Prepared for:

RESPONSES TO DTSC COMMENTS ON THE CHARACTERIZATION REPORT FEATURE F-33, FORMER LARGE MOTOR WASHOUT AREA, LOCKHEED MARTIN BEAUMONT SITE 1 BEAUMONT, C

RESPONSES TO DTSC COMMENTS ON THE CHARACTERIZATION REPORT FEATURE F-33,
FORMER LARGE MOTOR WASHOUT AREA, LOCKHEED MARTIN BEAUMONT SITE 1
BEAUMONT, CALIFORNIA, SUBMITTED APRIL 2009
TETRA TECH, INC
DTSC COMMENTS OF JUNE 10, 2009

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Specific Comments		
Comment	**Response**	**Proposed Action**
3. Appendix E: The bottom end cap in all well diagrams should be illustrated and identified. Also, the illustrations should indicate that the bentonite chip seal is hydrated.	As built well diagrams have been modified to include the requested changes. Bentonite Chips have been modified to "Hydrated Bentonite Chips", and "End Cap" has been added to each figure and identified as such.	Add the changes requested by the reviewer.

RESPONSES TO DTSC COMMENTS ON THE CHARACTERIZATION REPORT FEATURE F-33,
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Specific Comments		
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4. Appendix F: The acronyms HSU, QA, and MEF should be identified in the table.	The table has been modified to delete the column referring to HSUs (Hydrostratigraphic units); therefore, HSU has not been defined. In the footnotes section at the bottom of the table, the following acronyms have been defined: QA = Quaternary Alluvium, PVC – polyvinyl chloride. In addition, the following acronyms have been modified to be more generic: TOC = top of casing, in feet below ground surface (bgs) TOS = top of screen in feet bgs BOS = bottom of screen in feet bgs bgs = below ground surface msl = elevation as measured in feet above mean sea level. The acronym MEF has been deleted from the table. There is no need to define it.	Modify the table to include those items identified in the "response"

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

This Remedial Design Characterization Report (Report) for the Former Beaumont Site 1 Feature F-33 Large Motor Washout Area (herein referred to as "Feature F-33") was prepared by Tetra Tech, Inc. (Tetra Tech), on behalf of Lockheed Martin Corporation (LMC). The work, conducted as part of the characterization of Feature F-33, was based on the June 2008 Characterization Work Plan (Work Plan, 2008), which outlined the characterization approach for Feature F-33 and was approved by California Department of Toxic Substances Control (DTSC) in a letter dated 01 July 2008. This Report documents the characterization activities associated with Feature F-33.

The objectives of this Report are to:

Summarize the results of the previous investigations;

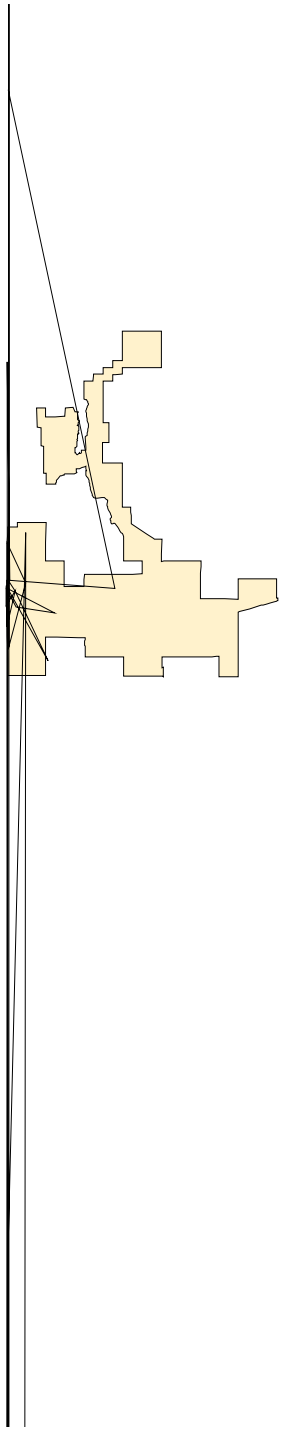
Describe the technical approach implemented during the characterization activities;

Provide an interpretation of the surface and subsurface geology and sampling activities conducted;

Assess the impact to soils and groundwater in and around Feature F-33; and

Provide data necessary to evaluate remedial alternatives.

This section of the Report provides an overview of the document and briefly summarizes historical

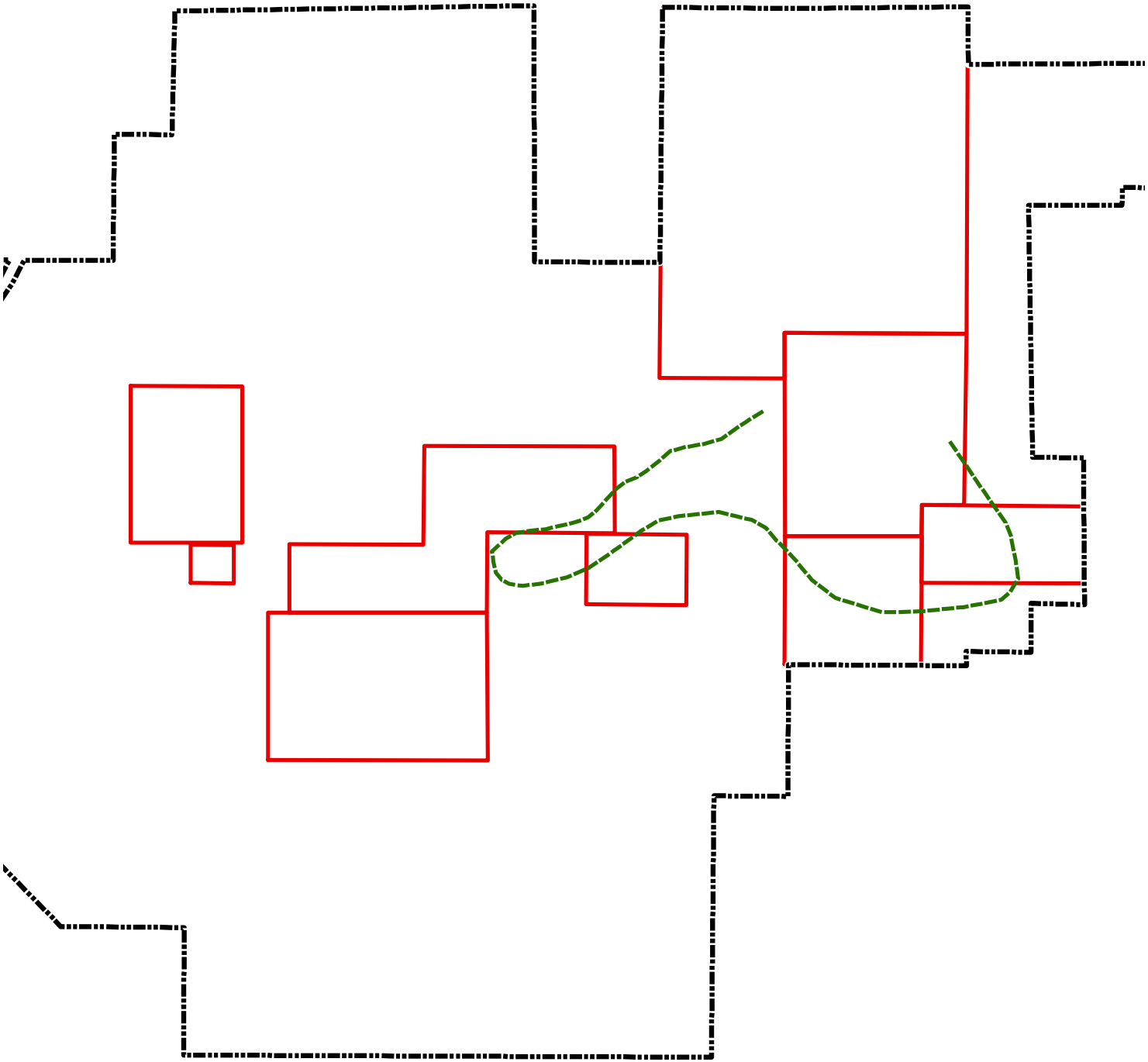


2003a). Activities at the Site also included burning of process chemicals and waste rocket propellants in an area commonly referred to as the burn pit area (BPA). Nine (9) Historical Operational Areas have been identified at the Site. The Historical Operational Areas and the Features are presented in Figure 1-2.

Feature F-33 is located in the western portion of the Site in Historical Operational Area F. Operational Area F (The LPC Test Services Area) includes the following facilities: 1) three (3) bays for structural load tests, 2) a 13-foot-diameter spherical pressure vessel, 3) six (6) temperature conditioning chambers, 4) five (5) environmental chambers, 5) a 25-million electron volt Betatron for X-raying large structures, 6) personnel and instrumentation protection bunkers, and 7) supporting work shops and storage areas (Radian, 1986). These facilities were classified into 13 features, designated Features 33 through 45. The Large Motor Washout Area was designated Feature F-33 (Tetra Tech, 2003a).

Feature F-33, located in the south-central portion of Historical Operational Area F (Figure 1-3), is on a bluff that extends out into the Potrero Creek drainage. The drainage wraps around the bluff, and the elevation of the bluff is approximately 15 to 20 feet higher than the drainage. The creek is ephemeral and supports a riparian corridor. Although flows increase during storm events, much of the time Potrero Creek's ephemeral flow is attributed to discharging groundwater.

Defective solid rocket propellant was washed out of the motor casings with groundwater supplied by a groundwater production well (W-1), which was properly destroyed (Tetra Tech, 2006). A high-pressure water jet was used to flush propellant from the motor casings. The solid propellant pieces produced from the washout operations were collected in a sieve and Tca TJ 0.00pundwn



In March 2000, Earth Tech prepared a Five Year Review Report that evaluated the protectiveness of remedial systems implemented at the Beaumont Site 1 facility. DTSC comments on the Five Year Review Report indicated the need to evaluate additional analytes, including the emerging contaminants 1,4-dioxane and perchlorate. LMC's response to DTSC comments included implementation of a Sampling and Analysis Plan (SAP), prepared by Earth Tech in June 2002 (Earth Tech, 2002).

During SAP implementation in 2002, perchlorate and 1,4-dioxane were detected in groundwater at concentrations above California Recommended Action Levels (Tetra Tech, 2002). As a result of the detection of these two compounds, characterization was reinitiated at the Site, including Feature F-33.

After a delay associated with protection of endangered species, the initial investigation of Feature F-33 began in 2004. Nine soil borings and soil gas probes were installed to a depth of 41.5 feet below ground surface (bgs) at Feature F-33 (Tetra Tech, 2005). Soil samples were analyzed for VOCs, semi-volatile organic compounds, total petroleum hydrocarbons (TPH), perchlorate, 1,4-dioxane, and Title 22 metals. 1,4-dioxane was not detected at concentrations above the reporting limits (RLs). Diesel-range TPH was detected at concentrations ranging from 6.3 to 45 milligrams per kilogram (mg/kg), and perchlorate was detected at concentrations ranging from 20 to 57,100 micrograms per kilogram (µg/kg). The organics acetone, benzene, toluene, 1,2,4-trichlorobenzene, and bis(2-ethylhexyl)phthalate were detected at concentrations ranging from 0.52 to 124 µg/kg. Acetone detections may have been associated with laboratory cross-contamination. However, benzene, toluene, and 1,2,4-trichlorobenzene are commonly associated with fuel, and bis(2-ethylhexyl)phthalate is found in many plastics and is widely used in the

concentrations above the method detection limit (MDL) in 13 of the 18 soil samples, with concentrations

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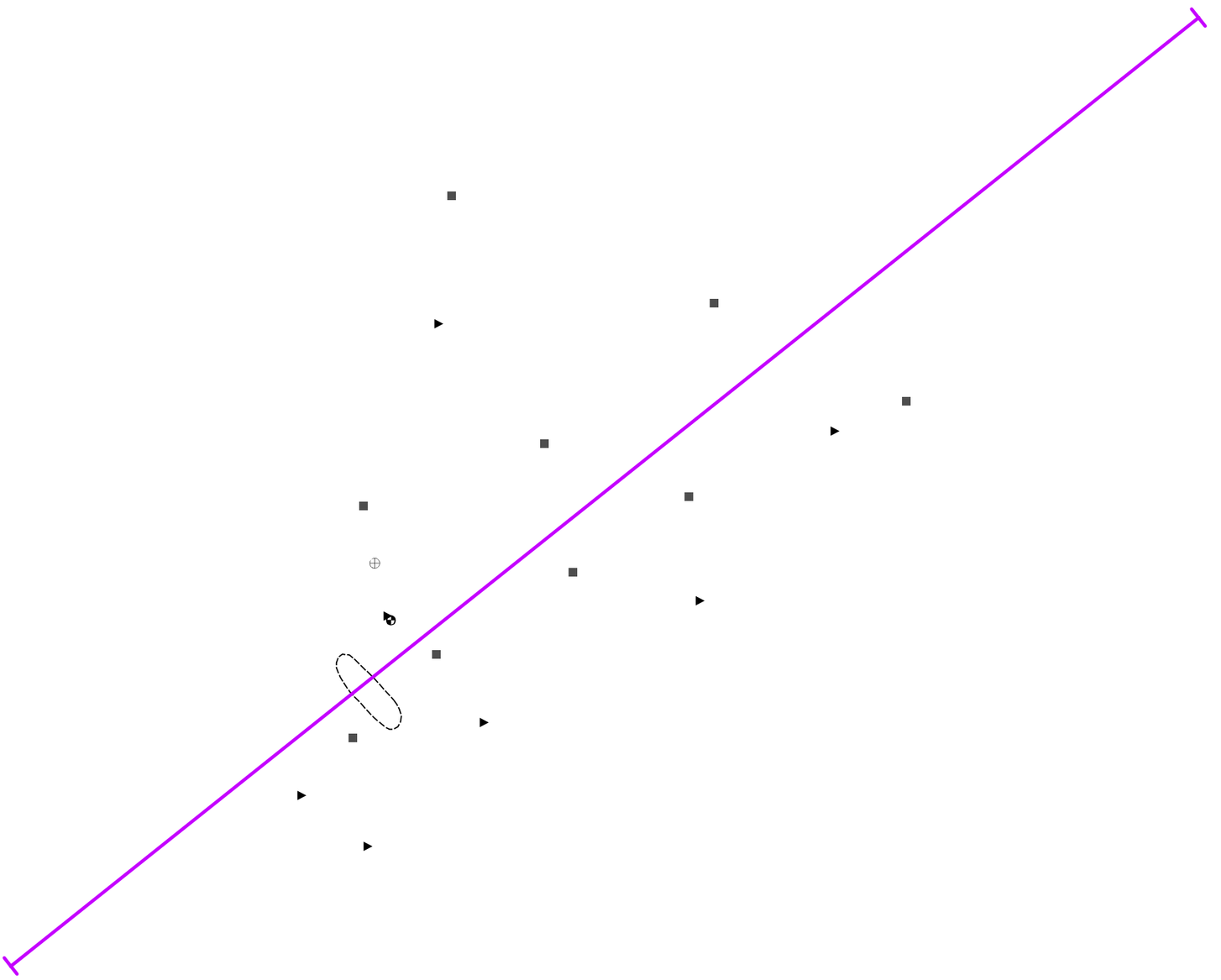
Groundwater Impacts



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Beaumont Site 1

Figure 1-5b

Refraction Profile
Large Motor Washout Area

into the saturated zone to allow for proper measurement of a seismic velocity at that depth. The seismic velocity survey was conducted in October 2007; the bottom of MW-70 was 34 feet bgs and the water table was measured at 31 feet bgs. Based on field logs, the well did not penetrate competent Mt. Eden material and, therefore, a velocity consistent with competent sandstone was not observed in the downhole velocity survey (Terra Physics, 2008).

Based on the seismic refraction data, the top of the competent Mt. Eden bedrock ranges from approximately 6 feet bgs near the southeastern end of the profile to about 46 feet bgs near MW-70. Moderately weathered Mt. Eden is exposed on the southeast and northwest ends of the profile and is represented as moderately weathered Mt. Eden in the seismic profiles.

Based on the profile, the stream bed appears to have historically meandered across a significant portion of the area surveyed. The deepest expression of the historic drainage is beneath the northwest edge of the current streambed. The weathered Mt. Eden unit is thickest beneath monitoring well MW-70.

2.0 INVESTIGATION APPROACH

3.0 RESULTS OF DETAILED SITE CHARACTERIZATION

This section describes the surface and subsurface geology and presents the characterization results.

3.1 SURFACE AND SUBSURFACE GEOLOGY

Based on numerous characterization studies performed to date, the surface and subsurface geology of Feature F-33 is very well understood. The site is situated on a bluff adjacent to Potrero Creek. The bluff contains alluvial sediment derived from local sources including alluvium from Potrero Creek and from the surrounding hillsides that are predominantly Mt. Eden Sandstone and the lower part of the San Timoteo Formation. The maximum depth to more competent Mt. Eden Sandstone is estimated to be about 45 feet bgs near monitoring well MW-70 based on seismic refraction data. Based on data collected from the numerous direct-push sampling points and borehole logs from the hollow-stem auger borings, depth to Mt. Eden Sandstone is 20 feet bgs at the north end of the site but was not encountered in the boreholes drilled on the bluff to a depth of 36 feet bgs (MW-82 and MW-70). Electronic boring logs are presented in Appendix A. Mapping soil and bedrock exposures along Potrero Creek shows that Mt. Eden Sandstone is exposed in Potrero Creek at several locations along the bluff – active channel interface. Also, within Potrero Creek itself, Mt. Eden Sandstone is present in several exposures at the eastern tip of the bluff. Based on numerous boreholes, field mapping of the site, and the seismic refraction data collected at the site, more competent Mt. Eden Sandstone is present at relatively shallow depths. Figure 3-1 shows sampling, well, and cross-section locations at Feature F-33. Figures 3-2 and 3-3 are idealized geologic cross-sections across Feature F-33.

The dominant soil type present at the site includes silty sand and sandy silt on the bluffs (see geologic cross-sections Figures 3-2 and 3-3). Within the stream channel itself, the dominant soil type is poorly graded sand. In general, the bluff soils do not contain a significant amount fine-grained soils such as silts and clays. Borehole logs suggest that the soil on the bluff is channel deposits that have been elevated as a result of down cutting of Potrero Creek over time. Small lenses of fine-grained silty sand and sandy silt are present in isolated locations but overall, the soil is predominantly sand.

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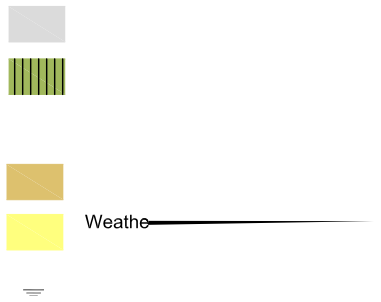
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Table 3.1 Summary of Validated Perchlorate Results in Soil at Feature F-33 Using EPA Method 314.0

Borehole Name	Feet below ground surface					
	0.5-2	3-4	5-9	10-14	15-19	20-24
MDL (1) 10.2 - 20.7	Laboratory results in µg/kg					
F33-DP17	2230	NA	324	12100	1390	NA
F33-DP18	258	NA	2170	4880 Jf	149000	NA
F33-DP19	38	NA	29.4	NA	4560 Jf	ND
F33-DP20	1700	NA	NA	133000	302000	210000
F33-DP21	41.6	NA	58.3	NA	134	ND
F33-DP22	31.7	NA	NA	ND	192	771
F33-DP23	ND	NA	ND	NA	ND	ND
F33-DP24	ND	NA	ND	NA	56.4	212
F33-DP25	NA	NA	ND	ND	ND	NA
F33-DP26	ND	NA	ND	ND	ND	NA
MW-82	NA	NA	ND	35.1	62.9	ND
MW-83	NA	NA	100	3020	230	ND
F33-TW1	ND	ND	NA	NA	NA	NA
F33-TW2	ND	ND	NA	NA	NA	NA
F33-TW3	ND	ND	NA	NA	NA	NA
F33-TW4	ND	ND	NA	NA	NA	NA
F33-TW5	ND	ND	NA	NA	NA	NA
F33-TW6	ND	ND	NA	NA	NA	NA

MDL - Method Detection Limit

(1) Method Detection Limit (MDL) - MDLs may vary if sample was analyzed from a diluted aliquot.

µg/kg - micrograms per kilogram

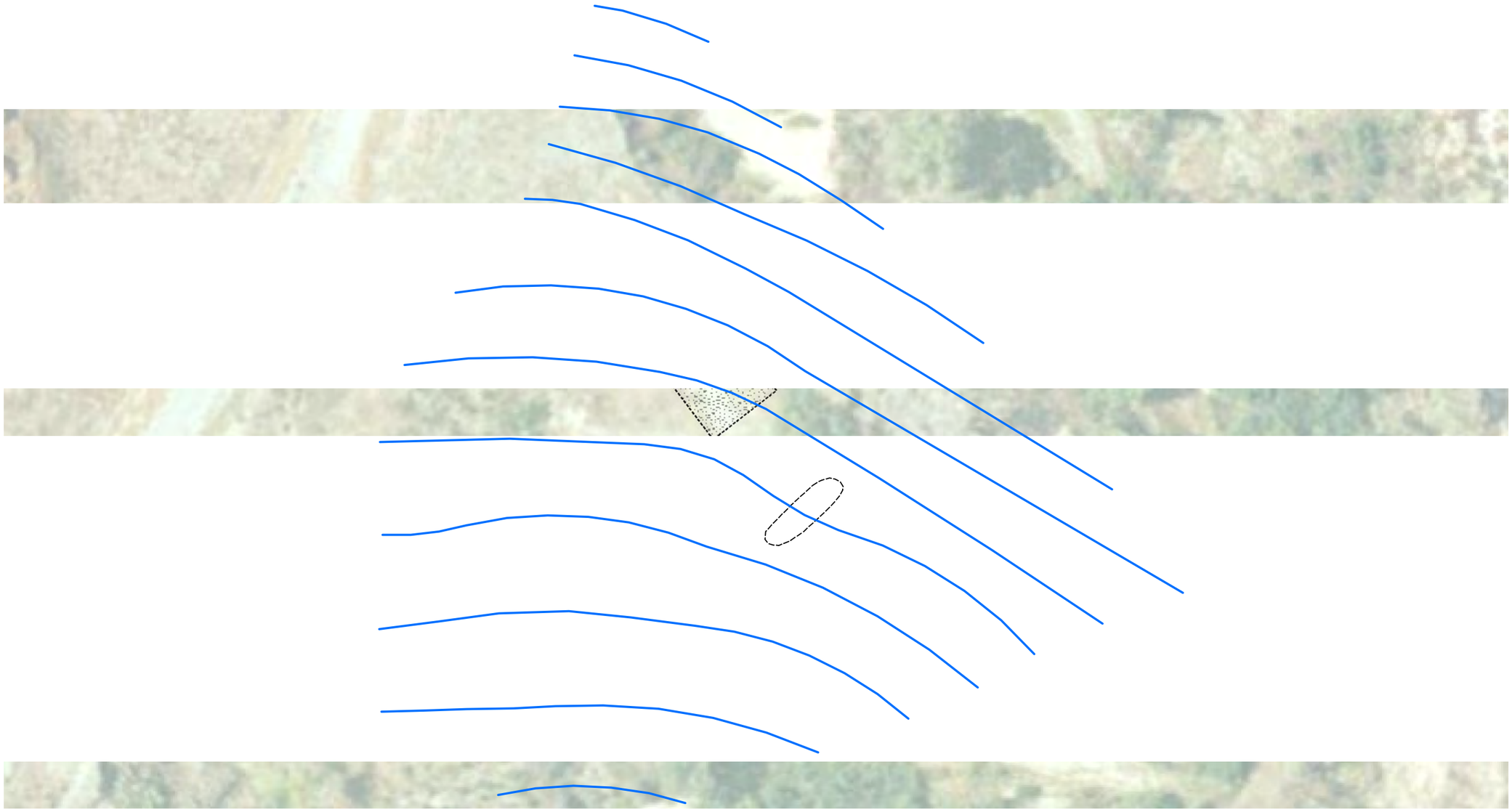
J - The analyte was positively identified, but the analyte concentration is an estimated value.

NA - not analyzed at indicated depth.

ND - sample was analyzed but was below the MDL

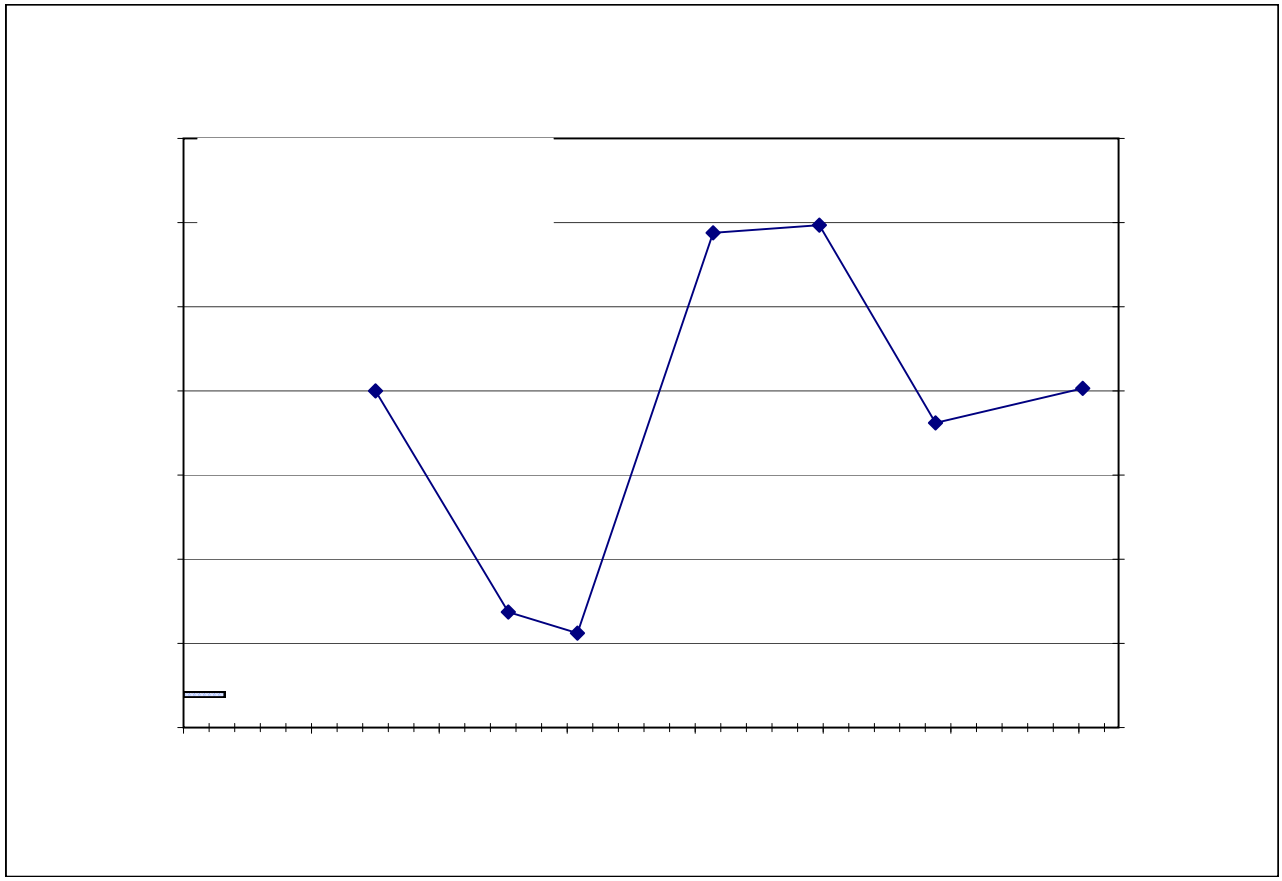
Table 3-2

Sample Name	Filter Status	Sample Date	Matrix	Perchlorate -ug/L	1,4-Dioxane -ug/L	Methane -ug/L	Sulfide -mg/L	Sulfate -mg/L	Total Organic Carbon -mg/L	Dissolved Organic Carbon -mg/L	Iron -mg/L	Acetic Acid -mg/L	Lactic Acid And Hiba -mg/L	Chloromethane -ug/L	1,1-Dichloroethane -ug/L	1,1-Dichloroethethethethethethethethethethetheth



Sample Location	Sample Date	Perchlorate ug/L	DO - mg/L	ORP - mVs	Acetic Acid - mg/L	Butyric Acid - mg/L	i-Hexanoic Acid -mg/L	Hexanoic Acid - mg/L	Lactic Acid and HIBA - mg/L	Pyruvic Acid - mg/L	i-Pentanoic Acid - mg/L	Propionic Acid - mg/L	Pentanoic Acid - mg/L	Dissolved Organic Carbon - mg/L	Total Organic Carbon - mg/L	Hydrogen -nM	Methane ug/L	Sulfide - mg/L	Nitrate (as N) - mg/L	Sulfate - mg/L	Ferrous Iron - mg/L	Iron - mg/L	
F33-TW1	8/18/2008	ND	0.33	45.5	0.14	<0.06	<0.08	<0.08	<0.07	<0.07	<0.07	<0.05	<0.07	3.22	3.06	NA	55	0.8	<0.05	109	<2.5	0.118 Jq	
F33-TW2	8/18/2008	ND	0.33	-120.7	0.26	<0.06	<0.08	<0.08	0.37	<0.07	<0.07	<0.05	<0.07	2.88	3.03	NA	150	0.8	<0.05	62.1	<2.5	0.8	
F33-TW3	8/18/2008	ND	0.27	-94.2	0.14	<0.06	<0.08	<0.08	0.15	<0.07	<0.07	<0.05	<0.07	1.82	1.76	NA	16	0.8	<0.05	55.9	<2.5	0.454	
F33-TW4	8/19/2008	ND	0.62	-124.9	0.1	<0.06	<0.08	<0.08	0.15	<0.07	<0.07	<0.05	<0.07	3.28	3.22	NA	61	0.8 Jq	<0.05	73.8	<2.5	0.521	
F33-TW5	8/18/2008	ND	0.34	16.2	0.11	<0.06	<0.08	<0.08	0.20	<0.07	<0.07	<0.05	<0.07	3.73	3.45	NA	97	1.2	<0.05	74.1	<2.5	0.12 Jq	
F33-TW6	8/19/2008	ND	0.37	-34.5	0.12	<0.06	<0.08	<0.08	0.15	<0.07	<0.07	<0.05	<0.07	3.16	3.36	NA	1.8 Jq	0.8 Jq	<0.05	94.3	<2.5	0.295	
MW-18	11/2/2007	4.7	0.29	53.6	0.140	<0.060	<0.080	<0.080	0.300	<0.070	<0.070	<0.050	<0.070	9.43	1.47	2.400	2.7	<0.1	0.633	57.5	<2.5	<0.04	
MW-18	5/30/2008	6.7	0.14	112.3	0.12	<0.06	<0.08	0.25	0.2	<0.07	<0.07	<0.05	<0.07	1.26	2.13	2.1	1.2 Jq	<0.1 UJe	0.457	52.2	<2.5	<0.04	
MW-37	11/8/2007	7.3	0.58	-57.1	0.130	<0.060	<0.080	<0.080	<0.070	<0.070	<0.070	<0.050	<0.070	1.32	0.816 Jq	5.200	1.2 Jq	<0.1	<0.05	41.9	<2.5	<0.04	
MW-37	5/29/2008	2.6	0.36	-171.8	0.14	<0.06	<0.08	0.13 Jf	0.21	<0.07	<0.07	0.11	<0.07	0.815 Jq	1.21	3.1	1.2 Jq	<0.1	0.496	34.4	<2.5	<0.04	
MW-43	5/29/2008	5.4	0.31	172.5	0.19	<0.06	<0.08	<0.08	0.29	0.3	<0.07	<0.05	<0.07	0.555 Jq	0.69 Jq	11	330	<0.1	0.846	11.7	<2.5	0.064 Jq	
MW-67	11/2/2007	0.78 Jq	0.24	59.1	0.210	<0.060	<0.080	<0.080	<0.070	<0.070	<0.070	<0.050	<0.070	13.3	4.89	1.600	4.2	<0.1	<0.05	220	<2.5	<0.04	
MW-67	5/30/2008	0.86 Jq	0.15	153.1	0.14	<0.06	<0.08	0.18	<0.07 UJc	<0.07 UJc	<0.07	<0.05	<0.07	5.35	6.45	60	25	<0.1 UJe	<0.05	106	<2.5	<0.04	

Sample Name	Sample Date	Perchlorate -ug/L	Well ID	Date Measured	Measuring Point Elevation (feet MSL)	December 2008 Depth to Water (feet bgs)	December 2008 Groundwater Elevation (feet MSL)
MW-70	6/15/2007	<0.5	MW-70	05/31/07	1976.15	28.15	1948.00
MW-70	9/28/2007	<0.5	MW-70	09/10/07	1976.15	30.78	1945.37
MW-70	10/25/2007	<0.5	MW-70	09/12/07	1976.15	30.78	1945.37
MW-70	11/8/2007	<0.5					



3.3.4 DO and ORP

µg/L; and under mildly methanogenic conditions, methane is generally measured at concentrations greater than 100 µg/L. In this area, it appears that conditions are mildly anaerobic, albeit sufficiently to support perchlorate biodegradation.

3.3.8 Hydrogen

Hydrogen concentrations were greater than 1.0 nanoMoles (nM) in all monitoring wells where it was analyzed. This high level of hydrogen detected in TW1 and TW2 is likely artificially elevated. Newly installed monitoring wells should be allowed up to six months to stabilize prior to testing for hydrogen. These wells were not allowed to stabilize before they were sampled. Once stabilized, hydrogen greater than 1.0 nM is indicative of anaerobic conditions with the likelihood of the onset of mildly sulfate-reducing conditions. This level of hydrogen is supportive of natural perchlorate biodegradation. Hydrogen is a much better indicator of redox conditions than ORP because it is easier to measure to a higher degree of accuracy because instrument ORP measurements can sometimes be impacted by the various redox pairs in the groundwater. In general, hydrogen measurements in all monitoring wells at Feature F-33 suggest anaerobic conditions are reducing enough to support perchlorate biodegradation.

3.3.9 TOC and DOC

These parameters were both generally measured at concentrations greater than 3 mg/L. Although these concentrations do not suggest an aquifer rich in natural organic carbon, they are likely to be sufficient to sustain natural biodegradation of low levels of perchlorate. Furthermore, the fact that other electron acceptors such as iron, nitrate, and DO do not appear to be competing for organic carbon supports the case that native organic carbon in groundwater is currently sufficient for native microorganisms to degrade low concentrations of perchlorate.

3.3.10 VFAs

Volatile fatty acids are a more direct indication of the carbon substrate form that is immediately available to native microorganisms. Perhaps the most important of the VFAs is acetic acid. Acetic acid plays an important and direct role in metabolism and energy generation. Acetic acid, when present even in small amounts, could indicate that there is an excess of it available for consumption by perchlorate-reducing microorganisms. In the Feature F-33 vicinity, acetic acid concentrations ranged from 100 to 260 µg/L, which appears to be currently sufficient to sustain the metabolic activity of perchlorate-reducing microorganisms.

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4.0 SUMMARY AND RECOMMENDATIONS

4.1 SUMMARY

Investigations of Feature F-33 indicate that approximately 37,783 cubic yards of vadose-zone soil are impacted with perchlorate at concentrations above 10 µg/kg. The depth of vadose-zone-contaminated soil ranges from ground surface to the groundwater table, which is encountered from 19.5 to 31 feet bgs. The highest detected perchlorate concentration in soil is 302,000 µg/kg at 16 feet bgs at sampling location F33-DP20. The highest concentrations of impacted soil are also located along the northeast side of the bluff between sampling locations F33-HSAS4 and F33-HSA7.

Several sampling events have been conducted within the vicinity of Feature F-33 to assess the extent of perchlorate contamination in groundwater, as well as to gain a better understanding of the geochemical environment in the groundwater aquifer at this unit. As part of these sampling efforts, the primary source area well, MW-70, has been sampled and analyzed for perchlorate eight times since it was installed in 2007. Although most of the sampling events indicated perchlorate concentrations below detection limits, three events from March to August 2008 detected elevated perchlorate concentrations, ranging from 6.9 to 48.5 µg/L. During the fourth period between the November 2007 (perchlorate not detected) and the March 2008 (highest detected perchlorate concentration of 48.5 µg/L) sampling events, 14.5 inches of rain were recorded. These results suggest that as groundwater levels became higher, perchlorate contamination from the overlying soil was flushed into the groundwater aquifer, resulting in the observed increase in perchlorate concentrations. The second highest detection of 21.7 µg/L also correlates with increased precipitation.

Analysis of geochemical parameters in the aquifer reveals that the environmental conditions are capable of supporting natural perchlorate biodegradation in groundwater. The redox conditions, the absence of electron acceptor competition, and the availability of low levels of useable organic carbon appear to be promoting perchlorate degradation. The groundwater currently possesses the appropriate geochemical characteristics to naturally biodegrade perchlorate, and biodegradation appears to be occurring for the bulk of soil contamination in the area. However, during periods of high rainfall, some perchlorate is being transported downward into the groundwater as observed locally in MW-70.

4.2 RECOMMENDATIONS

Based on the data collected at Feature F-33 during previous investigations, this investigation, and the routine groundwater monitoring program, the nature and extent of both the impacts to soil and groundwater are defined. Therefore, no further investigations are proposed.

Because additional data collected indicate that the impacts to groundwater appear to be limited in their nature and extent and attenuate before leaving the Site, no IRM is proposed at this time.

The following recommendations are made:

- Continue sampling groundwater monitoring wells on a semiannual basis to determine the seasonal fluctuations in water levels, the distribution of contaminant concentrations, and natural attenuation parameters for wells around the site.
- Include F-33 in the future Site wide RI / FS and risk assessments to evaluate and determine the appropriate mitigation measures for the area.

6.0 ACRONYMS AND ABBREVIATIONS

AQMD (South Coast) Air Quality Management District

TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
VFA	Volatile Fatty Acids
VOC	volatile organic compound