Appendix A

Mactec Letter Report, OU CTP SVE Pilot Study Test

MACTEC

January 22, 2004

4087030023 11

Mr. Peter Kelsall
Shaw Environmental & Infrastructure, Inc.
4005 Port Chicago Highway
Concord, California 94520-1120

OU CTP SVE Pilot Study Test

Dear Mr. Kelsall:

MACTEC has proposed that a soil vapor extraction (SVE) pilot study be performed in the vicinity of Lexington Court at the Former Fort Ord facility as part of the OU CTP RI/FS program. This letter documents the objectives of this pilot study and background of the site leading up to the Army's decision to proceed in order to assist Shaw E&I, Inc. (Shaw) with the preparation of the SVE pilot study Work Plan.

The goal of the pilot study is to reduce soil vapor concentrations at depth that represent an apparent persistent carbon tetrachloride (CT) source that continues to contaminate groundwater. However, shallow (6 foot) soil vapor concentrations have also been measured and, although they are below human health risk action levels, the pilot study will also be conducted to monitor the effectiveness of removing contaminated soil vapor at shallow depths.

The objective of conducting the pilot test is to determine if the use of SVE is an acceptable preferred alternative to remediate the source of the groundwater plume at OU CTP. The information will be reported in detail within the OU CTP FS.

Background

The Army has been investigating the presence of carbon tetrachloride (CT) in groundwater since 1997 in response to its detection in two monitoring wells (MW-B-13-180 and MW-B-14-A) during the basewide quarterly groundwater monitoring program. Since 1997, monitoring wells have been installed within the A-Aquifer, the Upper and Lower 180-Foot Aquifers, and the 400-Foot Aquifer to delineate the extent of contamination and locate its original source area. In addition to the field investigation, historical aerial photos were reviewed in an attempt to identify previous land uses that may have involved the use of CT.

Additional groundwater data in the A-Aquifer, upgradient and south of the original monitoring wells with CT contamination, suggested that the source may have been located in what is now the Preston Park housing area. Soil vapor samples were collected in July 2002 from 24 locations (CTP-SG-1 through CTP-SG-24) throughout the Preston Park housing area, generally from depths of 6 feet, 20 feet, and 60 feet, to screen the area for the presence of CT (Plate 1). A mobile laboratory, owned and operated by Centrum Analytical, was used to analyze soil vapor samples; the reporting limit for CT was 79 parts per billion by volume (ppb v/v). Of these samples, CT was detected at four samples, all located to the south of the study area in the vicinity of Lexington Court. CT concentrations ranged from 86 to 160 ppb v/v and was

MACTEC Engineering and Consulting
600 Grand Avenue, Suite 300 • Oakland, CA 94610
510-451-1001 • Fax: 510-451-3165

consistently detected at a depth of 60 feet with the exception of the detection at 45 feet at CTP-SG-05 (Plate 2). No other VOCs were detected.

To further investigate the low detections of CT in the first phase, a second phase of soil vapor investigation was conducted in March 2003 from six locations (CTP-SG-26 through CTP-SG-31), generally from depths of 6 feet, 30 feet, 50 feet, and 70 feet (Plate 1). STL Laboratories was used to analyze these samples to obtain a lower reporting limit (0.20 ppb v/v) for CT, chloroform (CF), tetrachloroethene (PCE), and trichloroethene (TCE). Lower detection levels are typically achievable in fixed-location laboratories as opposed to mobile laboratories as was used during the first phase of investigation. CT concentrations ranged from the reporting limit to 280 ppb v/v at a depth of 59 feet in this set of samples; the maximum concentration of CF, PCE, and TCE, were 14, 6.7, and 38 ppb v/v, respectively.

Based on results from the second phase of investigation, additional data was collected in May 2003 to confirm the extent of contamination in the Lexington and Ready Courts area (Plate 1). This phase of work also included the installation of 6-foot deep soil vapor probes to allow for repeated sample collection. Soil vapor samples were collected from 15 borings (CTP-SG-33 through CTP-SG-47) and from 8 soil vapor probes (CTP-SGP-35, -37, -40, -41, -42, -44, -45, and -48). Samples were again analyzed by STL laboratories as with the second phase of soil vapor investigation. CT concentrations ranged from the reporting limit to a maximum of 290 ppb v/v at a depth of 75 feet; maximum CF, PCE, and TCE concentrations were 16, 6.9, and 1.8 ppb v/v, respectively.

All soil vapor concentration data are summarized on Table 1 and illustrated on Plates 2 through 6. Plate 2 illustrates soil vapor data from the 6-foot depth, Plate 3 from depths between 19 and 30 feet, Plate 4 from depths between 40 and 50 feet, Plate 5 from depths between 55 and 66 feet, and Plate 6 from depths greater than 66 feet.

Please do not hesitate to contact me at (510) 628-3222 if you have any questions concerning this pilot study or results from the previous soil vapor investigations.

Yours very truly,

MACTEC Engineering and Consulting, Inc.

Michael Taraszki, RG, CHg
Principal Hydrogeologist

Carlene Merey, Gp
Senior Principal Environmental Scientist

MT/CM/yml:YL60360-FO

Enclosures: Table 1 – Summary of Detected Select VOCs in Soil Gas

Plate 1 – Soil Vapor Sample Locations
Plate 2 – Carbon Tetrachloride Concentrations in Soil Vapor, 6 Foot Depth
Plate 3 – Carbon Tetrachloride Concentrations in Soil Vapor, 19-30 Foot Depth
Plate 4 – Carbon Tetrachloride Concentrations in Soil Vapor, 40-50 Foot Depth
Plate 5 – Carbon Tetrachloride Concentrations in Soil Vapor, 55-60 Foot Depth
Plate 6 – Carbon Tetrachloride Concentrations in Soil Vapor, >66 Foot Depth

Table 1. Summary of Detected Select VOCs in Soil Gas
OU CTP RI/FS
Preston Park Housing Area, Former Fort Ord, California

Boring name	Date	Carbon tetrachloride	Chloroform	Tetrachloroethene	Trichloroethene
CTP-SG-01-06	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-01-20	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-01-60	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-02-06	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-02-20	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-03-06	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-03-20	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-03-60	7/10/2002	**100**	ND (205)	ND (147)	ND (93)
CTP-SG-04-06	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-04-30	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-04-60	7/11/2002	**160**	ND (205)	ND (147)	ND (93)
CTP-SG-05-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-05-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-05-45	7/12/2002	**160**	ND (205)	ND (147)	ND (93)
CTP-SG-06-06	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-06-20	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-06-49	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-07-06	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-07-20	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-07-60	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-08-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-08-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-08-45	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-09-06	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-09-20	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-09-50	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-10-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-10-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-10-60	7/12/2002	**86**	ND (205)	ND (147)	ND (93)
CTP-SG-11-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-11-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-11-60	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-12-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-12-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-12-55	7/12/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-13-06A	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-13-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-14-06	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-14-20	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-14-45	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-15-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-15-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-16-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-16-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-17-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-17-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-17-40	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-18-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-18-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-19-06	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-19-20	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-19-50	7/10/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-20-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-20-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-21-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-21-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)

Table 1. Summary of Detected Select VOCs in Soil Gas
OU CTP RI/FS
Preston Park Housing Area, Former Fort Ord, California

Boring name	Date	Carbon tetrachloride	Chloroform	Tetrachloroethene	Trichloroethene
CTP-SG-22-06	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-22-20	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-22-60	7/11/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-23-06	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-23-20	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-23-45	7/9/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-24-06	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-24-20	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-24-45	7/8/2002	ND (79)	ND (205)	ND (147)	ND (93)
CTP-SG-26-06	3/3/2003	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
CTP-SG-26-29	3/3/2003	**4.4**	**0.24**	**0.48**	**0.53**
CTP-SG-26-40	3/3/2003	**10**	**0.81**	**0.42**	**1.2**
CTP-SG-26-66	3/3/2003	**14**	**1.7**	**0.51**	**2.7**
CTP-SG-26-86	3/5/2003	**18**	**2.5**	**0.78**	**4**
CTP-SG-27-06	3/12/2003	**2.7**	**0.65**	**0.96**	**0.4**
CTP-SG-27-30	3/12/2003	**18**	**1.9**	**2.6**	**3.4**
CTP-SG-27-44	3/12/2003	**21**	**2.4**	**2.3**	**3.8**
CTP-SG-27-59	3/12/2003	**27**	**3.5**	**3.4**	**5.1**
CTP-SG-27-78	3/12/2003	**31**	**4.5**	**4.1**	**6.8**
CTP-SG-28-06	3/12/2003	**6.6**	**0.42**	**1.1**	ND (0.20)
CTP-SG-28-27	3/12/2003	**24**	**1.3**	**3.6**	**0.93**
CTP-SG-28-44	3/13/2003	**35**	**2.3**	**4.2**	**38**
CTP-SG-28-59	3/13/2003	**66**	**3.9**	**6.7**	**4**
CTP-SG-29-06	3/3/2003	**12**	**2**	**0.68**	**0.67**
CTP-SG-29-19	3/3/2003	**0.2**	ND (0.20)	**0.58**	ND (0.20)
CTP-SG-29-40	3/3/2003	**85**	**4.6**	**2.8**	**7**
CTP-SG-29-60	3/3/2003	**120**	**7.3**	**3.3**	**11**
CTP-SG-30-06	3/12/2003	**9.9**	**0.56**	**0.49**	ND (0.40)
CTP-SG-30-20	3/12/2003	**27**	**1.3**	**0.95**	**0.46**
CTP-SG-30-40	3/14/2003	**81**	**3**	**2.1**	**2.2**
CTP-SG-30-59	3/14/2003	**280**	**13**	**5.3**	**12**
CTP-SG-30-78	3/14/2003	**280**	**14**	**5.6**	**14**
CTP-SG-31-06	3/5/2003	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
CTP-SG-31-20	3/5/2003	**10**	**0.67**	**0.46**	ND (0.20)
CTP-SG-31-40	3/5/2003	**22**	**1.5**	**0.81**	**0.82**
CTP-SG-31-64	3/5/2003	**35**	**2.6**	**1.1**	**1.6**
CTP-SG-31-85	3/12/2003	**40**	**3.4**	**1.6**	**2.5**
CTP-SG-33-06	5/22/2003	**5.2**	**11**	ND (1.9)	ND (1.9)
CTP-SG-34-06	5/22/2003	ND (0.20)	ND (0.20)	ND (0.20)	**0.2**
CTP-SG-34-30	5/22/2003	**1.2**	**0.7**	**0.74**	**0.48**
CTP-SG-34-50	5/22/2003	**1.7**	**1**	**0.34**	**0.92**
CTP-SG-34-70	5/22/2003	**1.8**	**1.3**	**0.35**	**1.1**
CTP-SG-36-06	5/23/2003	**1.1**	**0.41**	**0.95**	ND (0.20)
CTP-SG-36-30	5/23/2003	**7.2**	**3**	**3.4**	ND (0.40)
CTP-SG-36-50	5/23/2003	**21**	**2.9**	**5.5**	ND (0.40)
CTP-SG-36-75	5/23/2003	**55**	**2.7**	**6.9**	**1.6**
CTP-SG-38-06	5/23/2003	**2.8**	**0.31**	ND (0.20)	ND (0.20)
CTP-SG-39-06	5/23/2003	**1.1**	**0.79**	**0.24**	ND (0.20)
CTP-SG-40-06	5/22/2003	**1**	**0.32**	**1**	ND (0.20)
CTP-SG-40-30	5/22/2003	**5.1**	**0.79**	**1.9**	ND (0.45)
CTP-SG-40-50	5/22/2003	**13**	**1.9**	**2.4**	ND (0.43)
CTP-SG-40-65	5/22/2003	**12**	**2.2**	**2**	ND (0.20)
CTP-SG-41-30	5/21/2003	**18**	**6.2**	**1.6**	ND (0.39)
CTP-SG-41-55	5/21/2003	**34**	**5.7**	**2.8**	ND (0.20)
CTP-SG-41-70	5/21/2003	**36**	**5.5**	**3**	**0.3**
CTP-SG-42-06	5/22/2003	ND (0.20)	**1.4**	**0.29**	ND (0.20)

Table 1. Summary of Detected Select VOCs in Soil Gas
OU CTP RI/FS
Preston Park Housing Area, Former Fort Ord, California

Boring name	Date	Carbon tetrachloride	Chloroform	Tetrachloroethene	Trichloroethene
CTP-SG-42-30	5/22/2003	**0.38**	**0.35**	**0.21**	ND (0.20)
CTP-SG-42-50	5/22/2003	**0.58**	ND (0.38)	(ND 0.38)	(ND 0.38)
CTP-SG-42-70	5/22/2003	**0.82**	**0.49**	(ND 0.39)	ND (0.39)
CTP-SG-43-06	5/21/2003	**8.9**	**1.2**	**0.58**	ND (0.20)
CTP-SG-43-30	5/21/2003	**40**	**5.6**	**1.7**	ND (0.20)
CTP-SG-43-50	5/21/2003	**57**	**6.7**	**1.3**	ND (0.41)
CTP-SG-43-75	5/21/2003	**290**	**16**	**4.6**	**1.8**
CTP-SG-46-06	5/23/2003	ND (0.20)	ND (0.20)	**0.25**	ND (0.20)
CTP-SG-47-06	5/23/2003	ND (0.20)	**0.4**	ND (0.20)	ND (0.20)
CTP-SGP-35	6/9/2003	**9.5**	**0.51**	**0.66**	ND (0.20)
CTP-SGP-37	6/10/2003	**16**	**0.92**	**0.5**	ND (0.20)
CTP-SGP-40	6/10/2003	**0.87**	**0.76**	**0.69**	ND (0.20)
CTP-SGP-41	6/10/2003	ND (0.20)	**0.64**	ND (0.20)	ND (0.20)
CTP-SGP-42	6/10/2003	**2.9**	**0.74**	ND (0.20)	ND (0.20)
CTP-SGP-44	6/10/2003	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
CTP-SGP-45	6/10/2003	**4.4**	**0.29**	**0.76**	ND (0.20)
CTP-SGP-48	6/10/2003	**13**	**5.6**	**0.41**	ND (0.20)

Notes:
All Concentrations in ppb (v/v).

Fort Ord GIS - proposed_soil_gas_11x17.mxd - 1/27/04

Legend

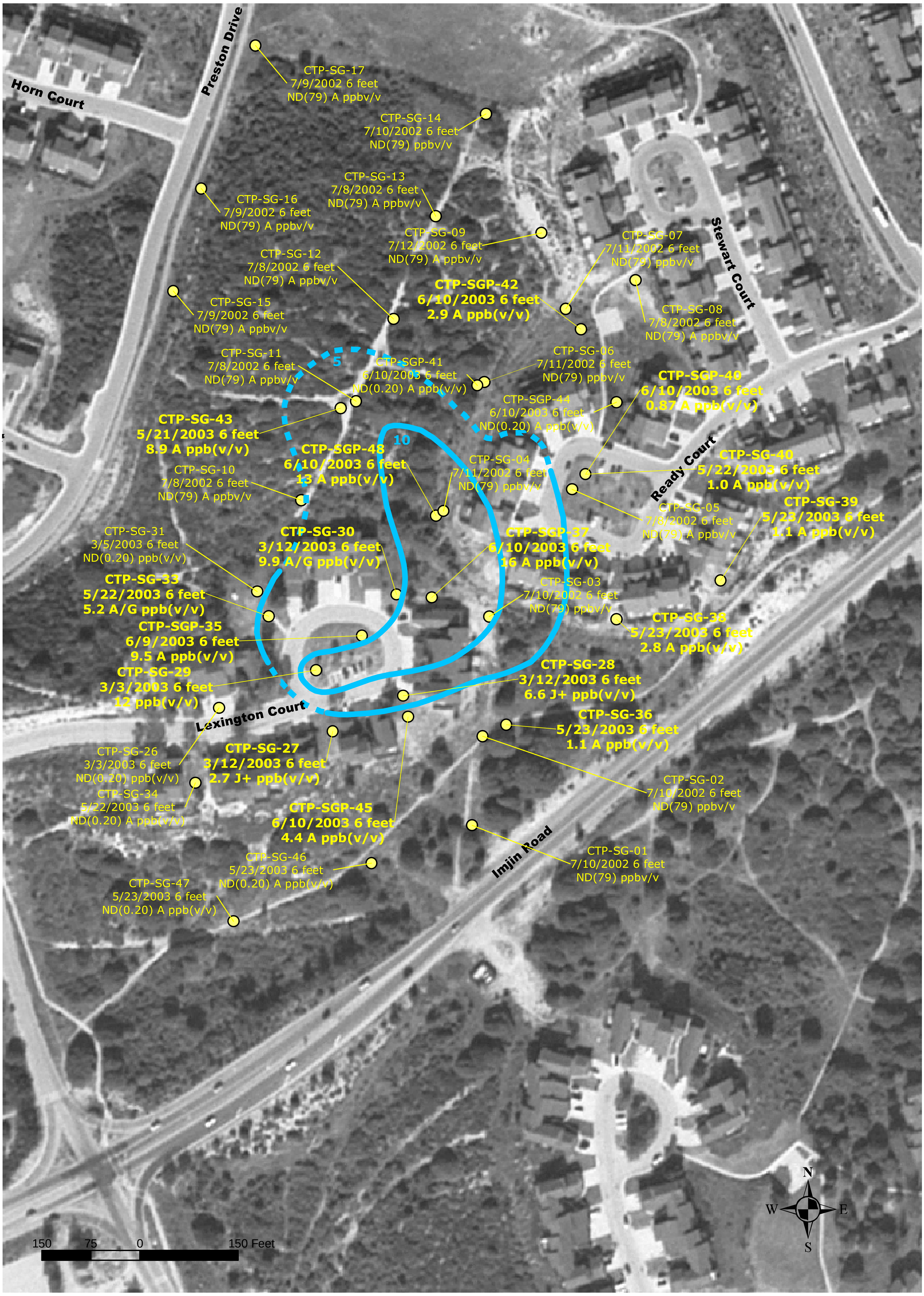
● Soil Gas Boring Locations

MACTEC

Soil Gas Boring Locations; 1999 Aerial Photo
OU CTP RI/FS
Former Fort Ord, California

PLATE
1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		05/03	



Legend

Soil Gas Sample Locations

Carbon Tetrachloride Concentration Contours in (ppb v/v); Dashed where inferred

CTP-SGP-45	(Carbon Tetrachloride Plume - Soil Gas Probe #45)
6/10/2003 6 feet	(Sample Date and Depth of Sample)
4.4 A ppb(v/v)	(Concentration, Qualifer, and units)

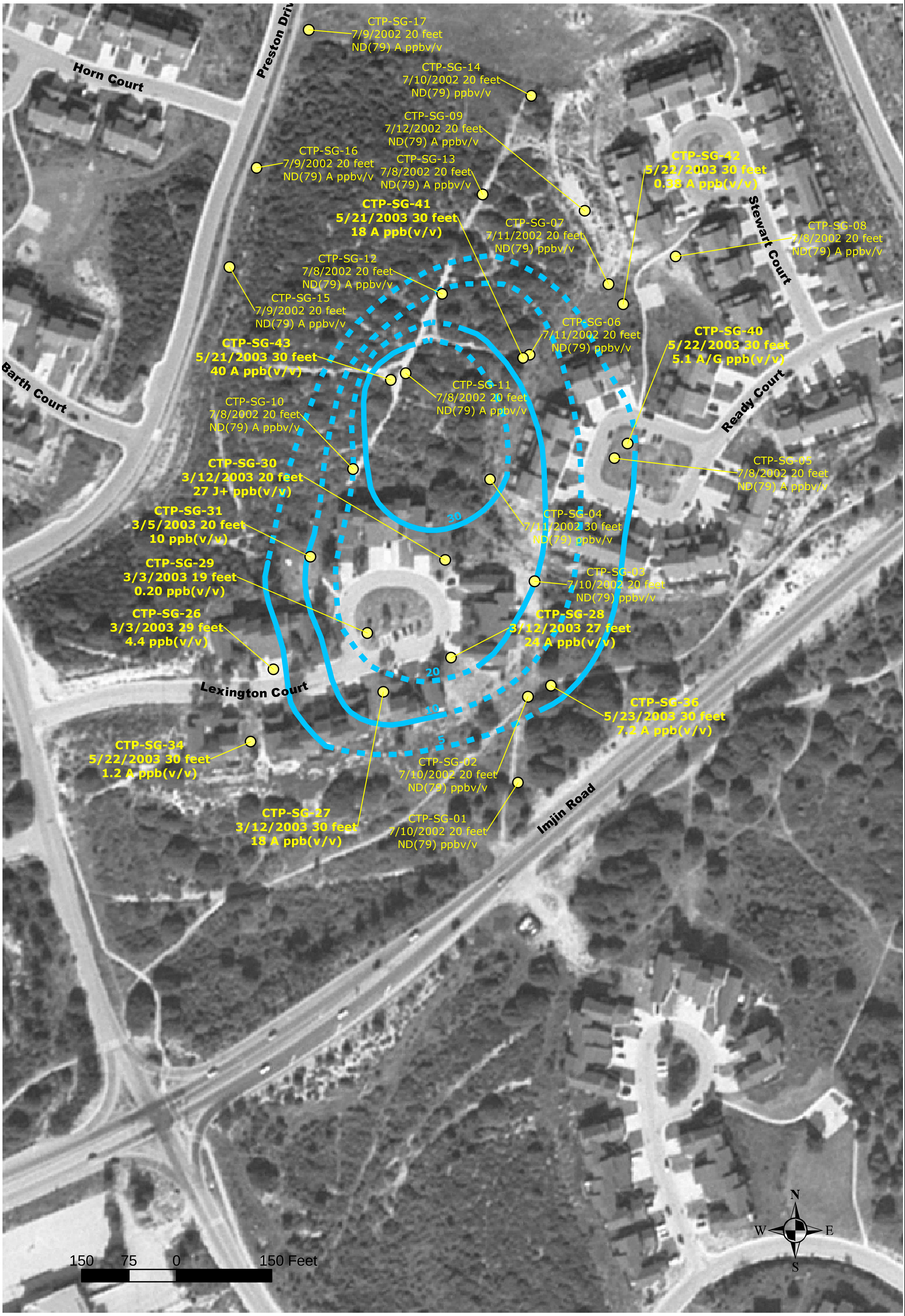
MACTEC

Carbon Tetrachloride Concentrations in Soil Gas at 6 feet
OU CTP RI/FS
Former Fort Ord, California

PLATE 2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		09/03	

Fort Ord GIS - soil_gasRI_6ft.mxd - September 25, 2003



Legend

- Soil Gas Sample Locations
- Carbon Tetrachloride Concentration Contours in ppb (v/v); Dashed where inferred

CTP-SGP-45	(Carbon Tetrachloride Plume - Soil Gas Probe #45)
6/10/2003 6 feet	(Sample Date and Depth of Sample)
4.4 A ppb(v/v)	(Concentration, Qualifer, and units)

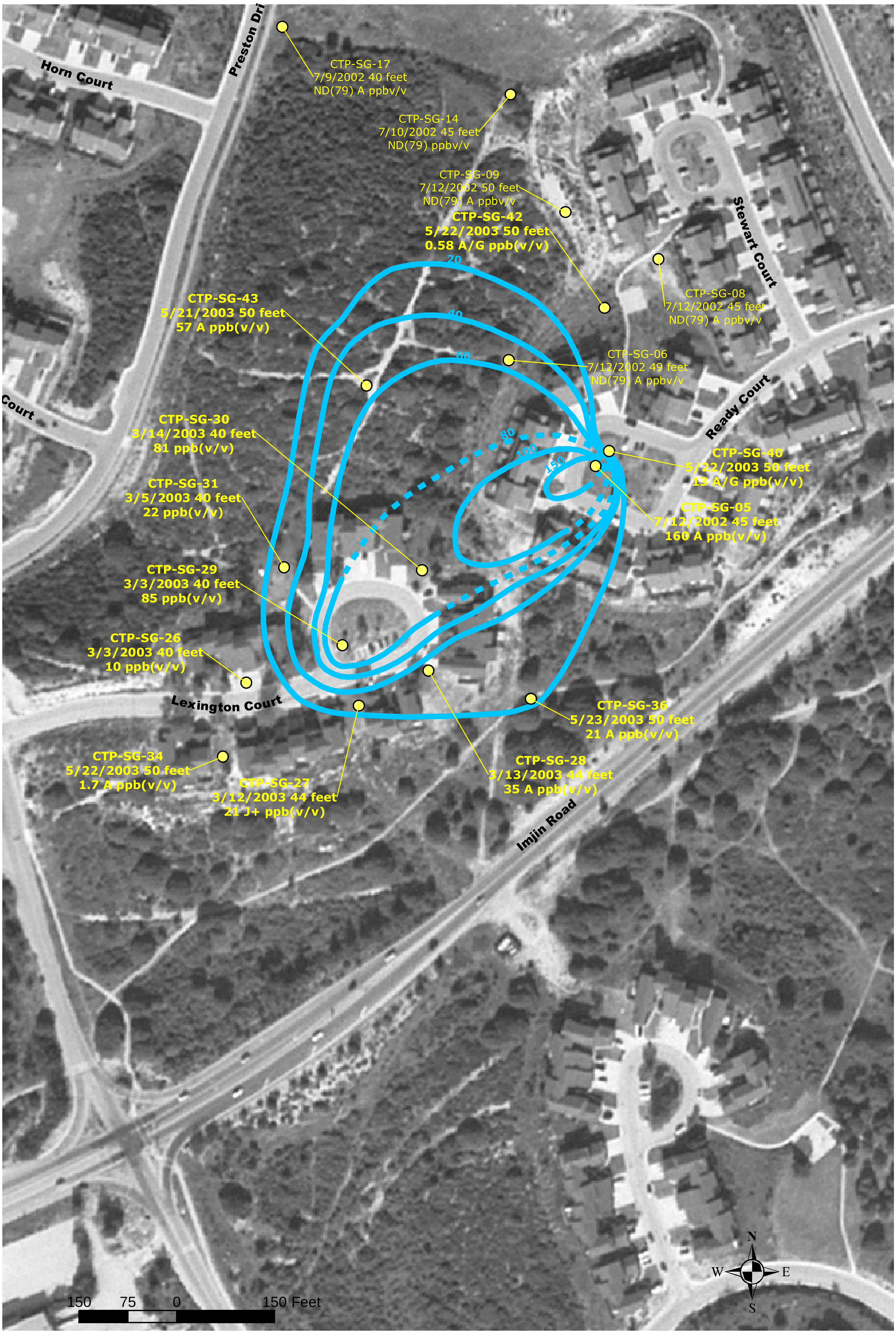
MACTEC

Carbon Tetrachloride Concentrations in Soil Gas from 19 to 30 feet
OU CTP RI/FS
Former Fort Ord, California

PLATE
3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		10/03	

Fort Ord GIS - Soil-GasRI_19-30.mxd - 3 October 03



Legend

Soil Gas Sample Locations

Carbon Tetrachloride Concentration Contours in ppb (v/v);
Dashed where inferred

CTP-SGP-45	(Carbon Tetrachloride Plume - Soil Gas Probe #45)
6/10/2003 6 feet	(Sample Date and Depth of Sample)
4.4 A ppb(v/v)	(Concentration, Qualifer, and units)

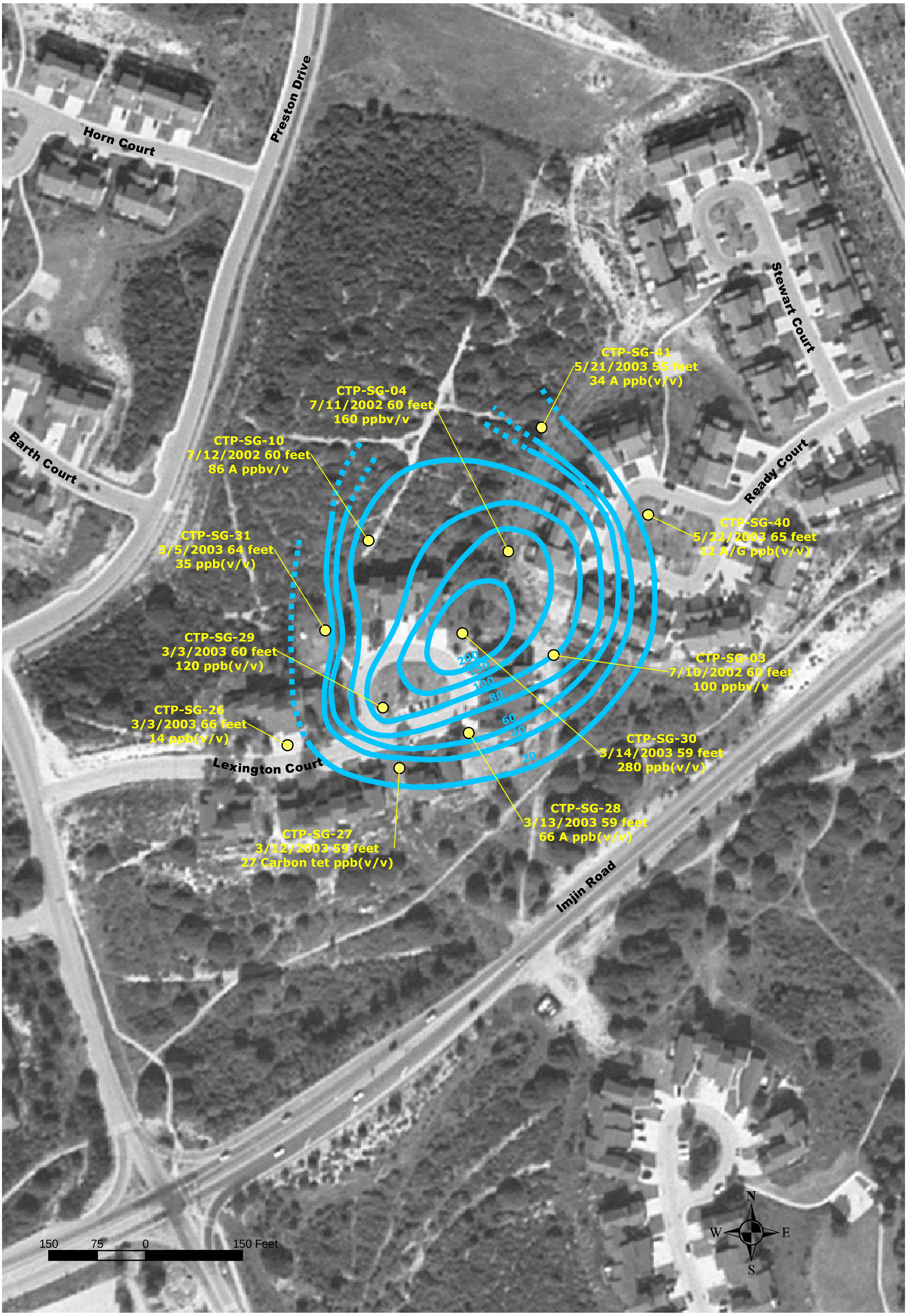
MACTEC

Carbon Tetrachloride Concentrations in Soil Gas from 40 to 50 feet
OU CTP RI/FS
Former Fort Ord, California

PLATE 4

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		05/03	

Fort Ord GIS - soil_gasRI_40-50ft_11x17.mxd - 1 May 03



Legend

Soil Gas Sample Locations

Carbon Tetrachloride Concentration Contours in ppb (v/v);
Dashed where inferred

CTP-SGP-45	(Carbon Tetrachloride Plume - Soil Gas Probe #45)
6/10/2003 6 feet	(Sample Date and Depth of Sample)
4.4 A ppb(v/v)	(Concentration, Qualifer, and units)

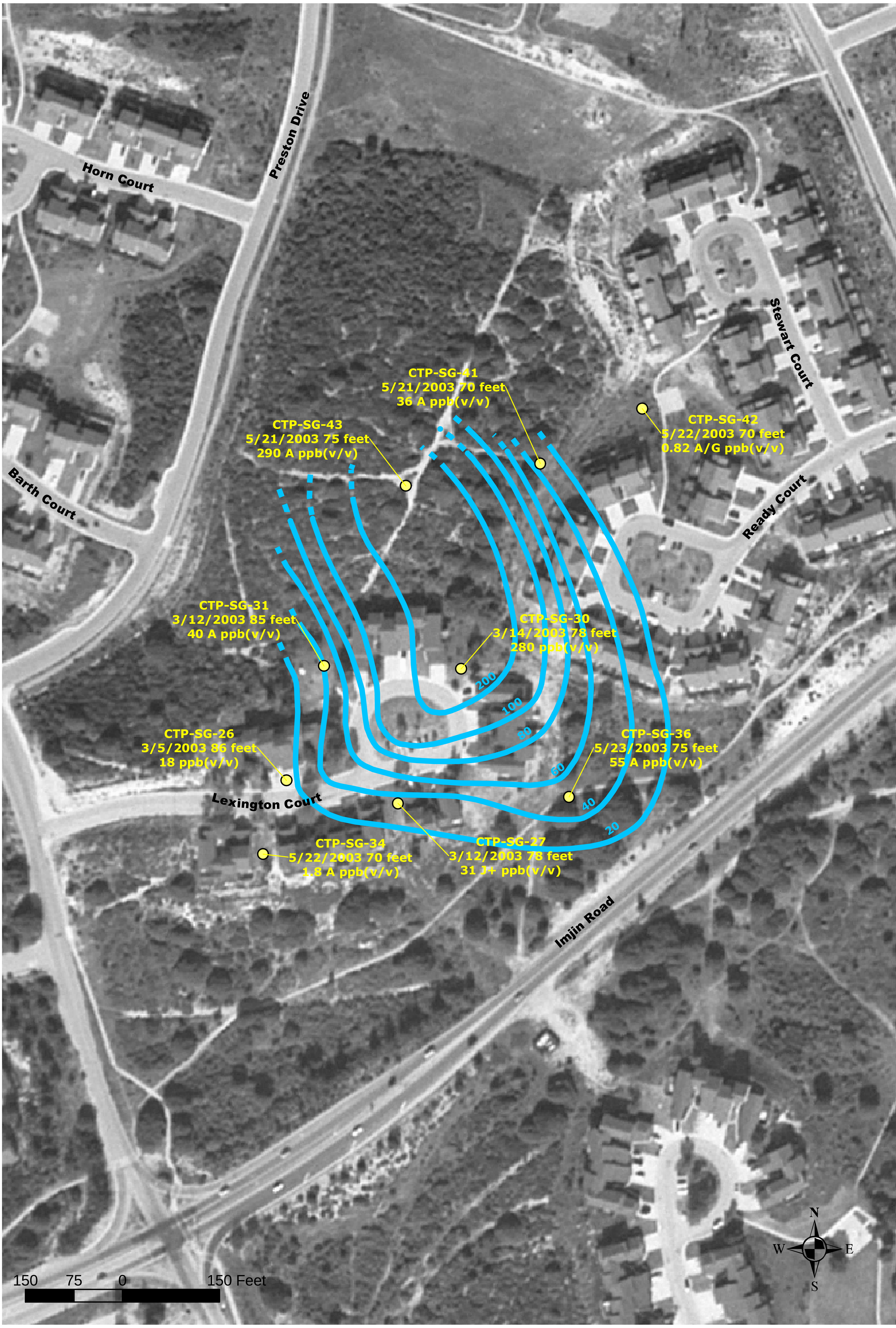
MACTEC

Carbon Tetrachloride Concentrations in Soil Gas between 55-66 feet
OU CTP RI/FS
Former Fort Ord, California

PLATE 5

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		09/03	

Fort Ord GIS - soil_gasRI_55-66ft.mxd - September 25, 2003



Legend

- Soil Gas Sample Locations
- Carbon Tetrachloride Concentration Contours in ppb (v/v); Dashed where inferred

CTP-SGP-45	(Carbon Tetrachloride Plume - Soil Gas Probe #45)
6/10/2003 6 feet	(Sample Date and Depth of Sample)
4.4 A ppb(v/v)	(Concentration, Qualifer, and units)

MACTEC

Carbon Tetrachloride Concentrations in Soil Gas below 66 feet
OU CTP RI/FS
Former Fort Ord, California

PLATE 6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
JCB	4087030007 010203		05/03	

Fort Ord GIS - proposed_soil_gas.mxd - 1 May 03

Appendix B

OU2 Landfill Gas Pilot Test Analyses

Table of Contents

List of Tables

List of Figures

1.0 Introduction

A pilot test was performed on the landfill gas (LFG) mitigation system adjacent to Area F within Operable Unit 2 (OU2) at the former Fort Ord, Marina, California. For this pilot test, flow testing was conducted on three vertical extraction wells of the LFG mitigation system to obtain estimates of the optimal operating vacuum pressure for the extraction wells in terms of radius of influence and flow rate, and the methane, nitrogen and oxygen content in the effluent gas. This appendix describes the methods used to estimate the soil permeability from vacuum pressure data measured during the flow tests of the LFG extraction wells.

2.0 Flow Testing of Extraction Wells

In May 2001, flow testing was performed on three vertical extraction wells, EW-2, EW-6, and EW-10, in the LFG mitigation system. These extraction wells were installed by IT Corporation (IT) in April 2001. The design and construction of these wells is described in the Draft Evaluation Report for the Landfill Gas Pilot Test (Shaw Environmental, Inc. [Shaw], 2003).

The flow tests of the vertical extraction wells were conducted according to the general procedures outlined in the Landfill Gas Pilot Test Work Plan and Contractor Quality Control Plan, Operable Unit 2 Landfills, Former Fort Ord, California (IT, 2001). The flow tests were performed by applying incremental vacuum pressures at an extraction well, and monitoring vacuum pressures and effluent gas temperature and composition in adjacent monitoring probes at varying distances from the extraction well. The monitoring probes were installed at a 12-foot depth and at a depth of 22 or 32 feet corresponding to the bottom elevation of the waste in Area F (Shaw, 2003).

The flow tests were performed at incremental vacuum pressures between 2.5 and 10.0 inches of water column (WC). Extraction well EW-2 was flow tested at vacuum pressures of 2.5, 5.0, and 10.0 inches WC. Extraction well EW-6 was flow tested at vacuum pressures of 2.5, 5.0, and 7.5 inches WC. Extraction well EW-10 was tested at vacuum pressures of 2.5 and 5.0 inches WC. Each flow test was conducted for approximately six hours (Shaw, 2003).

3.0 Soil Permeability Analysis of Flow Tests

The radial vacuum pressure distribution data from the flow tests were analyzed to obtain estimates of the air permeability of the shallow soils in the vicinity of the LFG mitigation system. The vacuum gauge pressures at the monitoring probes were first converted to absolute vacuum pressures using the barometric pressure measured during the tests. The corrected vacuum gauge pressures were then fitted to the transient radial pressure distribution equation for leaky confined aquifers of Beckett and Huntley (1994) using mathematics computer-aided-design software. For these analyses, the leaky confining layer was assumed to have a thickness of 10 feet (304.8 cm) and a horizontal permeability (k_h) equal to ten times the vertical permeability (k_v)

3.1 Estimated Soil Permeabilities

The results of the analyses of the vacuum pressure distribution data from the flow tests test are summarized in Table X-1 and the analyses are included in this Appendix. The soil permeabilities estimated by the Beckett and Huntley (1994) method for the monitoring probes range between 2.1 x 10^{-7} and 3.3 x 10^{-7} cm^2 (21 and 33 Darcies).

4.0 References

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," *Ground Water*, Vol. 32, No. 2, p. 239-247.

IT Corporation (IT), 2001, "Landfill Gas Pilot Test Work Plan and Contractor Quality Control Plan, Operable Unit 2 Landfills, Former Fort Ord, California," prepared for Department of the Army Corps of Engineers, Sacramento, California.

Shaw Environmental, Inc. (Shaw), 2003, "Draft Evaluation Report, Landfill Gas Pilot Test, Operable Unit 2 Landfills, Former Fort Ord, California, Revision C," prepared for Department of the Army Corps of Engineers, Sacramento, California.

Table B-1
Estimated Air Permeability of Shallow A Aquifer
Landfill Gas Pilot Tests
Operable Unit 2 Landfill
Fort Ord, California

Extraction Well	Vacuum Pressure (Inches WC)	Effluent Flow Rate (Scfm)	Elapsed Test Time (Hours)	Estimated k (cm^2)
EW-2	2.5	17.0	5.0	2.35E-07
	5.0	32.0	5.0	2.60E-07
	10.0	52.0	5.0	2.10E-07
EW-6	2.5	20.0	4.5	3.20E-07
	5.0	34.0	4.5	2.55E-07
	7.5	55.0	3.0	3.00E-07
EW-10	2.5	20.0	4.0	3.30E-07
	5.0	34.0	3.5	2.80E-07

Shaw® Shaw Environmental, Inc.

By __TFC____Date 12/7/03 Subject Fort Ord CTP Pilot SVE Design________Sheet No. ___of ___.
Chkd By _____Date _______. EW-2 SVE Pilot Test 2.5 in. WC - Estimated K__Proj. No. _783751___.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 2.35\cdot10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 2.35\cdot10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 403.5\cdot2490.8891$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 15\cdot471.947443$	cm^3/sec	(15 ft^3/min)

Observation Well

Elapsed Test Time (t)	$t := 5.0\cdot3600$	sec	(5.0 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$3.705 \cdot 10^{-9}$
1	$3.705 \cdot 10^{-7}$
2	$1.337 \cdot 10^{-6}$
3	$2.904 \cdot 10^{-6}$
4	$5.072 \cdot 10^{-6}$
5	$7.839 \cdot 10^{-6}$
6	$1.121 \cdot 10^{-5}$
7	$1.517 \cdot 10^{-5}$
8	$1.974 \cdot 10^{-5}$
9	$2.491 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$$B = 1.43 \times 10^3$$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$8.279\cdot10^3$
1	$5.697\cdot10^3$
2	$4.977\cdot10^3$
3	$4.542\cdot10^3$
4	$4.23\cdot10^3$
5	$3.986\cdot10^3$
6	$3.786\cdot10^3$
7	$3.617\cdot10^3$
8	$3.47\cdot10^3$
9	$3.34\cdot10^3$

$sec^{2}\,cm^{-1}$

Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	1310.64
2	1341.12
3	2804.16
4	2987.04
5	4084.32

cm

Observed Vacuum (V_o)

$V_o :=$

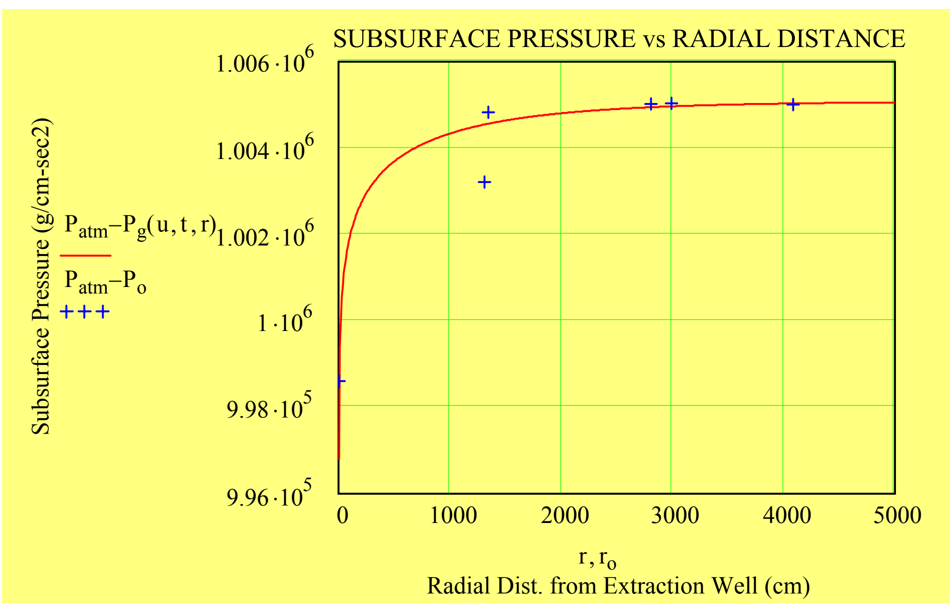
	0
0	2.600
1	0.750
2	0.100
3	0.025
4	0.020
5	0.030

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

By __TFC_____Date 12/7/03 Subject Fort Ord CTP Pilot SVE Design ________Sheet No. ___of ___.
Chkd By _____Date _______. EW-2 SVE Pilot Test 5 in. WC - Estimated K ___Proj. No. 783751 ___.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 2.6\cdot 10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 2.6\cdot 10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot 10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot 10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 404.7\cdot 2490.8891$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 32\cdot 471.947443$	cm^3/sec	($32\ ft^3/min$)

Observation Well

Elapsed Test Time (t)	$t := 5.0\cdot 3600$	sec	(5.0 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$3.338 \cdot 10^{-9}$
1	$3.338 \cdot 10^{-7}$
2	$1.205 \cdot 10^{-6}$
3	$2.617 \cdot 10^{-6}$
4	$4.57 \cdot 10^{-6}$
5	$7.064 \cdot 10^{-6}$
6	$1.01 \cdot 10^{-5}$
7	$1.367 \cdot 10^{-5}$
8	$1.779 \cdot 10^{-5}$
9	$2.245 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4 \cdot B^2 \cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4 \cdot \pi \cdot k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m} \cdot \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4 \cdot B^2 \cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$1.596 \cdot 10^4$
1	$1.098 \cdot 10^4$
2	$9.596 \cdot 10^3$
3	$8.758 \cdot 10^3$
4	$8.156 \cdot 10^3$
5	$7.686 \cdot 10^3$
6	$7.3 \cdot 10^3$
7	$6.974 \cdot 10^3$
8	$6.69 \cdot 10^3$
9	$6.44 \cdot 10^3$

$sec^2 \, cm^{-1}$

Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	1310.64
2	1341.12
3	
4	
5	

cm

Observed Vacuum (V_o)

$V_o :=$

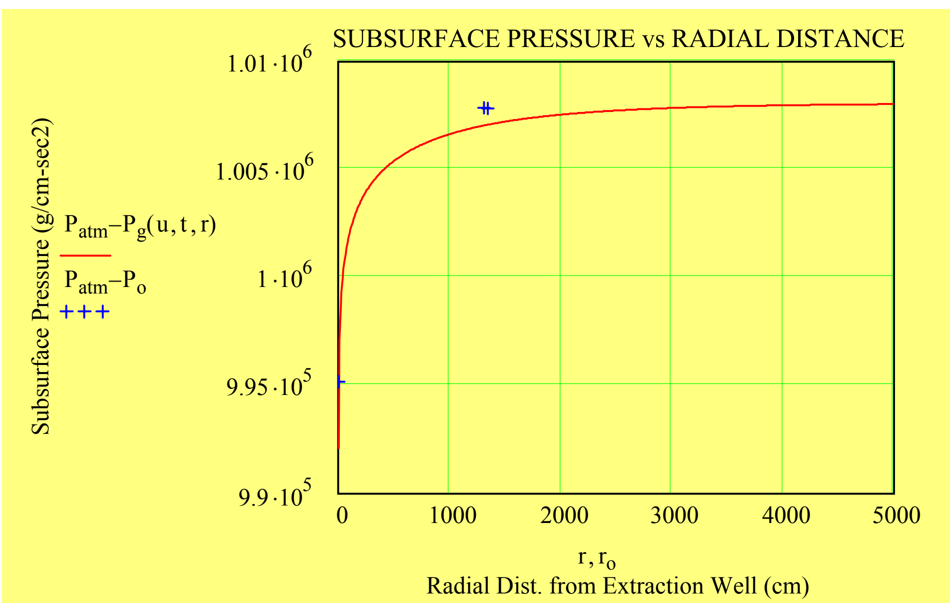
	0
0	5.170
1	0.090
2	0.100
3	
4	
5	

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Shaw® Shaw Environmental, Inc.

By __TFC_____Date 12/7/03 Subject Fort Ord CTP Pilot SVE Design________Sheet No. ___of ___.
Chkd By _____Date _______. EW-2 SVE Pilot Test 10 in. WC - Estimated K __Proj. No. _783751____.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 2.1\cdot10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 2.1\cdot10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 403.1\cdot2490.8891$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 52\cdot471.947443$	cm^3/sec	(52 ft^3/min)

Observation Well

Elapsed Test Time (t)	$t := 5.0\cdot3600$	sec	(5.0 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$4.15 \cdot 10^{-9}$
1	$4.15 \cdot 10^{-7}$
2	$1.498 \cdot 10^{-6}$
3	$3.253 \cdot 10^{-6}$
4	$5.681 \cdot 10^{-6}$
5	$8.781 \cdot 10^{-6}$
6	$1.255 \cdot 10^{-5}$
7	$1.7 \cdot 10^{-5}$
8	$2.211 \cdot 10^{-5}$
9	$2.79 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_V}{\frac{k_V \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$3.212\cdot10^{4}$
1	$2.21\cdot10^{4}$
2	$1.931\cdot10^{4}$
3	$1.762\cdot10^{4}$
4	$1.641\cdot10^{4}$
5	$1.546\cdot10^{4}$
6	$1.469\cdot10^{4}$
7	$1.403\cdot10^{4}$
8	$1.346\cdot10^{4}$
9	$1.296\cdot10^{4}$

$sec^{2}\,cm^{-1}$

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

r_o := (cm)

	0
0	5.08
1	1310.64
2	1341.12
3	2804.16
4	2987.04
5	

Observed Vacuum (V_o)

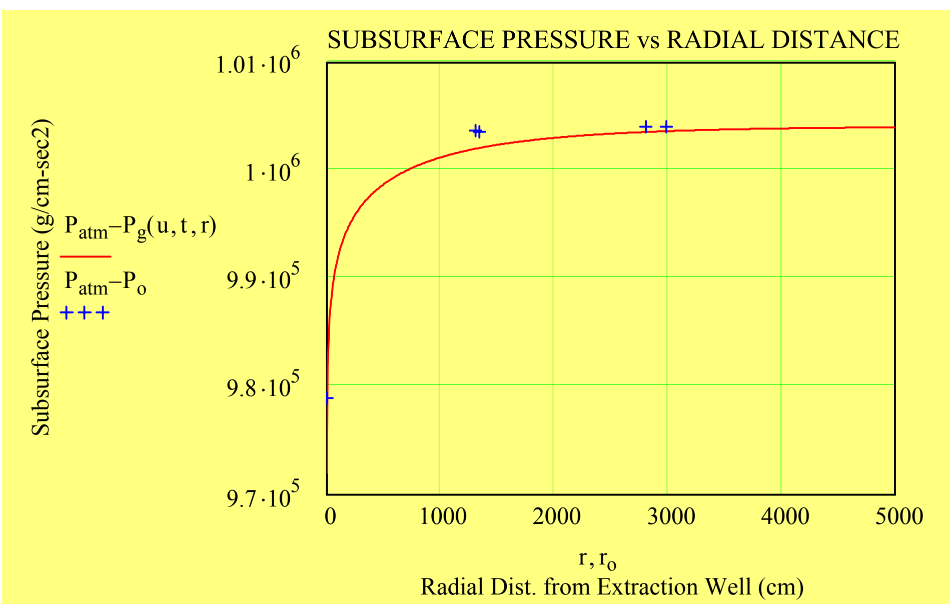
V_o := (in H_2O)

	0
0	10.100
1	0.160
2	0.205
3	0.025
4	0.015
5	

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Shaw® Shaw Environmental, Inc.

By __TFC____Date 12/7/03 Subject Fort Ord CTP Pilot SVE Design________Sheet No. ___of ___.
Chkd By _____Date _______.__EW-6 SVE Pilot Test 2.5 in. WC - Estimated K__Proj. No. _783751____.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 3.2\cdot 10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 3.2\cdot 10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot 10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot 10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 405.28\cdot 2490.889$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 20\cdot 471.947443$	cm^3/sec	(20 ft^3/min)

Observation Well

Elapsed Test Time (t)	$t := 4.5\cdot 3600$	sec	(4.5 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$3.01 \cdot 10^{-9}$
1	$3.01 \cdot 10^{-7}$
2	$1.086 \cdot 10^{-6}$
3	$2.36 \cdot 10^{-6}$
4	$4.12 \cdot 10^{-6}$
5	$6.368 \cdot 10^{-6}$
6	$9.104 \cdot 10^{-6}$
7	$1.233 \cdot 10^{-5}$
8	$1.604 \cdot 10^{-5}$
9	$2.024 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_V}{\frac{k_V \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ $g/cm\text{-}sec^2$

	0
0	$8.107\cdot10^3$
1	$5.578\cdot10^3$
2	$4.873\cdot10^3$
3	$4.447\cdot10^3$
4	$4.142\cdot10^3$
5	$3.903\cdot10^3$
6	$3.707\cdot10^3$
7	$3.541\cdot10^3$
8	$3.397\cdot10^3$
9	$3.27\cdot10^3$

$sec^2\,cm^{-1}$

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	883.92
2	1554.48
3	2712.72
4	
5	

cm

Observed Vacuum (V_o)

$V_o :=$

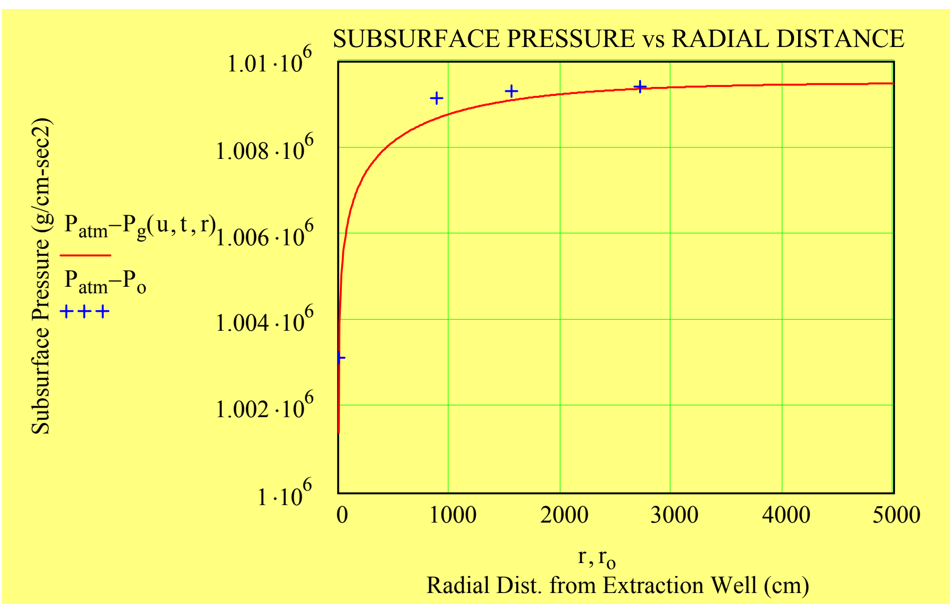
	0
0	2.560
1	0.143
2	0.080
3	0.036
4	
5	

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Shaw® Shaw Environmental, Inc.

By __TFC_____Date 12/7/03_Subject _Fort Ord CTP Pilot SVE Design_________Sheet No. ___of ___.
Chkd By _____Date _______.__EW-6 SVE Pilot Test 5 in. WC - Estimated K___Proj. No. _783751____.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^\infty \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx \quad \text{here} \quad u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t} \quad \text{and} \quad B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 2.55\cdot 10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 2.55\cdot 10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot 10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot 10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 406.37\cdot 2490.889$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 34\cdot 471.947443$	cm^3/sec	($34\ ft^3/min$)

Observation Well

Elapsed Test Time (t)	$t := 4.5\cdot 3600$	sec	(4.5 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$3.767 \cdot 10^{-9}$
1	$3.767 \cdot 10^{-7}$
2	$1.36 \cdot 10^{-6}$
3	$2.953 \cdot 10^{-6}$
4	$5.156 \cdot 10^{-6}$
5	$7.97 \cdot 10^{-6}$
6	$1.139 \cdot 10^{-5}$
7	$1.543 \cdot 10^{-5}$
8	$2.007 \cdot 10^{-5}$
9	$2.533 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$1.729\cdot10^{4}$
1	$1.19\cdot10^{4}$
2	$1.04\cdot10^{4}$
3	$9.488\cdot10^{3}$
4	$8.836\cdot10^{3}$
5	$8.326\cdot10^{3}$
6	$7.909\cdot10^{3}$
7	$7.555\cdot10^{3}$
8	$7.248\cdot10^{3}$
9	$6.977\cdot10^{3}$

$sec^{2}\,cm^{-1}$

Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	883.92
2	1554.48
3	2712.72
4	3048.00
5	4023.36

cm

Observed Vacuum (V_o)

$V_o :=$

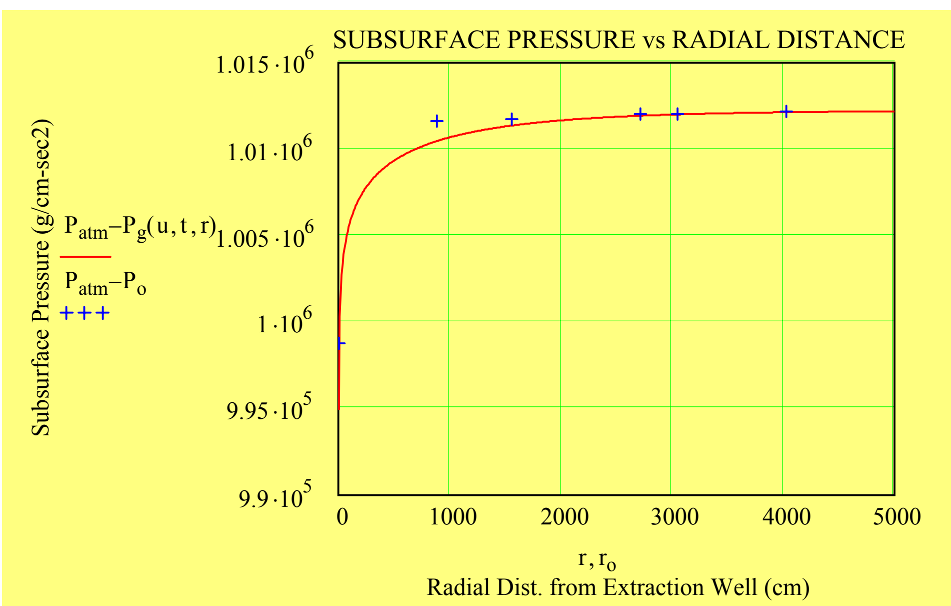
	0
0	5.400
1	0.250
2	0.200
3	0.075
4	0.075
5	0.020

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Shaw® Shaw Environmental, Inc.

By __TFC_____Date 12/7/03 Subject _Fort Ord CTP Pilot SVE Design_________Sheet No. ___of ___.
Chkd By ______Date _______.__EW-6 SVE Pilot Test 7.5 in. WC - Estimated K__Proj. No. _783751____.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 3.0\cdot 10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 3.0\cdot 10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot 10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot 10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 406.78\cdot 2490.889$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 55\cdot 471.947443$	cm^3/sec	($55\ ft^3/min$)

Observation Well

Elapsed Test Time (t)	$t := 3.0\cdot 3600$	sec	(3.0 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$4.798 \cdot 10^{-9}$
1	$4.798 \cdot 10^{-7}$
2	$1.732 \cdot 10^{-6}$
3	$3.761 \cdot 10^{-6}$
4	$6.568 \cdot 10^{-6}$
5	$1.015 \cdot 10^{-5}$
6	$1.451 \cdot 10^{-5}$
7	$1.965 \cdot 10^{-5}$
8	$2.557 \cdot 10^{-5}$
9	$3.226 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$2.378\cdot10^4$
1	$1.636\cdot10^4$
2	$1.429\cdot10^4$
3	$1.305\cdot10^4$
4	$1.215\cdot10^4$
5	$1.145\cdot10^4$
6	$1.087\cdot10^4$
7	$1.039\cdot10^4$
8	$9.966\cdot10^3$
9	$9.593\cdot10^3$

$sec^{2}\,cm^{-1}$

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	883.92
2	1554.48
3	2712.72
4	3048.00
5	4023.36

cm

Observed Vacuum (V_o)

$V_o :=$

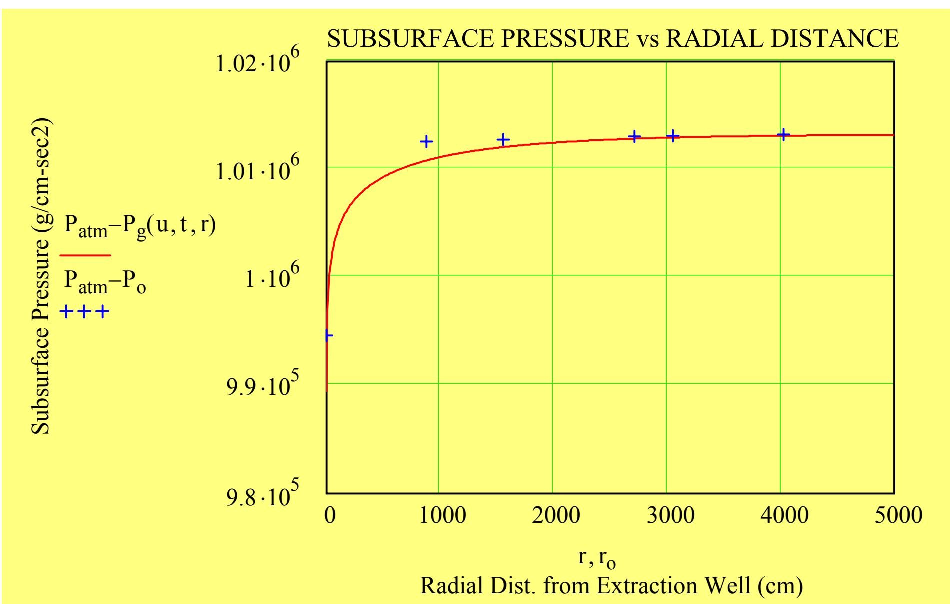
	0
0	7.490
1	0.270
2	0.200
3	0.090
4	0.070
5	0.015

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Shaw Environmental, Inc.

By __TFC____Date 12/7/03 Subject Fort Ord CTP Pilot SVE Design________Sheet No. ___of ___.
Chkd By _____Date _______. EW-10 SVE Pilot Test 2.5 in. WC - Estimated K Proj. No. 783751___.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_u^{\infty}\frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

here

$$u := \frac{r^2\cdot\varepsilon\cdot\mu}{4\cdot k\cdot P_{atm}\cdot t}$$

and

$$B := \sqrt{k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m\cdot\left(\frac{m_v}{\frac{k_v\cdot\rho\cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 3.3\cdot10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 3.3\cdot10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8\cdot10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17\cdot10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 406.78\cdot2490.889$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 20\cdot471.947443$	cm^3/sec	(20 ft^3/min)

Observation Well

Elapsed Test Time (t)	$t := 4.5\cdot3600$	sec	(4.5 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$2.908 \cdot 10^{-9}$
1	$2.908 \cdot 10^{-7}$
2	$1.05 \cdot 10^{-6}$
3	$2.28 \cdot 10^{-6}$
4	$3.981 \cdot 10^{-6}$
5	$6.153 \cdot 10^{-6}$
6	$8.796 \cdot 10^{-6}$
7	$1.191 \cdot 10^{-5}$
8	$1.549 \cdot 10^{-5}$
9	$1.955 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$B = 1.43 \times 10^3$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$7.861\cdot10^3$
1	$5.409\cdot10^3$
2	$4.725\cdot10^3$
3	$4.313\cdot10^3$
4	$4.016\cdot10^3$
5	$3.785\cdot10^3$
6	$3.595\cdot10^3$
7	$3.434\cdot10^3$
8	$3.294\cdot10^3$
9	$3.171\cdot10^3$

$sec^{2}\,cm^{-1}$

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	609.60
2	2651.76
3	2956.56
4	3048.00
5	

cm

Observed Vacuum (V_o)

$V_o :=$

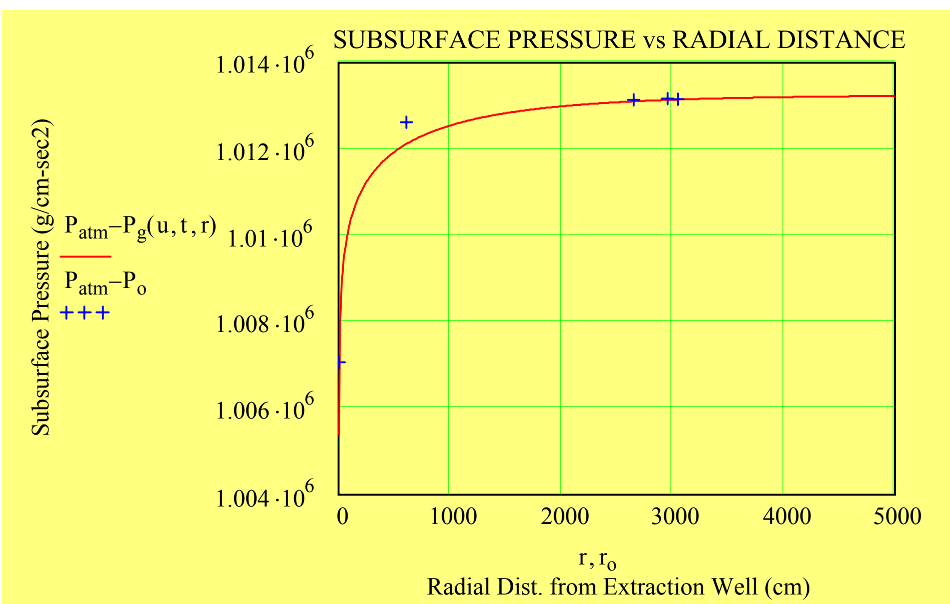
	0
0	2.480
1	0.250
2	0.044
3	0.031
4	0.040
5	

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

PURPOSE:

Estimate the radial subsurface pressure change during a single-well, constant-pressure, soil vapor extraction (SVE) pilot test.

METHOD:

Subsurface pressure change (P_g) during pilot test was estimated using the transient radial pressure distribution equation for leaky confined flow condtions of Beckett and Huntley (1994):

$$P_g := \frac{Q}{4 \cdot \pi \cdot k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m} \cdot \int_u^{\infty} \frac{e^{\left[-x-\left(\frac{r^2}{4 \cdot B^2 \cdot x}\right)\right]}}{x} \, dx$$

here

$$u := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

and

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

ASSUMPTIONS:

CALCULATIONS:

Soil Properties

Permeability (k)	$k := 2.8 \cdot 10^{-7}$	cm^2	
Vertical Permeability of Conf. Layer (k_v)	$k_v := 2.8 \cdot 10^{-8}$	cm^2	
Thickness (m)	$m := 670.56$	cm	(22 ft)
Thickness of Conf. Layer (m_v)	$m_v := 304.8$	cm	(10 ft)
Air-filled Porosity (ε)	$\varepsilon := 0.35$	dimensionless	
Air Viscosity (μ)	$\mu := 1.8 \cdot 10^{-4}$	g/cm-sec	
Air Density (ρ)	$\rho := 1.17 \cdot 10^{-3}$	g/cm^3	
Ambient Atmospheric Pressure (P_{atm})	$P_{atm} := 406.78 \cdot 2490.889$	$g/cm\text{-}sec^2$	

Extraction Well

Volumetric Flow Rate (Q)	$Q := 34 \cdot 471.947443$	cm^3/sec	($34\ ft^3/min$)

Observation Well

Elapsed Test Time (t)	$t := 3.5 \cdot 3600$	sec	(3.5 hours)
Radial Distance from Extraction Well (r)	$r := 1, 10 .. 5000$	cm	(1 - 50 m)

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Calculation of u

$$u(t,r) := \frac{r^2 \cdot \varepsilon \cdot \mu}{4 \cdot k \cdot P_{atm} \cdot t}$$

$u(t,r) =$

	0
0	$4.406 \cdot 10^{-9}$
1	$4.406 \cdot 10^{-7}$
2	$1.591 \cdot 10^{-6}$
3	$3.454 \cdot 10^{-6}$
4	$6.032 \cdot 10^{-6}$
5	$9.323 \cdot 10^{-6}$
6	$1.333 \cdot 10^{-5}$
7	$1.805 \cdot 10^{-5}$
8	$2.348 \cdot 10^{-5}$
9	$2.963 \cdot 10^{-5}$

Calculation of B and r/B

$$B := \sqrt{k \cdot \left(\frac{\rho \cdot g}{\mu}\right) \cdot m \cdot \left(\frac{m_v}{\frac{k_v \cdot \rho \cdot g}{\mu}}\right)}$$

$$B = 1.43 \times 10^3$$

$\frac{r}{B} =$

	0
0	$6.995 \cdot 10^{-4}$
1	$6.995 \cdot 10^{-3}$
2	0.013
3	0.02
4	0.026
5	0.032
6	0.038
7	0.045
8	0.051
9	0.057

Calculation of $Ei_1(x)$

$Ei_1(x)$ is exponential integral of x. For |x| < 4 an accurate value of $Ei_1(x)$ is obtained with n = u to 100.

$$Ei_1(u,t,r) := \int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$Ei_1(u,t,r) =$

	0
0	14.762
1	10.157
2	8.874
3	8.099
4	7.542
5	7.107
6	6.751
7	6.449
8	6.187
9	5.955

Calculation of Pressure Change (P_g) with Radial Distance (r)

$$P_g(u,t,r) := \frac{Q}{4\cdot\pi\cdot k\cdot\left(\frac{\rho\cdot g}{\mu}\right)\cdot m}\cdot\int_{u(t,r)}^{100} \frac{e^{\left[-x-\left(\frac{r^2}{4\cdot B^2\cdot x}\right)\right]}}{x}\,dx$$

$P_g(u,t,r) =$ g/cm-sec^2

	0
0	$1.575\cdot10^{4}$
1	$1.084\cdot10^{4}$
2	$9.468\cdot10^{3}$
3	$8.641\cdot10^{3}$
4	$8.047\cdot10^{3}$
5	$7.583\cdot10^{3}$
6	$7.203\cdot10^{3}$
7	$6.88\cdot10^{3}$
8	$6.601\cdot10^{3}$
9	$6.354\cdot10^{3}$

$sec^2\,cm^{-1}$

Shaw® Shaw Environmental, Inc.

By __________Date ______Subject ________________________________Sheet No. ___of ___.
Chkd By _____Date ______.______________________________________Proj. No. ________.

Pilot Test Data

Observation Point Radius (r_o)

$r_o :=$

	0
0	5.08
1	609.60
2	2651.76
3	2956.56
4	3048.00
5	4907.28

cm

Observed Vacuum (V_o)

$V_o :=$

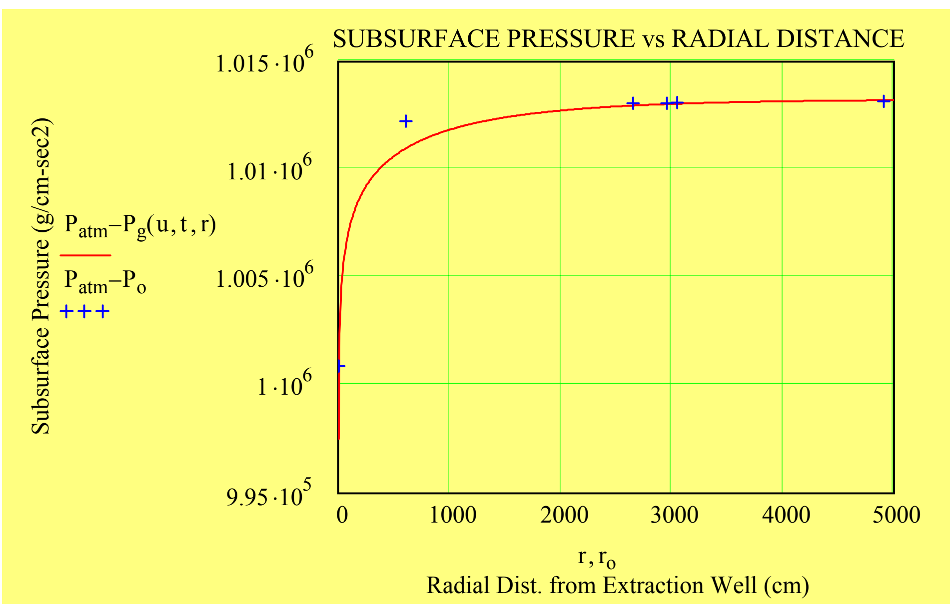
	0
0	4.960
1	0.410
2	0.070
3	0.080
4	0.058
5	0.035

in H_2O

Observed Pressure Change in gm/cm^2-sec (P_o)

$$P_o := V_o \cdot 2490.8891$$

Observed vs Calculated Subsurface Pressure



REFERENCES:

Beckett, G.D., and D. Huntley, 1994, "Characterization of Flow Parameters Controlling Soil Vapor Extraction," ***Ground Water***, Vol. 32, No. 2, p. 239-247.

Appendix C

OU CTP SVE Modeling Results

Table of Contents

List of Figures

1.0 Introduction

A numerical vadose zone airflow model was developed for Operable Unit Carbon Tetachloride Plume (OU CTP) at the Former Fort Ord in Marina, California. The airflow model was used to support the design of a pilot soil vapor extraction (SVE) well system to remediate soils above the water table in the suspected source area for the carbon tetratchloride (CT) groundwater plume. This appendix describes the design of the airflow model, the methods that were used to develop the pilot SVE well system design, and summarizes the results of SVE well field design simulations.

2.0 Model Design

This section describes the principal design elements of the OU CTP airflow model. These design elements include the model code that was selected to develop the airflow model, the major assumptions in the model design, the model grid and layering, the boundary conditions used in the model, and the vadose zone properties assigned to each model layer.

The OU CTP airflow model was designed, constructed, and calibrated in accordance with the American Society for Testing and Materials (ASTM) guidelines for vadose zone airflow modeling (ASTM, 1995) and generally accepted industry practice for numerical groundwater modeling (Anderson and Woessner, 1992). The ASTM guidelines were developed as part of a cooperative agreement between the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), and the U.S. Navy.

2.1 Model Code

The model code that was used to develop the OU CTP airflow model is MODAIR, a three-dimensional, finite-difference, airflow model developed by S.S. Papadopulos and Associates, Inc. (S.S. Papadopulos). MODAIR is an adaptation of the groundwater flow model code MODFLOW (McDonald and Harbaugh, 1988) for vadose zone airflow simulations. MODAIR was selected for development of the OU CTP airflow model because it is well documented and based on the model code MODFLOW. MODFLOW was developed by the USGS, has been verified for a wide range of field problems (EPA, 1993), and is widely used in groundwater investigations (Anderson and Woessner, 1992).

2.2 Assumptions of Model Design

The following simplifying assumptions were made in the design of the OU CTP airflow model:

The unsaturated zone is considered to be under confined flow conditions.

The elevation component of pneumatic head is insignificant.

Air phase permeability is independent of pressure and the Klinkenberg effect is negligible.

Water movement and consolidation of the soils is insignificant, and soil porosity is constant with respect to time.

There is no significant airflow across the water table.

The water table is at an approximate depth of 100 feet.

The shallow soils have a uniform horizontal and vertical air permeability.

2.3 Model Grid

The model grid constructed for the OU CTP airflow model is a eight-layer, 40-row by 40-column, uniformly spaced, finite-difference grid (Figure X-1). The i-direction of the model grid is oriented in a north-south direction with the grid origin (upper left-hand corner) at site coordinates X = 5,747,300 feet East, Y = 2,138,540 feet North. The row and column spacing of the model grid are a uniform 40 feet (1219 centimeters [cm]).

2.4 Model Layers

Airflow in the suspected OU CTP source area is simulated in the model grid by eight layers (Figure X-2):

Layer 1 represents the connection between the vadose zone and the atmosphere
Layer 2 through 7 represents the shallow soils in the suspected OU CTP source area
Layer 8 represents the water table.

Layer 1 is a constant-pressure boundary that simulates the interaction of the atmosphere with the vadose zone (Section X.2.6)

The shallow soils in the suspected OU CTP source area were subdivided into six layers in the model grid to more accurately simulate vertical airflow in the soils. The thickness of these model layers are 10, 20, 20, 20, 20 and 10 feet, respectively (Figure X-2).

Layer 8 is a no-flow boundary that which represents the top of the top of water table (Section X.2.6). The top elevation of this layer is at a depth of 100 feet, the approximate depth of the water table in the suspected CTP source area.

2.5 Flow Conditions

Flow conditions in the DBA V airflow model are simulated as confined (MODFLOW layer type LAYCON=0). The transmissivities calculated for these layers remain constant for the entire model simulation period (McDonald and Harbaugh, 1988). Airflow in the unsaturated zone is considered to be confined as a simplifying assumption in the model design (Section X.2.2).

2.6 Boundary Conditions

The following boundary conditions are used in the OU CTP airflow model:

Upper boundary of model – constant-pressure boundary
Lower boundary of model – no-flow boundary
Lateral boundaries of layers 2, 3, 4, and 5 – no-flow boundaries.

The upper boundary of the model grid (layer 1) is a constant-pressure boundary. This boundary is assigned a constant-pressure at atmospheric pressure (1.0 atmosphere [atm]) and represents the interaction of the atmosphere with the vadose zone.

The lower boundary of the model grid is a no-flow boundary, which represents the top of the top of water table. Vertical airflow between the unsaturated zone and the water table is assumed to be relatively insignificant as a simplifying assumption in the model design (Section X.2.2).

The north, south, east, and west boundaries of layers 2, 3, 4, 5, and 6 are constant-pressure boundaries (Figure X-3). These boundaries are assigned a constant-pressure at atmospheric pressure (1.0 atm).

2.7 Air Permeability

A uniform air permeability of 3×10^{-7} cm^2 was used for all layers in the OU CTP airflow model. This value of air permeability was estimated from SVE pilot tests of the shallow soils in the Operable Unit 2 (OU2) Landfill Gas Mitigation System (Appendix X). Horizontal permeability values are equal to vertical permeability values in all model layers. Uniform values of horizontal and vertical air permeability were used as a simplifying assumption in the model design (Section X.2.2).

3.0 SVE Well System Simulations

The airflow model was used to estimate the number and location of the vent wells needed for the pilot OU CTP SVE system. These wells will be installed to maintain an approximate 0.1 inch of water column (WC) vacuum over the suspected OU CTP source area where CT concentrations in soil gas are greater than 20 parts per billion by volume (ppbv). The model was also used to estimate the required operating vacuums for the individual extraction wells and the total airflow rate from the SVE system.

3.1 Simulation of SVE Well System Operation

Operation of the SVE system was simulated by adding constant-pressure nodes (well nodes) to layers 6 and 7 of the airflow model to represent the vertical vent wells screened over an approximate depth interval between 70 and 100 feet. The number, location, and operating vacuums of the well nodes representing the wells were then varied in successive simulations to achieve a significant vacuum (0.1 inch WC) over the suspected CTP source area where CT concentrations in soil gas are greater than 20 ppbv.X.3.2 Results of SVE Well System Simulations:

The airflow simulations indicated that at least five vent wells would be required for the pilot SVE system. The results of the airflow simulation for a five well SVE system are shown in Figures E-4 and E-8. These figures show the location of the vent wells, the steady-state vacuum solution, and the suspected OU CTP source area where CT concentrations in soil gas are greater than 20 ppbv. The airflow simulations show that a 0.1 inch WC vacuum could be maintained over the suspected CTP source area with a five vent system operating at wellhead vacuum of 8 in. WC. The total airflow rate solution for this simulation is 670 actual cubic feet per minute (acfm).

4.0 References

American Society for Testing and Materials (ASTM), 1995, "Standard Guide for Simulation of Subsurface Airflow Using Ground-Water Flow Modeling Codes," ASTM Standard D 5719-95, 5 pp.

Anderson, Mary P., and W.W. Woessner, 1992, Applied Groundwater Modeling, Academic Press, Inc., San Diego, CA, 381 pp.

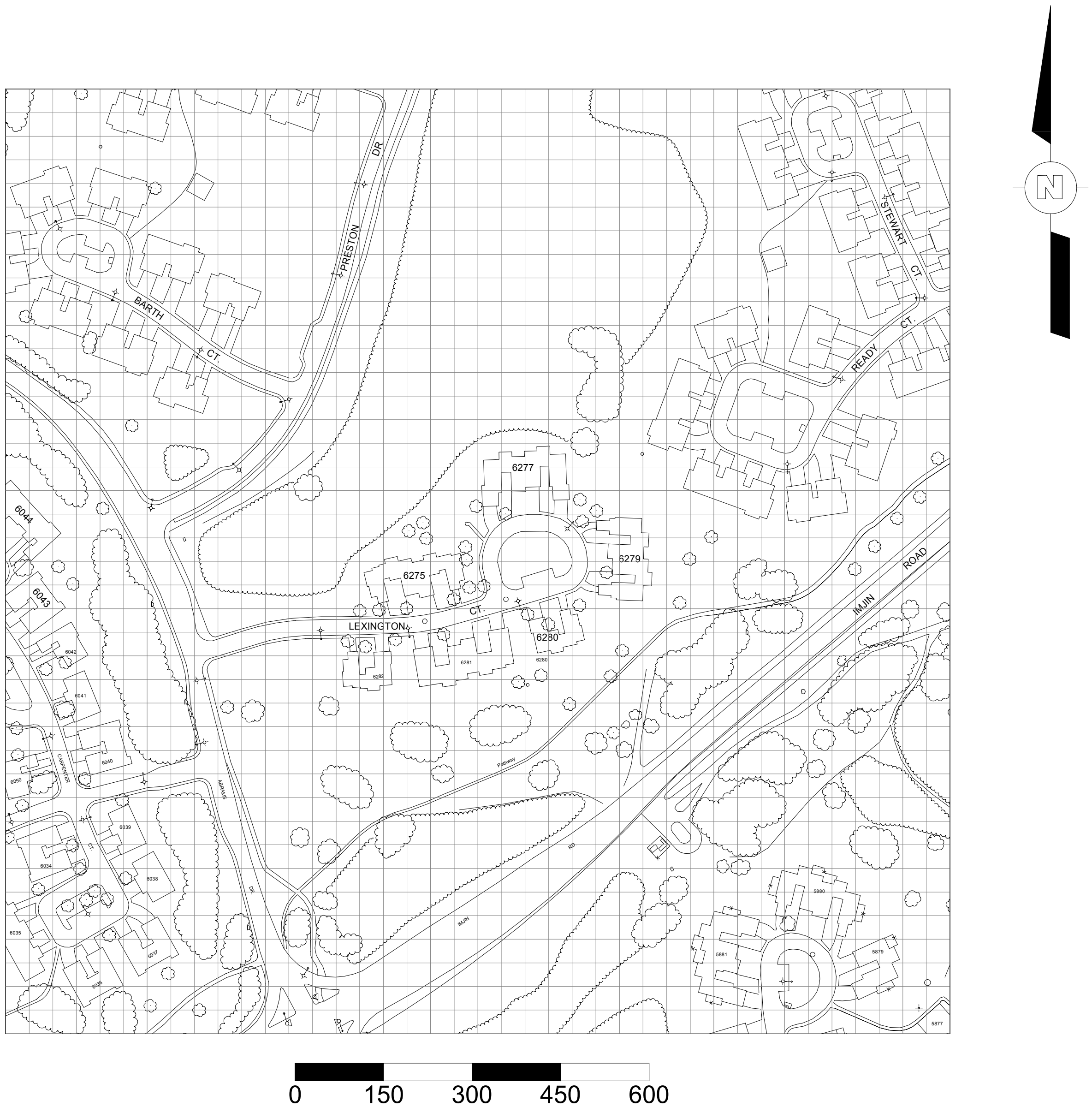
McDonald, M.G., and A.W. Harbaugh, 1988, "A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model," Techniques of Water-Resources Investigations of the United States Geological Survey, Book 6, Chapter A1, 576 pp.

S.S. Papadopulos & Associates, Inc., 1996, Modair Version 1.0, Software for Modeling Air Flow in Unsaturated Soils, SSP&A Software.

U.S. Environmental Protection Agency (EPA), 1993, A Manual of Instructional Problems for the U.S.G.S. MODFLOW Model, EPA/600/R93/010, EPA.

DRAWING NUMBER 783751-SRF-001

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY
DNV	T. Cota	01/07/04		

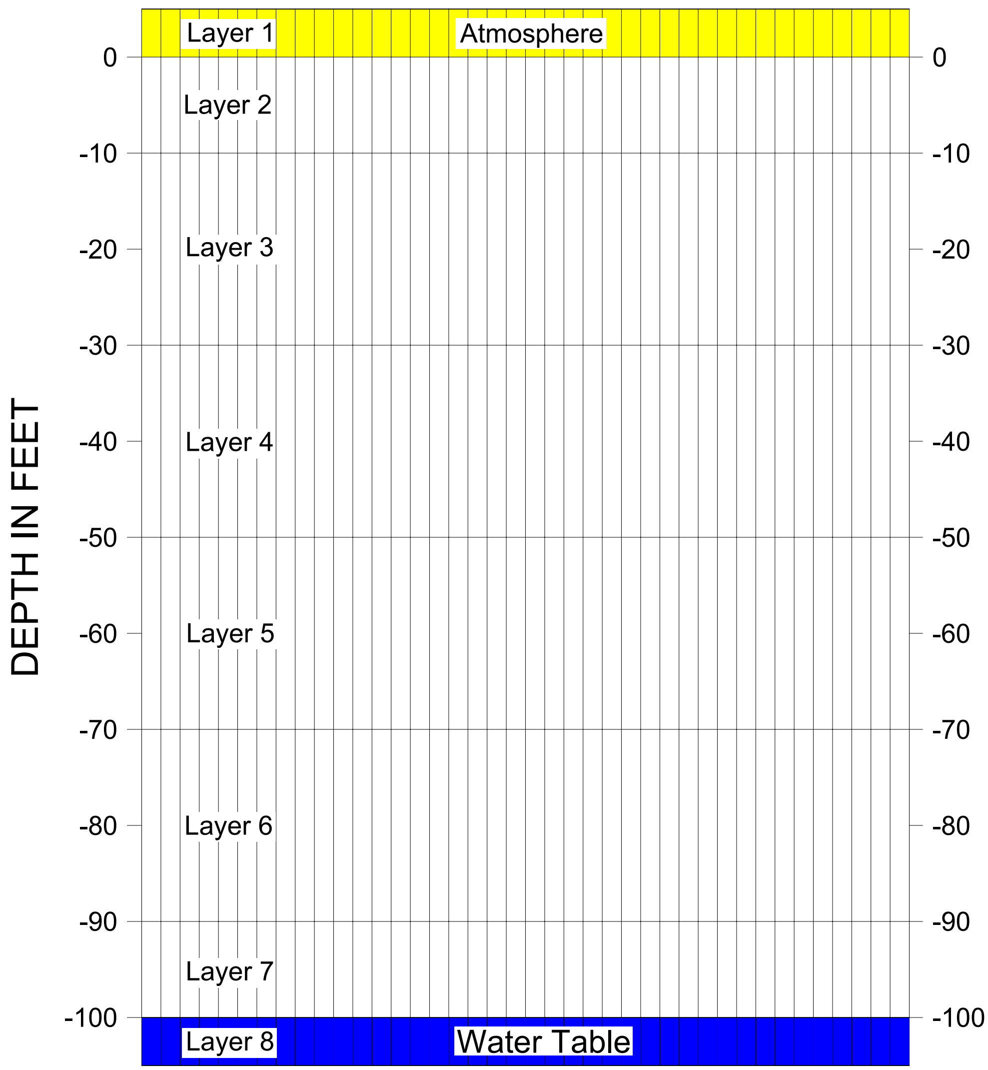


SCALE IN FEET

Shaw
Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-1
FINITE-DIFFERENCE GRID
OU CTP SOURCE AREA AIRFLOW MODEL



OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
DNV	T. Cota	01/07/04			783751-SRF-002

Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-2
MODEL GRID LAYERS
OU CTP SOURCE AREA AIRFLOW MODEL

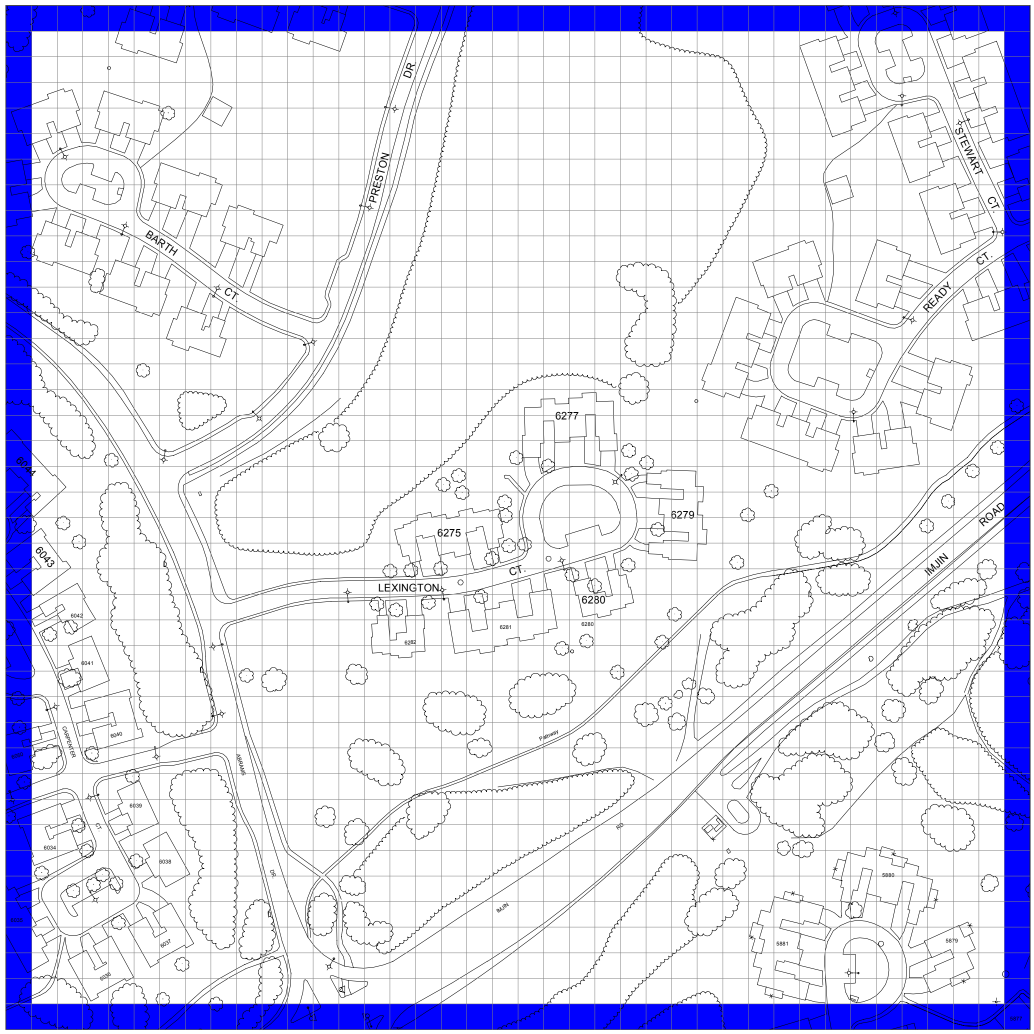
OFFICE: DNV

DRAWN BY: T. Cota 01/07/04

CHECKED BY:

APPROVED BY:

DRAWING NUMBER: 783751-SRF-003



0 150 300 450 600

SCALE IN FEET

LEGEND

Constant-Pressure (1.0 atm) Boundary

Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-3
LATERAL BOUNDARY CONDITIONS
LAYERS 2-6
OU CTP SOURCE AREA AIRFLOW MODEL

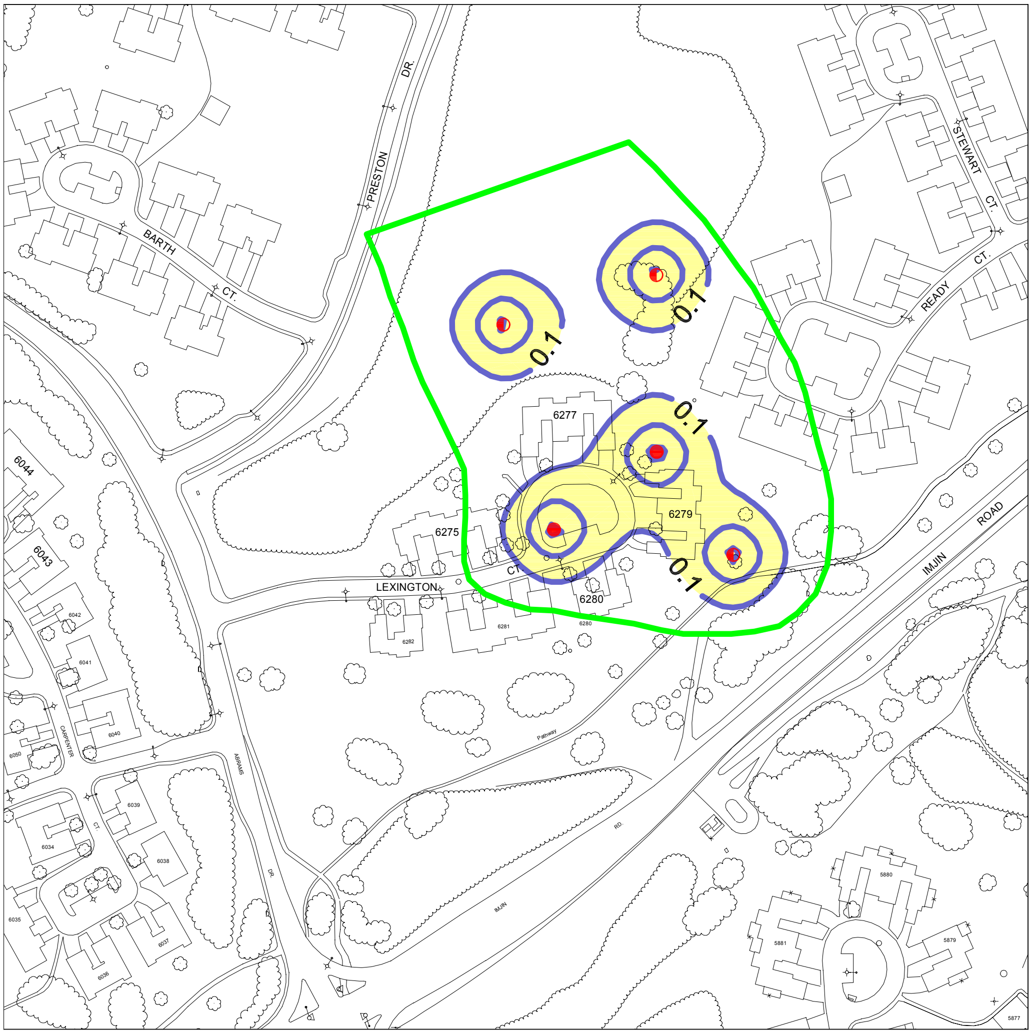
DRAWING NUMBER 783751-SRF-004

APPROVED BY

CHECKED BY

DRAWN BY T. Cota 01/07/04

OFFICE DNV



0 150 300 450 600

SCALE IN FEET

LEGEND

0.1 — Vacuum Contour (in. H20)

Effective SVE Remediation Area

20 ppbv Carbon Tetrachloride Conc. in Soil Gas Below 66

Existing SVE Well

New SVE Well

Shaw
Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-4
VACUUM SOLUTION
15 FT BELOW GROUND SURFACE (LAYER 3)
OU CTP SOURCE AREA AIRFLOW MODEL

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
DNV	T. Cota	01/07/04			783751-SRF-005

LEGEND

- 0.1 — Vacuum Contour (in. H20)
- Effective SVE Remediation Area
- 20 ppbv Carbon Tetrachloride Conc. in Soil Gas Below 66 Feet
- Existing SVE Well
- New SVE Well

Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-5
STEADY-STATE VACUUM SOLUTION
35 FT BELOW GROUND SURFACE (LAYER 4)
OU CTP SOURCE AREA AIRFLOW MODEL

LEGEND

0.1	Vacuum Contour (in. H20)
	Effective SVE Remediation Area
	20 ppbv Carbon Tetrachloride Conc. in Soil Gas Below 66 Feet
	Existing SVE Well
	New SVE Well

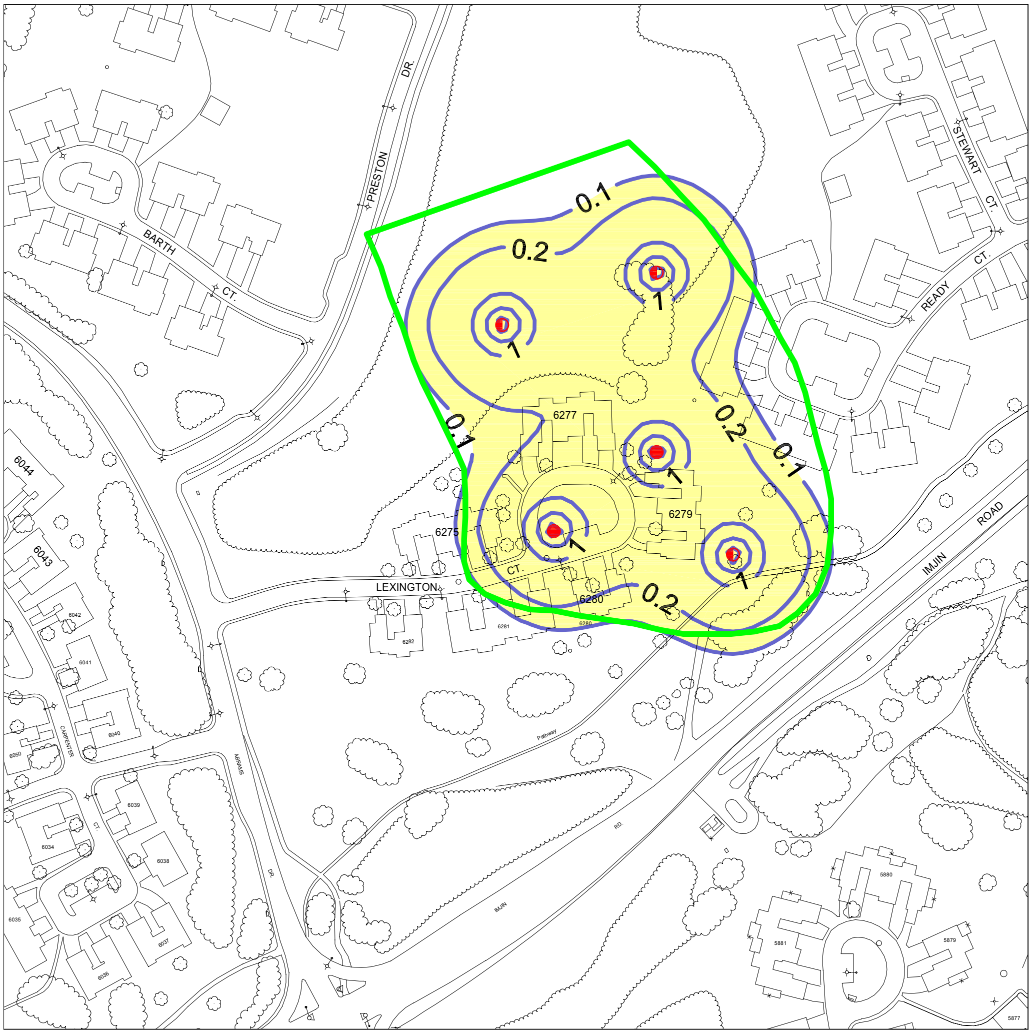
Shaw
Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-6
STEADY-STATE VACUUM SOLUTION
55 FT BELOW GROUND SURFACE (LAYER 5)
OU CTP SOURCE AREA AIRFLOW MODEL

OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
DNV	T. Cota 01/07/04			783751-SRF-006

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
DNV	T. Cota	01/07/04			783751-SRF-007



0 150 300 450 600

SCALE IN FEET

LEGEND

0.1 — Vacuum Contour (in. H20)

Effective SVE Remediation Area

20 ppbv Carbon Tetrachloride Conc. in Soil Gas Below 66 Feet

Existing SVE Well

New SVE Well

Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-7
STEADY-STATE VACUUM SOLUTION
75 FT BELOW GROUND SURFACE (LAYER 6)
OU CTP SOURCE AREA AIRFLOW MODEL

LEGEND

- 0.1 — Vacuum Contour (in. H20)
- Effective SVE Remediation Area
- 20 ppbv Carbon Tetrachloride Conc. in Soil Gas Below 66 Feet
- Existing SVE Well
- New SVE Well

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
DNV	T. Cota	01/07/04			783751-SRF-008

Shaw E & I, Inc.

FORMER FORT ORD
MONTEREY COUNTY, CALIFORNIA

FIGURE C-8
STEADY-STATE VACUUM SOLUTION
90 FT BELOW GROUND SURFACE (LAYER 7)
OU CTP SOURCE AREA AIRFLOW MODEL

Appendix D

Construction Specifications

Table of Contents

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Submittals

1.1.2 Submittal Procedures

1.1.3 Submittal Approval

1.1.4 Schedules

1.1.5 Product Information

1.1.6 Drawings

1.1.7 Reports

1.1.8 Records

1.2 SUBMITTALS

1.2.1 Shaw Environmental and Infrastructure (Shaw) Approved Submittals

1.2.1.1 Shaw approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items designated by Shaw.

1.2.1.2 Upon completion of review of submittals requiring Shaw approval, the submittals will be identified as having received approval by being so stamped and dated. Six copies of the submittal will be retained by Shaw and two copies of the submittal will be returned to the Subcontractor.

1.2.2 Information Only Submittals

1.2.2.1 Submittals not requiring Shaw approval will be for information only (FIO).

1.2.2.2 Normally submittals for information only will not be returned. Approval of Shaw is not required on information only submittals. Shaw reserves the right to require the Subcontractor to resubmit any item found not to comply with the contract. This does not relieve the Subcontractor from the obligation to furnish material conforming to the drawings and specifications and will not prevent Shaw from requiring removal and replacement of nonconforming material incorporated in the work. This does not relieve the Subcontractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.3 SUBMITTALS PROCEDURES

1.3.1 Submit schedules, product information, drawings, reports, and records as required in the particular section of the Work.

1.3.2 All items listed as ITA submittals in the specification will be mailed directly to the addressee shown below as directed.

Project Manager
Shaw E&I
P.O. Box 1698
Marina, CA 93933-1698

1.3.3 Except as noted in the specification, five copies for items listed as FIO submittals will be submitted to Shaw by correspondence at the address provided above. Items not to be submitted in quintuplicate, such as samples and test cylinders, will also be submitted to Shaw.

1.3.4 Transmit each submittal, as specified in the applicable specification section, by correspondence written on company letterhead.

1.3.5 Identify Project, Subcontractor, or Subcontractor supplier; pertinent drawing and detail number and specification number, as appropriate. Units of weights and measures used on submittals will be the same used in the Contract Drawings.

1.3.6 Apply Subcontractor’s stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work.

1.3.7 For each submittal for review, allow 35 calendar days, excluding delivery time to and from Shaw.

1.3.8 Each submittals will be complete and sufficient in detail to allow ready determination of compliance with Contract Requirements. Variations from Contract Documents, and product or system limitations which may be detrimental to successful performance of the completed Work, will be identified.

1.3.9 Provide space for review stamps.

1.3.10 Prior to submittal, all items will be checked and approved by the Subcontractor's Quality Control (CQC) representative. Each item will be stamped, signed, and dated by the CQC representative indicating action taken.

1.3.11 Revise, resubmit, and identify changes made since previous submission.

1.3.12 Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.

1.4 SUBMITTAL APPROVAL

1.4.1 Approved Submittals

1.4.1.1 Shaw approval of submittals will not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory.

1.4.1.2 Approval will not relieve the Subcontractor of the responsibility for any error which may exist, as the Subcontractor under the Construction Quality Control requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of work.

1.4.2 Disapproved Submittals

The Subcontractor will make corrections required by Shaw and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Subcontractor considers any correction indicated on the submittals to constitute a change to the Contract, a notice in accordance with the Contract Clause "Changes" will be submitted promptly to Shaw.

1.4.3 Withholding of Payment

Payment for materials incorporated in the Work will not be made if required approvals have not been obtained.

1.5 SCHEDULES

1.5.1 Submit a master construction schedule in duplicate within seven calendar days of Notice to Proceed. The schedule will:

- List major work activities
- Identify critical path items

- Show appropriate logic ties between activities
- Identify intermediate milestones in addition to construction completion.
- Indicate submittal dates required for drawings, product information, and delivery dates, including those furnished by Shaw.

1.5.2 Revise and resubmit the schedule whenever it no longer represents the reality of the actual construction progress, identifying changes since previous version.

1.5.3 Submit two-week look-ahead schedules on a weekly basis prior to the weekly progress meeting. Indicate estimated percentage of completion for each item of Work at each submission.

1.6 PRODUCT INFORMATION

1.6.1 Proposed Products List

1.6.1.1 Within 15 days after date of Shaw-Subcontractor Agreement Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model of each product.

1.6.1.2 For products specified by reference standards, submit name of manufacturer, model/catalog designation, and reference standards.

1.6.2 Product Data

1.6.2.1 Submit eight copies of product information including product data, catalog cuts, and other descriptive data.

1.6.2.2 Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to the Work.

1.6.2.3 Submittals on component items forming a system or that are interrelated will be submitted at one time as a single submittal to demonstrate that the items have been properly coordinated and will function as a unit.

1.6.3 Manufacturer's Installation Instructions

1.6.3.1 When specified in individual specification sections, submit printed instructions for installation to Shaw in quantities specified for Product Data.

1.6.3.2 Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.6.4 Certificates of Compliance

1.6.4.1 Where required, submit three copies of certificates as proof of compliance of materials with specification requirements. Indicate material or product conforms to or exceeds specified requirements and submit supporting reference data, affidavits, and certifications as appropriate.

1.6.4.2 Each certificate will be signed by an official authorized to certify on behalf of the manufacturing company.

1.6.4.3 Each certificate will contain the following information:

- The name and address of the subcontractor
- The project name and location
- The quantity of the product and date(s) of shipment or delivery to which the certificates apply.

1.7 DRAWINGS

1.7.1 Submit one reproducible and one print of the drawing for approval. Reproducible will be brownlike diazo or sepia and prints will be blueprint.

1.7.2 Submit as-built drawings and associated electronic data files with the final application for payment. As-builts will be drafted on mylar and electronic data files will be compatible with the latest release of AutoCAD.

1.8 REPORTS

1.8.1 Variations

Submit written request to and obtain approval from Shaw in advance of variations to the scope of work, specification, or drawing which may affect the quality or safe and timely completion of the work.

1.8.2 Daily Activity Report

Prepare an activity report daily, and submit it the morning of the following work day. The report will contain the following information:

- Identification of each significant work activity performed during the day
- Number of workers
- Major pieces of equipment
- Test results
- Events, if any, which may impact the performance of the Work.

1.8.3 Material Status Report

Submit a material status report weekly with material description, vendor, purchase order number, delivery date, and quantity. Identify and justify any significant variances from original quantities.

1.9 RECORDS

1.9.1 Submit record of quantities daily.

1.9.2 Submit certified payrolls weekly.

1.9.3 Submit three copies of test records and results.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01440

SUBCONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 References

1.1.2 Submittals

1.1.3 Quality Control Project Requirements

1.1.4 General Quality Control

1.1.5 Acceptance of Plan

1.1.6 Control

1.1.7 Tests

1.1.8 Completion Inspection

1.1.9 Documentation

1.1.10 Sample Forms

1.1.11 Notification of Noncompliance

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D3740	Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E329	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

US ARMY CORP OF ENGINEERS (USACE) Contractor Quality Control/Chemical Data Quality Management Plan, QC, (CDQMP), Total Environmental Restoration Contract DACW05-95-D-0001, Sacramento District

Shaw Environmental and Infrastructure (Shaw), Work Plan and Contractor Quality Control/Sampling and Analysis Plan (Work Plan), Carbon Tetrachloride SVE Pilot Test, Fort Ord, California

1.2 SUBMITTALS

1.2.1 Prepare submittals in accordance with Section 01300, SUBMITTALS.

1.2.2 Submit the following qualifications, designations, and certifications, reporting to Shaw prior to the execution of work.

- The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

- A copy of the letter to the subcontractor's Quality Control (QC) Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the QC Manager, including authority to stop work which is not in compliance with the Contract. The QC Manager will issue letters of direction to various QC representatives outlining duties, authorities, and responsibilities. Copies of these letters will also be furnished to Shaw. Shaw will forward these documents to the Government for review .

1.3 QUALITY CONTROL PROJECT REQUIREMENTS

Comply with the Quality Control (QC) program requirements included in the following documents:

- CDQMP
- Work Plan

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL QUALITY CONTROL

Shaw is responsible for QC and maintains an effective QC system in compliance with the CQC/CDQMP. The QC system consists of plans, procedures, and organization necessary to produce an end product which complies with Contract requirements. The system incorporates construction operations, both onsite and offsite, and is keyed to the proposed construction sequence. All work performed on this delivery order will be performed in accordance with the CQC/CDQMP and the CQC/SAP.

Subcontractors may be required to provide task-specific work plans. Under all circumstances, the subcontractor will be required to comply with the CQC and site-specific QC plans. The Subcontractor's project superintendent will be held responsible for the quality of work on the job and is subject to removal by Shaw for non-compliance with quality requirements specified in the Contract. The project manager is the individual responsible for the overall management of the project, including quality and production.

3.2 ACCEPTANCE OF PLAN

Acceptance of the Subcontractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Shaw reserves the right to require the Subcontractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.3 NOTIFICATION OF CHANGES

After acceptance of the CQC Plan, the Subcontractor will notify Shaw in writing of any proposed change. Proposed changes are subject to acceptance by Shaw.

3.4 CONTROL

Subcontractor QC is the means by which Shaw ensures that the construction, including that of subcontractors and suppliers, complies with Contract requirements. At least three phases of control will be conducted by the CQC System Manager for each definable feature of work as follows:

3.4.1 Preparatory Phase

This phase will be performed prior to beginning work on each definable feature of work and will include:

- A review of each paragraph of applicable specifications.
- A review of the Contract drawings.
- A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- Review of provisions that have been made to provide required control inspection and testing.
- Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

- A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

- A review of the appropriate activity hazard analysis to assure safety requirements are met.

- Discussion of procedures for controlling quality of the work including repetitive deficiencies. Documentation of construction tolerances and workmanship standards for that feature of work.

- A check to ensure that the portion of the plan for the work to be performed has been accepted by Shaw.

- Discussion of the initial control phase.

- The Government will be notified at least 72 hours in advance of beginning the preparatory control phase. This phase will include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions will be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Subcontractor will instruct applicable workers as to the acceptable level of workmanship required in order to meet Contract specifications.

3.4.2 Initial Phase

This phase will be accomplished at the beginning of a definable feature of work. The following will be accomplished:

- A check of work to ensure that it is in full compliance with Contract requirements. Review minutes of the preparatory meeting.

- Verify adequacy of controls to ensure full Contract compliance. Verify required control inspection and testing.

- Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

- Resolve all differences.

- Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

- The Government will be notified at least 72 hours in advance of beginning the initial phase. Separate minutes of this phase will be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase will be indicated for future reference and comparison with follow-up phases.

- The initial phase will be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.4.3 Follow-up Phase

Daily checks will be performed to assure control activities are providing continued compliance with Contract requirements, until completion of the particular feature of work. The checks, which include passed and/or failed test results, will be made a matter of record in the CQC documentation. Final follow-up checks will be conducted and deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Subcontractor will not build upon or conceal non-conforming work.

3.4.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases will be conducted on the same definable features of work if:

- The quality of on-going work is unacceptable

- There are changes in the applicable CQC staff

- Onsite production supervision or work crew

- Work on a definable feature is resumed after a substantial period of inactivity

- Other problems develop.

3.5 TESTS

3.5.1 Testing Procedure

Shaw and/or its Subcontractors will perform specified or required tests to verify that control measures are adequate to provide a product which conforms with Contract requirements. Testing will be performed in accordance with the CQC/CDQMP. Upon request, Shaw and/or its Subcontractor will furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified.

Shaw will procure the services of a USACE approved testing laboratory or establish an approved testing laboratory at the project site. Shaw will perform the following activities and record and provide the following data:

- Verify that testing procedures comply with Contract requirements.

- Verify that facilities and testing equipment are available and comply with testing standards.

- Check test instrument calibration data against certified standards.

- Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

- Results of all tests taken, both passing and failing tests, will be recorded on the CQC daily report for the date taken. Specification paragraph reference, three dimensional location where tests were taken (i.e., station, off-set, and elevation), and the sequential control number identifying the test will be given. (The test number of any test which is a retest, verifying corrections of any failures will be the failed test number followed by an "A." If necessary, following retest numbers will be followed by "B", "C", etc.) If approved by Shaw, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility will be provided directly to Shaw. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this Contract.

3.5.2 Testing Laboratories

3.5.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the Contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel will meet criteria detailed in ASTM D3740 and ASTM E329.

3.5.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Subcontractor will reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Subcontractor.

3.5.3 Onsite Laboratory

The Government reserves the right to utilize the Subcontractor's control testing laboratory and equipment to conduct assurance tests and check the Subcontractor's testing procedures, techniques, and test results.

3.5.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Subcontractor. Samples of materials for test verification and acceptance testing by the Government will be delivered to the Government's Designated Laboratory.

Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.6 COMPLETION INSPECTION

3.6.1 Pre-Final Inspection

At the completion of work or any increment thereof established by these specifications, the CQC System Manager will conduct an inspection of the work and develop a "Punch List" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies will be included in the CQC documentation and will include the estimated date by which the deficiencies will be corrected. Once this is accomplished, Shaw will notify the Government that the facility is complete and is ready for the Government's "Prefinal" inspection. The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Prefinal Punch List" will be developed as a result of this inspection. The Shaw CQC System Manager will ensure that items on this list have been corrected and so notify the Government so that a "Final" inspection with the customer can be scheduled. Any items noted on the "Final" inspection will be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.6.2 Final Acceptance Inspection

The Subcontractor's Quality Control inspection personnel, his superintendent or other primary management person and an Shaw representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by Shaw based upon notice from the Subcontractor. This notice will be given to Shaw at least 14 days prior to the final acceptance inspection and must include the Subcontractor's assurance that all specific items previously identified to the Subcontractor as being acceptable, along with all remaining work performed under the Contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Subcontractor to have all contract work acceptably complete for this inspection will be cause for Shaw to bill the Subcontractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction."

3.7 DOCUMENTATION

3.7.1 Shaw and its Subcontractors will maintain current records providing factual evidence that required QC activities and/or tests have been performed. These records will include the work of subcontractors and suppliers and will be on an acceptable form that includes, as a minimum, the following information:

- Subcontractor/supplier and their area of responsibility.
- Operating plant/equipment with hours worked, idle, or down for repair.
- Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- Submittals reviewed, with Contract reference, by whom, and action taken.
- Offsite surveillance activities, including actions taken.
- Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- Instructions given/received and conflicts in plans and/or specifications.
- Subcontractor's verification statement.

3.7.2 These records will indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records will cover both conforming and deficient features and will include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. The original and one copy of these records in report form will be furnished to Shaw daily within 24 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. All calendar days will be accounted for throughout the life of the Contract. The first report following a day of no work will be for that day only. Reports will be signed and dated by the Subcontractor's QC manager. The report from the QC Manager will include copies of test reports and copies of reports prepared by all subordinate QC personnel. Copies of Contract required reports will be forwarded to the Government by Shaw.

3.8 SAMPLE FORMS

Sample forms will be provided by Shaw.

3.9 NOTIFICATION OF NONCOMPLIANCE

Shaw will notify the Subcontractor of any detected noncompliance with the foregoing requirements. The Subcontractor will take immediate corrective action after receipt of such notice. Such notice, when delivered to the Subcontractor at the work site, will be deemed sufficient for the purpose of notification. If the Subcontractor fails or refuses to comply promptly, Shaw may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Subcontractor.

END OF SECTION

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 References

1.1.2 General Requirements

1.1.3 Availability and Use of Utility Services

1.1.4 Protection and Maintenance of Traffic

1.1.5 Subcontractor's Temporary Facilities

1.1.6 Plant Communication

1.1.7 Temporary Safety Fencing

1.1.8 Cleanup

1.1.9 Decontamination Area

1.1.10 Dust Suppression

1.2 REFERENCES

1.2.1 Shaw Environmental and Infrastructure (Shaw), Work Plan and Contractor Quality Control/Sampling and Analysis Plan (Work Plan), Carbon Tetrachloride SVE Pilot Test, Fort Ord, California

.

1.2.2 Shaw, Site Safety and Health Plan (SSHP), Fort Ord, California, Rev 7.

1.3 GENERAL REQUIREMENTS

1.3.1 Subcontractor Storage Area: Before beginning work, indicate the proposed number of trailers and storage area requirements. Indicate if the use of a supplemental or other staging area is desired. Due to sensitive species concerns, proposed fenced areas and their access routes require approval by Shaw prior to construction.

1.3.2 Identification of Employees: The Subcontractor's employees engaged on the work are required to display identification as approved and directed by Shaw. Prescribed identification will immediately be delivered to Shaw for cancellation upon release of any employee. When required, the Subcontractor will obtain and provide fingerprints of persons employed on the project. Subcontractor and personnel will wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.3.3 Employee Parking: Park privately owned vehicles in an area designated by Shaw. Parking area will be within reasonable walking distance of the construction site.

1.4 AVAILABILITY AND USE OF UTILITY SERVICES

1.4.1 Payment for Utility Services: Government will provide utility service available to the Subcontractor from existing outlets and supplies. The amount of each utility service consumed will be charged to or paid for by the Subcontractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by Shaw.

1.4.2 Meters and Temporary Connections: Provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. Notify Shaw, in writing, five working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Subcontractor's temporary wiring installation. Under no circumstance will the Subcontractor make the final electrical connection.

1.4.3 Advance Deposit: Pay an advance deposit for utilities consisting of an estimated month's usage or a minimum of $250.00 to Shaw. The last monthly bills for the fiscal year will normally be offset by the deposit, and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning October 1, will require a new deposit. Notification of the due date for this deposit will be mailed to the Subcontractor prior to the end of the current fiscal year.

1.4.4 Final Meter Reading: Before completion and final acceptance of the work by the Government, notify Shaw, in writing, five working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meter(s). The Subcontractor will then remove all the temporary distribution lines, meter base(s), and associated equipment. The Subcontractor will pay all outstanding utility bills before final acceptance of the work by the Government.

1.4.5 Sanitation: Provide and maintain within the construction area minimum field-type sanitary facilities approved by Shaw. Government or Shaw restroom facilities will not be available to Subcontractor's personnel.

1.4.6 Telephone: Make arrangements and pay costs for telephone facilities.

1.5 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction, Shaw will be responsible for traffic control and provide access and temporary relocated or detour roads as necessary to maintain traffic. The Subcontractor's traffic on roads selected for hauling material to and from the site will interfere as little as possible with public traffic. The Subcontractor will investigate the adequacy of existing roads and the allowable load limit on these roads. The Subcontractor will be responsible for the repair of any damage to roads caused by Subcontractor construction operations. The Subcontractor will be responsible for replacement of sections of road removed by the Subcontractor to complete this work.

1.5.1 General: Conduct operations as to offer the least possible obstruction and inconvenience to pedestrian and vehicular traffic. Do not have under construction a greater amount of work than can be prosecuted properly with due regard for the rights of the public. The length of construction for purposes of traffic control will be defined as any section of public street or public right-of-way upon which the full width of existing roadway is not available for vehicular or pedestrian traffic because of interference from construction equipment, excavation, stockpiled material, or untraversable areas.

1.5.2 Protection of Pedestrian Traffic: Protect the public from construction activities.

1.6 SUBCONTRACTOR'S TEMPORARY FACILITIES

1.6.1 Administrative Field Offices: Provide and maintain administrative field office facilities within the construction area at a site designated by Shaw. Government office facilities will not be available to the Subcontractor's personnel.

1.6.2 Storage Area: Use the fenced equipment storage area indicated on the Site Plan. Trailers, materials, or equipment will not be placed or stored outside the fenced area unless approved by Shaw. At the end of each work day mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, and materials will be left in an organized manner as approved by Shaw.

1.6.3 Supplemental Storage Area: If needed, Shaw will designate another or supplemental area for the Subcontractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity to the construction site but will be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Subcontractor will be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.6.4 Appearance of Trailers: Provide trailers with a clean and neat exterior appearance and in a state of good repair. Trailers which, in the opinion of Shaw, require exterior painting or maintenance will not be allowed on the military property.

1.6.5 Maintenance of Storage Area: Maintain storage areas and fencing around storage areas in a state of good repair and proper alignment. Do not traverse with construction equipment or other vehicles grassed or unpaved areas which are not established roadways.

1.6.6 Security Provisions: Adequate outside security lighting will be provided at the Subcontractor's temporary facilities. Subcontractor is responsible for the security of its own equipment; in addition, the Subcontractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.7 PLANT COMMUNICATION

Whenever the Subcontractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, install a satisfactory means of communication, such as telephone or other suitable devices. The devices will be made available for use by Government personnel.

1.8 TEMPORARY SAFETY FENCING

If specified or required to protect the public, provide a temporary safety fencing around the work area. As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing will be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10-foot centers, constructed at the approved location. Maintain the safety fencing during the duration of the Subcontract and, upon completion and acceptance of the work, remove from the work site.

1.9 CLEANUP

Dirt or mud tracked onto paved or surfaced roadways will be cleaned away upon completion. Materials resulting from demolition activities which are salvageable will be stored within the fenced area or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, will be neatly stacked.

1.9.1 Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

1.9.2 Collect and remove waste materials, debris, and rubbish from site weekly.

1.9.3 Furnish a minimum of one 2-cubic-yard capacity waste bin for rubbish disposal and provide for weekly disposal service at a minimum. Locate the waste bin near the construction facilities. Arrange for disposal service on an as-needed basis.

1.10 DECONTAMINATION AREA

1.10.1 Use Shaw equipment decontamination facilities within the contamination reduction zone for removing contaminants from vehicles and equipment leaving the work area.

1.10.2 Collect decontamination wastewater in storage tank.

1.10.3 Do not allow wastewater to run off of the site onto rights-of-way or adjacent property.

1.10.4 Personnel engaged in vehicle decontamination will wear protective equipment including disposable clothing and respiratory protection as required by the SSHP.

1.10.5 Consider the decontamination area a hazardous work area; Any item taken into the exclusion zone, will be contaminated and decontaminated before removing item from the area. Clean all contaminated vehicles, equipment, and materials prior to leaving the site.

1.11 DUST SUPPRESSION

1.11.1 Conduct operations and maintain the site so as to minimize the creation and dispersion of dust.

1.11.2 Use dust control throughout the work, especially during soil excavation, handling and transport, rough grading, and placement of final cover.

1.11.3 Provide clean water, free from salt, oil, or other deleterious material for on-site dust control in any area.

1.11.4 Supply water spraying equipment capable of accessing all work areas.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Products

1.1.2 Transportation and Handling

1.1.3 Storage and Protection

1.1.4 Product Options

1.1.5 Substitutions

1.2 PRODUCTS

1.2.1 Do not use materials and equipment removed from existing premises, except as specifically permitted.

1.2.2 Provide interchangeable components of the same manufacture for components being replaced.

1.3 TRANSPORTATION AND HANDLING

1.3.1 Transport and handle Products in accordance with manufacturer's instructions.

1.3.2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.

1.3.3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE AND PROTECTION

1.4.1 Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible.

1.4.2 Store sensitive Products in weather tight, climate controlled enclosures.

1.4.3 For exterior storage of fabricated Products, place on sloped supports, above ground.

1.4.4 Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

1.4.5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of Product.

1.4.6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

1.4.7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

1.4.8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

1.5.1 Products specified by reference standards or by description only: any Product meeting those standards or description.

1.5.2 Products specified by naming one or more manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

1.5.3 Products specified by naming one or more manufacturers with a provision for substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

1.5.4 “Or Equal”

- Where the phrase “or equal” or “or approved equal” occurs in the Contract Documents, do not assume materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by Shaw Environmental and Infrastructure (Shaw).

- The decision of Shaw is final.

1.6 SUBSTITUTIONS

1.6.1 Shaw will consider requests for Substitutions only within 30 days after Notice to Proceed.

1.6.2 Substitutions may be considered when a Product becomes unavailable through no fault of the Subcontractor.

1.6.3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

1.6.4 A request constitutes a representation that the Subcontractor:

- Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
- Will provide the same warranty for the Substitution as for the specified Product.
- Will coordinate installation and make changes to other work which may be required for the Work to be complete with no additional cost to the Government.
- Waives claims for additional costs or time extension which may subsequently become apparent.
- Will reimburse the Government for review or redesign services by Shaw associated with re-approval by authorities.

1.6.5 Substitutions will not be considered when they are indicated or implied on drawing or product data submittal, without separate written request, or when acceptance will require substantial revision to the Contract Documents.

1.6.6 Do not order or install substitute products without written acceptance.

1.6.7 Only one request for substitution for each product will be considered. When substitution is not accepted, provide specified product.

1.6.8 Shaw will determine acceptability of substitutions.

1.6.9 Identify product by Specification Section and Article numbers. Provide manufacturer's name and address, trade name of product, and model or casting number. List fabricators and suppliers as appropriate.

1.6.10 Give itemized comparison of proposed substitution with specified product, listing variations, and reference to Specification Section and Article numbers.

1.6.11 Give quality and performance comparison between proposed substitution and the specified product.

1.6.12 Give cost data comparing proposed substitution with specified product, and amount of net change to Contract Sum.

1.6.13 List availability of maintenance services and replacement materials.

1.6.14 State effect of substitution on construction schedule, and changes required in other work or products.

1.6.15 Request for substitution constitutes a representation that Subcontractor has investigated proposed product and has determined that it is equal to or superior in all respects to specified products (or that the cost reduction offered is ample justification for accepting the offered substitution).

1.6.16 Provide same warranty for substitution as for specified product.

1.6.17 Coordinate installation of accepted substitute, making such changes as may be required for Work to be complete.

1.6.18 Certify that cost data presented are complete and include related costs.

1.6.19 Waive claims for additional costs related to substitution which may later become apparent.

1.6.20 Substitution Submittal Procedure:

- Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
- Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
- Shaw will notify Subcontractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

.

END OF SECTION

SECTION 02521

SOIL VAPOR EXTRACTION WELLS

PART 1 GENERAL

1.1 SECTION INCLUDES

Vertical soil vapor extraction wells, well heads, connection pipe, seals, and vaults.

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2488	Description and Identification of Soils (Visual - Manual Procedure)
ASTM D 3034	Polyvinyl Chloride (PVC) Pipe

1.3 SUBMITTALS

1.3.1 Prepare submittals in accordance with Section 01300, SUBMITTALS.

1.3.2 Submit product data for the following materials:

- Bentonite pellets
- Pea gravel
- Well materials
- Well head assembly (by Shaw Environmental and Infrastructure[Shaw])
- Well head connection (by Shaw)

1.3.3 Submit prior to field work:

- Driller qualifications, including the driller's license number
- Proposed method of drilling
- Names, qualifications and safety record for any proposed onsite subcontractor

1.3.4 Submit proposed variances from regulations and procedures.

1.3.5 Submit a driller's daily work report or daily ticket, including the following information:

- Time on job
- Standby time and down time
- Well number
- Footage drilled
- Footage constructed
- Materials used

- Other activities

1.3.6 Shaw will obtain and submit permits (if required) before mobilizing to site.

1.3.7 Final Well Log: (Provided by Shaw)

Include the following:

- Project title and number
- Description of the installed well
- Date of drilling
- Borehole diameter
- Depth of bottom of casing and bottom of borehole
- Casing diameter and wall thickness, and length installed
- Perforated or screened interval
- Description of geologic materials encountered (ASTM D 2488)
- Presence or absence of water
- Drilling advancement rates
- Time, depth, and description of unusual occurrences or problems during drilling
- Type, size, and quantity of gravel pack installed
- Coordinates (California State Plane) of well
- Name of logger (Shaw)

1.4 QUALITY ASSURANCE

1.4.1 Provide experienced competent driller and crew on site during drilling and well installation activities.

1.4.2 Drilling and well installation will be supervised by Shaw.

1.4.3 Do not change proposed field personnel without written permission from Shaw.

PART 2 PRODUCTS

2.1 VERTICAL WELLS

2.1.1 Wells: Pipes, couplings, end caps, and fittings: PVC, Schedule 40 (ASTM D1785), square flush-threaded with o-ring, 4-inch-diameter, 8 threads per inch (tpi).

2.1.2 Screens: PVC, Schedule 40 (ASTM D1785), square flush-threaded with o-ring, 4-inch-diameter, 8 tpi, machine-slotted, 1/8-inch slots, 30 feet, each well.

2.2 Wellhead Assembly

2.2.1 CES Landtec Accu-Flo (supplied by Shaw).

2.3 Wellhead Connection

2.3.1 Components: compression adaptor, flexible coupling, compatible with the wellhead model.

2.4 SEALING MATERIALS

2.4.1 Gravel pack: 3/8-inch crushed or natural washed pea gravel.

2.4.2 Bentonite-cement grout: One sack (94 lbs) of Type II Portland cement and 3 to 5 percent bentonite powder for each 4-1/2 to 6-1/2 gallons of clean water.

2.4.3 Bentonite Seal: 3/8-inch chip.

2.5 CONCRETE WELL VAULT

2.5.1 Supplied and installed by Shaw.

PART 3 EXECUTION

3.1 DRILLING

3.1.1 Drilling Methods: Provide a minimum borehole diameter of 8 inches to the maximum depth of 90 feet.

3.1.2 Boring Depths: Actual depths will depend on conditions encountered during drilling.

3.1.3 Obstructed Borings: If obstructions are encountered during borehole advancement, do not attempt to penetrate obstruction. Shaw will determine which of the following courses of action to be taken.

3.1.3.1 Abandonment: Abandon borehole by backfilling with bentonite slurry and relocate borehole at the direction of Shaw. No submittals will be required.

3.1.3.2 Completion: Complete borehole and install well to the depth obtained.

3.2 WELL INSTALLATION

3.2.1 Drill borehole so as to permit installation of well casing assembly in a plumb and true line.

3.2.2 Well Casing: Assemble the solid and perforated casing sections together. Center casing assembly in borehole. Maintain casing assembly vertically plumb during backfilling of borehole.

3.2.2.1 Perforated Casing: Pipe lengths vary and will be determined based on data obtained during drilling activities. Order perforated casing pipe with end cap prefabricated, and field trim excess length to fit the borehole.

3.2.2.2 Joints: Flush thread with O-ring.

3.2.3 Gravel Pack: To prevent bridging, pour pea gravel carefully into annular space to the design level above the top of the well screen, as determined by volume measurements and sounding with a weighted tape. Remove drill rods slowly, at the same rate that the pea gravel is placed. Sound frequently enough so that placement is accurate to within 0.2 foot.

3.2.4 Bentonite Seal: Pour bentonite pellets gradually and carefully to the design level as determined by volume measurements and sounding with a weighted tape.

3.2.5 Bentonite-Cement Grout: Wait 30 minutes after placing bentonite seal, then place bentonite-cement grout to design level of the bottom of well box.

3.3 WELLHEAD INSTALLATION

3.3.1 Follow manufacturer's recommendations for wellhead installation.

3.4 FIELD QUALITY CONTROL

3.4.1 No field testing is required.

3.4.2 Verify personnel, equipment, and materials match approved submittals.

3.4.3 Verify that boreholes are straight and plumb.

3.5 CLEAN UP, CLEANING, AND DECONTAMINATION

3.5.1 Do not combine waste materials (e.g. cement bags) with drilling mud and cuttings.

3.5.2 Clean up and remove waste materials from each drill site before demobilization from the project site.

3.5.3 Steam-clean drilling equipment, scrub with brush and laboratory-grade detergent and water solution and rinse with potable water prior to initial use and before departing site.

END OF SECTION

SECTION 02830

FENCING

PART1 GENERAL

1.1 SECTION INCLUDES

1.1.1 References

1.1.2 Submittals

1.1.3 Delivery, Storage, and Handling

1.1.4 Chain Link Fence

1.1.5 Barbed Wire Fence

1.1.5 Concrete

1.1.6 Padlocks

1.1.7 Installation

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A121	Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A176	Stainless and Heat-Resisting Chromium-nickel Steel Plate, Sheet, and Strip
ASTM A478	Chromium-nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
ASTM A666	Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A702	Barbed Wire Fence Posts
ASTM C94	Ready-Mixed Concrete
ASTM F883	Padlocks

AMERICAN WELDING SOCIETY (AWS)

AWS WZC Welding Zinc-Coated Steels

California Department of Transportation (CALTRANS), Standard Specifications

City of Salinas (SALINAS) Department of Public Works, Design Standards and Standard Specifications

1.3 SUBMITTALS

1.3.1 Prepare submittals in accordance with Section 01300, SUBMITTALS.

1.3.2 Submit manufacturer=s data sheets and installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

Store and handle in accordance with manufacturer=s instructions.

PART2 PRODUCTS

2.1 CHAIN LINK FENCE

2.1.1 Fabric: Zinc coated, 6 feet wide, CALTRANS Specification Section 80-4.01B

2.1.2 Gates: CALTRANS Specification Section 80-4.01D

2.1.3 Posts and Braces: Metal, zinc-coated, CALTRANS Specification Section 80-4.01A

2.1.4 Accessories: CALTRANS Specification 80-4.01C

2.2 BARBED WIRE FENCE

2.2.1 Barbed Wire: 12 2-gauge Class 1, CALTRANS Specification Section 80-3.01C

2.2.2 Gates: CALTRANS Specification 80-3.01E

2.2.3 Posts and Braces: Zinc-coated metal, CALTRANS Specification Section 80-3.01A

2.2.4 Accessories: CALTRANS Specification Section 80-3.01F

2.3 CONCRETE: CALTRANS Specification Section 80-3.01F and 80-4.01C

2.4 PADLOCKS: ASTM F883, Type PO1, Grade 2, Size 1-3/4 inch, keyed alike.

PART3 EXECUTION

3.1 INSTALLATION

3.1.1 Barbed Wire Fence: CALTRANS Specification Section 80-3.02, 10-foot post spacing.

3.1.2 Chain Link Fence: CALTRANS Specification Section 80-4.02, SALINAS Standard Plan 42, 10-foot post spacing, Type CL-6.

3.1.3 Gates: CALTRANS Specification Section 80-4.01D, double swing gate with 6-foot leaves.

3.1.4 Grounding: Install one ground per each fence enclosure.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

Portland cement concrete (PCC), formwork, reinforcement, and curing.

1.2 REFERENCES

1.2.1 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A615	Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM C33	Concrete Aggregates
ASTM C94	Ready-Mixed Concrete
ASTM C150	Portland Cement

1.2.2 AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	Structural Concrete for Buildings
ACI 305R	Hot Weather Concrete
ACI 308	Standard Practice for Curing Concrete

1.3 SUBMITTALS

1.3.1 Prepare submittals in accordance with Section 01300, SUBMITTALS. As used herein, the notation ITA means to submit for Shaw Environmental and Infrastructure's approval; FIO means to submit for information only.

1.3.2 Submit the following information 7 working days prior to scheduled use:

1.3.2.1 Concrete mix design (ITA):

- Dry weights of cement and saturated surface-dry-weights of fine and coarse aggregates per cubic yard of concrete.
- Type, name, and quantity of admixtures per cubic yard of concrete.

- Quantity of water per cubic yard of concrete.

- Evidence that materials to be used and proportions proposed will produce the quality of concrete required.

1.3.3 Variance from the approved design must be approved by the Engineer.

1.4 PROJECT RECORD DOCUMENTS

1.4.1 Accurately record locations of embedded pipes and components that are concealed from view.

1.5 QUALITY ASSURANCE

1.5.1 Perform work in accordance with ACI 301.

1.5.2 Acquire cement and aggregate from same source for concrete work.

1.5.3 Conform to ACI 305R when concreting during hot weather.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

2.1.1 Cement: Domestic portland cement (ASTM C150), Type IIA - Air Entraining.

2.1.2 Fine Aggregate: Natural sand (ASTM C33), with no deleterious material such as cryptocrystalline quartz or other material that could cause structural problems with the concrete.

2.1.3 Coarse Aggregate: Well-graded crushed stone (ASTM C33), Size No. 67, with no deleterious material such as cryptocrystalline quartz or other material that could cause structural problems with the concrete.

2.1.4 Water: Potable, clean, and free from deleterious materials, acids, alkalis, oils, or organic matter.

2.2 CONCRETE MIX

2.2.1 Concrete Mix: Minimum 3,000 pounds per square inch (psi) compressive strength after 28 days, unless otherwise stated on the Drawings. Not mixed for more than 45 minutes (ASTM C94), delivered with premix delivery tickets with batching start time, beginning and end of pour, and any changes to mix in the field.

2.3 REINFORCEMENT

2.3.1 Steel Rebar: #4 and #5, ASTM A615.

2.3.2 Welded Steel Wire Mesh: 10 gage, 6 inches on center, ASTM A185.

2.4 FORMWORK

2.4.1 Form Materials: Soft plywood, PS1 D Grade Group 3 pine species; Grade B lumber with grade stamp clearly marked or prefabricated forms as approved by Engineer.

2.5 FORMWORK ACCESSORIES

2.5.1 Form Ties: Removable or snap-off type, metal, adjustable length.

2.5.2 Form Release Agent: Colorless mineral oil that will not stain concrete or absorb moisture.

2.5.3 Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place when placing concrete.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

3.1.2 Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

3.1.3 Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

3.1.4 Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.1.5 Clean formed cavities of debris prior to placing concrete.

3.1.6 Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.

3.2 PLACING CONCRETE AND REINFORCEMENT

3.2.1 Place reinforcement in the exact positions shown on the Drawings. Secure overlaps of the reinforcement with annealed iron wire ties. Ensure that reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

SECTION 02686

SOIL VAPOR MONITORING PROBES

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Soil Vapor Monitoring Probes and Bollards

1.2 REFERENCES

ASTM D1785	Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D 2488	Description and Identification of Soils (Visual - Manual Procedure)

1.3 SUBMITTALS

1.3.1 Prepare submittals in accordance with Section 01300, SUBMITTALS.

1.3.2 Submit product data for the following materials:

- Bentonite pellets
- Pea gravel
- Probe materials

1.3.3 Submit prior to field work:

- Driller qualifications, including the driller's license number
- Proposed method of drilling
- Names, qualifications and safety record for any proposed onsite subcontractor

1.3.4 Submit proposed variances from regulations and procedures.

1.3.5 Submit a driller's daily work report or daily ticket, including the following information:

- Time on job
- Standby time and down time
- Well number
- Footage drilled
- Footage constructed
- Materials used
- Other activities.

1.3.6 Shaw will obtain and submit permits (if required) before mobilizing to site.

1.3.7 Final Well Log: (Provided by Shaw Environmental and Infrastructure[Shaw])

Include the following:

- Project title and number
- Description of the installed well
- Date of drilling
- Borehole diameter
- Depth of bottom of casing and bottom of borehole
- Casing diameter and wall thickness, and length installed
- Perforated or screened interval
- Description of geologic materials encountered (ASTM D 2488)
- Presence or absence of water
- Drilling advancement rates
- Time, depth, and description of unusual occurrences or problems during drilling
- Type, size, and quantity of gravel pack installed
- Coordinates (California State Plane) of well
- Name of logger Shaw

1.4 QUALITY ASSURANCE

1.4.1 Provide experienced and competent driller and crew on site during drilling and probe installation activities.

1.4.2 Drilling and well installation will be supervised by Shaw.

1.4.3 Do not change proposed field personnel without written permission from Shaw.

PART 2 PRODUCTS

2.1 MONITORING PROBES

2.1.1 Probes: Pipes, couplings, end caps, and fittings: PVC, Schedule 40 (ASTM D1785), square flush-threaded with o-ring, 3/4-inch-diameter, 8 threads per inch (tpi).

2.1.2 Valves: 3/4-inch brass gas valves, ¾-inch x 3/16-inch bushing reducer, 3/16-inch tapered hose barb threaded onto ¾-inch PVC probe.

2.1.3 Screens: PVC, Schedule 40 (ASTM D1785), square flush-threaded with o-ring, 3/4-inch-diameter, 8 tpi, machine-slotted, 0.02-inch slots, 5 feet, each probe.

2.2 SEALING MATERIALS

2.2.1 Gravel Pack: 3/8-inch crushed or natural washed pea gravel.

2.2.2 Bentonite Seal: 3/8-inch chips.

2.2.3 Surface Seal: Concrete in accordance with Section 03300, CAST-IN-PLACE CONCRETE.

2.3 PROTECTIVE CASING FOR MONITORING PROBES

2.3.1 Locking, steel 12-inch-diameter standpipe, minimum 5 feet long.

2.3.2 Locks: Master-keyed alike, with waterproof color-coded tags labeled "Soil Vapor Monitoring Probe."

2.4 IDENTIFICATION

2.4.1 Stamp and paint probe cluster number on well cover.

2.5 BOLLARDS

2.5.1 Schedule 40 carbon steel pipe (ASTM A53), 4-inch-diameter, concrete-filled.

2.5.2 Paint: reflective yellow.

PART 3 EXECUTION

3.1 DRILLING

3.1.1 Drilling Methods: Provide a minimum borehole diameter of 8 inches to the maximum depth of 85 feet.

3.1.2 Boring Depths: Actual depths will depend on conditions encountered during drilling.

3.1.3 Obstructed Borings: If obstructions are encountered during borehole advancement, do not attempt to penetrate obstruction. Shaw will determine which of the following courses of action to be taken.

3.1.3.1 Abandonment: Abandon borehole by backfilling with bentonite slurry and relocate borehole at the direction of Shaw. No submittals will be required.

3.1.3.2 Completion: Complete borehole and install well to the depth obtained.

3.2 WELL INSTALLATION

3.2.1 Drill borehole so as to permit installation of well casing assembly in a plumb and true line.

3.2.2 Well Casing: Assemble the solid and perforated casing sections together. Center casing assembly in borehole. Maintain casing assembly vertically plumb during backfilling of borehole.

3.2.2.1 Perforated Casing: Pipe lengths vary and will be determined based on data obtained during drilling activities. Order perforated casing pipe with end cap prefabricated, and field trim excess length to fit the borehole.

3.2.2.2 Joints: Flush thread with O-ring.

3.2.3 Gravel Pack: To prevent bridging, pour pea gravel carefully into annular space to the design level above the top of the well screen, as determined by volume measurements and sounding with a weighted tape. Remove drill rods slowly, at the same rate that the pea gravel is placed. Sound frequently enough so that placement is accurate to within 0.2 foot.

3.2.4 Bentonite Seal: Pour bentonite pellets gradually and carefully to the design level as determined by volume measurements and sounding with a weighted tape.

3.2.5 Bentonite-Cement Grout: Wait 30 minutes after placing bentonite seal, then place bentonite-cement grout to design level of the bottom of well box.

3.3 FIELD QUALITY CONTROL

3.3.1 No field testing is required.

3.3.2 Verify personnel, equipment, and materials match approved submittals.

3.3.3 Verify that boreholes are straight and plumb.

3.4 CLEAN UP, CLEANING, AND DECONTAMINATION

3.4.1 Do not combine waste materials (e.g. cement bags) with drilling mud and cuttings.

3.4.2 Clean up and remove waste materials from each drill site before demobilization from the project site.

3.4.3 Steam-clean drilling equipment, scrub with brush and laboratory-grade detergent and water solution and rinse with potable water prior to initial use and before departing site.

END OF SECTION

3.2.2 Place concrete in accordance with ACI 301.

3.2.3 Tool edges with ordinary edging tools to a smooth radius.

3.3 CONCRETE FINISHING

3.3.1 Concrete surfaces to receive a broom finish.

3.4 CURING AND PROTECTION

3.4.1 Immediately after placement, protect concrete from premature drying, excessively hot temperature, and mechanical injury.

3.4.2 Cure concrete in accordance with ACI 308.

3.5 PATCHING

3.5.1 Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

3.5.2 Patch imperfections as directed in accordance with ACI 301.

3.6 DEFECTIVE CONCRETE

3.6.1 Defective Concrete: Not conforming to dimensions, with excessive honeycomb, debris, bulges, or depressions.

3.6.2 Repair or replacement of defective concrete will be determined by Engineer.

END OF SECTION

SECTION 15480
PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. All piping as shown on the Contract Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to, the following:

1. Gas piping
2. Gas condensate piping (drainage and force main)
3. Air supply piping
4. Road crossings

1.02 REFERENCES

A. ASTM D1785 Standard Specifications for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

B. ASTM D2466 Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

C. ASTM D2564 Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe Fittings

D. ASTM D2467 Standard Specification for Socket -Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

E. ASTM D2464 Standard Specification for Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

F. ASTM D3915 Standard Specifications for Polyvinyl Chloride (PVC) and Related Plastic Pipe and Fittings Compounds

G. ASTM F656 Standard Practice for Primers for Use in Solvent Cement Joints at Polyvinyl Chloride (PVC) Plastic Pipe Fittings

H. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings

I. ASTM D3350 Standard Specification for Polyethylene (PE) Plastic Pipe and Fittings Materials

J. ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

K. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

L. ASTM D1248 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

M. ASTM D2241 Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

N. ANSI B16.5 Steel Pipe Flanges, Flanged Valves, and Fittings

O. ASTM F405 Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings

P. ASTM F667 Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings

Q. AASHTO M252 Standard Specification for Corrugated Polyethylene Drainage Tubing

R. AASHTO M294 Standard Specification for Corrugated Polyethylene Pipe, 12- to 24-inch Diameter

S. ASTM A53 Specification for Welded and Seamless Steel Pipe

T. ASTM A120 Specification for Welded and Seamless Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized)

U. ANSI B16.3 Cast-Iron Threaded Fittings, Class 150 and 300

V. ASTM B43 Specification for Seamless Red Brass Pipe, Standard Sizes

W. ANSI B31.1 Safety Code for Pressure Piping

X. ASTM D2513 Standard Specification for High Density Polyethylene (HDPE) pipe and fittings.

1.03 SUBMITTALS

A. Product Data: Within 15 calendar days after the CONTRACTOR has received the OWNER's Notice to Proceed, submit

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's Specifications, catalog cuts, and other data needed to prove compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when approved by the OWNER/ENGINEER, will become the basis for accepting or rejecting actual installation procedures used on the work.

B. Shop Drawings: Within 15 calendar days after the CONTRACTOR has received the OWNER's Notice to Proceed, submit Shop Drawings and other data as required to indicate method of constructing, installing and supporting piping except where such details are fully shown on the Contract Drawings.

C. Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the OWNER/ENGINEER operation and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Regulatory Requirements:

1. Without additional cost to the OWNER, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
2. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
3. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern unless otherwise directed by the OWNER/ENGINEER.

C. In addition to complying to the specified requirements, comply with the directions of the OWNER/ENGINEER.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store all piping in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE:

A. Provide Schedule 40 and Schedule 80 PVC pipe complying with ASTM D 1785.

B. PVC Fittings:

1. Provide Schedule 40 PVC fittings 8 inches and smaller complying with ASTM D 2466, socket-type.
2. Provide PVC fittings 10 inches and larger rated for minimum pressure of 80 psig at 73°F and injection molded from Type 1 PVC.
3. Provide Schedule 80 PVC fittings complying with ASTM D 2467 for socket-type and ASTM D 2464 for threaded-type.

C. PVC Flanges:

1. Provide 150-pound, flat-face, socket-type Schedule 80 PVC flanges. Diameter and drilling of flanges shall comply with ANSI B16.5 for Class 150.
2. Provide full-face, neoprene flange gaskets, 1/16-inch thick with "A" scale hardness of 45 to 60 durometer.
3. Provide correct number and sizes of steel hexagon bolts, washers, and hexagon nuts, electrogalvanized with zinc or cadmium.

D. PVC Solvent Primer: Provide solvent primer as recommended by PVC product supplier and complying with ASTM F 656.

E. PVC Solvent Cement: Provide medium-bodied solvent cement as recommended by PVC product supplier and complying with ASTM D 2564.

2.02 FLEXIBLE PIPE COUPLINGS

A. Provide flexible couplings for pipe expansion/contraction compensation as shown on the Contract Drawings, Industrial Tube Corporation Model IT-6000 or ENGINEER approved equal.

B. Provide stainless steel hose band-clamps of correct size with hexagonal and slotted adjusting screw.

2.03 FLEX HOSE

A. Provide flex hose for well head assemblies as shown on the Contract Drawings, industrial vacuum loader hose by Salem-Republic Rubber Company (800.686.4199), or ENGINEER approved equal, for medium-vacuum, methane applications. Hose shall be provided with soft cuffs, with inside diameter to match the outside diameter of PVC or HDPE pipe to be connected. Minimum bend radius shall provide permanent 90° bend between wellhead and lateral pipe, without causing internal damage or kinking. Hose shall be fabricated from a polyester reinforced styrene-butadiene rubber (SBR) and neoprene rubber (NR) blend, with embedded high-tensile steel wire. Outer cover shall be resistant to UV, ozone, and weathering for long-term, exposed service.

B. Provide stainless steel hose band-clamps of correct size with hexagonal and slotted adjusting screw.

2.04 POLYETHYLENE (PE) PIPE

A. Provide PE pipe of SDR indicated on the Contract Drawings complying with ASTM D 2513 and ASTM D 3350, D 3287, and F 714, where applicable made from resins conforming to ASTM D 1248.

B. PE Fittings:

1. Provide PE fittings complying with ASTM D2513 and ASTM D3350 and D3261, where applicable made from resins conforming to ASTM D1248.
2. Provide PE fittings of the same manufacturer and resin material as PE pipe.
3. Provide fabricated fittings fabricated from PE pipe with an SDR which are equal to or one rating heavier (thicker wall) than the pipe to which they are joined.

C. PE Resin:

1. Provide PE products made from a high density, high modulus resin conforming with cell classification PE 345434C or better in accordance with ASTM D3350.

2.05 CONDENSATE PIPING

1. Condensate drain lines and force mains for the field condensate sumps shall be HPDE, SDR 11, fabricated from materials as specified in paragraph 2.04 of this section.

2. Air supply lines for the field condensate sumps shall be HPDE, SDR 9, fabricated from materials as specified in paragraph 2.04 of this section.

2.06 CORRUGATED METAL PIPE

A. All corrugated metal pipe to be used for road crossing encasements for the main header pipe shall be 16 gauge galvanized steel or aluminum pipe.

B. Corrugated metal pipes are intended to contain all pipes at each road crossing, with sufficient clearance to allow future movement or removal.

2.07 VALVES

A. Gate Valves:

1. Provide PVC body and trim valves with non-rising stem, as manufactured by Asahi-America or approved equal.

B. Butterfly Valves:

1. Provide PVC, wafer-type butterfly valves with nitrile seals, Asahi-America, +GF+, or ENGINEER approved equal.
2. 4 Inch and Smaller: Provide lever-operated handle.
3. 6 Inch and Larger: Provide gear-operated handle.

C. Check valves:

1. 2 inch and smaller: Provide PVC, true union body, threaded or socket ball check valves, with viton seals.
2. 3 inch and larger: Provide PVC, flanged, double disc check valves, Technocheck or ENGINEER approved equal.

D. Condensate Ball valves, 2 inch and smaller: Provide PVC, true union body, threaded or socket type valves, with Teflon seats and nitrile seals.

E. Air and Condensate Isolation butterfly valves, 2-inch: Provide CSR HDPE Time Saver Valve, SDR 11 System, or ENGINEERED approved equal, with Viton seats and seals for condensate applications. Provide air and condensate isolation valves at each isolation valve location.

F. True Unions: Provide PVC Sch 80 unions, threaded or socket type, with Viton O-rings.

G. Header Monitoring Ports: Provide polypropylene quick-disconnect couplings, Colder Products or ENGINEER approved equal, 1/8-inch female shut-off with 1/4-inch male NPT end. Ports to match extraction wellhead monitoring ports.

H. Provide propane valves as shown in the Contract Drawings.

2.08 PIPE SUPPORTS

A. Provide the pipe supports as shown on the Contract Drawings, specified, and required to adequately support and secure all piping systems and to minimize stress to all equipment connections, pipe, valves, and fittings.

1. Provide pipe supports fabricated from metal framing channel and fittings with electrogalvanized zinc or cadmium finish, as supplied by Unistrut, Superstrut, or ENGINEER approved equal.
2. Pipe supports shall provide clearance between guides and the outside diameter of the pipes, to allow free sliding.

2.09 GRADE BOXES

A. Header isolation valves: Provide rectangular valve box and lid, Christy Fibrelyte FL36 or ENGINEER approved equal, at each header isolation valve.

B. Condensate sumps: Provide a concrete vault, Christy R27x36 or ENGINEER approved equal, at each sump location to house sump-head and all necessary compressed air and condensate piping, valves, and instruments, as shown on the Contract Drawings. Provide each vault with non-traffic rated, aluminum or galvanized steel double-leaf access doors. Doors shall be hinged and spring assisted, with stainless steel hardware, locking support arm, and neoprene weather seal.

C. Monitoring ports: Provide circular valve box and lid, Christy Fibrelyte FL8 or ENGINEER approved equal, at each header monitoring point.

2.10 PIPE TRENCH BACKFILL MATERIALS

A. Materials will be designated by the OWNER/ENGINEER, and is that material removed from excavation or on-site sources, predominantly non-expansive soils free from roots and other deleterious matter.

2.11 OTHER MATERIALS

A. Provide all other materials, not specifically described but required for a complete and proper installation, as selected by the CONTRACTOR subject to the approval of the OWNER/ENGINEER.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected. Notify the OWNER/ENGINEER of such conditions and proposed corrective action before correcting unsatisfactory conditions.

3.02 PREPARATION

A. Lay out the piping systems in careful coordination with the Contract Drawings, determining proper elevations and locations for all components of the system and using only the minimum number of fitting bends to produce a satisfactorily functioning system. In special cases and with the approval of the OWNER/ENGINEER, bends in piping shown on the Contract Drawings may be eliminated by gradual deflection of straight pipe runs.

B. Follow the general layout shown on the Contract Drawings in all cases except where other work may interfere or field conditions deviate from conditions shown in Contract Drawings.

C. Obtain the approval of the OWNER/ENGINEER for the layout of all piping systems before and during pipe installation.

3.03 INSTALLATION

A. General:

1. Proceed as rapidly as other sitework activities will permit.
2. Thoroughly clean piping materials before installation. Cap pipe openings to exclude rodents and dirt until final connections have been made.
3. Cut pipe accurately, and work into place without springing or forcing.
4. Install gas piping at a minimum of 3 percent slope unless otherwise noted on the Contract Drawing or approved by the OWNER/ENGINEER.
5. Provide sufficient expansion and contraction compensation, flexible couplings, and devices necessary for a flexible piping system, whether or not shown on the Contract Drawings.

B. Equipment Access: Install piping, equipment, and accessories to permit access for maintenance. Relocate items as necessary to provide such access, and without additional cost to the OWNER.

C. Flange Connections: Install gaskets centered on flanges and tighten bolts to torque requirements recommended by flange and/or valve manufacturer. Replace flanges damaged by overtightening, at no cost to the OWNER.

D. Flexible couplings:

1. Install flexible couplings as pipe laying and pipe anchors are being installed at locations shown on the Contract Drawings. Flexible couplings shall be compressed or expanded to meet temperature conditions at the time of installation as shown on the Contract Drawings.
2. Bevel and clean both pipe ends.
3. Insert pipe ends into coupling cuffs 2-1/2 inches.
4. Install and tighten (but do not overtighten) hose clamps.

E. Polyvinyl chloride (PVC) pipe and fitting:

1. Construct PVC piping system using solvent cemented joints made in accordance with the pipe manufacturer's instructions.
2. Inspect PVC pipe and fittings for cleanliness and damage prior to placing and joining. Remove and replace all damaged piping materials.
3. Wipe clean both inside and outside surfaces of the two ends to be joined and remove dirt, oil, and foreign materials.
4. Ensure that primer and cement are kept free of contaminants.
5. Allow cemented joints to cure in accordance with the times recommended by the pipe manufacturer.
6. Do not test, stress, pull, or lay new joints on ground until joint has sufficiently cured.
7. Visually inspect each new joint for misalignments, gaps, or voids in joint.
8. Paint all exposed PVC piping and fittings. Do not paint any moving parts.

F. Polyethylene (PE) pipe and fitting:

1. Construct PE piping systems using butt fusion methods in accordance with the pipe and fusion equipment manufacturer's instructions. Allow for additional lengths of pipe for expansion and contraction.
2. Provide appropriate fusion equipment for pipe size under construction.
3. Inspect PE pipe and fittings for cleanliness and damage prior to placing and joining. Remove and replace all damaged piping material.
4. Wipe clean both inside and outside surfaces of the two ends to be joined and remove dirt and foreign materials.
5. After cutting pipe ends, do not touch newly-faced surfaces.
6. Ensure that fusion tools are free of contaminants.
7. Heat the surfaces to be joined simultaneously and fuse together in accordance with time and temperature requirements recommended by the material manufacturer.
8. Allow butt fused joints to cool for time duration recommended by manufacturer.
9. Do not remove new joint from fusion equipment for an additional three minutes.
10. Do not test, stress, pull, or lay new joint on ground for 10 minutes after removal from fusion unit.
11. Visually inspect each new joint for misalignments, gaps, or voids in joint. Bead thickness and melt pattern shall comply with manufacturer's recommendations. Joints not meeting OWNER's/ENGINEER's approval shall be cut out and remade at no additional cost to the OWNER.

3.04 PIPE SUPPORTS

A. Space supports for horizontal pipes as shown on the Contract Drawings.

B. Arrange pipe supports to prevent excessive pipe deflection, and to avoid excessive bending stress.

C. Anchor pipe supports in concrete slabs or footings, as shown on the Contract Drawings.

D. Space wood blocks for supporting piping within the encased road crossings and elevated crossing to prevent excessive pipe deflection, and to avoid excessive bending stress.

3.05 VALVES

A. Locate and arrange valves to provide complete adjustment between fully open to fully closed position.

B. Install valves in at least the following locations:

1. On both sides of apparatus and equipment.
2. For shutoff of branch mains.
3. Where shown on the Contract Drawings.

C. Locate valves for easy accessibility and maintenance.

D. Install valves in closed position, with valve stems vertical.

3.06 TRENCHING AND BACKFILLING

A. Contractor shall conform to all requirements for Trench and Site Safety.

B. Perform excavation of every description and of whatever substances encountered to depth indicated or as otherwise shown and specified. Grade trench bottoms to suit required piping slopes. Grade as necessary to prevent surface water from flowing into trenches. Remove any water accumulating therein by pumping or other approved methods. Notify the OWNER/ENGINEER immediately of any continuous water flow into trench. Sheet and brace excavations as necessary to fully protect workmen and adjacent structures and permit proper installation of work. Under no circumstances lay pipe or install appurtenances in water, without approval of the OWNER/ENGINEER. The presence of ground water in soil or the necessity of sheeting or bracing of excavations shall not constitute a condition for which any increase may be made in contract price.

C. Excavate trenches to the necessary width for proper laying of pipe. Backfill overdepths using methods and procedures specified for backfilling the lower portion of trenches. When wet or unstable material is encountered at bottom of trench, remove such material to depth required as directed by OWNER/ENGINEER and backfill to proper grade with suitable approved material. Grade bottom of trench accurately to provide uniform bearing and support for each piping section at every point along its entire length. Remove stones and all other protrusions from trench bottom.

D. Place bedding material to dimensions shown in drawings. Bedding material shall be carefully placed in bottom of trench, so as to ensure a uniform thickness below the pipe.

E. Backfill pipe trenches with the backfill materials shown and specified, and compact as shown and/or specified.

F. After backfill is completed, remove unused excavated and backfill materials to areas designated by OWNER/ENGINEER.

3.07 PRESSURE TESTING

A. Before pressure testing, blow the pipe clean of dirt and debris and remove from systems equipment which would be damaged by test pressure. Replace equipment after testing. Systems may be tested in sections.

B. Pressure tests shall be performed on the following piping systems and specified parameters:

1. Collection piping: Compressed air, with a test pressure of 10 psi.
2. 2-inch HDPE condensate forcemain piping: Water, with a test pressure of 100 psi
3. Air supply piping: Water, with a test pressure of 150 psi

C. Conduct all pressure testing in accordance with the pipe manufacturer’s recommendations and procedures. Test pressures shall be contained for a minimum of 1-hour, with no change in pressure, except that calculated due to temperature change.

D. Locate and repair all leaks. Correct leaks by replacing faulty materials with new material.

E. Repeat pressure testing until all piping systems pass. Perform additional pressure tests after repair of each system at no cost to the OWNER.

F. Test solenoid and pressure relief valves for proper operation at settings indicated. Test pressure relief valves three times.

G. The CONTRACTOR will be responsible for notifying the OWNER/ENGINEER at least 48 hours in advance so that the OWNER/ENGINEER may be present during testing.

3.08 PROTECTION

A. Protect all installations and materials from damage until final acceptance by the OWNER/ENGINEER.

B. Prevent debris from entering into piping systems during installation.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Piping: Measurement for HDPE piping will be from, and including, the flex hose at the well heads to the inlet to the butterfly valve located at the inlet to the knockout pot on the Blower/Flare skid for each size of pipe. Measurement will include all trenching, pipe joining and installation, backfilling, compaction, testing, fittings, valves, grade boxes, and other appurtenances needed to complete the piping system as shown on the Contract Drawings.

B. Condensate Air Supply/Force Main Piping: Measurement for HDPE condensate and air supply piping installed outside the Blower/Flare Facility will include all trenching, pipe joining and installation, backfilling, compaction, testing, fittings, valves, grade boxes, and other appurtenances needed to complete the HDPE piping systems as shown on the Contract Drawings.

C. Encased Road Crossings: Measurement for encased road crossings will be by length of corrugated metal pipe in place, and will include all additional trenching, pipe installation, backfilling, compaction, testing, and other appurtenances needed to complete the above and below ground encased road crossings as shown on the Contract Drawings.

D. Flare Facility Piping: Measurement for providing and installing and piping, condensate piping, air piping, and propane piping shown within the Blower/Flare Facility shall be based on the lump sum price for furnishing all labor and materials for Equipment Complex piping, valves, and fittings.

4.02 PAYMENT

A. Piping: Payment for piping shall be based on the unit price quoted per linear foot in the Bid Schedule for each pipe size and constitutes full compensation for furnishing all labor, equipment, materials, and incidentals necessary to install the piping in accordance with the Contract Drawings, as specified, and as may otherwise be required.

B. Condensate Air Supply/Force Main Piping: Payment for piping shall be based on the unit price quoted per linear foot in the Bid Schedule and constitutes full compensation for furnishing all labor, equipment, materials, and incidentals necessary to install the HDPE piping in accordance with the Contract Drawings, as specified, and as may otherwise be required.

C. Encased Road Crossings: Payment for encased road crossings shall be based on the unit price quoted per linear foot in the Bid Schedule for "Road Crossings" and constitutes full compensation for all labor, equipment, materials, and installation in accordance with the Drawings.

D. Flare Facility Piping: Payment for Flare Facility Piping (piping, condensate piping, air piping, and propane piping) shown for the Equipment Complex shall be by the lump sum quoted in the Bid Schedule.

END OF SECTION

Appendix E

Activity Hazard Analysis

ACTIVITY HAZARD ANALYSIS
INSTALLATION OF EXTRACTION AND TREATMENT SYSTEM

Activity	Potential Hazards	Recommended Controls
• Mobilization/Demobilization	• Physical: Injury from heavy equipment; heavy lifting. Pinch points; slip, trip, and fall hazards.	• Train equipment operators. • Minimize work and personnel in vicinity of equipment. • Provide ergonomic training, institute good housekeeping procedures • Keep feet and hands clear of moving/suspended materials and equipment.
• UXO Clearing	• Potential encounter with UXO, animals, poisonous plants, snakes and insects. (Poison Oak prevalent)	• Use trained UXO personnel as needed. • Use proper UXO and avoidance procedures as provided in the BOEWP. • Use caution with wild animals; learn to recognize poisonous plants, wear insect repellant. • Wear PPE required by SSHO.
• Brush clearing	• Cuts, slashes, dismemberment • Potential encounter with animals, poisonous plants, snakes and insects. (Poison Oak prevalent)	• Keep personnel in area to a minimum • Use only trained equipment operators, • Wear required PPE, safety glasses, face shields. • Use caution with wild animals; learn to recognize poisonous plants, wear insect repellant.
• Chainsaw cutting	• Cuts, slashes, dismemberment, fire, noise • Potential encounter with animals, poisonous plants, snakes and insects. (Poison Oak prevalent)	• Use only chainsaws with automatic brakes and anti-kickback. • Wear proper PPE, chaps, safety glasses, face shields. • Wear appropriate hearing protection. • Follow manufacturer's safety instructions
• Loading/hauling operations	• Physical contact with moving equipment, flying debris, vehicle traffic, dust, noise. • Heavy lifting of pipes, fittings and/or equipment	• Use only trained operators. • Wear required PPE • Wear Hi-visibility safety vests, use spotter to guide operators when necessary • Secure and cover loads.
• Cutting/welding/installing HDPE pipe	• Fumes, burns, heavy lifting repetitive motion	• Inspect welding equipment daily for proper maintenance and operations • Observe ergonomic precautions regarding lifting and repetitive motion • Wear proper PPE

ACTIVITY HAZARD ANALYSIS
INSTALLATION OF EXTRACTION AND TREATMENT SYSTEM

Activity	Potential Hazards	Recommended Controls
• Drilling Operations • Changing flights	• Contact with heavy equipment, underground utility lines, vehicle traffic, noise • Pinch points and fall hazards • Inhalation exposure to VOCs and other gases • Strains, sprains, slips, fall, injured hands, dropped equipment. • Dermal contact with contaminated soils • Loose clothing.	• Inspect equipment daily for safe operation • Minimize personnel in area of operating equipment • Conduct checks for underground utilities prior to set up and use. Pothole by hand to 5 ft prior to drilling. • Wear proper PPE assigned by the SSHO. • Periodically monitor/test the atmosphere to make sure vapors are not collecting on the ground at unsafe levels • Observe all drilling precautions.
• Installing extraction wells and monitoring probes	• Dermal contact with contaminated soils • Inhalation exposure to VOCs and other gases • Inhalation of cement and silica dust.	• Minimize personnel in area of operating equipment • Periodically monitor/test the atmosphere to make sure vapors are not collecting on the ground at unsafe levels • Avoid breathing of dust • Wear PPE required by SSHO
• Heavy equipment operation (forklift/crane/backhoe/ trenching equipment)	• Physical contact with equipment • Training.	• Inspect equipment daily for safe operation • Use only trained operators (certified) • Minimize personnel in area of operating equipment
• Fueling	• Fire, exposure to fuel vapors	• Only UL/FM-approved safety cans shall be used to store fuel • Do not fuel equipment while it is operating • Fire extinguishers shall be readily available • Stand upwind during fueling • Do not fuel near any ignition source.
• Trenching	• Physical contact with equipment • Uneven terrain • Trench failure	• Conduct checks for u/g utilities prior to set up and use. Pothole by hand to depth of trench every 50 ft or less. • Assess any uneven terrain for proper equipment support • Minimize personnel in area of trench and equipment • Wear proper PPE and Hi-visibility safety vests assigned by the SSHO.

ACTIVITY HAZARD ANALYSIS
INSTALLATION OF EXTRACTION AND TREATMENT SYSTEM

Activity	Potential Hazards	Recommended Controls
• Constructing pad and setting up treatment system	• Physical: Injury from heavy equipment; heavy lifting. Pinch points; slip, trip, and fall hazards.	• Train equipment operators. • Minimize work and personnel in vicinity of equipment. • Conduct checks for underground utilities prior to construction and set up. • Provide ergonomic training, institute good housekeeping procedures • Keep feet and hands clear of moving/suspended materials and equipment.
• Installing electrical components	• Fire, explosion hazards, electrocution	• Implement lockout/tagout procedures • Work to be conducted by qualified/certified electrician • Work and materials will conform to the latest rules of the National Board of Fire Underwriters' Code, regulations of the State Fire Marshal, and applicable local and state codes.
• Decontamination/Pressure washing/Steam cleaning	• Dermal contact with contaminated soils and water • Physical contact with pressurized streams (injection hazard) • Physical contact with hot water/steam/objects • Burns and flying debris	• Wear appropriate PPE; follow SOP for decontamination procedures • PPE may include face shields, chemical resistant coveralls, latex or nitrile gloves • Stage equipment for decontamination securely • Separate contaminated and decontaminated equipment into the proper zones. Cleaned equipment shall not be stored in the EZ or CRZ. • Decontamination stations shall be located at least 10 feet or more from operating equipment.

ACTIVITY HAZARD ANALYSIS
INSTALLATION OF EXTRACTION AND TREATMENT SYSTEM

PPE TO BE USED	MONITORING REQUIREMENTS	OTHER REQUIREMENTS
• Level D PPE • Street clothes or coveralls, Steel-toed work boots (except UXO personnel), Safety glasses, Hearing protection (if necessary), Hardhat, Leather gloves	• Periodically monitor/test the atmosphere to make sure vapors are not collecting on the ground at unsafe levels.	• Meet training requirements below • If additional skin protection from poisonous plants or potentially contaminated water is required, then upgrade to Modified Level B • Upgrade to Level C if monitoring shows the presence of VOCs or other gases above action limits
• Modified Level D PPE • Same as Level D with the addition of Tyvek™ coveralls with elastic wrists and ankles, nitrile gloves (inner), splash shield (if necessary).	• Periodically monitor/test the atmosphere to make sure vapors are not collecting on the ground at unsafe levels.	• Upgrade to Level C if monitoring shows the presence of VOCs or other gases above action limits
• Level C PPE • Same as Modified Level D with the addition of a full faced APR.	• Periodically monitor/test the atmosphere to make sure vapors are not collecting on the ground at unsafe levels. • Monitor for heat and cold stress	• Medically cleared and certified to wear a respirator and trained in the proper use and care of respirators

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Drill rigs • Backhoes, crane, forklift, trencher • HDPE Fusion cutter/fusion machine • Chain saws • Compressors • Hydrostatic testers • Blower • Water truck • Fire extinguishers • Traffic cones • Delineators • Signs • Barricades • Radios • Hand tools • High pressure washers • Steam cleaners • First Aid Kits • Eyewash Stations	• Pre-maintenance checks of equipment and documented inspection check off lists. • Proper registrations and certifications for equipment and equipment operators. • Proper certifications of workers on the site. • Underground utility inspections. • Daily inspection of the project site by the site superintendent.	• 40 hour HAZWOPER trained • Additional 8 hours Supervisor training. • 3 days of supervised hazardous waste site experience. • Bloodborne pathogens training • First-aid/CPR (2 individuals on site) • Mobilization and site-specific orientation. • Tailgate Safety Meetings • Hazard communication • Instruction on Manufacturer's safety requirements for equipment assigned, • Training on specific jobs, tools or equipment. • Competent person for trenching and excavation

ACTIVITY HAZARD ANALYSIS
SAMPLING OF MONITORING PROBES AND EXTRACTION WELLS

Activity	Potential Hazards	Recommended Controls
• Mobilizing and equipment staging	• Pinch points; slip, trip and fall hazards • Biological hazards, insects, snakes, animals and poison oak • Heavy lifting • Fire.	• Good housekeeping practices shall be performed. • Keep work areas picked up and clean as feasible. • Use proper PPE • Avoidance procedures in SSHP • Use proper lifting techniques • Lifts greater than 60 pounds require assistance or mechanical equipment; size up the lift • Fire extinguishers shall be readily accessible and maintained.
• Purging and sampling	• Inhalation exposure to VOCs and other gases • Potential encounter with insects (e.g. spiders) that have made homes inside the protective casing and vaults. • Contact with potentially contaminated materials and gas	• Stay upwind when opening protective casing and vaults • Test the atmosphere before purging and sampling to make sure vapors are not at unsafe levels • Wear PPE assigned by the SSHO. Upgrade PPE when directed by SSHO • Perform remote venting during purging • Wear nitrile gloves during purging and sampling • Inspect protective casing and vaults for insects • Proper decontamination procedures shall be followed • Label all containers.
• Moving and shipping collected samples	• Heavy lifting • Slip, trip and fall hazards	• Use proper lifting techniques • Lifts greater than 60 pounds require assistance or mechanical equipment; size up the lift • Good housekeeping practices shall be performed • Keep work areas picked up and clean as feasible • Label all containers • Store collected sample containers in secure area.

ACTIVITY HAZARD ANALYSIS
SAMPLING OF MONITORING PROBES AND EXTRACTION WELLS

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Hand tools, radios • Level D PPE (hardhat, safety vest, safety glasses, steel toed boots, hearing protection) • Sampling equipment (probes, collection pipe/tube, sampling pump and sample containers) • Project vehicle.	• Equipment calibration • Pre-maintenance • Visual prior to use • Post-maintenance.	• Hazardous waste operations (40 hour and 8 hour refresher training) • Hazard communication training • Site safety orientation • Daily tailgate safety meeting.

ACTIVITY HAZARD ANALYSIS
TRENCHING/EXCAVATION

Activity	Potential Hazards	Recommended Controls
• Mobilization/Demobilization	• Physical; Injury from heavy equipment; heavy lifting • Pinch points; slip, trip and fall hazards	• Train equipment operators. Minimize work and personnel in vicinity of equipment. Provide ergonomic training • Institute good housekeeping procedures; keep feet and hands clear of moving/suspended materials and equipment.
• Heavy Equipment Operations	• Contact with heavy equipment, vehicle traffic, overhead utility lines, underground utilities • Potential UXO encounters	• Inspect equipment daily for safe operating conditions. Do not use faulty equipment. Minimize personnel in area of equipment use • Use positive shut down means for repairs, manual lubrications, securing attachments and/or refueling operations. Lockout/tagout if necessary • Getting on or off equipment while it is in motion is prohibited. Do not permit equipment to operate unattended • Use UXO clearance/escort prior to and during heavy equipment operations.
• Clearing/Grubbing	• Cuts, slashes, dismemberment, fire	• Use only chainsaws with an automatic brake and anti-kick back. Chain shall not move when the engine is idling. Turn chainsaw off while walking through heavy brush, wet surfaces, and when adjacent to other personnel. Inspect equipment before use. • Operators will wear proper PPE (i.e, eye, ear, hand, foot, safety shoes); leg protection required as a minimum • Hold the saw with both hands during cutting; never use to cut above the operators shoulder height. Use only trained personnel.
• Excavation Operations (Manual)	• Burn/Shock hazard	• Personnel will wear approved electrical safety equipment while performing shoveling tasks • Qualified electrician shall perform an inspection on the

ACTIVITY HAZARD ANALYSIS
TRENCHING/EXCAVATION

Activity	Potential Hazards	Recommended Controls
	• Falling into trench and trench collapses	integrity of all energized lines to assure of it safety for workers • PG&E will be on standby to shut down energy in the event of an emergency • The Program CIH shall be onsite to oversee activity • Personnel will stay clear of the excavation. Nobody shall be allowed to enter the excavation • Store spoils a minimum of 4 feet away from excavation edge. Excavations greater than 4 feet shall use sloping or benching, etc. • Shoring shall be utilized for excavation deeper than 5 feet in depth.
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
• Vehicles • Fire extinguishers, First aid kits • Blocking, bracing and shoring materials • Manual hand tools • Mechanized equipment • Geophysical instrumentation • Personal Protective Equipment (PPE) • Communications equipment	• Daily preventative maintenance and operational checks • First aid kits and fire extinguishers • Daily trench and excavation inspections	• 40-hour qualification per 29 CFR 1910.120 • 8-hour refresher training • UXO personnel EOD training • Tailgate safety meetings • Site-specific orientation • Lead awareness training • Poison oak awareness training • Trench and excavation competent person

Appendix F

Vendor Submittals

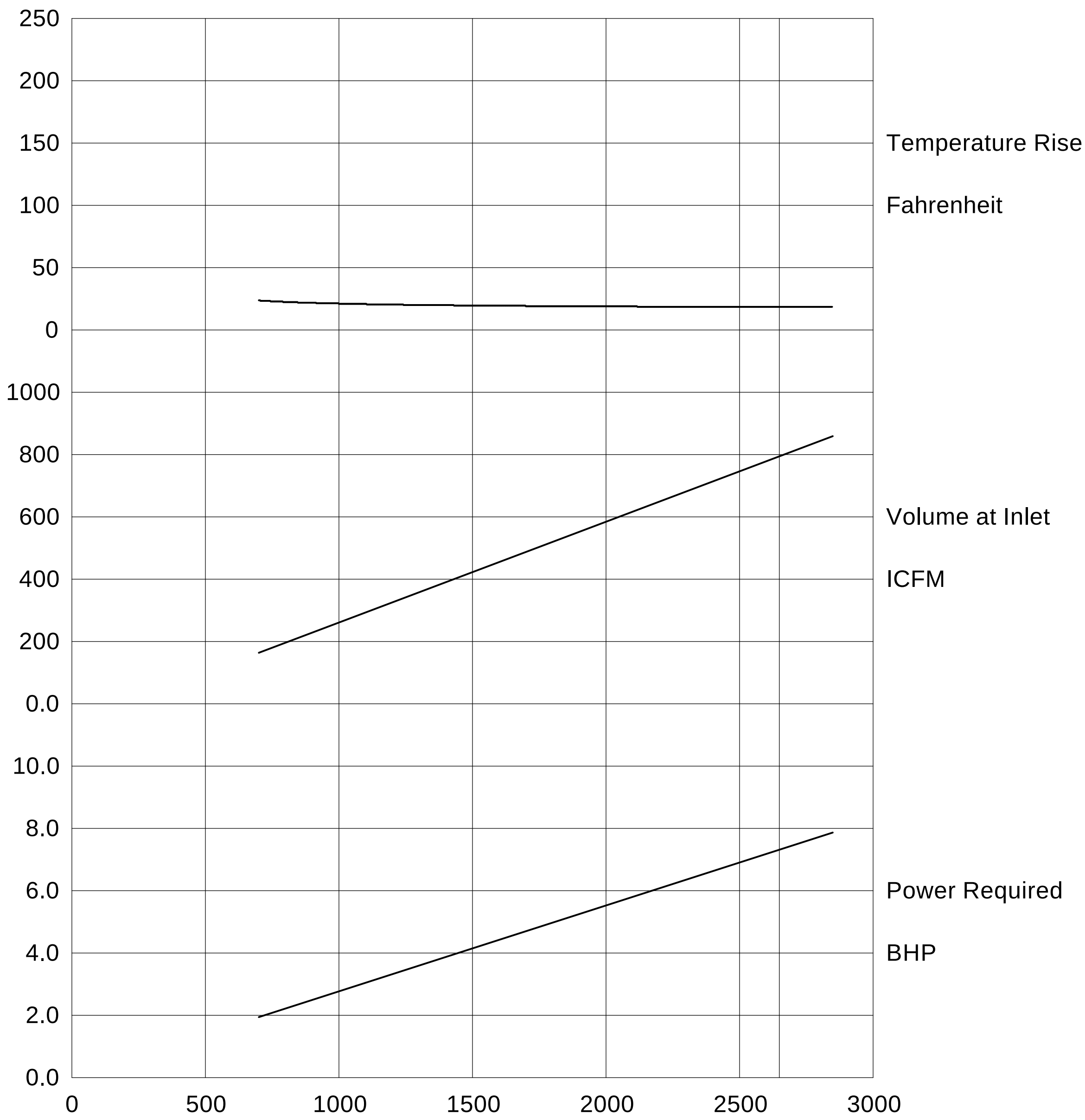
TUTHILL
Vacuum & Blower Systems

Date: 3/1/2004

Factory Offices
Tuthill Vacuum & Blower Systems
4840 West Kearney Street
P. O. Box 2877
Springfield, Missouri USA 65801-2877
Tel: (417) 865-8715 Toll Free: (800) 825-6937
Fax: (417) 865-2950
blowerxpert@tuthill.com

Normal Condition Performance Curve for 5009-21L2

Reference/Quote:

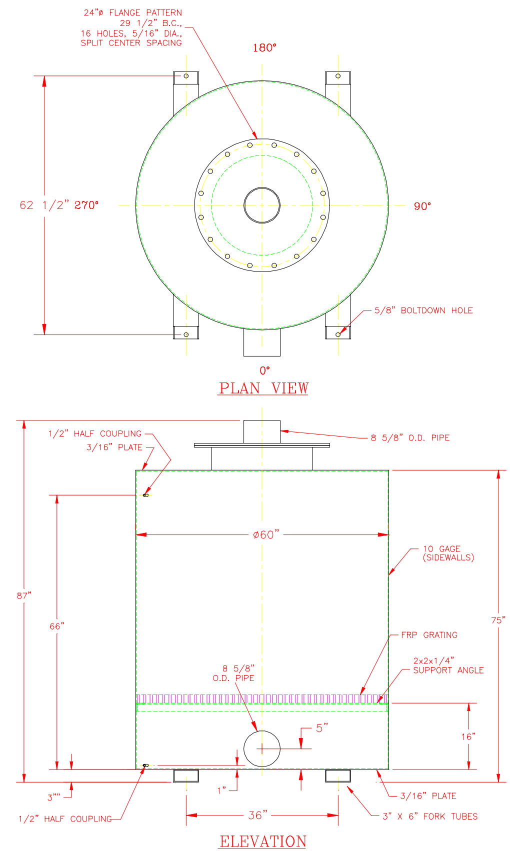


Performance Curve Based Upon The Conditions Of:

Displacement	0.323 CFR
Atmospheric Pressure:	14.7 PSIA
Elevation:	0 Feet
Gas:	AIR
Inlet Temperature	70 Fahrenheit
Molecular Weight	28.966
K Value	1.398
Inlet Pressure	47.65 in. H20 vac
Discharge Pressure	0.5522 PSIG (includes 0.252 PSI silencer loss)

GAS PHASE CARBON ADSORBERS

GPC 20R



Specifications

Dimensions: 5'ODx7'2"H
Bed Area:: 19.63 sq. ft.
Flow Range: 200-1800 cfm
Carbon Capacity: 2,000 lbs
Fittings: 8 5/8" nozzle,
(2) 1/2" half couplings,
24" access port

Empty Weight: 1,200 lbs
Operating Weight: 3,200 lbs

Inlet Ports:
Discharge Stacks
(Optional)

Options: Carbon
Hose Kits

CARBONAIR®
ENVIRONMENTAL SYSTEMS

MINNESOTA: (corp hdqrtrs)
Carbonair
2731 Nevada Ave. N.
New Hope, MN 55427
PH:800-526-4999
763-544-2154
FAX:763-544-2151
Homepage: www.carbonair.com

FLORIDA:
Carbonair
2603 NW 74th Place
Gainesville, FL 32653
PH:800-241-7833
352-376-9528
FAX:352-373-4971

VIRGINIA:
Carbonair
761 Union Street
Salem, VA 24153
PH:800-204-0324
540-387-0540
FAX:540-389-6860

TEXAS:
Carbonair
4105 Hunter Rd. #10
San Marcos, TX 78666
PH:800-893-5937
512-392-0085
FAX:512-392-0066

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE
(Read Instructions on the reverse side prior to initiating this form)

DATE: March 15, 2004

TRANSMITTAL NO.: 005

Section I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This Section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE:
Doug Stanley U.S. Army Corps of Engineers 1325 "J" Street Sacramento, CA 95814-2922	Peter Kelsall Shaw Environmental, Inc. P.O. Box 1698 Marina, CA 93933-1698	DACW05-96-D-0011 T.O. # 011 WAD # 12	X THIS IS A NEW TRANSMITTAL THIS IS A RESUBMITTAL OF TRANSMITTAL

SPECIFICATION NO. (Cover only one section with each transmittal)

PROJECT TITLE AND LOCATION: FORMER FORT ORD, CALIFORNIA

ITEM NO a.	DESCRIPTION OF ITEM SUBMITTED *(Type, size, model number, etc.)* b.	MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. *(See Instruction No. 8)* c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION *(See Instruction No. 6)* h.	FOR C E USE CODE i.
003	Final Work Plan and Sampling and Analysis Plan, Pilot Soil Vapor Extraction and Treatment, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California, Revision 0 (For Your Information Only)	N/A	30	SOP17		A		
004	DRF for the Final Work Plan and Sampling and Analysis Plan, Pilot Soil Vapor Extraction and Treatment, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California, Revision 0 (For Your Information Only)	N/A	30	SOP17		F		

REMARKS

cc: See Distribution List

CONTRACTOR QUALITY CONTROL SYSTEMS MANAGER
Shaw Environmental, Inc.

___✓___ Approved
_________ Approved with corrections as noted on submittal data and/or attached sheet(s).

SIGNATURE: Signature on File
TITLE: CONTRACTOR QUALITY CONTROL SYSTEM MANAGER

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

Shaw Environmental, Inc.

Signature on File /PETER KELSALL
NAME AND SIGNATURE OF CONTRACTOR

Section II - APPROVAL ACTION

ENCLOSURES RETURNED (List by Item No.)	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

Shaw Environmental, Inc.

DOCUMENT REVIEW AND RELEASE FORM

Client: USACE	Authors: Shaw Environmental, Inc.	Submittal Register Item No.: 004	Date: March 15, 2004

Document Title:	Final Work Plan and Sampling and Analysis Plan, Pilot Soil Vapor Extraction and Treatment, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California	Revision: 0	T.O. # 011	WAD# 12

Reviewer (*print*)	Reviewer Initial & Date	Technical	Project Manager	CQC	Health and Safety Manager	Task Manager	Chemistry	UXO	Construction	Reviewer Comments Resolved (*Signature & Date)*
Peter Kelsall			X							Signature on File
Tom Ghigliotto				X						Signature on File
Eric Schmidt							X			
Same as Technical Reviewer above		X	Topic outline with objectives for each section submitted prior to Rev. A							

Program Reviewer's Acceptance for Document Submittal	Signature	Yes	No
1) A 4025 (as applicable) prepared and submitted with document?	Signature on File	X	
2) Technical Conclusions adequately supported by text and data?	Signature on File	X	
3) Tables and Figures are in the proper format and checked and approved?	Signature on File	X	
4) The Table of Contents consistent with text information?	Signature on File	X	
5) Technical Reviewers are qualified and accepted by Project Manager?	Signature on File	X	
6) A document Distribution List been prepared and submitted with document?	Signature on File	X	

Recommended
4025 Code A

Signature on File
Project Manager

Signature on File
Contractor Quality Control Systems Manager

FORT ORD

DISTRIBUTION LIST FOR: **Final Work Plan and Sampling and Analysis Plan, Pilot Soil Vapor Extraction and Treatment, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California, Revision 0**

No. of CDs	No. of Paper	Name	Company	Address	City and State	Zip Code	Controlled Yes or No
1		Doug Stanley	Department of the Army, USACE	1325 "J" Street	Sacramento, CA	95814-2922	Yes
1		Derek Lieberman	Department of the Army, USACE	BRAC, Bldg. #4463 Gigling Road	Monterey, CA	93944-5004	Yes
1		Dave Eisen	Department of the Army, USACE	BRAC, Bldg. #4463 Gigling Road	Monterey, CA	93944-5004	Yes
1		Fred Hart	Department of the Army, USACE	1325 "J" Street	Sacramento, CA	95814-2922	Yes
1		Glen Mitchell	Department of the Army, USACE	1325 "J" Street	Sacramento, CA	95814-2922	Yes
	1	Marc Edwards	Department of the Army, USACE	Project Office	Presidio of Monterey, CA	95814-2922	Yes
	1	Mellissa Hlebasko	Department of the Army	BRAC, Bldg. #4463 Gigling Road	Monterey, CA	93944-5004	Yes
	1	Gail Youngblood	DENR	BRAC, Bldg. #4463 Gigling Road	Monterey, CA	93944-5004	Yes
1		Eric Schmidt	Shaw Environmental, Inc.	3001 Concord Court	Marina, CA	93933	No
	1	Jen Moser/ Tom Ghigliotto	Shaw Environmental, Inc.	PO Box 1698	Marina, CA	93933	Yes
1	1	Ed Ticken	Mactec	5341 Old Redwood Hwy; Suite 300	Petaluma, CA	94954	No
	1	John Christopher	California Department of Toxic Substances Control	8800 California Center Drive	Sacramento, CA	95826	Yes
	1	Roman Racca	California Department of Toxic Substances Control	8800 California Center Drive	Sacramento, CA	95826	Yes
	1	Grant Himebaugh	California Regional Water Quality Control Board	81 Higuera Street, Suite 200	San Luis Obispo, CA	93401-5414	No
	1	Jeff Raines	Tech Law, Inc.	90 New Montgomery Street; Suite 1010	San Francisco, CA	94105	No
	1	John Chesnutt	U.S. Environmental Protection Agency	75 Hawthorne Street, Mail SFD-8-3	San Francisco, CA	94105	Yes
1		Tom Kellogg	Department of the Army, USACE	1325 "J" Street	Sacramento, CA	95814-2922	Yes

FORT ORD

DISTRIBUTION LIST FOR: **Final Work Plan and Sampling and Analysis Plan, Pilot Soil Vapor Extraction and Treatment, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California, Revision 0**

No. of CDs	No. of Paper	Name	Company	Address	City and State	Zip Code	Controlled Yes or No
	3	Mary Bakan	Administrative Records	BRAC, Bldg #4463 Gigling Road	Monterey, CA	93944-5004	No
1		Sandy Reese	Administrative Records	BRAC, Bldg #4463 Gigling Road	Monterey, CA	93944-5004	No
	1	LeVonne Stone	Environmental Justice Network	P.O. Box 361	Marina, CA	93933	No
	1	Christine Bettencourt	Temple Health/Life 2000	PO Box 1852	Greenfield, CA	93921	No
1		Curt Gandy	Fort Ord Toxic Project	PO Box 1904	Monterey, CA	93942	No
	1	Mike Weaver		52 Corral De Tierra Road	Salinas, CA	93908	No
	1	Nat Rojanasathira		802 Sunset Drive; Apt G	Pacific Grove, CA	93950	No
1	1	Project File	Shaw Environmental, Inc.	PO Box 1698	Marina, CA	93933	Yes
1		Program File (Kathy Grider)	Shaw Environmental, Inc.	4005 Port Chicago Highway	Concord, CA	94520-1120	Yes
12	18						

Approved: Signature on File
Glen Mitchell, USACE
Project Manager

Shaw Environmental, Inc.

Field Work Variance No. TII-077

FIELD WORK VARIANCE

Project Name/Number	Fort Ord / 783751	CTO/WAD	12
Applicable Document	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	Date	May 18, 2004

Problem Description:

The sampling and analytical schedule provided in Table 6-2 requires revision. The soil vapor extraction system has currently been in operation for 6 weeks. Based on the preliminary results received to date, the CT concentrations in the interior of the original soil gas plume have been reduced significantly (see attached figure). At this stage, additional probe data from the interior of the plume are not needed. Additional information from perimeter probes is needed to show that CT concentrations in the outer parts of the plume have also been reduced significantly. Subject to confirmation from these perimeter probes, it appears that it will be appropriate to shut down the system after approx. 2 months of operation when the carbon tetrachloride (CT) concentration in the influent will approach 1 ppbv.

Recommended solution:

Table 6-2 has been revised (attached) to combine the original “months 1 and 2” sampling periods as “week 6”, and bring forward the original “month 3” to “month 2”.

“Week 6” sampling will include the deep and shallow probes at the following perimeter probe locations (CTP SGP 51 through 60; excluding 55). The intermediate probes are not needed because data can be extrapolated from the deep and shallow probes. The shallow and interior probes specified for months 1 and 2 in the original schedule (CTP SGP 35, 37, 48, 49, 50, 61, and 62) will not be sampled during this revised round of sampling.

The week 6 sampling will occur approximately May 18, 2004. The system will be operated until the data are received and evaluated, approximately June 3. The system will then be shut down and the month 2 sampling will be conduced the week of June 7. The probes to be included in the month 2 sampling will be determined based on the data and may be revised by an additional FWV.

The original months 1 and 2 sampling of the extraction wells will be combined for one sampling round in week 6. Also, since there has been no evidence of breakthrough at the granulated activated carbon units, and CT concentrations have been reduced significantly, the effluent sample will be cancelled in the week 6 sampling.

Impact on present and completed work:

Due to the successful SVE performance the data required for the RI/FS can be provided with approx. 13 fewer samples, with resulting cost savings.

Requested by:

Eric Schmidt

Recommended solution/disposition:

Clarification ☐ Minor Change ☒ Major Change ☐

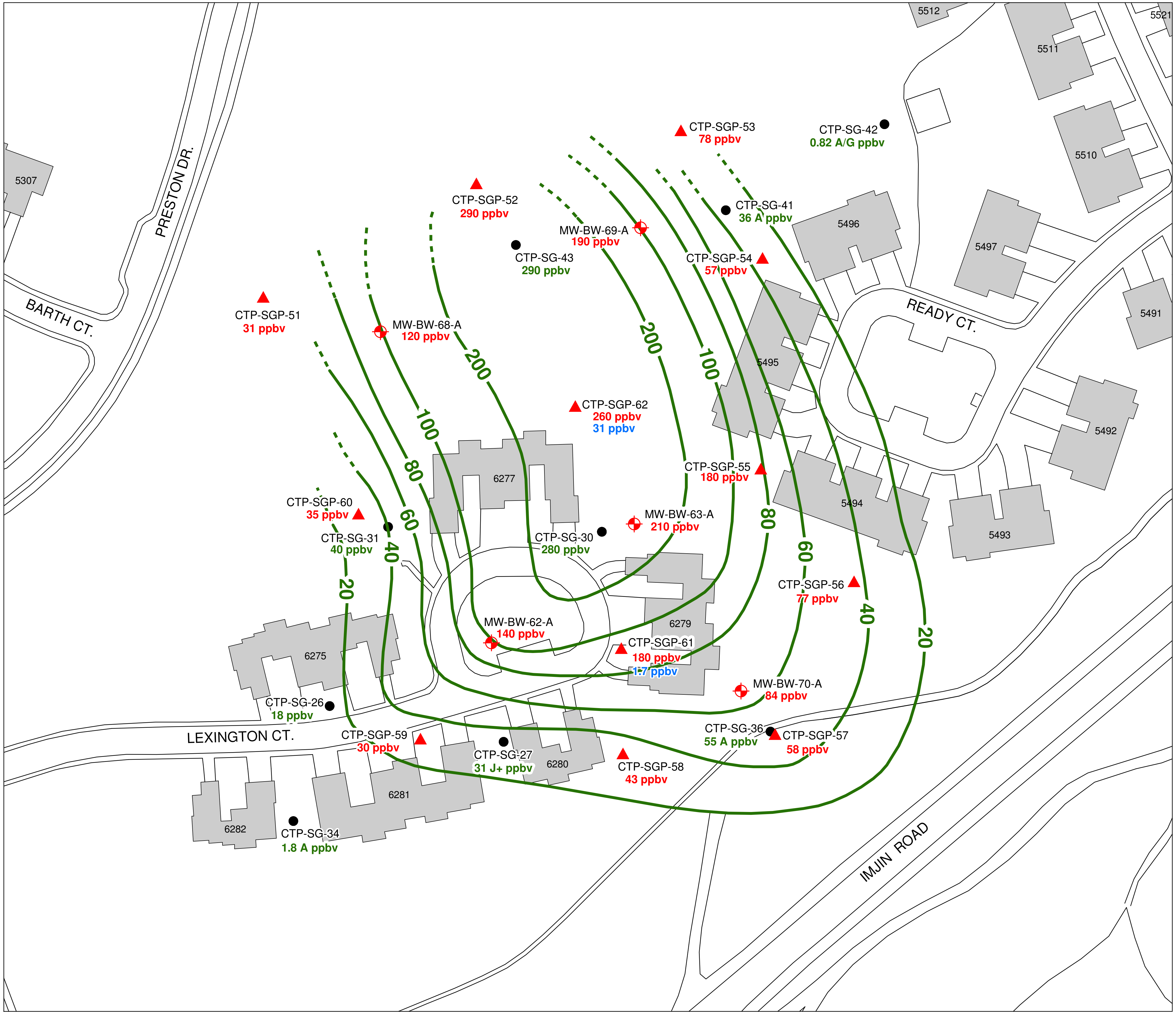
Signature ____________________ Date __________

Technical Reviewer

Shaw Environmental, Inc.

Shaw Approvals:				*If Major Change:*			
Signature		Date		Signature		Date	
	Project/Task Manager				*Sr. Project Manager*		
Signature		Date					
	Project QC System Manager						

USACE Approval:				*If Major Change:*			
Approved	☐	Rejected	☐	Signature		Date	
					USACE COR or TM		



LEGEND

- SVE WELL
- DEEP (85 FT.) MONITORING PROBE
- SOIL GAS SAMPLE LOCATION
- 31 ppbv — CARBON TETRACHLORIDE CONCENTRATION APRIL 2004
- 35 ppbv — CARBON TETRACHLORIDE CONCENTRATION MARCH 2004
- 18 ppbv — CARBON TETRACHLORIDE CONCENTRATION MARCH-JUNE 2003
- CARBON TETRACHLORIDE CONCENTRATION CONTOURS BELOW 66 FT. DEPTH (ppbv); DASHED WHERE INFERRED
- BUILDING

NOTES:

1. April Carbon Tetrachloride concentrations measured 4/28/04.
2. March Carbon Tetrachloride concentrations measured between 3/29/04 and 3/31/04.
3. A, A/G, and J+ are laboratory qualifiers.
4. Carbon Tetrachloride concentration contours provided by Mactec and based on data collected March to July 2003.

N

0 100 200 FEET

REVISION	DATE	DESCRIPTION	CHKD	APPR

Shaw® Shaw Environmental, Inc.

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California

DESIGNED: E. SCHMIDT
DRAWN: K. BLACK
CHECKED: P. KELSALL

Figure __
CARBON TETRACHLORIDE CONCENTRATIONS
DEEP MONITORING PROBES
OPERABLE UNIT CARBON TETRACHLORIDE
Former Fort Ord, California

SUBMITTED: DATE

SCALE: SPEC. No.
SHEET FILE No. CTdeep_1Q04+2003.mxd

Table 6-2
Performance Monitoring Volatile Organic Compound Sampling Schedule
Revised for FWV 077

Sampling Location		Phase 1 Operation									Optional 6 Month System Operation			
		Baseline	Week 1					Week 2	Week 6	Month 2	Months 4-5	Month 6	Months 7-8	Month 9
Extraction Wells	MW-BW-62-A	1						1	1	1		1		1
	MW-BW-63-A	1						1	1	1		1		1
	MW-BW-68-A	1						1	1	1		1		1
	MW-BW-69-A	1						1	1	1		1		1
	MW-BW-70-A	1						1	1	1		1		1
Monitoring Probes	Interior													
	CTP-SGP-61	3						3		3		3		3
	CTP-SGP-62	3						3		3		3		3
	Perimeter													
	CTP-SGP-51	3							2	3				3
	CTP-SGP-52	3							2	3		3		3
	CTP-SGP-53	3							2	3				3
	CTP-SGP-54	3							2	3				3
	CTP-SGP-55	3								3		3		3
	CTP-SGP-56	3							2	3				3
	CTP-SGP-57	3							2	3				3
	CTP-SGP-58	3							2	3		3		3
	CTP-SGP-59	3							2	3				3
	CTP-SGP-60	3							2	3		3		3
	Shallow													
	CTP-SGP-35	1								1				1
	CTP-SGP-37	1						1		1		1		1
	CTP-SGP-48	1						1		1		1		1
	6277 Lexington Court													
	CTP-SGP-49 (Sub-Slab)							1		1		1		1
	CTP-SGP-50 (Exterior)							1		1		1		1
	Sub-total	44	0	0	0	0	0	15	23	46	0	27	0	46

Sampling Location		Phase 1 Operation									Optional 6 Month System Operation			
			Week 1					Week 2	Week 6	Month 2	Months 4-5	Month 6	Months 7-8	Month 9
		Baseline	Day 1 (24-hour)	Day 2	Day 3 (24-hour)	Day 4	Day 5							
Soil Vapor Treatment System	Influent	na	1	1	1	1	1	na	1	1	2	1	2	1
	Lead Carbon Vessel	na	1					na	1	1	2	1	2	1
	Effluent	na	1	1	1	1	1	na		1	2	1	2	1
	Sub-total	0	3	2	2	2	2	0	2	3	6	3	6	3

	Baseline	Day 1	Day 2	Day 3	Day 4	Day 5	Week 2	Week 6	Month 2	Months 4-5	Month 6	Months 7-8	Month 9
Total Samples	44	3	2	2	2	2	15	25	49	6	30	6	49

3 MONTH OPERATION	
TOTAL GAS SAMPLES =	144
FIELD DUPLICATES =	9
CUMULATIVE TOTAL =	153
OPTIONAL 6 MONTH OPERATION	
TOTAL GAS SAMPLES =	91
FIELD DUPLICATES =	5
CUMULATIVE TOTAL =	96

Shaw® Shaw Environmental, Inc.

Field Work Variance No.	TII-082
Page 1 of	2

FIELD WORK VARIANCE

Project Name/Number	Fort Ord / 783751	CTO/WAD	12
Applicable Document	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	Date	August 5, 2004

Problem Description:

1. A data gap exists at the northern end of the soil gas carbon tetrachloride plume (CTP). Additional probes are required to be able to determine if the SVE is complete in this area.
2. There is no data to evaluate if elevated soil gas concentrations may exist at depth immediately above the A-aquifer in areas where the CT concentration in groundwater is higher than observed in the SVE area.

Recommended solution:

1. Install three additional nested probes along the projected northern extent of the soil gas CTP. These probes will be drilled near Lexington Court approximately 200 feet north of the existing soil gas probes to further define the northern extent of the soil vapor plume. 2. A fourth probe will be drilled approximately 1000 feet north of the soil gas CTP to evaluate the presence of elevated soil gas concentrations at depth immediately above the A-aquifer. This probe is located near Preston Road where the CT concentration in groundwater is approximately 10 ppbv.

Figure 1 shows the location of the four monitoring probes. The probes will consist of three nested probes installed at approximate depths of 85, 60, and 30 ft bgs. The probes will be constructed following specifications presented in the Work Plan 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 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 will be installed on each nested monitoring probe.

Collect one round of soil gas samples from each probe at the three locations near Lexington Court (9 total) and one from the deep probe in Preston Road. Samples will analyzed by the laboratory on standard TAT for EPA Method TO15 (TCE, PCE, Chloroform, & CT only).

Impact on present and completed work:

The additional data will close the contours on the northeastern end of the soil gas CTP and provide data to determine the need for additional SVE. Costs are presented in WVN 207.

Requested by: Jen Moser

Recommended solution/disposition:

Implemented as recommended above.

Clarification ☐ Minor Change ☐ Major Change ☒

Signature ____________ Date ________

Technical Reviewer

Shaw® Shaw Environmental, Inc.

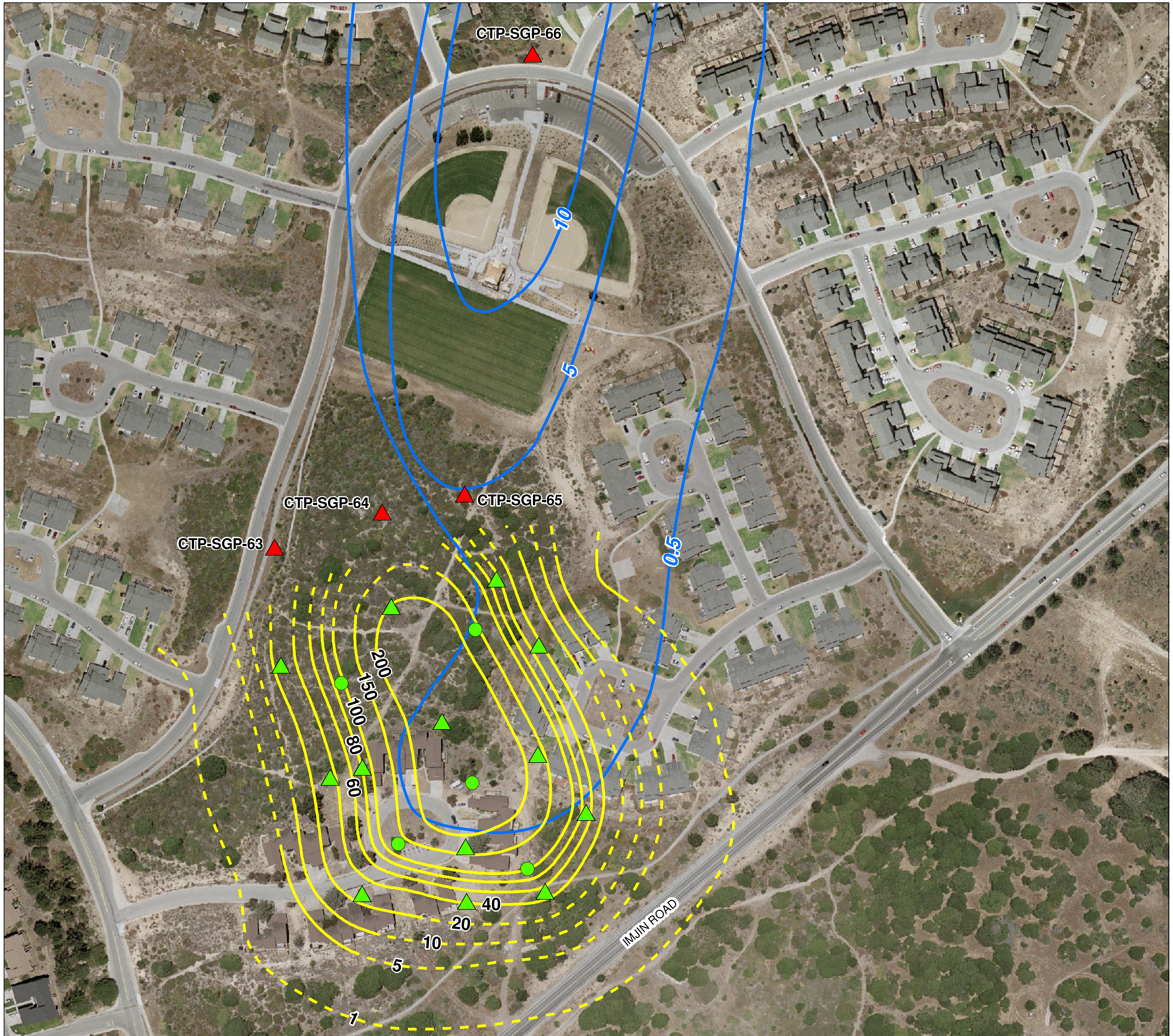
Shaw Approvals: *If Major Change:*

Signature ______________ Date ________ Signature ______________ Date ________
Project/Task Manager *Sr. Project Manager*

Signature ______________ Date ________
Project QC System Manager

USACE Approval: *If Major Change:*

Approved ☐ Rejected ☐ Signature ______________ Date ________
USACE COR or TM



LEGEND

- SOIL VAPOR EXTRACTION WELL
- EXISTING NESTED SOIL VAPOR MONITORING PROBE (30, 60, AND 85 FT. BGS)
- PROPOSED NESTED SOIL VAPOR MONITORING PROBE (30, 60, AND 85 FT. BGS)
- SOIL GAS CARBON TETRACHLORIDE CONCENTRATION CONTOURS AT 85 FT. DEPTH (ppbv); DASHED WHERE INFERRED
- A-AQUIFER CARBON TETRACHLORIDE CONCENTRATION CONTOURS (ppbv)

NOTES:

1. Soil gas concentrations existing prior to soil vapor extraction.
2. Groundwater Carbon Tetrachloride concentration contours provided by Mactec and based on data collected December 2003.

N

0 200 400 FEET

REVISION	DATE	DESCRIPTION	CHKD	APPR

Shaw® Shaw Environmental, Inc.

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California

DESIGNED: T. GHIGLIOTTO
DRAWN: K. BLACK
CHECKED: P. KELSALL

Figure 1
ADDITIONAL MONITORING PROBES OPERABLE UNIT CARBON TETRACHLORIDE PLUME
Former Fort Ord, California

SUBMITTED: DATE SCALE: SPEC. No. SHEET FILE No. Proposed_Probes.mxd

FIELD WORK VARIANCE

Project Name/Number	Fort Ord / 783751	CTO/WAD	12
Applicable Document	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	Date	Sept. 9, 2004

Problem Description:

Table 6-2 of the work plan proposed a set number of samples to be collected for Phase II operation of the Carbon Tetrachloride Soil Vapor Extraction system (CT SVE). At the time the original plan was prepared it was assumed that Phase II operation would be 6 months with probe sampling conducted after months 3 and 6. The CT SVE was operated from April to June 14, 2004 (Phase I). The system was then shut down because the CT concentrations had been reduced to low levels. Since shutdown, 3 rounds of sampling have occurred at two of the deep probes (SGP-55 and 62) to evaluate whether any rebound of VOCs is occurring. This FWV presents a revised plan for Phase II sampling based on evaluation of the Phase 1 data. It incorporates the rebound sampling already conducted, as well as additional sampling in 3 additional probes that were installed north of the original probes in accordance with FWV 82.

Recommended solution:

The CT SVE system will be operated (Phase II) for a period of approximately 1 month. At the end of this time, the performance of the pilot SVE system will be evaluated. This evaluation will determine whether the operation period may continue at the direction of the Army until either: a) cleanup levels have been attained, or b) the removal of volatile organic compounds from the soils is low and continued operation of the system is not cost effective.

The new sampling schedule presented in the attached revised Table 6-2 will be implemented for Phase II. Data will be collected before the SVE is restarted to provide additional evidence for rebound while the system was shut down, during Phase II, and at the completion of one month operation. The selection of certain probes is based on: 1) the concentrations of volatile organic compounds (VOCs) at the initial baseline; 2) physical location in the CTP; and 3) the concentration of VOCs after Phase 1 operations were completed.

Impact on present and completed work:

No impact on other work. The analytical cost is approximately the same as approved for Phase II operations.

Requested by: Eric Schmidt

Recommended solution/disposition: Implemented as recommended above.

Clarification ☐ Minor Change ☒ Major Change ☐

Signature ______________ Date ________

Technical Reviewer

Shaw® Shaw Environmental, Inc.

Shaw Approvals:				*If Major Change:*			
Signature		Date		Signature		Date	
	Project/Task Manager				*Sr. Project Manager*		
Signature		Date					
	Project QC System Manager						

USACE Approval:				*If Major Change:*			
Approved	☐	Rejected	☐	Signature		Date	
					USACE COR or TM		

Table 6-2
Performance Monitoring Volatile Organic Compound Sampling Schedule

	Sampling Location	Phase 1 Operation											Phase 2 Operation				
		3/25 - 4/1/2004	4/6/2004	4/7/2004	4/13/2004	4/16/2004	4/27/2004	4/28/2004	5/18 - 5/19/2004	6/14 - 6/18/2004	7/2/2004	7/20/2004	8/4/2004	New Baseline	Day 1	Day 15	Shutdown
Extraction Wells	MW-BW-62-A	1						1	1	1							1
	MW-BW-63-A	**2**						1	1	1							1
	MW-BW-68-A	1						1	1	1							1
	MW-BW-69-A	1						1	1	1							1
	MW-BW-70-A	1						1	1	1							1
Monitoring Probes	Interior																
	CTP-SGP-61	3						3		3							2
	CTP-SGP-62	3						3		3	1	1	1	1		1	2
	Perimeter																
	CTP-SGP-51	3							2	3							2
	CTP-SGP-52	3							2	**4**				1		1	2
	CTP-SGP-53	**4**							2	3				1		1	2
	CTP-SGP-54	3							2	3							2
	CTP-SGP-55	3								**4**	1	1	1	1		1	2
	CTP-SGP-56	3							2	3				1		1	2
	CTP-SGP-57	3							2	3							2
	CTP-SGP-58	3							2	3							2
	CTP-SGP-59	3							2	3							2
	CTP-SGP-60	3							3	3							2
	Shallow																
	CTP-SGP-35	1								1							1
	CTP-SGP-37	1						1		**2**							1
	CTP-SGP-48	1						1		1							1
	6277 Lexington Court																
	CTP-SGP-49 (Sub-Slab)							1		1							1
	CTP-SGP-50 (Exterior)							1		1							1
	New Probes																
	CTP-SGP-63													3		1	2
	CTP-SGP-64													3		1	2
	CTP-SGP-65													3		1	2
	CTP-SGP-66													1			
	CTP-SGP-50 (Exterior)																
	Sub-total	46	0	0	0	0	0	15	24	49	2	2	2	15		8	40
	Influent	na	1	1	1	1	1		1	1					1	1	1
	Lead Carbon Vessel	na	1							1					1		
	Effluent	na	1	1	1	1	1			1					1	1	1
	Sub-total	0	3	2	2	2	2	0	1	3	0	0	0	0	3	2	2
	Total Samples	46	3	2	2	2	2	15	25	52	2	2	2	15	3	10	42

PHASE 1 OPERATION	
TOTAL GAS SAMPLES =	153
FIELD DUPLICATES =	4
CUMULATIVE TOTAL =	153
PHASE 2 OPERATION	
TOTAL GAS SAMPLES =	72
FIELD DUPLICATES =	4
CUMULATIVE TOTAL =	76

Shaw® Shaw Environmental, Inc.

Field Work Variance No. TII-089

Page 1 of 1

FIELD WORK VARIANCE

Project Name/Number	Fort Ord / 783751	CTO/WAD	12
Applicable Document	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	Date	Nov. 23, 2004

Problem Description:

As presented at the BCT on 11/8/04 the SVE was shut down on 11/8/04. The sampling schedule presented in Table 6-2 of the work plan requires modification based on analytical results obtained during the first part of Phase II operations to.

Recommended solution:

This FWV updates the sampling schedule in Table 6-2 and presents a revised plan for the final Phase II sampling based on a technical evaluation of the Phase I/II data that has been obtained to date. The new sampling schedule presented in the attached revised Table 6-2 will be implemented for Phase II (dates where sampling occurred have been provided). The selection of the probes for the final Phase II sampling is based on: 1) providing a clear picture of the final concentration of VOCs present (or absent) in the carbon tetrachloride plume (CTP); 2) physical location in the CTP; and 3) the concentration of VOCs in the plumes measured in Phases I and II.

Impact on present and completed work:

No impact on other work. The analytical cost is approximately the same as approved for Phase II operations.

Requested by: Eric Schmidt

Recommended solution/disposition: Implement as recommended above.

Clarification ☐ Minor Change ☒ Major Change ☐

Signature ____________ Date ________
Technical Reviewer

Shaw Approvals: *If Major Change:*

Signature ____________ Date ________ Signature ____________ Date ________
Project/Task Manager *Sr. Project Manager*

Signature ____________ Date ________
Project QC System Manager

USACE Approval: *If Major Change:*

Approved ☐ Rejected ☐ Signature ____________ Date ________
USACE COR or TM

Table 6-2
Performance Monitoring Volatile Organic Compound Sampling Schedule

	Sampling Location	Phase 1 Operation										
		3/25 - 4/1/2004	4/6/2004	4/7/2004	4/13/2004	4/16/2004	4/27/2004	4/28/2004	5/18 - 5/19/2004	6/14 - 6/18/2004	7/2/2004	7/20/2004
Extraction Wells	MW-BW-62-A	1						1	1	1		
	MW-BW-63-A	**2**						1	1	1		
	MW-BW-68-A	1						1	1	1		
	MW-BW-69-A	1						1	1	1		
	MW-BW-70-A	1						1	1	1		
Monitoring Probes	Interior											
	CTP-SGP-61	3						3		3		
	CTP-SGP-62	3						3		3	1	1
	Perimeter											
	CTP-SGP-51	3							2	3		
	CTP-SGP-52	3							2	**4**		
	CTP-SGP-53	**4**							2	3		
	CTP-SGP-54	3							2	3		
	CTP-SGP-55	3								**4**	1	1
	CTP-SGP-56	3							2	3		
	CTP-SGP-57	3							2	3		
	CTP-SGP-58	3							2	3		
	CTP-SGP-59	3							2	3		
	CTP-SGP-60	3							3	3		
	Shallow											
	CTP-SGP-35	1								1		
	CTP-SGP-37	1						1		**2**		
	CTP-SGP-48	1						1		1		
	6277 Lexington Court											
	CTP-SGP-49 (Sub-Slab)							1		1		
	CTP-SGP-50 (Exterior)							1		1		
	MacTec Probes (6 foot)											
	CTP-SGP-40											
	CTP-SGP-41											
	CTP-SGP-42											
	CTP-SGP-44											
	CTP-SGP-45											
	New Probes											
	CTP-SGP-63											
	CTP-SGP-64											
	CTP-SGP-65											
	CTP-SGP-66											
	Sub-total	46	0	0	0	0	0	15	24	49	2	2
	Influent		1	1	1	1	1		1	1		
	Lead Carbon Vessel		1							1		
	Effluent		1	1	1	1	1			1		
	Sub-total	0	3	2	2	2	2	0	1	3	0	0
	Total Samples	46	3	2	2	2	2	15	25	52	2	2

Table 6-2
Performance Monitoring Volatile Organic Compound Sampling Schedule

		Phase 2 Operation								
	Sampling Location	8/4/2004	9/02 - 9/02/2004	9/9/2004	9/23/2004	10/7/2004	10/14/2004	10/22/2004	11/8/2004	Proposed Final
Extraction Wells	MW-BW-62-A								1	
	MW-BW-63-A								1	
	MW-BW-68-A								1	
	MW-BW-69-A								1	
	MW-BW-70-A								1	
Monitoring Probes	Interior									
	CTP-SGP-61									
	CTP-SGP-62	1	1		1					
	Perimeter									
	CTP-SGP-51									2
	CTP-SGP-52		1		1					2
	CTP-SGP-53		1		1					2
	CTP-SGP-54				1					
	CTP-SGP-55	1	**2**		1	1	1			2
	CTP-SGP-56		1			**2**	1			2
	CTP-SGP-57									
	CTP-SGP-58									2
	CTP-SGP-59									2
	CTP-SGP-60									2
	Shallow									
	CTP-SGP-35									
	CTP-SGP-37									
	CTP-SGP-48									
	6277 Lexington Court									
	CTP-SGP-49 (Sub-Slab)									
	CTP-SGP-50 (Exterior)									
	MacTec Probes (6 foot)									
	CTP-SGP-40									1
	CTP-SGP-41									1
	CTP-SGP-42									1
	CTP-SGP-44									1
	CTP-SGP-45									1
	New Probes									
	CTP-SGP-63		3		1	1	1	1		2
	CTP-SGP-64		3		1					**3**
	CTP-SGP-65		3		1	1	1	1		2
	CTP-SGP-66		1							
	Sub-total	2	16		8	5	4	2	5	28
	Influent			1	**2**	1	1	1	1	
	Lead Carbon Vessel			1					1	
	Effluent			1	1				1	
	Sub-total	0	0	3	3	1	1	1	3	0
	Total Samples	2	16	3	11	6	5	3	8	28

PHASE 1 OPERATION	
TOTAL GAS SAMPLES =	153
FIELD DUPLICATES =	5
CUMULATIVE TOTAL =	158
PHASE 2 OPERATION	
TOTAL GAS SAMPLES =	82
FIELD DUPLICATES =	4
CUMULATIVE TOTAL =	86

FIELD WORK VARIANCE

Project Name/Number	Fort Ord / 783751	CTO/WAD	12
Applicable Document	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	Date	May 9, 2005

Problem Description:

The Carbon Tetrachloride Soil Vapor Extraction System (CT SVE) was shut down on 11/8/04. As evidenced by the reduction in VOCs in the influent, monitoring probes, and extraction wells, the pilot SVE was very effective in removing VOCs, specifically CT from the soil gas.

Additional sampling of select probes is required in order to confirm that there has been no significant increase in concentrations since the system was shutdown.

The sampling schedule presented in Table 6-2 of the work plan requires modification in order to include the select probes that will be sampled during this additional round.

Recommended solution:

This FWV updates the sampling schedule in Table 6-2 and presents a revised plan for the additional sampling that will be conducted to confirm that there has been no significant change in concentrations since the CT SVE shutdown on 11/8/2004.

The selection of the probes for the additional sampling is based on:

1) Providing a representative picture of the current concentration of VOCs present (or absent) in the carbon tetrachloride plume (CTP); and

2) The probes physical location in the CTP.

Impact on present and completed work:

No impact on other work. The analytical cost is covered under WVN 226.

Requested by: Eric Schmidt

Recommended solution/disposition: Implement as recommended above.

Clarification ☐ Minor Change ☐ Major Change ☒

Signature ______________ Date ________

Technical Reviewer

Shaw Shaw Environmental, Inc.

Field Work Variance No. TII-093

Page 2 of 2

Shaw Approvals:		*If Major Change:*	
Signature [signature] *Project/Task Manager*	Date 5/10/05	Signature [signature] *Sr. Project Manager*	Date 5/9/05
Signature [signature] *Project QC System Manager*	Date 5/9/05		

USACE Approval:		*If Major Change:*	
Approved ☑	Rejected ☐	Signature [signature] *USACE COR or TM*	Date 5/17/05

Table 6-2

Performance Monitoring Volatile Organic Compound Sampling Schedule

	Sampling Location	3/25 - 4/1/2004	4/6/2004	4/7/2004	4/13/2004	4/16/2004	4/27/2004	4/28/2004	5/18 - 5/19/2004	6/14 - 6/18/2004	7/2/2004	7/20/2004	8/4/2004	9/02 - 9/02/2004	9/9/2004
		Phase 1 Operation													
Extraction Wells	MW-BW-62-A	1						1	1	1					
	MW-BW-63-A	2						1	1	1					
	MW-BW-68-A	1						1	1	1					
	MW-BW-69-A	1						1	1	1					
	MW-BW-70-A	1						1	1	1					
Monitoring Probes	Interior														
	CTP-SGP-61	3						3		3					
	CTP-SGP-62	3						3		3	1	1	1	1	
	Perimeter														
	CTP-SGP-51	3							2	3					
	CTP-SGP-52	3							2	4				1	
	CTP-SGP-53	4							2	3				1	
	CTP-SGP-54	3							2	3					
	CTP-SGP-55	3								4	1	1	1	2	
	CTP-SGP-56	3							2	3				1	
	CTP-SGP-57	3							2	3					
	CTP-SGP-58	3							2	3					
	CTP-SGP-59	3							2	3					
	CTP-SGP-60	3							3	3					
	Shallow														
	CTP-SGP-35	1								1					
	CTP-SGP-37	1						1		2					
	CTP-SGP-48	1						1		1					
	6277 Lexington Court														
	CTP-SGP-49 (Sub-Slab)							1		1					
	CTP-SGP-50 (Exterior)							1		1					
	MacTec Probes (6 foot)														
	CTP-SGP-40														
	CTP-SGP-41														
	CTP-SGP-42														
	CTP-SGP-44														
	CTP-SGP-45														
	New Probes														
	CTP-SGP-63													3	
	CTP-SGP-64													3	
	CTP-SGP-65													3	
	CTP-SGP-66													1	
	Sub-total	46	0	0	0	0	0	15	24	49	2	2	2	16	
	Influent		1	1	1	1	1		1	1					1
	Lead Carbon Vessel		1							1					1
	Effluent		1	1	1	1	1			1					1
	Sub-total	0	3	2	2	2	2	0	1	3	0	0	0	0	3
	Total Samples	46	3	2	2	2	2	15	25	52	2	2	2	16	3

Table 6-2

Performance Monitoring Volatile Organic Compound Sampling Schedule

		Phase 2 Operation						
	Sampling Location	9/23/2004	10/7/2004	10/14/2004	10/22/2004	11/8/2004	11/8 - 12/1/2004	Additional Sampling
Extraction Wells	MW-BW-62-A					1		
	MW-BW-63-A					1		
	MW-BW-68-A					1		
	MW-BW-69-A					1		
	MW-BW-70-A					1		
Monitoring Probes	Interior							
	CTP-SGP-61							
	CTP-SGP-62	1						2
	Perimeter							
	CTP-SGP-51						2	2
	CTP-SGP-52	1					2	2
	CTP-SGP-53	1					2	2
	CTP-SGP-54	1						
	CTP-SGP-55	1	1	1			2	2
	CTP-SGP-56		2	1			2	2
	CTP-SGP-57							
	CTP-SGP-58						2	2
	CTP-SGP-59						2	2
	CTP-SGP-60						2	2
	Shallow							
	CTP-SGP-35							
	CTP-SGP-37							
	CTP-SGP-48							
	6277 Lexington Court							
	CTP-SGP-49 (Sub-Slab)							
	CTP-SGP-50 (Exterior)							1
	MacTec Probes (6 foot)							
	CTP-SGP-40						1	
	CTP-SGP-41						1	
	CTP-SGP-42						1	
	CTP-SGP-44						1	
	CTP-SGP-45						1	
	New Probes							
	CTP-SGP-63	1	1	1	1		2	2
	CTP-SGP-64	1					3	3
	CTP-SGP-65	1	1	1	1		2	2
	CTP-SGP-66							
	Sub-total	8	5	4	2	5	28	26
	Influent	2	1	1	1	1		
	Lead Carbon Vessel					1		
	Effluent	1				1		
	Sub-total	3	1	1	1	3	0	0
	Total Samples	11	6	5	3	8	28	26

PHASE 1 OPERATION	
TOTAL GAS SAMPLES =	148
FIELD DUPLICATES =	5
CUMULATIVE TOTAL =	153
PHASE 2 OPERATION	
TOTAL GAS SAMPLES =	78
FIELD DUPLICATES =	4
CUMULATIVE TOTAL =	86
ADDITIONAL ROUND	
TOTAL GAS SAMPLES =	25
FIELD DUPLICATES =	1
CUMULATIVE TOTAL =	26