TETRA TECH, INC.

TECHNICAL MEMORANDUM

Basewide Groundwater Monitoring Program Report
Summer 2005
Installation Restoration Program Site 20, Area 1
Vandenberg Air Force Base, California

07 December 2005

Prepared by:
Tetra Tech, Inc.
4213 State Street, Suite 100
Santa Barbara, CA 93110

1.0 INTRODUCTION

This report documents the activities and results of the summer 2005 groundwater monitoring at Installation Restoration Program Site 20, Area 1 (Underground Storage Tank [UST] Area), Operable Unit 1, Vandenberg Air Force Base, Santa Barbara County, California. Tetra Tech, Inc. (Tetra Tech) collected groundwater samples at Site 20, Area 1 during August 2005. The location of Site 20 is shown on Figure 1.

The groundwater monitoring is being completed in accordance with the Basewide Groundwater Monitoring Program (BGMP) Work Plan (U.S. Air Force 2000a), the BGMP Health and Safety Plan Addendum (U.S. Air Force 2000b), the Basewide Sampling and Analysis Plan (U.S. Air Force 2003), the BGMP Quality Assurance Project Plan (QAPP) Addendum (U.S. Air Force 2004), Vandenberg AFB Hazardous Waste Management Plan (U.S. Air Force 2002), and the Waste Management Plan Addendum (U.S. Air Force 2005). Regulatory oversight of the work is being performed by the California Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board—Central Coast Region (RWQCB).

Site background information is summarized in Section 2.0. The scope of work and methodology for sampling are presented in Section 3.0. The results of the groundwater monitoring are presented in Section 4.0. Quality Assurance/Quality Control (QA/QC) is discussed in Section 5.0. Recommendations for future sampling rounds are presented in Section 6.0.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

Site 20, Area 1 (UST Area) is located in the main cantonment area, on the west side of Utah Avenue (Figure 1). Site 20 also includes Landfill 1 (Area 2) and Drum Disposal Site 1 (Area 3), which are discussed separately in this report due to the differences in hydrogeology, chemicals of concern, and sampling program. Site 20, Area 1 groundwater monitoring is performed semiannually, during winter and summer quarters. Site 20, Areas 2 and 3 is sampled annually, with the exception of well 20-MW-3, which is sampled semiannually, and any surface water that is collected during periods of rainfall.

Area 1 is located in the northern portion of Site 20. Three 10,000-gallon, concrete USTs were removed from Area 1 in 1993. The USTs were used to store diesel fuel from 1942 until 1946 and gasoline from 1951 to 1953. The USTs were apparently not used after 1953. Total petroleum hydrocarbons quantified as both diesel and gasoline; benzene, toluene, ethylbenzene, and xylene (BTEX) compounds; 1,2-dichloroethane (DCA); and 1,2-dibromoethane (EDB) have been detected in groundwater samples from Area 1. A complete description of Area 1 can be found in the draft *Site 20 Underground Storage Tank Site Assessment Report* (Jacobs Engineering Group [JEG] 1997).

In 1998, a source reduction system (SRS) was installed to remove petroleum hydrocarbons from the soil and groundwater near the former UST locations (Montgomery Watson Harza [MWH 2001]). JEG operated this system from August 1998 to June 1999. The system was offline between June 1999 and January 2001; it has been operated by MWH since January 2001. The system consists of a dual-phase extraction system in well 11669-EW-1, which is located between monitoring wells 11669-MW-4 and 11669-MW-5 (Figure 1). The SRS operations were transitioned to Shaw Environmental, Inc. (Shaw) in September 2004 and are ongoing. Additional information on the extraction system operations can be obtained by contacting 30 CES/CEVR or MWH.

2.2 HYDROGEOLOGY

Groundwater levels measured in July and August 2005, with the extraction system in operation, indicate that groundwater elevations ranged from approximately 406 to 419 feet above mean sea level (msl) (Table 1). During summer 2005, the interpreted direction of groundwater flow at Site 20, Area 1 was to the northeast with an average hydraulic gradient of 0.04 feet per foot. The gradient has been influenced by operation of extraction well 11669-EW-1. The extraction well radius of influence is approximated in the groundwater elevation contour map (Figure 1). Groundwater monitoring well 11669-MW-4, which is upgradient of the extraction well, appears to be outside of this radius of influence. Downslope and downgradient from Storage Road, groundwater has discharged during past quarters to the surface at seeps Area 1-SP-1 and Area 1-SP-2 at approximately 403 feet above msl.

3.0 SCOPE OF WORK

The work performed during summer 2005 at Site 20, Area 1 included measuring groundwater levels, collecting groundwater samples for laboratory analysis, and preparing this report.

3.1 GROUNDWATER MONITORING METHODOLOGY

Four monitoring wells were sampled at Site 20, Area 1 during summer 2005. A MicroPurge pump, Grundfos pumps, and a bailer were used for purging groundwater at wells 11669-MW-2 and 11669-MW-4 through 11669-MW-6. Sampling was conducted in accordance with the documents cited in Section 1.0. Measured groundwater elevations are presented in Table 1, and groundwater contours are illustrated on Figure 1. Purge records are provided in Appendix A.

In general, wells were purged until a minimum of one pump and tubing volume of water (for MicroPurge pumps) or three well volumes of water (for Grundfos pumps and bailers) were removed and water quality parameters had stabilized. Criteria for determining stabilization are three successive measurements of temperature within ±0.1 degree Celsius, pH within ±0.1, conductivity within ±5 percent, and a turbidity reading of less than 5 nephelometric turbidity units (NTUs). In cases where parameter stability or a turbidity reading of less than 5 NTUs was not obtained, samples were collected after purging a minimum of five pump and tubing volumes of water (for MicroPurge pumps) or five well volumes of water (for Grundfos pumps and bailers).

3.1.1 MicroPurge Groundwater Sampling

MicroPurge sampling was conducted at monitoring well 11669-MW-2. The pumping rate was determined prior to sampling and calibrated to maintain a static water level (i.e., no drawdown). This well was sampled after purging a minimum of five pump and tubing volumes due to unstable pH readings.

3.1.2 Standard Groundwater Sampling

A 2-inch Grundfos pump was used for purging groundwater at monitoring wells 11669-MW-4 and 11669-MW-6. Well 11669-MW-5 was purged using a disposable Teflon bailer. All of these wells were purged dry and sampled after sufficient recharge using a disposable Teflon bailer.

4.0 RESULTS

Temperature, conductivity, pH, and turbidity were measured in the field during purging. These measurements are presented in Appendix A. Readings taken immediately prior to sampling are presented

in Table 2. Fixed laboratory analyses were performed by EMAX Laboratories, Inc. in Torrance, California. Samples were analyzed according to the BGMP Work Plan (U.S. Air Force 2000a) for total petroleum hydrocarbons as gasoline (TPHg) and total petroleum hydrocarbons as diesel (TPHd) by U.S. Environmental Protection Agency (EPA) method SW8015B and for volatile organic compounds (VOCs) by EPA method SW8260B. Laboratory analyses and data validation were conducted according to the BGMP QAPP Addendum (U.S. Air Force 2004). Data validation was performed on 100 percent of the analytical data. Analytical results are presented in Tables 3 and 4 and on Figure 2. Historical data for key contaminants of concern are presented in Table 5 and on Figures 3A and 3B. Figure 3A contains historical data for key COCs from October 1998 through fall 2003, and Figure 3B contains historical data for key COCs from winter 2004 to present. Chain-of-custody records are provided in Appendix B.

4.1 TOTAL PETROLEUM HYDROCARBONS

Groundwater samples collected from the four wells sampled at Site 20, Area 1 were analyzed for TPHg. TPHg were detected in groundwater from wells 11669-MW-4 and 11669-MW-5, at concentrations of 0.049 and 0.43 milligrams per liter (mg/L), respectively (Table 3). The TPHg concentration in groundwater from well 11669-MW-4 decreased from 0.26 mg/L detected during winter 2005. The TPHg concentration in groundwater from well 11669-MW-5 was essentially the same as in winter 2005, but has generally been decreasing since October 1998 (Table 5).

Groundwater samples collected from wells 11669-MW-2, 11669-MW-5, and 11669-MW-6 were analyzed for TPHd. TPHd were detected in groundwater from well 11669-MW-5 at a concentration of 0.11 mg/L,. which is within the historic range for this well.

4.2 VOLATILE ORGANIC COMPOUNDS

Groundwater samples collected from the four wells sampled at Site 20, Area 1 were analyzed for VOCs. VOCs were detected in groundwater from three of these wells (Table 4). No VOCs were detected in groundwater from well 11669-MW-6.

Benzene was detected above the primary maximum contaminant level (MCL) of 1 microgram per liter (μg/L) in groundwater from well 11669-MW-5 at a concentration of 56 μg/L. The compound 1,2-dichloroethane (1,2-DCA) was detected above the primary MCL of 0.5 μg/L in groundwater from wells 11669-MW-2 and 11669-MW-5, at concentrations of 8 μg/L (8.4 μg/L in the duplicate sample) and 20 μg/L, respectively.

Concentrations of benzene in wells 11669-MW-4 and 11669-MW-5 have been consistently decreasing since winter 2004 (Table 5). Concentrations of 1,2-DCA in groundwater from well 11669-MW-2 have been generally decreasing since winter 2002. Concentrations of 1,2-DCA in groundwater from well 11669-MW-5 have been decreasing since summer 2003.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

All of the analytical data presented in this report were validated according to the QAPP Addendum (U.S. Air Force 2004). The data validation process included a review of sample preservation, temperature, and hold times; detection and quantitation limits; instrument calibration; and equipment blank, trip blank, method blank, laboratory control sample, and matrix spike/matrix spike duplicate. Data validation qualifiers and comments are provided on the data tables to indicate the results of the data validation and to quantitatively indicate the usability of the data. In addition, field sampling records are reviewed to assess the potential for any field conditions to adversely impact the data quality.

There were no significant quality assurance/quality control discrepancies with the data presented in this report. The data quality objectives for the summer 2005 sampling at Site 20, Area 1 were achieved.

6.0 RECOMMENDATIONS

The winter 2006 sampling will be conducted according to the work plan (U.S. Air Force 2000a).

7.0 REFERENCES

Jacobs Engineering Group, Inc. (JEG)

1997 *Site 20 Underground Storage Tank Assessment Report.* September.

Montgomery Watson Harza (MWH)

2001 *Performance Monitoring Report, Site 20 Source Reduction System.* Vandenberg Air Force Base, California. October.

U.S. Air Force

2000a *Basewide Groundwater Monitoring Program Work Plan.* Prepared for 30 CES/CEV, Installation Restoration Program, Vandenberg Air Force Base, California, and Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. Prepared by Tetra Tech, Inc. December.

U.S. Air Force

2000b *Basewide Groundwater Monitoring Program Health and Safety Plan Addendum.* Prepared for 30 CES/CEV, Installation Restoration Program, Vandenberg Air Force Base, California, and Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. Prepared by Tetra Tech, Inc. December.

U.S. Air Force

2002 *Headquarters Thirtieth Space Wing, Vandenberg AFB, California. Hazardous Waste Management Plan, 30 SW Plan 32-7043-A, Change 1.* HQ 30th Space Wing, Vandenberg Air Force Base, California 93437-6261. April.

U.S. Air Force

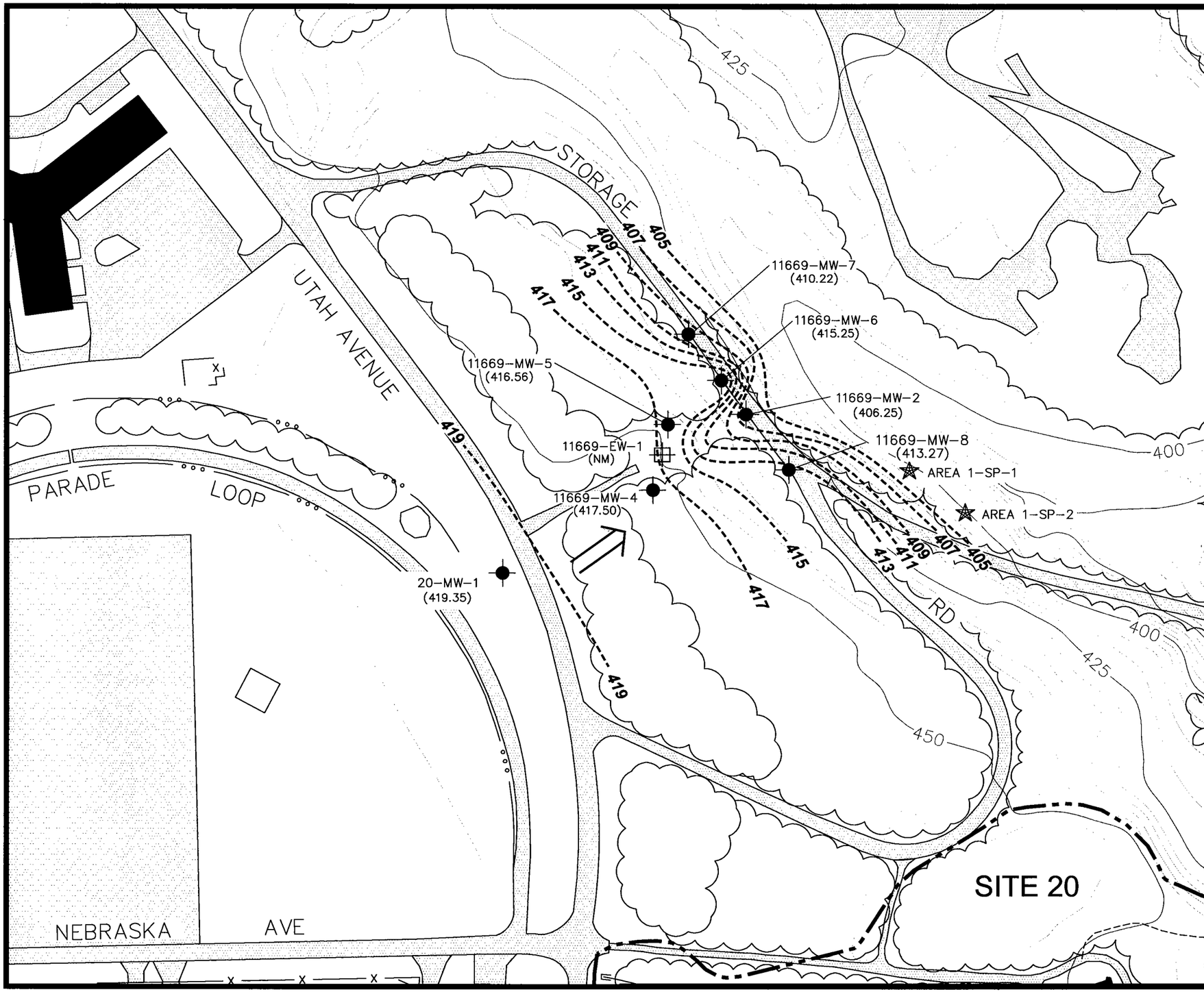
2003 *Basewide Sampling and Analysis Plan. Final.* Prepared for 30 CES/CEV Installation Restoration Program, Vandenberg Air Force Base, California, and Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. Prepared by Tetra Tech, Inc. September.

U.S. Air Force

2004 *Basewide Groundwater Monitoring Program Quality Assurance Project Plan Addendum. Final.* Prepared for Department of the Air Force 30 CES/CEVR, 806 13th Street, Suite 116, Vandenberg Air Force Base, California, and Department of the Air Force, Air Force Center for Environmental Excellence, DERA Restoration Division, 3300 Sidney Brooks, Brooks City-Base, Texas. Prepared by Tetra Tech, Inc. July.

U.S. Air Force

2005 *Waste Management Plan Addendum. Final.* 730 CES/CEVR, IRP, Vandenberg Air Force Base, California, and Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. Prepared by Tetra Tech, Inc. February.



LEGEND

425	CONTOUR LINE, 5-FOOT INTERVALS (FEET ABOVE MSL, NAVD 1988)
	RAILROAD
— x —	FENCE
	PAVED ROAD OR STREET
	DIRT ROAD
11352	BUILDING
	CONCRETE OR PAVED AREAS
	VEGETATION LINE
	DRAINAGE ROUTE
	SITE BOUNDARY
11669-MW-2 (406.25)	GROUNDWATER MONITORING WELL WITH GROUNDWATER ELEVATION
AREA 1-SP-1	SEEP SAMPLING LOCATION
11669-EW-1	LOCATION OF EXTRACTION WELL
	INFERRED GROUNDWATER FLOW DIRECTION
417 — 417	GROUNDWATER ELEVATION CONTOUR APPROXIMATED BY LINEAR INTERPOLATION (DASHED WHERE INFERRED); POTENTIOMETRIC SURFACE INFLUENCED BY EXTRACTION WELL 11669-EW-1.
NM	WATER LEVEL NOT MEASURED

NOTE(S): GROUNDWATER ELEVATIONS ARE IN FEET ABOVE MSL AS MEASURED IN JULY AND AUGUST 2005.

N

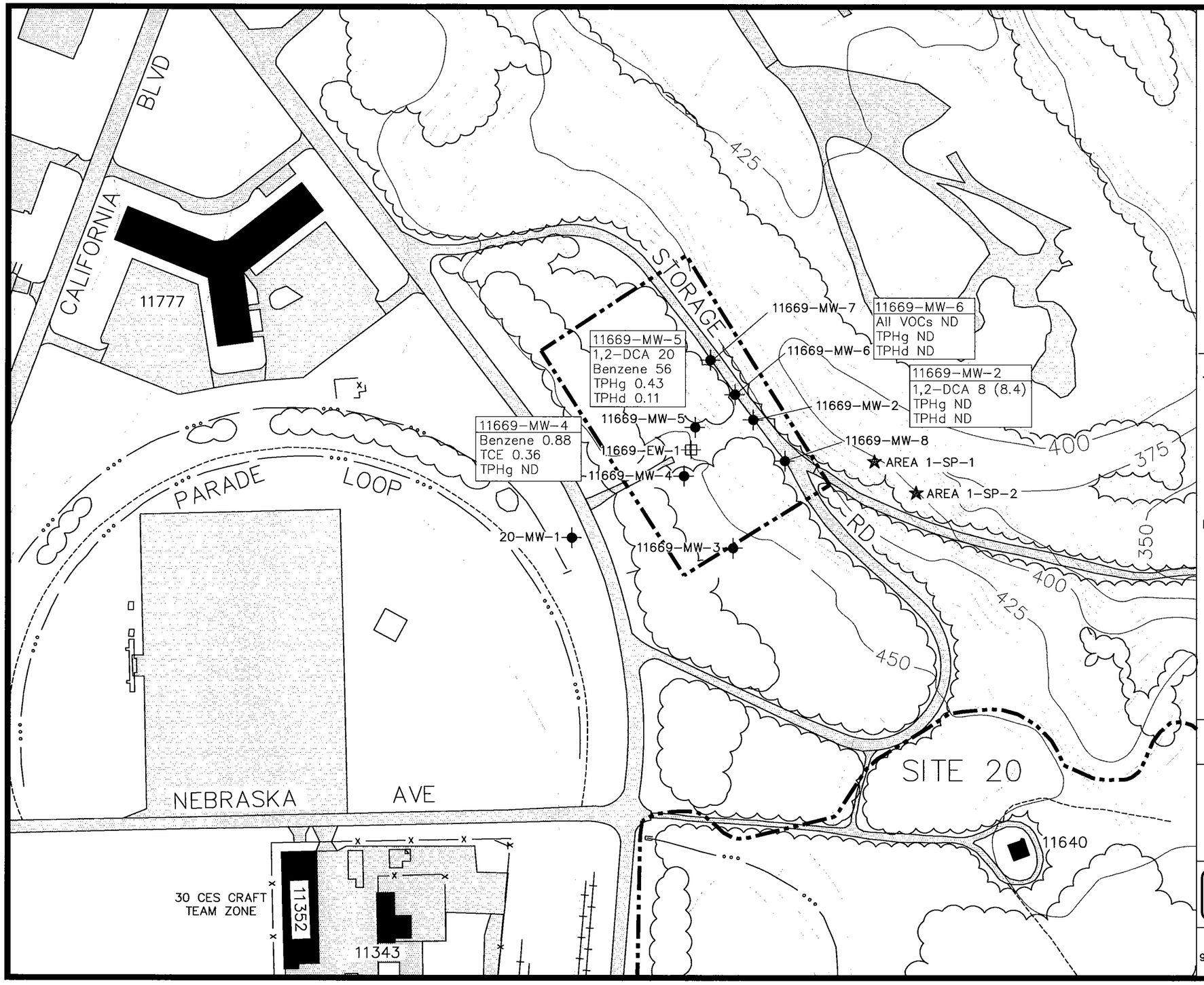
0 75' 150' 225'
SCALE

UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE

SITE 20
AREA 1 (UST AREA) SITE PLAN
AND GROUNDWATER CONTOURS
SUMMER 2005

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	11/28/05	RANDALL	TAB21	5167	1



LEGEND

- 425 — CONTOUR LINE, 5-FOOT INTERVALS (FEET ABOVE MSL, NAVD 1988)
- RAILROAD
- FENCE
- PAVED ROAD OR STREET
- DIRT ROAD
- 1788 — BUILDING
- CONCRETE OR PAVED AREAS
- VEGETATION LINE
- DRAINAGE ROUTE
- SITE BOUNDARY
- 11669-MW-2 — GROUNDWATER MONITORING WELL
- AREA 1-SP-1 — SEEP SAMPLING LOCATION
- 11669-EW-1 — LOCATION OF EXTRACTION WELL
- ND — NOT DETECTED; RESULT IS LESS THAN THE METHOD DETECTION LIMIT

NOTE(S): RESULTS FOR ALL COMPOUNDS EXCEPT TPHg AND TPHd ARE IN µg/L. TPHg AND TPHd RESULTS ARE IN mg/L. RESULTS IN PARENTHESES ARE FROM DUPLICATE SAMPLES.

N

0 100' 200' 300'
SCALE

UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE

SITE 20 AREA 1 (UST AREA)
ANALYTICAL RESULTS
SUMMER 2005

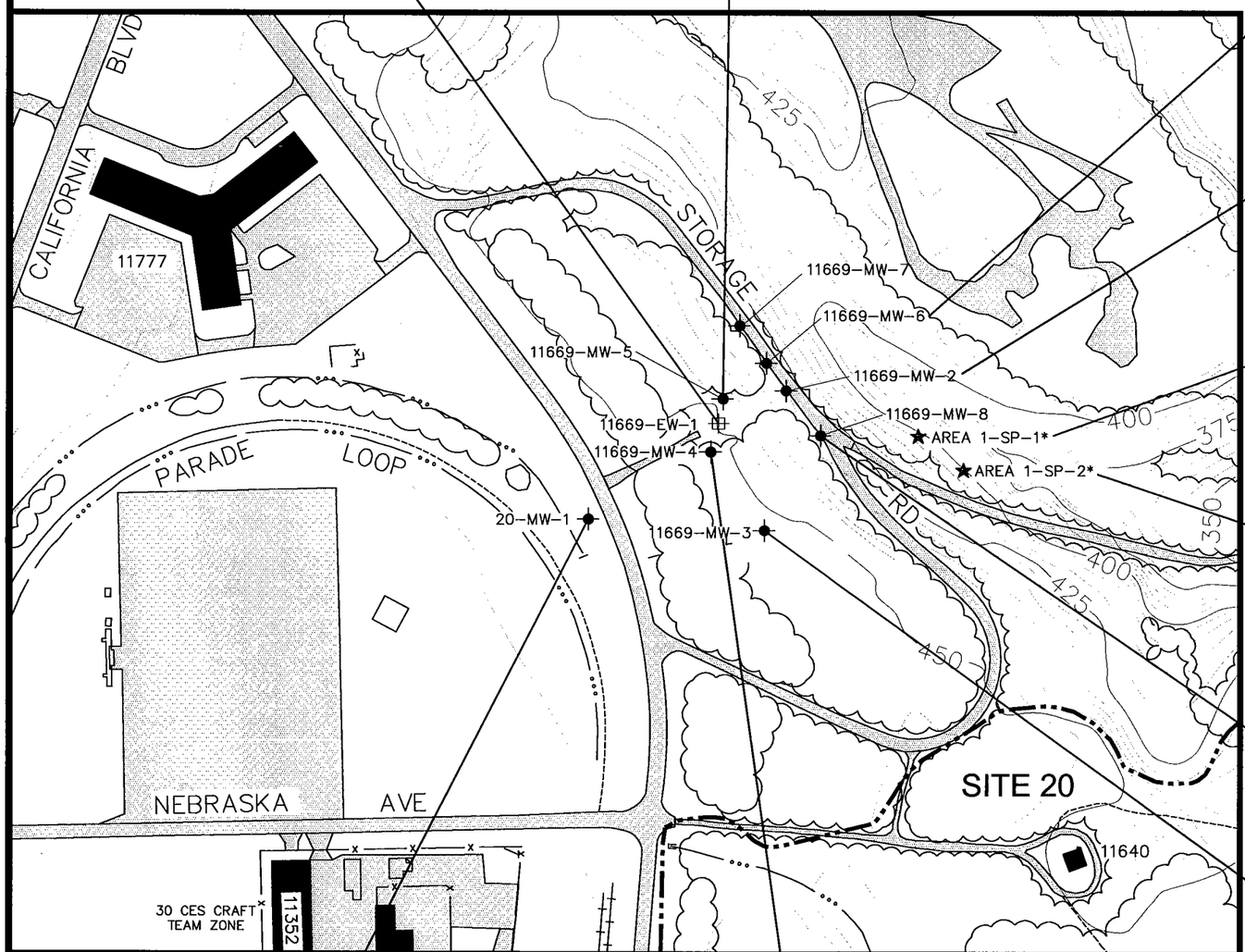
TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	11/28/05	RANDALL	TAB21	5244	2

11669-MW-7	TPHg
Oct-98	0.0282
Feb-99	ND
Sept-99	ND
Sum-00	ND
Win-01	ND
Sum-01	ND
Win-02	ND
Sum-02	ND
Sum-03	ND

11669-MW-5	EDB	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene	TPHg	TPHd	1,2-DCA	1,2-DCP
Oct-98	125	4,520	270	1,350	814	279	12.1	ND	490	ND
Feb-99	ND	2,980	126	165	320	79	8.06	ND	347	ND
Jun-99	ND	1,300	39	170	320	110	5.29	0.94	180	ND
Sept-99	19	1,300	28	270	420	ND	5.37	NA	200	ND
Sum-00	39	2,400	72	400	580	110	5.1	NA	360	36
Win-01	29	1,800	38	120	300	78	7.5	NA	180	27
Sum-01	13	1,200	12	6.2	100	29	3.4	NA	ND	24
Win-02	3.4	510	ND	ND	ND	ND	2.6	NA	65	12.0
Sum-02	ND	150	ND	0.68	8.9	1.3	1.2	NA	ND	5.9
Win-03	ND	200	ND	0.66	5.8	1.2	1.2	NA	ND	ND
Sum-03	ND	220	ND	ND	15	3.3	1.32	NA	43	7.1

11669-MW-6	TPHg
Oct-98	ND
Feb-99	ND
Sept-99	ND
Sum-00	ND
Win-01	ND
Sum-01	ND
Win-02	ND
Sum-02	ND
Win-03	ND
Sum-03	ND



11669-MW-2	1,2-DCA	1,2-DCP
Oct-98	6.3	ND
Feb-99	6.83	ND
Jun-99	11	ND
Sept-99	10	ND
Sum-00	13	ND
Win-01	19	ND
Sum-01	22	0.87
Win-02	27	0.91
Sum-02	21	0.71
Win-03	20	ND
Sum-03	13	0.36

Area1-SP-1	TPHg
Win-01	ND
Win-02	ND
Sum-02	DRY
Win-03	ND
Sum-03	DRY

Area1-SP-2	TPHg
Win-01	ND
Sum-01	ND
Win-02	ND
Sum-02	ND
Win-03	ND
Sum-03	DRY

11669-MW-8	TPHg
Oct-98	ND
Feb-99	0.0231
Jun-99	ND
Sept-99	ND
Sum-00	ND
Win-01	ND
Sum-01	ND
Win-02	ND
Sum-02	ND
Win-03	ND
Sum-03	ND

11669-MW-3	Toluene	TPHg
Oct-98	ND	0.0379
Feb-99	0.39	ND
Jun-99	ND	ND
Sept-99	0.26	ND
Sum-00	ND	ND
Win-01	ND	ND
Sum-01	ND	ND
Win-02	ND	ND
Win-03	ND	ND

20-MW-1	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene
Oct-98	ND	0.292	0.265	1.68	0.864
Feb-99	ND	ND	ND	ND	ND
Jun-99	0.23	ND	ND	ND	ND
Sept-99	ND	ND	ND	ND	ND
Sum-00	ND	ND	ND	ND	ND
Win-01	ND	ND	ND	ND	ND
Sum-01	ND	ND	ND	ND	ND
Win-02	ND	ND	ND	ND	ND
Win-03	ND	ND	ND	ND	ND

11669-MW-4	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene	TPHg	1,2-DCA
Oct-98	ND	ND	ND	ND	ND	ND	ND
Feb-99	1.05	ND	ND	0.655	ND	0.212	ND
Jun-99	ND	ND	ND	ND	ND	0.104	ND
Sept-99	ND	ND	ND	ND	ND	0.021	1.1
Sum-00	1.4	ND	ND	ND	ND	0.4	ND
Win-01	1.4	ND	ND	ND	ND	0.64	ND
Sum-01	0.90	ND	ND	ND	ND	0.42	ND
Win-02	2.8	ND	ND	ND	ND	0.44	1.3
Sum-02	4.4	0.53	0.63	1.3	ND	0.59	ND
Win-03	4.2	0.55	0.75	1.5	ND	0.07a	ND
Sum-03	0.72	ND	ND	ND	ND	0.07a	0.25

LEGEND

- 425 — CONTOUR LINE, 5-FOOT INTERVALS (FEET ABOVE MSL, NGVD 1988)
- RAILROAD
- FENCE
- PAVED ROAD OR STREET
- DIRT ROAD
- 11352 — BUILDING
- CONCRETE OR PAVED AREAS
- VEGETATION LINE
- UNLINED DRAINAGE ROUTE AND FLOW DIRECTION
- SITE BOUNDARY
- 20-MW-1 — GROUNDWATER MONITORING WELL
- 11669-EW-1 — EXTRACTION WELL
- AREA1 1-SP-1 — SURFACE SEEP LOCATION
- a — RESULT WAS QUALIFIED FOR BLANK CONTAMINATION (B-QUALIFIED) AND IS SUSPECTED TO BE FALSE POSITIVE
- DRY — WELL WAS DRY OR HAD INSUFFICIENT WATER FOR SAMPLING

NOTE(S): ALL RESULTS ARE IN µg/L EXCEPT TPHg AND TPHd RESULTS. TPHg AND TPHd RESULTS ARE IN mg/L.

N

0 125' 250' 375'
SCALE

UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE

SITE 20 AREA 1 (UST AREA)
HISTORICAL ANALYTICAL RESULTS OF KEY CONTAMINANTS OF CONCERN
OCTOBER 1998 THROUGH FALL 2003

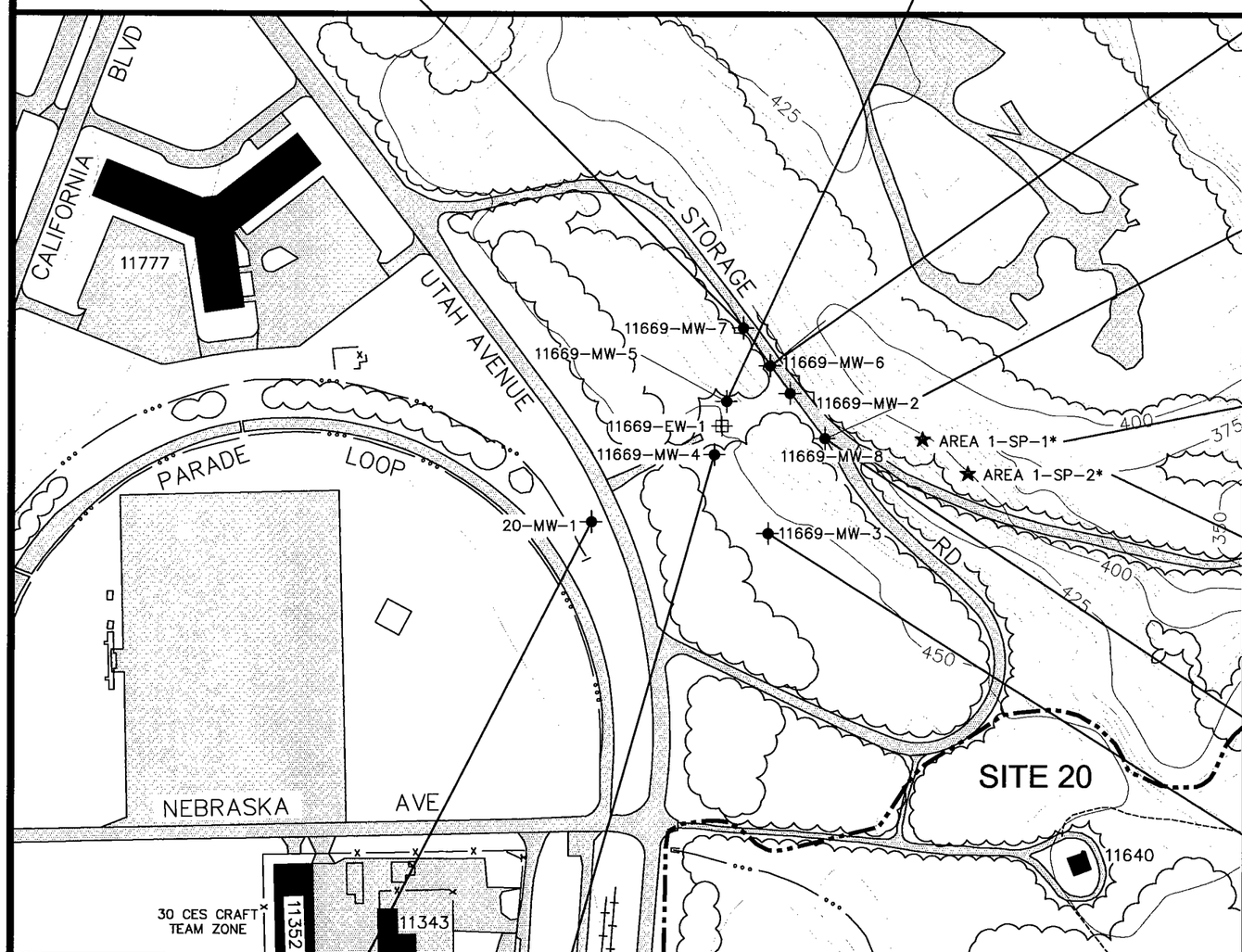
TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	10/19/05	PRICHARD	TAB21	5259	3A

11669-MW-7	TPHg
Win-04	0.03[a]
Sum-04	ND
Win-05	ND

11669-MW-5	EDB	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene	TPHg	TPHd	1,2-DCA	1,2-DCP
Win-04	1.04	300	ND	0.66	7.09	2.29	0.95	0.26	39.5	ND
Sum-04	0.54	91	ND	0.31	1.8	0.85	0.55	ND	28	3.7
Win-05	ND	64	ND	ND	ND	ND	0.42	ND	26	ND
Sum-05	ND	56	ND	ND	ND	ND	0.43	0.11	20	ND

11669-MW-6	TPHg
Win-04	0.03[a]
Sum-04	ND
Win-05	ND
Sum-05	ND



11669-MW-2	1,2-DCA	1,2-DCP
Win-04	15.4	0.35
Sum-04	11	0.25
Win-05	9.9	0.22
Sum-05	8.4	ND

Area1-SP-1	TPHg
Win-04	0.03[a]
Sum-04	ND
Win-05	ND

Area1-SP-2	TPHg
Win-04	0.03[a]
Sum-04	ND
Win-05	ND

11669-MW-8	TPHg
Win-04	0.03[a]
Sum-04	ND
Win-05	ND

11669-MW-3	Toluene	TPHg
Win-04	ND	0.03[a]

20-MW-1	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene
Win-04	ND	ND	ND	ND	ND

11669-MW-4	Benzene	Ethylbenzene	Toluene	m,p-Xylenes	o-Xylene	TPHg	1,2-DCA
Win-04	5.93	0.37	0.66	1.56	ND	0.62	1.74
Sum-04	4.9	ND	0.35	1.1	0.23	0.27	1.5
Win-05	3.7	ND	ND	0.59	ND	0.26	ND
Sum-05	0.88	ND	ND	ND	ND	0.049	ND

LEGEND

- 425 — CONTOUR LINE, 5-FOOT INTERVALS (FEET ABOVE MSL, NGVD 1988)
- RAILROAD
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- PAVED ROAD OR STREET
- DIRT ROAD
- 11352 — BUILDING
- CONCRETE OR PAVED AREAS
- VEGETATION LINE
- UNLINED DRAINAGE ROUTE AND FLOW DIRECTION
- SITE BOUNDARY
- 20-MW-1 — GROUNDWATER MONITORING WELL
- 11669-EW-1 — EXTRACTION WELL
- AREA1 1-SP-1 — SURFACE SEEP LOCATION
- ND — NOT DETECTED; RESULT WAS LESS THAN THE METHOD DETECTION LIMIT
- a — RESULT WAS QUALIFIED FOR BLANK CONTAMINATION (B-QUALIFIED) AND IS SUSPECTED TO BE FALSE POSITIVE

NOTES: RESULTS FOR ALL COMPOUNDS EXCEPT TPHg AND TPHd ARE IN µg/L. TPHg AND TPHd RESULTS ARE IN mg/L.

N

0 125' 250' 375'
SCALE

UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE

SITE 20 AREA 1 (UST AREA)
HISTORICAL ANALYTICAL RESULTS OF KEY CONTAMINANTS OF CONCERN
WINTER 2004 THROUGH SUMMER 2005

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	11/28/05	RANDALL	TAB21	5252	3B

Table 1
Groundwater Elevations
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

Monitoring Well	Top of Casing Elevation (feet above msl)	Date Measured Summer 2005	Groundwater Depth (feet below TOC) Summer 2005	Groundwater Elevation (feet above msl) Summer 2005	Winter 2005	Summer 2004	Winter 2004
20-MW-1	459.01	26-Jul-05	39.66	419.35	418.91	419.23	419.37
11669-EW-1	451.27	NM	NM	NM	NM	NM	NM
11669-MW-2	430.73	03-Aug-05	24.48	406.25	406.16	406.56	406.80
11669-MW-4	453.40	04-Aug-05	35.90	417.50	417.30	417.48	417.62
11669-MW-5	445.94	04-Aug-05	29.38	416.56	416.42	416.55	406.42
11669-MW-6	430.98	04-Aug-05	15.73	415.25	413.06	413.20	413.53
11669-MW-7	433.18	18-Aug-05	22.96	410.22	410.59	410.27	NM
11669-MW-8	430.01	18-Aug-05	16.74	413.27	413.43	413.19	413.38

Definition(s):

msl - mean sea level
NM - not measured
TOC - top of well casing

Table 2
Water Quality Parameters
Summer 2005
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

Sampling Location	**11669-MW-2**	**11669-MW-4**	**11669-MW-5**	**11669-MW-6**
Sample ID	**V11669MW2**	**V11669MW4**	**V11669MW5**	**V11669MW6M**
Collection Date	**3-Aug-05**	**4-Aug-05**	**4-Aug-05**	**4-Aug-05**
Field Parameters[1]:				
Temperature (° Celsius)	18.44	17.70	15.64	19.42
Conductivity (µmhos/cm)	2,036	8,437	3,044	1,840
pH	5.83	5.32	5.91	5.46
Turbidity (NTUs)	2.28	1.44	18.4	6.34

Definition(s):

µmhos/cm - micromhos per centimeter
NTU - nephelometric turbidity unit

Note(s):

1 - Field parameters measured immediately prior to sampling.

Table 3
TPH in Groundwater
Summer 2005
EPA Method SW8015B (mg/L)
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date		TPH as Gasoline			TPH as Diesel		
			MDL[1]	0.02			0.19		
			PQL[1]	0.1			1.0		
11669-MW-2	V11669MW2	3-Aug-05		0.02	U	g	0.095	U	g
11669-MW-2	V99W548 (D)	3-Aug-05		0.02	U	g	0.099	U	g
11669-MW-4	V11669MW4	4-Aug-05		0.049	J	q	NA		
11669-MW-5	V11669MW5	4-Aug-05		0.43		g	0.11	J	q
11669-MW-6	V11669MW6M	4-Aug-05		0.02	U	g	0.094	U	g

Data Validity Qualifier(s):

J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

g - The data met prescribed criteria as detailed in the QAPP.
q - The analyte detection was below the PQL.

Definition(s):

(D) - duplicate sample
MDL - method detection limit
mg/L - milligrams per liter
NA - not analyzed
PQL - practical quantitation limit
QAPP - Quality Assurance Project Plan
TPH - total petroleum hydrocarbons

Note(s):

1 - Values from QAPP Addendum (U.S. Air Force 2004).

Table 4
VOCs in Groundwater
Summer 2005
EPA Method SW8260B (µg/L)
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

Sample Location				**11669-MW-2**	**11669-MW-2**	**11669-MW-4**	**11669-MW-5**	**11669-MW-6**
Sample ID				**V11669MW2**	**V99W548 (D)**	**V11669MW4**	**V11669MW5**	**V11669MW6M**
Collection Date				**03-Aug-05**	**03-Aug-05**	**04-Aug-05**	**04-Aug-05**	**04-Aug-05**
	MDL[a]	**PQL[a]**	**Primary MCL**					
1,2-DCA	0.06	1.0	0.5	**8** g	**8.4** g	0.2 U g	**20** g	0.2 U g
Benzene	0.07	0.4	1	0.2 U g	0.2 U g	0.88 g	**56** g	0.2 U g
TCE	0.18	1.0	5	0.2 U g	0.2 U g	0.36 J q	0.2 U g	0.2 U g
All other analytes	N/A	N/A	N/A	ND	ND	ND	ND	ND

Data Validity Qualifier(s):

J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.

U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

g - The data met prescribed criteria as detailed in the QAPP.

q - The analyte detection was below the PQL.

Definition(s):

(D) - duplicate sample
DCA - dichloroethane
MCL - maximum contaminant level
MDL - method detection limit
µg/L - micrograms per liter
N/A - not applicable
ND - not detected; result is less than the MDL.
PQL - practical quantitation limit
QAPP - Quality Assurance Project Plan
TCE - trichloroethene

Note(s):

Bold type indicates results that were above the MCL.

a - Values from QAPP Addendum (U.S. Air Force 2004).

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

	Benzene (µg/L)[a]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	ND	ND	0.23	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	**1.05**	ND	ND	**1.4**	**1.4**	0.90	**2.8**	**4.2**	**4.2**	0.72	**5.93**	**4.9**	**3.7**	0.88
11669-MW-5	**4,520**	**2,980**	**1,300**	**1,300**	**2,400**	**1,800**	**1,200**	**510**	**200**	**200**	**220**	**300**	**91**	**64**	**56**
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

	Toluene (µg/L)[b]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	0.265	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	0.39	ND	0.26	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	0.63	0.75	ND	0.66	0.35	ND	ND
11669-MW-5	**1,350**	**165**	**170**	**270**	**400**	120	6.2	ND	0.68	0.66	ND	0.66	0.31	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

	Ethylbenzene (µg/L)[c]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	0.292	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	0.15	NA	NA	NA
11669-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	0.53	0.55	ND	0.37	ND	ND	ND
11669-MW-5	270	126	39	28	72	38	12	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

	EDB (µg/L)[d]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-5	**125**	ND	ND	**19**	**39**	**29**	**13**	**3.4**	ND	ND	ND	**1.04**	**0.54**	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

	m,p-Xylene (µg/L)[e]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	1.68	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	0.655	ND	ND	ND	ND	ND	ND	1.3	1.5	ND	1.56	1.1	0.59	ND
11669-MW-5	814	320	320	420	580	300	100	ND	8.9	5.8	15	7.09	1.8	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

	o-Xylene (µg/L)[e]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	0.864	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	ND
11669-MW-5	279	79	110	ND	110	78	29	ND	1.3	1.2	3.3	2.29	0.85	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

	1,2-DCP (µg/L)[f]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	0.87	0.91	0.71	ND	0.36	0.35	0.25	0.22	ND
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-5	ND	ND	ND	ND	**36**	**27**	**24**	**12.0**	**5.9**	ND	**7.1**	ND	3.7	ND	ND
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

	1,2-DCA (µg/L)[g]														
	Oct-98	**Feb-99**	**Jun-99**	**Sept-99**	**Sum-00**	**Win-01**	**Sum-01**	**Win-02**	**Sum-02**	**Win-03**	**Sum-03**	**Win-04**	**Sum-04**	**Win-05**	**Sum-05**
20-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-2	**6.3**	**6.83**	**11**	**10**	**13**	**19**	**22**	**27**	**21**	**20**	**13**	**15.4**	**11**	**9.9**	**8.4**
11669-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA
11669-MW-4	ND	ND	ND	**1.1**	ND	ND	ND	**1.3**	ND	ND	0.25	**1.74**	**1.5**	ND	ND
11669-MW-5	**490**	**347**	**180**	**200**	**360**	**180**	ND	**65**	ND	ND	**43**	**39.5**	**28**	**26**	**20**
11669-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11669-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	NA
11669-MW-8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	ND	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	ND	ND	ND	NA

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

	TPHg (mg/L)														
	Oct-98	Feb-99	Jun-99	Sept-99	Sum-00	Win-01	Sum-01	Win-02	Sum-02	Win-03	Sum-03	Win-04	Sum-04	Win-05	Sum-05
20-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	0.03[h]	NA	NA	NA
11669-MW-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04[h]	ND	ND	ND
11669-MW-3	0.0379	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	0.03[h]	NA	NA	NA
11669-MW-4	ND	0.212	0.104	0.021	0.4	0.64	0.42	0.44	0.59	0.66	0.07[h]	0.62	0.27	0.26	0.049
11669-MW-5	12.1	8.06	5.29	5.37	5.1	7.5	3.4	2.6	1.2	1.2	1.32	0.95	0.55	0.42	0.43
11669-MW-6	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	0.03[h]	ND	ND	ND
11669-MW-7	0.0282	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	0.03[h]	ND	ND	NA
11669-MW-8	ND	0.0231	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03[h]	ND	ND	NA
Area1-SP-1	NA	NA	NA	NA	NA	ND	NA	ND	DRY	ND	DRY	0.03[h]	ND	ND	NA
Area1-SP-2	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	DRY	0.03[h]	ND	ND	NA

	TPHd (mg/L)														
	Oct-98	Feb-99	Jun-99	Sept-99	Sum-00	Win-01	Sum-01	Win-02	Sum-02	Win-03	Sum-03	Win-04	Sum-04	Win-05	Sum-05
20-MW-1	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11669-MW-2	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND
11669-MW-3	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11669-MW-4	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11669-MW-5	ND	ND	0.94	1.4	NA	NA	NA	NA	NA	NA	NA	0.26	ND	ND	0.11
11669-MW-6	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND
11669-MW-7	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11669-MW-8	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Area1-SP-1	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Area1-SP-2	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5
Summary of Key Contaminants of Concern
IRP Site 20, Area 1 (UST Area)
Vandenberg AFB, California

Definition(s):

DCA	-	dichloroethane
DCP	-	dichloropropane
DRY	-	well was dry or had insufficient water for sampling
EDB	-	1,2-dibromoethane (ethylene dibromide)
MCL	-	maximum contaminant level
µg/L	-	micrograms per liter
mg/L	-	milligrams per liter
NA	-	not analyzed
ND	-	not detected; result is less than the MDL.
TPHd	-	total petroleum hydrocarbons as diesel
TPHg	-	total petroleum hydrocarbons as gasoline

Note(s):

Bold type indicates results that were above the MCL.

a	-	The MCL for benzene is 1 µg/L.
b	-	The MCL for toluene is 150 µg/L.
c	-	The MCL for ethylbenzene is 300 µg/L.
d	-	The MCL for 1,2-EDB is 0.05 µg/L.
e	-	The MCL for the sum of m-xylene, o-xylene, and p-xylene is 1,750 µg/L.
f	-	The MCL for 1,2-DCP is 5 µg/L.
g	-	The MCL for 1,2-DCA is 0.5 µg/L.
h	-	The data were qualified for blank contamination during the validation process. The laboratory method blank result showed the same order of magnitude as the sample result, which is considered not to have originated from the environmental sample, due to possible cross-contamination. The result is strongly suspected to be false positive.

APPENDIX A PURGE RECORDS

TETRA TECH, INC.
4213 State Street, STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

DATE 8/3/05 SITE NUMBER 28 A1 PURGING DEVICE MICROPURGE DEDICATED PUMP

PROGRAM NAME BGMP SAMPLING DEVICE MICROPURGE DEDICATED PUMP

MONITORING WELL IDENTIFICATION 11669-MW-2 PID READING IN CASING (ppm) (initial) 0.0 (vented to) 0.0

SAMPLE I.D. V11669MW2 DUPLICATE I.D. V99W548 PID READING IN BREATHING ZONE (ppm) (initial) 0.0 (vented to) 0.0

STATIC WATER LEVEL (ft btoc) 24.48 TOTAL WELL DEPTH (ft btoc) 42.6 SBD (feet) —

WATER COLUMN (feet) 18.1 TUBING DIAMETER (in) 1/4 SAMPLER'S SIGNATURE [signature]

PUMP & TUBING (V) (L) 0.25 3 V (L) 0.75

Time	Activity	Water Level (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (L)	Pump & Tubing Volumes Purged	Flow Rate (LPM)
1443	BEGIN PURGE	—										0.20
1445		24.65	19.93	1968	6.26	18.5 ~~24.65~~	2.18	-31.1	CLOUDY	0.40	1.60	0.20
1447		24.68	18.73	2017	6.04	4.32	1.54	-7.1	CLEAR	0.80	3.20	0.20
1449		24.78	18.51	2025	5.89	2.77	1.33	9.6	CLEAR	1.20	4.80	0.20
1451		24.81	18.44	2036	5.83	2.28	1.27	15.5	CLEAR	1.60	6.40	0.20
1452	END PURGE	—										
1500	SAMPLE	—										

U:\SBA-SMX-MCP\Forms\Operation\Tto049\Field_Data_Log_Sheet_Micropurge.xls

Form number Tt-O-049 (6/02)

Fe+2 (ppm) — Taken immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 24.97

Comments:

PARAMETERS FOR WATER QUALITY STABILIZATION

Temperature ±1 C (1.8 F)	Conductivity ±5%
pH ±0.1	Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities and the PID readings will be recorded in the logbook.

TETRA TECH, INC.
4213 State Street STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

DATE 8/4/05 SITE NUMBER 20A1

PROGRAM NAME BGMP

MONITORING WELL IDENTIFICATION 11669-MW-4

SAMPLE I.D. V11669MW4 DUPLICATE I.D. —

STATIC WATER LEVEL (ft btoc) 35.90 TOTAL WELL DEPTH (ft btoc) 47.4

WATER COLUMN (feet) 11.5 CASING DIAMETER (in) 4

WELL VOLUME (V) (gals) 7.48 3 V (gals) 22.4

PURGING DEVICE 2" SUBMERSIBLE GRUNDFOS PUMP

SAMPLING DEVICE DISPOSABLE TEFLON BAILER

PID READING IN CASING (ppm) (initial) NM (vented to) —

PID READING IN BREATHING ZONE (ppm) (initial) NM (vented to) —

SAMPLER'S SIGNATURE P Leonard
Mark M. [illegible]

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
1321	Begin Purge		42										0.5
1326		37.55		19.01	8535	5.28	7.64	1.25	165.5	clear	2.5	0.33	
1331		38.31		18.92	8140	5.26	2.29	1.07	177.8	clear	5.0	0.67	
1336		39.13		18.82	5565	5.26	2.11	1.08	152.0	clear	7.5	1.0	
1341		39.82		18.85	5340	5.34	3.07	1.07	106.1	clear	10.0	1.33	
1346		42.15		17.60	5790	5.28	4.89	0.89	98.1	clear	15.0	2.00	1.0
1351		44.40		17.58	7740	5.31	2.53	0.92	63.7	clear	20.0	2.67	
1356		46.39		17.70	8437	5.32	1.44	0.95	60.7	CLEAR	25.0	3.34	
1357	End Purge			— Well Dry									
1415	Sample			18.40	7420	5.61	8.43	4.77	13.9				

Form number Tt-O-050 (6/02)

Fe+2 (ppm) — Taken from first bailer, immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 42.16

Comments:

PARAMETERS FOR WATER QUALITY STABILIZATION

Temperature ±1 C (1.8 F)	Conductivity ± 5%
pH ± 0.1	Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be monitored during purging and sampling activities and the PID readings will be recorded in the logbook.

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TETRA TECH, INC.
4213 State Street STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

DATE 8/4/05 SITE NUMBER 20A1 PURGING DEVICE bailer ~~2" SUBMERSIBLE GRUNDFOS PUMP~~

PROGRAM NAME BGMP SAMPLING DEVICE DISPOSABLE TEFLON BAILER

MONITORING WELL IDENTIFICATION 11669-MW-5 PID READING IN CASING (ppm) (initial) ND (vented to) —

SAMPLE I.D. V11669MW5 DUPLICATE I.D. — PID READING IN BREATHING ZONE (ppm) (initial) ND (vented to) —

STATIC WATER LEVEL (ft btoc) 29.38 TOTAL WELL DEPTH (ft btoc) 33.0

WATER COLUMN (feet) 3.62 CASING DIAMETER (in) 4 SAMPLER'S SIGNATURE [signature]

WELL VOLUME (V) (gals) 2.35 (8.9 LITERS) 3 V (gals) 7.05 (26.69 LITERS) Mark M. Hahn

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged ~~(gals)~~ L	Well Volumes Purged	Flow Rate (GPM)
1436	Begin Purge/bail												
1440		30.08	—	16.67	3534	5.82	5.84	2.88	-37.2	clear	4.0	0.45	—
1445		30.06	—	15.46	3487	5.86	5.44	3.90	-35.2	clear	8.0	0.90	—
1450		31.12	—	15.43	3446	5.87	7.19	4.30	-32.9	clear	12.0	~~0.~~ 1.35	—
1454		31.65	—	15.51	3360	5.88	9.43	4.30	-30.6	clear	16.0	1.80	—
1505		31.95	—	15.50	3232	5.89	14.3	4.14	-29.5	clear	20.0	2.25	—
1510		32.55	—	15.64	3044	5.91	16.4	3.72	-36.7	clear	24.0	2.70	—
1511	End bail	—	well	dry									
1520	Sample	—	—	16.06	2885	6.0	16.7	3.90	-32.6	clear	—		

Form number Tt-O-050 (6/02) Fe+2 (ppm) — Taken from first bailer, immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 32.05

Comments: Strong H_2S odor

PARAMETERS FOR WATER QUALITY STABILIZATION
Temperature ±1 C (1.8 F) Conductivity ±5%
pH ±0.1 Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be

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TETRA TECH, INC.
4213 State Street STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL FIELD DATA LOG SHEET - PURGING

DATE 8-4-05 SITE NUMBER 20A1

PROGRAM NAME BGMP

MONITORING WELL IDENTIFICATION 11669-MW-6

SAMPLE I.D. V11669MW6M DUPLICATE I.D. —

STATIC WATER LEVEL (ft btoc) 15.73 TOTAL WELL DEPTH (ft btoc) 30.2

WATER COLUMN (feet) 14.5 CASING DIAMETER (in) 4"

WELL VOLUME (V) (gals) 9.41 3 V (gals) 28.22

PURGING DEVICE 2" SUBMERSIBLE GRUNDFOS PUMP

SAMPLING DEVICE DISPOSABLE TEFLON BAILER

PID READING IN CASING (ppm) (initial) 0.0 (vented to) 0.0

PID READING IN BREATHING ZONE (ppm) (initial) 0.0 (vented to) 0.0

SAMPLER'S SIGNATURE [signature]

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
1319	Begin Purge	—	30.0	—	—	—	—	—	—	—	—	—	0.5
1324		19.95	↓	22.12	1830	5.74	39.5	4.49	120.6	cloudy	2.5	0.27	↓
1329		21.30		19.01	1821	5.50	19.6	3.85	167.0	clear	5.0	0.54	
1334		23.70		19.18	1828	5.50	11.7	3.84	170.5	clear	7.5	0.81	
1339		24.55		19.47	1837	5.51	9.08	3.72	170.1	clear	10.0	1.08	
1344		26.13		19.52	1838	5.50	6.69	3.86	173.1	clear	12.5	1.35	
1349		27.15		19.71	1846	5.51	6.36	3.72	173.4	clear	15.0	1.62	
1354		28.70	↓	19.42	1840	5.46	6.34	3.99	163.0	clear	17.5	1.89	↓
1355	End Purge - WELL DRY	—	—	—	—	—	—	—	—	—	—	—	—
1530	Sample	—	—	16.27	1768	5.80	32.2	5.64	83.3	—	—	—	—

Form number Tt-O-050 (6/02)

Fe+2 (ppm) — Taken from first bailer, immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 27.32

Comments: —

PARAMETERS FOR WATER QUALITY STABILIZATION

Temperature ±1 C (1.8 F)	Conductivity ±5%
pH ±0.1	Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be

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APPENDIX B CHAIN-OF-CUSTODY RECORDS

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110
Phone (805) 681-3100
FAX (805) 681-3108

SHIPPED TO: EMAX Labs
1835 West 205th Street
Torrance, CA 90501

05H029

CHAIN OF CUSTODY RECORD

J2 | VW01-08

SITE 20 A1 DATE 8/3/05 PAGE 1 OF 1

CLIENT: Vandenberg, AFB
PROJECT NAME: BGMP
PROJECT MANAGER: Kevin McNamara
TC#: T99105-06
SAMPLERS (Signatures)
X [signature]
X [signature]

TURN-AROUND TIME: Standard

OBSERVATIONS/COMMENTS:

ANALYTICAL METHODS

	SAMPLE NO.	DATE	TIME	SW8260 Volatile Organics	SW8015 ~~Diesel~~ / Gasoline	SW8081 Pesticides	SW8082 PCBs	SW8270 SVOCs	SW8270 SIM PAHs	SW6010 / 7470 / 7471 Metals	E218.6 Chromium VI	E300/310.1/160.1 CL/S/ALK/TDS	E353.3/E415.1 N / TOC	RSK 175	E376.2 Sulfide	E314.0 Perchlorate	SW8015 DIESEL				Matrix Type	Container Type	Number of Containers	Filtered Sample
1	V20TB1071	8/3/05	0810	X																	W	G	2	
2	V11669MW2	↓	1500	X	X												X				W	G	8	
3	V99W548	↓	1730	X	X												X				W	G	8	

MATRIX TYPE: S = Soil, W = Water, SD = Sediment

CONTAINER TYPE: E = Encore; G = Glass, SS = Stainless Steel, P = Plastic

PRESERVATIVES: All samples are preserved at 4° C. Water samples are preserved as indicated on the sample labels.

TEMPERATURE BLANK EACH COOLER: YES NO

RELINQUISHED BY: Brian Dow	SIGNATURE: [signature]	TETRA TECH, INC.	DATE: 8/4/05	TIME: 1115	TOTAL NUMBER OF CONTAINERS: 18
RECEIVED BY: Phil Hatcher	SIGNATURE: [signature]	COMPANY: EMAX	DATE: 8-4-05	TIME: 1175	METHOD OF SHIPMENT
RELINQUISHED BY: Phil Hatcher	SIGNATURE: [signature]	COMPANY: EMAX	DATE: 8-4-05	TIME: 1330	SPECIAL SHIPMENT/HANDLING/STORAGE REQUIREMENTS:
RECEIVED BY: INDRA PATEL	SIGNATURE: [signature]	COMPANY: EMAX	DATE: 8-4-05	TIME: 1330	

Cooler #1 T = 3.2°C Cooler #3 T = 2.5°C Cooler #5 = 3.3°C
Cooler #2 T = 2.8°C Cooler #4 T = 2.2°C Cooler #6 = 3.5°C

001

Tt-IRP-009 (04/26/05)

DISTRIBUTION: White = Lab Canary = Client Pink = Tetra Tech, Inc.

TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110
Phone (805) 681-3100
FAX (805) 681-3108

SHIPPED TO: EMAX Labs
1835 West 205th Street
Torrance, CA 90501

05H047

CHAIN OF CUSTODY RECORD

C14/VW01-06

SITE 20A1 DATE 8/4/05 PAGE 1 OF 1

CLIENT: Vandenberg, AFB
PROJECT NAME: BGMP
PROJECT MANAGER: Kevin McNamara
TC#: T99105-06
SAMPLERS (Signatures)
X
X

TURN-AROUND TIME: Standard

OBSERVATIONS/COMMENTS:

ANALYTICAL METHODS

	SAMPLE NO.	DATE	TIME	SW8260 Volatile Organics	SW8015 ~~Diesel~~ /Gasoline	SW8081 Pesticides	SW8082 PCBs	SW8270 SVOCs	SW8270 SIM PAHs	SW6010 / 7470 / 7471 Metals	E218.6 Chromium VI	E300/310.1/160.1 CL/S/ALK/TDS	E353.3/E415.1 N / TOC	RSK 175	E376.2 Sulfide	E314.0 Perchlorate	SW8015 Diesel			Matrix Type	Container Type	Number of Containers	Filtered Sample	OBSERVATIONS/COMMENTS
1	V20TB1073	8/4/05	0800	X																W	G	2		
2	V11669MW4		1415	X	X																G	6		
3	V11669MW5		1520	X	X												X				G	8		
4	V11669MW6M		1530	X	X												X				G	22		MS/MSD

MATRIX TYPE: S = Soil, W = Water, SD = Sediment
CONTAINER TYPE: E = Encore; G = Glass, SS = Stainless Steel, P = Plastic
PRESERVATIVES: All samples are preserved at 4° C. Water samples are preserved as indicated on the sample labels.
TEMPERATURE BLANK EACH COOLER: YES NO

RELINQUISHED BY:	SIGNATURE:		DATE:	TIME:	TOTAL NUMBER OF CONTAINERS
K. Simon		TETRA TECH, INC.	8-5-05	10:45	38
RECEIVED BY: Phil Hatcher	SIGNATURE:	COMPANY: EMAX	DATE: 8-5-05	TIME: 10:45	METHOD OF SHIPMENT: Courier
RELINQUISHED BY: Phil Hatcher	SIGNATURE:	COMPANY: EMAX	DATE: 8-5-05	TIME: 1300	SPECIAL SHIPMENT/HANDLING/STORAGE REQUIREMENTS:
RECEIVED BY: INDRA PATEL	SIGNATURE:	COMPANY: EMAX	DATE: 8-5-05	TIME: 1300	

Cooler #1 $T_1 = 2.8°C$
Cooler #2 $T_2 = 3.5°C$

1001

Tt-IRP-009 (04/26/05)

DISTRIBUTION: White = Lab Canary = Client Pink = Tetra Tech, Inc.