soil permeability can be extrapolated from previous design work for the OU2 landfill gas (LFG) system. Data gaps that will be addressed by the pilot test include:

- **Flow rate vs time.** At the present time the concentration of the CT and other VOCs in vadose zone probes is known but there is no data regarding the flow rate. In the extraction system it is expected that the flow rate will be a function of induced vacuum, and it may vary with time and location.
- **Soil gas vapor composition vs time.** At the present time the composition and concentration of the soil gas vapor are known but there is no data on how these concentrations will behave over time while the system is in operation. A rapid

decrease in soil vapor concentrations to near zero in all extraction wells and monitoring probes may indicate that a vadose zone source for CT is not present.

- **Radius of influence (ROI) of extraction wells.** The ROI of extraction wells may be estimated but various assumptions are involved in the calculation including the permeability and homogeneity of the soil. Flow to the wells may be influenced by the presence of silty strata.

2.1.8 Define Courses of Action for Achieving Site Closeout

The TPP Team directed Shaw to develop this work plan and implement the pilot SVE system after review and approval.

2.2 General Description

The pilot SVE system will consist of vertical extraction wells, monitoring probes, and a vapor treatment system installed in the vicinity of Lexington Court and Ready Court, the suspected source area for the CT groundwater plume. The pilot SVE system will reduce the migration of VOCs from the vadose zone into the groundwater and reduce the potential for soil vapor intrusion into nearby housing areas. The pilot SVE system will be operated for three months to provide data on the effectiveness of this remedial technology for the OU CTP RI/FS. At the end of three months of system operation, the performance of the pilot SVE system will be evaluated. If this evaluation shows that the system is effectively removing VOCs from the vadose zone soils, operation will continue at the direction of the Army until either: a) cleanup levels have been attained, or b) removal of VOCs from the soils is low and continued operation of the system is not cost effective.

2.2.1 Extraction Wells

Shaw will convert two existing monitoring wells, MW-BW-62-A and MW-BW-63-A, to soil vapor extraction wells and will install three additional extraction wells in the vicinity of Lexington Court and Ready Court. The new extraction wells will be constructed similar to the existing monitoring wells and will be screened approximately over the lower 30 feet (ft) of the vadose zone. Based on estimates of the air permeability of soils from pilot tests of the OU2 LFG System (Appendix B) and three-dimensional airflow modeling of the pilot SVE system (Appendix C), the spacing between extraction wells in the pilot SVE system is set at approximately 300 ft. Figure 2-1 shows that the combined expected ROI of the five extraction wells will vent the soils within the 20 ppbv contour.

2.2.2 Monitoring Probes

Twelve nested soil vapor probes will be installed to monitor the performance of the pilot SVE system (Figure 2-2). The nested monitoring probes will consist of three probes installed at approximate depths of 85, 60, and 30 ft below ground surface (bgs). The probes will be equipped to allow for the collection of induced vacuum measurements and soil vapor samples during operation of the pilot SVE system. Three existing shallow (6-ft) probes will also be monitored during system operation.

In addition, two shallow probes are to be installed in connection with indoor ambient air sampling (Shaw, 2004). One probe will be installed through the slab of the building at 6277 Lexington Court and the other outside the building to a depth of 6 ft. These probes will be monitored as part of the pilot test.

2.2.3 Treatment System

The wells will be tied in via pipeline to a soil vapor treatment system installed in a garage in Lexington Court (Figure 2-3) .The treatment system will consist of a 20-horsepower (hp) vacuum blower, and two 2,000-pound (lb) vessels of GAC connected in series. The blower will provide the suction for removal of the soil vapor and the pressure for treatment of the recovered soil vapors by the downstream GAC adsorption vessels.

Treatment using GAC is a standard industry treatment for VOC vapor control. The GAC chemically traps VOCs, removing them from the vapor stream. The GAC has a finite capacity for VOCs. However, based on the expected low CT concentrations in the influent it is likely that GAC replacement will not be required during the period of the pilot test (Section 6.3). If GAC replacement is required, the spent GAC will be sent offsite for disposal or thermal regeneration. Two GAC vessels in series will be used to provide a measure of redundancy for vapor treatment.

The blower and control panels will be housed in a garage located on Lexington Court. The GAC vessels will be placed outside the garage. Adequate soundproofing and weatherproofing will be installed in the garage to minimize noise and allow for safe operation of the process equipment. Power for treatment system operation will be provided initially by a diesel generator. A service connection to Pacific Gas and Electric (PG&E) power will be added later if feasible. A fence will be installed to provide security.

2.3 Benefits of the Pilot SVE System

Installation and operation of the pilot SVE system will have the following benefits:

1. The pilot extraction and treatment system will provide data on the effectiveness of soil vapor extraction technology for removing CT and other VOCs from vadose zone soils that can be used in the evaluation of alternative remedial technologies during preparation of the OU CTP RI/FS.

2. Soil vapor extraction removes CT and other VOCs that otherwise may be transported to the groundwater. Soil vapor extraction may shorten future groundwater treatment and reduce groundwater treatment costs.

3. Soil vapor extraction removes CT and other VOCs that otherwise may escape to the atmosphere and impact ambient air quality or result in vapor intrusion into nearby residential housing.

4. If soil vapor extraction is effective in removing CT and other VOCs from the vadose zone soils, the pilot system may be adequate to remediate the entire suspected source area for the OU CTP.

3.0 Regulatory Requirements

This section presents the applicable regulatory requirements for the discharge of organic compounds to the atmosphere by the treatment system, and the installation of the extraction wells and monitoring probes.

Based on our review of the applicable or relevant and appropriate requirements (ARARs) for the soil vapor treatment system, no permitting will be required because this system is a component of a pilot test system. However, discharge of organic compounds by the treatment system will be designed to be in compliance with the following air quality standards of the Monterey Bay Unified Air Pollution Control District (MBUAPCD):

- MBUAPCD Regulation II (New Sources) – Rule 207
- MBUAPCD Regulation X (Toxic Air Contaminants) – Rule 1000.

Installation of the soil vapor extraction wells and monitoring probes will be subject to the well permitting requirements of the Monterey County Health Department, Division of Environmental Health, Hazardous Materials.

3.1 Monterey Bay Unified Air Pollution Control District Regulations

MBUAPCD Regulation II (New Sources) and Regulation X (Toxic Air Contaminants) - Rule 207 and Rule 1000

3.1.1 Regulation II, Rule 207

The MBUAPCD regulates New Sources under the permitting requirements described in Regulation II, Rule 207. Under Rule 207, Best Available Control Technology (BACT) shall be required for any new or modified permit unit with a potential to emit 25 pounds per day (lbs/day) or more of VOCs or nitric oxide (Nox). In no event shall the application of BACT result in the emissions of any pollutant which exceed the emissions allowed by any applicable standard in 40 Code of Federal Regulations (CFR) Part 60 (New Source Performance Standards), or in 40 CFR Part 61 (National Emission Standards for Hazardous Air Pollutants), or in 40 CFR Part 63 (National Emission Standards for Hazardous Air Pollutants for Source Categories).

Based on the contours shown in Figure 1-2, the CT concentrations at the 5 proposed extraction well locations range from approximately 65 to 300 ppbv, with an average of approximately 160 ppbv. With this average concentration the daily emissions of CT without treatment would be approximately 0.09 lbs. This is a conservative estimate of actual emissions for a number of reasons: 1) the 140 ppbv average is based on concentrations at greater than 66 ft depth which are higher than concentrations at shallower depths; 2) concentrations of CT in the influent are expected to decline significantly as the system is operated; 3) GAC treatment will be installed.

The concentrations of the other compounds found in the soil gas are lower than those of CT. For the expected influent CT concentration of 160 ppbv, the equivalent expected concentrations are chloroform 10 ppbv, PCE 5 ppbv, and TCE 8 ppbv.

The controlled emissions for the pilot SVE system are expected to be far below the allowable maximum.

3.1.2 Regulation X, Rule 1000

The soil vapor treatment system has the potential to emit very low levels of carcinogenic air contaminants (CTAC), or toxic air contaminants (TAC) so it will be designed to meet MBUAPCD Rule 1000, Permit Guidelines and Requirements for Sources Emitting Toxic Air Contaminants. Under MBUAPCD Rule 1000, the emission limits are health-based and are expressed in terms of allowable increased risks of no more than 1 in 100,000 (or 1 x 10^{-5}).. To demonstrate that the treatment system emissions are in substantial compliance with this rule the following items must be completed:

- Reasonable Control Technology must be installed to control emissions of TAC's.
- BCT must be installed to control emissions of CTAC's.
- Emissions of any TAC or CTAC may not exceed 1/420th of the permissible exposure limit (PEL) at the property line.
- A risk assessment must be completed to demonstrate that the emissions from the system will not cause a net increased cancer risk in excess of one incidence per 100,000 population.

The PEL for CT is 2,000 ppbv and 1/420th of the PEL is 4.76 ppbv. As described above, it is expected that the concentration in the influent to the treatment system will be less than 140 ppbv at the beginning of the test, and will decline thereafter. Also, the expected removal efficiency for one vessel of GAC is at least 95 percent (%). This means that the concentration after one vessel should be approximately 7 ppbv, and after two vessels in series approximately 0.35 ppbv. Based on this analysis, the CT concentration after one vessel will only slightly exceed 1/420th of the PEL, and the concentration after two vessels will be approximately 7% of 1/420th of the PEL. Because of dispersion, concentrations at the property line or any potential receptor would be much less.

The other VOCs present in the influent to the treatment system are expected to be present at lower concentrations then the CT at the beginning of the test, and as with CT, the concentrations will decline thereafter. The following table shows the expected initial influent concentration and the corresponding 1/420th of the PEL:

	Expected influent concentration (ppbv)	PEL (ppbv)	1/420th PEL (ppbv)
Chloroform	10	2000	4.8
PCE	5	25,000	59.5
TCE	8	25,000	59.5

This indicates that the concentrations of PCE and TCE will be below 1/420th PEL even without treatment, while the concentrations of chloroform without treatment will be only two times the 1/420th PEL value. It is concluded that the concentrations after treatment will be significantly less than the 1/420th PEL values. This will be confirmed by monitoring during system operations.

3.2 Monterey County Health Department, Division of Environmental Health, Hazardous Materials-Well Drilling Permits

The new soil vapor extraction wells and monitoring probes are designed to intercept CT and other VOC migration to the groundwater table. Permits will be obtained from the Monterey County Health Department, Division of Environmental Health, Hazardous Materials Branch prior to the start of construction activities. One application will be submitted for each extraction and monitoring probe location.

4.0 Construction Work Plan, Soil Vapor Extraction System

Construction of the pilot soil vapor extraction system will include the conversion of two existing monitoring wells in the vicinity of Lexington Court and Ready Court to soil vapor extraction wells, the installation of three new extraction wells and 12 nested monitoring probes, and the installation of a buried collection header system for the extracted soil vapor. The construction requirements for the extraction system are summarized below.

4.1 Soil Vapor Extraction Wells and Monitoring Probes

4.1.1 Extraction Wells

Two existing monitoring wells will be converted to soil vapor extraction wells and three new extraction wells will be installed for the pilot soil vapor extraction system. These wells will be located so that the extraction well system will effectively vent the portion of the suspected source area where CT concentrations in soil gas are greater than 20 ppbv.

Figure 2-3 shows the site layout, the location of the extraction wells, and the collection header system layout. The construction details for the extraction wells, wellheads, and vaults are shown in Figure 4-1.

4.1.1.1 Conversion of Existing Monitoring Wells

Two existing monitoring wells, MW-BW-62-A and MW-BW-63-A, will be converted to soil vapor extraction wells. These wells were installed with two screens, the first from approximate depths of 58 to 88 ft bgs for soil vapor monitoring, and the second from 98 to 128 ft bgs for groundwater monitoring. The water table occurs between the lower and upper screens at a depth of approximately 100 ft, and will effectively seal off the lower screen. As a result, no subsurface modifications are required to convert the monitoring well to a soil vapor extraction well. After the SVE is completed the well will remain in place for groundwater monitoring.

A CES-Landtec Accu-flo™ wellhead will be installed at each well in a protective concrete vault. To minimize air infiltration through the ground surface, a plastic sheet will be placed on the surface around the well, below each protective vault.

4.1.1.2 Installation of New Extraction Wells

Three new soil vapor extraction wells will be installed at the locations shown in Figure 2-3. Locations were chosen to provide capture within the 20-ppbv CT contour, with minor adjustments for field conditions such as trees and utilities. The extraction wells will be constructed with 4-in. diameter Schedule 40 Polyvinyl Chloride (PVC) casing and screen. Each extraction well will be constructed to approximately 90 ft bgs, with the bottom 30 ft constructed with a 0.125 (1/8 inch [in.])-slotted Schedule 40 PVC well screen. The annulus surrounding the well screen will be backfilled with 3/8-in. crushed or natural washed pea gravel per Specification Section 02521 (Appendix D). A CES-Landtec Accu-flo™ wellhead will be installed at each well in a protective concrete vault. To minimize air infiltration through the ground surface, a plastic sheet will be placed on the surface around each well, below the protective vault.

The construction and installation details for the extraction wells, wellheads, and vaults are shown in Figure 4-1.

4.1.1.3 Extraction Well Vaults

Extraction wells will be completed below grade, enclosed in 2-ft by 2-ft by 2-ft concrete vaults with locking aluminum covers. Construction details for the vaults are presented in Figure 4-1. The extraction wells will be connected to the collection header laterals with a CES-Landtec Accu-flo™ wellhead.

4.1.2 Monitoring Probes

Twelve nested soil vapor probes will be installed to monitor the performance of the pilot soil vapor extraction and treatment system. The nested monitoring probes will consist of three probes installed at approximate depths of 85, 60, and 30 ft bgs. The monitoring probes will be constructed with ¾-in. diameter Schedule 40 PVC casing and screen. The bottom 5 ft of each probe will be constructed with a 0.125 (1/8 in.)-slotted Schedule 40 PVC well screen. The annulus surrounding the well screens will be backfilled with 3/8-in. crushed or natural washed pea gravel per Specification Section 02521 (Appendix D). The probes will be equipped with sampling port assemblies to allow for the collection of induced vacuum measurements and soil vapor samples during system operation. A 12-in diameter stovepipe or flush-mount protective cover will be installed on each nested monitoring probe.

Figure 2-2 shows the location of the monitoring probes. The construction and installation details for the monitoring probes are shown in Figure 4-2.

4.1.3 Extraction Well and Monitoring Probe Permits

Permits for the extraction wells and monitoring probes will be obtained from the Monterey County Health Department, Division of Environmental Health, Hazardous Materials Branch prior to the start of construction. One application will be submitted for each extraction well and monitoring probe location.

4.1.4 Drilling Equipment Decontamination

Tools and equipment used during drilling operations will be pressure washed using hot water prior to initial use, between boreholes, and before departing the project site.

Well materials, exclusive of sand pack, bentonite, and grout shall be decontaminated before placement in the borehole as described above. Following decontamination, all materials shall be placed on clean metal racks or clean plastic sheeting. If materials are not used immediately, they shall be wrapped or covered with clean plastic sheeting.

4.2 Collection Header System

4.2.1 Collection Pipes and Valves

The soil vapor extraction wells will be connected to a common 6-in. diameter high-density polyethylene (HDPE) SDR 17 header pipe. Lateral connections will be constructed of 4-in. diameter HDPE SDR 17 pipe (Figure 2-3). The header and laterals will be installed below grade. The piping runs and invert elevations will be engineered in the field to ensure proper drainage of condensate into the extraction wells.

Control valves will be installed at each extraction well connection. A butterfly valve will be installed in the main header before the blower.

The header pipe and laterals will be pressure tested to 5 pounds per square inch for 20 minutes. If there is a pressure drop, the leak will be isolated and repaired. Then the line(s) will be re-tested until all of the lines pass the pressure testing. The pressure testing will be conducted in accordance with the manufacturer's recommendations and procedures.

Piping will be single wall and not double-contained. Double-contained pipe is not considered necessary because the piping will contain only small amounts of condensed soil vapor moisture (water) under vacuum, rather than pressure. Also, the SVE will be installed above the footprint of the existing impacted groundwater plume. Also, the specified HDPE pipe is strong and durable and will be pressure tested for leakage before long-term operation.

4.2.2 Condensate Management

The piping layout will be designed so that most condensate in the piping system will drain back to the wells. In addition, a condensate sump consisting of a cleanout riser will be installed near the location where the header pipe enters the treatment building. This location is expected to be a local low in the pipe run elevation that will be prone to condensate accumulation. This sump will be pumped out manually as necessary. The volume of condensate is expected to be small because of the high vapor flow rate and installation of the piping below grade, where it will be insulated from potentially colder surface temperatures. If higher than expected volumes of condensate are realized and removal of the higher volume of condensate becomes labor-intensive, the system can be modified with a larger subgrade condensate sump equipped with automatic pump-out controls.

4.3 Environmental Protection

Environmental impacts associated with drilling and construction activities will be mitigated as described in the following sections.

4.3.1 Habitat Protection

Site preparation will include brush clearance and tree trimming in the work areas.

Vegetation clearance will be conducted in a manner to protect the existing oak trees. Tree branches may be trimmed as necessary to provide access, but no trees will be removed. Brush will be cut to a height approximately 6 ins. above the ground, where necessary for access. Where feasible, a mechanical device mounted on a backhoe will be used. Manual tools such as brush hogs and trimmers will be used in tight areas, such as between the trees. Brush will be excavated only where necessary for pipeline installation. Vegetation removed from work areas will be taken to Marina Landfill.

4.3.2 Dust Control

It is not anticipated that significant dust will be generated. Water trucks will be used to spray water in active construction areas, if noticeable dust is generated. If required, due to high winds, additional engineering measures will be implemented to control dust during drilling and construction activities.

4.3.3 Erosion Control

Mitigation measures to minimize disturbance of the vegetative cover and sensitive habitat were described in Section 4.3.1. Erosion damage is not expected because of the low relief and small amount of ground disturbance. If required, erosion control measures such as berms and silt fencing will be used to prevent erosion damage if inclement weather is forecast.

4.3.4 Security

The treatment facility will be protected with a security fence as described in Section 5.3. Temporary excavations and drill sites will be protected as necessary with temporary fencing and security patrols.

4.4 Construction Derived Waste

Wastes will be kept separate by type (i.e. soil cuttings will not be mixed with wastewater). Soil cuttings will be collected and tested to determine disposal requirements. Water generated during pressure washing will be contained and transported to the OU2 groundwater treatment plant. Other wastes (e.g. cement bags) will be disposed of as regular waste.

4.5 Demobilization

After completion of the pilot test all pipelines, valves, condensate tanks, and well vaults will be removed. These locations will be restored as near as possible to original surface conditions. The extraction wells and monitoring probes will be left in place for inclusion in a future well abandonment program.

5.0 Construction Work Plan, Soil Vapor Treatment System

This section presents the construction and electrical requirements for installation of the soil vapor treatment system. The treatment system will consist of a vacuum blower, and two GAC adsorption vessels. The blower will be installed in the garage at 6277 Lexington Court and the GAC vessels will be placed outdoors adjacent to the garage. The piping and instrumentation are shown in Figure 5-1.

A security fence and an outdoor light will be installed around the driveway to limit access to the treatment system.

5.1 Installation of the Blower and GAC Vessels

The garage will require minor modifications for the installation of the electrical service (including use of the temporary generator), installation of the blower, connection to the GAC vessels, and sound proofing.

The intake piping will be installed subgrade to the side of the garage, where a 6-in. riser and elbow will be installed to allow penetration of the building. Prior to the riser, a 6-inch tee will be installed in the line that will serve as a condensate sump and cleanout for any condensed moisture. The 6-in. header will be installed through a penetration in the side of the garage. Prior to connection to the blower, an adequate straight section of pipe will be installed to enable measurement of the airflow velocity using a pitot tube. Permanent penetrations will be installed in this straight section of pipe for pitot tube insertion.

The 20-hp regenerative-type 480-volt three phase vacuum blower will be installed in the garage, where it will be lagged to the floor. The blower will be equipped with thermal protection. A blower control panel consisting of a disconnect with adequate fusing for three-phase power, blower start and shutdown button, and a blower starter will be installed on an adjacent wall. As shown in Figure 5-1, a pressure switch and a temperature switch will be installed immediately downstream of the blower. In the event of a high temperature or pressure conditions, these switches will cause blower shutdown by interrupting power at the blower starter within the control panel.

Connection from the blower to the GAC vessels will consist of a flexible metal hose that penetrates the garage wall. This type of hose will also be used for the interconnection of the two GAC vessels. The use of flexible metal hose will allow the order of the GAC vessels to be changed without physically moving the vessels.

The GAC vessels will be placed alongside the garage driveway. A vapor sampling port will be installed between the vessels. The last vessel will be equipped with a five-foot long PVC stack fitted to the top flange. This stack will have a rain guard. Access gates will be installed to facilitate GAC change out.

Other modifications to the garage include installation of sheetrock to meet fire code requirements. As necessary, the existing vents will be modified to improve ventilation. Insulation and/or baffles will be added to reduce noise outside the building.

5.2 Electrical Installation

The total electrical load of the treatment system will be approximately 20 hp. Initially, a 35-kilowatt (KW) portable diesel generator will provide electrical power. A grounding rod will be installed adjacent to the generator.

Electrical cables will be used to convey power from the diesel generator to the treatment system components in the building interior. These cables will be placed in an above-grade metal conduit to protect the cables against damage. The cables will penetrate into the building either through a penetration in the wall or the garage door. In either case, a metal conduit will be placed within the penetration to guard against cable abrasion.

Inside the garage, the power will be connected to appropriate fusing and the disconnect switch. Grounding lugs on the disconnect and on the motor will be connected back to the generator ground, which in turn will be grounded through a grounding rod.

Shaw has requested a permanent power connection from PG&E. This will require running conduit to a transformer located approximately 550 ft west of the treatment location (Figure 2-3). It is not expected that this power source will be available at the beginning of pilot SVE system operations.

5.3 Fencing

The GAC vessels and generator and diesel tank will be enclosed by a security fence. The fence will be 8-ft tall chain link topped with 3 strands of barbed wire. Green slats will be added for privacy screening. Two 12-ft swing gates will be included.

5.4 Demobilization

After completion of the pilot test, equipment and fencing will be removed. These locations will be restored as near as possible to original conditions. Holes to garage walls will be repaired. All other modifications to the garage will be left in place.

6.0 Treatment System Operations and Maintenance

This section presents the procedures and requirements for the initial shakedown, start-up and monitoring of the treatment system, as well as normal operations and maintenance.

The primary objectives for the shakedown and start-up operations are to:

- Balance airflow and applied vacuum between the extraction wells
- Measure the influent and effluent VOC concentrations
- Measure the induced vacuum in the network of subsurface monitoring probes
- Prove the blower and other systems for unattended operation
- Prove the effectiveness of the treatment system.

The primary goal of normal operation is to ensure that operation and maintenance is optimized so that the design basis objectives of the pilot test are met.

The above tasks are described in further detail in the following sections.

6.1 Shakedown and Start-up Operations and Maintenance

Initial shakedown of the treatment system includes inspection by the design engineer and site-operator training. Specific tasks include:

- Test generator and power to blower, including blower rotation direction
- Test blower disconnect
- Confirm the applied vacuum and flow are present at extraction wells
- Test and assure correct operation of other controls and systems
- Train site operator in basic operations and troubleshooting.

6.1.1 Equipment Inspection

During the start-up phase, after initial shakedown, the site operator will visually inspect the treatment facility equipment and piping daily. The following items will be inspected each day, for the first five days of operation:

- Generator operation and diesel fuel tank level
- In-line sumps at pipe run low-points
- Blower inlet and discharge piping instrumentation
  - Inlet vacuum

- Inlet gas temperature
- Discharge pressure
- Discharge gas temperature

The site operator will note and immediately schedule repair and maintenance items.

6.1.2 Monitoring

Start-up monitoring activities consist of monitoring and sampling of the soil vapor extraction wells and monitoring probes, and treatment system influent and effluent streams. To achieve the start-up objectives, the following will be performed daily during the first five days of operation of the treatment system:

- Measure flow rate and applied vacuum at each extraction well per the monitoring schedule (Table 6-1).
- Measure induced vacuum at all of the monitoring probes per the monitoring schedule (Table 6-1).
- Measure flow rate to the GAC vessels twice per day for the first two days and daily for the next three days per the monitoring schedule (Table 6-1).
- Measure VOC concentrations in the influent and effluent streams on a 24-hour laboratory turn-around-time (TAT) on days 1 and 3 and standard TAT on days 2, 4 and 5per the sampling schedule (Table 6-2).
- Baseline monitoring of VOCs concentrations in the extraction wells and monitoring probes prior to system operation, as described in the SAP (Section 7.0).

6.2 Normal Operation Operations and Maintenance

Normal operations are defined as operations of the treatment system after the initial five-day shakedown and start-up period. At a minimum the system will be inspected weekly. Prior to connection to the local PG&E, more frequent system inspection may be required to top off the generator.

6.2.1 Equipment Maintenance

Equipment maintenance activities consist of:

- Maintain generator operation according to the manufacturer requirements and maintaining appropriate fuel tank level;
- Monitor in-line sumps and empty, if necessary;
- Monitor blower inlet and discharge piping instrumentation
  - Inlet vacuum

– Inlet gas temperature
– Discharge pressure
– Discharge gas temperature

- Monitor influent and effluent stream VOC concentrations to determine the effectiveness of emissions control in meeting regulatory requirements;
- Monitor applied vacuum and vapor flow rates in the extraction wells and adjustment of flow rate, if necessary;
- Monitor the induced vacuum and VOC concentrations at the subsurface monitoring points.

6.3 Monitoring

The performance of the system will be monitored using a combination of field instruments and laboratory analysis. Field instruments will be used to measure flow rate, applied and induced vacuum. As described in the SAP (Section 7.0), samples will be sent to an analytical laboratory to measure the concentration of CT and other VOCs.

Monitoring for flow rate and vacuum will be performed per the schedule outlined in Table 6-1. Monitoring for the concentration of CT and other VOCs will be performed per the schedule outlined in Table 6-2. These schedules may be modified by field work variance depending on observed data.

System performance will be gauged by the results of sampling and monitoring of extraction wells, monitoring probes, and treatment system influent, mid and effluent streams.

6.3.1 Instrumentation

A GEM-500™ will be used measure applied vacuum from 0.1 to 100 ins. water column (w.c.), and flow rate (scfm). The GEM-500™ can measure vacuum at a resolution of 0.1 ins. wc. This instrument has integrated microprocessors that will calculate the flow rate after the required parameters are programmed in; they store about 200 readings, which can be downloaded into a computer. A second port in the GEM-500™ will measure a velocity head (differential pressure) across a flow-measuring device (orifice).

A Dwyer series 475 Mark III (model 475-1-FM) digital manometer will be used to measure induced vacuum from 0.01 to 19.99 ins. w.c. This manometer has a resolution of 0.01 ins. w.c. The operator shall read the manufacturer supplied operation manual prior to use, and perform all required instrument calibrations according to the manufacturer's specifications.

A digital barometer will be used to measure atmospheric pressure concurrently with the induced vacuum measurements. The operator shall read the manufacturer supplied operation manual prior to use, and perform all required instrument calibrations according to the manufacturer's specifications.

The principles of operation, operating procedures, calibration procedures, and preventative maintenance of these instruments must be thoroughly understood in order to perform accurate monitoring. The operator must also understand the operating limitations of the instruments.

6.4 GAC Changeouts

As described in Section 3.1, it is expected that the concentration in the influent to the treatment system will be less than 140 ppbv at the beginning of the test, and will decline thereafter. Also, the expected removal efficiency for one vessel of GAC is at least 95%. This means that the concentration should not exceed 7 ppbv after one vessel, and should not exceed 0.35 ppbv after two vessels in series.

For purposes of monitoring and developing decision rules relating to GAC changeout (Section 7.2.5), breakthrough will be defined as the detection of CT exceeding 7 ppbv in a sample collected midstream between the two GAC vessels, or a CT concentration exceeding 4.76 ppbv (1/420th of the PEL as explained in Section 3.1.2) in the effluent sample collected downstream of the second vessel. In the event of breakthrough of the first vessel, the system will be shut down, the first vessel changed and the order of operation of the vessels rotated so that the second vessel becomes the lead vessel. The use of flexible hoses between the vessels will enable this operation. In the event of breakthrough of the second vessel, the system will be shut down, and both GAC vessels will be replaced. A qualified GAC vendor equipped with a vacuum truck will change the GAC vessels. Vapor-phase, virgin GAC will be used for the vessels.

The expected life of one 2,000-pound GAC vessel before significant breakthrough occurs is approximately 600 days for an influent CT concentration of 160 ppbv. Therefore, breakthrough is not expected during the course of the pilot test. Two sets of samples will be obtained on a rapid turnaround during the first week of the test (6.1.3) to provide data to verify assumptions. Thereafter, sampling of the GAC system will be performed on normal turnaround.

The other VOCs present in the influent to the treatment system are expected to be present at lower concentrations then the CT at the beginning of the test, and as with CT concentrations will decline thereafter. Based on expected influent concentrations it is not expected that any of these compounds will breakthrough before CT.

6.5 Notifications

The Army shall notify the MBUAPCD at least 24 hours prior to start-up of the pilot SVE system.

7.0 Sampling and Analysis Plan

This SAP describes the sampling and analytical methods that will be performed associated with the pilot test. Sampling will be conducted to measure the concentration of selected VOCs in the following locations:

- Extraction wells
- Monitoring probes
- Soil vapor treatment system.

All sampling will be performed following the guidance of the *Standard Quality Procedures/Standard Operating Procedures Manual, Former Fort Ord, California* (SQP/SOP) (IT, 2002), and the *Chemical Data Quality Management Plan, Former Fort Ord, California, Revision 0* (CDQMP) (IT, 2001).

This SAP establishes the data quality objectives (DQOs), sampling design, analytical methods, and sampling procedures that will be used in collecting data. Consideration is given to both laboratory analytical and field monitoring requirements and methods.

7.1 Background

Background information and general objectives for the pilot SVE system were provided in Sections 1.0 and 2.0 of this work plan. Additional background soil gas data are provided in Appendix A.

This SAP is intended to outline the sampling and analysis that will occur to measure VOC concentrations in the extraction wells, monitoring probes, and soil vapor extraction system. The chemicals of concern are four VOCs that have been detected in the soil gas and the underlying groundwater plume:

- Carbon Tetrachloride
- Chloroform
- Trichloroethene
- Tetrachloroethene.

7.2 Data Quality Objectives

Data generated from the sampling and analysis activities for this project will be verified against established DQOs to determine if the data are of sufficient quality to be used in meeting the primary end-use requirements. The DQO process is designed to provide a means to determine what type of data need to be collected, as well as to ensure that the data collected are scientifically sound, defensible, and of known, acceptable documented quality. The DQO process is established in accordance with the procedures outlined in the Guidance for Planning for Data Collection in Support of Environmental Decision Making using Data Quality Objectives Process (EPA, 1994).

The DQO process consists of the seven steps outlined below:

- State the problem
- Identify the decisions
- Identify inputs to decisions
- Define the study boundaries
- Develop decision rules
- Specify tolerable limits on decision errors
- Optimize investigation design for obtaining data.

7.2.1 State the problem

Define the problem so the focus of the study will be unambiguous

Volatile organic compounds (primarily CT) exist in a shallow soil gas plume. These are suspected to be a continuing source of groundwater contamination and present a potential vapor intrusion problem into the nearby housing. A pilot SVE system will be installed to extract the VOCs that are present and thus reduce and remove the source of contamination. Sampling and analysis for VOCs and other field measurements are required in order to optimize the performance and monitor the effectiveness of the pilot SVE system.

Identify members of the planning team and the primary decision-maker

The planning team will consist of project and technical staff from Shaw, Mactec and USACE. Initial technical decisions will be made by the project engineer/manager, and will be submitted to the USACE technical team leader for approval.

Specify available resources and relevant deadlines for the study.

Shaw will conduct the work with technical oversight from USACE. The Army has directed that the mitigation should be implemented as soon as possible. An objective is to provide approximately 3 months of test data by June 2004 for inclusion in the OU CTP RI/FS.

7.2.2 Identify the Decisions

Identify the principal study question

The principal study question is:

1) Is the pilot SVE system effectively removing VOCs from the soil gas?

Additional study questions are:

2) Can the pilot SVE system be optimized to more effectively remove the VOCs from the soil gas?

3) Is VOC breakthrough occurring in the GAC system?

These questions will be addressed on a continuing basis, to determine how system performance is changing versus time.

Define the alternative actions that could result from resolution of the principal study question

The current sampling design for the pilot SVE system includes 5 extraction wells and 17 monitoring probes. Also included are 3 locations at the treatment system: 1) influent stream, 2) midstream between the two GAC vessels, and 3) effluent stream. The alternative actions that could result from the study questions outlined above are that:

1) The flow rate of each of the extraction wells may be modified based on the induced vacuum measurements or concentrations of VOCs observed in the monitoring probes. (e.g., the rate of extraction could be increased in wells with higher concentration of VOCs and reduced in wells with lower concentrations)

2) The concentration of VOCs measured in the influent stream to the pilot SVE system will quantify the amount that is removed from the plume. Based on this information, the frequency of system operation or the flow rate may be modified or the operation of the system may be shutdown if its operation is no longer cost effective

3) The concentration of VOCs measured in the after the lead GAC vessel will determine when breakthrough is occurring and determine that a GAC change out is necessary

4) The concentration of VOCs measured in the effluent stream will determine the ability to achieve the requirements set forth in MBUAPCD Rule 1000.

7.2.3 Identify Inputs to Decisions

Identify the information that will be required to resolve the decision statement

The following information will be required in order to resolve the decision statements:

- Flow rates from extraction wells as a function of applied vacuum;
- Applied vacuum in the extraction wells;
- Induced vacuum in the monitoring probes;

- VOC concentrations of the gas taken from the monitoring and extraction wells, influent, mid, and effluent streams of the treatment system;

Determine the sources for each item of information identified

A field portable landfill gas (LFG) analyzer (CES-Landtec GEM-500™) will be used to measure flow rate and applied vacuum in the extraction wells. Lower induced vacuums (e.g., at the monitoring probes) will be measured with a digital manometer with a resolution of 0.01 ins. wc.

Volatile organic compounds will be measured in the soil gas samples by a fixed-based analytical laboratory using *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)* (EPA, 1999).

7.2.4 Define Study Boundaries

Define the spatial and temporal boundaries that are covered by the decision statement

The Technical Planning process (Section 2.1) determined that the boundary of the pilot test would be the 20 ppbv CT contour in soil gas (Figure 1-2).

The Army has directed that the mitigation should be implemented as soon as possible. An objective is to provide approximately 3 months of test data by June 2004 for inclusion in the OU CTP RI/FS.

Determine the timeframe to which the decision applies.

A majority of the decisions will be made in the early phases of operation of the pilot SVE system; monitoring frequency will be reduced as the system is optimized for performance efficiency. The initial phase of operation is for 3 months. At the end of the three months of system operation, the performance of the pilot SVE system will be evaluated. If this evaluation shows that the system is effectively removing VOCs, an optional 6-month operation period may continue at the direction of the Army until either: a) cleanup levels have been attained, or b) removal of VOCs from the soils is low and continued operation of the system is not cost effective.

7.2.5 Develop Decision Rules

The planning team has not identified a complete set of quantitative decision rules for the pilot test. In consultation with USACE and Mactec, Shaw will evaluate the test data as the pilot test is conducted. The following decision rules will be applied:

- During the initial 3-month pilot test, operating parameters may be adjusted to optimize performance at the discretion of the Project Engineer.
- At the completion of 3 months, or at any subsequent evaluation, the test may be concluded if two or more of the following apply:
  - Concentrations of VOCs in the vadose zone are lower than a target cleanup level for the shallow soil vapor back-calculated from the acceptable risk in the housing;
  - Concentrations of VOCs in the vadose zone are lower than a target cleanup level for the deep soil vapor back-calculated based on a soil gas concentration equivalent to the groundwater cleanup level; and
  - Concentrations of VOCs in the influent stream have declined to an asymptotic level such that it is not cost-effective to continue operation
- The two GAC vessels will be reversed based upon an evaluation of the results of the midstream sample
- The two GAC vessels will be replaced based upon a review of the effluent sample results

7.2.6 Specify Tolerable Limits on Decision Errors

Identify sources of errors and biases that could affect the decision

Decisions could be adversely affected by errors in field or laboratory measurements, or if the flow rate, vacuum, and VOC concentrations that are measured during operation are not representative.

Describe ways to minimize biases and errors

Potential biases and errors may result from field instrument measurements, and fixed-based laboratory analyses. The following types of decision errors are possible:

- Accepting field measurements for determining the appropriate conditions for pilot SVE system optimization when the measurements are higher then they truly are; and
- Accepting field measurements for determining the appropriate conditions for pilot SVE system optimization when the measurements are lower then they truly are.
- Accepting fixed-based laboratory results for determining the appropriate conditions for pilot SVE system optimization when the results are higher then they truly are; and

- Accepting fixed-based laboratory results for determining the appropriate conditions for pilot SVE system optimization when the results are lower then they truly are.
- Performing a GAC change out before it is needed because the fixed-based laboratory results are higher then they truly are.
- Not performing a GAC change out when it is needed because the fixed-based laboratory results are lower then they truly.
- Determining that the source of contamination for the CTP has not been removed because the fixed-based results are higher then they truly are.
- Determining that the source of contamination for the CTP has been removed because the fixed-based results are lower then they truly.

Errors associated with field instruments will be minimized by the use of established methods and calibration according to manufacturers' instructions. Errors associated with laboratory chemical analyses may result from analytical and sample collection processes. To limit decision errors during analysis, method requirements have been established. The laboratory will perform analysis in accordance with Compendium Method TO-15 (EPA, 1999) to reduce the occurrence of false positive and negative analytical errors. In order to limit decision errors in the field, samples will be collected following the guidance of the SQP/SOP manual, CDQMP, and this SAP. Additionally, quality control (QC) samples (field duplicates) will be collected at a rate of 5% to measure potential sources of error during the sample collection.

To the extent possible, uncertainty in the test data will be factored into any decisions made with regard to pilot SVE system optimization, GAC change outs, and pilot SVE system shutdown.

7.2.7 Optimize Design for Obtaining Data

The following sections describe the optimization of design and sampling procedures for each type of measurement that will be collected for this project.

7.2.7.1 Sampling for Volatile Organic Compounds

This section presents procedures and sampling method requirements for collecting VOC samples from the extraction wells, monitoring probes, sub-slab probe, and the components associated with the pilot SVE system (influent, mid, and effluent streams). A summary of the samples that will be collected, and the frequency of collection are presented in Table 6-2. It is believed that frequency of sampling provided in Table 6-2 provides sufficient information in order to resolve the decision statements.

As explained in Section 3.1, it will be necessary to measure the concentrations of target VOCs to at or below a value 1/420th of the PEL. The practical quantitation limits (PQLs) for target VOCs are 0.5 ppbv. Table 7-1 shows that the PQLs are sufficient to quantify concentrations significantly below the 1/420th PEL value for each of the target chemicals.

Pre-sampling Activities

Prior to collection of samples that will be sent to the fixed-based analytical laboratory, the field technician should obtain the following:

1) Evacuated 6-liter passivated stainless-steel SUMMA™ canisters provided by the laboratory

2) Teflon connecting tubing and fittings, etc.

3) Vacuum gauge for measuring initial and final pressures in the canister

4) Barometer for measuring atmospheric pressure

5) Map showing the sample locations (extraction wells, monitoring probes, etc.)

6) Sample collection logs (Form 7-1), clipboard, and pen.

7) Analysis Request/Chains-of-Custody (AR/COC) (Form 7-2)

Sampling Procedure

Volatile organic compound samples will be collected using the following sampling requirements and procedures:

1) Purge monitoring probes by attaching a personal sampling pump (Gil-Air™ or equivalent) with a Tygon connecting tube to the sample port. Approximately 3 well/probe volumes of gas shall be removed prior to sampling. The pump should be operated at rate of approximately 200 milliliters/minute. If sampling is during normal operations, shut down the treatment system prior to sampling.

2) Purge extraction wells initially (prior to full system startup) by using the blower from the treatment system to remove a minimum of 3 casing volumes a predetermined period of time. During normal operations, shut down the treatment system prior to sampling.

3) Check the SUMMA™ canister using the vacuum gauge to confirm that it is negatively pressurized (vacuum should be at least 27 inches. mercury [ins. Hg]);

4) Attach the stainless steel canister using a Teflon connecting tube, and collect the sample by opening the vacuum gauge attached to the canister to allow the slow intake of sample. Continue sampling until the gauge shows a negative pressure between 2 to 5 ins. Hg.

5) Affix a label to the stainless steel canister that will be taped with clear tape and a custody seal. The stainless steel canister is stored in a box.

6) Close sampling port and cap when sampling is complete.

7) Complete sample collection logs (Form 7-1) and AR/COC (Form 7-2)

8) Sample collector will change powder-free nitrile gloves between samples.

Data Recording

The following data should be recorded in the sample collection log for each sample collected:

1) Name of person(s) collecting sample;

2) Date and time collected

3) Atmospheric pressure, and whether rising or falling

4) Weather conditions, wind and rain

5) Sample number and source location (e.g., extraction well, influent, etc.)

6) Initial and final SUMMA™ canister pressure

Sampling Method Requirements

Gas samples will be collected in accordance with the SQP/SOP Manual (IT, 2002). Applicable SOPs are as follows:

SOP No.	SOP Title
1.1	Chain of Custody
2.1	Sample Handling, Packaging, and Shipping
17.1	Sample Labeling
19.1	Onsite Sample Storage

Sample Numbering System

A sequential sample numbering system will be employed. All samples to be collected from the CTP will be designated with the prefix "CTP". Following this prefix the sample number will have a designation of its location (EW = extraction well, MP = monitoring probe (also referred to as soil gas probe), INF = Influent, MID = midstream, EFF = effluent). After the location designation, the extraction well or monitoring probe number will be identified. All samples in order of collection will be assigned the next number in the consecutive sequence. For example, CTP-EW62A-001 is the first sample collected from an extraction well 62A, CTP-MP51-005 is the fifth sample collected from a monitoring probe 51.

Sample Labels

A sample label will be attached to each and every sample container. Indelible ink must be used when filling out all sample labels. Persons responsible for sample labeling must ensure that each sample collected has a label and that the information documented on the sample label corresponds with the information documented on the AR/COC.

Sample Handling, Packaging, and Shipping

The stainless steel canisters will be shipped back to the laboratory in the same box they were received via surface transport. The canisters do not require preservation.

Analysis Request/Chain of Custody Procedures

It is critical that AR/COCs are properly maintained and that all AR/COC procedures are properly implemented.

Quality Control Samples

The sampling methodologies described in this sampling and analysis plan have been selected to ensure appropriate data quality. The appropriateness of the field sampling protocol will be verified by inclusion of field duplicate samples.

Field duplicates are replicates submitted blind to the contract laboratory for the purpose of assessing contract laboratory precision and measuring potential sources of error during the sample collection process. Field duplicate samples for this project will be collected at a rate of 5% of the total samples collected, and analyzed for the same parameters as the corresponding primary sample. Field duplicates will be collected using two SUMMA™ canisters attached together using a manifold to avoid bias.

7.2.7.2 Field Measurements for Flow Rate and Pressure

Flow rate and vacuum measurements will be made on the extraction wells, monitoring probes, sub-slab probe, and the pilot SVE system. These measurements are made in order to fully optimize the system for maximum removal of VOCs from the soils. A summary of the measurements that will be made and their frequency is presented in Table 6-1.

Pre-sampling Activities

Prior to collection of data, the field technician should obtain the following:

1) A map showing extraction well and monitoring probe locations and identifications

2) Calibrated GEM-500™ LFG analyzer

3) Calibrated digital manometer (with resolution of 0.01 ins. w.c.)

4) Calibrated digital barometer

5) Teflon connecting tubing and fittings, etc.

6) Sample collection log (Form 7-3)

Vacuum and Flow Rate Measurements

The type of measurement and the instrumentation used will depend upon the location that is being measured. For example, extraction wells will have a higher vacuum then monitoring wells, and will require flow measurements. For this reason, the measurement of pressure and flow rate at extraction wells will be performed using a GEM-500™ LFG analyzer. Lower vacuums at the monitoring wells, and sub-slab probe will be measured using a digital manometer (with a resolution of 0.01 ins. w.c.). The sampling requirements and procedures are as follows:

1) Read pressure (ins. w.c.) using either the GEM-500™ or a digital manometer (depending upon sample location);

2) Read barometric pressure (mm Hg) using digital barometer

3) Attach GEM-500™ to the probe using a Teflon connecting tube. Measure flow rate in standard cubic feet per minute (scfm);

4) Disconnect the GEM-500™ (or digital manometer);

5) Reseal the well/probe/port when monitoring is complete. The sampling point should always remain sealed when not being monitored;

6) Complete the sample collection log (Form 7-3). Additional information and comments will be documented in a field activity daily log (Form 7-4).

Instrumentation

Section 6.3.1 provides detailed information about the field instrumentation that will be used.

7.2.8 Analytical Method Requirements

EPA Method TO-15 (EPA, 1999) is a procedure for sampling and analysis of VOCs in gas. The VOCs are separated by gas chromatography and measured by a mass spectrometer or by multi-detector techniques. The method presents procedures for sampling into canisters to final pressures both above and below atmospheric pressure (respectively referred to as pressurized and sub-atmospheric pressure sampling).

Analysis of samples will be performed per the requirements presented in Tables 7-1 – 7-7. Air Toxics Ltd., Folsom, California, will perform analyses.

8.0 Site Safety and Health Plan

Work activities will be performed utilizing safe work practices as detailed in the *Site Safety and Health Plan, Fort Ord Remedial Action, Former Fort Ord, California* (Basewide SSHP) (Shaw, 2003). Activity Hazard Analyses providing a summary of the hazards anticipated during the construction and operation of the pilot SVE system, and actions to be implemented to avoid and minimize the impact of these hazards, are presented in Appendix E.

9.0 Contractor Quality Control Plan

This Contractor Quality Control Plan (CQCP) has been developed in accordance with the requirements of the *Program Contractor Quality Control Plan for Sacramento TERC II* (PCQCP) (ICF Kaiser, 1998). A table showing the summary of project team QC responsibilities is presented in Table 9-1.

9.1 Project Organization

This section provides a brief description of the roles and responsibilities of personnel who will be involved with installation and testing of the pilot soil vapor extraction and treatment system. A project organization chart is presented in Figure 9-1.

9.1.1 Project Manager

The Project Manager, Peter Kelsall, is responsible for the quality and cost and schedule performance of all project activities, including those performed by subcontractors. The Project Manager is the primary interface with the Army and regulatory agencies.

9.1.2 Project Engineer

The Project Engineer, John Pietz P.E., is responsible for the design of the pilot soil vapor extraction and treatment system and will provide technical direction for installation, testing and operations. Changes to the design or testing procedures will be reviewed and approved by the Project Engineer. The Project Engineer is responsible to the Project Manager and the Task Manager on project issues.

9.1.3 Task Manager

The Task Manager, Jen Moser R. G., is responsible for day-to-day management of engineering, construction, operation, monitoring and testing activities including, but not limited to:

- Detailed planning and scheduling
- Managing Shaw resources and subcontractors
- Coordinating testing and monitoring activities
- Data compilation and reporting
- Tracking the project cost and schedule and implementing corrective measures when necessary.

9.1.4 Contractor Quality Control System Manager

The Contractor Quality Control System Manager (CQCSM), Tom Ghigliotto, supports the Task Manager in day-to-day operations; however, the CQCSM will report functionally to the TERC II QC Supervisor, Michael Reed. The CQCSM has sufficient authority, including stop work authority; to ensure that all project site activities comply with approved work documents. This authority applies equally to all project activities, whether performed by Shaw or its subcontractors and suppliers.

The CQCSM will be responsible for planning and executing QC oversight of project operations and shall ensure compliance with specified QC requirements in project plans, procedures, and contract documents.

9.1.5 Certified Industrial Hygienist

The TERC II Program Certified Industrial Hygienist (CIH), Dr. Rudy Von Burg, is responsible for the development, implementation, and oversight of the Basewide Site Safety and Health Plan (SSHP) (Shaw, 2003). The CIH will provide oversight during construction and sampling activities.

9.1.6 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO), Charles Luckie, is responsible for implementation of the Basewide SSHP (Shaw, 2003) and applicable corporate Health and Safety (HS) procedures. Specific responsibilities include developing AHAs and monitoring construction and sampling activities for compliance with the Basewide SSHP. The SSHO is responsible to the Task Manager in day-to-day operations, but reports functionally to the TERC II Program CIH, Dr. Rudy Von Burg.

9.1.7 Project Superintendent

The Project Superintendent, Dan Nohrden, is responsible for overseeing construction activities performed at the site. Field activities may be conducted by qualified in-house staff or by subcontractors. The Project Superintendent reports to the Task Manager.

9.1.8 Project Subcontractors

A subcontractor to be selected later will perform extraction well drilling and installation. Subcontracted work will be conducted in accordance with the requirements of the contract, subcontractor scopes of work.

9.2 Definable Features of Work

The definable features of work are as follows:

1. Prepare Work Plan

2. Drill and install extraction wells and monitoring probes
3. Install extraction well piping, vaults and condensate collection tank, and convert monitoring wells MW-BW-62A and MW-BW-63 to extraction wells
4. Prepare treatment system site and required utilities, install treatment system, and connect extraction piping to the treatment system.
5. Phase 1 system operation including preparation of a data report.
6. Phase 2 system operation including preparation of a data report.

9.3 Deliverables

Project deliverables for this project include the following:

- Pilot Soil Vapor Extraction and Treatment Work Plan, including SAP and Contractor Quality Control Plan
- Construction record drawings showing all installed systems.
- Phase 1 data report
- Phase 2 data report

10.0 References

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