Revised

Groundwater Monitoring Well Installation and Sampling Report Lockheed Martin Corporation, Beaumont Site 2 Beaumont, California

Prepared for:

LOCKHEED MARTIN

Prepared by:

TETRA TECH
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TC# 21706-01 / April 2009

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LOCKHEED MARTIN

April 2, 2009

Dan Zogaib
Southern California Cleanup Operations
Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Subject: Submittal of Final *Groundwater Monitoring Well Installation and Sampling Report, Lockheed Martin Corporation, Beaumont Site 2, Beaumont, California*

Dear Mr. Zogaib:

Please find enclosed one (1) hard copy of the body of the report and two (2) CDs of the report and appendices of the Final *Groundwater Monitoring Well Installation and Sampling Report, Lockheed Martin Corporation, Beaumont Site 2, Beaumont, California*. This report has been revised based on DTSC's comments, which follow immediately behind this transmittal.

If you have any questions regarding this submittal, please contact me at 408.756.9595 or denise.kato@lmco.com.

Sincerely,

Denise Kato
Remediation Analyst Senior Staff

Enclosures

Copy with Enc:
Beaumont Library (1 pdf)
Gene Matsushita, LMC (1 pdf and 1 hard copy)
John Eisenbeis, Camp, Dresser, McKee (1 pdf)
Thomas J. Villeneuve, Tetra Tech, Inc. (1 pdf and 1 hard copy)

RESPONSE TO COMMENTS
AUGUST 2008
GROUNDWATER WELL INSTALLATION AND SAMPLING REPORT, LOCKHEED MARTIN BEAUMONT SITE 2.
DTSC WELL INSTALLATION REPORT COMMENTS DATED AUGUST 5, 2008

Comment	Response	Proposed Action
DTSC Comments / Responses		
General Comments		
1. All Figures should have practical scale that can be used with a common engineering scale. The *print scaling* should be checked before printing from a .pdf document.	The figures in this report were scaled individually to maximize the areas and data being presented. Tetra Tech does concur that standardized scales are helpful to the reader and therefore will make this change in all future documents. However, the level of effort to revise the figures in the current document is a lot given that the report has already been submitted and reviewed.	Standardized scales will be generated using a common engineering scale for future reports.
2. All cross-sections and cross section traces should be identified as A-A', B-B', 1-1', 2-2', 3-3', etc.	The report will be revised to reflect the cross section identification scheme.	Cross sections will be identified as A-A', B-B', etc.

Comment	Response	Proposed Action
3. Both arsenic and bis-(2-ethylhexyl) phthalate may be attributed to past operations at the site. More convincing information should be provided to back up statements that relate bis-(2-ethylhexyl) phthalate to laboratory contamination and arsenic to background.-	Arsenic and Bis-(2-eythlyhexyl) phthalate are not considered COPCs at this time. A Screening Ecological Risk Assessment (SERA) for soil was completed and a draft of the document was submitted for regulatory review. The SERA shows that arsenic has a background concentration of 6.5 mg/kg in soil at Site 2. This is approximately 100 times the residential and eight times the commercial industrial California Modified PRGs for soil. Arsenic has not been identified as a COPC for soil. Background concentrations in water have not been determined. Since arsenic does not appear to be a contaminant of concern for soil at the site, it is not considered a COPC for groundwater at this time. A Human Health and Ecological Risk Assessment (HHERA) for groundwater will be conducted in the future and arsenic will be further evaluated at that time to assess background arsenic concentrations in groundwater. Until the risk assessment is completed, all monitoring wells on the site continue to be sampled for metals, including arsenic, annually. Bis-(2-eythylhexyl) phthalate has been tested for 18 times in 12 different monitoring wells. The compound has been detected twice. It was detected at a concentration of 22 ug/l in TT-MW2-3 in September 2004. This well was tested again in February 2005 and June 2006 and the compound was not detected. The compound was also detected in TT-MW2-12 at a concentration of 17 ug/l. This well has not been tested again. Twelve equipment blanks have been collected and tested for the compound. The compound was detected in two of the blank samples. Bis-(2-eythylhexyl) phthalate is an organic compound used in the manufacture of many plastics including PVC and is a common field and laboratory contaminant. Therefore, bis-(2-ethylhexyl) phthalate is not considered a site COPC. During the upcoming HHERA for Site 2 groundwater, all compounds will be evaluated further.	Text will be added to support the statement that arsenic is related to background concentrations and that bis-(2-eythelhexyl) phthalate is considered a laboratory or field contaminant and that additional data analysis will be completed during the Site 2 HHERA to further define groundwater COPCs at the site.

Comment	Response	Proposed Action
4. A rationale should be provided differentiating between “primary” and ”secondary” COCs. The need and implications in answering this question should be provided. VOCs can be risk drivers for several contaminant migration pathways.	The intent is not to eliminate the secondary COPCs from consideration or future testing but to limit the number of compounds that are mapped and discussed in detail during routine reporting. The groundwater COPCs are reevaluated annually. All compounds detected will be considered during source area evaluations and pending risk assessments. Primary Chemicals of Potential Concern (COPCs) are those analytes that define or best represent the different types of compounds released at a site and the maximum extent (horizontally and vertically) of contamination at a particular site. The purpose of defining primary versus secondary COPCs is to reduce the total number of analytes that require detailed analysis. COPCs are re-evaluated on a routine basis to make sure that the primary COPC list continues to accurately represent site conditions over time and still meets objectives of the monitoring program and regulatory requirements.	Text will be added to the report to clarify the difference between Primary and Secondary COPCs.

Comment	Response	Proposed Action
5. A rationale should also be provided that explains why tracer chemicals for NDMA such as ammonia and formaldehyde are excluded.	The historical record did not indicate that NDMA was used at the Site. NDMA was tested for because, although no liquid rocket fuel motors were reportedly tested at the Site, a small bottle of unsymmetrical dimethyl hydrazine (UDMH) was found at the former landfill. It was reportedly disposed of there by a sub-lessee conducting testing at the Site. NDMA can be found in a variety of compounds including meats, fertilizers, cutting oils, tobacco smoke, herbicides, pesticides, rubber products, and various drugs formulated with aminopyrine. NDMA is also a breakdown product of hydrazine and UDMH. NDMA was tested for because it is a breakdown product of UDMH. Analytical methods for ammonia and formaldehyde have relatively high detection limits in the mg/l range. In looking for potential sources of UDMH at Beaumont Site 2, we chose to analyze groundwater samples for NDMA because the detection limit for this analytical method is much lower than for ammonia and formaldehyde. In addition, NDMA is much more toxic and presents a much higher risk if encountered. Based on this, groundwater samples were collected and samples were analyzed for NDMA from 5 wells located at key locations around Site 2 including the landfill. NDMA was present in 3 of the 5 wells at trace levels below the DWNLs. Additional groundwater samples were collected later from the same three wells to confirm the presence of NDMA at Site 2. NDMA was detected in two of the three wells at concentrations similar to or less than the first time it was detected. To further evaluate the extent of the NDMA, all monitoring wells on the site will be tested for NDMA during the upcoming groundwater monitoring program.	Text will be added to the report to clarify this point.

Comment	Response	Proposed Action
6. Soil and groundwater samples should be analyzed with a comprehensive suite of analyses in the burn pit discharge ponds areas. The analyte list should include, among others, hexavalent chromium.	The suites of analyses to be performed during the investigations of both the burn area and the discharge area were comprehensive and were included in the work plans specific to those investigations. These work plans have been approved by the DTSC and implemented. Both total chromium and hexavalent chromium have been tested for in various locations at the Site. The concentrations detected did not exceed relevant risk screening criteria. Future soil and groundwater investigations will include a list of target analytes. If appropriate, metals will be included. The routine groundwater monitoring program includes testing for CAM 17 metals annually.	Text will be added to the report to discuss the analytical data from the groundwater monitoring report that discusses the detected hexavalent chrome results.
7. Standard Operating Procedures (SOPs) for soil and groundwater sampling should be included.	Standard Operating Procedures are appropriate for work plans and other planning documents; however to include these in a report documenting the work that was done seems redundant. SOPs should be included in work plans so that the field crews know how to perform the specific field tasks. SOPs for this effort were provided in Appendix A of the Quality Assurance Project Plan (*Lockheed Martin Beaumont Site 1 and 2 Soil Investigation Work Plan [dated October 31, 2003]),* the *Groundwater Sampling and Analysis Plan, Lockheed Martin Corporation, Beaumont Site 2, (dated May 2007), and in the Groundwater Monitoring Well Installation Work Plan, Lockheed Martin Corporation, Beaumont Site 2 (dated April 2006).*	No change to the document is recommended at this time.
8. The conceptual site model should be reviewed and revised based off of these comments and recommendations.	The conceptual site model has been updated to reflect the information and data collected during this investigation. The Conceptual Site Model will be re-evaluated based on the comments provided here by DSTC.	The conceptual site model will be reviewed based on the comments provided to this report and revised as necessary.

Comment	Response	Proposed Action
9. GSU concurs with recommendations for Site 2.	No action necessary.	No action necessary
Specific Comments		
10. Section 2.2.3, Page 2.6, last paragraph: It should be clarified whether or no the sand pack was surged to avoid bridging during installation. Also, it should be specified if actual locks are placed on the locking lids, if at all.	Text will be added to Section 2 stating that prior to placing the bentonite seal, the filter pack was surged to ensure proper filter pack placement and to avoid bridging during well installation. In addition, a statement will be added to state that locks were installed on the locking lids to prevent vandalism of the wells.	Text will be added to clarify that the sand pack was surged to avoid bridging during the well installation process. A statement will also be added that locks have been placed on newly installed wells to prevent tampering.

Groundwater Monitoring Well Installation and Sampling Report

Lockheed Martin Corporation, Beaumont Site 2
Beaumont, California

April 2009
TC #: 21706-01

Prepared for
Lockheed Martin Corporation
Burbank, California

Prepared by
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Section 1.0

Introduction

1.0 INTRODUCTION

This Groundwater Monitoring Well Installation and Sampling Report (Report) was prepared by Tetra Tech, Inc. (Tetra Tech), on behalf of Lockheed Martin Corporation (LMC). The purpose of this Report is to document the well installation and groundwater sampling activities associated with 14 monitoring wells/piezometers installed as part of the continued assessment of the nature and extent of affected groundwater at Beaumont Site 2 (Site).

The objectives of this Report are to:

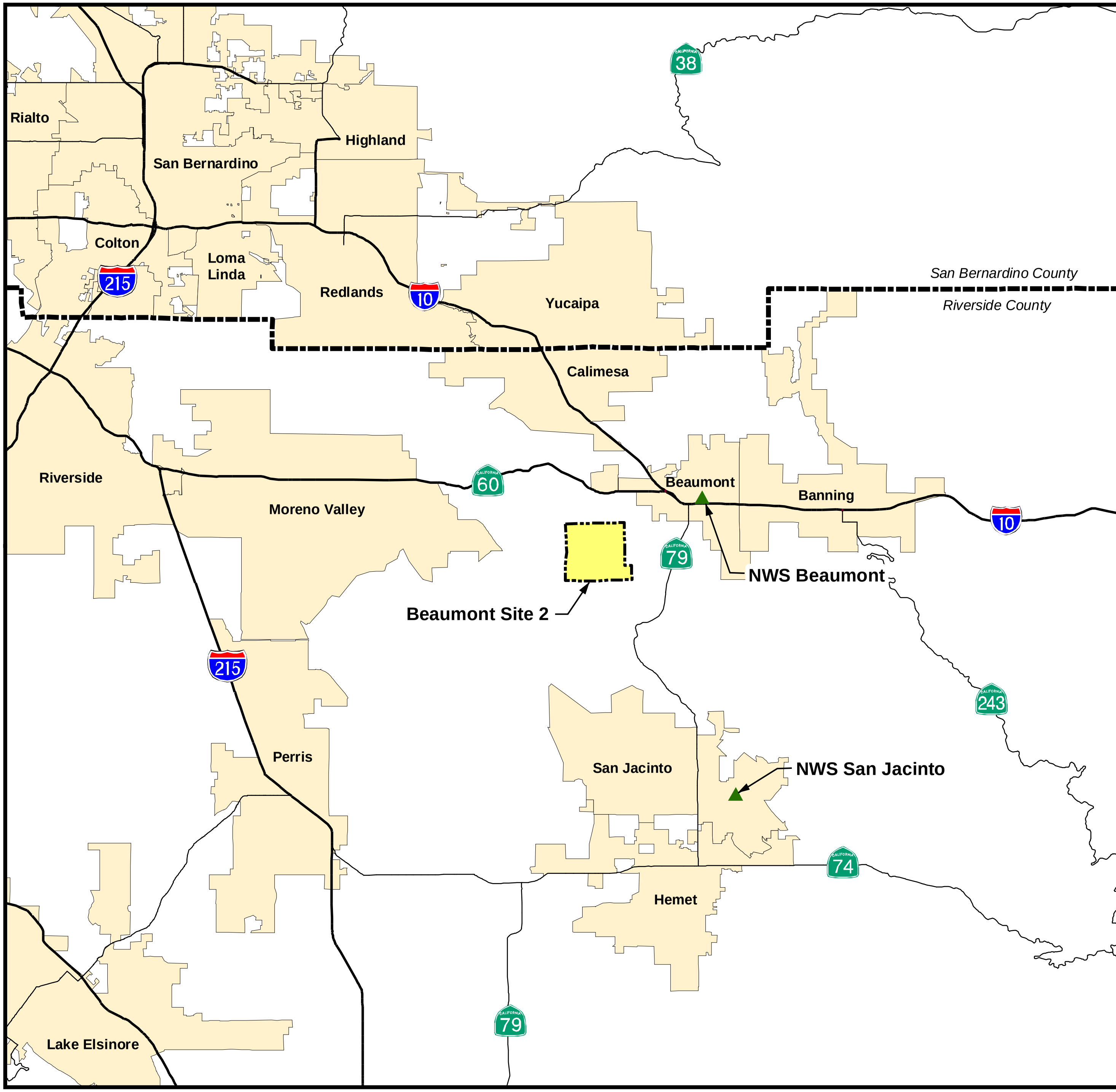
- Present the background history, and the local and regional settings, geology and hydrogeology;
- Describe the procedures used for well installation, development, and sampling activities;
- Analyze and evaluate the water elevation and chemical data generated from the newly installed wells;
- Present an updated conceptual Site model (CSM) based on data obtained from the newly installed wells; and
- Present conclusions, data gaps and recommendations for further action.

This Report is organized into 4 major sections: 1) Introduction, 2) Field Methodology, 3), Results of Field Activities and 4) Conclusions and Recommendations.

1.1 SITE BACKGROUND

The Site is a 2,668-acre parcel located southwest of Beaumont, California (Figure 1-1). The parcels that comprise the Site were owned by individuals and the United States (U.S.) government prior to 1958. Between 1958 and 1960, portions of the Site were purchased by Grand Central Rocket Company (GCR) and utilized as a remote test facility for early space and defense program efforts (Radian, 1968a). In 1960, Lockheed Aircraft Corporation (LAC) purchased one-half interest in GCR. GCR became a wholly-owned subsidiary of LAC in 1961. The remaining parcels of land that comprise the Site were purchased from the U.S. government between 1961 and 1964. Figure 1-2 presents a layout of the historical operational areas and features of the Site. In 1963, Lockheed Propulsion Company (LPC) became an operating division of LAC and was responsible for the operation of the Site until its closure in 1974.

Prior to 1958 the Site was used for agriculture. The Site was utilized by GCR and LPC from 1958 to 1974 for small rocket motor assembly, testing operations, propellant incineration, and minor disposal activities (Radian, 1986a). Ogden Labs is known to have leased portions of the Site in the 1970s.



Adapted from:

U.S. Census Bureau TIGER line data, 2000.

LEGEND

- ▲ National Weather Service Station
- -·-·-·- Beaumont Site 2 Property Boundary

Beaumont Site 2

Figure 1-1
Regional Location of Beaumont Site 2

TETRA TECH

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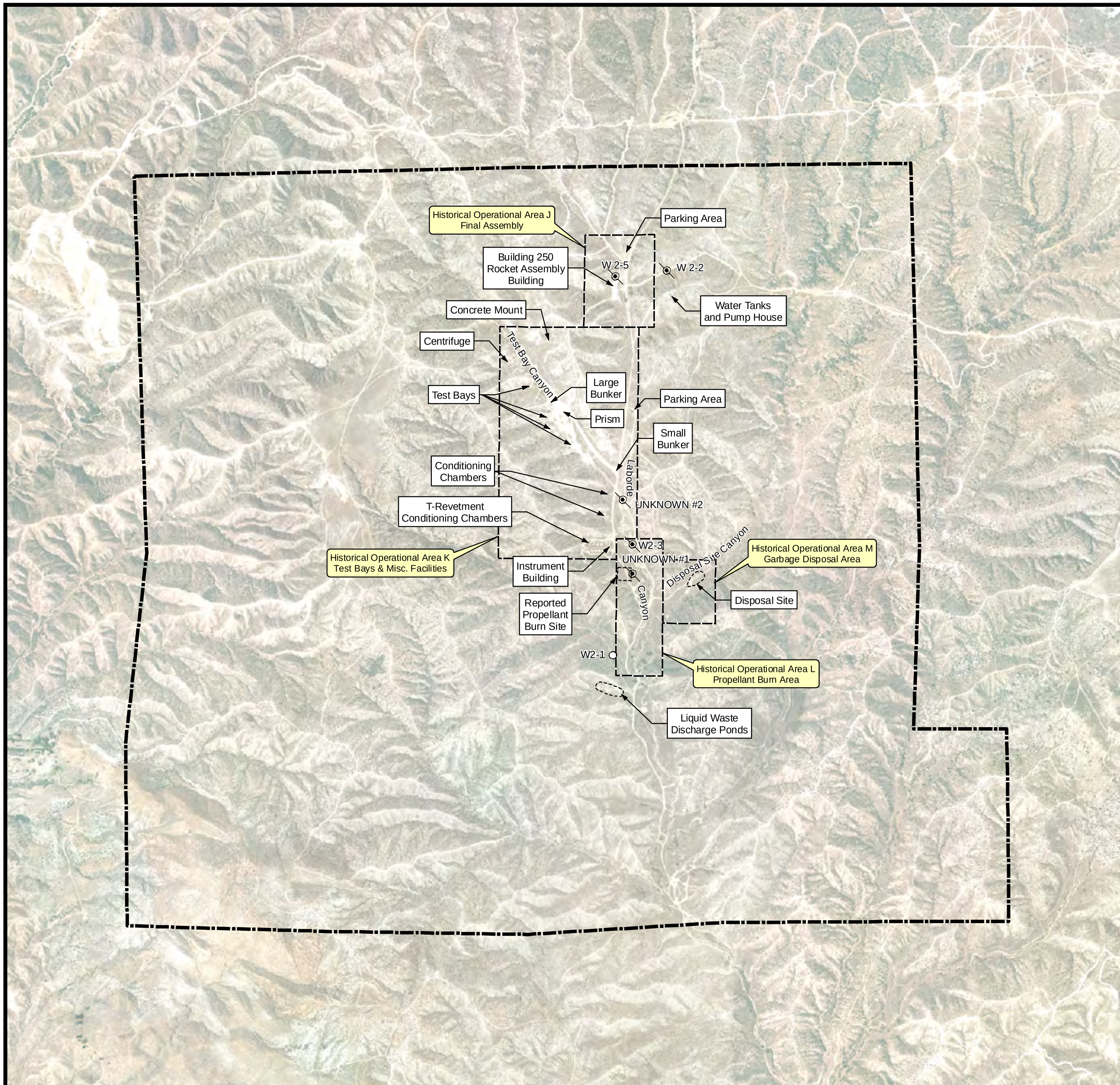

Adapted from: March 2007 aerial photograph.

LEGEND

- Destroyed Production Well Location
- Reported Production Well Location
- Historical Operational Unit Boundary
- Beaumont Site 2 Property Boundary

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Propellant Burn Site perimeter is estimated (Radian, 1986a).

Beaumont Site 2

Figure 1-2
Historical Operational Areas and Site Features

TETRA TECH

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In 1989, the Department of Toxic Substances Control (DTSC) issued a consent order requiring LMC to cleanup contamination at the Site related to past testing activities (CDHS, 1989). Based on characterization and cleanup activities performed at the Site, the DTSC issued a no further remedial action letter to LMC closing the Site in 1993.

Based on regulatory interest in perchlorate and 1,4-dioxane, a groundwater sample was collected from an inactive groundwater production well (identified as W2-3) at the Site in January 2003. The sample was analyzed for volatile organic compounds (VOCs), perchlorate, and 1,4-dioxane to determine the potential presence and concentration of those chemicals in groundwater. The analytical results indicated that VOCs and 1,4-dioxane were not present at or above their respective laboratory reporting limits (LRLs). However, perchlorate was reported at a concentration of 4,080 micrograms per liter (µg/L), which exceeded the State of California Maximum Contaminant Level (MCL) of six (6) µg/L. Based on the detection of perchlorate in the groundwater sample collected, the DTSC reopened the Site for further assessment.

Four (4) primary historical operational areas have been identified at the Site (Figure 1-2). Each operational area was responsible for various activities associated with rocket motor assembly, testing, and propellant incineration. A brief description of each operational area follows:

Historical Operational Area J (Area J) – Final Assembly

Rocket motor casings with solid propellant were transported to Building 250 where final assembly of the rocket hardware was conducted (Radian, 1986a). The building was used from 1970 to 1974 for final assembly and shipment of short range attack missile rocket motors. Rocket motor assembly operations included installation of the nozzle and headcap, pressure check of the motor, installation of electrical systems, and preparations for shipment. During plant closure in 1974, all usable parts of this facility were dismantled, taken off-Site, and sold.

Historical Operational Area K (Area K) – Test Bays and Miscellaneous Facilities

The primary features included a large earthen structure known as the “Prism,” conditioning chambers, two (2) control bunkers, a centrifuge, and four (4) test bays. The Prism was reportedly built between 1984 and 1990 and was used to test radar by General Dynamics (Tetra Tech, 2007d). Details concerning construction of the Prism are not available, but it appears to have been constructed from soils near the test bays.

The conditioning chambers were used to examine the effects of extreme temperatures on rocket motors and to meet specification requirements (Radian, 1986a). A centrifuge was located in the northwestern portion of Area K, where rocket motors were tested in order to determine if the solid propellant would separate from its casing under increased gravitational forces.

Previously, only three (3) test bays were known; however, a recent interview with a former employee reported a fourth test bay (located north of the other three (3) bays) was also previously used in Area K Tetra Tech, 2007d). The initial testing activities had a history of explosions that destroyed complete test areas, especially during the period when GCR operated at the Site (Radian, 1986a). Consequently, while vestiges from three (3) test bays are currently visible at the Site, the fourth test bay was reportedly destroyed from an explosion during testing.

Historical Operational Area L (Area L) – Propellant Burn Area

Solid propellant was reportedly transported to the burn area and set directly on the ground surface for burning (Radian, 1986a). No pits or trenches were dug as part of the burning process. The solid propellant was saturated with diesel fuel to initiate combustion. Reportedly, the solid propellant would burn rapidly. There are no evidence or physical features that identify the precise location of burning activities. A waste discharge permit was recently discovered indicating that up 5,000 gallons per year of waste water from rocket testing operations could be discharged into small surface depressions located in a small side canyon just south of Area L.

Historical Operational Area M (Area M) – Garbage Disposal Area

A garbage disposal area was located adjacent to a small creek at the Site (Radian, 1986a). Scrap metal, paper, wood, and concrete materials were disposed of at the disposal site by LPC. Hazardous materials, including explosives and propellants, were never disposed of at the disposal site by LPC according to employee interviews. Ogden Labs, a company that tested valves and explosive items, also used this disposal site. Reportedly, Ogden Labs disposed of hazardous waste at the disposal site. In 1972, a Lockheed Safety Technician was exposed to toxic vapors of unsymmetrical dimethyl hydrazine (UDMH) from a pressurized gas container located within the disposal site. Based on potential exposure risks to occupants, LPC's safety group required Ogden Labs to take measures to remove any potentially hazardous materials at the disposal site. Shortly thereafter, a disposal company was contracted by Ogden Labs to clean up the disposal site.

1.2 GEOLOGY AND HYDROGEOLOGY

This section includes a general discussion about regional and local conditions.

1.2.1 Physical Setting

The Site is located at the northern end of the Peninsular Range Geomorphic Province (Harden, 1998). The Peninsular Range is a large block uplifted abruptly along its eastern edge and tilted westward. The province has a subtle northwest trend expressed by its higher mountains and longer valleys (Figure 1-3) [Sharp, 1975]. The Site is primarily located within the confines of the Laborde Canyon valley floor, which lies between the western foothills of the San Jacinto Mountains to the southeast and a “Badlands” topographic area to the northwest. The “Badlands,” refers to areas of relatively soft sedimentary sandstone and siltstone deeply incised into canyons by runoff. On-Site elevations range from approximately 2,500 feet mean sea level (msl) on the ridges at the northern boundary to about 1,800 feet msl near the mouth of Laborde Canyon to the south.

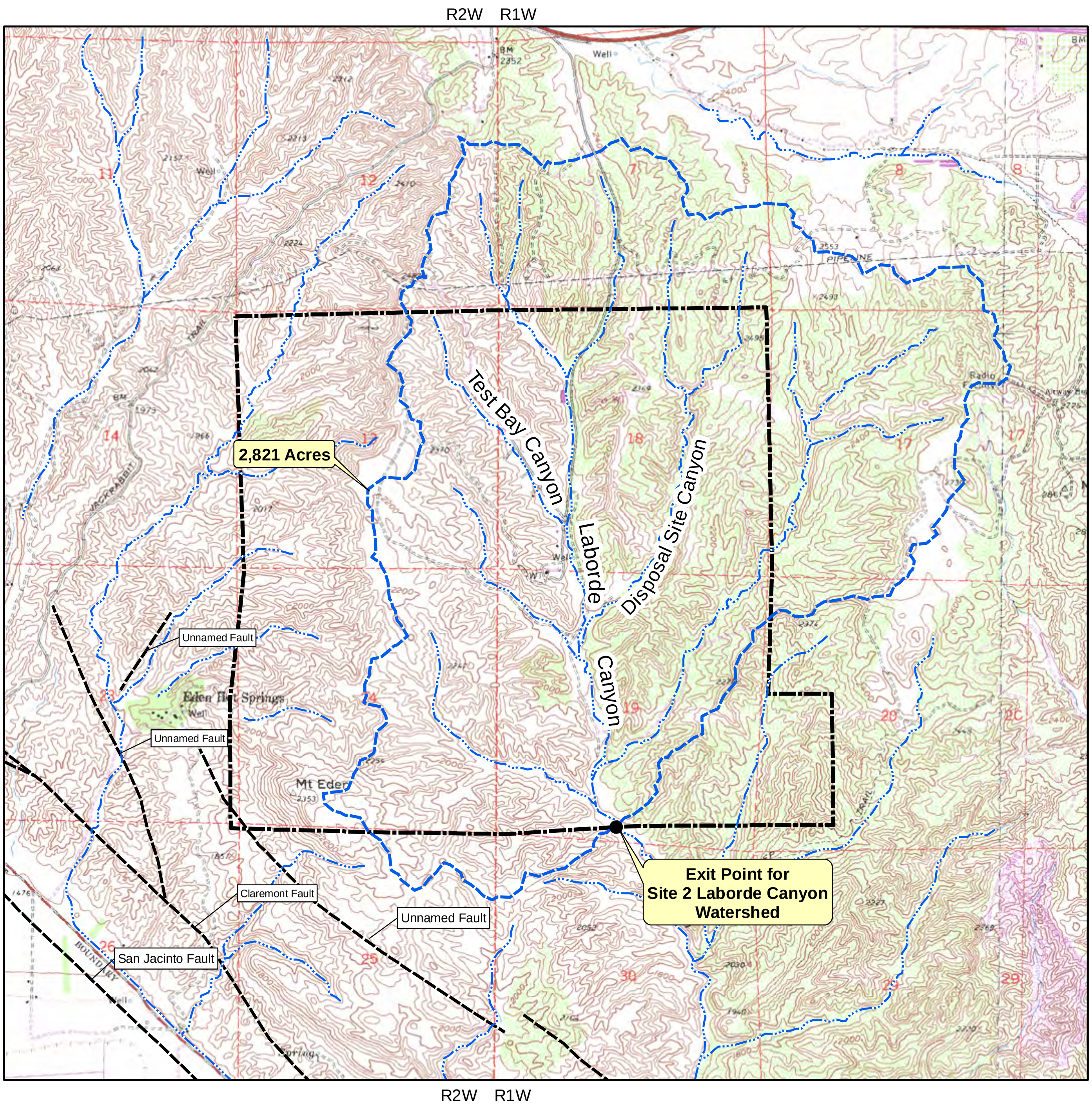
1.2.2 Precipitation

Southern California has a Mediterranean climate which is characterized by mild wet-winters and warm dry-summers. The wettest months at the Site are December through March. The Riverside County Flood Control District has two (2) weather stations in the general area of the Site, the Beaumont National Weather Service (NWS) station and the San Jacinto NWS station. The locations of the stations are included in Figure 1-1 and Table 1-1 presents a monthly and annual summary of the precipitation data.

Table 1-1 Summary of Precipitation – Beaumont and San Jacinto NWS Monitoring Stations for the Years 1888 – 2007 Beaumont Site 2

Precipitation (inches)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean Monthly	Annual Total
2007	0.48	3.27	0.63	1.10	0.00	0.00	0.00	0.00	0.47	0.20	-	-		0.62
Mean	2.83	2.91	2.53	1.04	0.52	0.09	0.09	0.23	0.29	0.61	1.16	1.97	1.18	14.12
Median	1.82	2.31	1.61	0.55	0.10	0.00	0.00	0.00	0.00	0.12	0.76	1.40	1.15	13.77
Maximum	18.80	12.81	11.20	9.10	4.83	1.70	2.10	2.80	4.41	6.82	4.99	14.43	3.30	39.60
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
San Jacinto NWS Monitoring Station (for the years 1886 - 2007)														
Precipitation (inches)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean Monthly	Annual Total
2007	0.11	0.44	0.12	0.43	0.00	0.00	0.00	0.03	0.32	0.03	-	-		0.15
Mean	2.15	2.12	1.91	0.87	0.35	0.06	0.10	0.20	0.30	0.53	0.93	1.46	0.92	10.90
Median	1.42	1.50	1.40	0.47	0.10	0.00	0.00	0.00	0.00	0.14	0.64	1.05	0.84	10.07
Maximum	13.70	10.30	7.80	6.89	3.40	1.00	1.50	2.32	4.73	5.64	6.47	11.29	2.33	28.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
NWS - National Weather Service. “ – “ Not available.



Adapted from:

USGS 7.5' Topographic Quadrangle, El Casco. 1979.

Faults from Geologic Map of California - Santa Ana Sheet California Division of Mines and Geology, 1966.

Watershed boundary calculated from USGS digital elevation model using hydrologic modeling tools in ArcGIS 9.2 Spatial Analyst/3D Analyst.

LEGEND

- Beaumont Site 2 Property Boundary
- Intermittent Creek/Drainage
- Fault
- Laborde Canyon Watershed (2,821 Acres)

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Beaumont Site 2

Figure 1-3

Physical Setting and Estimated Watershed

TETRA TECH

1.2.3 Surface Water

The Site is bisected by Laborde Canyon, which traverses a north-south pathway through the area. Laborde Canyon forms the principal drainage course through the Site and allows ephemeral storm water to drain southward toward the San Jacinto Valley. The watershed area for the Site (designated as Laborde Canyon watershed, as shown on Figure 1-3), is ephemeral in nature and remains dry when there is no rainfall. Therefore, no permanent streams, creeks, or other major surface water bodies occur at the Site.

1.2.4 Geology

The following subsections describe the regional and local geology in the area of the Site based on previous investigations and reports.

Regional Geology

The Site is located in the San Timoteo Badlands of the San Jacinto Mountain block (Radian, 1990). The San Jacinto Mountain block is a recently elevated mass with San Jacinto Peak being the highest point at 10,804 feet. The San Timoteo Formation (STF) is the most abundant rock type that outcrops in the San Timoteo Badlands. The "Badlands," refers to areas of relatively soft sedimentary sandstone and siltstone deeply incised into canyons by runoff. On-Site elevations range from approximately 2,500 feet msl on the ridges at the northern boundary to about 1,800 feet msl near the mouth of Laborde Canyon to the south. Minor alluvial deposits are located primarily in canyon floors and ridge tops and slopes.

The regional stratigraphy in the vicinity of the Site has been described and mapped by Dibblee (Dibblee, 1981). Geologic units, from oldest to youngest, consist of the basement complex of late Paleozoic to middle Mesozoic age meta-sedimentary rocks and Mesozoic granitic rocks; non-marine sedimentary rocks of the Tertiary (Pliocene to Pleistocene) Mount Eden Formation overlain by the non-marine Tertiary sandstones and siltstones of the STF; and Quaternary alluvium (QAL) [Radian, 1990]. Figure 1-4 presents the regional geology of the area depicting the STF as the "undivided Pliocene nonmarine" unit and QAL as "alluvium." While QAL appears present in canyons at the Site, the source of Figure 1-4 is a regional geologic map at a resolution that does not show such local details.

Local Geology

Findings from geologic studies conducted at the Site are consistent with the regional geologic mapping performed by Dibblee (1981). Subsurface investigations and seismic surveys conducted at the Site identified the QAL and STF (weathered and more competent).

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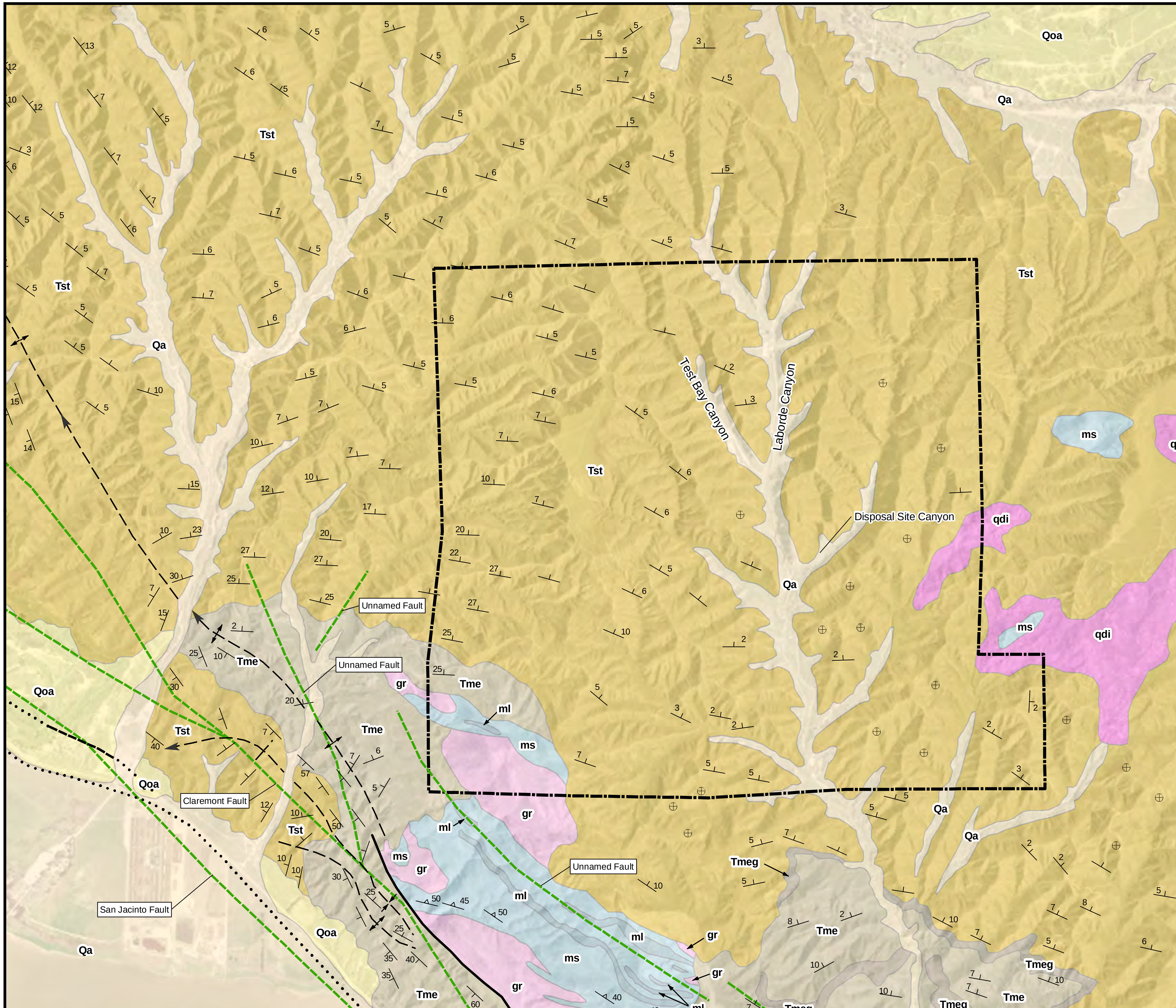


N

0 1,000 2,000 Feet

LEGEND

Beaumont Site 2 Property Boundary

Faults
(from Dibblee, 2003)
- Fault
- Fault (Concealed)
- Fault (Indefinite)

(from California Division of Mines and Geology, 1966)
- Fault

Anticline
Arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments.

Strike and Dip of Sedimentary Rocks
15 Inclined
Horizontal

Strike and Dip of Metmorphic or Igneous Rock Foliation or Flow Banding or Compositional Layers
20 Inclined

Geology

Surficial Sediments

Qg	Alluvial gravel and sand of stream channels
Qa	Alluvial sand, gravel and clay of level areas, covered by residual soil

Older Surficial Sediments

Qoa	Alluvial gravel and sand, light reddish brown and of granititc and gneissic detritus of San Bernardino Mountains in north areas, brownish gray in south area; top surface slopes slightly from source terrains

San Timoteo Formation

QTst	Upper part, sandstone, light gray to tan, fine to coarse grained arkosic and minor conglomerate of mostly granitic detritus, some gneissic and quartzitic detritus; includes thin layers of soft greenish to light reddish silty claystone, overlain by older alluvium
Tst	Main part (middle part of Morton and Matti, 2001) sandstone, minor conglomerate and claystone, similar to those of upper part; comformably overlain by upper part (QTst), conformably underlain by Mount Eden Formation (Tme), but thins and buttresses eastward onto basement rocks as shown

Mount Eden Formation

Tme	Sandstone, medium grained, arkosic, includes interbeds of micaceous silty shale, strata light gray to light reddish maroon, locally contains concretions
Tmeg	Granitic conglomerate, composed of subrounded to subangulat boulders and cobbles of light gray massive biotite-hornblende quartz diorite (tonalite), unsorted; form lenses within and at top of unit Tme, derived from quartz diorite to NE (Morton and Mattei, 2001)

Plutonic Rocks

gr	Granitic rock of Mount Eden, granite to monzo-granite (Morton and Matti, 2001) composed of quartz, potassic feldspar and sodic plagioclase feldspar in nearly equal amounts but with somewhat more potassic feldspar, scattered flakes of white mica and almost no mafic minerals, nearly white, massive; intrusive into meta-sedimentary rocks; exposed only near and SE of Mount Eden
qdi	Granodiorite of east area; composed of quartz, potassic feldspar and sodic plagioclase feldspar in nearly equal amounts but with somewhat more sodic plagioclase feldspar, minor biotite, light gray, massive to very faintly gneissoid

Metasedimentary Rocks

ms	Mica schist-phyllite. composed of biotite mica, feldspar and quartz, ranges to fine grained gneiss, locally includes calcsilicate skarn, dark gray, foliated along relict bedding planes
ml	Marble, of calcite and dolomite, pale gray to white, medium to coarse grained, indistinctly bedded, locally contains skarn of dipside, wollastonite, fosterite, garnet and graphite (Morton and Matti 2001) occurs as layers and lenses in unit ms

Adapted from:

Geologic Map of the El Casco Quadrangle, Riverside County, California. Thomas W. Dibblee, Jr. 2003.

Geologic Map of California - Santa Ana Sheet California Division of Mines and Geology, 1966.

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Beaumont Site 2

Figure 1-4

Regional Geology

TETRA TECH

The seismic survey used formation velocities to estimate stratigraphic boundaries and thicknesses at the Site. The results identified the following stratigraphic profile (from top to bottom):

- Recent, dry, unconsolidated silt and sand alluvium or dry, completely weathered San Timoteo or Mount Eden formation;
- Dry, partially consolidated silt and sand alluvium or dry, moderately weathered San Timoteo or Mount Eden formation;
- Dry, slightly weathered San Timoteo formation;
- Saturated, slightly weathered San Timoteo formation; and
- Competent San Timoteo or Mount Eden formation.

Figure 1-5 identifies the locations of the vertical and horizontal seismic survey lines and depicts 12 cross-sectional interpretations of the seismic results. Stratigraphic boundaries mapped by seismic surveys indicated variable thicknesses in the alluvium within Laborde Canyon, ranging from approximately 30 to 90 feet thick. Cross-Sections 10-10’ and 11-11’ on Figure 1-5, transect along the unnamed canyon in Area K where the test bays are located (Test Bay Canyon) and the northern end of Laborde Canyon, show the variability in thickness of the alluvium and the change in elevation across the survey area.

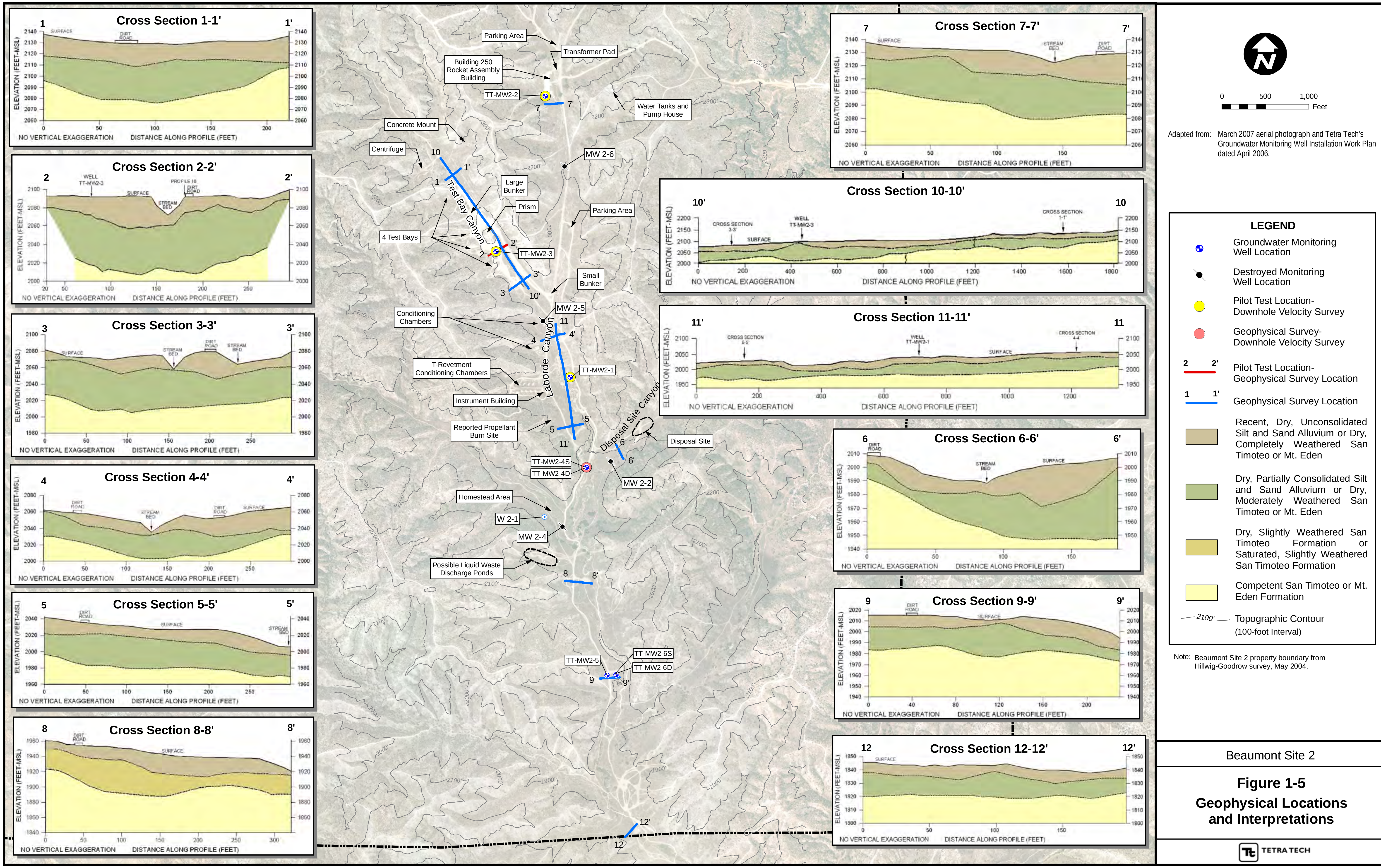
Soil borings completed at the Site identified the QAL and underlying STF. A summary of the geology is presented below.

Quaternary Alluvium

The QAL, primarily located within the confines of the Laborde Canyon valley, appears derived from the weathering of hillsides directly adjacent to the canyon. Alluvial deposits consist of very fine- to fine-grained silty sands and fine- to medium-grained poorly graded sands. These sandy zones are typically interbedded with finer grained silts and, in some cases, with silty clays.

San Timoteo

The STF, as encountered in the subsurface and exposed on the Site, generally consists of siltstone and sandstone. Some coarse pebbles and gravels are encountered in the more coarse-grained portions of the formation. The upper portion of the San Timoteo (wSTF) is characterized by 20 to 60 feet thick weathered siltstone and sandstone fragments composed of silty sand, sand, clayey silt, and sandy, silty clay. At depth, the formation becomes more competent.



Beaumont Site 2

Figure 1-5
Geophysical Locations and Interpretations

TETRA TECH

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Site Structure

Review of the geologic map for the El Casco quadrangle indicates that the STF dip ranges from zero (0) to 27 degrees to the northeast (Dibblee, 2003). This portion of the STF forms part of the northeast limb of the northwest plunging San Timoteo Anticline, the axis of which is approximately 0.2 miles from the southwest corner of the Site (Figure 1-4).

The Site is located between the strike-slip San Andreas and San Jacinto Fault Zones that bisect the San Bernardino Basin. Branch faults associated with the San Jacinto Fault have been mapped near the southern Site boundary. The San Jacinto Fault Zone is located to the southwest, and generally parallel to the San Timoteo Anticline axis. Approximately 8 miles northeast of the Site, the Banning fault adjoins with the San Andreas Fault. The San Jacinto and San Andreas Fault zones have been active with moderate to major earthquakes occurring over the last 200 years. Numerous smaller faults are assumed to be associated with the movement of these two (2) major faults (Figures 1-3 and 1-4).

1.2.5 Hydrogeology

Regional Hydrogeology

The Site is part of the San Jacinto Watershed, which underlies the Cities of Beaumont, San Jacinto, Perris, Hemet, and Moreno Valley in western Riverside County (EMWD, 2005). All of the streams and rivers in the watershed are ephemeral; they flow only when precipitation occurs and much of this flow infiltrates to groundwater. The San Jacinto River rises in and drains the western slopes of the San Jacinto Mountains, including Laborde Canyon. The San Jacinto groundwater basin lies within alluvium-filled valleys carved into the elevated bedrock plateau of the Perris Block. The San Jacinto groundwater basin and adjacent basins are nearly surrounded by impermeable bedrock mountains and hills. Groundwater is the major supply of water in the Cities of Hemet and San Jacinto.

The San Jacinto and Casa Loma fault zones are the major geologic features that bound and/or crosscut many of the basins within the San Jacinto Watershed, and typically are effective barriers to groundwater flow (EMWD, 2005). The San Jacinto fault is a known barrier to groundwater flow, and separates the San Jacinto Graben from the San Timoteo Badlands and the San Jacinto Mountains. Historically, the active faults within the northwest-trending San Jacinto fault zone have served as barriers to groundwater movement (DWR, 1959). East of the City of San Jacinto, a branch of the San Jacinto fault zone cuts the alluvial fill by extending southeast across the San Jacinto River and along the channel of Bautista Creek until it intersects the Park Hill fault (EMWD, 2005).

The area between the San Jacinto and Casa Loma faults is a deep, alluvium-filled graben of tectonic origin, commonly referred to as the San Jacinto Graben (EMWD, 2005). The San Jacinto Graben consists of a fore bay area in the southeast where surface water recharge primarily occurs and a pressure area in the northwest where deep aquifers exist under confined conditions. The effective base of freshwater in the graben is known to be quite deep but has not been precisely determined.

Local Hydrogeology

Based on historical investigations, groundwater at the Site is found primarily in the siltstones of the STF, although these deposits yield only small quantities of water (Radian, 1986b). More recent investigations confirm that groundwater is generally found in the STF. Recharge to groundwater through alluvium occurs from direct infiltration of rainfall, and loss from surface drainage through the sides and bottoms of ephemeral stream channels.

Local Hydraulic Conductivities

Hydraulic conductivity (K) values calculated from slug testing for selected wells at the Site range from 0.017 to 10.4 feet per day (ft/day). Where possible, K values were also calculated based on the results of a modified specific capacity test. Table 1-2 presents a summary of the K values.

Table 1-2 Hydraulic Conductivities of Alluvial, Weathered San Timoteo Formation and San Timoteo Formation Beaumont Site 2

Well ID	Hydrostratigraphic Unit Monitored	Hydraulic Conductivity - Averaged - Slug Test (feet per day)	Hydraulic Conductivity - Falling Head Slug Test (feet per day)	Hydraulic Conductivity - Rising Head Slug Test(feet per day)	Hydraulic Conductivity – Modified Specific Capacity Drawdown Test (feet per day)
TT-MW2-1	Alluvium/wSTF	10.1	9.3	10.4	16.13
TT-MW2-2	STF	Not available.	Not available.	Not available.	< 0.39
TT-MW2-3	Alluvium/wSTF	1.5	1.6	1.3	2.54
TT-MW2-4S	STF	0.018	0.019	0.017	< 0.84
TT-MW2-4D	STF	Not available.	Not available.	Not available.	< 0.72
TT-MW2-5	Alluvium/wSTF	0.90	0.45	1.4	< 2.76
TT-MW2-6S	Alluvial/w STF	Not available.	Not available.	Not available.	< 1.52
TT-MW2-6D	STF	8.2	6.0	10.4	0.96

Local Groundwater Flow

Shallow groundwater flow at the Site occurs mainly through alluvium and the weathered portion of the STF. Based on the results of the well installations, geophysical profiling and surveying, and groundwater monitoring activities, two (2) hydrostratigraphic units (HSUs) have been identified at the Site, an alluvial/wSTF unit and a STF unit. Based on groundwater level measurements and topography, groundwater flow in the alluvial/wSTF appears to follow the southward topographic slope of the Laborde Canyon floor. While data is more limited for the STF, groundwater also appears to flow southward down the slope of the Laborde Canyon.

1.3 PREVIOUS ENVIRONMENTAL ACTIVITIES

Environmental activities have been conducted at the Site since 1986. Reports and documentation regarding previous environmental activities (i.e., soil/groundwater investigations, excavations, regulatory agency correspondence, etc.) were reviewed to provide a historical environmental evaluation of the Site. These investigations are briefly summarized in the following subsections.

1.3.1 Preliminary Remedial Investigation

In October 1986, Radian Corporation (Radian) conducted a preliminary remedial groundwater and geophysical investigation at the Site (Radian, 1986b). The objective of the remedial investigation was to determine the potential presence and lateral extents of possible contaminants in the groundwater beneath the Site. The remedial groundwater investigation was to include sampling four (4) of the existing groundwater production wells (designated W2-1, W2-2, W2-3, and W2-5 and shown on Figure 1-2) at the Site (Radian, 1986b). However, only well W2-3, located upgradient of the probable surface Propellant Burn Site (Area L) was accessible during this investigation. A sample was collected from well W2-3 and analyzed for purgeable hydrocarbons using U.S. Environmental Protection Agency (EPA) Method 601. Trichloroethene (TCE) was reported at a concentration of 4.2 µg/L in the sample. The only other VOCs detected in the sample were methylene chloride and trichlorofluoromethane; however these were reported as blank contaminants.

1.3.2 Hydrogeologic Investigation

In 1992, Radian performed a hydrogeologic investigation at the Site to assess potential source areas and to characterize subsurface soil and groundwater conditions (Radian, 1992). The investigation included groundwater well installation and sampling.

During this investigation, four (4) groundwater monitoring wells (designated MW2-2, MW2-4, MW2-5, and MW2-6 and shown on Figure 1-6) were installed at the Site (Radian, 1992). MW2-2 was located approximately 400 feet southeast of the probable surface Propellant Burn Site (Area L) and downgradient of the Disposal Site (Area M). Well MW2-4 was the furthest downgradient well and was located approximately 800 feet south of the probable surface Propellant Burn Site (Area L). Wells MW2-5 and

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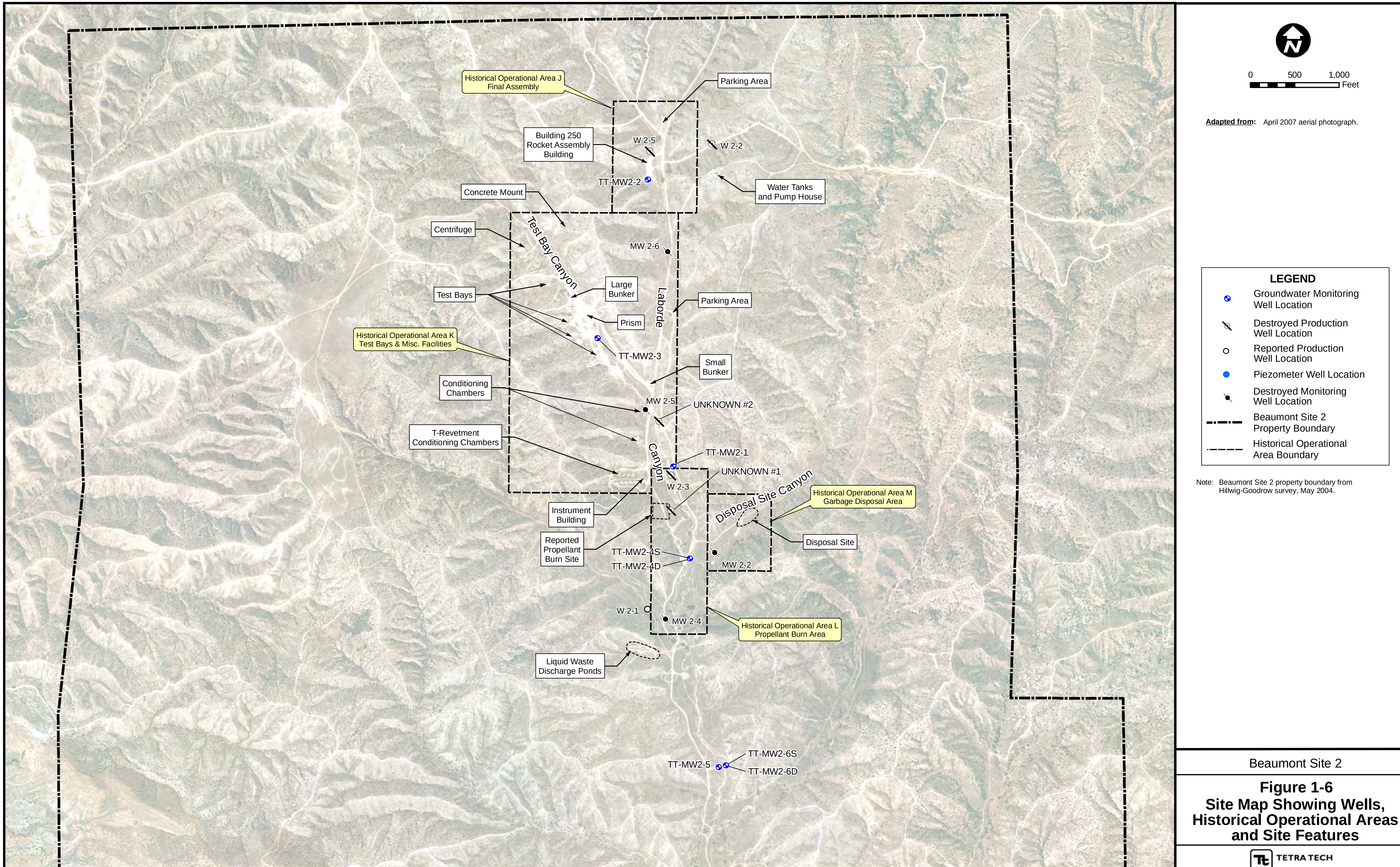


Beaumont Site 2

Figure 1-6
Site Map Showing Wells, Historical Operational Areas and Site Features

TETRA TECH

MW2-6 were located approximately 2,600 feet and 800 feet, respectively, south of the Rocket Assembly Building (Area J).

Groundwater monitoring wells MW2-2, MW2-4, MW2-5, and MW2-6, along with three (3) of the existing production wells (designated W2-3, W2-4, and W2-5), were sampled during this investigation and analyzed for VOCs, metals, and perchlorate. Laboratory results reported no VOCs above their respective LRLs in groundwater samples collected. Inorganic analytical results were also less than their respective LRLs for all metals except zinc, which ranged from 1,600 to 2,100 µg/L. Perchlorate was reported in one (1) sample, collected from production well W2-3 located downgradient of the test bays, at a concentration of 3,300 µg/L.

1.3.3 Disposal Area Removal Action

An electromagnetic (i.e., EM) survey (Radian, 1993) was conducted to determine the location and boundary of the former Disposal Site (Area M). Subsurface anomalies were detected in the center portion of Area M in an area approximately 250 feet wide by 450 feet long. In order to visually confirm the presence of debris, a total of 12 hand-auger borings were advanced to depths ranging from between 3 to 5.5 feet below ground surface (bgs). Based on hand-auger sampling activities, subsurface debris coincided with the surface debris area. Subsequently, three (3) trenches were excavated (designated north, central, and south) to approximately 5 to 8 feet bgs across the debris area. A total of nine (9) soil samples were collected and analyzed for VOCs, semi-volatile organic compounds (SVOCs), and metals. Neither VOCs nor SVOCs were reported above their respective detection limits. All metals results were below the 10 times Soluble Threshold Limit Concentration guidelines. An excavation was performed to remove all debris. A total of 816 tons of debris was removed and disposed of off-Site. Three (3) perimeter confirmation soil samples were collected and analyzed for VOCs, SVOCs, and metals. The excavation was backfilled to surrounding grade. Excavation activities were performed under the supervision of the DTSC (Radian 1993).

1.3.4 Remedial Action Certification Letter

The DTSC issued a Remedial Action Certification Form on July 20, 1993 in a letter titled *Remedial Action Certification for Lockheed Beaumont No. 2, Beaumont, California*. Based on the information known at the time of the letter, the DTSC stated that appropriate response actions had been completed, that all acceptable engineering practices were implemented, and that no further removal/remedial action was necessary.

1.3.5 Monitoring Well Destruction Report

Based on the July 20, 1993 Remedial Action Certification letter issued by DTSC, groundwater monitoring wells MW2-2, MW2-4, MW2-5, and MW2-6 were abandoned (LMC, 1995). Prior to abandonment activities in 1995, the four (4) monitoring wells were sampled and analyzed for VOCs using EPA Methods 8010 and 8020. VOC concentrations were not reported above their respective LRLs.

Well abandonment activities were performed in accordance with an abandonment work plan approved by the California Regional Water Quality Control Board and in compliance with the County of Riverside Department of Environmental Health Services and California Department of Water Resources Bulletin 74-90 guidelines. The wells were abandoned using a neat cement/bentonite injection technique, cutting, capping, and removal of the top 5 feet of casing through excavation, and backfilling the excavation area with native clean soils.

1.3.6 Groundwater Sampling Results From Former Production Well W2-3

In January 2003, Tetra Tech collected a groundwater sample to confirm the historical detection of perchlorate in the groundwater sample collected from the Site (Tetra Tech, 2003). Field activities included the location and identification of existing production wells, recording the physical condition of each well, and groundwater sampling and analysis. Two (2) of the four (4) production wells, W2-3 and W2-5, were visually identified at the Site. A visual inspection with a mirror identified an obstruction in well W2-5, possibly consisting of dirt and debris. Therefore, only well W2-3 was sampled.

As discussed in Section 1.1, a groundwater sample was collected from W2-3 and analyzed for VOCs, perchlorate and 1,4-dioxane. Concentrations of VOCs and 1,4-dioxane were not reported above their respective LRLs. Perchlorate was reported at a concentration of 4,080 µg/L in the groundwater sample.

1.3.7 2004 Monitoring Well Installation Program

In August and September 2004, Tetra Tech installed and sampled five (5) groundwater monitoring wells [designated TT-MW2-1, TT-MW2-2, TT-MW2-3, TT-MW2-4S (for shallow screened) and TT-MW2-4D (for deep screened) and shown on Figure 1-6] at the Site (Tetra Tech, 2004b). The objective of the groundwater well installation activities was to provide data for an initial evaluation of groundwater conditions (water quality and groundwater flow direction) at the Site (Tetra Tech, 2004a).

The five (5) groundwater monitoring wells were sampled in September 2004 and analyzed for VOCs, SVOCs (including 1,4-dioxane and N-nitrosodimethylamine [NDMA, commonly associated with the gas UDMH]), Title 22 Metals, and perchlorate (Tetra Tech, 2004b). Based on analytical results, the following constituents were reported above their respective Maximum Contaminant Levels (MCLs) or California

Department of Health Services drinking water notification levels (DWNLs) in groundwater samples collected: perchlorate was detected in wells located in Area K (TT-MW2-3) and Area L (TT-MW2-1); arsenic was detected in the nested wells (TT-MW2-4S) and (TT-MW2-4D); and bis-(2-ethylhexyl) phthalate and TCE were detected in TT-MW2-3. Additionally, groundwater levels collected from the wells indicated that groundwater flow was approximately south-southwest.

1.3.8 2004 Soil Investigation Program

In September 2004, a soil investigation was conducted to assess the presence or absence of shallow affected soil at historical areas/features identified based on past chemical usage and historical operations (Tetra Tech, 2005a). A total of 52 boreholes were drilled and 251 soil samples were analyzed for one (1) or more of the following constituents: VOCs, SVOCs, 1,4-dioxane, perchlorate, metals, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH). In general, SVOCs, 1,4-dioxane, and PCBs were not reported above their respective LRLs, however TPH and the VOCs acetone, benzene, 1,1-dichloroethene (1,1-DCE), ethylbenzene, toluene, and xylene were reported at relatively low concentrations. Perchlorate was reported at concentrations ranging to 4,510 micrograms per kilogram (µg/kg) [Area K, Test Bays]. The metals antimony, arsenic, barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, molybdenum, nickel, selenium, silver, vanadium and zinc were also reported. The only compound reported above its USEPA Region IX Preliminary Remediation Goal (PRG) was arsenic. Concentrations of arsenic were reported ranging to 6.52 milligrams per kilogram (mg/kg), the residential arsenic soil PRG is 0.39 mg/kg and the industrial PRG is 1.6 mg/kg.

A human health and ecological risk assessment will be performed to evaluate metals background concentrations, identify chemicals of potential concern (COPCs) in soil, evaluate exposures to potential receptors, assess chemical toxicity, and characterize the risk (Tetra Tech, 2007c).

A brief discussion of the soil analytical results of the preliminary soil investigation (Tetra Tech, 2005a) is presented below. Further evaluation of soil analytical data is presented in Section 4 of this Report.

Area J Soil Results

SVOCs, perchlorate, 1,4-dioxane, and PCBs were not detected at concentrations above their respective LRLs in soil samples collected from the nine (9) soil boring and one (1) hand auger locations. TPH concentrations detected in soil samples ranged from 5.2 to 77 mg/kg, and total benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations ranged from 1.1 to 20.5 µg/kg. During this initial investigation, no soil borings in Area J extended below 20 feet bgs, depth to groundwater in this area was approximately 66 feet bgs (TT-MW2-2).

Area K Soil Results

SVOCs, 1,4-dioxane, TPH, and PCBs were not detected at concentrations above their respective LRLs in soil samples collected from 21 soil boring and two (2) hand auger locations. Total VOC concentrations (i.e., 1,1-DCE, acetone, benzene, and toluene) ranged from 1.00 to 99.4 µg/kg.

Perchlorate was detected above reporting limits in soil samples collected from 10 of the 23 sampling locations within Area K, primarily at the Prism, centrifuge area, bunker area, and the three (3) southernmost test bays. Generally, perchlorate was not detected above the LRL in samples collected within the southern half of Area K. The detected concentrations ranged from 28.4 to 4,510 µg/kg and were present across all sampled depth intervals (0.5 to 20 feet bgs). The highest concentrations were primarily in the 10 and 20 foot samples in borings completed around the Prism and the test bays. During this initial investigation, no soil borings in Area K extended below 20 feet bgs, depth to groundwater in this area was approximately 66 feet bgs (TT-MW2-3).

Area L Soil Results

SVOCs and 1,4-dioxane were not detected at concentrations above their respective LRLs in soil samples collected from 11 soil boring and two (2) hand auger locations. TPH concentrations ranged from 30 to 89 mg/kg, and total VOC concentrations ranged from 3.3 to 76.6 µg/kg.

Perchlorate was detected above reporting limits in samples collected from three (3) of the 13 sampling locations within Area L. The detected concentrations were in samples from the 30-foot and 40-foot depth intervals and ranged from 22.3 to 111 µg/kg. During this initial investigation, no soil borings in Area L extended below 40 feet bgs, depth to groundwater in this area ranged from approximately 47 to 50 feet bgs (TT-MW2-4S and TT-MW2-1).

Area M Soil Results

SVOCs, 1,4-dioxane, TPH, and PCBs were not detected at concentrations above their respective LRLs in soil samples collected from 11 soil boring and two (2) hand auger locations. Total BTEX concentrations ranged from 1.5 to 17 µg/kg.

Perchlorate was detected above reporting limits in samples collected from two (2) of the 11 sampling locations within Area M. The detected concentrations were in all sampled depth intervals between 0.5 and 20 feet bgs and ranged from 22.4 to 2,220 µg/kg. During this initial investigation, no soil borings in Area M extended below 20 feet bgs. There were no monitoring wells in this area at the time of the soil investigation.

1.3.9 Seismic Survey

Based on observations made during installation of monitoring wells TT-MW2-1, TT-MW2-2, TT-MW2-3, TT-MW2-4S and TT-MW2-4D and the results of groundwater sampling, it was decided that determining the boundary between unconsolidated alluvium and underlying material (e.g., the STF) was important to future groundwater investigations at the Site (Tetra Tech, 2006a). While unconsolidated alluvium and underlying materials at the Site are similar in color and grain size, differences in density should exist. Seismic geophysical surveys have proven to be a useful tool for imaging boundaries between materials with different densities. The objective of the seismic imaging was to identify areas where groundwater is likely to accumulate (for example, thicker alluvium/weathered bedrock layers) and evaluate possible flow pathways.

Between April and September 2005, geophysical pilot testing was performed at the Site to assess optimum groundwater monitoring well placement. Based on the successful results of the geophysical pilot test, depths to boundaries between different velocity zones were estimated, stratigraphic correlations were assigned, and a full-scale geophysical survey was subsequently performed. The full-scale geophysical survey consisted of one (1) vertical seismic profile and 10 horizontal seismic surveys. Eight (8) of the profiles were oriented across the valley floor and two (2) profiles were oriented approximately parallel to the valley floor (i.e., perpendicular to the other profiles). The data were used to select the monitoring well locations for the installations described in this Report (Tetra Tech, 2006a).

1.3.10 2005 Downgradient Monitoring Well Installation Program

In November 2005, Tetra Tech prepared a letter work plan describing proposed activities to install downgradient groundwater monitoring wells approximately 0.5 miles south of the TT-MW2-4S/D well nest. The work plan was subsequently approved in a letter from the DTSC dated November 16, 2005.

In November and December 2005, Tetra Tech installed three (3) groundwater monitoring wells (TT-MW2-5, TT-MW2-6S and TT-MW2-6D) south of the TT-MW2-4S/D well nest. The newly installed monitoring wells were sampled as part of the Fourth Quarter 2005 groundwater monitoring activities. A report and supplemental work plan documenting the field activities, results of the groundwater sampling and proposed additional well installations was provided in the *Installation and Sampling of Downgradient Groundwater Monitoring Wells (TT-MW2-5 and TT-MW2-6S/D) Letter Report and Revised Supplemental Downgradient Well Installation Letter Work Plan* (Tetra Tech, 2006a).

1.3.11 Groundwater User Survey

A groundwater user survey was conducted for the properties located south (topographically down-gradient) of the Site. Based on data obtained from United States Geological Survey topographic maps, the Western Municipal Water District database, and the California Department of Water Resources records, various private and municipal wells were identified that had been used for domestic, irrigation, or agricultural purposes. Many of these wells were not located during subsequent field visits. However, some wells (and springs that were also reportedly used for domestic uses) were identified on off-Site properties. Between January and February 2007, in coordination with the DTSC, water quality samples were collected from four off-Site properties for perchlorate testing:

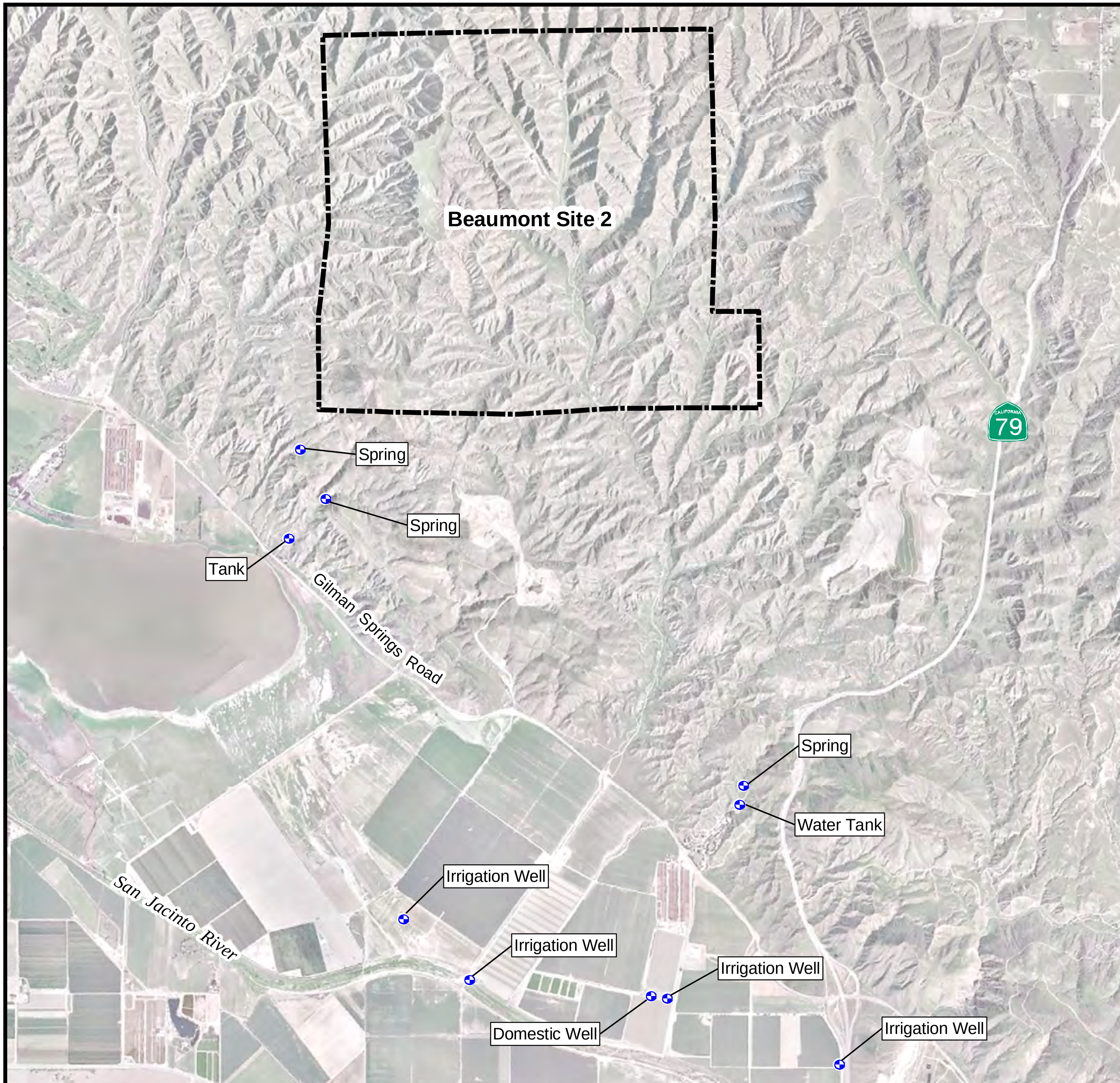
1. Samples were collected from two (2) locations associated with springs that were being used for domestic purposes. Samples were collected from a storage tank and from a valve that tapped water from the spring with 2-inch piping.
2. Samples were collected from two (2) irrigation wells.
3. Samples were collected from two (2) irrigation wells and one (1) domestic well.
4. Samples were collected from a dry spring (i.e., dry at the time of sampling), an active spring, and a tank that formerly was fed by the dry spring. Since the dry spring did not contain water, soil samples were collected for analysis.

All samples were tested for perchlorate using EPA Method 314. Because of its proximity to LMC Beaumont Site 1, in addition, one (1) well was tested for VOCs using EPA Method 8260B. VOCs are a contaminant of concern at nearby LMC Beaumont Site 1. No samples reported perchlorate or VOCs above their respective LRLs. Sampling locations are shown on Figure 1-7.

1.3.12 Soil Investigation at Prism and Ponds Area

Between June and August 2007, soil investigation activities were conducted at the Prism structure and at the locations of possible liquid waste discharge ponds [*Site Investigation Report for Soil Investigations at the Earthen Prism Shaped Structure and Possible Liquid Waste Discharge Ponds at Lockheed Martin Beaumont Site 2* (Tetra Tech 2007d)].

Soil samples were collected from the Prism at eight (8) locations. The objective of the field sampling program was to assess possible affected soil used to construct the Prism and the interior construction of the Prism. The soil samples were analyzed for perchlorate, VOCs, SVOCs, California Assessment Manual (CAM) 17 metals, and asbestos. Concentrations of SVOCs and asbestos were not reported above their respective LRLs in any of the samples collected. Perchlorate was reported in soil samples collected



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Adapted from: I3 Prime World 2D Imagery, 2007.

LEGEND

Sample Location

Beaumont Site 2 Property Boundary

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Beaumont Site 2

Figure 1-7
Off-Site Groundwater Sampling Locations

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X:\GIS\LOCKHEED 20307-03\ OFFSITE WELLS_GW_INST.MXD at concentrations ranging from 19.8 J (where the qualifier "J" represents an estimated value) to 2,950 µg/kg. The VOCs benzene, 2-butanone and toluene were reported in soil samples collected, with total VOC (excluding acetone) concentrations ranging from 6.1 to 18.8 µg/kg. Various metals were detected that will be further evaluated during the forthcoming risk assessment.

The Waste Discharge Area was investigated following the recent discovery of a 1962 waste discharge permit (Tetra Tech, 2007d). The objective of the soil sampling program was to assess the presence of possible affected soil within the Waste Discharge Area and topographically downgradient. Five (5) soil borings were completed to a maximum depth of 30 feet bgs within the Waste Discharge Area. The soil samples were analyzed for perchlorate, VOCs, SVOCs and CAM 17 metals. Based on the laboratory results, perchlorate was detected in four (4) of the five (5) sampling locations ranging from 29.5 to 13,400 µg/kg. The highest concentration was detected in a 25-foot sample collected from the boring referred to as Pond No. 4. No samples were collected below 25 feet bgs in this boring. Concentrations of SVOCs were not reported above their respective LRLs in any of the samples collected at the Waste Discharge Area. The VOCs acetone, benzene, 2-butanone carbon disulfide, methylene chloride, toluene, TCE and m,p-xylenes were reported in soil samples collected with total VOC concentrations ranging from 12.3 to 96 µg/kg. Various metals were detected that will be further evaluated during the forthcoming risk assessment.

Based on the results of the Waste Discharge Area soil investigation, a work plan was prepared which proposes further assessment of perchlorate affected soil and groundwater (Tetra Tech, 2007d). The work plan proposed additional soil sampling to continue assessment of the lateral and vertical extent of affected soil and the installation of four (4) groundwater monitoring wells to evaluate groundwater flow direction and quality in this area.

1.4 GROUNDWATER MONITORING PROGRAM

Quarterly water level measurements and water quality monitoring have taken place at the Site since First Quarter 2005. The current groundwater monitoring program (GMP) includes quarterly groundwater level measurements from all 21 groundwater monitoring wells and one (1) piezometer at the Site, and quarterly water quality monitoring from 16 of the wells, semi-annual water quality monitoring from three (3) of the wells, annual water quality monitoring from one (1) well. One (1) is classified as redundant and not sampled. Water level measurements and sampling are performed in general accordance with procedures described in the January 2007 *Groundwater Sampling and Analysis Plan* prepared by Tetra Tech (Tetra Tech, 2007a) and subsequent correspondences (LMC, 2007), as approved by DTSC. Groundwater samples are analyzed for VOCs, Title 22 metals, and perchlorate. Selected testing for general minerals is also performed. Tabular summaries of groundwater monitoring analytical results are presented in Appendix A.

Section 2.0

Field Methodology

2.0 FIELD METHODOLOGY

This section discusses the technical approach and objectives, site preparation activities, soil boring and sampling, well installation, well development and initial groundwater sampling, investigation-derived waste (IDW) handling, and surveying activities. A *Groundwater Monitoring Well Installation Work Plan* (Work Plan), dated April 2006, outlined the proposed subsurface investigation program (Tetra Tech, 2006b). In a letter dated 16 May 2006, the Work Plan was approved by the DTSC.

2.1 OBJECTIVES AND TECHNICAL APPROACH

The objectives of the investigation program were: to continue assessment of the lateral and vertical extents of perchlorate and TCE affected groundwater, and obtain additional information on the groundwater flow patterns at the Site.

To attain these objectives, 13 soil boring/monitoring well locations and one (1) piezometer location were selected across the Site. The final location of each well was determined in the field and was based on environmental constraints and short-term/long-term access. Seismic survey data were reviewed to estimate unit contact depths and thicknesses. The data were used to identify areas where groundwater is likely to accumulate (e.g., thicker alluvium/weathered bedrock layers) and evaluate possible flow pathways. Wells were also installed at the southernmost property boundary to evaluate potential off-Site migration of affected groundwater. Table 2-1 presents a summary of the installed monitoring wells and screen interval rationale. Figure 2-1 shows all newly-installed well and piezometer locations at the Site.

Additionally, soil samples were collected for perchlorate analysis from the proposed monitoring well and piezometer locations to evaluate perchlorate soil concentrations in the vicinity. Three (3) soil samples were generally collected at each location: shallow, intermediate, and deep. The shallow sample was generally collected between 5 and 6.5 feet bgs, the deep sample was collected immediately above the first water-bearing zone, and an intermediate sample was collected at the relative mid-point between the shallow and deep samples. Depths of the intermediate and deep samples varied between borings, depending on the depth of the first water-bearing zone. Soil samples were analyzed for perchlorate using EPA Method 314.0.

Well screen intervals were determined based on inspection of soil cores for degree of moisture. While some soil cores showed obvious signs of saturation, others were only moist or damp. Due to the low hydraulic conductivities in the known water-bearing zones, borings were often left open for up to 12 hours to determine if free water was present and a well could be constructed.

Table 2-1 Summary of Monitoring Well Locations Beaumont Site 2

Monitoring Well Location (1)	Location (2)	HSU Screened	Comments
TT-MW2-7	Installed south of Area L downgradient from TT-MW2-5 and TT-MW2-6S/D. This location is just north of the southern property line of the Site.	QAL / wSTF	Perchlorate detected in wells TT-MW2-5 and TT-MW2-6S. Installed well above STF to evaluate water quality in QAL / wSTF downgradient of wells TT-MW2-5 and TT-MW2-6S/D and lateral variability of perchlorate plume at Site boundary.
TT-MW2-8	Installed south of Area L downgradient from TT-MW2-5 and TT-MW2-6S/D. This location is just north of the southern property line of the Site.	QAL / wSTF	Perchlorate detected in wells TT-MW2-5 and TT-MW2-6S. Installed well above STF to evaluate water quality in QAL / wSTF downgradient of wells TT-MW2-5 and TT-MW2-6S/D and lateral variability of perchlorate plume at Site boundary.
TT-MW2-9S and TT-MW2-9D	Installed downgradient of Historical Operational Areas L and M and upgradient of TT-MW2-5 and TT-MW2- 6S/D.	QAL / wSTF and STF	Perchlorate detected in QAL / wSTF well in Area L and soil in Area M (Tetra Tech, 2005a). Installed well above STF to evaluate water quality in QAL / wSTF downgradient of Areas L and M. Installed second well to evaluate water quality in the STF and the hydraulic communication between the QAL / wSTF and the STF.
TT-MW2-10	Installed well in Area L near wells TT-MW2-4S/D.	QAL / wSTF	Installed well at a shallower depth to screen the QAL / wSTF HSU near STF screened wells TT-MW2-4S/D.
TT-MW2-11	Installed in Area M downgradient of former Garbage Disposal Area.	QAL / wSTF	Perchlorate detected in soils at former Garbage Disposal Area (Tetra Tech, 2005a). Installed well above STF to evaluate water quality in QAL / wSTF downgradient of former Garbage Disposal Area.
TT-MW2-12	Installed in Area L downgradient of TT-MW2-1.	STF	Perchlorate detected in QAL / wSTF well TT-MW2-1. Installed well at first observed water to evaluate water quality downgradient of well TT-MW2-1.
TT-MW2-13	Installed in Area K downgradient from TT-MW2-3 and upgradient of TT-MW2-1.	QAL / wSTF	Perchlorate detected in QAL / wSTF wells TT-MW2-1 and TT-MW2-3. Installed well above STF to evaluate water quality in QAL / wSTF upgradient of TT-MW2-1 and downgradient of well TT-MW2-3.
TT-MW2-14	Installed in Area K downgradient from TT-MW2-3.	QAL / wSTF	Perchlorate and TCE detected in well TT-MW2-3. Installed well to evaluate water quality downgradient of well TT-MW2-3.
TT-MW2-16	Installed in Area J adjacent to TT-MW2-2, downgradient from former Building 250.	QAL / wSTF	TT-MW2-2 is screened in STF and may not be monitoring first water. Installed well in QAL / wSTF to evaluate first water quality downgradient of former Building 250.
TT-MW2-17 S/D	Installed a set of nested wells in Area K adjacent to well TT-MW2-3 (proposed to be destroyed).	QAL / wSTF and QAL / wSTF	Perchlorate and TCE detected in well TT-MW2-3. Installed nested well to evaluate vertical distribution of impacts in area of well TT-MW2-3.
TT-MW2-18	Installed well in Area L adjacent to well TT-MW2-1.	STF	Perchlorate detected in QAL / wSTF well TT-MW2-1. Installed well below QAL / wSTF to evaluate water quality in STF below well TT-MW2-1.
TT-PZ2-1	Installed piezometer south of Area L downgradient from TT-MW2-5 and TT-MW2-6S/D.	QAL / wSTF	The piezometer will be used to evaluate groundwater flow conditions in the QAL / wSTF at the southern property boundary. The piezometer will be used for water level measurements only.

Notes:

(1) - Proposed monitoring well TT-MW2-15 was not installed, see subsection 3.1.3.

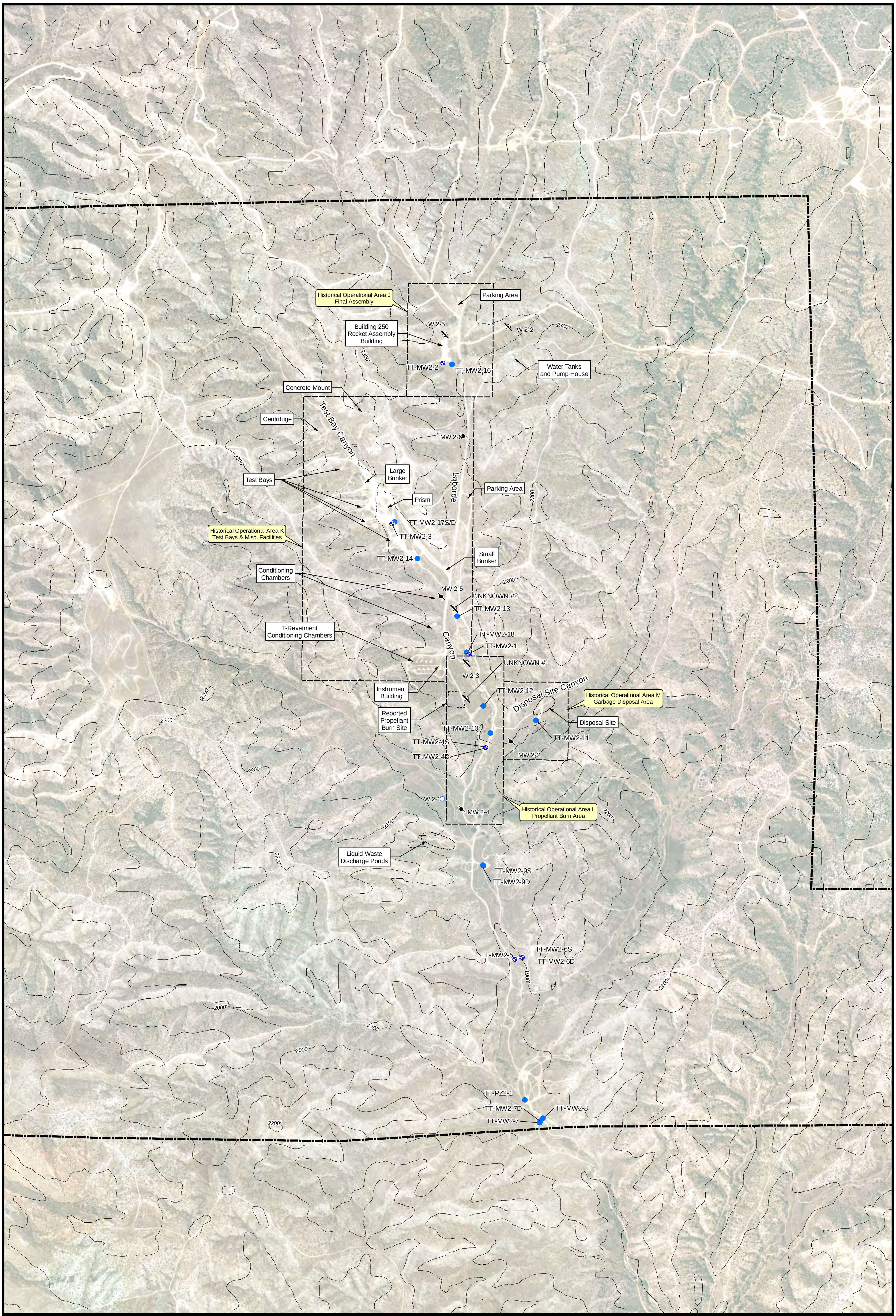
(2) - “Upgradient’ and “downgradient” directions are based on topography and overall groundwater elevations.

HSU - Hydrostratigraphic Unit.

QAL - Quaternary alluvium.

wSTF - Weathered San Timoteo Formation.

STF - San Timoteo Formation.



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LEGEND

- Newly Installed Groundwater Monitoring Well/ Piezometer Location
- Groundwater Monitoring Well Location
- Inactive Production Well Location
- Destroyed Production Well Location
- Reported Production Well Location
- Destroyed Monitoring Well Location
- Beaumont Site 2 Property Boundary
- Topographic Contour (100-foot interval)

Adapted from: April 2007 aerial photograph.

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

0 500 1,000
Feet

Beaumont Site 2

Figure 2-1
Newly Installed Monitoring Wells and Piezometer Locations

TETRA TECH

Following development, all wells were sampled for perchlorate and VOCs. Laboratory analysis of 1,4-dioxane, hexavalent chromium, metals, SVOCs, explosives and general minerals were also performed on selected samples. In general, the monitoring wells selected for additional analyses were the farthest downgradient wells (TT-MW2-7 and TT-MW2-8), the well downgradient of the disposal area in Area M (TT-MW2-11), a well located in Area L [TT-MW2-12] and a well downgradient of the test bays and earthen prism in Area K (TT-MW2-14).

2.2 FIELD INVESTIGATION PROGRAM

Field activities were conducted as outlined in the Work Plan (Tetra Tech, 2006b). The field activities at the Site included soil boring and sampling, installation, development and initial groundwater sampling of 13 groundwater monitoring wells and installation of one (1) piezometer, well, and surveying activities.

2.2.1 Site Preparation Activities

Prior to initiating field activities, a biological survey of the surrounding area of each proposed well location was performed by a Section 10A permitted or sub-permitted biologist to evaluate the potential for impacts during field activities to sensitive species/habitats including the Stephen’s Kangaroo Rat (SKR). As part of the biological survey, the biologist identified and marked potential or suspected SKR burrows located in the vicinity of each borehole location to avoid the potential “take” (i.e., harm, harassment, and/or death) of SKR. The biologist marked ingress and egress routes to each well location in an effort to minimize the overall footprint of field activities and impacts to SKR habitat. After surveying the work areas, the biologist remained on-Site during field activities to implement requirements of the approved Habitat Conservation Plan (USFWS, 2005) and subsequent clarifications (LMC, 2006a and 2006b).

Prior to field work, well installation permits were obtained from the County of Riverside Department of Environmental Health (Appendix B).

The proposed drilling locations were marked with wooden stakes, and Underground Service Alert was contacted prior to the commencement of field activities to identify underground utility and service lines. As an added precaution, prior to drilling, the boring location was hand-augered to 5 feet bgs to prevent damage to drilling equipment from unidentified shallow subsurface obstructions. No obstructions were encountered during the hand-augering process and drilling operations proceeded as planned at all proposed locations.

2.2.2 Soil Boring and Sampling

Borings were drilled using a combination of hollow stem auger (HSA) and sonic drilling methods. In general, HSA drilling was used to install wells in the QAL/wSTF, and sonic drilling was used to install monitoring wells in the more competent STF and in areas where vertical migration of affected groundwater during drilling might be an issue. While air-rotary casing hammer was proposed in the Work Plan, sonic drilling was preferred in order to obtain detailed lithologic information through continuous coring. This method is better suited to potentially identify the transitions from QAL to wSTF to STF and allow better selection of screened intervals for wells.

Soil samples from HSA drilling were collected at approximately 5-foot intervals using a California split-spoon sampler lined with sleeves. Soil samples from sonic drilling, in the form of a continuous core, were collected in the core barrel as the borehole was advanced under a controlled vibration and discharged into plastic sample bags.

During borehole advancement, select soil samples were collected for lithologic characterization, headspace analysis, and laboratory analysis. Undisturbed soil samples were collected by driving a split-spoon sampler ahead of the augers or collected from a continuous core. A detailed log of the drilling activities and materials encountered was compiled and maintained by the on-Site geologist/hydrogeologist. Soil samples were analyzed for perchlorate by EMAX Laboratories, Inc. (EMAX), a State Certified Laboratory, using EPA Method 314.0, Modified.

Soil samples from boreholes were logged for percent recovery and soil type, using the Unified Soil Classification System. Information recorded on the boring log includes name of driller, name of geologist, drilling method, bit size, approximate sample interval, organic vapor analyzer (OVA) readings, odors, color, discolorations, and location. Copies of the boring logs are presented in Appendix C.

Augers, bits and casing were pressure washed with hot water prior to use and between each boring location. The split-spoon sampler was washed in a solution of soap (non-phosphate) and clean tap water, rinsed in clean tap water, and final rinsed in distilled water between each sample. Water from decontaminating sampling equipment was stored in 55-gallon U.S. Department of Transportation (DOT) 17H drums on-Site pending characterization and subsequent disposal.

2.2.3 Monitoring Well Installation

Tetra Tech retained WDC Exploration & Wells, of Montclair, California to drill and construct the 13 monitoring wells and one (1) piezometer. One (1) proposed well was not installed (TT-MW2-15) since no obvious water-bearing zone was encountered within the QAL/wSTF. In its place, monitoring well TT-MW2-9D was installed, serving as a deep well clustered with TT-MW2-9S. Overall, a total of 10 monitoring wells and one (1) piezometer were screened in the QAL or wSTF, while three (3) monitoring wells were screened in the STF.

The monitoring wells were installed in general accordance to the Work Plan (Tetra Tech, 2006b) and modified, as necessary, based on data collected during the advancement of each boring (i.e., lithologic information obtained from the cores/cuttings generated during borehole drilling). The monitoring wells were designed by the on-Site geologist/hydrogeologist and the supervising Professional Geologist or Engineer.

Monitoring wells were constructed vertically with the well string suspended in place during construction. Each well was constructed with 4-inch Schedule 40 flush threaded polyvinyl chloride (PVC) and a screen slot size of 0.020, with the exception of monitoring well nest TT-MW2-17S/D and piezometer TT-PZ2-1 which were constructed of 2-inch Schedule 40 flush threaded PVC. Blank PVC was placed from above the top of the screened interval to approximately three (3) feet above the surface grade. Filter pack material was placed in the annulus around the outside of the well screen and extended approximately two (2) feet above the top of the well screen. Prior to placing the bentonite seal, the filter pack was surged to ensure proper filter pack placement and to avoid bridging during well installation. A sanitary seal was installed using bentonite chips placed in the annulus between the PVC well casing and the borehole wall, and hydrated in place. The screen and filter pack were swabbed prior to placement of the seal to consolidate the filter pack material. After the bentonite seal hydrated, the remaining annulus was grouted using a cement/bentonite mixture. Each monitoring well, monitoring well nest and piezometer was completed with an above ground protective steel monument with a locking lid, and set in place with a 3-foot square concrete apron. Locks were installed on the locking lids to prevent vandalism of the wells. A summary of well construction details is presented in Table 2-2, and detailed well logs are presented in Appendix D.

2.3 MONITORING WELL DEVELOPMENT

Each newly installed monitoring well was developed no sooner than 48 hours following well completion. Groundwater Monitoring Well Development Field Data Sheets are presented in Appendix E.

The wells were developed using a combination of bailing, swabbing, surging, and pumping. The wells were initially bailed until most of the settleable solids had been removed. The well casing bottoms were then probed to confirm the total depth of the well. The wells were swabbed using a surge block to flush fine-grained materials from the filter pack. After swabbing, the fine-grained materials that had accumulated inside the well casings were bailed from the wells until most of the settleable solids were removed. The well casing bottoms were then probed a second time. After two (2) or more bailing periods, if the well recharged at a sufficient rate and turbidity levels were low (so as to not run dry or

Table 2-2 New Well Construction Summary Beaumont Site 2

Well ID	Date Installed	Well Type	HSU	Ground Surface Elevation (feet msl)	TOC Elevation (feet msl)	Depth to TOS (feet bgs)	Depth to BOS (feet bgs)	Screen Length (feet)	Depth of Well (feet bgs)	Depth of Borehole (feet bgs)	Borehole Diameter (inches)	Casing Diameter (inches) and Material	Screen Slot Material and Size (inches)	Drilling Method	Filter Pack	Northing Coordinate	Easting Coordinate
TT-MW2-7	08/21/06	M	Q/W	1836.99	1839.25	11.5	26.5	15.0	26.5	29.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/12	2268227.74	6326158.83
TT-MW2-8	08/22/06	M	Q/W	1833.43	1836.32	13.5	23.5	10.0	23.5	31.5	10	4 PVC	PVC 0.020	HSA	Lonestar #2/12	2268277.35	6326195.41
TT-MW2-9S	08/29/06	M	Q/W	1935.46	1938.38	29.0	44.0	15.0	44.4	46.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2271079.03	6325536.53
TT-MW2-9D	08/28/06	M	STF	1936.00	1938.78	64.6	69.6	5.0	70.0	70.5	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2271087.05	6325529.52
TT-MW2-10	09/13/06	M	Q/W	1999.04	2001.57	42.1	57.1	15.0	57.5	61.5	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2272551.89	6325612.71
TT-MW2-11	08/31/06	M	Q/W	2001.82	2004.51	44.2	54.2	10.0	54.6	55.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2272694.04	6326119.79
TT-MW2-12	09/05/06	M	STF	2013.12	2016.26	49.0	59.0	10.0	59.4	60.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2272851.92	6325533.11
TT-MW2-13	09/12/06	M	Q/W	2045.89	2049.39	60.0	70.0	10.0	70.4	72.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/16	2273848.43	6325243.90
TT-SB2-14	Borehole abandoned	NA	NA	2071.80	NA	NA	NA	NA	NA	66.0	10	NA	NA	HSA	NA	2274489.3	6324803.86
TT-MW2-14	11/07/06	M	Q/W	2073.58	2076.23	66.0	71.0	5.0	71.0	77.2	7 5/8	4 PVC	PVC 0.020	Sonic	Lonestar #2/16	2274484.91	6324807.33
TT-SB2-15	Borehole abandoned	NA	NA	2121.30	NA	NA	NA	NA	NA	54.0	10	NA	NA	HSA	NA	2275763.33	6324047.12
TT-MW2-16	08/25/06	M	Q/W	2135.19	2137.2	56.5	66.5	10.0	66.8	71.0	10	4 PVC	PVC 0.020	HSA	Lonestar #2/12	2276648.22	6325185.27
TT-MW2-17S	11/03/06	M	Q/W	2092.1	2097	65.0	75.0	10.0	75.0	105.0	7 5/8	2 PVC	PVC 0.020	Sonic	Lonestar #2/16	2274898.05	6324549.63
TT-MW2-17D	11/03/06	M	Q/W	2092.1	2096.78	94.0	99.0	5.0	99.0	105.0	7 5/8	2 PVC	PVC 0.020	Sonic	Lonestar #2/16	2274898.22	6324549.79
TT-MW2-18	09/13/06	M	STF	2032.52	2035.32	93.1	98.1	5.0	98.4	102.0	7 5/8	4 PVC	PVC 0.020	Sonic	Lonestar #2/16	2273448.87	6325348.60
TT-PZ2-1	08/23/06	PZ	Q/W	1844.00	1847.06	14.3	34.3	20.0	34.7	40.5	10	2 PVC	PVC 0.020	HSA	Lonestar #2/12	2268479.29	6325996.01

Notes:

msl - Mean sea level.
bgs - Below ground surface.
HSA - Hollow stem auger.
HSU - Hydrostratigraphic unit.
M - Monitoring well.
NA - Not applicable.
PZ - Piezometer.
PVC - Polyvinyl chloride.
Q/W - Quaternary alluvium / weathered STF.
SS - Stainless steel.
STF - San Timoteo Formation.
TOC - Top of casing.
TOS - Top of screen.
BOS - Bottom of screen

damage the submersible pump), a submersible pump was placed inside the wells and the well pumped. During pumping, the pump was turned off several times until the purge water was relatively clear and free of suspended solids. The purpose of this is to surge the filter pack and mobilize any fine-grained sediments still trapped in the filter pack. However, except in the case of well TT-MW2-17D, this pumping was not able to be performed because recharge rates were generally very slow and turbidity levels remained high, especially for those wells screened in the QAL/wSTF.

During pumping and bailing, water quality parameters consisting of pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), and turbidity were monitored and recorded on the Groundwater Monitoring Well Development Field Data Sheet. After water quality parameters have stabilized (i.e., pH ± 0.1 pH units, EC ± 5 percent of previous readings, temperature ±1°C, DO ±0.3 milligrams per liter [mg/L], and, if possible, turbidity ≤ 5 nephelometric turbidity units [NTUs]), then the submersible pump was turned off and removed from the monitoring well. Development equipment was decontaminated in the same manner as the water sampling equipment (described in subsection 2.4).

As described in the Work Plan (Tetra Tech, 2006b), as part of well development, water level measurements and pumping rates (if sustainable) were also recorded on the Groundwater Monitoring Well Development Field Data Sheet to calculate the specific capacity of the well. Pumping rates were measured using either the bucket/stopwatch method or an in-line flow meter. The volume (in gallons) pumped during development were calculated based on the average pumping rate and the total time the well was pumped. The water level draw down achieved by the end of the purging divided by the total gallons pumped was recorded on the logging sheet.

2.4 GROUNDWATER MONITORING

Depth to groundwater was measured in all wells. Measurements were recorded to the nearest 0.01 feet. Well purging and sampling was conducted no sooner than 72 hours after well development to allow the monitoring wells to stabilize after the agitation and aeration caused by development activities. Groundwater samples were collected from monitoring wells using a peristaltic or submersible purge pump or a disposable bailer. Field instruments and equipment were properly maintained, calibrated, and operated based on manufactures guidelines and recommendations. Daily field calibration logs were maintained as part of groundwater monitoring and sampling activities. Groundwater monitoring and sampling procedures are described in the following paragraphs.

Equipment blanks were collected prior to sampling the first well of the day. After decontaminating the pump and discharge line, distilled water was pumped through the system. When two (2) hose volumes have been allowed to clear the lines, the equipment blank samples were collected.

After the equipment blanks were collected, groundwater sampling activities could begin. Monitoring wells were sampled in order of (suspected) increasing contamination on each day and throughout the sampling event. The submersible purge pump was placed at wetted midpoint of the screen or at depth of maximum draw down. An indication of expected well performance can be obtained from the well development field sheets.

Purging and sampling were performed in a manner that minimized the agitation of sediments in the monitoring well and formation. Pumping began at a rate no greater than 0.5 gallons per minute. After pumping at least one (1) hose volume, the first set of water quality readings and water level measurements were taken.

After taking the first set of water quality parameters and water level measurements, readings were taken at 5-minute intervals. The groundwater samples were collected after a minimum of six (6) readings (water quality parameters) of which the water quality parameters had stabilized within the last three (3) readings. Stabilization of parameters is as follows: temperature ± 1°C, pH ± 0.1 unit, EC ± 5%, turbidity <5 NTUs, DO ± 0.3 mg/L, and static water level 0.1 foot. Reasonable attempts were made to minimize the drawdown in the well to less than 0.33 feet.

If these parameters did not stabilize, purging was continued until stabilization was achieved or until the monitoring well was pumped dry. If the well was pumped dry, the well was sampled with a disposable bailer after sufficient recharge had taken place to allow sampling.

Groundwater samples collected were analyzed by EMAX. Groundwater samples were analyzed for VOCs (EPA Method 8260), Title 22 Metals (EPA Methods 6010/7000), and perchlorate (EPA Method 314.0).

Based on the reported historical presence of UDMH (subsection 1.1) in the former Garbage Disposal Area (Area M), groundwater samples collected from monitoring well TT-MW2-11 were also analyzed for NDMA (Method 1625B Modified), since it is commonly associated with the gas UDMH. The historical record did not indicate that NDMA was used at the Site. NDMA was analyzed for because, although no liquid rocket fuel motors were reportedly tested at the Site, a small bottle of UDMH was found at the former landfill. It was reportedly disposed of there by a sub-lessee conducting testing at the Site. NDMA can be found in a variety of compounds including meats, fertilizers, cutting oils, tobacco smoke, herbicides, pesticides, rubber products, and various drugs formulated with aminopyrine. NDMA is also a breakdown product of hydrazine and UDMH. NDMA was tested for because it is a breakdown product of UDMH. Analytical methods for ammonia and formaldehyde have relatively high detection limits in the mg/l range. To look for potential sources of UDMH at Beaumont Site 2, groundwater samples were analyzed for NDMA because the detection limit for this analytical method is much lower than for ammonia and formaldehyde. In addition, NDMA is much more toxic and presents a much higher risk if encountered. Based on this, groundwater samples were collected and samples were analyzed for NDMA from 5 wells located at key locations around Site 2 including the landfill.

Select groundwater monitoring wells located in strategic locations across the Site were also tested for 1,4-dioxane, hexavalent chromium, SVOCs, and explosives. All of the wells on the Site were tested for general minerals. Table 2-3 lists the well sampled and analytical methods.

Groundwater samples were placed into glass or plastic jars prepared for the specified analysis as described by the method. A borosilicate micro fiber was used as a prefilter to remove suspended particulate matter, as required. Groundwater samples were collected in order of decreasing volatilization potential as follows:

- Volatile organics;
- Semi-volatile organics; and
- Inorganics (perchlorate, metals, and general water chemistry).

A sample identification label was affixed to each sample container and sample custody was maintained by a chain-of-custody record. Collected samples were chilled and transported to EMAX, via courier, thus maintaining proper temperatures and sample integrity. Trip blanks (LTBs, designated “L” for LMC) and equipment blanks (LEBs) were collected to assess cross-contamination potential of water samples while in transit and/or via sampling equipment.

Decontamination procedures were completed after each monitoring well had been sampled. Purge equipment, including pumps and discharge lines, were decontaminated by flushing/pumping an Alconox/water or equivalent solution, potable water, then deionized water through the components. Lifting lines were washed with an Alconox/water or equivalent solution and rinsed with potable and deionized water. Measuring equipment, such as thermometers or conductivity probes, were rinsed with deionized water prior to each use and between sampling points.

Discarded materials, including towels and decontamination fluids, were stored in DOT approved 55-gallon drums for disposal in accordance with applicable regulations, following chemical characterization and evaluation of disposal options.

Table 2-3 Sampling Schedule and Analysis Methods – Groundwater Beaumont Site 2

Monitoring Well Location	Perchlorate (EPA 314.1)	VOCs (EPA 8260B)	SVOCs (EPA 8270C)	1,4-Dioxane (EPA 8270 SIM)	Metals (EPA 6010B and 7470A)	Explosives (EPA 8330)	Hexavalent Chromium (EPA 218.6)	N-Nitroso-dimethylamine (EPA 1625 B modified)	Total Dissolved Solids (EPA 160.1)	Anions (EPA 300.0)	Alkalinity (EPA 2320 B)
TT-MW2-1									X	X	X
TT-MW2-2									X	X	X
TT-MW2-3									X	X	X
TT-MW2-4S									X	X	X
TT-MW2-4D									X	X	X
TT-MW2-5									X	X	X
TT-MW2-6S									X	X	X
TT-MW2- 6D									X	X	X
TT-MW2-7	X	X	X	X	X	X	X	X	X	X	X
TT-MW2-8	X	X	X	X	X	X	X	X	X	X	X
TT-MW2-9S	X	X							X	X	X
TT-MW2- 9D	X	X							X	X	X
TT-MW2-10	X	X							X	X	X
TT-MW2-11	X	X	X	X	X	X		X	X	X	X
TT-MW2-12	X	X	X	X	X	X		X	X	X	X
TT-MW2-13	X	X							X	X	X
TT-MW2-14	X	X	X	X	X	X		X	X	X	X
TT-MW2-16	X	X							X	X	X
TT-MW2-17S	X	X							X	X	X
TT-MW2-17D	X	X							X	X	X
TT-MW2-18	X	X							X	X	X

Total Sample Locations: 21
Total Samples Collected: 21
Sample Locations Not Accessible: 0
Dry Sample Locations: 0

Notes:

EPA - United States Environmental Protection Agency.
MS / MSD - Matrix Spike / Matrix Spike Duplicate.
QA / QC - Quality Assurance / Quality Control.
SVOCs - Semi-volatile organic compounds.
VOCs - Volatile organic compounds.

During Fourth Quarter 2006, dedicated submersible groundwater sampling pumps were installed in all of the newly installed monitoring wells, except the TT-MW2-17S/D nest. Well nest TT-MW2-17S/D was not yet completed and therefore dedicated submersible groundwater sampling pumps were installed in Second Quarter 2007.

2.5 INVESTIGATION-DERIVED WASTE HANDLING AND DISPOSAL

IDW including soil cuttings from boreholes, groundwater from development of the newly constructed groundwater monitoring wells, groundwater from purging prior to sampling wells, decontamination fluids, and disposable protective clothing and supplies was placed in 94 labeled DOT approved 55-gallon drums and disposed of off-Site following completion of field activities. General procedures employed for containerizing, temporarily storing, sampling and evaluating analytical results, and transporting/disposing of IDW are discussed below. Waste disposal manifests and the laboratory analytical data package are presented in Appendix F.

2.6 SURVEYING

Upon completion of well installation activities, a survey of the monitoring well locations and elevations was performed by Hillwig-Goodrow LLC, a California-certified land surveyor. Each well location was surveyed for vertical and horizontal coordinates based on the California State Plane Coordinate System, Zone 5, using NAGVD88 datum for vertical control and NAD83 datum for horizontal control. At each well location, a measuring or reference point was clearly marked on the top rim of the casing on the north side. Two (2) elevations were then surveyed at each well location, one (1) at the measuring point and the other at the ground surface adjacent to the well monument. Elevations of the casing were surveyed to the nearest 0.01 foot and elevations of the ground surface were measured to the nearest 0.01 foot, referenced to msl. The resulting horizontal coordinates, expressed as northings and eastings (in feet), and vertical coordinates (elevation in feet above msl) for each well are provided in Table 2-2. A copy of the survey data from the licensed land surveyor is included in Appendix G.

Section 3.0

Results of Field Activities

3.0 RESULTS OF FIELD ACTIVITIES

This section presents the results of the investigation activities conducted.

3.1 SITE LITHOLOGY

The soil borings showed a stratigraphic sequence consisting (from top to bottom) of QAL, wSTF, and the more competent STF. The QAL consists of light brown to light olive gray, silty sand, poorly to well graded, with occasional gravels, pebbles, oxide mottling. The wSTF consists of light brown to shades of gray, poorly graded silty sand and/or highly weathered, friable, poorly indurated silty sandstone to sandy siltstone fragments with occasional fine gravels, clays, oxide staining. The STF consists of light brown to shades of gray, friable, poorly indurated sandstones, silty sandstones, siltstones and/or silty claystones. Each formation exhibited a weak to strong hydrochloric acid (i.e., HCl) reaction.

Based on the results of the soil borings, the thickness of the QAL ranges from about 10 feet in the southern portion of the Site to 50 feet thick along Test Bay Canyon and Northern Laborde Canyon. The bottom of the STF was not reached during investigations conducted at the Site, but regional literature indicates the STF is estimated to be between 1,500 and 2,000 feet thick (CGB, 2004). The density of the STF investigated varies but it appears to generally increase with depth. A cross section location map is presented in Figure 3-1, and based on the results of the soil borings installed; updated geologic cross sections through the Site are presented in Figures 3-2 and 3-3. No distinctive traceable marker beds were apparent between borings. Copies of the soil boring logs are provided in Appendix C.

At six (6) locations (TT-MW2-9S, TT-MW2-12, TT-MW2-13, TT-SB2-15, TT-MW2-16 and TT-MW2-17S) silty clayey/siltstone/claystone material was observed in the soil samples collected. While this material was observed at several locations, because of the relatively large elevation changes and the generally northward dipping strata encountered at the Site, the extent and significance of this material is not known. Monitoring wells TT-MW2-9S, TT-MW2-16 and TT-MW2-17S were subsequently screened so as not to cross the siltstone/claystone material as it appeared to be a possible confining layer.

3.2 GROUNDWATER ELEVATIONS

Table 3-1 presents groundwater levels measured in the newly installed monitoring wells at the Site in November 2006. Groundwater elevations ranged from approximately 2079 feet msl at upgradient location TT-MW2-16 to 1819 feet msl at downgradient location TT-MW2-8.

3.3 GROUNDWATER FLOW

Groundwater contour maps for the QAL/wSTF HSU and a distribution of groundwater elevations for the STF HSU groundwater levels measured in the newly installed wells are presented in Figures 3-4 and 3-5.

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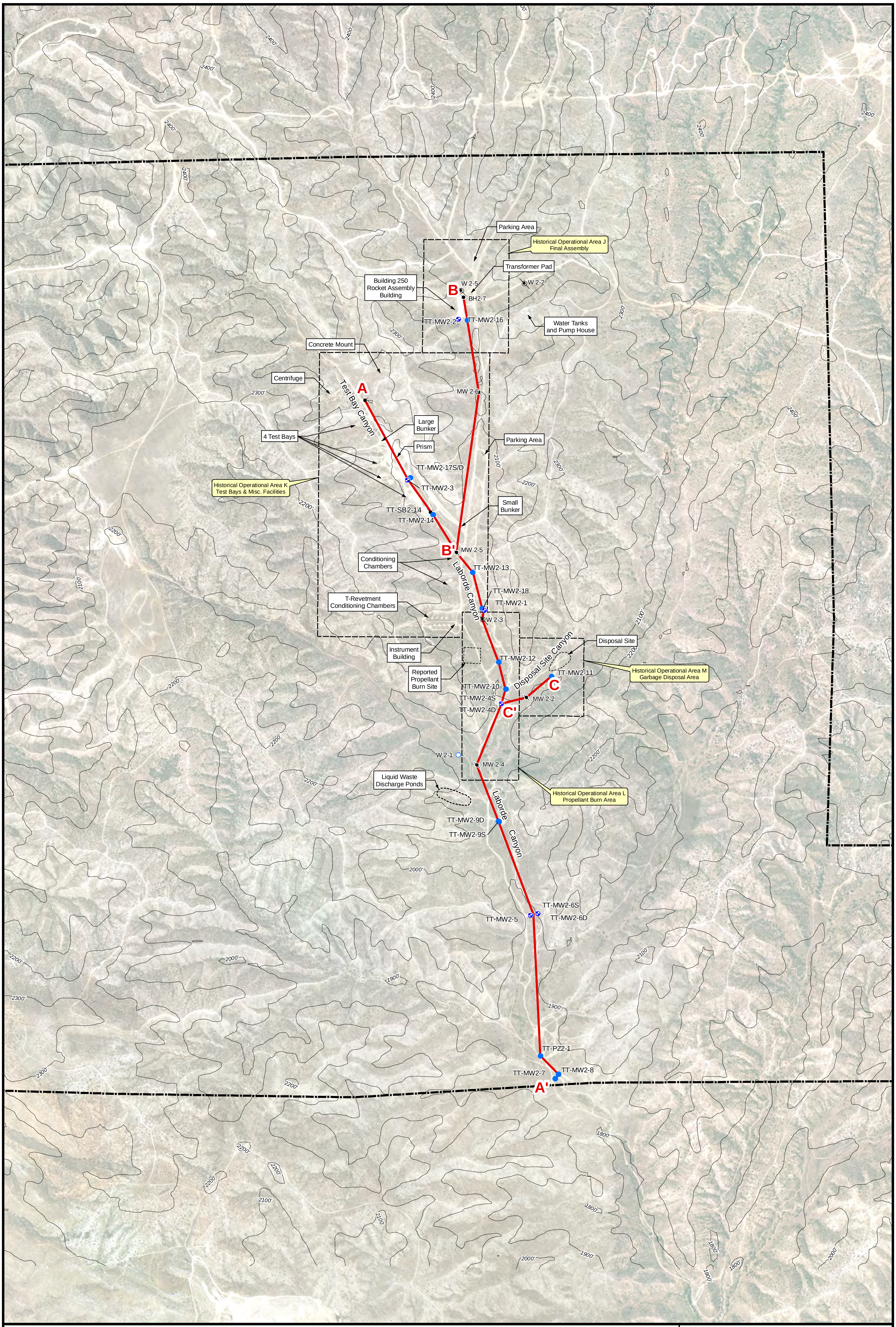


LEGEND

- Newly Installed Groundwater Monitoring Well/ Piezometer Location
- Groundwater Monitoring Well Location
- Reported Production Well Location
- Destroyed Production Well Location
- Abandoned Soil Boring
- Destroyed Monitoring Well Location
- Cross Section Location
- Historical Operational Area Boundary
- Beaumont Site 2 Property Boundary
- 2200 Topographic Contour (100-foot interval)

N

0 500 1,000 Feet

Adapted from: April 2007 aerial photograph.

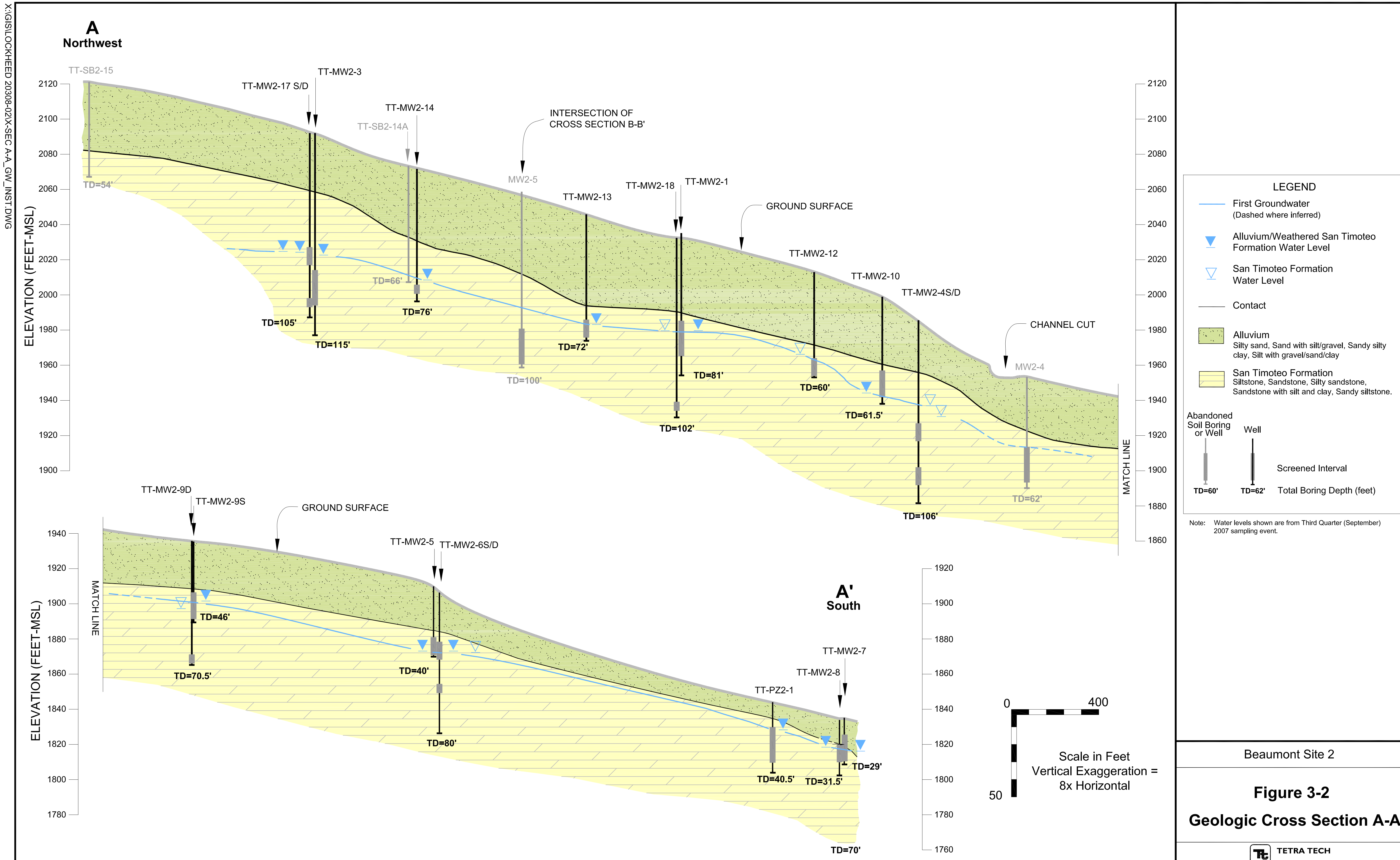
Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Beaumont Site 2

Figure 3-1

Cross Section Location Map with Newly Installed Wells

TETRA TECH



Beaumont Site 2

Figure 3-2

Geologic Cross Section A-A'

TETRA TECH

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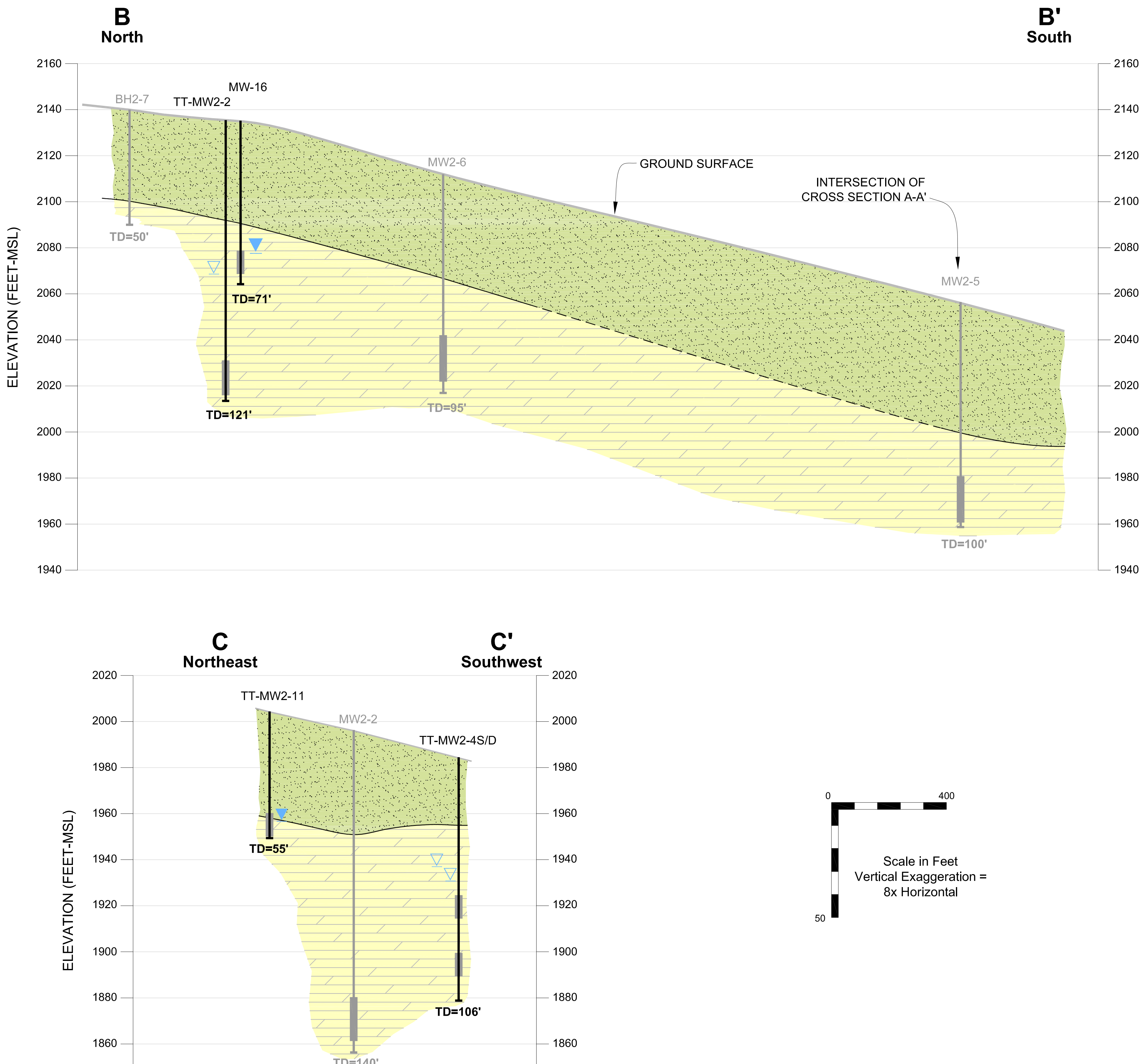

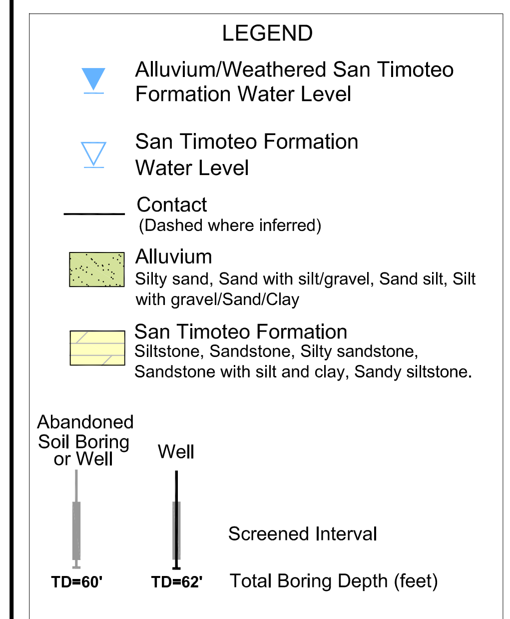

Note: Water levels shown are from Third Quarter (September) 2007 sampling event.

Beaumont Site 2

Figure 3-3
Geologic Cross Sections B-B' and C-C'

TETRA TECH

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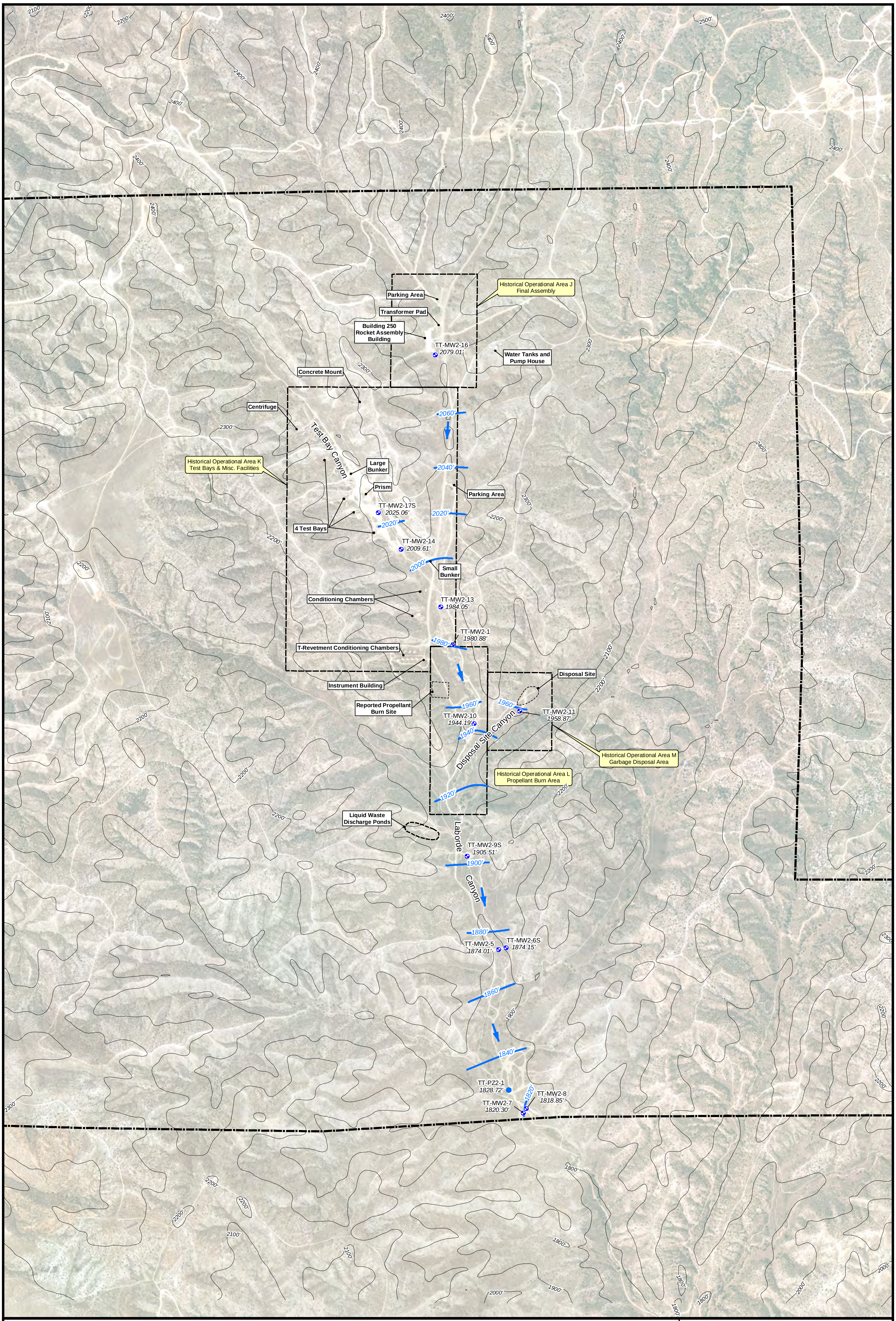

LEGEND

- Groundwater Monitoring Well Location with Elevation (feet msl)
- Piezometer Well Location with Elevation (feet msl)
- Former Historical Operational Area Boundary
- Beaumont Site 2 Property Boundary
- 2200' Topographic Contour (100-foot interval)
- Groundwater Flow Direction

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

20-foot groundwater contour interval.

Groundwater elevation in feet MSL.

0 500 1,000 Feet

Adapted from: April 2007 aerial photograph.

Beaumont Site 2

Figure 3-4

First Groundwater Contours November 2006

TETRA TECH

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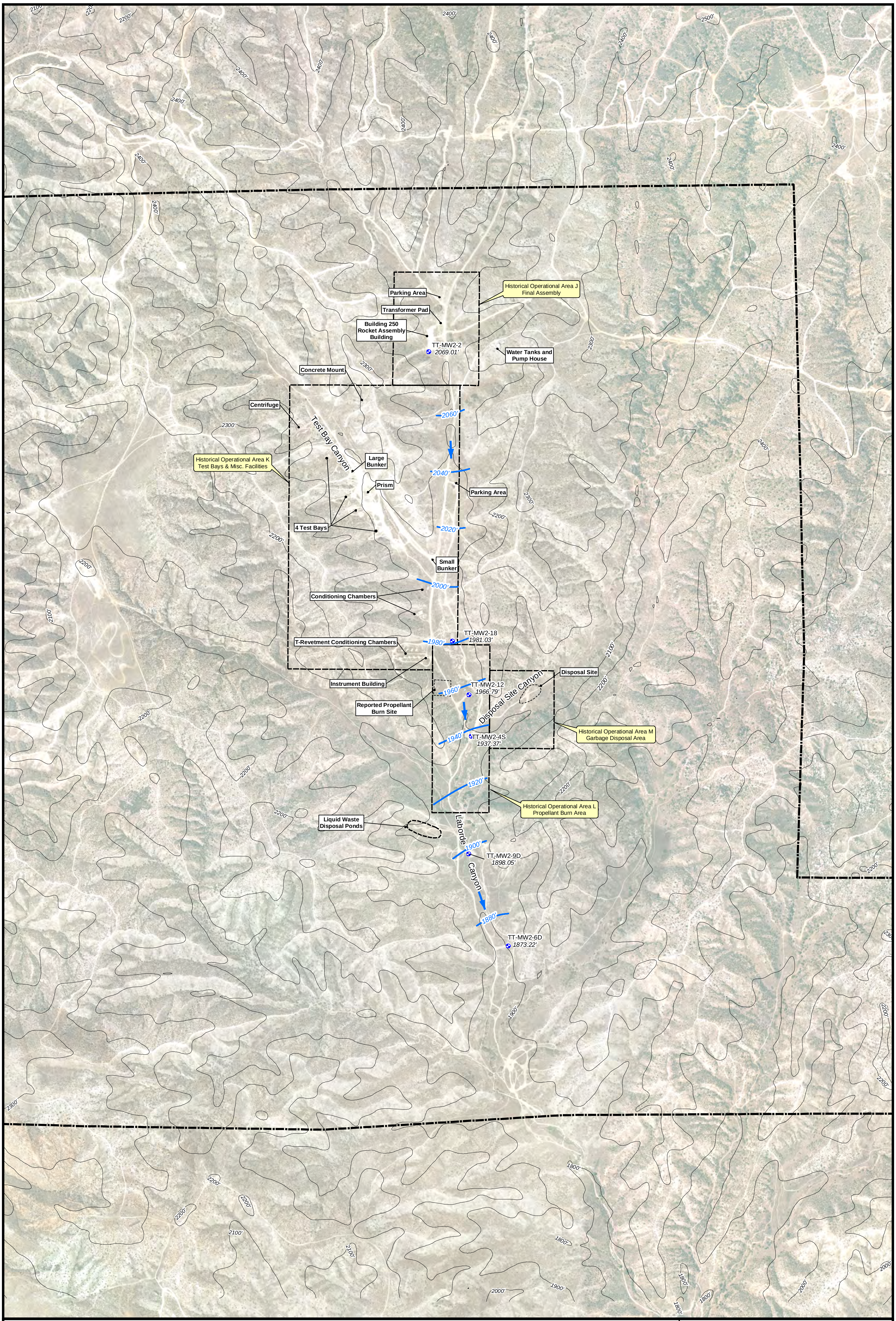

LEGEND

- Groundwater Monitoring Well Location with Elevation (feet msl)
- Former Historical Operational Area Boundary
- Beaumont Site 2 Property Boundary
- 2200' Topographic Contour (100-foot interval)
- Groundwater Flow Direction

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

20-foot groundwater contour interval.

Groundwater elevation in feet MSL.

Quaternary alluvium/Weathered San Timoteo Formation screened wells are not used for contouring.

N

0 500 1,000 Feet

Adapted from: April 2007 aerial photograph.

Beaumont Site 2

Figure 3-5
Groundwater Contours for San Timoteo Formation November 2006

TETRA TECH

Table 3-1 Groundwater Elevation Data, Beaumont Site 2

Well ID	Date Installed	Date Measured	Groundwater Elevation (feet msl)	HSU Screened
TT-MW2-1	09/01/04	11/20/06	1980.88	QAL / wSTF
TT-MW2-2	08/30/04	11/20/06	2069.10	STF
TT-MW2-3	08/31/04	11/20/06	2024.87	QAL / wSTF
TT-MW2-4S	09/07/04	11/20/06	1937.37	STF
TT-MW2-4D	09/07/04	11/20/06	1931.11	STF
TT-MW2-5	12/01/05	11/20/06	1874.01	QAL / wSTF
TT-MW2-6S	12/01/05	11/20/06	1874.15	QAL / wSTF
TT-MW2-6D	12/01/05	11/20/06	1873.22	STF
TT-MW2-7	08/21/06	11/20/06	1820.30	QAL / wSTF
TT-MW2-8	08/22/06	11/20/06	1818.85	QAL / wSTF
TT-MW2-9S	08/29/06	11/20/06	1902.51	QAL / wSTF
TT-MW2-9D	08/28/06	11/20/06	1898.05	STF
TT-MW2-10	09/13/06	11/20/06	1944.19	QAL / wSTF
TT-MW2-11	08/31/06	11/20/06	1958.87	QAL / wSTF
TT-MW2-12	09/05/06	11/20/06	1966.92	STF
TT-MW2-13	09/12/06	11/20/06	1984.05	QAL / wSTF
TT-MW2-14	11/07/06	11/20/06	2011.06	QAL / wSTF
TT-MW2-16	08/25/06	11/20/06	2079.01	QAL / wSTF
TT-MW2-17S	11/03/06	11/20/06	2026.29	QAL / wSTF
TT-MW2-17D	11/03/06	11/20/06	2026.24	QAL / wSTF
TT-MW2-18	09/13/06	11/20/06	1978.23	STF
TT-PZ2-1	08/23/06	11/20/06	1828.72	QAL / wSTF

Notes:

HSU - Hydrostratigraphic Unit.
QAL / wSTF - Quaternary alluvium / weathered San Timoteo Formation.
msl - Mean sea level.
STF - San Timoteo Formation.
NA - Not applicable.

For completeness, groundwater elevations collected as part of quarterly groundwater monitoring activities for the previously existing wells are also included for the November period.

Shallow groundwater flow (i.e., QAL/wSTF HSU) generally follows the topography (i.e., to the south, Figures 3-4). It appears that shallow groundwater generally flows from the tributaries into Laborde Canyon and moves southward down Laborde Canyon (downgradient, in terms of flow and topography).

It appears that deeper groundwater flow (i.e., STF HSU) also moves southward (downgradient, in terms of flow and topography, Figures 3-5). However, the wells screened in the STF form a relatively straight line southward, which limits assessing a more accurate groundwater flow direction.

3.3.1 Horizontal Groundwater Gradients

Based on the groundwater levels measured in the QAL and wSTF screened monitoring wells, the shallow groundwater gradient, approximating a flow line from TT-MW2-16 (furthest upgradient well) to TT-MW2-6S (1,800 feet from Site boundary) was calculated to be 0.030 feet per foot (ft/ft).

Based on the groundwater levels measured in STF screened monitoring wells, the deeper groundwater gradient, approximating a flow line from TT-MW2-2 (furthest upgradient well) to TT-MW2-6D (1800 feet from Site boundary) was calculated to be 0.029 ft/ft.

3.3.2 Vertical Groundwater Gradients

Vertical groundwater gradients for newly installed well pairs are shown in Table 3-2. Well pairs indicated downward vertical groundwater gradients, ranging from -0.011 to -0.20 ft/ft. No well pairs showed an upward vertical gradient.

Table 3-2
Summary of Calculated Vertical Hydraulic Gradients for Well Pairs
Beaumont Site 2

Well Pair	Location	December 2006
TT-MW2-16 /TT-MW2-2	Area J (upgradient)	-0.20 ft/ft
TT-MW2-17S /TT-MW2-17D	Area K	-0.011 ft/ft
TT-MW2-9S /TT-MW2-9D	Downgradient	-0.16 ft/ft

Notes:
ft/ft - Feet per foot

3.4 HYDRAULIC CONDUCTIVITIES

Hydraulic conductivities values were calculated from modified specific capacity tests. Table 3-3 presents a summary of the K values. The K values for the wells screened within the QAL/wSTF range from <0.77 ft/day to 18.08 ft/day. The K values for the wells screened within the STF range from <0.63 to <1.53 ft/day.

3.5 ANALYTICAL DATA QUALITY REVIEW

The data for the soil boring/well installation and initial groundwater sampling activities were contained in analytical data packages (See Appendix H for soil analytical data and Appendix I for groundwater analytical data). The results for soil and groundwater samples collected for analytical testing were reviewed using the latest versions of the *National Functional Guidelines for Organic and Inorganic Data Review* documents from the EPA (EPA, 1999 and 2004).

The quality control samples were reviewed as described in the Work Plan (Tetra Tech, 2006b). Within each environmental sample, the sample specific quality control spike recoveries were examined. These data examinations include comparing statically calculated control limits to percent recoveries of all spiked

Table 3-3 Hydraulic Conductivities of Alluvial/ Weathered San Timoteo Formation and San Timoteo Formation Beaumont Site 2

Well ID	HSU Monitored	Hydraulic Conductivity - Averaged - Slug Test (feet per day)	Hydraulic Conductivity - Falling Head Slug Test (feet per day)	Hydraulic Conductivity - Rising Head Slug Test (feet per day)	Hydraulic Conductivity – Modified Specific Capacity Drawdown Test (feet per day)
Tt-MW2-7	QAL/wSTF	--	--	--	18.08
Tt-MW2-8	QAL/wSTF	--	--	--	2.08
Tt-MW2-9S	QAL/wSTF	--	--	--	< 0.77
Tt-MW2-9D	STF	--	--	--	< 0.63
Tt-MW2-10	QAL/wSTF	--	--	--	< 5.19
Tt-MW2-11	QAL/wSTF	--	--	--	< 0.83
Tt-MW2-12	STF	--	--	--	< 1.53
Tt-MW2-13	QAL/wSTF	--	--	--	< 5.38
Tt-MW2-14	QAL/wSTF	--	--	--	< 2.16
Tt-MW2-16	QAL/wSTF	--	--	--	< 0.81
Tt-MW2-17S	QAL/wSTF	--	--	--	< 1.20
Tt-MW2-17D	QAL/wSTF	--	--	--	3.36
Tt-MW2-18	STF	--	--	--	< 0.84

Notes:

STF - San Timoteo Formation
QAL/WSTF - Quaternary Alluvium and weathered San Timoteo Formation
HSU - Hydrostratigraphic Unit
-- - No data

analytes and duplicate spiked analytes results as compared to Relative Percent Difference control limits. Surrogate recoveries were examined for all VOC analyses and compared to their control limits. Environmental samples were analyzed by the following methods: Methods E314.0 for perchlorate, Method SW8260B for VOCs, Method 8270C for SVOCs, Method 8330 for explosives, Method 6010B for metals, Method 7470A for mercury, Method 218.6 for hexavalent chromium, Method 1625B (modified) for NDMA, Method 8081A for pesticides, Method 8151A for herbicides, Method 160.1 for total dissolved solids, Method 300.0 for anions and Method 2320B for alkalinity. All the data reviewed (except as listed below) met quality control criteria and did not need any qualification. These data are of known precision and accuracy and may be used as stated.

Method E314.0 for perchlorate had 3.1 % of its data qualified as estimated for exceeding holding times. Method SW8270C for SVOCs had 28.6 % of its data qualified as estimated for exceeding holding times. A holding time calculation error caused the holding time exceedances, however, all of the holding time exceedances were minor and the data is usable for the intended purpose.

Method 160.1 (Total Dissolved Solids) had 100 % of the data qualified for holding time violations. The holding time violation was minor and had little effect on the data quality. Method SW6010B for metals had matrix spike recovery outside control limits and caused 0.6 % of the data to be qualified as estimated. Field duplicate error caused 0.6 % of the data to be qualified as estimated. The data qualified as estimated is usable for the intended purpose.

Method SW6010B for Metals had 0.6 % of its data qualified for equipment blank contamination. Samples TT-MW2-14 and TT-MW2-114 (duplicate of TT-MW2-14) had thallium qualified for blank contamination. Sample detections qualified for blank contamination are considered not to have originated from the native sample since cross-contamination is likely.

3.6 SOIL ANALYTICAL RESULTS

Soil samples from each boring were analyzed for perchlorate by EPA Method 6850. Summaries of validated laboratory analytical results for soil samples collected as part of the soil boring/well installation activities are presented in Table 3-4 and Figures 3-6 through 3-8. A complete list of analytes tested, along with validated sample results by analytical method for soil are provided in Appendix J. Laboratory analytical data packages, which include all environmental, field quality control (QC), and laboratory QC results for soil, are provided in Appendix H.

As discussed in Section 2.1, soil samples were generally collected from at a shallow, intermediate, and deep interval. A total of 37 soil samples were collected from 13 boreholes during the well installations for perchlorate analysis. Perchlorate was reported above the method detection limit in 11 of 37 soil samples from seven (7) of the 13 borehole location at concentrations ranging from 17.3 µg/kg to 1,860 µg/kg.

In four (4) of the borehole locations (TT-MW2-7, TT-MW2-13, TT-MW2-14, and TT-MW2-18), perchlorate was not detected in the shallow and intermediate sample only in the deep sample near the water table, suggesting these results are from perchlorate impacted groundwater that has either wicked up the soil column or seasonal fluctuations in groundwater elevation.

Perchlorate was reported in shallow and intermediate depth soil samples in three (3) borings, TT-MW2-17S/D (located near the Prism in Area K) and in the farthest downgradient locations TT-PZ2-1 and TT-MW2-8. The perchlorate detected in the soil at the TT-MW2-17S/D location in Area K is distributed across the vadose zone. This is consistent with our understanding of the area. The facilities in Area K are known to be the primary source area for perchlorate contamination. TT-PZ2-1 and TT-MW2-8 are located near the Site boundary. Groundwater is relatively shallow in the area and only two (2) soil samples were collected from these boreholes. Both samples from the TT-PZ2-1 location were impacted and only the shallowest sample from the TT-MW2-8 location was impacted. Both are located close to the ephemeral drainage channel but TT-MW2-8 is almost in the channel. While the identified affected soil cannot be fully explained at this time, the possibility exists that it resulted from

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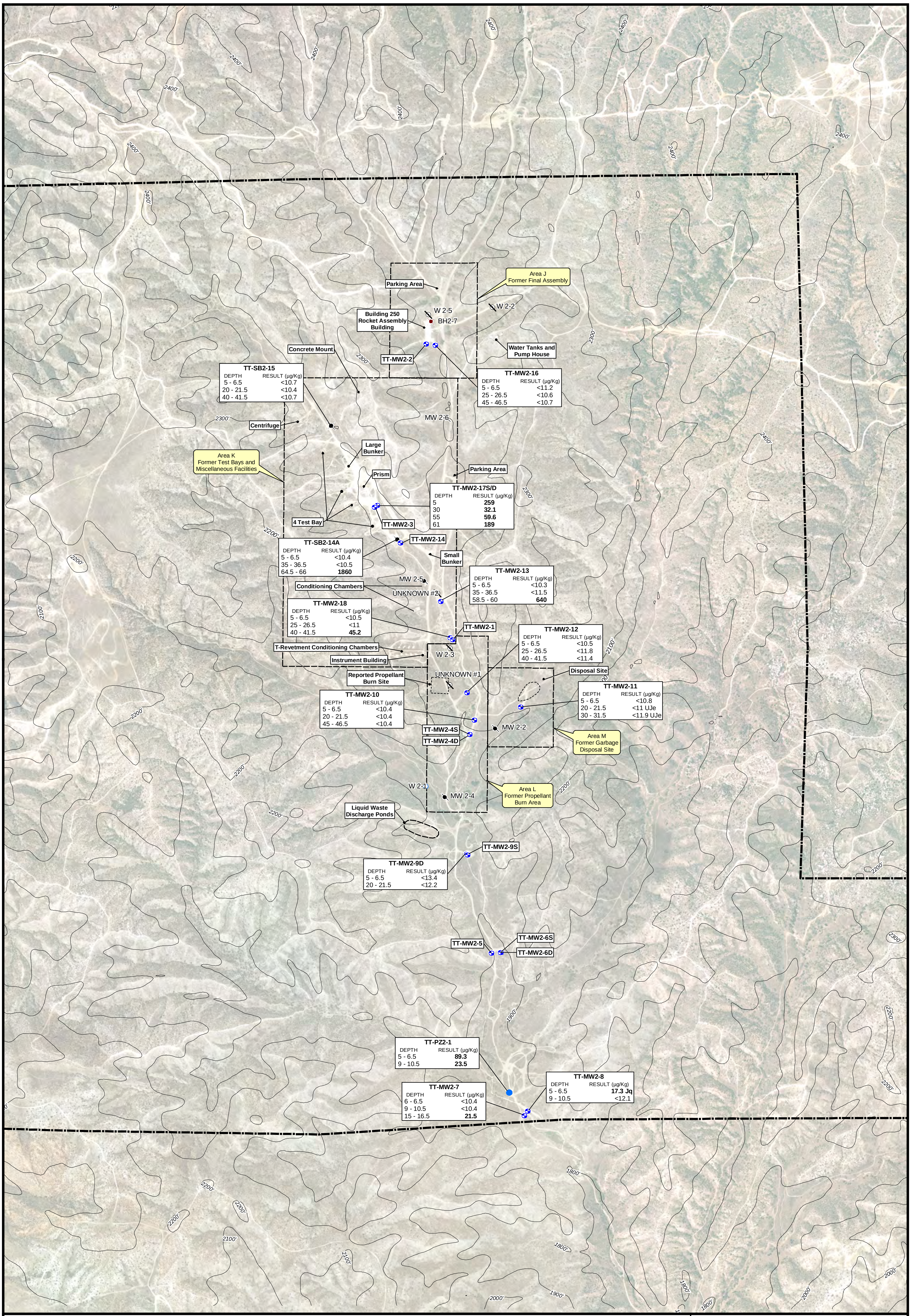

LEGEND

- Groundwater Monitoring Well/Piezometer Location
- Inactive Production Well Location
- Destroyed Monitoring Well Location
- Destroyed Production Well Location
- Abandoned Soil Boring
- Beaumont Site 2 Property Boundary
- 2200' Topographic Contour (100-foot interval)

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Depths are in feet below ground surface.

µg/kg Micrograms per kilogram.

0 500 1,000 Feet

Adapted from: April 2007 aerial photograph.

Beaumont Site 2

Figure 3-6
Perchlorate Soil Sampling Results (µg/Kg)

TETRA TECH

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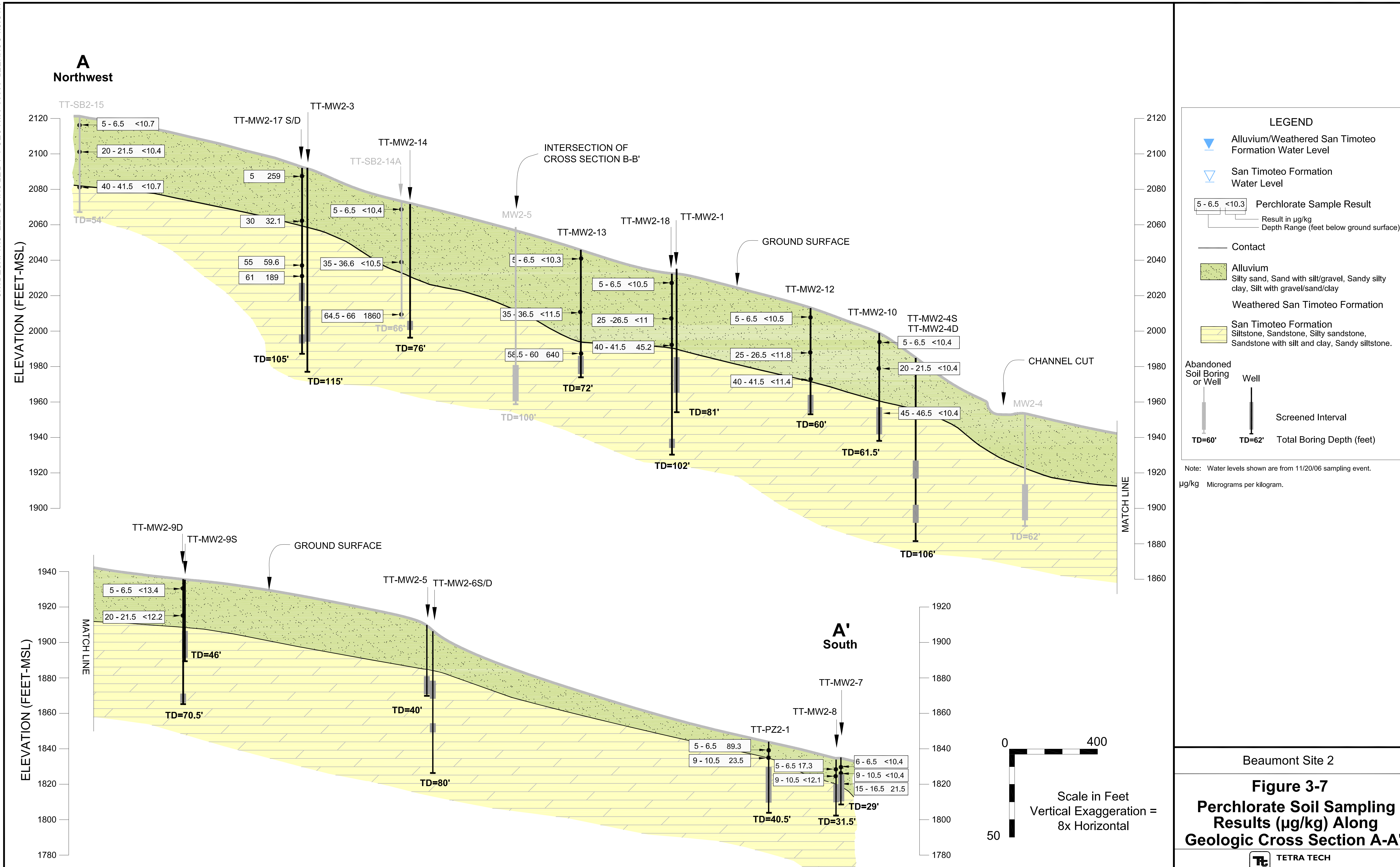
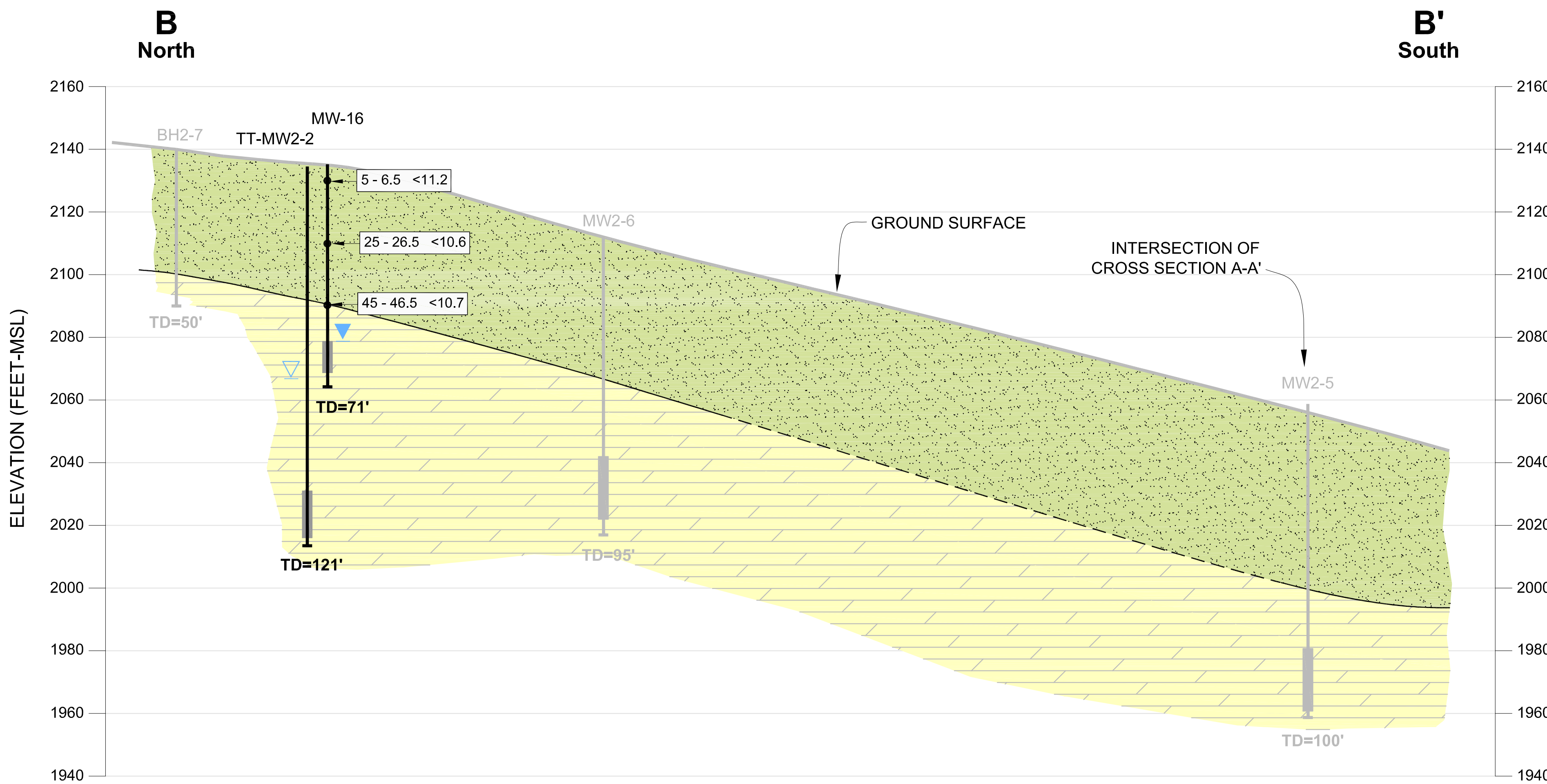
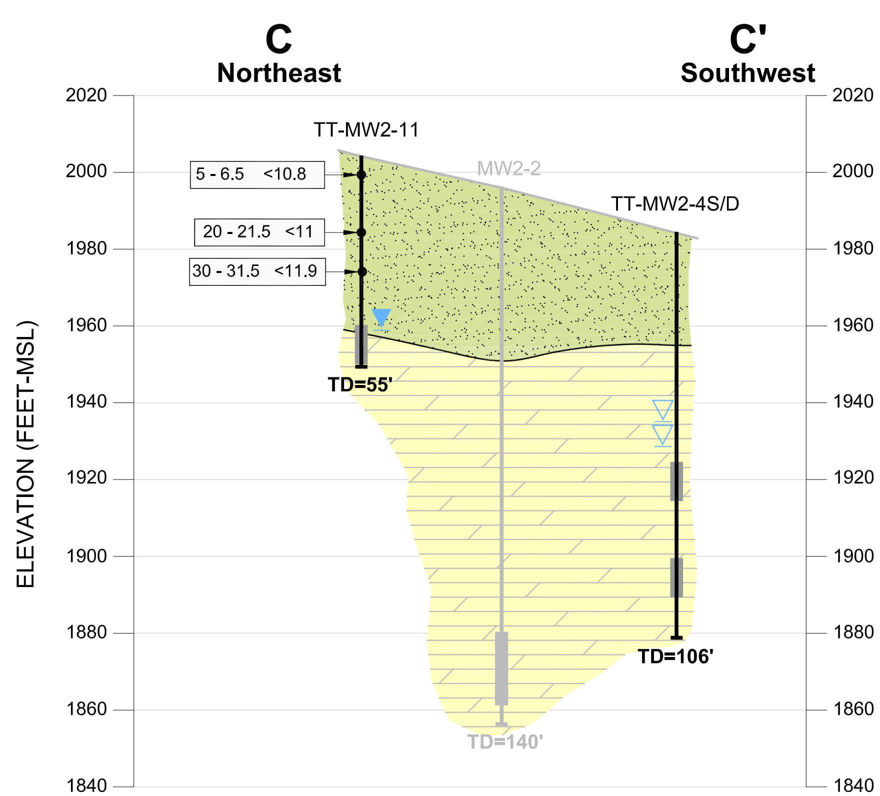


Beaumont Site 2

Figure 3-7
Perchlorate Soil Sampling Results (µg/kg) Along Geologic Cross Section A-A'

TETRA TECH





Scale in Feet
0 400
50
Vertical Exaggeration =
8x Horizontal

LEGEND

- Alluvium/Weathered San Timoteo Formation Water Level
- San Timoteo Formation Water Level
- 5 - 6.5 <10.3 Perchlorate Sample Result — Result in µg/Kg; Depth Range (feet below ground surface)
- Contact (Dashed where inferred)
- Alluvium — Silty sand, Sand with silt/gravel, Sandy silty clay, Silt with gravel/Sand/Clay
- San Timoteo Formation — Siltstone, Sandstone, Silty sandstone, Sandstone with silt and clay, Sandy siltstone. Approximate dipping angle of beds is depicted.
- Abandoned Soil Boring or Well; Well
- Screened Interval
- TD=60' TD=62' Total Boring Depth (feet)

Note: Water levels shown are from 11/20/06 sampling event.

µg/kg Micrograms per kilogram.

Beaumont Site 2

Figure 3-8
Perchlorate Soil Sampling Results (µg/kg) Along Geologic Cross Sections B-B' and C-C'

TETRA TECH

Table 3-4 Summary of Validated Perchlorate Analysis – Soil - Newly Installed Wells Beaumont Site 2

Sample Identification			
Sample Location	Depth Interval (feet bgs)	Sample Date	Perchlorate (µg/kg)
TT-MW2-7	6-6.5	08/21/06	<10.4
	9-10.5	08/21/06	<10.4
	15-16.5	08/21/06	**21.5**
TT-MW2-8	5-6.5	08/22/06	**17.3 Jq**
	9-10.5	08/22/06	<12.1
TT-MW2-9D	5-6.5	08/25/06	<13.4
	20-21.5	08/25/06	<12.2
TT-MW2-10	5-6.5	09/05/06	<10.4
	20-21.5	09/05/06	<10.4
	45-46.5	09/05/06	<10.4
TT-MW2-11	5-6.5	08/30/06	<10.8
	20-21.5	08/30/06	<11 UJe
	30-31.5	08/30/06	<11.9 UJe
TT-MW2-12	5-6.5	09/01/06	<10.5
	25-26.5	09/01/06	<11.8
	40-41.5	09/01/06	<11.4
TT-MW2-13	5-6.5	09/11/06	<10.3
	35-36.5	09/11/06	<11.5
	58.5-60	09/11/06	**640**
Laboratory Reporting Limit (µg/kg)			2
Method Detection Limit (µg/kg)			0.43

Sample Identification			
Sample Location	Depth Interval (feet bgs)	Sample Date	Perchlorate (µg/kg)
TT-MW2-14	5-6.5	09/06/06	<10.4
	35-36.5	09/06/06	<10.5
	64.5-66	09/08/06	**1860**
TT-SB2-15	5-6.5	08/29/06	<10.7
	20-21.5	08/29/06	<10.4
	40-41.5	08/29/06	<10.7
TT-MW2-16	5-6.5	08/23/06	<11.2
	25-26.5	08/23/06	<10.6
	45-46.5	08/23/06	<10.7
TT-MW2-17 S/D	5	09/14/06	**259**
	30	09/14/06	**32.1**
	55	09/14/06	**59.6**
	61	11/01/06	**189**
TT-MW2-18	5-6.5	09/12/06	<10.5
	25-26.5	09/12/06	<11
	40-41.5	09/12/06	**45.2**
TT-PZ2-1	5-6.5	08/22/06	**89.3**
	9-10.5	08/22/06	**23.5**
Laboratory Reporting Limit (µg/kg)			2
Method Detection Limit (µg/kg)			0.43

Notes:

bgs - Below ground surface.

Jq - Estimated value below the laboratory reporting limit.

µg/kg - Micrograms per kilogram.

UJe - The analyte was not detected above the method detection limit (MDL); however, the MDL is uncertain and may be elevated above normal levels. A holding time violation occurred.

perchlorate-affected surface water down Laborde Canyon from the Site's Operational Areas, from seasonal fluctuations in elevation of the impacted groundwater, or from a local source. Additional data are required to confirm the potential sources of perchlorate affected soil in this area.

3.7 GROUNDWATER ANALYTICAL RESULTS

Groundwater samples were collected from all of the wells on Site for general minerals testing and each newly installed well for perchlorate and VOC testing. Laboratory analysis of 1,4-dioxane, hexavalent chromium, metals, SVOCs, and explosives were also performed on selected well samples. In general, the monitoring wells selected for additional analyses were the farthest downgradient wells (TT-MW2-7 and TT-MW2-8), the well downgradient of the former Garbage Disposal Area (TT-MW2-11), and the wells downgradient of the identified perchlorate plume (TT-MW2-12 and TT-MW2-14). A complete list of the analytes tested for along with validated sample results by analytical method are provided in Appendix K. Laboratory analytical data packages, which include all environmental, field QC, and laboratory QC results, are provided in Appendix I. Consolidated tabular summaries of groundwater analytical results are presented in Appendix A. The results for the general minerals, organics, and other inorganics collected as part of this groundwater investigation are discussed in the following sections of the document. Recent groundwater sampling results from other Site wells are included for completeness.

3.7.1 General Minerals

Groundwater samples were collected for general mineral analysis from all Site monitoring wells in October 2007. The data collected was used to facilitate the identification of the QAL/wSTF, and the STF HSUs. A summary of the test results is included in Table 3-5.

The most abundant dissolved constituents measured in groundwater are the major ions, which can be both positively charged (cations) and negatively charged (anions) [Bartos, et. al., 2002]. Because of the requirements of electroneutrality, cations and anions are present at equal concentrations in water and comprise most of the dissolved solids in groundwater. The most abundant cations present in water are calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K); the most abundant anions are bicarbonate (HCO_3), chloride (Cl), and sulfate (SO_4). By measuring the concentrations of these ions in groundwater samples, the ionic composition of the water is determined and the chemical quality of the water can be characterized and described.

The ionic composition of water is used to classify it into ionic types based on the dominant dissolved cation and anion, expressed in milliequivalents per liter (meq/L) [Bartos, et. al., 2002]. Table 3-6 presents a summary of the general minerals data reported in milliequivalents. A milliequivalent (meq) is a measurement of the molar concentration of the ion, normalized by the ionic charge of the ion. The dominant dissolved ion must be greater than 50 % of the total. For example, water classified as a sodium-bicarbonate type water contains more than 50 % of the total cation milliequivalents as sodium and more than 50 % of the total anion milliequivalents as bicarbonate. If no cation or anion is dominant (greater than 50 %), the water is classified as mixed and the two (2) most common cations or anions in decreasing order of abundance are used to describe the water type.

Site 2 has elevated levels of perchlorate in the groundwater and does exhibit reduced conditions in some of the wells. Under reducing conditions, perchlorate will reduce to oxygen and chloride resulting in increased levels of chloride anions. There does appear to be a correlation between elevated perchlorate

Table 3-5 General Mineral Concentrations - October 2007 Beaumont Site 2

Sample Location	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Total Dissolved Solids (mg/L)	Chloride (mg/L)	Nitrate (mg/L) (1)	Sulfate (mg/L)	Bicarbonate (mg/L) (2)	Carbonate (mg/L) (2)	Perchlorate (mg/L)	ORP (mv)	DO (mg/L)	pH
TT-MW2-1	50.6	9.22	1.6 Jq	169	635 Je	212	7.85	38.2	210	<1	6890	119.7	3.91	7.57
TT-MW2-2	5.3	0.449 Jq	1.11 Jq	120	370 Je	50.9	<0.05	48	125	10	<0.5	-199.	1.93	7.75
TT-MW2-3	106	22.1	2.89	129	685 Je	182	17.9	43.9	193	<1	11300	152.5	5.86	7.34
TT-MW2-4S	5.31	0.407 Jq	1.18 Jq	108	300 Je	31.5	0.403	34.1	133	<1	<0.5	6.8	6.13	8.13
TT-MW2-4D	4.2	0.243 Jq	<1	95.7	290 Je	25.1	0.379	43.4	90	5	<0.5	51.7	3.44	8.32
TT-MW2-5	90	9.15	1.01 Jq	188	830 Je	171	10.6	136	235	<1	924	108.8	6.77	7.04
TT-MW2-6S	82.5	7.21	<1	180	810 Je	153	5.55	141	278	<1	283	28.8	3.19	7.13
TT-MW2-6D	7.03	0.423 Jq	1.28 Jq	175	560 Je	104	<0.05	128	135	10	<0.5	-37.1	1.18	8.38
TT-MW2-7	75.6	8.39	1.54 Jq	217	930 Je	167	7.09	187	300	<1	437	113.4	2.18	7.08
TT-MW2-8	52.8	3.54	1.27 Jq	213	870 Je	138	6.53	182	270	<1	274	89.7	1.59	7.29
TT-MW2-9S	119	12.4	2.8	190	930 Je	156	10	153	325	<1	141	62.8	4.71	6.91
TT-MW2-9D	11.3	0.674 Jq	2.02	121	415 Je	44.5	<0.05	82.7	113	<1	1.93 Jq	57.8	2.34	7.64
TT-MW2-10	46.2	4.09	2.32	197	660 Je	197	0.0664 Jq	71.8	185	<1	<0.5	178.0	2.49	7.33
TT-MW2-11	52.2	5.79	4.01	225	790 Je	259	16.5	33.7	185	<1	285	139.5	3.08	7.58
TT-MW2-12	6.05	0.431 Jq	1.31 Jq	207	610 Je	193	0.0609 Jq	73.3	115	10	<0.5	-85.2	2.35	8.29
TT-MW2-13	68	12.7	1.31 Jq	202	770 Je	259	7.78	42.7	210	<1	2880	48.6	5.83	7.39
TT-MW2-14	72.1	8.68	2.54	304	1000 Je	368	14.9	78.5	175	<1	41200	198.9	3.80	7.55
TT-MW2-16	118	21.4	1.05 Jq	123	740 Je	81.4	27.7	33.1	360	<1	3.59	226.6	4.68	6.90
TT-MW2-17	69.1	18.2	4.89	132	555 Je	51	22.7	50.1	265	<1	2660	104.4	0.89	7.49
TT-MW2-17	78.4	13.8	3.68	182	720 Je	270	4.3	61.7	103	<1	38600	160.6	0.66	7.60
TT-MW2-18	9.98	1.06	1.9 Jq	177	560 Je	86.1	0.12	58.9	215	<1	13500	43.9	0.69	7.96
Method Detection Limit	0.100	0.100	1.00	0.25	5.00	0.100	0.0500	0.250	1.00	1.00	0.50	NA	NA	NA

Notes:

General mineral parameter data from October 2007.

(1) - As nitrogen (N).

(2) - As calcium carbonate (CaCO3).

DO - Dissolved oxygen.

Je - The analyte was positively identified and the result is usable; however, there was a holding time violation and the analyte concentration is an estimated

Jq - The analyte was positively identified; however, the analyte detection was below the Practical Quantitation Limit and is an estimated value.

mv - Millivolts.

NA - Not applicable.

ORP - Oxidation reduction potential.

mg/L - Milligrams per liter.

Table 3-6 Selected General Mineral Concentrations as Milliequivalents per Liter- October 2007, Beaumont Site 2

Sample Location	HSU	Cations				Anions					Water Type
		Calcium (meq/L)	Potassium (meq/L)	Magnesium (meq/L)	Sodium (meq/L)	Chloride (meq/L)	Nitrate (meq/L)	Sulfate (meq/L)	Bicarbonate (meq/L)	Carbonate (meq/L)	
TT-MW2-1	QAL / WSTF	2.53	0.04	0.76	7.35	5.98	0.13	0.80	3.44	<0.03	Na-Ca / Cl-HCO_3
TT-MW2-2	STF	0.26	0.03	0.04	5.22	1.44	<0.00	1.00	2.05	0.33	Na / HCO_3-Cl
TT-MW2-3	QAL / WSTF	5.29	0.07	1.82	5.61	5.13	0.29	0.91	3.16	<0.03	Na-Ca / Cl-HCO_3
TT-MW2-4D	STF	0.21	<0.03	0.02	4.16	0.71	0.01	0.90	1.47	0.17	Na / HCO_3-SO_4
TT-MW2-4S	STF	0.26	0.03	0.03	4.70	0.89	0.01	0.71	2.18	<0.03	Na / HCO_3-Cl
TT-MW2-5	QAL / WSTF	4.49	0.03	0.75	8.18	4.82	0.17	2.83	3.85	<0.03	Na-Ca / Cl-HCO_3-SO_4
TT-MW2-6S	QAL / WSTF	4.12	<0.03	0.59	7.83	4.32	0.09	2.94	4.56	<0.03	Na-Ca / HCO_3-Cl-SO_4
TT-MW2-6D	STF	0.35	0.03	0.03	7.61	2.93	<0.00	2.67	2.21	0.33	Na / CL-SO4-HCO_3
TT-MW2-7	QAL / WSTF	3.77	0.04	0.69	9.44	4.71	0.11	3.90	4.92	<0.03	Na-Ca / HCO_3-Cl-SO_4
TT-MW2-8	QAL / WSTF	2.63	0.03	0.29	9.26	3.89	0.11	3.79	4.42	<0.03	Na-Ca / HCO_3-Cl-SO_4
TT-MW2-9S	QAL / WSTF	5.94	0.07	1.02	8.26	4.40	0.16	3.19	5.33	<0.03	Na-Ca / HCO_3-Cl-SO_4
TT-MW2-9D	STF	0.56	0.05	0.06	5.26	1.26	<0.00	1.72	1.85	<0.03	Na / HCO3-SO_4-Cl
TT-MW2-10	QAL / WSTF	2.31	0.06	0.34	8.57	5.56	0.00	1.50	3.03	<0.03	Na-Ca / Cl-HCO_3
TT-MW2-11	QAL / WSTF	2.60	0.10	0.48	9.79	7.31	0.27	0.70	3.03	<0.03	Na-Ca / Cl-HCO_3
TT-MW2-12	STF	0.30	0.03	0.04	9.00	5.44	0.00	1.53	1.88	0.33	Na/ CL-HCO_3
TT-MW2-13	QAL / WSTF	3.39	0.03	1.05	8.79	7.31	0.13	0.89	3.44	<0.03	Na-Ca / Cl-HCO_3
TT-MW2-14	QAL / WSTF	3.60	0.06	0.71	13.22	10.38	0.24	1.64	2.87	<0.03	Na-Ca /Cl
TT-MW2-16	QAL / WSTF	5.89	0.03	1.76	5.35	2.30	0.45	0.69	5.90	<0.03	Ca-Na / HCO_3-Cl
TT-MW2-17S	QAL / WSTF	3.45	0.13	1.50	5.74	1.44	0.37	1.04	4.34	<0.03	Na-Ca /HCO_3
TT-MW2-17D	QAL / WSTF	3.91	0.09	1.14	7.92	7.62	0.07	1.29	1.69	<0.03	Na-Ca /Cl
TT-MW2-18	STF	0.50	0.05	0.09	7.70	2.43	0.00	1.23	3.52	<0.03	Na / HCO_3-Cl

Notes:

General mineral data from October 2007.

Ca - Calcium.

Cl - Chloride.

HCO_3 - Bicarbonate.

HSU - Hydrostratigraphic Unit.

Meq/L - Milliequivalents per liter.

Na - Sodium.

QAL / wSTF Quaternary alluvium / weathered San Timoteo Formation.

STF - San Timoteo Formation.

SO_4 - Sulfate.

and elevated chloride in some of the wells on the Site. Therefore, chloride was disregarded when considering the anion portion of the ionic signature.

In general, calcium and magnesium cations change from dominant to subordinate cations in relation to total cations with increasing depth and as groundwater flows away from sources of recharge. The shallower QAL/wSTF wells at the Site generally show a mixed sodium and calcium cation signature with a bicarbonate dominant or a mixed bicarbonate and sulfate anion signature. The mixed anion signature appears to be more prevalent in the southern half of the Site. The deeper STF wells on the Site show little or no calcium or magnesium resulting in a sodium dominant cation signature with a bicarbonate dominant or a mixed bicarbonate and sulfate anion signature. The dominance of sodium seems to be the most significant characteristic distinguishing the QAL/wSTF wells from the STF wells.

Stiff diagrams are a visual method to compare the relative proportions of ions in water. Ion concentrations in mg/L are converted to meq/L. Cations are plotted on the left side of the diagram, with anions plotted on the right. The lengths of the diagram vertices are proportional to ionic content. Different ion combinations can be plotted in Stiff diagrams depending on aqueous geochemistry. Again, as a result of little or no calcium in the deeper STF wells, two (2) distinct patterns resulted from the Stiff diagrams (Figure 3-9).

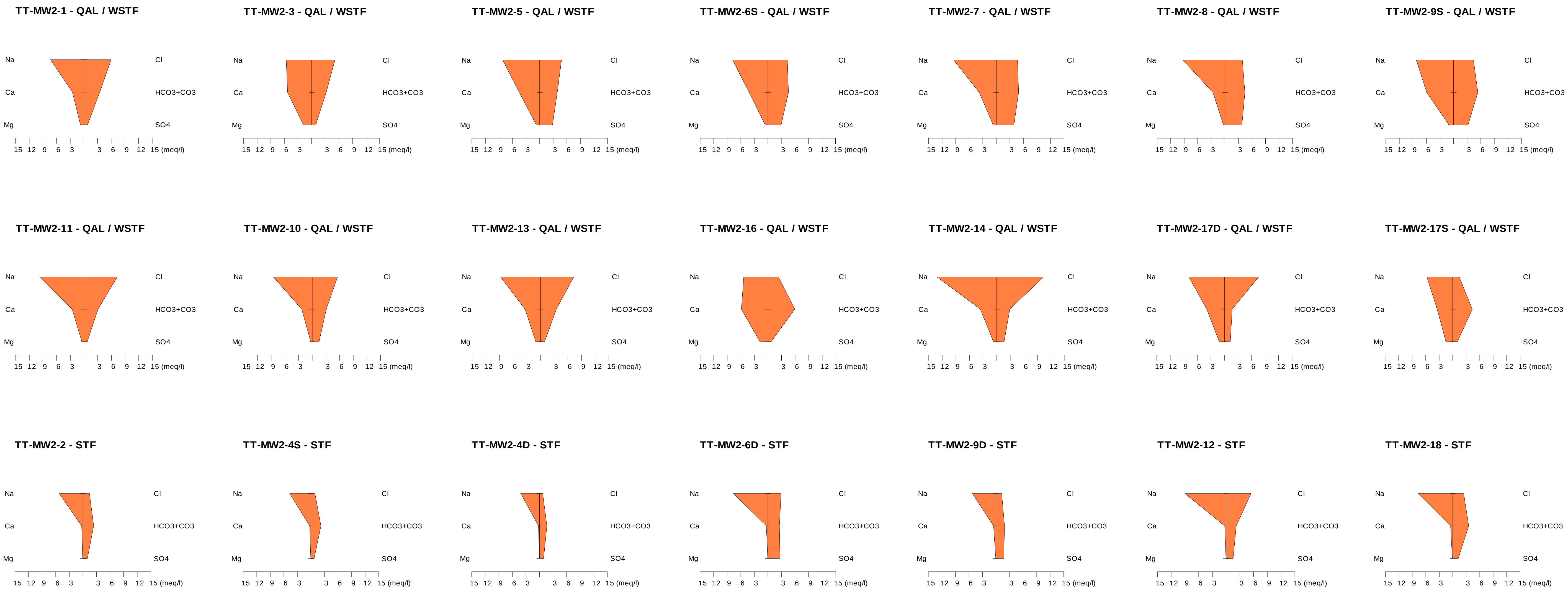
Based on the ionic composition evaluation discussed above the following monitoring wells on the Site have been designated STF monitoring wells: TT-MW2-2, TT-MW2-4S, TT-MW2-4D, TT-MW2-6D, TT-MW2-9D, TT-MW2-12, TT-MW2-18 and the balance have been designated QAL/wSTF.

3.7.2 Evaluation of COPC

An evaluation of COPCs based on the results of the initial groundwater sampling of the newly installed monitoring wells was performed. Primary COPCs are those analytes that define or best represent the different types of compounds released at a site and the maximum extent (horizontally and vertically) of contamination at a particular site. The purpose of defining primary versus secondary COPCs is to reduce the total number of analytes that require detailed analysis. COPCs are re-evaluated on a routine basis to make sure that the primary COPC list continues to accurately represent site conditions over time and still meets objectives of the monitoring program and regulatory requirements.

Table 3-7 presents a summary of the validated organic analytes detected and Table 3-8 presents a summary of the validated inorganic analytes detected. Sample results were compared to the published federal or state MCL (whichever is lower), or the DWNL for chemicals with no published MCL. Table 3-9 presents a statistical summary of organic and inorganic analytes detected during the initial groundwater sampling of the newly installed monitoring wells.

Figure 3-9 Stiff Diagrams
Beaumont Site 2



Notes: Ca - Calcium.
Cl - Chloride.
CO_3 - Carbonate.
HCO_3 - Bicarbonate.
Mg – Magnesium.
Na - Sodium.
QAL / WSTF – Quaternary alluvium / weathered San Timoteo Formation.
STF – San Timoteo Formation.
meq/L – Milliequivalents per liter.
SO_4 - Sulfate.

Table 3-7 Summary of Validated Organic Analytes - Groundwater - Newly Installed Wells, Beaumont Site 2

Sample Location	Sample Date	Acetone (µg/L)	Bis-(2-ethylhexyl) phthalate (µg/L	Chloromethane (µg/L)	Methylene Chloride (µg/L)	N-Nitroso-dimethylamine (ng/L)	Toluene (µg/L)	Trichloroethene (µg/L)	m, p-Xylene (µg/L)	o-Xylene (µg/L)
TT-MW2-7	10/03/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
	11/06/06	<5	<4.7	<0.2	<0.5	<0.540	<0.2	<0.2	<0.5	<0.2
	11/08/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-8	10/03/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
	11/06/06	<5	<4.9	<0.2	<0.5	<0.540	<0.2	<0.2	<0.5	<0.2
	11/08/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-9S	10/03/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
TT-MW2-9D	10/03/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
TT-MW2-10	10/04/06	<5	NA	<0.2	<0.5	NA	0.31 Jq	<0.2	<0.5	<0.2
TT-MW2-11	10/05/06	<5	<5.1	0.69 Jq	<0.5	8.89	<0.2	**7.1**	<0.5	<0.2
TT-MW2-12	10/05/06	20	**17 Jq**	<0.2	<0.5	7.59	0.22 Jq	<0.2	<0.5	<0.2
TT-MW2-13	10/05/06	<5	NA	<0.2	<0.5	NA	0.20	<0.2	<0.5	<0.2
TT-MW2-14	11/20/06	<5	<4.9 UJe	<0.2	**380**	3.05	<0.2	<0.2	<0.5	<0.2
TT-MW2-16	10/03/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
TT-MW2-17S	11/20/06	<5	NA	<0.2	<0.5	NA	<0.2	<0.2	<0.5	<0.2
TT-MW2-17D	11/20/06	<5	NA	<0.2	<0.5	NA	<0.2	3.2	<0.5	<0.2
TT-MW2-18	10/04/06	<5	NA	<0.2	<0.5	NA	0.84 Jq	<0.2	0.52 Jq	0.23 Jq
Method Detection Limit		5	0.540	0.2	0.5	0.540	0.2	0.2	0.5	0.2
Laboratory Reporting Limit		10	7.00	1.00	1.00	2.00	1.00	1.0	1.00	1.00
MCL/DWNL		—	**4**	—	**5**	10	**150**	**5**	**1750** (1)	**1750** (1)

Notes:

Bold - Maximum Contaminant Level exceeded.
— - Maximum Contaminant Level not established.
(1) - Total Xylene.
DWNL - California Department of Health services drinking water notification level.
Jq - Estimated value below the laboratory reporting limit.
MCL - Maximum Contaminant Level.
µg/L - Micrograms per liter.
ng/L - Nanograms per liter.
NA - Not analyzed.
UJe - The analyte was not detected above the method detection limit (MDL). However, the MDL may be elevated above the reported detection limit. A holding time violation occurred.

Table 3-8 Summary of Validated Inorganic Analytes - Groundwater - Newly Installed Wells, Beaumont Site 2

Sample Location	Sample Date	Perchlorate (µg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Cadmium (mg/L)	Chromium (total, mg/L)	Chromium (hexavalent, µg/L)	Cobalt (mg/L)	Copper (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Molybdenum (mg/L)	Mercury (µg/L)	Nickel (mg/L)	Silver (mg/L)	Thallium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)	Selenium (mg/L)
TT-MW2-7	10/03/06	**379**	NA	NA	NA	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/06/06	**374**	< 0.005	0.0249	<0.001	<0.002	< 0.005	NA	<0.005	<0.005	<0.003	9.01	0.0242 Jq	<0.1	<0.01	< 0.005	<0.005	0.00677 Jq	0.00856 Jq	0.00984 Jq
	11/08/06	NA	NA	NA	NA	NA	NA	0.278	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-8	10/03/06	**347**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/06/06	**343**	<0.005	0.029	<0.001	<0.002	< 0.005	NA	<0.005	<0.005	<0.003	8.52	0.0242 Jq	<0.1	<0.01	<0.005	<0.005	0.0166	<0.005	0.00781 Jq
	11/08/06	NA	NA	NA	NA	NA	NA	0.195 Jq	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-9S	10/03/06	**324**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-9D	10/03/06	**28.8**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-10	10/04/06	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-11	10/05/06	**191**	0.0216	0.0419	<0.001	<0.002	0.0197	NA	<0.005	0.0108	<0.003	20.4	0.0147 Jq	<0.1	0.0102	<0.005	**0.00899 Jq**	0.0146	0.0515	<0.005
TT-MW2-12	10/05/06	2.73	**0.0659**	**6.63**	**0.0217**	**0.0166**	**0.758**	NA	0.316	1.02	**0.264**	357	0.0193 Jq	0.233 Jq	**0.582**	0.00856 Jq	<0.005	1.63	1.77	<0.005
TT-MW2-13	10/05/06	**6350**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-14	11/20/06	**34800**	<0.005	0.09	< 0.001	<0.002	< 0.005	NA	<0.005	<0.005	<0.003	9.09	<0.01	<0.1	0.0103 Jq	<0.005	**0.011 Bk**	0.0155	0.0482 Jf	0.0151
TT-MW2-16	10/03/06	3.79	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-17S	11/20/06	**5870**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-17D	11/20/06	**79300**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-MW2-18	10/04/06	**15000**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method Detection Limit		0.43	0.00308	0.002	0.0020	0.002	0.005	0.005	0.005	0.005	0.003	0.1	0.01	0.0001	0.005	0.005	0.005	0.005	0.005	0.005
Laboratory Reporting Limit		2.0	0.01	0.01	0.01	0.01	0.01	0.2	0.01	0.01	0.01	1	0.05	0.0	0.01	0.01	0.01	0.01	0.01	0.01
MCL (unless noted) / DWNL		**6**	**0.05**	**1**	**0.004**	**0.005**	**0.05** (1)	**50**	—	**1.3**	**0.015**	—	—	**0.002**	**0.1**	—	**0.002**	—	—	**0.050**

Notes:

Analytical results for metals are from unfiltered groundwater samples (total metals).

Bold - MCL or DWNL exceeded.

— - Maximum Contaminant Level not established.

(1) - Currently regulated under chromium (total) MCL.

Bk - Contamination in the field blank.

DWNL - California Department of Health services drinking water notification level.

Jf - Estimated value due to duplicate results outside control limits.

Jq - Estimated value below the laboratory reporting limit.

MCL - Maximum Contaminant Level.

mg/L - Milligrams per liter.

µg/L - Micrograms per liter.

NA - Not analyzed.

Table 3-9 Summary Statistics of Validated Organic and Inorganic Analytes Detected – Groundwater – Newly Installed Wells, Beaumont Site 2

Organic Analytes Detected	Total Number of Samples Analyzed	Total Number of Detections (1)	Number of Detections Exceeding MCL or DWNL (1)	Corresponding MCL / DWNL	Minimum Concentration Detected	Maximum Concentration Detected
Acetone	13	1	0	-	< 5 µg/L	20 µg/L
Bis-(2-ethylhexyl) phthalate	5	1	1	4 µg/L	17 µg/L	17 µg/L
Chloromethane	13	1	0	-	0.69 µg/L	0.69 µg/L
Methylene chloride	13	1	1	5 µg/L	380 µg/L	380 µg/L
N-Nitrosodimethylamine	5	3	0	10 ng/L	3.05 ng/L	8.89 ng/L
Trichloroethene	13	2	1	5 µg/L	3.2 µg/L	7.1 µg/L
Toluene	13	4	0	150 µg/L	0.20 µg/L	0.84 µg/L
m,p - Xylenes	13	1	0	1750 µg/L (3)	0.52 µg/L	0.52 µg/L
o - Xylenes	13	1	0	1750 µg/L (3)	0.23 µg/L	0.23 µg/L

Inorganic Analytes Detected	Total Number of Samples Analyzed	Total Number of Detections (1)	Number of Detections Exceeding MCL or DWNL (1)	Corresponding MCL / DWNL	Minimum Concentration Detected	Maximum Concentration Detected
Perchlorate	13	12	10	6 µg/L	2.73 µg/L	79300 µg/L
Arsenic - (total)	5	2	1	0.05 mg/L	0.0216 mg/L	0.0659 mg/L
Barium - (total)	5	5	1	1 mg/L	0.0249 mg/L	6.63 mg/L
Beryllium - (total)	5	1	1	0.004 mg/L	0.0217 mg/L	0.0217 mg/L
Cadmium - (total)	5	1	1	0.05 mg/L	0.0166 mg/L	0.0166 mg/L
Chromium - (total)	5	2	0	50 µg/L (2)	0.0197 µg/L	0.758 µg/L
Chromium - (hexavalent)	2	2	0	50 µg/L (2)	0.195 µg/L	0.278 µg/L
Cobalt - (total)	5	1	0	-	0.316 mg/L	0.316 mg/L
Copper - (total))	5	2	0	1.3 mg/L	0.0108 mg/L	1.02 mg/L
Lead - (total)	5	1	1	0.015 mg/L	0.264 mg/L	0.264 mg/L
Molybdenum - (total)	5	4	0	-	0.0147 mg/L	0.0242 mg/L
Mercury - (total)	5	1	0	0.002 mg/L	0.233 µg/L	0.233 µg/L
Nickel - (total)	5	3	1	0.1 mg/L	0.0102 mg/L	0.582 mg/L
Silver - (total)	5	1	0	-	0.00856 mg/L	0.00856 mg/L
Thallium - (total)	5	1	1	0.002 mg/L	0.011 mg/L	0.011 mg/L
Vanadium - (total)	5	5	0	-	0.00677 mg/L	1.63 mg/L
Zinc - (total)	5	4	0	-	0.00856 mg/L	1.77 mg/L
Selenium - (total)	5	3	0	0.050 mg/L	0.00781 mg/L	0.0151 mg/L

Notes:

" - " - MCL or California Department of Health Services state drinking water notification level not established.

(1) - Number of detections exclude sample duplicates, trip blanks, equipment blanks, resampling events and general mineral results.

(2) - Currently regulated under chromium (total) MCL.

(3) - As total xylenes.

DWNL - California Department of Health Services state drinking water notification level.

Jq - Analyte was positively identified and the result is usable; however, the analyte concentration reported is an estimated value.

MCL - Maximum Contaminant Level.

ng/L - Nanograms per liter.

mg/L - Milligrams per liter.

µg/L - Micrograms per liter.

Organic Analytes

Three (3) organic analytes [TCE, methylene chloride and bis-(2-ethylhexyl) phthalate] were detected above published MCLs.

TCE was detected in two (2) monitoring wells during this investigation. TCE was reported above the MCL of 5 µg/L in Area M in monitoring well TT-MW2-11 at a concentration of 7.1 µg/L. TCE was reported in Area K in monitoring well TT-MW2-17D at a concentration of 3.2 µg/L. Table 3-6 presents TCE groundwater sampling analytical results for the initial groundwater sampling of the newly installed monitoring wells.

Methylene chloride was reported in the groundwater sample collected from one (1) monitoring well TT-MW2-14 at a concentration of 380 µg/L. Previous groundwater monitoring events reported methylene chloride at low levels (less than 5 µg/L), but its presence was associated with field and/or method blank contamination. Although not qualified during the data validation process, the methylene chloride detected during this investigation could have resulted from some type of undetected lab or field type of cross-contamination. At this time, methylene chloride will not be construed as a COPC. Subsequent sampling of this well should provide additional data as to whether the presence of this compound is representative of actual groundwater conditions encountered.

Bis-(2-ethylhexyl) phthalate was detected in well TT-MW2-12 at a concentration of 17 µg/L. This compound has been detected at low levels during previous investigations and is a common field/laboratory contaminant. Therefore, this compound will not be considered a COPC. Bis-(2-eythylhexyl) phthalate has been tested for 18 times in 12 different monitoring wells. The compound has been detected twice. It was detected at a concentration of 22 µg/l in TT-MW2-3 in September 2004. This well was tested again in February 2005 and June 2006 and the compound was not detected. The compound was also detected in TT-MW2-12 at a concentration of 17 µg/l. This well has not been tested again. Twelve equipment blanks have been collected and tested for the compound. The compound was detected in two of the blank samples. Bis-(2-eythylhexyl) phthalate is an organic compound used in the manufacture of many plastics including PVC and is a common field and laboratory contaminant. Therefore, bis-(2-ethylhexyl) phthalate is not considered a site COPC. During the upcoming HHERA for Site 2 groundwater, all compounds will be evaluated further.

Five wells in strategic locations across the Site were tested for emerging contaminants. NDMA was detected in three (3) of those wells (TT-MW2-11, TT-MW2-12, and TT-MW2-14) at concentrations ranging from 3.05 to 8.89 nanograms per liter (ng/L). The DWNL for NDMA is 10 ng/L. Additional groundwater samples were collected later from the same three wells to confirm the presence of NDMA at

Site 2. NDMA was detected in two of the three wells at concentrations similar to or less than the first time it was detected. To further evaluate the extent of the NDMA, all water table monitoring wells on the site will be tested for NDMA during the upcoming groundwater monitoring program. Results from this sampling round will be reviewed to determine if additional sampling is warranted. NDMA is not considered a COPC at this time but additional testing will be done to confirm the detection of the compound and further evaluate the nature and extent if confirmed.

Other organic analytes detected at low levels and below their respective MCLs, include acetone, chloromethane, toluene, o-xylene and m,p-xylene. Previously, acetone data at similar concentrations have been qualified as blank contamination (Tetra Tech, 2007b). While toluene, ethylbenzene and xylenes have been detected in groundwater samples collected from wells at the Site, these concentrations have also been well below their respective MCLs. None of these compounds will be considered as COPCs.

Based on the analysis of the concentrations detected from the initial groundwater sampling of the newly installed monitoring wells and existing groundwater monitoring data, no new organic COPCs have been identified. Based on the limited and relatively low TCE concentrations reported in groundwater samples, TCE remains regarded as a secondary COPC.

Inorganic Analytes

Eight (8) inorganic analytes (perchlorate, arsenic, barium, beryllium, cadmium, lead, nickel, and thallium) were detected above a published MCL or DWNL.

Perchlorate was reported in groundwater samples collected from 12 of the 13 newly installed monitoring wells sampled. Perchlorate exceeded the MCL of 6 μg/L in 10 wells, ranging in concentration from 28.8 to 79,300 μg/L. The highest concentrations of perchlorate reported were detected in the groundwater sample collected from monitoring well TT-MW2-17D located near the Prism in Area K. Table 3-6 presents groundwater perchlorate sampling analytical results for the initial groundwater sampling of the newly installed monitoring wells.

Arsenic was reported in one (1) of the five (5) groundwater samples collected for the initial groundwater sampling of the newly installed monitoring wells. Arsenic was reported in the groundwater sample collected from well TT-MW2-12 at a concentration of 0.0659 mg/L, which exceeds the arsenic MCL of 0.05 mg/L. Other inorganic analytes detected above their corresponding MCL from groundwater samples collected from well TT-MW2-12 include barium (6.630 mg/L), beryllium (0.0217 mg/L), cadmium (0.0166 mg/L), total chromium (0.758 mg/L), lead (0.264 mg/L), mercury (0.233 mg/L J) and nickel (0.582 mg/L). Thallium was reported in the groundwater sample collected from well TT-MW2-11 at a concentration of 0.00899 mg/L J, which exceeds the thallium MCL of 0.002 mg/L. As metals have not been reported at elevated levels in the soil (Tetra Tech, 2005a), the metals in groundwater may be naturally occurring.

A Screening Ecological Risk Assessment (SERA) for soil was completed and a draft of the document was submitted for regulatory review. The SERA shows that arsenic has a background concentration of 6.5 mg/kg in soil at Site 2. This is approximately 100 times the residential and eight times the commercial industrial California Modified PRGs for soil. Arsenic has not been identified as a COPC for soil. Background concentrations in water have not been determined. Since arsenic does not appear to be a contaminant of concern for soil at the site, it is not considered a COPC for groundwater at this time. A Human Health and Ecological Risk Assessment (HHERA) for groundwater will be conducted in the future and arsenic will be further evaluated at that time to assess background arsenic concentrations in groundwater. Until the risk assessment is completed, all monitoring wells on the site continue to be sampled for metals, including arsenic, annually. At this time, metals are considered neither primary nor secondary COPCs at the Site.

Both total chromium and hexavalent chromium have been tested for in various locations at the Site. The concentrations detected did not exceed relevant risk screening criteria. Future soil and groundwater investigations will include a list of target analytes. If appropriate, metals will be included. The routine groundwater monitoring program includes testing for CAM 17 metals annually. At this time, metals are considered neither primary nor secondary COPCs at the Site. An evaluation of background levels for metals at the Site will be conducted as part of the upcoming risk assessment for groundwater.

Based on the perchlorate concentrations reported in groundwater samples, perchlorate remains regarded as a primary COPC.

COPC Summary

Based on the analysis of the concentrations detected from the initial groundwater sampling of the newly installed monitoring wells and existing groundwater monitoring data, perchlorate is the only primary COPC identified and TCE is considered a secondary COPC at the Site.

3.7.3 Distribution of COPCs in Groundwater

The following section summarizes the distribution of the COPCs (perchlorate and TCE) in groundwater based on the initial monitoring well sampling activities. Recent groundwater sampling results from other Site wells (e.g., TT-MW2-1 through TT-MW2-6) are also included for completeness. The perchlorate and TCE results are presented in Figures 3-10 through Figure 3-12.

Area J

Area J is located within Laborde Canyon at the top of the Site and is topographically upslope and hydrogeologically upgradient of the other operational areas. Two (2) groundwater monitoring wells (TT-MW2-2 and TT-MW2-16) currently exist in Area J. TT-MW2-2 was installed in 2004 and the TT-MW2-16 was installed during this investigation.

TT-MW2-2 was installed in the deeper STF and no COPCs have been detected in the groundwater samples collected from this well.

TT-MW2-16 was installed at first groundwater in the QAL/wSTF to evaluate shallower groundwater quality near the former assembly building. One COPC was detected in the groundwater samples collected from TT-MW2-16. Perchlorate was detected at a concentration of 3.79 µg/L.

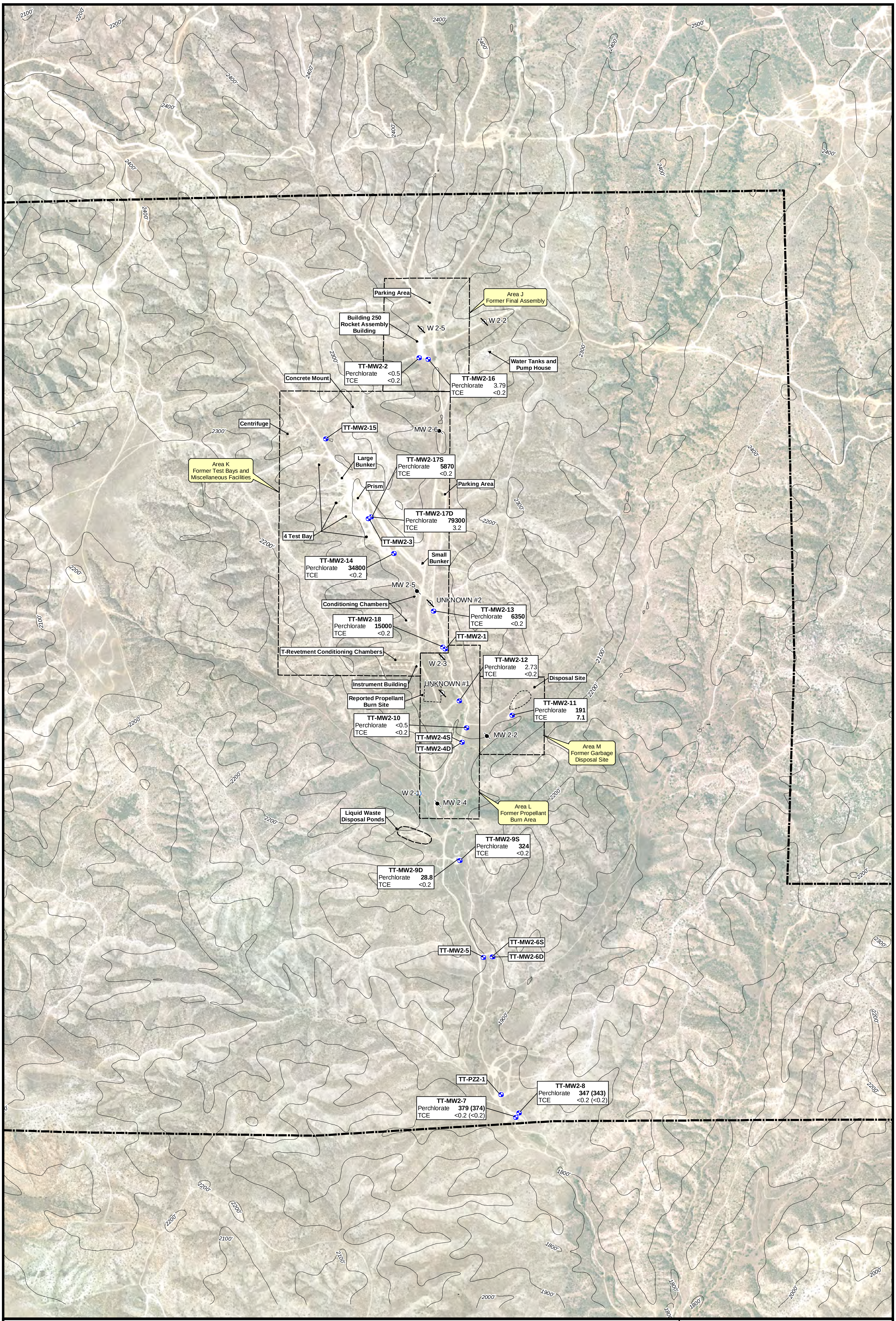
Although rocket motors were assembled in the area prior to being tested in Area K and at Beaumont Site 1, no impacts to soil were detected during soil investigations in this area. Based on the available data it would appear a small amount of perchlorate was released and has impacted the groundwater.

Area K

Area K is located in Laborde Canyon and Test Bay Canyon that drains into Laborde canyon from the west. Area K is located topographically down slope and hydrogeologically downgradient of Area J. Within Area K the test bays were located in Test Bay Canyon and the conditioning chambers were located in Laborde Canyon. Test Bay Canyon is topographically upslope and hydrogeologically upgradient of the area within Laborde Canyon where the conditioning chambers were located. Seven (7) groundwater monitoring wells (TT-MW2-1, TT-MW2-3, TT-MW2-13, TT-MW2-14, TT-MW2-17S, TT-MW2-17D, and TT-MW2-18) currently exist in Area K. TT-MW2-1 and TT-MW2-3 was installed in 2004 and the other five (5) were installed during this investigation.

TT-MW2-3 located in Test Bay Canyon was installed in the QAL/wSTF and historically has had the highest concentrations of perchlorate detected in groundwater at the Site. The concentration detected at the time of this investigation was 19,900 µg/L. This well is located near the earthen prism in front of the test bays.

TT-MW2-17S and D located in Test Bay Canyon were installed in the QAL/wSTF immediately adjacent to TT-MW2-3. The nested well pair was intended to evaluate water quality above and at the bottom of the interval monitored by TT-MW2-3. The concentration of perchlorate detected in the groundwater samples collected from TT-MW2-17S and D were 5,870 and 79,300 µg/L respectively.



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LEGEND

- Groundwater Monitoring Well\Piezometer Location
- Inactive Production Well Location
- Destroyed Monitoring Well Location
- Destroyed Production Well Location
- Beaumont Site 2 Property Boundary

2200' Topographic Contour (100-foot interval)

Note: Beaumont Site 2 property boundary from Hillwig-Goodrow survey, May 2004.

Bold indicates corresponding MCL.

Concentrations shown are in micrograms per liter (µg/L)

(374) Concentration in parenthesis is from resampling event.

0 500 1,000 Feet

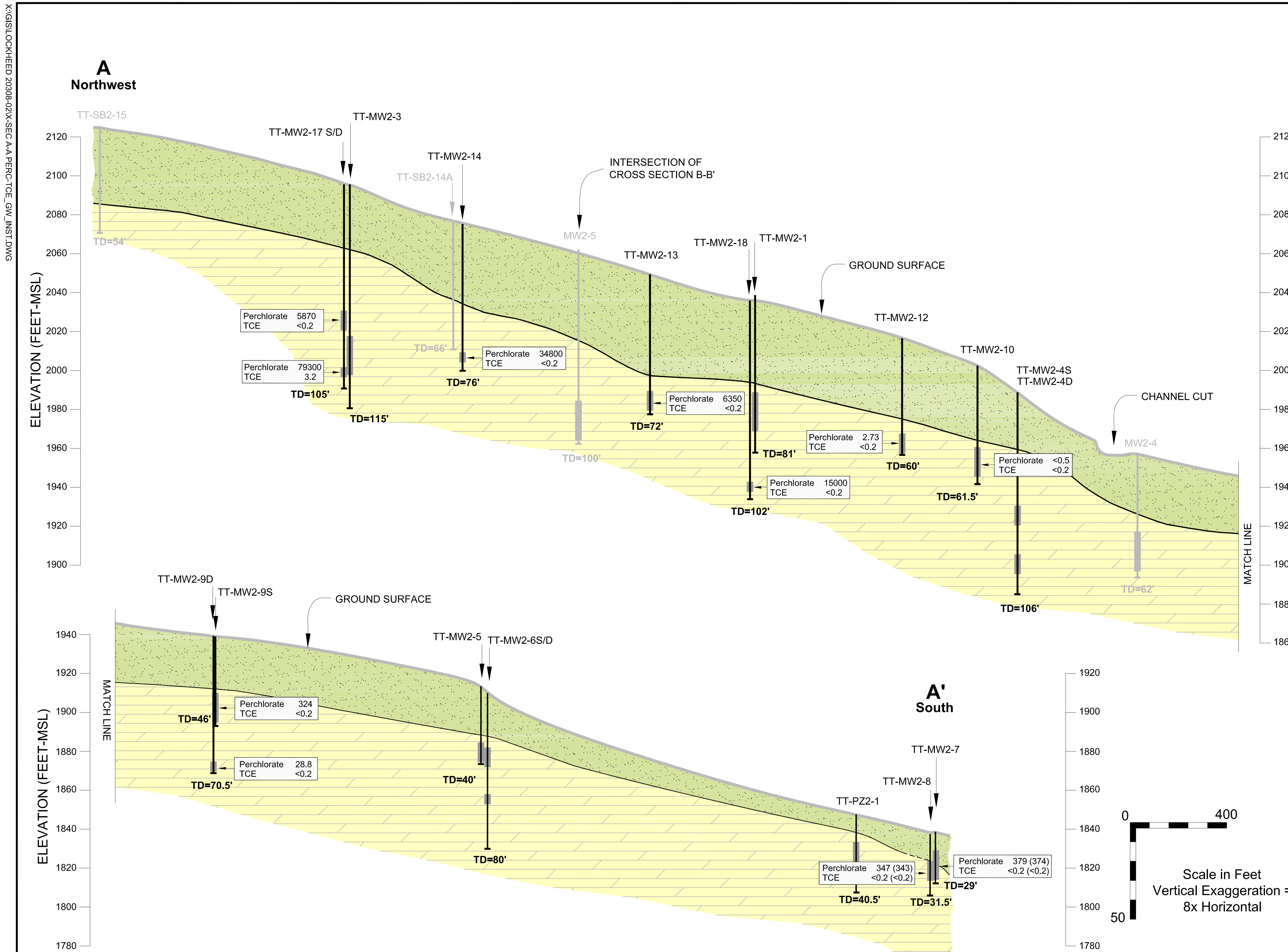
Adapted from: April 2007 aerial photograph.

Beaumont Site 2

Figure 3-10

Perchlorate and TCE Groundwater Sampling Results (µg/L)

TETRA TECH



LEGEND

- Alluvium/Weathered San Timoteo Formation Water Level
- San Timoteo Formation Water Level
- Perchlorate 324 / TCE <0.2 — Groundwater Sample Result (Result in µg/L; Chemical Compound)
- Contact
- Alluvium: Silty sand, Sand with silt/gravel, Sandy silty clay, Silt with gravel/Sand/Clay
- San Timoteo Formation: Siltstone, Sandstone, Silty sandstone, Sandstone with silt and clay, Sandy siltstone.
- Abandoned Soil Boring or Well / Well — Screened Interval
- TD=60' / TD=62' — Total Boring Depth (feet)

Note: Water levels shown are from 11/20/06 sampling event.

µg/L Micrograms per liter.

(343) Concentration in parenthesis is from resampling event.

Beaumont Site 2

Figure 3-11
Perchlorate and TCE Groundwater Results (µg/L) Along Geologic Cross Section A-A'

TETRA TECH

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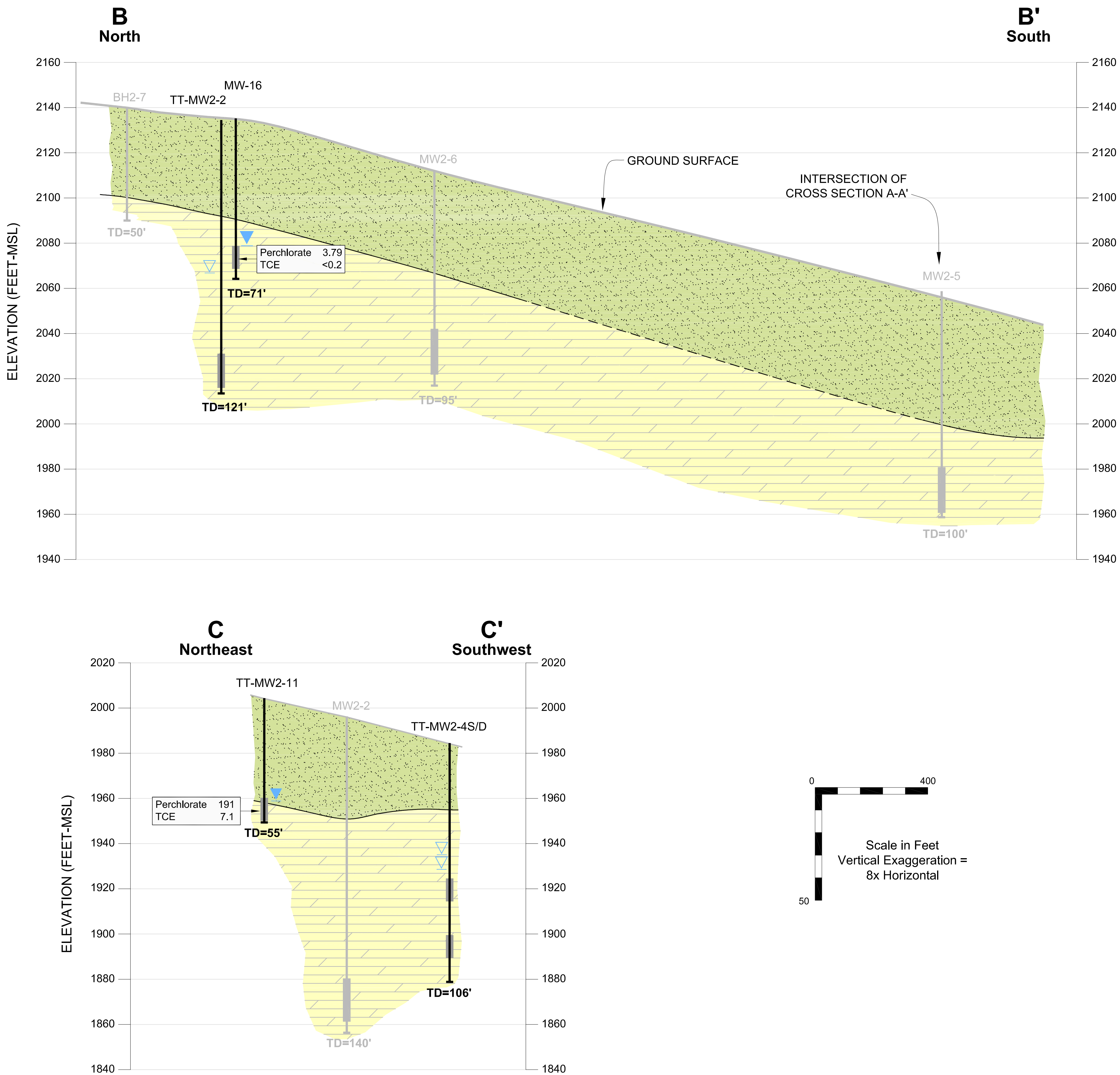

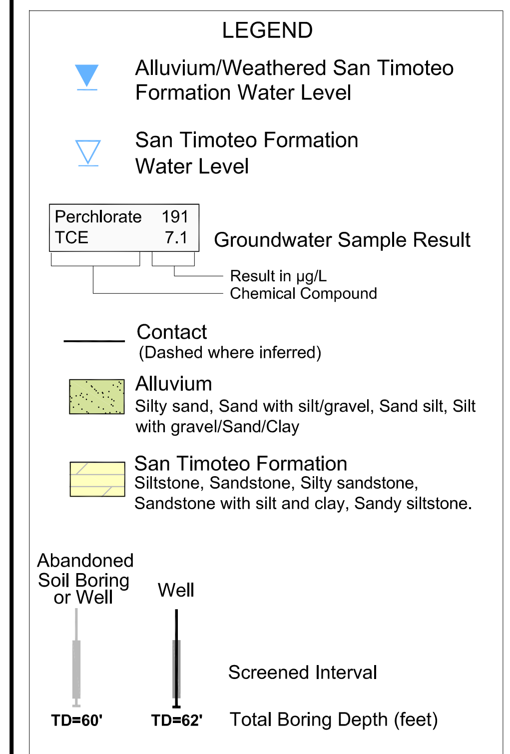

Note: Water levels shown are from 11/20/06 sampling event.

µg/L Micrograms per liter.

Beaumont Site 2

Figure 3-12
Perchlorate and TCE Groundwater Results (µg/L) Along Geologic Cross Sections B-B' and C-C'

TETRA TECH

TT-MW2-14 was installed topographically down slope and hydrogeologically downgradient of TT-MW2-3. The well was installed at first groundwater in the QAL/wSTF to evaluate groundwater quality in Test Bay Canyon downgradient of the test bays. The concentration of perchlorate detected in the groundwater sample collected from TT-MW2-14 was 34,800 µg/L.

TT-MW2-13 was installed in Laborde Canyon across the drainage from the conditioning chambers. The well is topographically down slope and hydrogeologically downgradient of TT-MW2-14 and the test bays. The well was installed at first groundwater in the QAL/wSTF to evaluate groundwater quality in Laborde Canyon across from the conditioning chambers downgradient of the test bays. The concentration of perchlorate detected in the groundwater sample collected from TT-MW2-13 was 6,350 µg/L.

TT-MW2-1 was installed in Laborde Canyon in 2004. The well is located adjacent to former production well W2-3 and across the drainage from the T-revetment conditioning chambers. The well was installed to evaluate groundwater quality adjacent to the former production wells and down gradient of the condition chambers. The well was installed in the QAL/wSTF and the concentration of perchlorate detected at the time of this investigation was 4,930 µg/L.

TT-MW2-18 was installed in the STF immediately adjacent to TT-MW2-1. The well was intended to evaluate water quality below the interval monitored by TT-MW2-1. The concentration of perchlorate detected in the groundwater sample collected from TT-MW2-18 was 15,000 µg/L.

The groundwater plume morphology observed supports that the primary source of the perchlorate impacting the groundwater in Area K was released at or near the test bays. This is consistent with the results of the earlier soil investigations performed at the Site. During those investigations and the limited soil testing done during this investigation, perchlorate impacted soils were found in and around the test bays and not in the samples collected from the conditioning chambers.

TCE was also detected in the groundwater collected from two wells (TT-MW2-3 and TT-MW2-17D) near the earthen prism in Area K. The concentrations detected in these two wells were 4.2 and 3.2 µg/L respectively. No impacts to soil were detected during soil investigations in this area. Based on the available data it would appear a small amount of TCE was released and has impacted the groundwater.

Area L

Area L is located within Laborde Canyon and is located topographically down slope and hydrogeologically downgradient of Area J and K. Four (4) groundwater monitoring wells (TT-MW2-4S, TT-MW2-4D, TT-MW2-10, and TT-MW2-12) currently exist in Area K. TT-MW2-4S and D were installed in 2004 and the other two (2) were installed during this investigation.

TT-MW2-12 is located adjacent to the reported propellant burn area and topographically down slope and hydrogeologically downgradient of the conditioning chambers. The well was installed at first observed water which was in the STF. The concentration of perchlorate detected in the groundwater sample collected from TT-MW2-12 was 2.73 µg/L.

TT-MW2-10 is located across the drainage and topographically down slope and hydrogeologically downgradient of TT-MW2-12. The well was installed at first observed water in the QAL/wSTF. Perchlorate was not detected in the groundwater sample collected from TT-MW2-10.

TT-MW2-4S and D were completed in the STF and no COPCs were detected in these wells at the time of this investigation.

The data from Area L further supports the condition observed in Area K. The groundwater plume morphology supports that the primary source of the perchlorate impacting the groundwater is in Area K and was released at or near the test bays. This is consistent with the results of the earlier soil investigations performed at the Site. During those investigations and the limited soil testing done during this investigation, perchlorate impacted soils were found in and around the test bays and not in the samples collected from the reported propellant burn area. It appears the perchlorate plume originating in Area K may not extend beyond the boundaries of Area L but the hydrogeology in this area is complex and it is possible the plume does extend downgradient of the former operational areas.

Area M

Area M is located within a smaller unnamed canyon adjacent to Area L. This unnamed canyon drains into Laborde Canyon from the east. A disposal area was located within the unnamed canyon (Disposal Area Canyon). Both surface water and groundwater from the Disposal Area Canyon appear to drain into Laborde Canyon near the end of Area K. One (1) groundwater monitoring well (TT-MW2-11) currently exists in Area M. It was installed during this investigation.

TT-MW2-11 was installed at first groundwater in the QAL/wSTF to evaluate groundwater quality downgradient of the former waste disposal area. Both COPCs were detected in the groundwater samples collected from TT-MW2-11. Perchlorate and TCE were detected at 191 and 7.1 µg/L respectively. Based on the available data it would appear a small amount of perchlorate and TCE were released and have impacted the groundwater. The limits of the impacted groundwater are not known at this time.

South Of The Former Operational Areas

Based on the available information groundwater at the Site generally flows to the south. Between the former operational areas and the property boundary seven (7) monitoring wells (TT-MW2-5,

TT-MW2-6S, TT-MW2-6D, TT-MW2-7, TT-MW2-8, TT-MW2-9S, and TT-MW2-9D) currently exist in this portion of the Site. All of these wells are topographically down slope and hydrogeologically downgradient of all of the former operational areas. Three monitoring wells (TT-MW2-5, TT-MW2-6S, and TT-MW2-6D) were installed in 2005 and the other four (4) monitoring wells were installed during this investigation.

TT-MW2-9S and D are a clustered wells pair located within Laborde Canyon. They are located adjacent to the recently discovered discharge ponds. TT-MW2-9S was installed at first groundwater and is completed in the QAL/wSTF. TT-MW2-9D was installed in the STF. Perchlorate is the only COPC detected in the wells. It was detected in the groundwater samples collected from TT-MW2-9S and TT-MW2-9D at a concentration of 324 and 28.8 µg/L respectively.

TT-MW2-6S and D are a clustered well pair located within Laborde Canyon near the drainage. They are located topographically down slope and hydrogeologically downgradient of monitoring wells TT-MW2-9S and D. TT-MW2-6S was installed at first groundwater and is completed in the QAL/wSTF. TT-MW2-6D was installed in the STF. Perchlorate is the only COPC detected in the groundwater in this location. It was detected in the groundwater samples collected from TT-MW2-6S at a concentration of 298 µg/L and it was not detected in the groundwater samples collected form TT-MW2-6D.

TT-MW2-5 is located within Laborde Canyon adjacent to TT-MW2-6S and D. It is located hydrogeologically crossgradient of monitoring wells TT-MW2-6S and D. TT-MW2-5 was installed at first groundwater and is completed in the QAL/wSTF. Perchlorate is the only COPC detected in the groundwater collected from this well and it was reported at a concentration of 981 µg/L.

TT-MW2-7 and TT-MW2-8 are located within Laborde Canyon at the property boundary. The wells are located cross gradient from one another and they are located topographically down slope and hydrogeologically downgradient of monitoring wells TT-MW2-6S and D. TT-MW2-7 and TT-MW2-8 were installed at first groundwater and are completed in the QAL/wSTF. Perchlorate is the only COPC detected in the groundwater collected from this well and it was reported at a concentration of 379 and 347 µg/L respectively.

The plume morphology observed suggests that a second source of perchlorate has impacted the groundwater south of the former operational areas. It is possible that the recently discovered Waste Discharge Area located near well cluster TT-MW2-9S and D is the source of the perchlorate plume observed. Due to the complex hydrogeology in this region it is possible that the perchlorate plume associated with Area K is also contributing to the plume south of the former operational areas but the migration pathway is not understood at this time. The limits of the groundwater plume observed south of the former operational areas is not known at this time.

3.8 HABITAT CONSERVATION

Consistent with the U.S. Fish and Wildlife Service approved Habitat Conservation Plan [(HCP), USFWS, 2005] and subsequent clarifications (LMC, 2006a and 2006b) of the HCP describing activities for environmental remediation at the Site, all field activities were performed under the supervision of a Section 10A permitted or sub-permitted biologist who monitored each work location. As a result, no impact to SKR occurred during the performance of the groundwater monitoring well installation, development and sampling field activities.

Section 4.0

Conclusions and Recommendations

4.0 CONCLUSIONS AND RECOMMENDATIONS

On behalf of LMC, Tetra Tech has completed an initial groundwater delineation program for Beaumont Site 2 in Beaumont, California. The objectives of the investigation program were: (1) to assess the lateral and vertical extents of perchlorate and TCE affected groundwater, and (2) obtain more information on groundwater flow patterns at the Site. As part of this investigation, 13 monitoring wells and one (1) piezometer were installed to evaluate groundwater flow direction and quality. In addition, soil sampling for perchlorate analysis was conducted at the monitoring well and piezometer locations. The soil and groundwater data collected from this investigation, coupled with historical sampling data and regional hydrogeologic, land use and water usage information, were used to revise the CSM. This section presents conclusions derived from the results of the investigation effort and presents recommendations for further action.

4.1 GEOLOGY

The Site is primarily located within the confines of the Laborde Canyon valley floor, which lies between the western foothills of the San Jacinto Mountains to the southeast and a “Badlands” topographic area to the northwest. Subsurface investigations and seismic surveys conducted at the Site identified the QAL and the STF (both unweathered and weathered portions). Based on the results of the soil borings, the thickness of the QAL/wSTF ranges from about 35 feet at the southernmost portions of the Site to approximately 70 feet in the northern most portions of the Site. At depth, the bedrock becomes less weathered and more competent. The bottom of the STF was not reached during investigations conducted at the Site, but regional literature indicates the STF is estimated to be between 1,500 and 2,000 feet thick (CGB, 2004). While distinctive traceable marker beds were not apparent between borings, strike and dip information around the Site ranges from north 3 degrees west to north 80 degrees east and dips ranging from horizontal to 27 degrees north.

The Site is located between the strike-slip San Andreas and San Jacinto Fault Zones that bisect the San Bernardino Basin. Branch faults associated with the San Jacinto Fault have been mapped near the southern Site boundary. The San Jacinto Fault Zone is located to the southwest, and generally parallel to the San Timoteo Anticline axis. Regional literature has suggested that the identified fault zones affect groundwater movement.

4.2 HYDROGEOLOGY

Based on groundwater level measurements and topography, groundwater flow in the QAL/wSTF appears to follow the southward topographic slope of the Laborde Canyon floor. While groundwater data is more limited for the STF, groundwater flow appears also to flow southward down the slope of Laborde

Canyon. The K values for the wells screened within the QAL/wSTF range from 0.45 ft/day to 18.08 ft/day. The K values for the wells screened within the STF range from 0.017 to 10.4 ft/day.

Based on the 2006 groundwater level measurements, shallow and deeper monitoring well pairs indicated a downward vertical gradient. Vertical gradients ranged from -0.011 to -0.48 ft/ft. The lowest vertical gradients are in the TT-MW2-17S/D well nest, located near the Prism. The highest vertical gradients are in the TT-MW2-6S/D well nest, located approximately 1,500 feet south of Area L.

Based on lithology observed during drilling and ionic groundwater signatures, two (2) HSUs have been identified at the Site, the QAL/wSTF and the STF HSU. With one exception, first groundwater is typically observed in the QAL/wSTF. TT-MW2-12 has been classified as an STF monitoring well but it represents first groundwater in the location where it was drilled.

4.3 CHEMICALS OF POTENTIAL CONCERN

Consistent with prior investigations, perchlorate was identified as a primary COPC and TCE was identified as a secondary COPC. Identified metals will be further evaluated during forthcoming risk assessments that will include determination of background concentrations for the Site. No new COPCs were identified during this investigation.

Perchlorate was reported in groundwater samples collected from 12 of the 13 newly installed monitoring wells sampled. Perchlorate exceeded the MCL of 6 µg/L in 10 wells, ranging in concentration from 28.8 to 79,300 µg/L.

TCE was reported above the MCL of 5 µg/L in the monitoring well in Area M at a concentration of 7.1 µg/L. TCE was also reported in a monitoring well in Area K at a concentration of 3.2 µg/L. The distribution of TCE is consistent with previous investigations in that it is found co-located with perchlorate, at two (2) locations, and at much lower concentrations.

Five (5) wells in strategic locations across the Site were tested for emerging contaminants. NDMA was detected in three (3) of those wells at concentrations ranging from 3.05 to 8.89 ng/L. The DWNL for NDMA is 10 ng/L. NDMA is not considered a COPC at this time but additional testing will be done to confirm the detection of the compound and further evaluate the extent of the compound if confirmed.

4.4 PRIMARY COPC DISTRIBUTION

The lateral and vertical distribution of perchlorate concentrations in soil and groundwater indicate several potential source areas are present at the Site. A summary of known/suspected perchlorate source areas and plume characteristics are presented below:

4.4.1 Area J - Final Assembly Area

Area J is located within Laborde Canyon at the top of the Site and is topographically upslope and hydrogeologically upgradient of the other operational areas. During this and earlier investigations perchlorate was not detected in the soil samples from the vadose zone in Area J. Two (2) groundwater monitoring wells (TT-MW2-2 and TT-MW2-16) currently exist in Area J. TT-MW2-2 was installed in 2004 and the TT-MW2-16 was installed during this investigation.

TT-MW2-2 was installed in the deeper STF and no COPCs have been detected in the groundwater samples collected from this well. TT-MW2-16 was installed at first groundwater in the QAL/wSTF to evaluate shallower groundwater quality near the former assembly building. Perchlorate was detected at a concentration less than the MCL of 6 µg/L in this monitoring well.

The closest existing downgradient monitoring well is TT-MW2-13 approximately 2,750 feet south of TT-MW2-16. This well is located in Laborde Canyon at the confluence of Laborde Canyon and Test Bay Canyon. Therefore, this monitoring well is downgradient of both Areas J and K. Perchlorate was detected in groundwater samples collected from TT-MW2-13 at a concentration three orders of magnitude greater than TT-MW2-16. However, based on its location, this detection is likely from Area K. This is further supported by previous investigations. In 1992, a groundwater sample collected from former downgradient monitoring well MW2-6 reported no detectable (<200 µg/L) perchlorate. Although the detection level was elevated during that earlier investigation, the data does not support that historical operations in Area J are responsible for the perchlorate detected in downgradient monitoring well TT-MW2-13. Based on the available data it would appear a small amount of perchlorate was released near the former assembly building and has locally impacted the shallow groundwater.

4.4.2 Area K - Test Bays and Miscellaneous Facilities

Area K is located in Laborde Canyon and Test Bay Canyon that drains into Laborde Canyon from the west. Area K is located topographically down slope and hydrogeologically downgradient of Area J. Within Area K the test bays were located in Test Bay Canyon and the conditioning chambers were located in Laborde Canyon. Analytical data from soil sampling performed during this investigation and previous investigations indicate a number of the features in the Test Bay Canyon may have impacted groundwater including the earthen prism, centrifuge area, bunker area, and the three (3) southernmost test bays. Test Bay Canyon is topographically upslope and hydrogeologically upgradient of the area within Laborde Canyon where the conditioning chambers were located. Seven (7) groundwater monitoring wells (TT-MW2-1, TT-MW2-3, TT-MW2-13, TT-MW2-14, TT-MW2-17S, TT-MW2-17D, and TT-MW2-18) currently exist in Area K. TT-MW2-1 and TT-MW2-3 were installed in 2004 and the other five (5) were installed during this investigation.

The highest concentrations of perchlorate in groundwater have been detected in groundwater near the earthen prism and the test bays. Nested monitoring well pair TT-MW2-17S and D were installed in that area to evaluate the vertical distribution of the perchlorate impacts. The concentrations in the deeper well were considerably higher than those detected in the shallower well. The conductivity in the deeper well is also higher than the shallower well. This could indicate that the source of the perchlorate detected in the groundwater in this area was released up or crossgradient and has migrated into the area along the preferred pathway.

TT-MW2-14, TT-MW2-13, and TT-MW2-18 were installed downgradient of the presumed source area in Test Bay Canyon. Perchlorate was detected in the groundwater samples collected from these wells. There are no known sources of perchlorate in this portion of Area K and the concentration gradient observed in three (3) wells supports an upgradient source of perchlorate.

All of the wells installed in Area K were completed in the wSTF except TT-MW2-18, it was completed in the STF. The well was completed near an older QAL/wSTF monitoring well (TT-MW2-1) and former production well W2-3. Based on perchlorate detected in this well it appears there has been hydraulic communication between the QAL/wSTF and STF in this area or upgradient of this area. The hydrogeology in the region is complicated. It is possible that there is vertical communication between the HSUs or the former production well may have been the conduit for vertical migration.

4.4.3 Area L - Propellant Burn Area

Area L is located within Laborde Canyon and is located topographically down slope and hydrogeologically downgradient of Area J and K. During this and earlier investigations perchlorate was not detected in the soil samples collected from the vadose zone. Four (4) groundwater monitoring wells (TT-MW2-4S, TT-MW2-4D, TT-MW2-10, and TT-MW2-12) have been installed in Area K. TT-MW2-4S and D were installed in 2004 and the other two (2) were installed during this investigation.

Perchlorate was detected in both the QAL/wSTF and STF HSUs in monitoring wells TT-MW2-1 and TT-MW2-18 at the southern limits of Area K. However, QAL/wSTF monitoring well TT-MW2-10 and STF monitoring wells TT-MW2-12, TT-MW2-4S, and TT-MW2-4D, located in the central portion of Area L, did not report perchlorate above the MCL of 6 µg/L.

The concentration gradient of the perchlorate plume detected in Area K and L is consistent with a single plume originating in Area K that has migrated into Area L. The plume was not detected in the southern portion of Area L. The absence of perchlorate may indicate the plume is delineated or it could be that the hydrogeology in this area is not completely understood at this time.

4.4.4 Area M - Garbage Disposal Area

Area M is located within a smaller unnamed canyon adjacent to Area L. This unnamed canyon drains into Laborde Canyon from the east. A disposal area was located within the unnamed canyon (Disposal Area Canyon). Both surface water and groundwater from the Disposal Area Canyon appear to drain into Laborde Canyon near the end of Area K. Perchlorate was detected in soil samples collected from the former disposal area during the 2004 investigation (2005a). One (1) groundwater monitoring well (TT-MW2-11) currently exists in Area M. It was installed during this investigation.

TT-MW2-11 was installed at first groundwater in the QAL/wSTF to evaluate groundwater quality downgradient of the former waste disposal area. Perchlorate was detected in groundwater collected from this well. No other monitoring wells are currently installed within Area M but, in 1992, a groundwater sample collected from former downgradient monitoring well, MW2-2, reported no detectable (<200 µg/L) perchlorate. Although the detection level was elevated during that earlier investigation, the data does not support that historical operations in Area M are a primary source for the perchlorate detected further down Laborde Canyon.

4.4.5 South Of The Former Operational Areas

Historical reports did not indicate that any operational activities took place in the area south of the four (4) known operational areas. This portion of the Site is topographically down slope and hydrogeologically downgradient of Areas J, K, L, and M. Perchlorate has been detected in soil samples collected in two (2) locations in this area. In the recently discovered waste discharge area and in soil samples collected during the installation of TT-PZ2-1. The origin of the perchlorate detected at TT-PZ2-1 is uncertain but the perchlorate detected at the discharge area indicates that a release has taken place in that area. Between the former operational areas and the property boundary seven (7) monitoring wells (TT-MW2-5, TT-MW2-6S, TT-MW2-6D, TT-MW2-7, TT-MW2-8, TT-MW2-9S, and TT-MW2-9D) currently exist in this portion of the Site. Three (3) monitoring wells (TT-MW2-5, TT-MW2-6S, and TT-MW2-6D) were installed in 2005 and the other four (4) monitoring wells were installed during this investigation.

The plume morphology observed suggests that a second source of perchlorate has impacted the groundwater south of the former operational areas. It is possible that the recently discovered waste discharge area located near well cluster TT-MW2-9S and D is the source of the perchlorate plume observed. Due to the complex hydrogeology in this region it is also possible that the perchlorate plume associated with Area K is also contributing to the plume south of the former operational areas but the migration pathway is not understood at this time. It appears the vertical limits of the impacted groundwater are generally limited to the QAL/wSTF HSU in this portion of the Site but the horizontal limits of the groundwater plume observed south of the former operational areas is not known at this time.

4.5 RECOMMENDATIONS

Based on previous investigations and the results of the soil and groundwater sampling associated with the 14 newly installed wells/piezometers at Beaumont Site 2, additional soil and groundwater investigation is recommended. Investigations at the Liquid Waste Discharge Area and south of the Site are already underway and not included in the recommendation listed below.

- Site Wide
    - All new wells will be included in the routine GMP. The approved program requires that all new wells be sampled quarterly and then classified for long-term monitoring.
    - Retest the three monitoring wells where NDMA was detected to confirm the detection of the compound. Collect and analyze groundwater samples from all water table wells for NDMA. Evaluate the results of the NDMA analyses to determine if additional sampling is required.
- Area J
    - No further soil or groundwater investigations are recommended in this area at this time.
- Area K
    - Soil investigation is recommended to better define the mass of the source of the perchlorate detected in the groundwater.
    - Better define the horizontal and vertical limits of the perchlorate impacts to groundwater.
- Area L
    - Test the small side canyon south of the T-revetment to determine if this area was used as the propellant burn area described in the historical report and if this activity impacted the soils.
    - Better define the horizontal and vertical limits of the perchlorate impacts to groundwater.

- Area M
  - Soil investigation is recommended to better define the mass of the source of the perchlorate detected in the groundwater.
  - Better define the horizontal and vertical limits of the perchlorate impacts to groundwater.
- South of the Former Operational Areas
  - Soil investigation is recommended to better define the limits of the perchlorate impacted soil near TT-PZ2-1.

Section 5.0

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5.0 REFERENCES

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Section 6.0

Acronyms

6.0 ACRONYMS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylene
CAM	California Assessment Manual
CDHS	California Department of Health Services
CGB	California’s Groundwater Bulletin
COPC	chemical(s) of potential concern
CSM	conceptual Site model
1,1-DCE	1,1-dichloroethene
DO	dissolved oxygen
DOT	U.S. Department of Transportation
DTSC	Department of Toxic Substances Control
DWNL	California Department of Health Services drinking water notification level
DWR	Department of Water Resources
EC	electrical conductivity
EM	electromagnetic
EMWD	Eastern Municipal Water District
EPA	U.S. Environmental Protection Agency
ft/day	feet per day
ft/ft	feet per foot
GCR	Grand Central Rocket
GMP	groundwater monitoring program
HCL	hydrochloric acid
HCP	Habitat Conservation Plan
HSA	hollow stem auger
HSUs	Hydrostratigraphic Units
K	hydraulic conductivity
IDW	investigation-derived waste handling
LAC	Lockheed Aircraft Corporation
LEBs	LMC equipment blanks
LMC	Lockheed Martin Corporation
LPC	Lockheed Propulsion Company
LRLs	laboratory reporting limits

LTBs	LMC trip blanks
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
meq/L	milliequivalent per liter
mV	millivolt
msl	mean sea level
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
NA	not analyzed
NDMA	N-nitrosodimethylamine
ng/L	nanograms per liter
NTUs	nephelometric turbidity units
NWS	National Weather Service
OVA	Organic vapor analyzer
PCBs	polychlorinated biphenyls
PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
QAL	Quaternary alluvium
QC	Quality Control
SKR	Stephens' kangaroo rat
STF	San Timoteo Formation
SVOCs	semi-volatile organic compounds
TCE	trichloroethene
TPH	total petroleum hydrocarbons
UDMH	unsymmetrical dimethyl hydrazine
U.S.	United States
USFWS	United States Fish and Wildlife Service
VOCs	volatile organic compounds
wSTF	weathered San Timoteo Formation