Revised

Scoping Ecological Risk Assessment
Lockheed Beaumont Site 1
Beaumont, California

Prepared for:

LOCKHEED MARTIN

TETRA TECH

301 E. Vanderbilt Way, Suite 450
San Bernardino, California 92408

TC# 100-LCC-T23473-04 / April 2010

Lockheed Martin Corporation, Shared Services
Energy, Environment, Safety and Health
2950 North Hollywood Way, Suite 125 Burbank, CA 91505
Telephone: 818.847.0197 Facsimile: 818.847.0256

LOCKHEED MARTIN

April 16, 2010

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

Subject: Submittal of the Final *Scoping Ecological Risk Assessment, Lockheed Beaumont Site 1, Beaumont, California*

Dear Mr. Zogaib:

Please find enclosed one hard copy of the body of the revised, final report and two CDs of the report and appendices of the final *Scoping Ecological Risk Assessment, Lockheed Beaumont Site 1, Beaumont, California* for your files. This report incorporates changes agreed to in the DTSC approved Response to Comments on the report; a summary of these responses is included as an enclosure to this letter.

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

Sincerely,

Denise Kato

Denise Kato
Remediation Analyst Senior Staff

Enclosures

Copy with Enclosures:
J Michael Eichelberger, DTSC (hard copy and CD)
Gene Matsushita, LMC (hard copy and CD)
Denise Kato, LMC (CD)
Ian Lo, CDM (CD)
Tom Villeneuve, Tetra Tech (hard copy and CD)
Kay Johnson, Tetra Tech (hard copy and CD)
Eddy Konno, CDFG (CD)

BUR081 Beau 1 Final SERA

Department of Toxic Substances Control

Linda S. Adams
Secretary for
Environmental Protection

Maziar Movassaghi
Acting Director
8800 Cal Center Drive
Sacramento, California 95826-3200

Arnold
Schwarzenegger
Governor

MEMORANDUM

TO: Daniel K. Zogaib
Hazardous Substances Engineer
California Environmental Protection Agency
Department of Toxic Substances Control (DTSC)
5796 Corporate Avenue
Cypress, CA 90630

FROM: J. Michael Eichelberger, Ph.D. J Michael Eichelberger
Staff Toxicologist
Human and Ecological Risk Office (HERO)
Ecological Risk Assessment Section (ERAS)

DATE: January 6, 2010

SUBJECT: SCOPING ECOLOGIAL RISK ASSESSMENT LOCKHEED BEAUMONT SITE 1 BEAUMONT, CALIFORNIA.

PCA: 11050 Site Code: 400200-00

Background

The Lockheed Martin Corporation (LMC) Site 1 facility is a 9,100 acre former rocket motor assembly and testing site, located west of the City of Beaumont and 70-miles east of Los Angeles in Riverside County. In addition to the rocket motor work, other activities at the site included ballistic tests of inert small caliber artillery shells and detonation of land mines. Low level radioactive waste was buried on site and incendiary bombs were exploded with at least one instance where the detonation occurred among drums filed with various types of fuels. Excess and unspent rocket propellant was burned on site. Roll over tests of military vehicles were also conducted. Lockheed Martin Corporation currently owns only 565 acres of the 9,100 acre Site 1 facility. The State of California purchased the balance of the property (8,552 acres) as a wildlife park and nature preserve. The Federally-endangered Stephen's kangaroo rat (SKR), is known to occur on site.

Document Reviewed

HERD reviewed "Scoping Ecological Risk Assessment Lockheed Beaumont Site 1, Beaumont, California" hereafter referred to as the report. The report was prepared by Tetra Tech (San Bernardino, CA) and dated September 10, 2009. HERD received the report for review September 14, 2009.

Scope of the Review

The report was reviewed for scientific content related to ecological risk assessment. Grammatical or typographical errors that do not affect the interpretation of the text have not been noted.

General Comments

Overall, the report is thorough and complete and meets the requirements set forth in DTSC guidance (http://www.dtsc.ca.gov/AssessingRisk/eco.cfm) regarding the preparation of a Scoping Ecological Risk Assessment (SERA). History of the site is provided including property ownership and a description of site related activities. The report describes the geographical location of eight operation areas identified as Areas of Concern (AOCs) contained therein, and provide maps showing their locations both regionally and locally. AOCs range in size from 980 acres to 15 acres but sampling was confined to areas within the AOCs where potential contamination was suspected. In addition, 4 riparian or aquatic AOCs have been identified and surface water and sediment samples have been collected from these. A list of potential biological receptors is provided and special status species potentially present are listed. Media-based Chemicals of Potential Ecological Concern (COPECs) are identified by AOC and a Conceptual Site Model based on general ecological guilds and site media is presented. In general these components described above meet the DTSC requirements for a SERA. Specific Comments to the SLERA are offered below.

Specific Comments

1. Table 2-3, Number of Soil Samples Collected from 2002 to 2008 (0-10 feet bgs). Calculation of a Reasonable Maximum Exposure (RME) based on individual COPECs by Operational Area will need to consider statistical power in determining if a 95percent Upper Confidence Limit on the Arithmetic mean or the maximum concentration is appropriate on a case by case basis. For example Table 2-3 shows the following number of samples per Operational Area for 1,4-Dioxane: A, 29; B, 85; C, 64; D, 7; F, 95; G, 4; H, 10; and, I, 5. The methodology for determining the RME will need to be described in the Predictive Ecological Risk Assessment Work Plan.

2. Page 2-31, Section 2.4.1, Summary of Soil Data. ERAS does not agree that the available data characterizes the 0-5 foot bgs sample interval. There are no intermediate data from the 2-3 foot depth. ERAS continues to recommend that the maximum of either the 0.5 foot or 5 foot sample be used to represent the intermediate depth of 2-3 feet.

3. Table 2-5, Shallow Groundwater Monitoring Wells. ERAS assumes the minimum depth to groundwater is meant to be in feet but is not specified in the table.

4. Page 2-41, Section 2.5.1, Soil COPECs. The report states "*Certain of the MDLs for antimony and cadmium in samples exceeded the mammalian Eco-SSL-based screening values, while certain of the MDLs for zinc exceeded the bird Eco-SSL and the plant benchmark (Appendix B)*". Since the Method Detection Limits (MDLs) were elevated it is clear that sampling for these constituents may not be adequate to determine lateral extent of levels that may pose a hazard to ecological receptors. Since ambient or background concentrations have been established, this section of the report should provide a comparison of the MDLs with the ambient or background concentrations for these three metals. Eco-SSLs are based on protective TRVs. Protection of endangered and threatened species such as the Stephen's kangaroo rat to the no-effect level is required. However, ERAS does not require protection be provided below ambient or background concentrations.

1. Table 3-2, Summary of Species Observed and Potentially Present in Each Habitat. The data presented in Table 3-2, regarding plants is a bit confusing. No plants were reported observed in Scrubs (including Coastal Sage Scrub) and Chamise/Chaparral. If there were no plants, by definition there would be no habitat. ERAS also finds it implausible no birds were observed in chamise/chaparral.

2. Table 3-4, List of Invertebrates in Each Area of Concern. The Fairy shrimp *Branchinecta lilndhali* has been observed in Operational Areas B and D. Please explain the asterisk for each observation, there is no footnote identifier.

3. Table 3-5, Comprehensive List of Amphibians and Reptiles in Each Area of Concern. The western spadefoot toad has been observed in Operational Areas A, D, F and G. The species is a California Species of Special Concern. Its lifecycle requirements include aquatic habitat such as vernal pools and stock ponds for breeding and upland areas up to a mile from the breeding areas that are utilized for foraging and aestivation in burrows a meter deep in the soil (http://www.buttehcp.com/documents/Revised_Models_12-6-07/Western_Spadefoot_Toad.pdf). The risk assessment will need to describe

methods for assessing hazard not only in the aquatic environment, but also in the terrestrial environment where the toad spends the vast majority of its life.

4. Page 3-25, Section 3.3.2, Species Lists by Habitat and AOC, Invertebrates. Please explain the discrepancy between Table 3-4 which shows that *Branchinecta lynchi* has been observed at Operation Areas B and D and the text on page 3-25 and Table 3-8 (Special Status Animals Potentially Present within Areas of Concern) which states that the species has not been observed on site.

5. Figure 4-1, Conceptual Site Model for Ecological Receptors. Reptiles may drink water. For example rattlesnakes will drink water when it is available. ERAS believes that the surface water ingestion pathway for reptiles should be listed as a potentially complete exposure pathway rather than potentially complete exposure route but insignificant and not evaluated. It is acknowledged however, that because of limited toxicity data reptiles will not be evaluated quantitatively in the risk assessment. Burrowing owls are carnivorous and therefore inhalation of burrow air should be considered a potentially complete exposure pathway. Finally, adult amphibians exposure from food in the terrestrial environment should not be listed as insignificant even if the exposure is evaluated because of a lack of exposure data.

6. Page 4-5, Section 4.2.1, Second bullet: The second bullet that states '*Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors*' needs to be qualified. ERAS would agree that for many COPECs, for example metals, this statement is true, but for others such as highly lipophilic chemicals, dermal absorption can be very significant and could exceed exposure due to ingestion. Please qualify the statement in terms of the COPECs the statement is intended to address.

Conclusions

ERAS believes the report meets the requirements of a SERA. The specific comments should be addressed but the report is largely complete and ERAS agrees with the conclusion of the report that a Predictive Ecological Risk Assessment should be performed.

Reviewed by: James M. Polisini, Ph.D. BF for JP
Staff Toxicologist, ERAS

Responses to DTSC Comments on the Draft Scoping Ecological Risk Assessment, Lockheed Martin Corporation, Beaumont Site 1, Beaumont, California
Tetra Tech, Inc
February 2010

Comments from J. Michael Eichelberger		
General Comments		
Comment	**Response**	**Proposed Action**
General Comments. Overall, the report is thorough and complete and meets the requirements set forth in DTSC guidance (http://www.dtsc.ca.gov/AssessingRisk/eco.cfm) regarding the preparation of a Scoping Ecological Risk Assessment (SERA). History of the site is provided including property ownership and a description of site related activities. The report describes the geographical location of eight operation areas identified as Areas of Concern (AOCs) contained therein, and provide maps showing their locations both regionally and locally. AOCs range in size from 980 acres to 15 acres but sampling was confined to areas within the AOCs where potential contamination was suspected. In addition, 4 riparian or aquatic AOCs have been identified and surface water and sediment samples have been collected from these. A list of potential biological receptors is provided and special status species potentially present are listed. Media-based Chemicals of Potential Ecological Concern (COPECs) are identified by AOC and a Conceptual Site Model based on general ecological guilds and site media is presented. In general these components described above meet the DTSC requirements for a SERA. Specific Comments to the SLERA are offered below.	Comments noted. Responses to specific comments are provided below.	None.

Comments from J. Michael Eichelberger		
Specific Comments		
Comment	**Response**	**Proposed Action**
Specific Comment 1, Table 2-23, Number of Soil Samples Collected from 2002 to 2008 (0-10 feet bgs). Calculation of a Reasonable Maximum Exposure (RME) based on individual COPECs by Operational Area will need to consider statistical power in determining if a 95 percent Upper Confidence Limit on the arithmetic mean or the maximum concentration is appropriate on a case by case basis. For example Table 2-3 shows the following number of samples per Operational Area for 1,4-Dioxane: A, 29; B, 85; C, 64; D, 7; F, 95; G, 4; H, 10; and I, 5. The methodology for determining the RME will need to be described in the Predictive Ecological Risk Assessment Work Plan.	A reasonable maximum exposure (RME) will generally be determined using a 95 percent upper confidence limit on the mean (UCL_{95}) concentration calculated using ProUCL v4 (USEPA 2009a), which follows current USEPA (2009b) guidance. ProUCL will only calculate a UCL_{95} when there are a sufficient number of sample results relative to the variability of the data. Depending on the variability, the minimum data set required may be as few as five detected concentrations. If there are insufficient detected sample results, then ProUCL will not calculate a UCL_{95} and the maximum detected concentration will be selected as the RME. The PERA Work Plan will discuss the potential uncertainty related to using UCLs for small data sets (e.g., 4 to 6 detected observations, as identified by USEPA [2009b]) when the maximum detection is not selected as the RME. For example, uncertainty in specific hazard quotients that are based on UCLs for 6 or fewer detections will be identified in the uncertainty analysis of the PERA.	The methodology for calculating the RME will be described in the Predictive Ecological Risk Assessment (PERA) Work Plan. The work plan will also discuss potential uncertainty related to the UCLs for small data sets.
Specific Comment 2, Page 2-31, Section 2.4.1, Summary of Soil Data. ERAS does not agree that the available data characterizes the 0-5 foot bgs sample interval. There are no intermediate data from the 2-3 foot depth. ERAS continues to recommend that the maximum of either the 0.5 foot or 5 foot sample be used to represent the intermediate depth of 2-3 feet.	Comment noted. At each boring, soil samples were collected at 0.5 and 5 feet bgs. To address the uncertainty related to the lack of samples collected at 2-3 feet bgs, as stated in the responses to comments (Tetra Tech 2009a) on the SERA for Beaumont Site 2 (Tetra Tech 2009b), the exposure point concentrations (EPCs) for the 0-2 and 0-5 feet bgs intervals will be calculated by replacing the lower concentration of the 0.5 and 5 foot samples with the higher of the two concentrations. Thus, the EPCs will be calculated using a total of two identical values, effectively, at each boring location.	The conservative approach for calculating the soil EPCs for the 0-2 and 0-5 feet bgs depth intervals will be described in the Site 1 PERA Work Plan.

Comments from J. Michael Eichelberger		
Specific Comments		
Comment	**Response**	**Proposed Action**
Specific Comment 3, Table 2-5, Shallow Groundwater Monitoring Wells. ERAS assumes the minimum depth to groundwater is meant to be in feet but is not specified in the table.	The minimum depth to groundwater is in units of feet.	The units of feet will be added to Table 2-5.
Specific Comment 4, Section 2.5.1, Soil COPECs. The report states "*Certain of the MDLs for antimony and cadmium in samples exceeded the mammalian Eco-SSL-based screening values, while certain of the MDLs for zinc exceeded the birds Eco-SSL and the plant benchmark (Appendix B)*". Since the Method Detection Limits (MDLs) were elevated it is clear that sampling for these constituents may not be adequate to determine lateral extent of levels that may pose a hazard to ecological receptors. Since ambient or background concentrations have been established, this section of the report should provide a comparison of MDLs with the ambient or background concentrations for these three metals. Eco-SSLs are based on protective TRVs. Protection of endangered and threatened species such as the Stephens' kangaroo rat to the no-effect level is required. However, ERAS does not require protection to be provided below ambient or background concentrations.	A reevaluation of the data indicated that for nondetects of zinc, all of the MDLs were less than the ecological screening levels (Eco-SSLs). Appendix B will be updated with the correct MDLs and zinc will be removed from the list of metals with elevated MDLs in Section 2.5.1. LMC agrees that background or ambient levels of metals may be used to determine whether site characterization has demonstrated the extent of any contamination. This is particularly useful when background metal concentrations are higher than risk-based concentrations, such as Eco-SSLs. In the cases of antimony and cadmium, the background threshold values (BTVs) for these two metals are lower than the lowest Eco-SSLs, making these risk-based concentrations a potentially more applicable set of criteria. Site characterization for antimony and cadmium is considered adequate with limited exceptions, based on the following lines of evidence: • Initial source characterization was conducted in 2002 and 2004, with MDLs for these two metals lower than the lowest Eco-SSLs. • The limited sampling conducted in 2007 and 2008 included MDLs for antimony (2.01-2.65 mg/kg) and cadmium (0.502-0.618 mg/kg) that exceeded the lowest Eco-SSLs (0.27	Appendix B will be updated with the correct MDLs for zinc, and zinc will be removed from the list of metals with elevated MDLs in Section 2.5.1. A comparison of MDLs, BTVs, and applicable Eco-SSLs will be provided for all samples in which antimony and cadmium were not detected. This comparison will also include comparisons with the MDLs the laboratory indicates will be achieved in the re-evaluation of the affected samples or, if available, the re-assessed analytical results. The adequacy of the characterization of antimony and cadmium in soil will be further

Comments from J. Michael Eichelberger		
Specific Comments		
Comment	**Response**	**Proposed Action**
	mg/kg for antimony and 0.36 mg/kg for cadmium). These MDLs also exceeded the BTVs for antimony and cadmium (0.132 and 0.21 mg/kg, respectively). The limited samples with elevated MDLs were collected from a single soil boring in Operational Area A in 2007 and 19 borings in Operational Area H in 2008. • All of the MDLs for antimony and cadmium were lower than the next lowest ecological screening values (i.e., the antimony benchmark for plants [5 mg/kg, Efroymson et al. 1997] and the avian Eco-SSL for cadmium [0.77 mg/kg]). • Areas where soil samples with detected antimony concentrations exceeded the lowest Eco-SSL were characterized using analyses with MDLs lower than the lowest Eco-SSLs. • All areas where soil samples had cadmium concentrations exceeding the lowest Eco-SSL were characterized using appropriately low MDLs, except in Operational Area H. As requested, the final SERA report will provide a comparison of MDLs and BTVs for all samples in which antimony and cadmium were undetected. Despite the limited occurrences of elevated MDLs for antimony and cadmium, the laboratory will re-evaluate the analytical results for these samples using lower MDLs. The laboratory has indicated that they can achieve an MDL for cadmium (0.1 mg/kg) that is lower than the corresponding Eco-SSL (0.36 mg/kg). The MDLs that can be achieved for antimony (1.0-1.5 mg/kg) will approach the lowest Eco-SSL (0.27 mg/kg), and should provide an adequate Site characterization considering the	discussed in Section 2.5.1.

Comments from J. Michael Eichelberger		
Specific Comments		
Comment	**Response**	**Proposed Action**
	above lines of evidence.	
Specific Comment 1, Summary of Species Observed and Potentially Present in Each Habitat. The data presented in Table 3-2, regarding plants is a bit confusing. No plants were reported observed in Scrubs (including Coastal Sage Scrub) and Chamise/Chaparral. If there were no plants, by definition there would be no habitat. ERAS also finds it implausible no birds were observed in chamise/chaparral.	The noted patterns of observations result from the sampling design of the biological survey. All survey locations were assigned to grassland and riparian habitats at the Site, as these habitats comprise areas of the Site where releases occurred or into which released chemicals may have been transported. As stated in Appendix C, Section 2.2.1, "No areas of scrub or chamise/chaparral habitats were surveyed because no LMC activities have taken place, or are expected in these areas." As shown in Table 3-2, a diverse array of plants and wildlife is considered potentially present in the unsurveyed scrub and chamise/chaparral habitats based on background research conducted for the SERA.	A footnote will be added to Table 3-2 indicating that all survey locations were assigned to grassland and riparian habitats.
Specific Comment 2, Table 3-4, List of Invertebrates in Each Area of Concern. The Fairy shrimp *Branchinecta lilndahli* has been observed in Operational Areas B and D. Please explain the asterisk for each observation, there is no footnote identifier.	The asterisk indicates that *Branchinecta lindahli* was observed in Operational Areas B and D during the 2008-2009 biological survey. The footnote was inadvertently omitted from the table.	The footnote for the asterisk will be added to Table 3-4.
Specific Comment 3, Table 3-5, Comprehensive List of Amphibians and Reptiles in Each Area of Concern. The western spadefoot toad has been observed in Operational Areas A, D, F and G. The species is a California Species of Special Concern. Its lifecycle requirements include aquatic habitat such as	LMC agrees that adult western spadefoots in upland habitats are potentially exposed to COPECs via soil and food ingestion. Exposures via dermal contact and inhalation during aestivation below the ground surface are likely negligible due to the inactive metabolic state of spadefoots during aestivation. The PERA Work Plan will describe the potentially complete	The PERA Work Plan will describe the potentially complete exposure pathways for western spadefoots in both aquatic and terrestrial upland

Comments from J. Michael Eichelberger		
Specific Comments		
Comment	**Response**	**Proposed Action**
vernal pools and stock ponds for breeding and upland areas up to a mile from breeding areas that are utilized for foraging and aestivation in burrows a meter deep in the soil (http://www.buttehcp.com/documents/Revised_Models_12-6-07/Western_Spadefoot_Toad.pdf). The risk assessment will need to describe methods for assessing hazard not only in the aquatic environment, but also in the terrestrial environment where the toad spends the vast majority of its life.	exposure pathways for western spadefoots in both aquatic and terrestrial upland habitats. While methodology for assessing risks in aquatic habitat during the sensitive embryolarval stage will be described, the work plan will also state that potential risks to juvenile and adult spadefoots via soil and food ingestion will not be quantitatively evaluated due to the lack of applicable exposure and toxicity data. These limitations are consistent with ERAS' comment on the lack of quantitative evaluation of risks to reptiles and adult amphibians in Specific Comment 5.	habitats. The work plan will also state that potential risks to spadefoots via soil and food ingestion will not be quantitatively evaluated due to the lack of applicable exposure and toxicity data.
Specific Comment 4, Page 3-25, Section 3.3.2, Species Lists by Habitat and AOC, Invertebrates. Please explain the discrepancy between Table 3-4 which shows that *Branchinecta lynchi* has been observed at Operational Areas B and D and the text on page 3-25 and Table 3-8 (Special Status Animals Potentially Present within Areas of Concern) which states that the species has not been observed on site.	*Branchinecta lindahli* was observed in Operational Areas B and D during the 2008-2009 survey (Table 3-4). However, this species has no special status designation and is not listed in Table 3-8 or discussed on page 3-25. As stated in Table 3-8 and in the text on page 3-25, *B. lynchi*, a federally threatened species, is potentially present in three operational areas but has not been observed at the Site. Please note that the 2008-2009 fairy shrimp survey was conducted during a relatively dry winter and the observations may have been affected by the limited persistence of pools. A follow-up wet season survey for federally listed branchiopods is currently being conducted. If possible, the fairy shrimp species list and text summary in the PERA Work Plan or PERA report will be updated with information from the 2009-2010 fairy shrimp survey.	The fairy shrimp species list and text summary will be updated in the PERA Work Plan or PERA report, using forthcoming results from the 2009-2010 fairy shrimp survey.
Specific Comment 5, Figure 4-1, Conceptual Site Model for Ecological Receptors. Reptiles may drink water. For example rattlesnakes will drink water when it is available. ERAS believes that the surface water ingestion pathway for reptiles should be listed as a potentially complete exposure pathway rather than	Comment noted; see proposed actions.	The surface water ingestion pathway for reptiles will be indicated as a potentially complete exposure pathway in Figure 4-1 and in the text

Comments from J. Michael Eichelberger		
Specific Comments		
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potentially complete exposure route but insignificant and not evaluated. It is acknowledged however, that because of limited toxicity data reptiles will not be evaluated quantitatively in the risk assessment. Burrowing owls are carnivorous and therefore inhalation of burrow air should be considered a potentially complete exposure pathway. Finally, adult amphibians exposure from food in the terrestrial environment should not be listed as insignificant even if the exposure is [not] evaluated because of a lack of exposure data.		in Section 4. The burrow air inhalation pathway for carnivorous birds will also be indicated as potentially complete but not evaluated quantitatively. Likewise, the soil/sediment and food ingestion pathways for adult amphibians will be indicated as potentially complete.
Specific Comment 6, Page 4-5, Section 4.2.1, Second bullet. The second bullet that states '*Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors*' needs to be qualified. ERAS would agree that for many COPECs, for example metals, this statement is true, but for others such as highly lipophilic chemicals, dermal absorption can be very significant and could exceed exposure due to ingestion. Please qualify the statement in terms of the COPECs the statement is intended to address.	The statement concerning the relative insignificance of the dermal exposure pathway compared to the ingestion pathway will be qualified to refer to specific COPECs including metals, VOCs, and SVOCs.	The second bullet under the dermal contact discussion will be modified to "*Results of exposure studies indicate that exposures to many COPECs such as metals, VOCs, and SVOCs due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (Peterle 1991)*".
Conclusions ERAS believes the report meets the requirements of a SERA. The specific comments should be addressed but the report is largely complete and ERAS agrees with the conclusion of the report that a Predictive Ecological Risk Assessment should be performed.	Following DTSC approval of these responses to comments, the proposed actions listed above will be incorporated into the Final SERA Report, and the preparation of the PERA Work Plan will commence.	The SERA Report will be modified in accordance to the specific proposed actions listed above.

REFERENCES

Efroymson, R.A., M.E. Will, and G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Prepared for the U.S. Department of Energy. ES/ER/TM-85/R3.

Peterle, T.J. 1991. Wildlife Toxicology. Van Nostrand Reinhold. New York.

Tetra Tech. 2008. Supplemental Soil Investigation Report, Historical Operational Areas A, B, C, D, F, G, and H, Lockheed Martin Corporation Beaumont Site 1, Beaumont, California. May.

Tetra Tech, Inc. 2009a. Responses to DTSC responses to Lockheed responses to comments on the Scoping Ecological Risk Assessment, Lockheed Martin Corporation, Beaumont Site 2, Beaumont, California. April.

Tetra Tech, Inc. 2009b. Scoping Ecological Risk Assessment, Lockheed Beaumont Site 2, Beaumont, California. June.

Tetra Tech. 2009c. Dynamic Site Investigation Report, Lockheed Martin Corporation, Beaumont Site 1, Beaumont, California. July.

U.S. Environmental Protection Agency (USEPA). 2009a. ProUCL Version 4.0 User Guide. Office of Research and Development. EPA/600/R-07/038.

U.S. Environmental Protection Agency (USEPA). 2009b. ProUCL Version 4.0 Technical Guide. Office of Research and Development. EPA/600/R-07/041.

Department of Toxic Substances Control

Maziar Movassaghi, Acting Director
5796 Corporate Avenue
Cypress, California 90630

Linda S. Adams
Secretary for
Environmental Protection

Arnold Schwarzenegger
Governor

March 24, 2010

Denise Kato
Remediation Analyst Senior Staff
Lockheed Martin Corp.
Corporate Energy, Environment, Safety & Health
1111 Lockheed Martin Way, Building 157 9K2S
Sunnyvale, CA 94089

SCOPING ECOLOGICAL RISK ASSESSMENT, LOCKHEED MARTIN CORPORATION BEAUMONT SITE 1, BEAUMONT, CALIFORNIA (Site Code: 400200)

Dear Ms. Kato:

The Department of Toxic Substances Control (DTSC) has reviewed the responses to our comments regarding the subject report and has found them to be acceptable. Enclosed are responses from DTSC's Human and Ecological Risk Division (HERD). Once we receive the revised document, we will send the approval letter.

Should you have any questions or comments, please contact me at (714) 484-5383.

Sincerely,

Daniel K. Zogaib
Project Manager
Brownfields and Environmental Restoration Program

cc: Mr. Gene Matsushita
Senior Manager
Environmental Remediation
Lockheed Martin Corporation
Energy, Environment, Safety & Health
2950 North Hollywood Way, Suite 125
Burbank, California 9150

cc: Mr. Thomas Villeneuve, P.E.
San Bernardino Operations Manager / Vice President
Tetra Tech Incorporated
348 W. Hospitality Lane, Suite 100
San Bernardino, CA 92408

Linda S. Adams
Secretary for
Environmental Protection

Department of Toxic Substances Control

Maziar Movassaghi
8800 Cal Center Drive
Sacramento, California 95826-0806

Arnold
Schwarzenegger
Governor

MEMORANDUM

TO: Daniel K. Zogaib
Hazardous Substances Engineer
California Environmental Protection Agency
Department of Toxic Substances Control (DTSC)
5796 Corporate Avenue
Cypress, CA 90630

FROM: J. Michael Eichelberger, Ph.D.
Staff Toxicologist
Human and Ecological Risk Office (HERO)
Ecological Risk Assessment Section (ERAS)

DATE: March 24, 2010

SUBJECT: SCOPING ECOLOGIAL RISK ASSESSMENT LOCKHEED BEAUMONT SITE 1 BEAUMONT, CALIFORNIA

PCA: 11050 Site Code: 400200-00

Background

The Lockheed Martin Corporation (LMC) Site 1 facility is a 9,100 acre former rocket motor assembly and testing site, located west of the City of Beaumont and 70-miles east of Los Angeles in Riverside County. In addition to the rocket motor work, other activities at the site included ballistic tests of inert small caliber artillery shells and detonation of land mines. Low level radioactive waste was buried on site and incendiary bombs were exploded with at least one instance where the detonation occurred among drums filed with various types of fuels. Excess and unspent rocket propellant was burned on site. Roll over tests of military vehicles were also conducted. Lockheed Martin Corporation currently owns only 565 acres of the 9,100 acre site 1 facility. The state of California purchased the balance of the property (8,552 acres) as a wildlife park and nature preserve. The Federally-endangered Stephen's kangaroo rat (SKR), is known to occur on site.

At the request of the DTSC project manager, ERAS is providing Comments to the

Lockheed responses to the ERAS (formerly Human and Ecological Risk Division [HERD]) memorandum to the Draft Scoping Ecological Risk Assessment, Lockheed Martin Corporation, Beaumont Site,

Document Reviewed

HERD reviewed "Responses to Scoping Ecological Risk Assessment Lockheed Beaumont Site 1, Beaumont, California" hereafter referred to as the report. The report was prepared by Tetra Tech (San Bernardino, CA) and dated February, 2010. HERD received the report for review that same month.

Scope of the Review

The report was reviewed for scientific content related to ecological risk assessment. Grammatical or typographical errors that do not affect the interpretation of the text have not been noted.

General Comments

Overall, the report is thorough and complete and meets the requirements set forth in DTSC guidance (http://www.dtsc.ca.gov/AssessingRisk/eco.cfm) regarding the preparation of a Scoping Ecological Risk Assessment (SERA). History of the site is provided including property ownership and a description of site related activities. The report describes the geographical location of eight operation areas identified as Areas of Concern (AOCs) contained therein, and provide maps showing their locations both regionally and locally. AOCs range in size from 980 acres to 15 acres but sampling was confined to areas within the AOCs where potential contamination was suspected. In addition, 4 riparian or aquatic AOCs have been identified and surface water and sediment samples have been collected from these. A list of potential biological receptors is provided and special status species potentially present are listed. Media based Chemicals of Potential Ecological Concern (COPECs) are identified by AOC and a Conceptual Site Model based on general ecological guilds and site media is presented. In general these components described above meet the DTSC requirements for a SLERA. Specific comments to the SLERA are offered below.

LOCKHEED RESPONSE – Comment noted. Responses to specific comments are provided below.

ERAS RESPONSE – Comment noted.

LOCKHEED PROPOSED ACTION – None.
ERAS RESPONSE – Comment noted.

Specific Comments

1. Table 2-3, Number of Soil Samples Collected from 2002 to 2008 (0-10 feet bgs). Calculation of a Reasonable Maximum Exposure (RME) based on individual COPECs by Operational Area will need to consider statistical power in determining if a 95[th] Upper Confidence Limit on the Arithmetic mean or the maximum concentration is appropriate on a case by case basis. For example Table 2-3 shows the following number of samples per Operational Area for 1,4-Dioxane: A, 29; B, 85; C, 64; D, 7; F, 95; G, 4; H, 10; I, 5. The methodology for determining the RME will need to be described in the Predictive Ecological Risk Assessment Work Plan

   LOCKHEED RESPONSE – A reasonable maximum exposure (RME) will generally be determined using a 95 percent upper confidence limit on the mean (UCL_{95}) concentration calculated using ProUCL v4 (USEPA 2009a), which follows current USEPA (2009b) guidance. ProUCL will only calculate a UCL_{95} when there are a sufficient number of sample results relative to the variability of the data. Depending on the variability, the minimum data set required may be as few as five detected concentrations. If there are insufficient detected sample results, then ProUCL will not calculate a UCL_{95} and the maximum detected concentration will be slected as the RME. The PERA Work Plan will discuss the potential uncertainty related to using UCLs for small data sets (e.g., 4 to 6 detected observations, as identified by USEPA [2009b]) when the maximum detection is not selected as the RME. For example, uncertainty in specific hazard quotients that are based on UCLs for 6 or fewer detections will be identified in the uncertainty analysis of the PERA.

   ERAS RESPONSE – Comment accepted.

   LOCKHEED PROPOSED ACTION – The methodology for calculating the RME will be described in the Predictive Ecological Risk Assessment (PERA) Work Plan. The work plan will also discuss potential uncertainty related to the UCLs for small data sets.

   ERAS RESPONSE – Comment accepted.

2. Page 2-31, Section 2.4.1, Summary of Soil Data. ERAS does not agree that the available data characterizes the 0-5 foot sample interval. There are no intermediate data from the 2-3 foot depth. ERAS continues to recommend that the maximum of either the 0.5 foot or 5 foot sample be used to represent the intermediate depth of 2-3 feet.

LOCKHEED RESPONSE – Comment noted. At each boring, soil samples were collected at 0.5 and 5 feet bgs. To address the uncertainty related to the lack of samples collected at 2-3 feet bgs, as stated in the responses to comments (Tetra Tech 2009a) on the SERA for Beaumont Site 2 (Tetra Tech 2009b), the exposure point concentrations (EPCs) for the 0-2 and 0-5 feet bgs intervals will be calculated by replacing the lower concentration of the 0.5 and 5 foot samples with the higher of the two concentrations. Thus, the EPCs will be calculated using a total of two identical values, effectively, at each boring location.

ERAS RESPONSE – Comment accepted

LOCKHEED PROPOSED ACTION – The conservative approach for calculating the soil EPCs for the 0-2 and 0-5 feet bgs depth intervals will be described in the Site 1 PERA Work Plan.

ERAS RESPONSE -

3. Table 2-5, Shallow Groundwater Monitoring Wells. ERAS assumes the minimum depth to groundwater is meant to be in feet but is not specified in the table.

   LOCKHEED RESPONSE – The minimum depth to groundwater is in units of feet.

   ERAS RESPONSE - Commented noted.

   LOCKHEED PROPOSED ACTION – The units of feet will be added to Table 2-5

   ERAS RESPONSE – Comment accepted.

4. Page 2-41, Section 2.5.1, Soil COPECs. The report states "*Certain of the MDLs for antimony and cadmium in samples exceeded the mammalian Eco-SSl-based screening values, while certain of the MDLs for zinc exceeded the bird Eco-SSl and the plant benchmark (Appendix B)*". Since the method detection limits were elevated it is clear that sampling for these constituents may not be adequate to determine lateral extent of levels that may pose a hazard to ecological receptors. Since ambient or background concentrations have been established, this section of the report should provide a comparison of the MDLs with the ambient or background concentrations for these three metals. The Eco-SSLs are based on back calculations from a No-Effect Toxicity Reference Value (TRV). Protection of endangered and threatened species such as the Stephen's kangaroo rat to the

no-effect level is required. However, ERAS does not require protection be provided below ambient or background concentrations.

LOCKHEED RESPONSE – A reevaluation of the data indicated that for no detects of zinc, all of the MDLs were less than the ecological screening levels (Eco-SSLs). Appendix B will be updated with the correct MDLs in Section 2.5.1.

LMC agrees that background or ambient levels of metals may be used to determine whether site characterization has demonstrated the extent of any contamination. This is particularly useful when background metal concentrations are higher than risk-based concentrations, such as Eco-SSLs. In the cases of antimony and cadmium, the background threshold values (BTVs) for these two metals are lower than the lowest Eco-SSLs, making these risk-based concentrations a potentially more applicable set of criteria.

Site characterization for antimony and cadmium is considered adequate with limited exceptions, based on the following lines of evidence:

- Initial source characterization was conducted in 2002 and 2004, with MDLs for these two metals lower than the lowest Eco-SSLs.
- The limited sampling conducted in 2007- and 2008 included MDLs for antimony (2.01-2.65 mg/kg) and cadmium (0.502-0.618 mg/kg) that exceeded the lowest Eco-SSLs (0.27 mg/kg for antimony and 0.36 mg/kg for cadmium). These MDLs also exceeded the BTVs for antimony and cadmium (0.132 and 0.21 mg/kg, respectively). The limited samples with elevated MDLs were collected from a single soil boring in Operational Area A in 2007 and 19 borings in Operational Area H in 2008.
- All of the MDLs for antimony and cadmium were lower than the next lowest ecological screening values (i.e., the antimony benchmark for plants [5 mg/kg, Efroymson et al. 1997] and the avian Eco-SSL for cadmium [0.77 mg/kg]).
- Areas where soil samples with detected antimony concentrations exceeded the lowest Eco-SSL were characterized using analyses with MDLs lower than the lowest Eco-SSLs.
- All areas where soil samples had cadmium concentrations exceeding the lowest Eco-SSL, were characterized using appropriately low MDLs, except in Operational Area H.

As requested, the final SLERA report will provide a comparison of MDLs and BTVs for all samples in which antimony and cadmium were undetected.

Despite the limited occurrences of elevated MDLs for antimony and cadmium, the laboratory will re-evaluate the analytical results for these samples using lower MDLs. The laboratory has indicated that they can achieve an MDL for cadmium

(0.1 mg/kg) that is lower than the corresponding Eco-SSL (0.36 mg kg). The MDLs that can be achieved for antimony (1.0-1.5 mg/kg) will approach the lowest Eco-SSL (0.27 mg/kg), and should provide an adequate Site characterization considering the above lines of evidence

<u>ERAS RESPONSE</u> – ERAS appreciates the effort to address this issue and believes that Lockheed has proposed appropriate measures to ensure that MDLs are appropriate and will be protective of ecological receptors.

<u>LOCKHEED PROPOSED ACTION</u> – Appendix B will be updated with the correct MDLs for zinc and zinc will be removed from the list of metals with elevated MDLs in Section 2.5.1.

A comparison of MDLs, BTVs, and applicable Eco-SSLs will be provided for all samples in which antimony and cadmium were not detected. This comparison will also include comparisons with the MDLs the laboratory indicates will be achieved in the re-evaluation of the affected samples or, if available the re-assessed analytical results. The adequacy of the characterization of antimony and cadmium in soil will be further discussed in Section 2.5.1.

<u>ERAS RESPONSE</u> – Comment accepted.

5. Table 3-2, Summary of Species Observed and Potentially Present in Each Habitat. The data presented in Table 3-2, regarding plants is a bit confusing. No plants were reported observed in Scrubs (including Coastal Sage Scrub) and Chamise/Chaparral. If there were no plants, by definition there would be no habitat. ERAS also finds it implausible no birds were observed in chamise/chaparral.

   <u>LOCKHEED RESPONSE</u> – The noted patterns of observations result from the sampling design of the biological survey. All survey locations were assigned to grassland and riparian habitats at the Site, as these habitats comprise areas of the Site where releases occurred or into which released chemicals may have been transported. As stated in Appendix C, Section 2.2.1, "No areas of scrub or chamise/chaparral habitats were surveyed because no LMC activities have taken place, or are expected in these areas." As shown in Table 3-2, a diverse array of plants and wildlife is considered potentially present in the unsurveyed scrub and chamise/chaparral habitats based on background research conducted for the SERA.

   <u>ERAS RESPONSE</u> – ERAS appreciates the clarification and believes the response satisfactorily address the ERAS comment.

LOCKHEED PROPOSED ACTION – A footnote will be added to Table 3-2 indicating that all survey locations were assigned to grassland and riparian habitats

ERAS RESPONSE –Comment accepted

6 Table 3-4, List of Invertebrates in Each Area of Concern. The Fairy shrimp *Branchinecta lilndhali* has been observed in Operational Areas B and D. Please explain the asterisk for each observation, there is no footnote identifier.

LOCKHEED RESPONSE - The asterisk indicates that *Branchinecta lindahli* was observed in Operational Areas B and D during the 2008-2009 biological survey. The footnote was inadvertently omitted from the table.

ERAS RESPONSE – Comment noted

LOCKHEED PROPOSED ACTION – The footnote for the asterisk will be added to Table 3-4.

ERAS RESPONSE – Comment accepted.

7. Table 3-5, Comprehensive List of Amphibians and Reptiles in Each Area of Concern. The western spadefoot toad has been observed in Operational Areas A, D, F and G. The species is a California Species of Special Concern. Its lifecycle requirements include aquatic habitat such as vernal pools and stock ponds for breeding and upland areas up to a mile from the breeding areas that are utilized for foraging and aestivation in burrows a meter deep in the soil (http://www.buttehcp.com/documents/Revised_Models_12-6-07/Western_Spadefoot_Toad.pdf). The risk assessment will need to describe methods for assessing hazard not only in the aquatic environment, but also in the terrestrial environment where the toad spends the vast majority of its life.

LOCKHEED RESPONSE – LMC agrees that adult western spadefoots in upland habitats are potentially exposed to COPECs vial soil and food ingestion. Exposures via dermal contact and inhalation during aestivation below the ground surface are likely negligible due to the inactive metabolic state of spadefoots during aestivation. The PERA Work Plan will describe the potentially complete exposure pathways for western spadefoots in both aquatic and terrestrial upland habitats. While methodology for assessing risks in aquatic habitat during the sensitive embryolarval stage will be described, the work plan will also state that potential risks to juvenile and adult spadefoots via soil and food ingestion will not be quantitatively evaluated due to the lack of applicable exposure and toxicity data. These limitations are consistent with ERAS' comment on the lack of quantitative evaluation of risk to reptiles and adult amphibians in Specific Comment 5.

ERAS RESPONSE – ERAS believes potential exposure to amphibians in aestivation is unknown, but agrees that quantitative evaluation is not feasible or practical. ERAS does not know if exposure would be negligible during aestivation. The skin of amphibians is an absorptive organ and much of the oxygen supply is absorbed through the skin. Lung-less salamanders (family Plethodontidae) are the extreme example, they absorb all of their oxygen through a combination of the mucosa in the mouth and the skin. In ERAS' opinion dermal absorption of VOCs is likely more important than inhalation. Nonetheless, ERAS appreciates that Lockheed will qualitatively evaluate exposure to adult amphibians.

LOCKHEED PROPOSED ACTION – The PERA Work Plan will describe the potentially complete exposure pathways for western spadefoots in both aquatic and terrestrial upland habitats. The work plan will also state that potential risks to spadefoots via soil and food ingestion will not be quantitatively evaluated due to the lack of applicable exposure and toxicity data.

ERAS RESPONSE – Comment accepted.

8. Page 3-25, Section 3.3.2, Species Lists by Habitat and AOC, Invertebrates. Please explain the discrepancy between Table 3-4 which shows that *Branchinecta lynchi* has been observed at Operation Areas B and D and the text on page 3-25 and Table 3-8 (Special Status Animals Potentially Present within Areas of Concern) which states that the species has not been observed on site.

   LOCKHEED RESPONSE – *Branchinecta lindhali* was observed in Operational Areas B and D during the 2008-2009 survey (Table 3-4). However, this species has no special status designation and is not listed in Table 3-8 or discussed on page 3-25. As stated in Table 3-8 and in the text on page 3-25, *B. lynchi*, a federally threatened species, is potentially present in three operational areas but has not been observed at the Site. Please note that the 2008-2009 fairy shrimp survey was conducted during a relatively dry winter and the observations may have been affected by the limited persistence of pools. A follow-up wet season survey for federally listed branchipods is currently being conducted. If possible, the fairy shrimp species list and text summary in the PERA Work Plan or PERA report will be updated with information from the 2009-2010 fairy shrimp survey.

ERAS RESPONSE – Comment accepted, ERAS looks forward to the opportunity to view the results of the survey.

LOCKHEED PROPOSED ACTION – The fairy shrimp species list and text summary will be updated in the PERA Work Plan or PERA report, using forthcoming results from the 2009-2010 fairy shrimp survey.

ERAS RESPONSE – Comment accepted.

9. Figure 4-1, Conceptual Site Model for Ecological Receptors. Reptiles may drink water. For example rattlesnakes will drink water when it is available. ERAS believes that the surface water ingestion pathway for reptiles should be listed as a potentially complete exposure pathway rather than potentially complete exposure route but insignificant and not evaluated. It is acknowledged however, that because of limited toxicity data reptiles will not be evaluated quantitatively in the risk assessment. Burrowing owls are carnivorous and therefore inhalation of burrow air should be considered a potentially complete exposure pathway. Finally, adult amphibians exposure from food in the terrestrial environment should not be listed as insignificant even if the exposure is evaluated because of a lack of exposure data.

   LOCKHEED RESPONSE – Commented noted; see proposed actions.

   ERAS RESPONSE – Comment noted.

   LOCKHEED PROPOSED ACTION - The surface water ingestion pathway for reptiles will be indicated as a potentially complete exposure pathway in Figure 4-1 and in the text in Section 4. The burrow air inhalation pathway for carnivorous birds will also be indicated as potentially complete but not evaluated quantitatively. Likewise the soil/sediment and food ingestion pathways for adult amphibians will be indicated as potentially complete.

   ERAS RESPONSE – Comment accepted.

10. Page 4-5, Section 4.2.1, Second bullet: The second bullet that states '*Results of exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors*' needs to be qualified. ERAS would agree that for many COPECs for example metals this statement is true, but for others such as highly lipophilic chemicals, dermal absorption can be very significant and could exceed exposure due to ingestion. Please qualify the statement in terms of the COPECs the statement is intended to address.

LOCKHEED RESPONSE – The statement concerning the relative insignificance of the dermal exposure pathway compared to the ingestion pathway will be qualified to refer to specific COPECs including metals, VOCs, and SVOCs.

ERAS RESPONSE – Comment accepted.

PROPOSED LOCKHEED ACTION – The second bullet under the dermal contact discussion will be modified to "*Results of exposure studies indicate that exposures to many COPECs such as metals, VOCs, and SVOCs due dermal absorption are insignificant compared to ingestion for terrestrial receptors (Peterle 1991)*".

ERAS RESPONSE - Comment accepted.

Conclusions

ERAS believes the report meets the requirements of a SERA. The specific comments should be addressed but the report is largely complete and ERAS agrees with conclusion of the report that a Predictive Ecological Risk Assessment should be performed.

LOCKHEED RESPONSE – Following DTSC approval of these responses to comments, the proposed actions listed above will be incorporated into the Final SERA Report, and the preparation of the PERA Work Plan will commence.

ERAS RESPONSE – Comment accepted.

LOCKHEED PROPOSED ACTION – The SERA Report will be modified in accordance to the specific proposed actions listed above.

ERAS RESPONSE – ERAS believes the outstanding issues regarding the Lockheed Beaumont Site 1 SLERA have been adequately addressed.

Reviewed by: Brian Faulkner, Ph.D
Associate Toxicologist, ERAS

Cc: James M. Polisini, Ph.D.
Senior Toxicologist, ERAS

SCOPING ECOLOGICAL RISK ASSESSMENT
Lockheed Beaumont Site 1
Beaumont, California

April 2010

Prepared for

Lockheed Martin Corporation

Burbank, California

Prepared by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Hygienists
ACE	Army Corps of Engineers
Aerojet	Aerojet Corporation
AF	assimilation fraction
AOC	area of concern
BEHP	bis(2-ethyl)hexylphthalate
bgs	below ground surface
BLM	Bureau of Land Management
BPA	burn pit area
C	concentration
CDFG	California Department of Fish and Game
CalEPA	California Environmental Protection Agency
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
COPEC	chemical of potential ecological concern
CSC	California Species of Special Concern
CSM	conceptual site model
1,1,1-DCE	1,1,1-dichloroethene
1,1-DCE	1,1-dichloroethene
DOE	Department of Energy
DQOs	data quality objectives
DSI	Dynamic Site Investigation
DTSC	Department of Toxic Substances Control
DW	dry weight
DWNL	drinking water notification level
DWR	Department of Water Resources
Eco-SSL	Ecological Soil Screening Level
EDAW	Eckbo, Dean and Williams
EMWD	Eastern Municipal Water District
EPA	Environmental Protection Agency
ERA	ecological risk assessment
FE	Federal endangered
FIT	Field Investigation Team
FSW	first surface water
ft	feet
FT	Federal threatened
GCR	Grand Central Rocket Company
GMP	groundwater monitoring program
GPS	global positioning survey
ha	hectare
HERD	DTSC Human and Ecological Risk Division
HHERA	human health and ecological risk assessment
HHRA	human health risk assessment
HSU	hydrostratigraphic unit
kg	kilogram
LAC	Lockheed Aircraft Corporation

LIST OF ACRONYMS (CONTINUED)

LMC	Lockheed Martin Corporation
LPC	Lockheed Propulsion Company
LRL	laboratory reporting limit
LSM	Large Solid Motor
LSW	last surface water
MCL	maximum contaminant level
MDLs	method detection limits
ME	Mount Eden
MEC	munitions and explosives of concern
MeV	million electron volt
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MSHCP	Western Riverside County Multiple Species Habitat Conservation Plan
MSL	mean sea level
MTBE	Methyl tert-butyl ether
N	Number of samples
NDMA	n-nitrosodimethylamine
NW	Northwest
OCP	organochlorine pesticides
OHV	off-highway vehicle
OPP	organophosphorous pesticides
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PERA	predictive ecological risk assessment
ppb	parts per billion
ppm	parts per million
PQL	practical quantification limit
PRG	Preliminary Remediation Goal
QAL	Quaternary alluvium
QA/QC	Quality Assurance/Quality Control
R&D	research and development
RCHCA	Riverside County Habitat Conservation Agency
RDX	Royal Demolition Explosive
RME	reasonable maximum exposure
SARWPCB	Santa Ana River Basin Regional Water Pollution Control Board
SE	California State endangered
SERA	scoping ecological risk assessment
sp.	species
spp.	species (plural)
SRAM	short range attack missile
ST	California State Threatened

LIST OF ACRONYMS (CONTINUED)

STF	San Timoteo formation
SVE	soil vapor extraction system
SVOCs	semi-volatile organic compounds
SW	Southwest
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCP	1,2,3-trichloropropane
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TPHd	total petroleum hydrocarbons as diesel
TPHg	total petroleum hydrocarbons as gasoline
UCL_{95}	95 percent upper confidence limit on the mean concentration
UDMH	unsymmetrical dimethyl hydrazine
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
US	United States
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
WRCC	Western Regional Climate Center
WRS	Wilcoxon rank sum test
wSTF	weathered San Timoteo formation

EXECUTIVE SUMMARY

An initial step of the ecological risk assessment (ERA) process is to complete a brief characterization of the chemical, physical, and biological aspects of the Site. The first step in determining what particular problem may exist at the Site involves developing a basic understanding of the local environment/ecology and to examine information that is available for constituents potentially released at the Site. This step typically involves a visit to the Site to help 1) determine what plants and animals (i.e., ecological receptors) may be at the Site, 2) assess whether ecological receptors could be exposed to chemicals at the Site, and 3) determine whether complete or potentially complete exposure pathways exist between facility-related contaminant releases and potential ecological receptors.

In general, if the finding of the SERA is that one or more complete pathways exist at the Site, the next step in the process is to perform a Predictive Ecological Risk Assessment (PERA) for the Site. Conversely, if the finding of the SERA is that there are no complete exposure pathways at the site, then the ecological risk assessment process is complete for the Site.

For Site 1, the specific objectives of the SERA are to:

- Identify habitats and ecological receptors that can potentially be impacted by constituents of potential ecological concern in or near each area of concern (AOC),
- Identify chemicals of potential ecological concern (COPEC),
- Identify potentially complete exposure pathways from impacted media to receptors,
- Produce a conceptual site model, and
- Identify areas that require a PERA.

Site 1 (hereinafter referred to as the “Site”) contains 9 operational areas. Eight of these operational areas (all except Operational Area E) were evaluated in this SERA. In addition, 4 riparian AOCs were identified and evaluated in this SERA. These 8 operational areas have a total area of approximately 2,454 acres.

Soil, soil gas, groundwater, surface water, and sediment samples were collected at the Site and variously analyzed for metals, perchlorate, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), 1,4-dioxane, polychlorinated biphenyls (PCBs), explosives, 1,2,3-trichloropropane (1,2,3-TCP), N-nitrosodimethylamine (NDMA), dioxins/furans, organochlorine pesticides, organophosphorous pesticides, chlorinated herbicides, diesel range organics, and gasoline range organics. VOCs, perchlorate, SVOCs, PAHs, PCBs, and dioxins/furans were detected

in soils and were identified as COPECs. Additionally, some metals detected in soils were determined to differ from background and were selected as COPECs. Up to 25 VOCs were detected in soil gas and identified as COPECs. VOCs, perchlorate, 1,4-dioxane, and metals were detected in shallow groundwater and identified as COPECs. Explosives, 1,2,3-TCP, and NDMA were not detected in shallow groundwater. Perchlorate, VOCs, SVOCs (including 1,4-dioxane), and metals were detected in surface water and identified as COPECs. Only VOCs and metals were detected in sediments and identified as COPECs.

Grasslands dominate the valley floors, although there are some small areas of woodlands and willow. The hills are dominated by scrubs (including coastal sage scrub) and chamise/chaparral. Riparian habitat was found along the creeks traversing the valley floors, with seasonal/perennial water in Potrero Creek and two ponds due to groundwater discharge. Biological surveys conducted at the Site observed 36 plant, 25 mammal, 89 bird, three amphibian, 11 reptile, and 13 invertebrate species. Another 232 plant, 15 mammal, 48 bird, five amphibian, 12 reptile, and three invertebrate species were identified as potentially present at the Site. The species observed, or likely to occur at the Site, include the following numbers of sensitive species: 4 plant species, 2 invertebrate species, 2 amphibian species, 7 reptile species, 26 birds species, and 13 mammal species.

Representative species groups were selected as ecological receptors for the Site. A pathway analysis was performed for the selected ecological receptors and it was determined that the ecological receptors at the Site may be exposed to COPECs in soils at all of the AOCs at the Site. Therefore, it is recommended that a PERA be conducted for all of the AOCs at the Site.

1.0 INTRODUCTION

On behalf of Lockheed Martin Corporation (LMC), Tetra Tech, Inc. (Tetra Tech) has conducted several investigations (Tetra Tech 2002, 2005a, 2005b, 2007, 2008a 2009a) for Operational Areas A through I of LMC's Beaumont Potrero Creek facility, also known as Beaumont Site 1 (hereinafter referred to as the "Site"), located approximately 70 miles east of Los Angeles in Riverside County, California. The preliminary subsurface investigation was performed in response to the Consent Order issued to LMC in June 1989 by the Department of Toxic Substances Control (DTSC). That Consent Order requires LMC to investigate and appropriately remediate any releases or threatened releases of hazardous substances to the air, soil, surface water, and groundwater at or from the Site. The State of California (Department of Parks and Recreation) owns 8,552 acres of the Site and LMC has retained an easement for the remaining 565 acres referred to as the conservation easement. The Site is managed by the California Department of Fish and Game (CDFG), and the State is currently developing a land use plan for its operation as a nature preserve.

Reports detailing the characterization activities since 2004 have been submitted to DTSC (Tetra Tech 2005a, 2005b, 2008a, 2009a). Based upon the investigation results, this Scoping Ecological Risk Assessment (SERA) was prepared.

The purpose of this SERA is to determine whether complete, or potentially complete, exposure pathways exist between facility-related constituents and potential ecological receptors at the Site. Determinations are based on available information regarding concentrations of constituents on-site and biological receptors either actually, or potentially, on-site that may be exposed to these constituents. If the finding of the SERA is that one or more complete exposure pathways exist at the Site, the next step in the process is to perform a Predictive Ecological Risk Assessment (PERA) for the Site. Conversely, if the finding of the SERA is that there are no complete exposure pathways at the Site, then the ecological risk assessment process is complete for the Site.

This SERA includes the following four subsections:

- Site characterization;
- Biological characterization;
- Pathway assessment; and
- Scoping assessment decision.

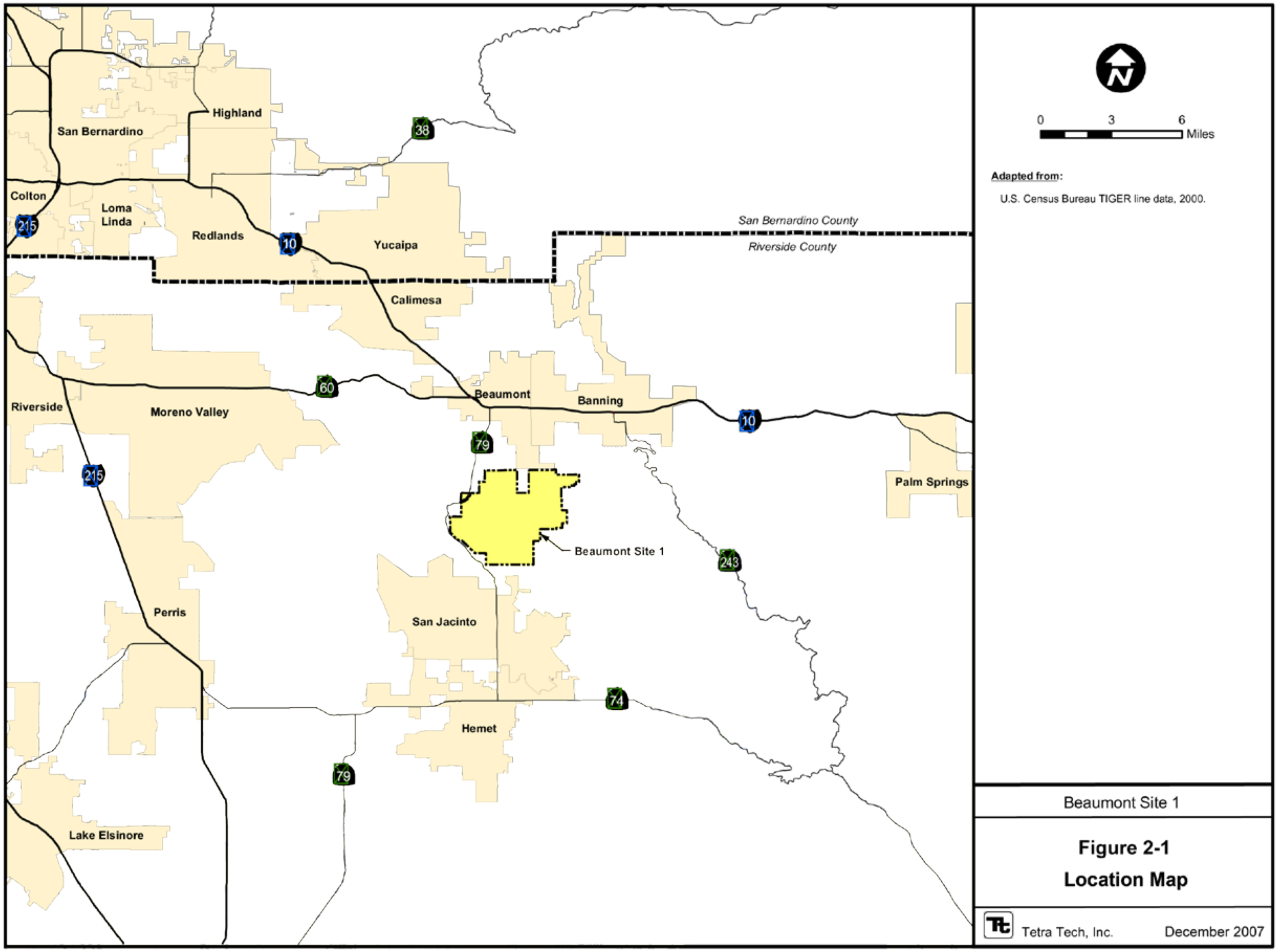
This SERA follows the Human Health and Ecological Risk Assessment Work Plan (Tetra Tech 2009b) (approved by DTSC in an email July 17, 2009), which was developed following the *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (DTSC 1996).

2.0 SITE CHARACTERIZATION

2.1 Site Overview

The Site consists of a single parcel of 9,117 acres located in an unincorporated area to the west of the City of Beaumont, approximately 70 miles east of Los Angeles in Riverside County, California (Figure 2-1). The Site is vacant and is generally characterized by hilly topography with associated drainages and valley bottom areas. Improvements at the Site include, but are not limited to, several abandoned buildings and bunkers in varying states of deterioration, paved roads, and several concrete foundations from removed structures, inactive/disabled test stands and pads, and revetments. A mobile trailer, an operational groundwater treatment system, and an inoperable catalytic oxidation (CatOx) system are also present on the Site. From 1960 and continuing until 1974, the Site was used by the Lockheed Propulsion Company (LPC). Activities at the Site included rocket motor production (mixing of solid rocket fuel, curing of solid rocket fuel, and testing of solid rocket fuel motors); ballistics testing; and destruction of process chemicals and waste rocket propellants in open burn pits (Earth Tech, 2002). In 1970, LMC began offering their test services to outside parties and leased property to Aerojet Corporation (Aerojet) and allowed General Dynamics to conduct testing on several occasions.

A large portion of the Site facilities was located in the broad Potrero Creek valley. The watershed area, including the valley itself, is approximately 35 square miles. The valley is roughly triangular in shape, and the valley floor covers approximately 800 acres. The streams at the Site are generally ephemeral in nature and generally only flow during significant rain events, except for those sections of the streams where artesian springs from confined groundwater aquifers discharge to the streambed. The valley is predominantly drained by Potrero Creek, which follows the valley from north to south before turning southwest to pass through Massacre Canyon toward its confluence with the San Jacinto River. Potrero Creek is notable in that it is the lone drainage of surface water emanating from the San Bernardino Mountains to the San Jacinto River drainage. Potrero Creek is fed by local tributary drainage and storm runoff from the city of Beaumont in the San Gorgonio Pass area and other streams (Bedsprings Creek) located in the southeast area of the Site. Potrero Creek and Bedsprings Creek convey intermittent or seasonal runoff and groundwater discharge flows. Groundwater generally flows from east to west across the Site and apparently discharges starting in approximately the area where Bedsprings and Potrero Creeks meet. On the Site, several artificial ponds have been constructed for operational use, and appear to be recharged from both shallow groundwater and surface water runoff.


Highland
San Bernardino
Colton
Loma Linda
Redlands
Yucaipa
San Bernardino County
Riverside County
Calimesa
Beaumont
Banning
Riverside
Moreno Valley
Palm Springs
Beaumont Site 1
Perris
San Jacinto
Hemet
Lake Elsinore
38
215
10
60
79
243
74
0
3
6
Miles
Adapted from:
U.S. Census Bureau TIGER line data, 2000.
Beaumont Site 1
Figure 2-1
Location Map
Tetra Tech, Inc.
December 2007

The climate is Mediterranean with hot, dry summers, and cooler, wetter winters. Average annual precipitation between 1980 and 2008 ranged from 16.3 inches per year at the Beaumont National Weather Service (NWS) station and 12.06 inches per year at the San Jacinto NWS (Tetra Tech 2009a). Most of the precipitation occurs between November and March. Consequently, under natural conditions, the San Jacinto River is intermittent with little or no flow in the summer months.

The parcels that comprise the Site were owned by private individuals, Riverside Cement Company/ American Cement Company, and the United States (US) government prior to 1960. Between 1960 and 1962, portions of the Site were purchased by the Grand Central Rocket (GCR). In 1960, Lockheed Aircraft Corporation (LAC) purchased one-half interest in GCR. GCR became a wholly-owned subsidiary of LAC in 1961. LPC purchased one of the Site parcels in 1962 and acquired the GCR-owned parcels in 1963. The remaining parcel of land that comprised the Site was purchased by LAC in 1963. LPC became an operating division of LAC in 1963 and was responsible for the operation of the Site until its closure in 1974. LPC operations included solid rocket propellant production and testing, rocket motor and weapons testing, and ballistics tests. Aerojet leased portions of the Site for ammunition research and development (R&D) from the mid-1960s to 1974.

LMC leased portions of the Site to several outside parties for use in various activities. The International Union of Operating Engineers (IUOE) utilized the Site from 1971 through 1991 for surveying and heavy equipment training. The main office of the IUOE was formerly located within Bunker 304 of Historical Operational Area F (LPC Test Services Area). The IUOE had approximately 75 to 100 pieces of heavy equipment on-site, including a rock crusher, for road building and other purposes (e.g., grading operations and landscaping). Additionally, IUOE operated an underground fuel storage tank. Based on interviews, degreasing of the IUOE equipment was reportedly conducted by steam cleaning with no solvent usage. The IUOE earth-moving activities involved maintaining roads and reshaping various parts of the Site, primarily within Historical Operational Areas F and G (Tetra Tech 2003a, 2003b).

A portion of the Site was also leased by a farmer who utilized a number of areas for sheep grazing and dry-land farming. Most level areas throughout the Site, including the burn pit area and the LPC and Aerojet test ranges, were planted with barley. Planting activities were preceded by mechanical cultivation of the soil to depths of approximately 1 foot (Radian 1986).

On several occasions, General Dynamics utilized Historical Operational Area B (Rocket Motor Production Area) for testing activities. In 1983, General Dynamics conducted a test of the Viper bazooka by firing rounds comprised of a 2.7-inch rocket motor, explosives, and shaped charges toward steel targets in Historical Operational Area B. Only shrapnel remained from this test. General Dynamics also fired 20mm and 30mm Phalanx Gatling guns from north to south toward a berm that was built near the former SRAM motor washout area. Only practice rounds were used during this activity (Radian 1986). During further investigations into munitions use in this area initiated in 2005, it was discovered that not all of the inert 20 and 30 mm projectiles were recovered. Many remain in the Phalanx gun firing berm. The investigation of Area B was concluded in 2007. Based on the information available at this time, no further investigation or cleanup of munitions and explosives of concern are anticipated.

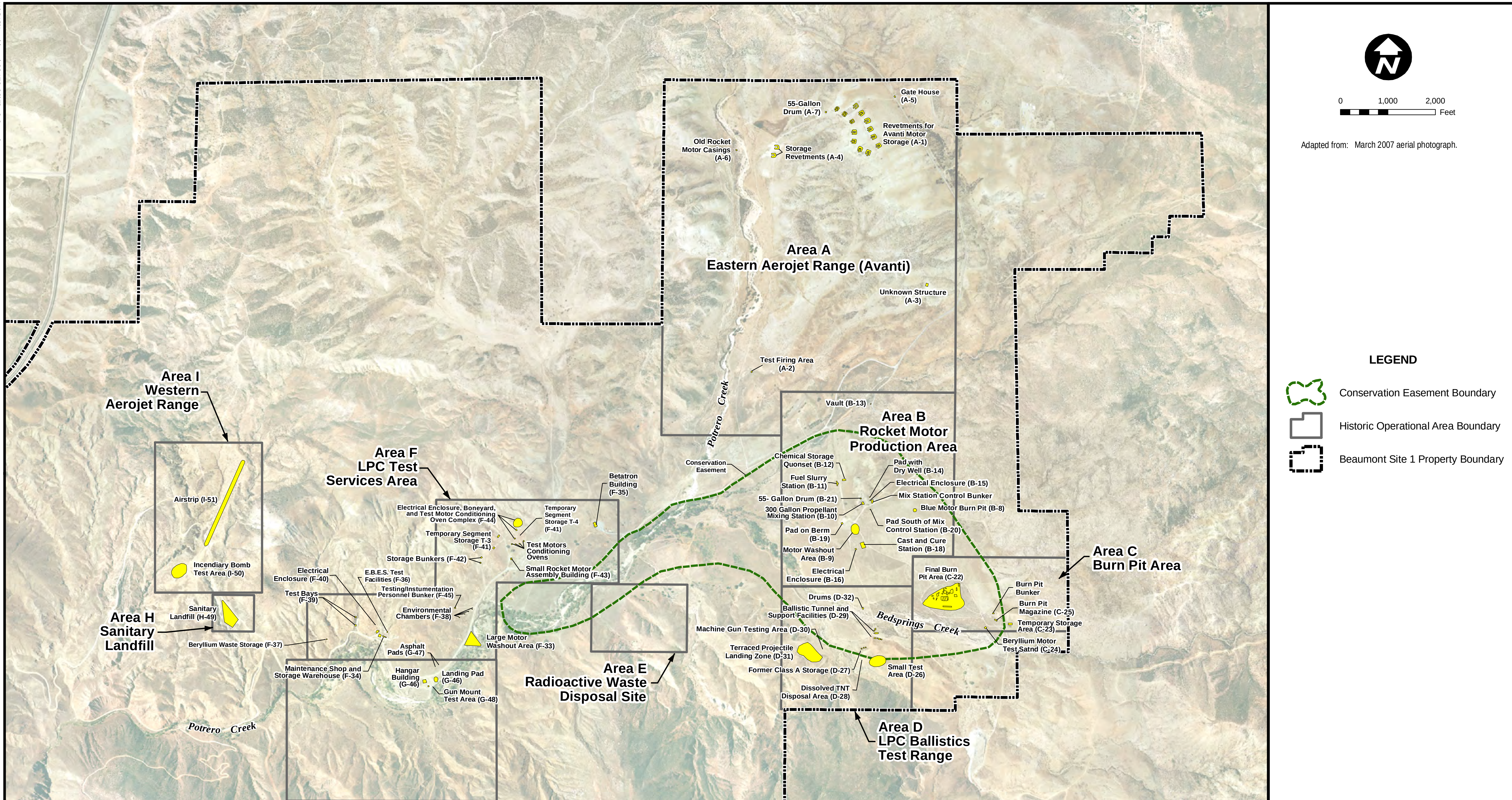
Structural Composites used the steep terrain of the Site for vehicle rollover tests on a number of occasions. Structural Composites also conducted heat and puncture tests on pressurized fiberglass and plastic reinforced cylinders. The tests involved shooting a single 30-caliber round at the cylinders and recording the result.

Currently, the site is inactive except for ongoing investigation activities. The State of California purchased 8,552 acres of the Site in December 2003, and they will be operated by the California Department of Fish and Game (CDFG) as a wildlife park and nature preserve. LMC owns the remaining 565 acres within the conservation easement (Figure 2-2).

2.2 Summary of Site Investigations

This section provides a brief discussion of previous investigations and remediation activities that have been conducted at the Site. Investigation reports including soil investigations, soil gas surveys, and hydrogeological investigations since 1984, as well as reports summarizing remedial excavations, were reviewed to identify areas of known or suspected chemical usage, storage, and/or releases. These include the *Supplemental Site Characterization Report, Beaumont Site 1, Beaumont, California* (Tetra Tech 2002), the *Soil Investigation Report Historical Operational Areas A, B, and C, Beaumont Site 1, Beaumont, California* (Tetra Tech 2005a) and the *Lockheed Martin Soil Investigation Report, Beaumont Site 1, Historical Operational Areas D, E. F, G, H and I, Beaumont California* (Tetra Tech 2005b). In addition, a recently completed Dynamic Site Investigation (DSI) (Tetra Tech 2008a, 2009a) has been conducted. A summary of each document reviewed is presented in Table 2-1.

Surface water in streams, ponds, and seeps is collected semi-annually at a minimum as part of the quarterly groundwater monitoring program (GMP) (Tetra Tech 2008b, c). Surface water and groundwater sampling are conducted simultaneously. Surface water samples are typically collected from about 20 fixed locations (depending on stream flow) and 2 locations determined at the time of sampling, the first and last observed surface water locations (FSW and LSW, respectively).



Beaumont Site 1

Figure 2-2
Site 1 Operational Areas

TETRA TECH

Table 2-1
General Summary of Investigations and Remediation
Historical Operational Areas A-I

Document Title, Author and Date	Report Findings
General Electric Engineering Appraisal Report for Lockheed Corporation Beaumont Site (Site No. 2) and Potrero Site (Site No. 1), General Electric Company (P.J. Jelito), July 1984	Report recommended remedial actions and repairs in the following areas based on field observations of vandalized equipment, including1) Remove soil adjacent to the transformer pad, west of the Betatron Building. 2) Remove soil adjacent to the concrete gutter. 3) Remove soil from the southern end of the concrete gutter. 4) Remove soil around the spot where soil sample #74 was collected. 5) Remove soil from the area next to the driveway. 6) Dispose of three transformers. 7) Dispose of three oil switches. 8) Dispose of all vandalized transformers to a commercial disposal site. 9) Store or dispose of five oil-fused cut out assemblies. 10) Drain and analyze an oil switch for PCB content. 11) Dispose of two abandoned power capacitors. Report also stated that an area adjacent to the Betatron Building transformer was excavated (approximately 5'x 7'x 6" deep) and soil disposed of at a disposal site located in Casmalia, California.
Lockheed Propulsion Company Beaumont Test Facilities Historical Report, Radian Corporation (C. Koerner, J. Billica), September 1986	The report identifies eight areas at the Site where additional investigation/activities should be performed (i.e., sampling, debris removal): Propellant Mixing Area, Motor Washout Areas, Burn Pit Area, LPC Test Area, LPC Ballistics Test Range, Aerojet Ballistics Test Areas, Permitted Sanitary Landfill, and the Radioactive Waste Disposal Area.
Hydrogeologic Study Report, Lockheed Propulsion Company, Beaumont Test Facilities, Radian Corporation, December 1986	This investigation details the findings of additional site characterization work in order to provide a better definition of the vertical and lateral extent of contamination in the soil vapor and groundwater and to gain a better understanding of the physical characteristics of the aquifer. During the investigation, soil vapor, soil, and groundwater samples were collected from areas near or adjacent to the burn pit area. Soil vapor analytical results showed that VOC concentrations range from 50 to approximately 6,400 parts per billion by volume (ppbv) in shallow soils and generally increased with depth within the burn pit area. Soil samples collected during the investigation reported low concentrations of 1,2-dichloroethane (1,2-DCA); 1,1,1-trichloroethane (1,1,1-TCA); and trichloroethene (TCE). Although low concentrations of VOCs were detected in the soil samples collected, the high soil vapor concentrations suggest that some residual concentrations reside in the vadose zone soils. The total VOCs concentration ranged from 2.2 to 12,000 micrograms per liter (µg/L) in groundwater.

Table 2-1 (continued)
General Summary of Investigations and Remediation
Historical Operational Areas A - I

Document Title, Author and Date	Report Findings
CERCLA Site Inspection Lockheed Propulsion Company Beaumont Test Facilities, Ecology and Environment Inc. (C. Lichens, A. Vargas), January 23, 1987	The Field Investigation Team (FIT) for Ecology and Environment recommended the following: 1) a soil vapor survey in the Burn Pit Area (BPA) to aid in determining locations of future monitoring wells to define the plume of hydrocarbon contamination in groundwater, 2) a soil vapor survey in the washout areas, 3) a soil vapor survey at the sanitary landfill, 4) soil removal from all three radioactive material canyons until the radioactive waste disposal area is located, and 5) the EPA monitor the progress of the investigation and the Department of Health Services (DHS) maintain the lead in the investigation.
Source and Hydrological Investigation, Lockheed Propulsion Company, Beaumont Test Facilities, Radian Corporation, February 1990	The source investigation involved removal of low-level radioactive material (within Operational Area E) and locating and sampling suspect areas within the previously identified sanitary landfill (within Operational Area H), burn pit area (within Operational Area C), and rocket motor production area (within Operational Area B) to identify waste materials and contaminant sources. Waste, soil, soil gas, and groundwater samples were collected and analyzed for VOCs, SVOCs, and metals during the investigation. The majority of the VOC and SVOC analytical results for soil and soil gas reported were assumed to have been due to laboratory contamination. However, validated reports of 1,1,1-TCA; 1,1-DCE; TCE; PCE and iron were detected at low concentrations.
Burn Pit Area Removal Action Report, Lockheed Propulsion Company, Beaumont Test Facilities, June 1993, Radian Corporation, June 1993	This report documents the remediation activities performed at the burn pit area of the Site. The scope of work for this investigation included: 1) removing all burn pit wastes and 2) collect confirmation soil samples to ensure that no burn pit or possible contaminated material remain. A total of nine burn pit areas were excavated and all debris removed and stockpiled. A total of 10 confirmation soil samples were collected from beneath the debris to ensure that no impacted soil or debris remains. Based on the analytical results, all underlying soils were considered to be clean. Approximately 48,600 cubic yards of topsoil and overburden soils were removed and replaced. Approximately 4,112 tons of non-hazardous material was excavated from the burn pits. Approximately 18.6 tons of specific wastes (a drum containing an oily substance, large chunks of unburned rocket propellant, and a blue burn rate modifier) were excavated from the burn pits and shipped off-site for disposal.

Table 2-1 (continued)
General Summary of Investigations and Remediation
Historical Operational Areas A - I

Document Title, Author and Date	Report Findings
Lockheed Beaumont no.1, June 1996 Vapor Sampling Report, Radian Corporation, October 10, 1996	Soil vapor samples were collected from 12 soil vapor wells and 3 air stripper locations and analyzed for volatile organic compounds using an on-site mobile laboratory. The results of the samples collected and analyzed in this round were compared to previous sampling results which indicated that the soil vapor concentrations are slowly diminishing over time.
Lockheed Beaumont No.1, August 1997 Vapor Sampling Report, Revised, Radian Corporation, August 17,1997	Soil vapor samples were collected from 16 soil vapor wells and 3 air stripper locations and analyzed for VOCs using an on-site mobile laboratory. After comparing results to previous sampling episodes, the soil vapor concentrations appear to be slowly diminishing over time. The same contaminants continue to be present with no new contaminants observed during this sampling round.
Supplemental Site Characterization Report, Beaumont Site 1, Tetra Tech, Inc., September 2002	A total of 40 soil and soil gas samples were collected and analyzed from 20 locations (10 within the RMPA and 10 within the BPA) at depths of 5 and 15 feet below ground surface (bgs). Soil gas samples collected from within the BPA contained detectable concentrations of 1,1-DCE, 1,1-DCA, 1,1,1- 1,1,1-TCA, and trichloroethylene (TCE). All detected VOCs in soil gas were within 250 feet of vapor extraction well VEW-11, which correlates to the areas of highest VOC affected groundwater. Soil gas samples collected from the RMPA reported detectable concentrations of TCE, 1,1-DCE, and fuel components. The chlorinated solvents were detected near the former motor casing washout area. The fuel components were detected near the northern portion of the RMPA. Concentrations of perchlorate were present in 3 out of 10 soil samples collected at the BPA and 8 out of 10 soil samples from the RMPA. The maximum concentration of perchlorate in soil was 1,260 µg/kg.
Lockheed Beaumont, Site 1 & 2, Phase 1 Environmental Site Assessment, Lockheed Martin Corporation, Beaumont, California, Tetra Tech, March 2003	The Phase I ESA summarized available documentation regarding historical and current potential features that may have resulted from past and/or current property usage. The ESA reported: storage, handling, and disposal practices of chemicals and hazardous materials; historical process lines, storage vessels, underground storage tanks and other features that may have served as discharge points for chemicals; and the historical use and operations that may have environmentally affected the properties during the past 50 years. Fifty-four (54) historical or potential features were identified at Beaumont Site 1.

Table 2-1 (continued)
General Summary of Investigations and Remediation
Historical Operational Areas A - I

Document Title, Author and Date	Report Findings
Soil Investigation Report, Historical Operational Areas A, B, and C, Beaumont Site 1, Lockheed Martin Corporation, Tetra Tech, Inc., August 2005	A total of 293 samples were collected and analyzed from 64 borings at depths ranging from 0.5 to 60 feet bgs. Soil samples were analyzed for one or more of the following constituents: VOCs, SVOCs, 1,4-dioxane, perchlorate, Title 22 metals, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH) , and explosive residues. PCBs, 1,4-dioxane, and explosive residues were not detected at concentrations above their respective reporting limits. VOCs were detected at concentrations ranging from 0.93 to 700 µg/kg. SVOCs were detected at concentrations ranging from 0.59 to 4.5 milligrams per kilogram (mg/kg). Perchlorate was detected at concentrations ranging from 23.6 to 171,000 µg/kg. Metals were detected with arsenic detected at concentrations up to 60.8 mg/kg. In addition, soil gas concentrations above reporting limits were detected for TCE, PCE, 1,1-DCE, Freon-113, and 1,1,1-TCA.
Soil Investigation Report, Historical Operational Areas D, E, F, G, H, and I, Beaumont Site 1, Lockheed Martin Corporation, Tetra Tech, Inc., October 2005	A total of 302 samples were collected and analyzed from 78 borings at depths ranging from 0.5 to 60 feet below ground surface in Historical Operational Areas D, E, F, G, H, and I (Tetra Tech 2005b). Soil samples were analyzed for one or more of the following constituents: VOCs, SVOCs, 1,4-dioxane, perchlorate, Title 22 metals, PCBs, TPH, and explosive residues. SVOCs, 1,4-dioxane, and explosive residues were not detected at concentrations above their respective LRLs. VOCs were detected at concentrations ranging up to 958 µg/kg. PCBs were detected at concentrations up to 910 µg/kg. Perchlorate was detected at concentrations ranging up to 57,100 µg/kg. Arsenic was detected at concentrations ranging up to 19 mg/kg. Vanadium was detected at concentrations up to 2.2 mg/kg. In general, limited affected soil was detected in Area D, G, and I. Perchlorate and VOC affected soil was further delineated in Areas F and H.
Geophysical surveys, Terra Physics, 2005	Geophysical surveys were performed to assist with the refinement of the CSM in November and December 2005. Downhole seismic velocity surveying was performed at the Site to (1) aid in differentiating boundaries between unconsolidated alluvium and the weathered and unweathered portions of the Mount Eden Formation, and (2) help refine the CSM and aid in future groundwater monitoring well placement. Geophysical reflection surveying was performed at the Site to more accurately locate published alluvium-concealed faults along the southeastern edge of the Site. The surveys and the associated data reduction and interpretation were performed by Terra Physics.

Table 2-1 (continued)
General Summary of Investigations and Remediation
Historical Operational Areas A - I

Document Title, Author and Date	Report Findings
Supplemental Soil Investigation Report, Beaumont Site 1, Lockheed Martin Corporation, Tetra Tech, May 2008	In 2007 Tetra Tech conducted a subsurface soil investigation which was a follow-on activity to the site investigation conducted by Tetra Tech in 2004 (Tetra Tech, 2008d). The supplemental investigation was conducted through a combined soil boring and soil gas program. The investigation was conducted in an attempt to delineate chemically impacted soil in Operational Areas A, B, C, D, F, G and H. During this investigation there were 86 borings installed, 190 soil samples analyzed, 9 groundwater samples collected and analyzed, 54 soil gas probes installed and sampled, and 3 groundwater monitoring wells installed. Tetra Tech delineated the extent of chemically impacted soil at 11 of the 21 features proposed during the 2007 soil investigation. Based on the results of this investigation, no further investigation of 3Operational Areas A and D is recommended. In addition, no features were identified in Operational Area E. According to the historical report (Radian, 1986), former employees at the Site reported a one-time burial of low-level radioactive waste. The radioactive waste disposal site was present in Operational Area E when assessed in 1986 and subsequently remediated in 1990. Of the 21 features investigated during this investigation, 10 features were recommended for further evaluation to complete the characterization of the nature, magnitude, and extent of affected soil or groundwater at each feature. Further investigation of these features is needed to determine the mass of affected soil at each location to evaluate potential long term threats to groundwater and human health and ecological risks.
Sediment and surface water sampling, October 2007	Sediment and surface water sampling was conducted by Tetra Tech in October 2007 at a total of 13 locations. The purpose of this investigation was to supplement previous surface water sampling conducted as part of the groundwater monitoring investigations and provide data on potentially affected ponds, seeps, and streams for the human health and ecological risk assessments. Sediment samples were collected from 13 locations and analyzed for total organic carbon (TOC), perchlorate, metals including mercury, PCBs, VOCs, and SVOCs including 1,4-dioxane. Surface water samples were collected where water was present at the time of sampling, comprising a total of 6 sampling locations. Surface water samples were analyzed for perchlorate, metals, VOCs, and SVOCs. Results of the sediment and surface water sampling were reported in the Semiannual Groundwater Monitoring Report, Third Quarter and Fourth Quarter 2007 (Tetra Tech 2008d).

Table 2-1 (continued)
General Summary of Investigations and Remediation
Historical Operational Areas A - I

Document Title, Author and Date	Report Findings
Dynamic Site Investigation (DSI), Beaumont Site 1, Lockheed Martin Corporation, Work Plan (May 2008), DSI Report (July 2009)	In 2008 Tetra Tech performed additional characterization of subsurface soils, soil gas, and groundwater at specific features requiring further investigation within Historical Operational Areas B, C, F, G, and H. The investigation utilized a dynamic sampling strategy to better define the soil and groundwater contamination and fill information gaps. The investigation included sampling for (1) perchlorate in soil and groundwater in Operational Area B, (2) perchlorate in soil and VOCs in shallow soil gas in Area C, (3) VOCs in soil gas and groundwater in Operational Area F, (4) VOCs in soil gas and groundwater in Area G, and (5) perchlorate and PCBs in soil, and possibly perchlorate in groundwater, in Operational Area H. In addition, soil sampling for background metals and evaluation of background metals data were performed. This data evaluation included development of metals background threshold values (BTVs) and comparisons of Site metals data to site-specific background data for specific soil types. Reporting of the DSI and background metals evaluation results is in preparation.
Area F, Large Motor Washout Area (Feature F-33)	A separate investigation of soil and groundwater has been conducted at the Large Motor Washout Area (Feature F-33) where defective solid rocket propellant was washed out of motor casings. The solid propellant pieces produced from the washout activities were collected in a sieve and later packed into drums and taken to the burn pit landfill for burning. Soil and groundwater samples had been previously analyzed for VOCs, perchlorate, 1,4-dioxane, while soil samples had also been analyzed for SVOCs, TPH, and metals. Recent investigations were (1) to characterize site geology and the extent of soil impacts and (2) to determine groundwater flow across the site, assess perchlorate impacts to groundwater, and to assess whether the carbon sources within the Potrero Creek drainage have any influence on the natural degradation of perchlorate in the groundwater.

2.3 Areas Evaluated

The Site was operated by LPC from 1960 to 1974 for solid propellant production and testing, rocket motor and weapons testing, motor casing washout, ballistics testing, and incineration of propellant and chemical waste. Aerojet leased portions of the Site for ammunition research and development (R&D) from the mid-1960s to 1974.

The activities at the Site by LPC and Aerojet in the 1960s and 1970s were primarily divided into nine (9) confined operational areas (designated A through I) (Table 2-2). Eight of these operational areas (all except Operational Area E) were identified as preliminary AOCs to be evaluated in the SERA for potential hazards to ecological receptors. In addition, 4 areas of riparian and aquatic habitats with surface water and sediments have been identified as AOCs. A summary of the activities performed within each operational area (Figure 2-2) is discussed in the following subsections. The locations of the surface water and sediment AOCs are shown on Figure 2-3.

Table 2-2
Areas of Concern

Area of Concern	Historical Operation Name	Area (acres)
Operational Area A	Eastern Aerojet Range	980
Operational Area B	Rocket Motor Production Area	329
Operational Area C	Burn Pit Area	117
Operational Area D	LPC Ballistics Test Range	164
Operational Area E[1]	Radioactive Waste Disposal Site	70
Operational Area F	LPC Test Services Area	287
Operational Area G	Helicopter Weapons Test Area	302
Operational Area H	Permitted Sanitary Landfill	15
Operational Area I	Western Aerojet Range	191
Ephemeral Ponds	None	-
Ephemeral Creeks	None	-
Groundwater Discharge Ponds	None	-
Potrero Creek	None	-

Note:
[1] No soil, soil vapor, shallow groundwater, surface water, or sediment samples were collected in Operational Area E as part of investigations conducted starting in 2002. Accordingly, exposure pathways are considered incomplete in the SERA.

The prior uses of each AOC are discussed below.

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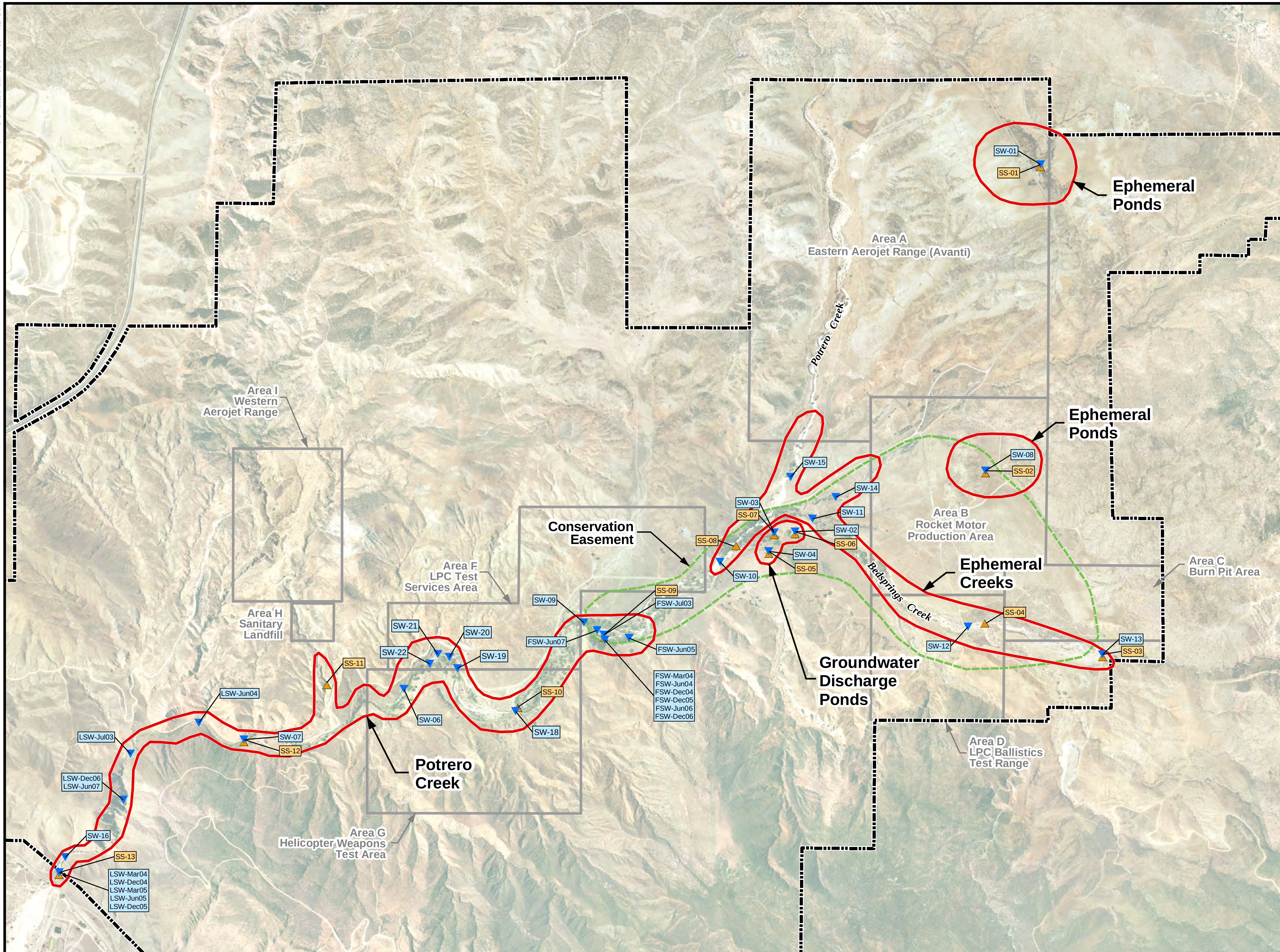

N

0 1,000 2,000 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Surface Water Sample Location
- Sediment Sample Location
- Beaumont Site 1 Property Boundary
- Historic Operational Area Boundary
- **Area of Concern for Surface Water and Sediments**
- Conservation Easement Boundary

Beaumont Site 1

Figure 2-3
Areas of Concern for Surface Water at Site 1

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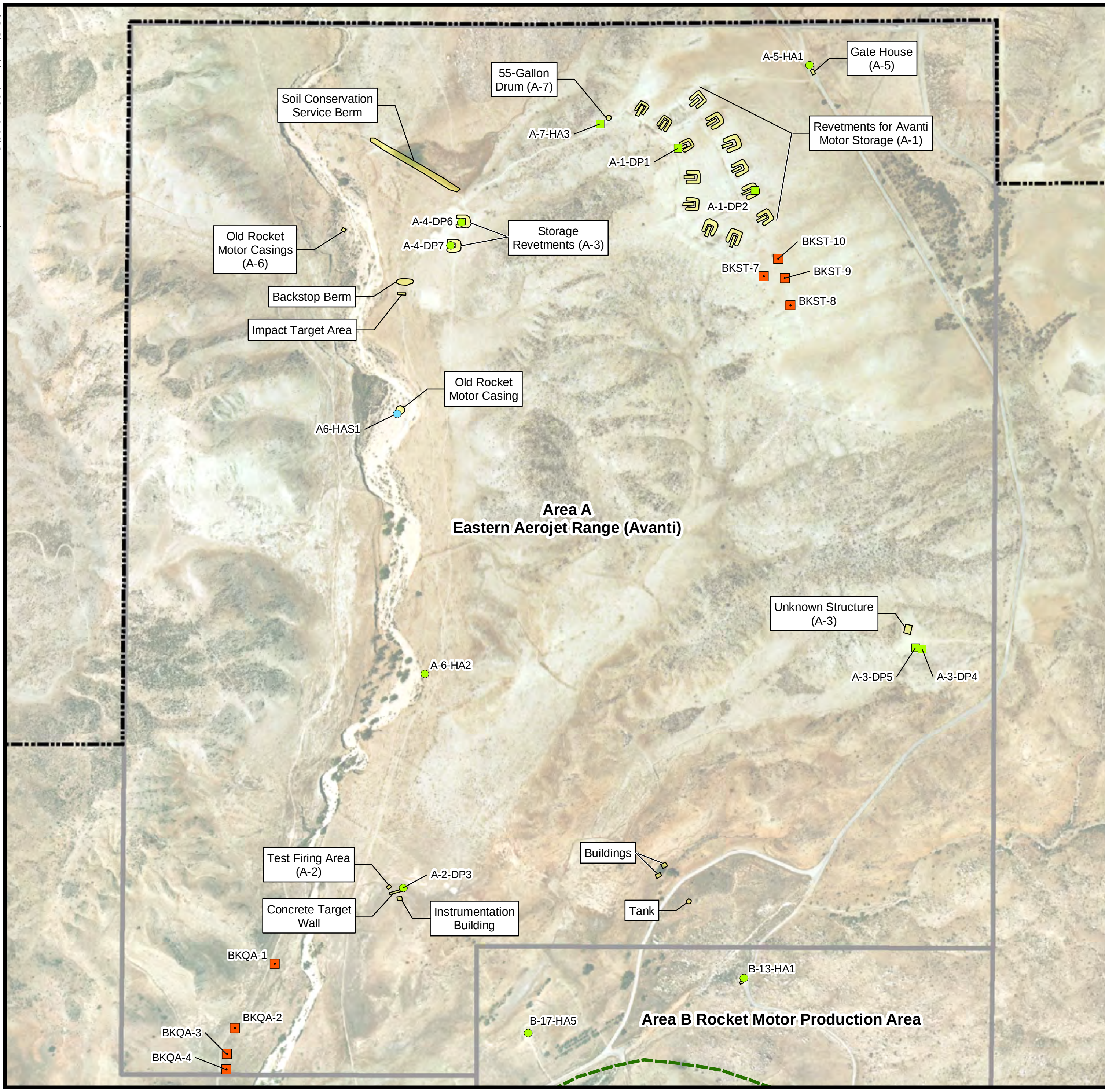
2.3.1 Operational Area "A" – Eastern Aerojet Range

The Eastern Aerojet Range was utilized by Aerojet and the Avanti project (Figure 2-4). Between 1970 and 1974 Aerojet leased the Eastern Aerojet Range for periodic R&D experimentation on several types of rounds for long-range 30-mm weapons. The projectiles were reportedly limited to specially machined and dummy aluminum bullets, and all rounds were accounted for during test procedures. The area was plowed and planted for sheep grazing at the conclusion of Aerojet's testing activities. Near the head of the canyon, the Soil Conservation Service constructed a berm to retain runoff and minimize downstream erosion. Avanti, a highly classified project, utilized the land directly to the east of the Eastern Aerojet Range, including for the storage of explosive materials and motors in several U-shaped revetments. Due to its highly classified status, the purpose of the Avanti projects and its operational procedures are unknown (Radian 1986).

During further investigations into munitions use in this area initiated in 2005, it was discovered that both inert and explosive projectiles were tested on the range by Aerojet and not all of the projectiles were recovered. The investigation and clearance of Area A was concluded in 2007. Based on the information available at this time, no further investigation or cleanup of munitions and explosives of concern (MEC) are anticipated.



Beaumont Site 1

Figure 2-4

Operational Area A

TETRA TECH

2.3.2 Operational Area "B" – Rocket Motor Production Area

The Rocket Motor Production Area (RMPA) was used for the processing and mixing of rocket motor solid propellants (Figure 2-5). The rocket motor production process consisted of: 1) fuel slurry stations, 2) mixing station, and 3) cast and curing station. The fuel slurry station and mix station were utilized to generate the solid propellants. Facilities used were Building 315 (mixing station), Building 317 (fuel slurry station), Building 319 (chemical storage), and Building 315-A (bunker control center). The production area operated under the Large Solid Motor (LSM) program until 1966, followed by the Short Range Attack Missile (SRAM) program starting in 1970. At the mix station, dry oxidizer, primarily ammonium perchlorate, was blended with liquid ingredients consisting of butadiene derivatives and a burn rate modifier (primarily ferrocene). Clean-up was performed by scraping and wiping down all containers and mixing equipment to remove all remaining propellant. Batches of propellant that did not meet specifications, as well as cleaning materials were incinerated in the burn pit area (Operational Area C) (Radian 1986). Other activities in the RMPA included propellant casting and curing (southwest of the mix station), propellant removal at the motor washout (south of the mix station), and collection of washout water slurry in a lined basin. Remaining solid fuel residue was collected and incinerated in Operational Area C. Any residues remaining on the ground in the motor washout area were burned with a flamethrower. A "blue motor" burn pit to the east of the mix station was used for destroying 4 motors including propellant in 1973 (Radian 1986).

2.3.3 Operational Area "C" – Burn Pit Area

The Burn Pit Area (BPA) consisted of three primary features: 1) chemical storage area, 2) burn pits, and 3) the beryllium test stand (Figure 2-6). Hazardous materials generated at the Site were stored in 55-gallon drums on a concrete pad east of the burn pits in the chemical storage area until enough material was generated for a burning event. Materials burned included ammonium perchlorate, wet propellant from motor washout, dry propellant, out-of-specification propellants, adhesives, resin curatives including a polybutadiene acrylonitrile/acrylic acid copolymer (PBAN), burn rate modifiers such as ferrocene, pyrotechnic and ignition components, packaging materials including metal and paper drums, and solvents (Radian 1986). Twenty or 21 burn pits were constructed by excavation into the ground. After burning activities, the burn pit trench was visually inspected for items that did not burn. Burn pits that were not reused were filled and covered with soil (Radian 1986). Near the burn pit instrumentation bunker, there was a one-time firing of small beryllium research motors (Radian 1986).

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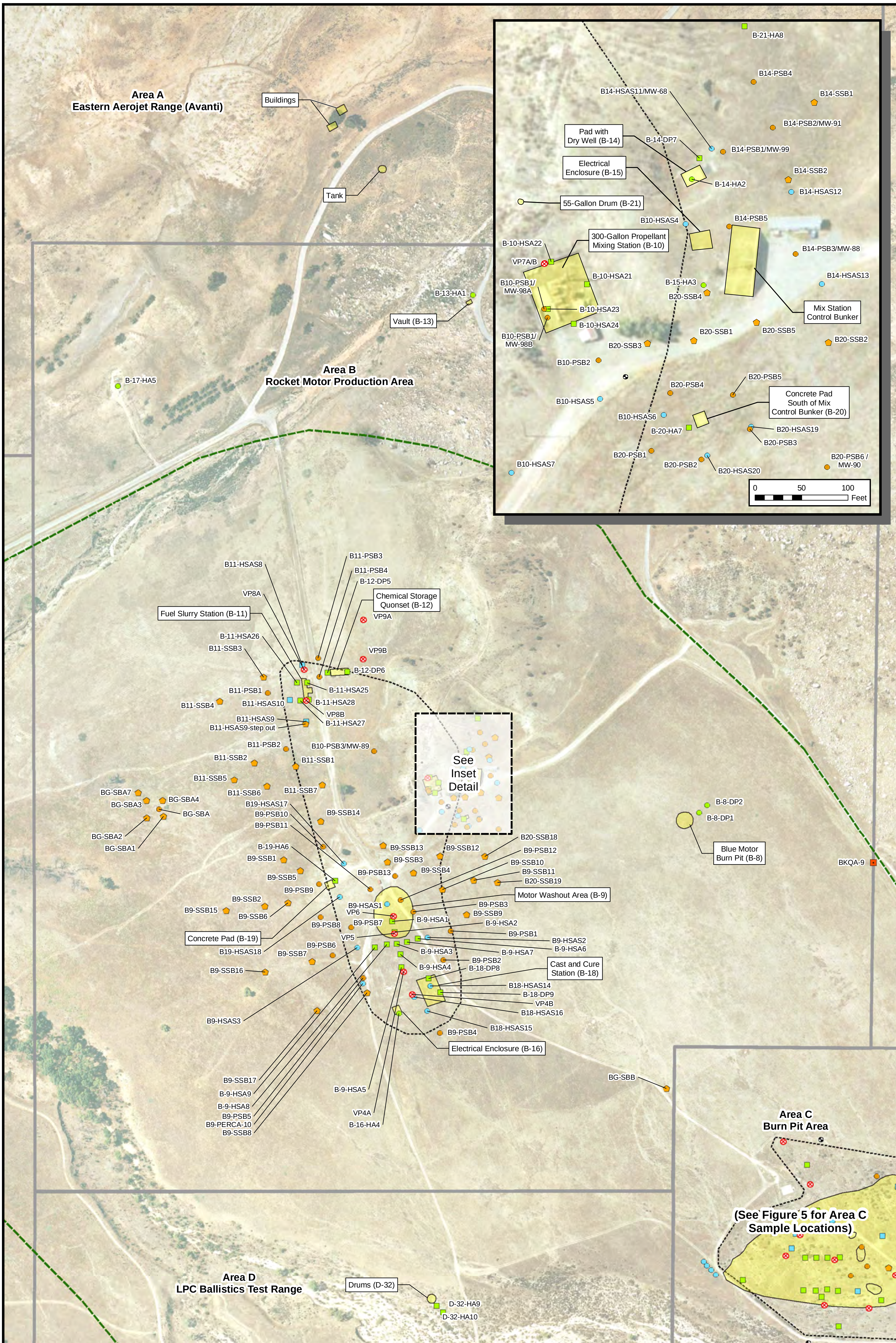

LEGEND

- Primary Soil Boring, 2008
- Soil Boring (BK), 2008
- Soil Boring, 2004
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Soil Boring/Soil Vapor, 2007
- Secondary Soil Boring
- Soil Vapor, 2002
- Well
- Feature Location
- Conservation Easement Boundary
- Historic Operational Area Boundary

N

0 200 400 Feet

Beaumont Site 1

Figure 2-5

Operational Area B

TETRA TECH

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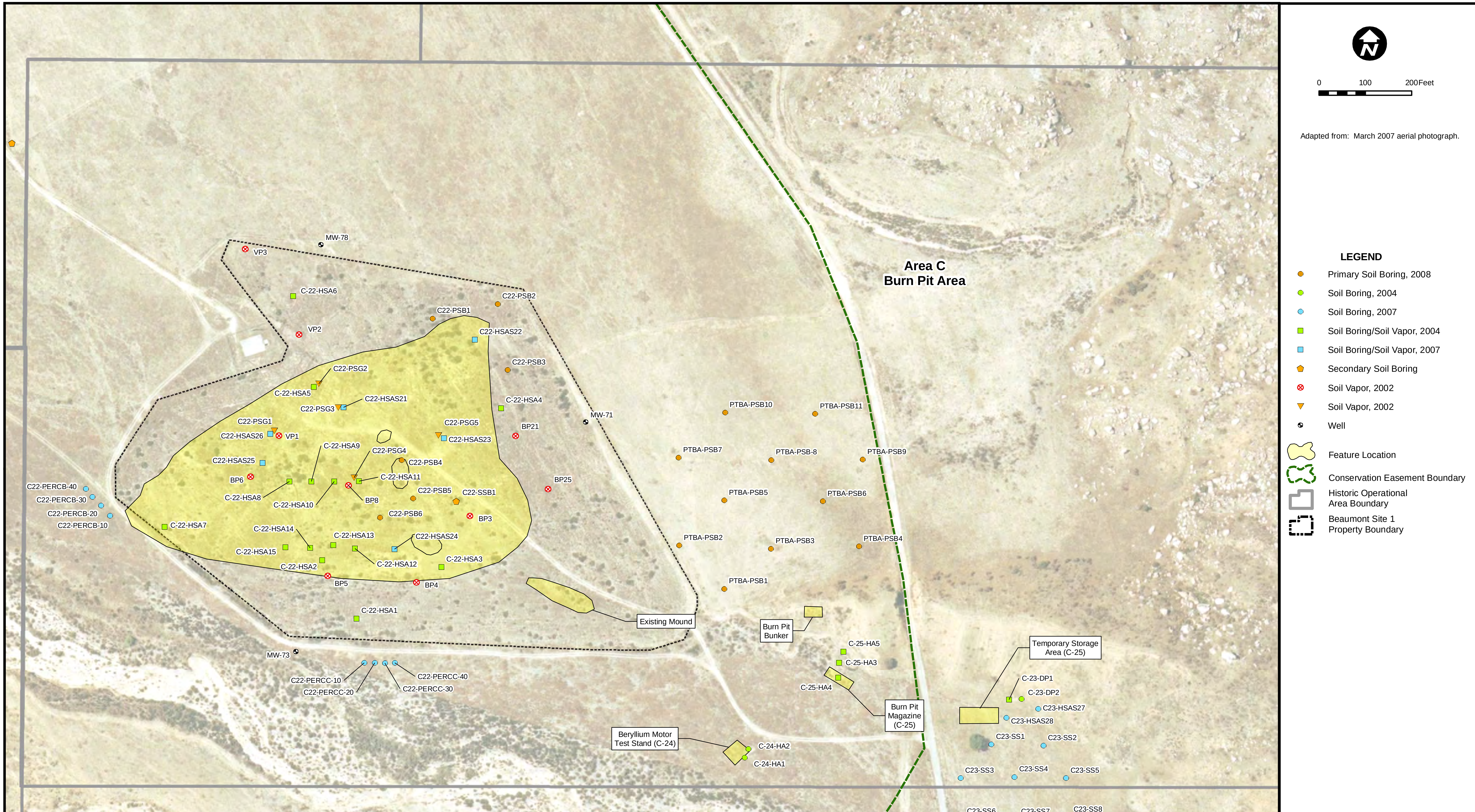

Beaumont Site 1

Figure 2-6
Operational Area C

TETRA TECH

2.3.4 Historical Operational Area "D" – LPC Ballistics Test Range

The LPC Ballistics Test Range facilities included gun mounts, a ballistic tunnel, and storage buildings and trailers (Figure 2-7). Guns were tested by firing toward a terraced hill. After firing, the hill was policed to pick up the remains of any projectiles. Explosive rounds were not used although projectiles were often specially shaped and weighted to simulate actual explosive rounds. Land mines were also tested here as well.

The ballistics tunnel consisted of large sections of drainage culvert cut lengthwise and supported on a concrete foundation. Various weapons were fired through the tunnel and photographed with special high-speed strobe photographic equipment. Another major project conducted in this area was experimentation on a rocket-assisted projectile to test penetration capability. Additional experiments included kinetic projectiles and impact testing of various motors and pieces of equipment.

Class A explosives were stored in two or three 10-foot by 10-foot buildings located behind a berm. During the closure of the facility, all explosive materials were detonated on-site. A small canyon behind the hill to the south of the former storage buildings may have been used as a small test area for incendiary bombs. An incendiary bomb was detonated in the center of drums containing various types of fuel (e.g., jet fuel, gasoline, and diesel) set in circles of different radii to observe shrapnel and penetration patterns. This activity was later reported to have been conducted in Operational Area I. At a small area near the bend in the road south of the Class A explosives storage area, acetone was used to dissolve TNT out of bombs so the propellant could be salvaged for testing. This was a one-time occurrence, the acetone was allowed to evaporate and the resulting TNT crystals were burned.

During further investigations into munitions use in this area initiated in 2005, it was discovered that unspent 20mm practice rounds and large caliber unspent burster tubes had been discarded near the streambed. The investigation and clearance of Operational Area D was concluded in 2007. Based on the information available at this time, no further investigation or cleanup of MEC is anticipated.

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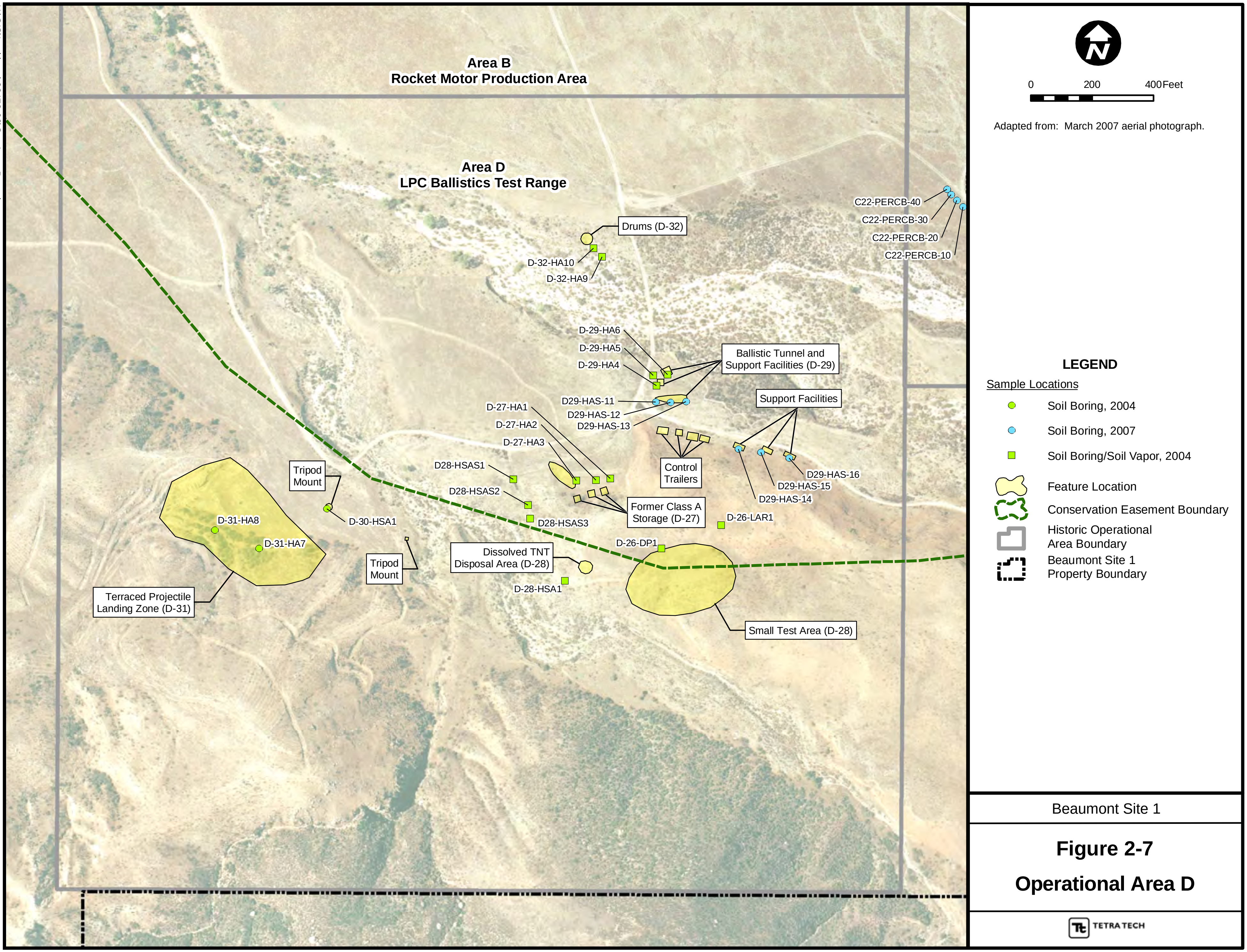

Beaumont Site 1

Figure 2-7

Operational Area D

TETRA TECH

2.3.5 Historical Operational Area "E" – Radioactive Waste Disposal Site

During 1971, a one-time burial of low-level radioactive wastes from cleaning laboratory surfaces at another facility occurred in one of four canyons southeast of the LPC test services area, as reported by former Site employees. The Radian (1990) *Source and Hydrogeologic Investigation* states that in September 1989 the radioactive waste disposal site was located, sampled, and excavated. Confirmation soil samples were analyzed for gross alpha, gross beta, and gamma radioactivity. Over-excavation of soils around the waste-containing jars and collection of confirmation samples determined that radioactivity in soils did not exceed naturally occurring levels. In the subsequent draft risk assessment (Radian 1992), Radian states that the radioactive waste site was no longer a possible source of contamination since all containers and surrounding soils were disposed of properly.

2.3.6 Historical Operational Area "F" – LPC Test Services Area

The LPC Test Services Area included the following features: 1) 3 bays for structural load tests, 2) a 13-foot-diamater spherical pressure vessel, 3) 6 temperature conditioning chambers, 4) 5 environmental chambers, 5) a 25-million electron volt (MeV) Betatron for X-raying large structures, 6) personnel and instrumentation protection bunkers, and 7) supporting work shops and storage areas (Figure 2-8).

Once a motor casing was prepared with solid propellant, the casing was transported to the LPC Test Services Area for integrity testing. Nondestructive inspection of the motor casing with a radiographic unit was performed in Building 303. The testing process also included simulated extreme environmental conditions. A spherical pressure vessel was utilized to simulate extreme pressures and was used as a source of high-pressure, high-volume gas or water for flow tests of valves, meters, and pumps. Temperature chambers exposed motors to temperatures ranging from –100 to +200°F. Environmental chambers simulated conditions of humidity, rain, immersion, infrared radiation, salt spray, sand and dust, and altitude. Buildings 306 and 314 of the LPC Test Services Area were work shops and storage facilities.

If defects were identified during the integrity and environmental testing activities, the rocket motors were taken to a secondary washout area located south of the conditioning chambers adjacent to Potrero Creek. A shaking sieve caught most of the solid propellant as it was washed out of the motor casing. This solid propellant was packed in barrels and taken to the burn pit area to be incinerated. A long trench, leading to an unlined catch basin, caught the overspray and contained the water and smaller pieces of solid propellant that passed through the sieve. After the water percolated into the soil, the remaining pieces of solid propellant were gathered and burned in the catch basin.

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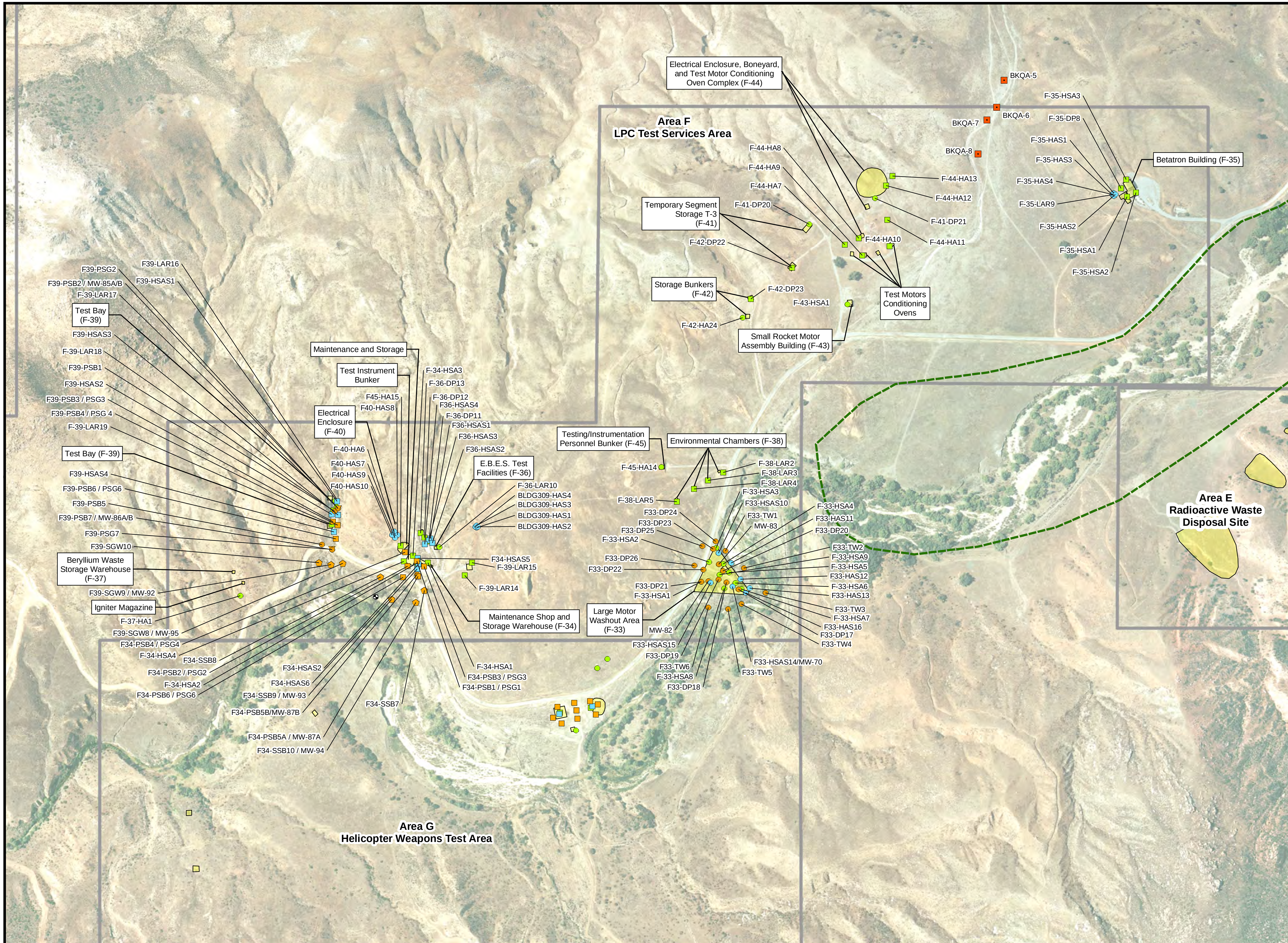


LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Soil Boring (BK), 2008
- Soil Boring, 2004
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Soil Boring/Soil Vapor, 2007
- Secondary Soil Boring
- Soil Vapor, 2002
- Well
- Feature Location
- Conservation Easement Boundary
- Historic Operational Area Boundary

Beaumont Site 1

Figure 2-8
Operational Area F

TETRA TECH

Rocket motor structural load testing under static and captive firing conditions occurred at the LPC test bays. During several of the initial tests conducted at Bay 309, the readied motor exploded instead of firing. Buildings 304 and 305 (bunkers) provided protection for personnel and instrumentation during various test activities. These buildings were all designated as inert and were not to contain any propellant.

Several storage areas existed at the LPC Test Service Area. Beryllium scrap from LMC's Redlands Facility was stored in 55-gallon drums near the igniter magazine in a small structure over a hill just to the west of Test Bay 310. An igniter magazine existed near the beryllium storage structure. This was a small, half-buried barrel with a door where squibs (small electric or pyrotechnic devices used to ignite a charge) were stored. A bone-yard was used as a storage area for a variety of steel framework and other heavy equipment used in the structural testing activities.

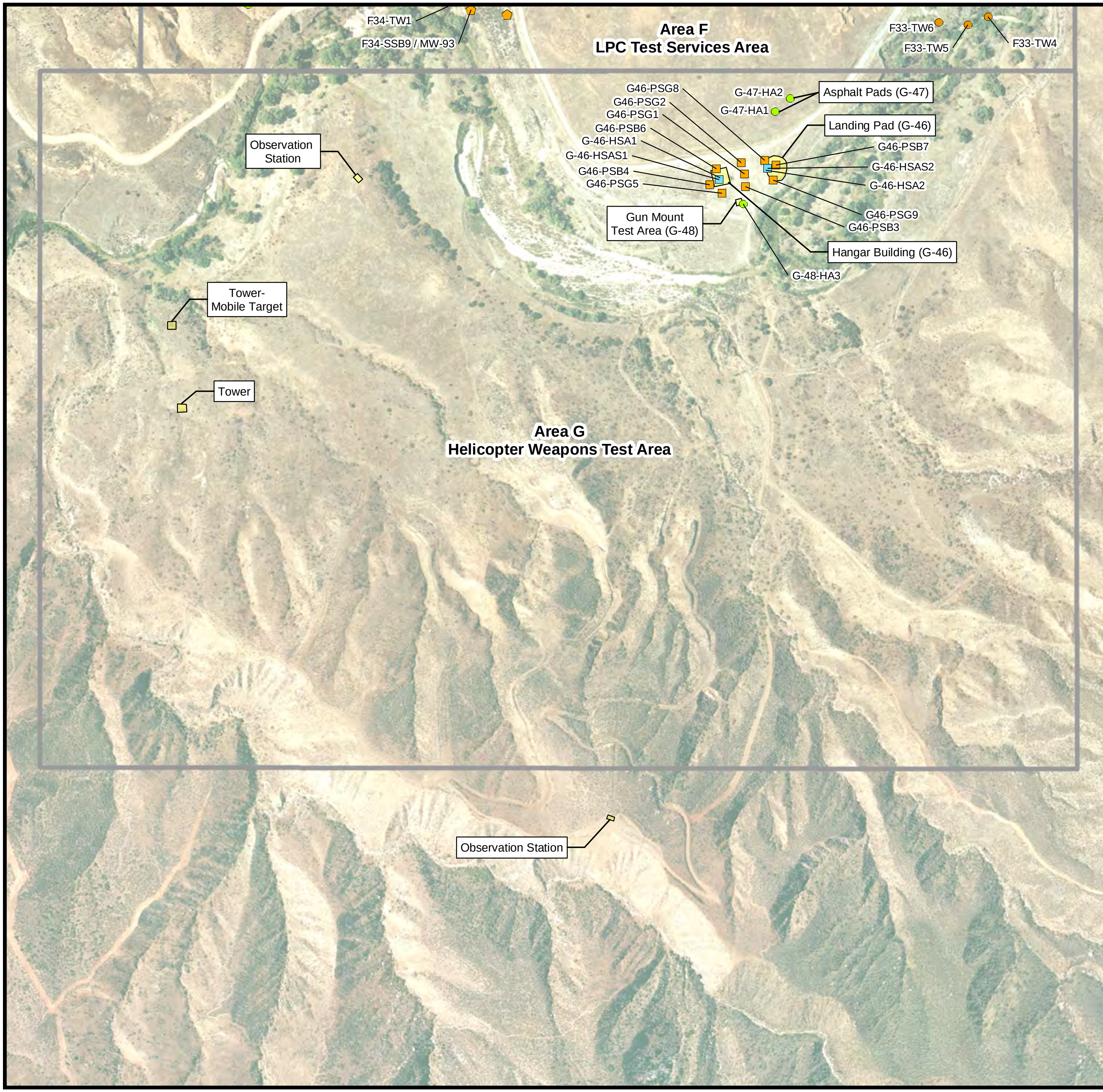
2.3.7 Historical Operational Area "G" – Helicopter Weapons Test Area

The helicopter weapons test area was used to develop equipment for handling helicopter weapons systems (Figure 2-9). The facilities within this area included a hanger (Building 302), helicopter landing pad, stationary ground mounted gun platforms, firing range, and a mobile target suspended between towers. The primary project at this test area was testing of both stationary guns and guns mounted on helicopters. Experimentation also was performed on the propellant portion of an armor-piercing round and a shape charge projectile. The majority of rounds were fired into the side of the creek wash, about 100 yards to the south of the hanger. A longer impact area labeled with distance markers was located in the canyon to the south of the wash. Three calibers of projectiles (40, 30, and 7.62 mm) were tested here. All were reportedly steel; explosive projectiles were not used during tests at this facility.

During further investigations into munitions use in this operational area initiated in 2005, the findings were consistent with the historical record. A sample of the projectiles that remain at the Site was collected and examined. All projectiles recovered were inert. The investigation of Operational Area G was concluded in 2007. Based on the information available at this time, no further investigation or cleanup of MEC is anticipated.

2.3.8 Historical Operational Area "H" – Sanitary Landfill

A permitted sanitary landfill was located along the western side of the Site (Figure 2-10). The permit for the landfill permitted LPC to dispose of trash such as paper, scrap metal, concrete, and wood generated during routine daily operations. Lockheed policy strictly dictated that hazardous materials were not to be disposed of at this landfill. The trenches were later covered and leveled, with only an occasional tire, metal scrap, or piece of wood remaining on the surface. During interviews with former employees it was learned that unspent 7.62mm practice ammunition was disposed of in the landfill.



0 300 600 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2007
- Secondary Soil Boring
- Feature Location
- Historic Operational Area Boundary

Beaumont Site 1

Figure 2-9

Operational Area G

TETRA TECH

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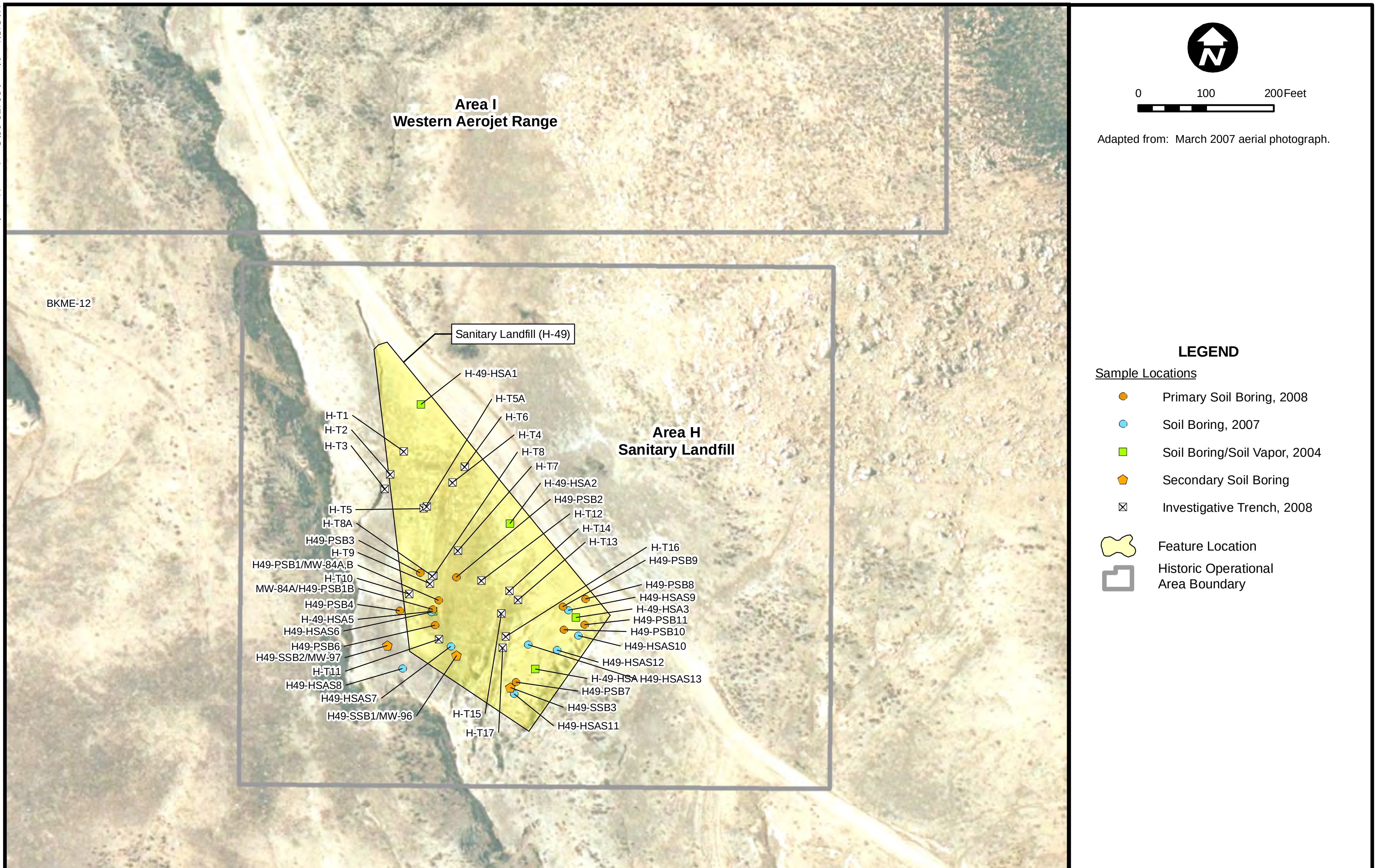

Beaumont Site 1

Figure 2-10

Operational Area H

TETRA TECH

2.3.9 Historical Operational Area "I" – Western Aerojet Range

Lockheed conducted an incendiary test with a 500-pound bomb at the southwest end of the Western Aerojet Range (Figure 2-11). This test was similar to testing reportedly performed at the LPC Ballistics Test Area. According to a historical report prepared by Radian in 1986, the Western Aerojet Range was originally leveled to be used as an airstrip (Radian, 1986a). Based on employee interviews, the leveled area may have been used only on one occasion.

During further investigations into munitions use in this operational area initiated in 2005, it was discovered that inert 27.5mm projectiles and 16mm tungsten penetrators were tested on the range by Aerojet and not all of the projectiles were recovered. The investigation and clearance of Operational Area I was concluded in 2007. Based on the information available at this time, no further investigation or cleanup of munitions and explosives of concern are anticipated.

2.3.10 Areas of Concern for Surface Water

This section describes AOCs for surface water. These AOCs are present in a number of aquatic habitats at the Site. As described in Section 2.1, Potrero Creek and Bedsprings Creek convey ephemeral or seasonal surface water flows. Bedsprings Creek converges with Potrero Creek west of Operational Area B; Potrero Creek then runs in a westerly direction through Massacre Canyon (Figure 2-3). Groundwater discharges near the convergence of the creeks, where two man-made ponds and two seeps are located. Surface water in the ponds and seeps, as well as along certain sections of Potrero Creek downgradient of its convergence with Bedsprings Creek, is generally long-standing or perennial. Other isolated ponds with ephemeral to seasonal surface water are also present at the Site.

These creeks, ponds, and seeps are potentially impacted by constituents in surface water runoff or groundwater discharge associated with upgradient releases at the Site. In order to fully assess these potentially impacted aquatic habitats, 4 additional AOCs were identified, as described below. These AOCs were defined on the basis of surface water, and will be further evaluated in the PERA for the corresponding receptors and exposure pathways, as described in Section 4.

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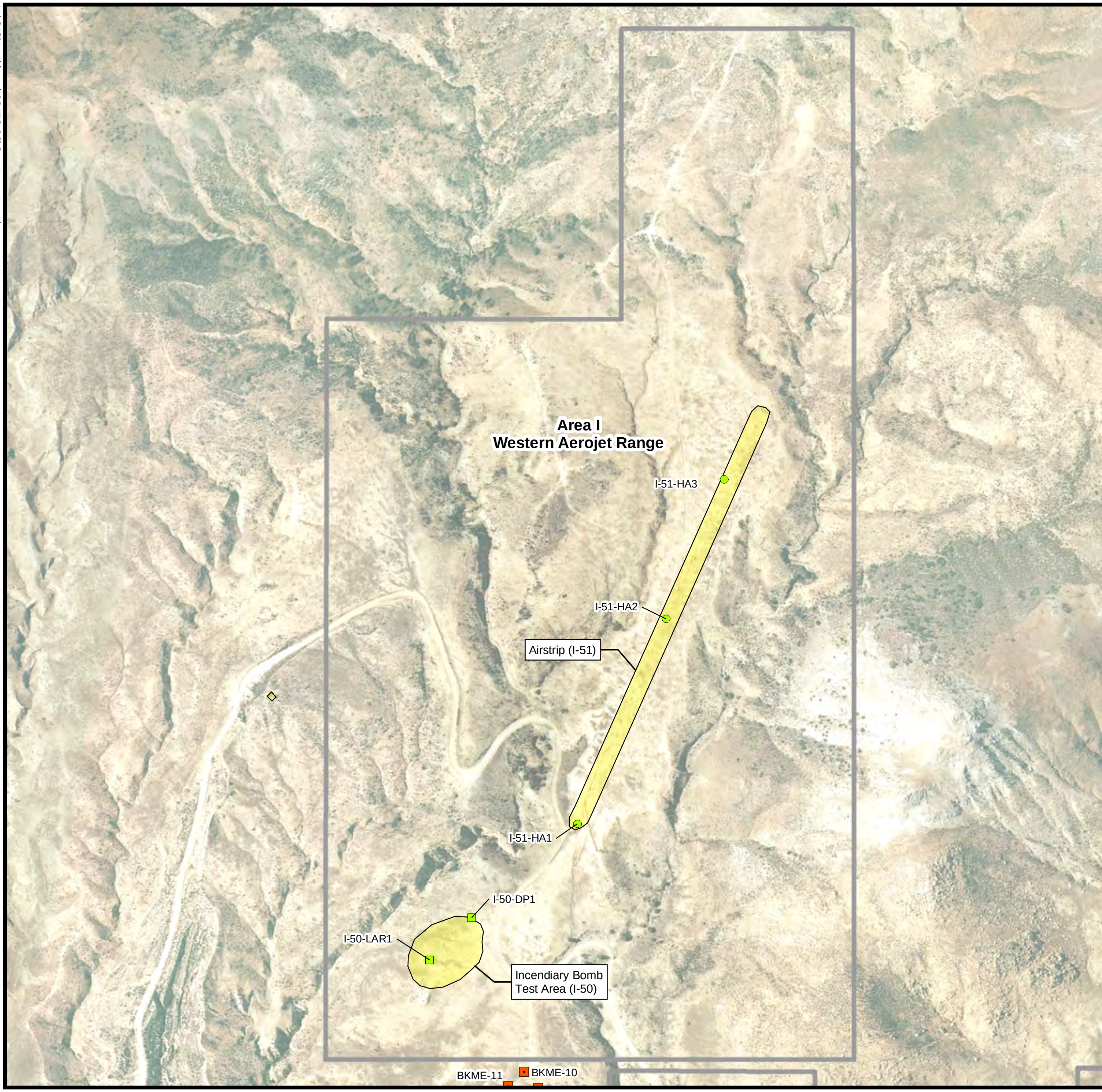


Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Soil Boring (BK), 2008
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Feature Location
- Historic Operational Area Boundary

Beaumont Site 1

Figure 2-11
Operational Area I

TETRA TECH

Ephemeral Ponds

Two ponds with ephemeral to seasonal surface water are located in upper portions of the watershed where releases potentially occurred. Although these ponds may be upgradient of releases, they were conservatively identified as an AOC for the SERA, "Ephemeral Ponds". One pond is located in the northeastern section of Operational Area A (Figure 2-3), east of the revetments for Avanti motor storage. The other pond is located in the central portion of Operational Area B, northeast of the mix station control bunker and other features of the RMPA. Both surface water and sediment samples have been collected from each of these ponds.

Ephemeral Creeks

Several creek segments in the central to eastern portions of the Site contain ephemeral surface water flows and were identified as the Ephemeral Creeks AOC. Bedsprings Creek and a small tributary are located in Operational Areas B, C, and D, and extend into the area west of Operational Area B where they converge just upstream of the confluence with Potrero Creek (Figure 2-3). The portion of Potrero Creek just above the confluence is also included. Bedsprings Creek extends upgradient of Operational Area C past surface water location SW-13. Bedsprings Creek and the upper portion of Potrero Creek contain ephemeral flows, typically during and immediately following rainstorms. The portion of Potrero Creek immediately below the confluence with Bedsprings Creek also contains ephemeral surface water. These creeks are not fed by groundwater discharge, but shallow groundwater may help support riparian vegetation in some areas. As described in Section 3.3.1.4, these ephemeral portions of Bedsprings and upper Potrero Creeks occur at higher elevations in the watershed, and support riparian habitat that may differ in composition and structure from riparian habitat lower in the watershed. The ephemeral creeks are potentially impacted by surface water runoff from upgradient Site features including the burn pits and RMPA. Surface water samples have been collected along Bedsprings Creek as well as along Potrero Creek immediately above and below the confluence (Figure 2-3). Sediment samples have been collected from upper Bedsprings Creek and from Potrero Creek immediately below the confluence.

Groundwater Discharge Pond

Just south of the confluence of Bedsprings and Potrero Creeks, 2 man-made ponds (indicated by location SW-03) and 2 seeps (indicated by locations SW-02 and SW-04) are fed by groundwater discharge (Figure 2-3). These features collectively comprise the Groundwater Discharge Pond AOC. The ponds and seeps typically contain long-standing or perennial surface water and are fringed by riparian vegetation including trees and emergent plants. These areas were apparently excavated by facility managers to facilitate groundwater discharge and to provide a source of water. The ponds and seeps are potentially impacted by groundwater constituents. Both surface water and sediment samples have been collected from each of the ponds and seeps.

Potrero Creek

The portion of Potrero Creek beginning in the vicinity of surface water location FSW-Jun05 and extending downstream along Massacre Canyon to the property boundary was identified as the Potrero Creek AOC (Figure 2-3). The FSW sample locations indicate the farthest upgradient area of the creek where surface water is long-standing or perennial. Surface water flows along the creek are primarily fed by groundwater discharge. This AOC includes creek segments with persistent flows as well as several intervening segments that are dry or ephemeral. The presence of surface water and shallow groundwater along the creek supports extensive riparian vegetation. Riparian habitat along this portion of Potrero Creek is generally taller, denser, and more pervasive than riparian habitat along ephemeral creeks higher in the watershed. Potrero Creek may be impacted by groundwater constituents as well as surface runoff from several Site features, including the maintenance shop and storage warehouse (F-34). Both surface water and sediment samples have been collected from this portion of Potrero Creek. In addition, a sediment sample was collected from the tributary extending south from Operational Area H (Sanitary Landfill) (Figure 2-3).

2.3.11 Wide-Ranging Receptor AOC

Individuals of wildlife species with relatively large home ranges or foraging areas may range across multiple AOCs. As they forage, they may be exposed to constituents from more than one AOC. To account for these potential cumulative exposures, an additional AOC encompassing all of the individual AOCs described above was identified.

2.4 Data Summary

This section summarizes the characterization data collected for the Site. The data are based on the results of investigations conducted since 2002 (Table 2-1) including data collected during the recent DSI (Tetra Tech 2009a). Summaries of the soil, soil gas, shallow groundwater, surface water and sediment data are provided below.

The data collected since 2002 will be used in characterizing risks. These data have been examined to ensure that quality assurance/quality control (QA/QC) procedures have been adhered to and that data are of sufficient quality to support a risk assessment under current guidance (USEPA 1999, 2004). Each of the Tetra Tech sampling investigation reports describes the results of the data validation, including descriptions of the overall data quality, adequacy, and representativeness. Specifically, the data validation process includes reviews of sample preservation, temperature, and holding times; detection and quantitation limits; instrument calibration; and equipment blank, trip blank, method blank, laboratory control sample, and matrix spike/matrix spike duplicate. All data determined to be usable meet the QA/QC criteria. In general, only "R"-qualified (rejected) data will be excluded from use in the SERA.

2.4.1 Summary of Soil Data

Five main soil investigations have been conducted at the Site between 2002 and 2008 (Tetra Tech 2002, 2005a, 2005b, 2008a, 2009a). Table 2-3 summarizes the number of samples collected during these sampling events for the depth interval that ecological receptors may be exposed to (i.e., from surface to 10 feet bgs).

- In 2002, 48 soil samples were collected from 20 locations and variously analyzed for VOCs, perchlorate, metals, and 1,4-dioxane (EPA Methods 8260, D314.1, 6010/7471, and 8270S, respectively) (Tetra Tech 2002).
- In 2004, 546 soil samples were collected from 145 locations and analyzed for VOCs, SVOCs, perchlorate, PAHs, metals, 1,4-Dioxane, PCBs, explosives, organochlorine pesticides, organophosphorous pesticides, chlorinated herbicides, diesel range organics, and gasoline range organics (EPA Methods 8260B, 8270C, E314.0, 8310, 6010B/7471A, E1624/E1625, 8082, 8330, 8081A, 8141A, 8151A, M8015D, and M8015V, respectively) (Tetra Tech 2005a, 2005b).
- In 2007, 213 soil samples were collected from 77 locations and variously analyzed for VOCs, SVOCs, perchlorate, metals, 1,4-Dioxane, PCBs, and explosives (EPA Methods 8260B, 8270C, E314.0, 6010B/7471A, S8270M, 8082, and 8330 respectively) (Tetra Tech 2006a, 2006b, 2008a).
- In 2008, 777 soil samples were collected from 138 locations and were variously analyzed for VOCs, SVOCs, perchlorate, metals, PCBs, and dioxins/furans (EPA Methods 8260B, 8270C, E314.0, 6010B/7471A, and 8290, respectively) (Tetra Tech 2008b, 2009a).

The sampling locations are shown in Figures 2-4 through 2-11.

Table 2-3
Number of Soil Samples Collected from 2002 to 2008 (0 - 10 feet bgs)

		Operational Area							
Matrix	**Chemical Group (Method)**	**A**	**B**	**C**	**D**	**F**	**G**	**H**	**I**
Soil									
	1,4-Dioxane (E1624/E1625C/8260B/S8270M)	29	85	64	7	95	4	10	5
	Chlorinated Herbicides (8151A)	-	-	-	-	-	-	-	6
	Dioxins/Furans (8290)	-	-	-	-	-	-	4	-
	Explosives (8330)	14	-	-	12	8	2	-	6
	Metals (6010B/7471A)	30	75	69	16	77	4	65	-
	Organochlorine Pesticides (8081A)	-	-	-	-	-	-	-	6
	Organophosphorus Pesticides (8141A)	-	-	-	-	-	-	-	6
	PAHs (8310)	-	-	-	-	-	-	15	-
	PCBs (8082)	18	25	4	-	76	-	83	-
	Perchlorate (E314)	13	326	107	14	128	-	92	6
	SVOCs (8270C/8270S)	19	79	56	4	93	-	65	-
	VOCs (8260B)	29	98	74	25	134	10	15	6

The range of chemical concentrations detected in soil and the frequency of detection in each of the AOCs are presented in Appendix A. Separate summaries are provided for the three depth intervals that ecological receptors may contact: 0.5 feet bgs, 0-5 feet bgs, and 0-10 feet bgs.

2.4.2 Summary of Soil Gas Data

Soil gas samples were collected between 2002 and 2008 in all operational areas (Tetra Tech 2002, 2005a, 2005b, 2006a, 2006b, 2008a, 2008b, and 2009a). Table 2-4 summarizes the number of samples collected during these sampling events for the depth interval that ecological receptors may be exposed to soil gas (i.e., from surface to 10 feet bgs).

- In 2002, 59 soil gas samples were collected at 32 soil gas probes and analyzed for VOCs using EPA Method 8260B (Tetra Tech 2002).
- In 2004, 182 soil gas samples were collected at 106 soil gas probes and analyzed for VOCs using EPA Method 8260B (Tetra Tech 2005a, 2005b).
- In 2007, 71 soil gas samples were collected at 26 soil gas probes and analyzed for VOCs using EPA Method TO-15 (Tetra Tech, 2008a).
- In 2008, 53 soil gas samples were collected at 25 soil gas probes and analyzed for VOCS using EPA Method TO-15 (Tetra Tech 2009a).

Table 2-4
Number of Soil Gas Samples Collected from 2002 to 2008 (0 - 10 feet bgs)

		Operational Area							
Matrix	**Chemical Group (Method)**	**A**	**B**	**C**	**D**	**F**	**G**	**H**	**I**
Soil Vapor									
	VOCs (8260B/TO-15)	5	36	47	13	56	23	5	2

The sampling locations are shown in Figure 2-12 through Figure 2-15.

The range of chemical concentrations detected in soil gas and the frequency of detection in each of the AOCs are presented in Appendix A.

2.4.3 Summary of Shallow Groundwater Data

Groundwater has been sampled at the Site on a quarterly basis in support of the GMP and also as part of the recent DSI (Tetra Tech 2008d, 2009a). Groundwater samples have been variously analyzed for VOCs, perchlorate, 1,4-dioxane, metals (including hexavalent chromium), explosives, NDMA, and 1,2,3-trichloropropane (1,2,3-TCP) (Table 2-5). In many locations, groundwater is found below 25 feet bgs, which is considered inaccessible by ecological receptors. Only groundwater near Potrero Creek occurs at depths within 25 feet of ground surface. Therefore, this shallow groundwater could potentially be accessible to deep rooting trees and other riparian vegetation. The data collected from twenty-nine monitoring wells are considered representative of shallow groundwater, because they have screened intervals starting above 25 feet bgs and depths to groundwater (measured between March 2003 and February 2009) were also less than 25 feet bgs (Figure 2-16 and Table 2-5).

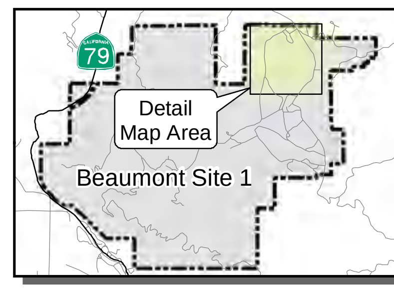
Shallow groundwater has been analyzed for the full suite of constituents listed above (using EPA Methods 8260B, E314.0, 8270M/8270S/E1624/E1625C, 6010B/7470A/E218.6, 8330, E1625C, and E524.2, respectively). Table 2-6 summarizes the number of groundwater samples collected from shallow monitoring wells (i.e., groundwater at less than 25 feet bgs).

The range of chemical concentrations detected in shallow groundwater and the frequency of detection are presented in Appendix A.

0 400 800 Feet

LEGEND

- Soil Gas Sampling Location
- Historic Operational Area Boundary
- Beaumont Site 1 Property Boundary



Beaumont Site 1

Figure 2-12
Soil Gas Sampling Locations in Operational Area A

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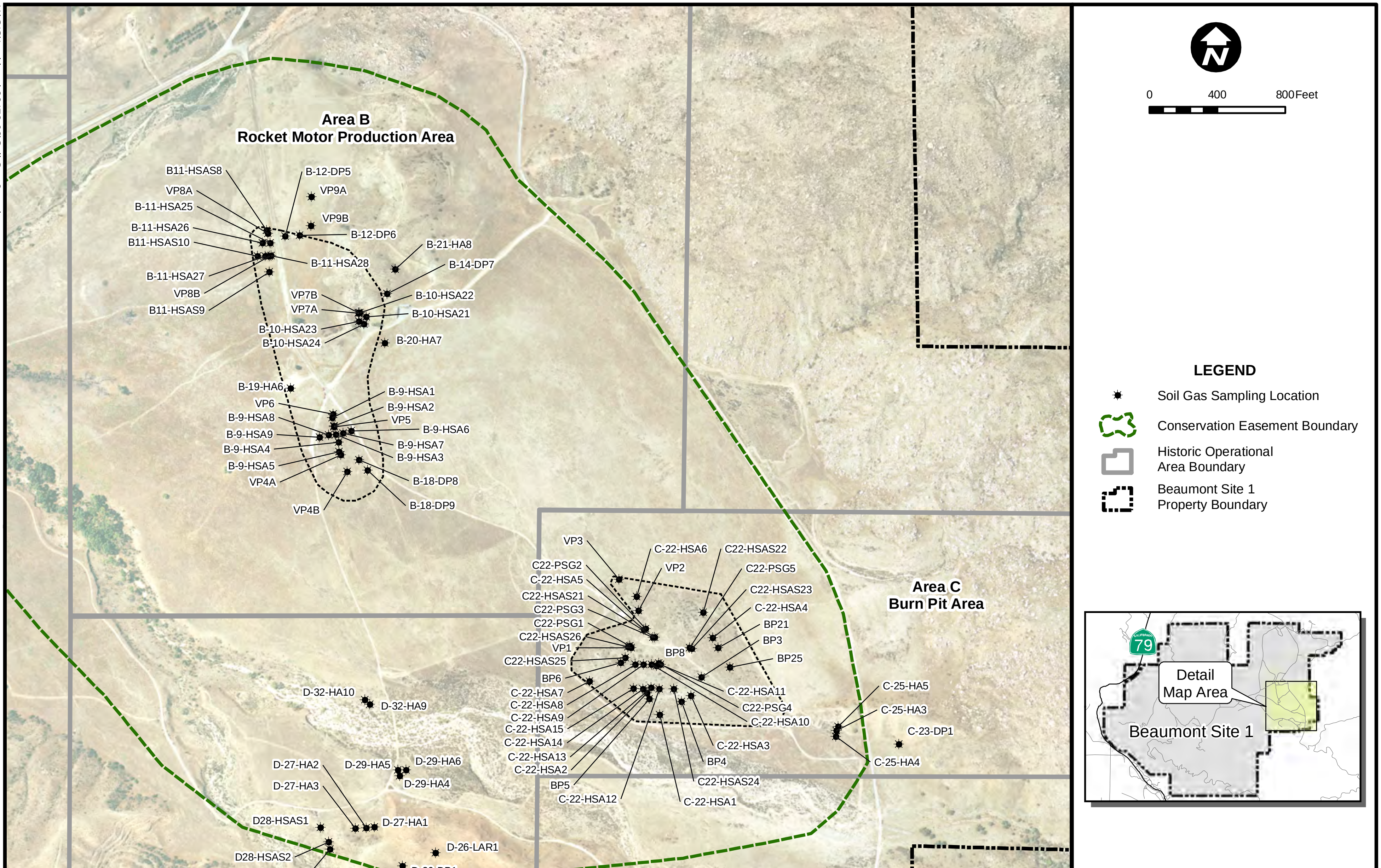
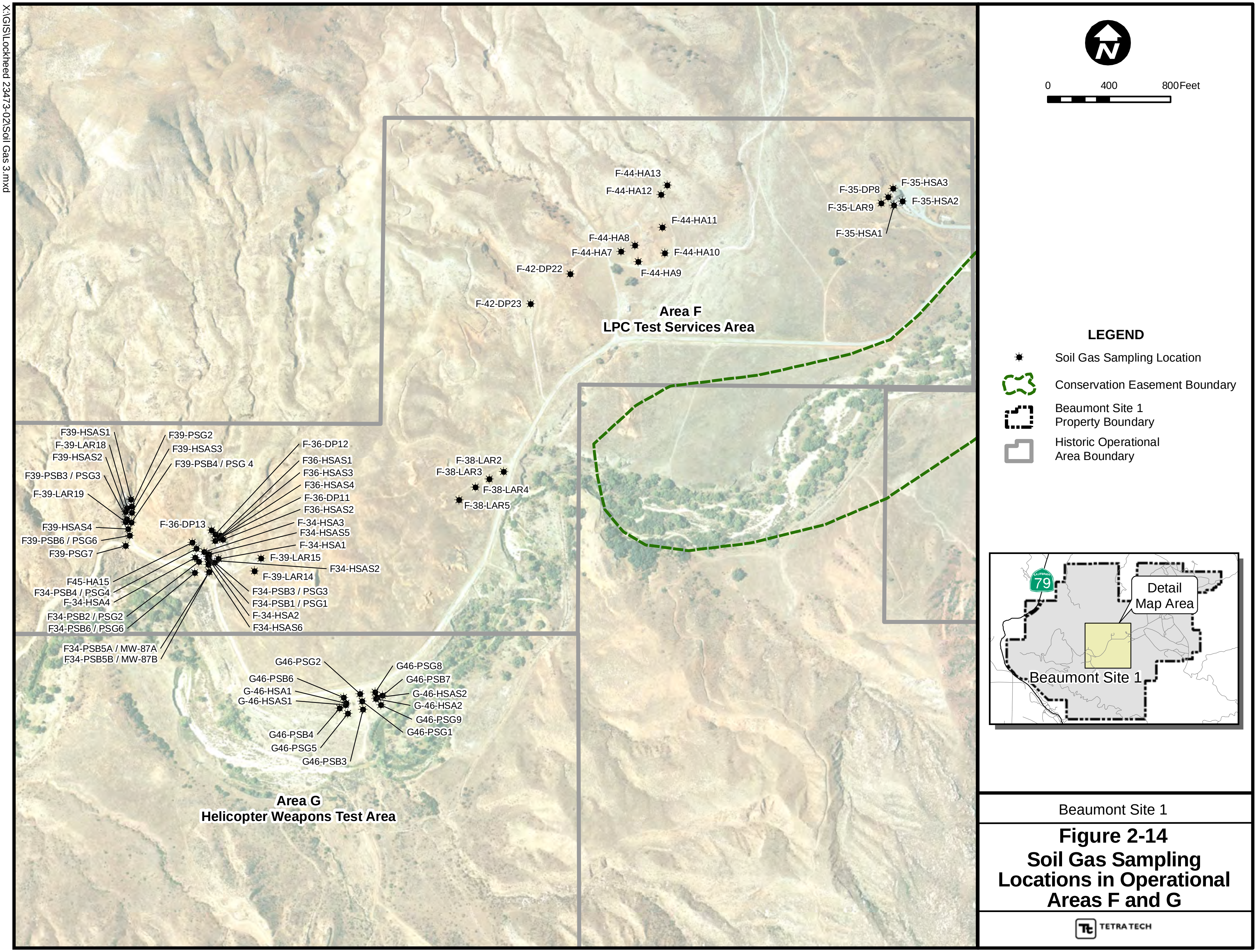


Beaumont Site 1

Figure 2-13
Soil Gas Sampling Locations in Operational Areas B, C, and D

TETRA TECH



Beaumont Site 1

Figure 2-14
Soil Gas Sampling Locations in Operational Areas F and G

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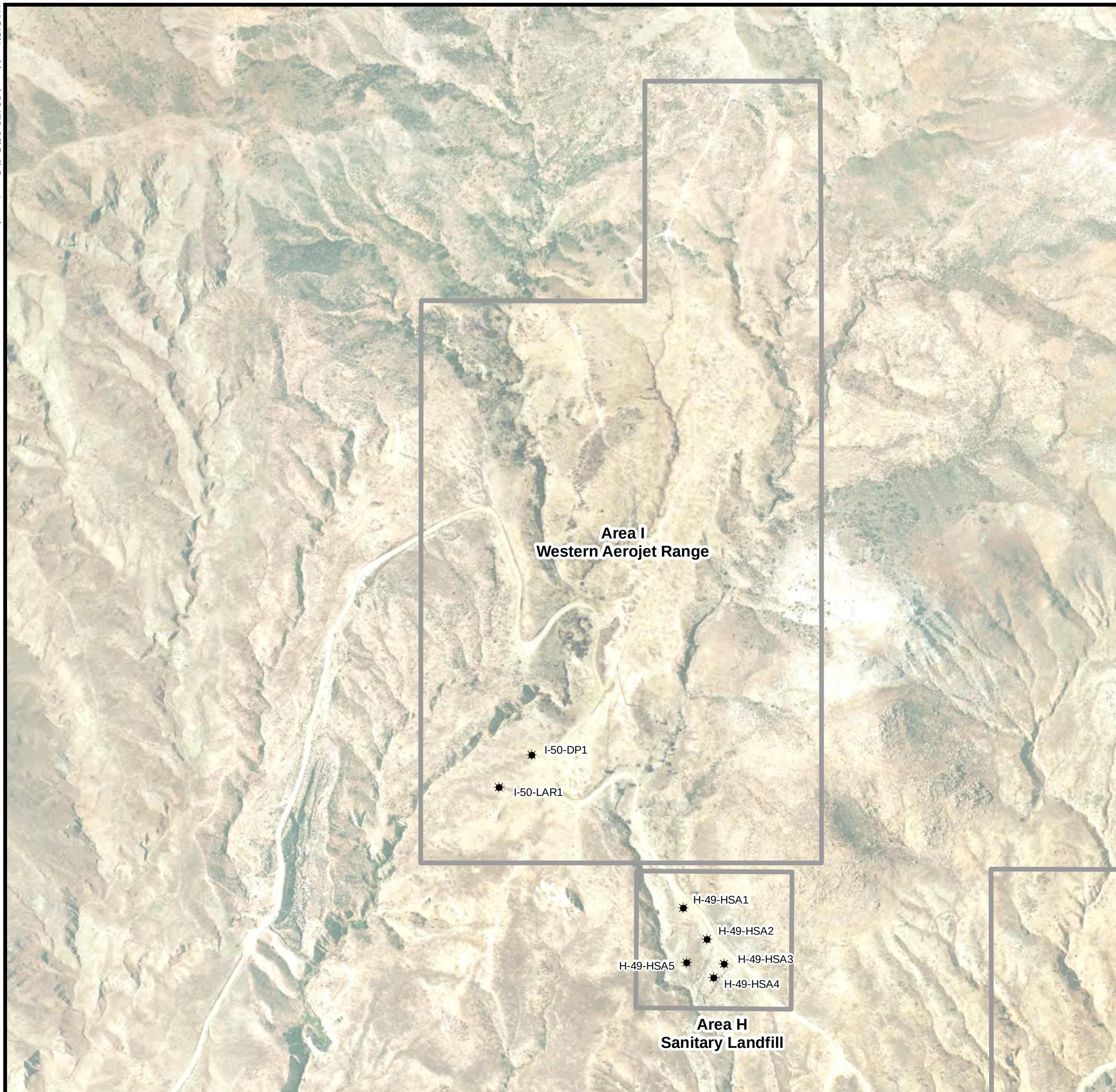
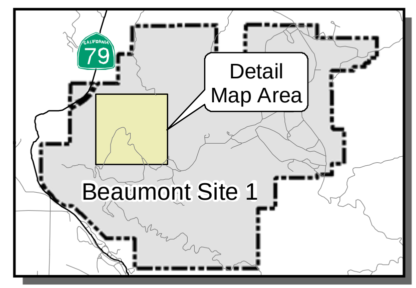
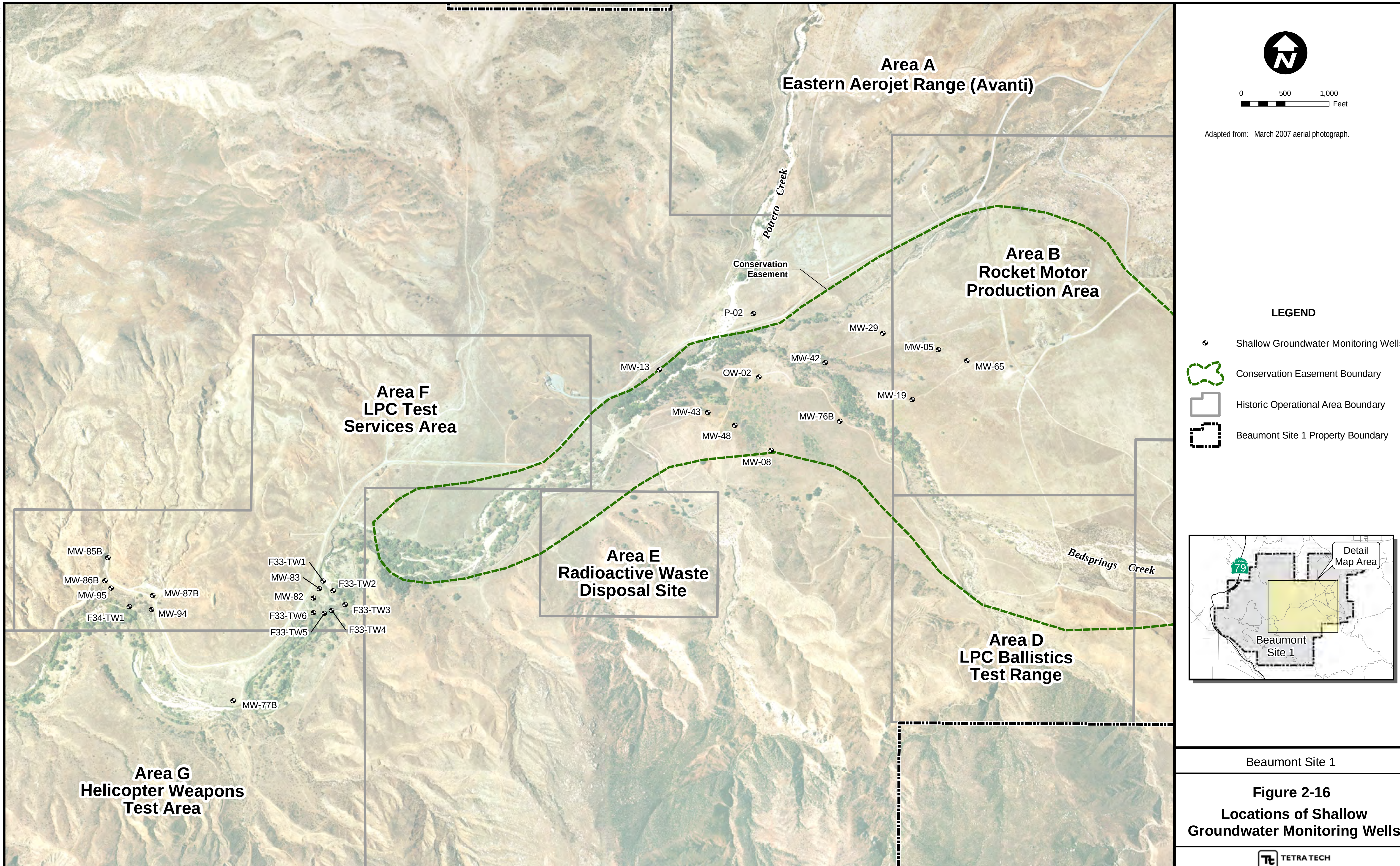




Beaumont Site 1

Figure 2-15
Soil Gas Sampling Locations in Operational Areas H and I

TETRA TECH



Beaumont Site 1

Figure 2-16
Locations of Shallow Groundwater Monitoring Wells

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Table 2-5
Shallow Groundwater Monitoring Wells

Monitoring Well	Minimum Depth to Groundwater (March 2003 to February 2009) (ft bgs)	Location	Notes
MW-05	13.41	Area B	-
MW-19	11.82	Area B	-
MW-65	17.17	Area B	No data collected
F33-TW1	6.93	Area F	-
F33-TW2	3.34	Area F	-
F33-TW3	3.40	Area F	-
F33-TW4	5.94	Area F	-
F33-TW5	5.73	Area F	-
F33-TW6	4.30	Area F	-
F34-TW1	4.71	Area F	-
MW-82	23.59	Area F	-
MW-83	22.09	Area F	-
MW-85B	1.08	Area F	-
MW-86B	16.50	Area F	-
MW-87B	19.95	Area F	-
MW-94	21.92	Area F	-
MW-95	21.17	Area F	-
MW-77B	16.17	Area G	-
MW-08	9.57	Northern Potrero Creek Area	-
MW-13	8.60	Northern Potrero Creek Area	-
MW-29	22.27	Northern Potrero Creek Area	No data collected
MW-42	4.00	Northern Potrero Creek Area	-
MW-43	2.80	Northern Potrero Creek Area	-
MW-48	5.95	Northern Potrero Creek Area	-
MW-76B	12.21	Northern Potrero Creek Area	-
OW-02	0.56	Northern Potrero Creek Area	-
P-02	11.64	Northern Potrero Creek Area	-

Notes:

ft - feet

bgs - below ground surface

Table 2-6
Number of Shallow Groundwater Samples Collected at the Site

Matrix	Chemical Group (Method)	Groundwater Samples (<25 ft. bgs)
Groundwater		
	1,4-Dioxane (E1624/E1625C/8270M/8270S)	110
	1,2,3-Trichloropropane (E524.2)	2
	Chromium, hexavalent (E218.6)	22
	Explosives (8330)	10
	Metals, total (SW6010B/SW7470A)	27
	Metals, dissolved (SW6010B/SW7470A)	2
	N-Nitrosodimethylamine (E1625C)	2
	Perchlorate (D314.0/E314.0)	110
	VOCs (8260B)	108

Notes:

ft. - feet

bgs - below ground surface

2.4.4 Summary of Surface Water Data

Surface water samples have been collected on at least an annual basis between 2002 and 2008 as part of the GMP and also as part of the recent DSI (Tetra Tech2008d, 2009a) Table 2-7 provides a summary of the surface water sampling activities conducted in the four riparian AOCs identified at the Site. Surface water samples have been variously analyzed for VOCs, SVOCs, perchlorate, 1,4-dioxane, metals (including hexavalent chromium), and explosives (using EPA Methods 8260B/8260S, 8270C, E314.0/E332/E314.1, 8270M/8270S/8270C/E1624/E1625C, 6010B/7470A/E218.6, and 8330, respectively). The sampling locations are shown in Figure 2-3.

Table 2-7
Number of Surface Water Samples Collected from 2002-2008

Matrix	Chemical Group (Method)	Ephemeral Ponds	Ephemeral Creeks	Groundwater Discharge Ponds	Potrero Creek
Surface Water					
	1,4-Dioxane (S8270S,M,C/E1624/E1625C)	6	5	43	69
	Chromium, hexavalent (E218.6)	3	1	8	16
	Explosives (SW8330)	-	-	1	4
	Metals, total (SW6010B/SW7470A)	6	5	16	27
	Metals, dissolved (SW6010B/SW7470A)	3	4	8	13
	Perchlorate (E314/E332/D314.1)	7	5	47	69
	SVOCs (SW8270C)	1	-	4	2
	VOCs (SW8260B/S8260S)	7	5	47	69

The range of chemical concentrations detected in surface water and the frequency of detection are presented in Appendix A.

2.4.5 Summary of Sediment Data

Sediment samples were collected at the Site in 2007 (Tetra Tech 2008d). Twenty sediment samples were collected from 18 locations and analyzed for perchlorate, VOCs, SVOCs, metals, PCBs, and 1,4-Dioxane (EPA Methods E314.0, 8260B, 8270C, 6010B/7471A, 8082, and 8270M, respectively). The sediment samples were collected in areas where surface water was either present or known to occur at least seasonally. Table 2-8 summarizes the number of samples collected in each AOC. The sampling locations are shown in Figure 2-3.

Table 2-8
Number of Sediment Samples Collected in 2007 (0 -1 ft. bgs)

Matrix	Chemical Group (Method)	Ephemeral Ponds	Ephemeral Creeks	Groundwater Discharge Ponds	Potrero Creek
Sediment					
	1,4-Dioxane (S8270M)	5	2	7	5
	Metals (6010B/7471A)	5	2	7	5
	PCBs (8082)	5	2	7	5
	Perchlorate (E314)	5	2	7	5
	SVOCs (8270C)	5	2	7	5
	VOCs (8260B)	5	2	7	5

The range of chemical concentrations detected in sediment and the frequency of detection are presented in Appendix A.

2.5 Identification of Chemicals of Potential Ecological Concern

Chemicals of potential ecological concern (COPECs) are chemicals that have been detected in the environment that may adversely affect receptors of concern. The chemical groups of particular interest at the Site include metals, perchlorate, VOCs, SVOCs, explosives, and PCBs.

As described in Section 2.4, past and recent investigations have sampled five environmental media at the Site, including soil, soil gas, shallow groundwater, surface water, and sediment. Chemicals have been detected in all of these environmental media. Accordingly, COPECs were identified for each environmental medium.

2.5.1 Soil COPECs

All organics detected in soils at 10 ft bgs, or less, are identified as COPECs in this SERA. Metals occur naturally in soils. One method for focusing the risk assessment is to screen out the metals that are not elevated over natural background (i.e., ambient) levels (DTSC 1996, 1999). The approach used for determining which metals detected in soils are elevated over background is described in detail in the DSI (Tetra Tech 2009a). A summary of the metals determined to be potentially elevated above background is provided in Appendix A. It should be noted that macronutrients (e.g., calcium, iron, magnesium, potassium, and sodium) are not considered as COPECs.

In soils, COPECs were selected for specific soil depth intervals, as appropriate for the ecological receptors identified for evaluation and the Site's soil characteristics. Depth intervals that were evaluated include shallow surface soil (i.e., 0-0.5 ft bgs), sub-surface soil (i.e., 0-5 ft bgs), and deep soil (i.e., 0-10 ft bgs). A list of the COPECs identified in soil in each operational area/AOC is summarized in Table 2-9 and include 17 metals, perchlorate, 10 VOCs, 9 SVOCs, 3 PCBs, and dioxins/furans.

A statistical summary of the detected chemicals for each depth interval in each AOC is provided in Appendix A, including the number of samples, number of detected values, percent detected, minimum and maximum detected values, and the range of detection limits for each COPEC. Additionally, the method detection limits (MDLs) for the soil samples collected as part of this investigation are compared to the USEPA (2003-2008) Ecological Soil Screening Levels (Eco-SSLs) and the Oak Ridge National Laboratory (Efroymson et al., 1997a, 1997b) invertebrate and plant soil screening benchmarks (see Appendix B.1). This comparison shows that the detection limits used in the various soil investigations conducted for this Site are generally low enough to detect chemicals that may represent a potential risk to ecological receptors.

Certain of the MDLs for antimony and cadmium exceed the lowest Eco-SSLs (Appendix B.1 to B.2). These elevated MDLs also exceed the background threshold values (BTVs) for antimony and cadmium (Appendix B.2). However, Site characterization for antimony and cadmium is considered adequate with limited exceptions, considering:

- Initial source characterization was conducted in 2002 and 2004, with MDLs for these two metals lower than the lowest Eco-SSLs.
- Only limited sampling conducted in 2007 and 2008 reported MDLs for antimony (2.01-2.65 mg/kg) and cadmium (0.502-0.618 mg/kg) that exceed the lowest Eco-SSLs (0.27 mg/kg for antimony and 0.36 mg/kg for cadmium). The limited samples with elevated MDLs were

collected from a single soil boring in Operational Area A in 2007 and 19 borings in Operational Area H in 2008.

- Areas where soil samples with detected antimony concentrations exceeded the lowest Eco-SSL were characterized using analyses with MDLs lower than the lowest Eco-SSLs.
- All areas where soil samples had cadmium concentrations exceeding the lowest Eco-SSL were characterized using appropriately low MDLs, except in Operational Area H.

Despite the limited occurrences of elevated MDLs for antimony and cadmium, this issue will be addressed by a laboratory re-evaluation of the analytical results for these samples using lower MDLs. The revised MDL projected for cadmium (0.1 mg/kg) would be lower than the corresponding Eco-SSL (0.36 mg/kg), while the revised MDLs for antimony (1.0-1.5 mg/kg) would approach the lowest Eco-SSL (0.27 mg/kg) (Appendix B.1).

2.5.2 Soil Gas COPECs

All VOCs detected in soil gas at 10 ft bgs or less are identified as COPECs in this SERA. The list of the COPECs identified in soil gas in each operational area/AOC is summarized in Table 2-10 and includes 25 VOCs. From 6 to 11 COPECs were identified in soil gas sampled in Operational Areas B, C, D, F, and G. No soil gas COPECs were identified for Operational Areas A, H, or I.

Table 2-9
Chemicals of Potential Ecological Concern in Soil in Each of the Operational Areas (by depth)

Chemical	Operational Area A			Operational Area B			Operational Area C			Operational Area D			Operational Area F			Operational Area G			Operational Area H			Operational Area I		
	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10	0-0.5	0-5	0-10
Inorganics*																								
Antimony						X																		
Arsenic	X	X	X			X					X	X												
Barium											X	X												
Beryllium	X	X	X	X	X	X	X	X	X		X	X									X			
Cadmium												X	X	X	X									
Chromium	X	X	X			X					X	X	X	X	X									
Cobalt	X	X	X	X	X	X					X	X	X	X	X		X	X			X			
Copper	X	X	X			X								X	X									
Lead	X	X	X			X					X	X	X	X	X									
Mercury					X	X		X	X															
Molybdenum			X			X					X	X												
Nickel	X	X	X			X					X	X	X	X	X									
Perchlorate				X	X	X	X	X	X				X	X	X				X	X	X			
Selenium	X	X	X		X	X		X	X				X	X	X									
Silver	X	X	X				X	X	X															
Thallium	X	X	X		X	X																		
Vanadium	X	X	X	X	X	X					X	X												
Zinc													X	X	X									
Volatile Organic Compounds (VOCs)																								
1,1-Dichloroethene		X	X																					
1,2,4-Trimethylbenzene					X	X		X	X															
4-Methyl-2-Pentanone					X	X																		
Acetone					X	X				X	X	X												
Chloroethane									X															
Chloroform				X	X	X																		
Methylene Chloride										X	X	X												
n-Propylbenzene		X	X																					
p-Isopropyltoluene										X	X	X							X	X	X			
Trichloroethene													X	X	X									

Definitions:

ft - feet below ground surface
COPEC - chemical of potential ecological concern
HPCDD - Heptachlorodibenzo-p-Dioxin
HPCDF - Heptachlorodibenzofuran
HXCDD - Hexachlorodibenzo-p-Dioxin
HXCDF - Hexachlorodibenzofuran
PCDD - Pentachlorodibenzo-p-Dioxin
PCDF - Pentachlorodibenzofuran
OCDD - Octachlorodibenzo-p-Dioxin
OCDF - Octachlorodibenzofuran
TCDD - Tetrachlorodibenzo-p-Dioxin

Notes:

COPECs identified by depth (feet) below ground surface
X - identified as a chemical of potential concern, either statistically or qualitatively
*Metals identified as COPEC based on comparison to background concentration (see Appendix A.6).
A detailed description of the background comparison is provided in the Dynamic Site Investigation Report (Tetra Tech 2009).
Any metal identified as potentially elevated above background in an area of concern, regardless of soil type, was identified as a COPEC.

Table 2-9 (continued)
Chemicals of Potential Ecological Concern in Soil in Each of the Operational Areas (by depth)

	Operational Area A			Operational Area B			Operational Area C			Operational Area D			Operational Area F			Operational Area G			Operational Area H			Operational Area I		
Chemical	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**	**0-0.5**	**0-5**	**0-10**
Semi-Volatile Organic Compounds (SVOCs)																										
1,2,4-Trichlorobenzene - 8270													X	X	X									
1-Methylnaphthalene				X	X	X																		
1,4-Dioxane					X	X																		
2-Methylnaphthalene				X	X	X																		
7,12-Dimethylbenz[a]anthracene				X	X	X																		
bis (2-Ethylhexyl) phthalate	X	X	X	X	X	X			X				X	X	X									
Butyl benzyl phthalate				X	X	X														X	X			
Phenol				X	X	X																		
Pyrene				X	X	X																		
Polychlorinated Biphenyls (PCBs)																								
PCB-1248 (Aroclor1248)													X	X	X					X	X			
PCB-1254 (Aroclor1254)															X				X	X	X			
PCB-1260 (Aroclor1260)													X	X	X				X	X	X			
Dioxins/Furans																								
1,2,3,4,6,7,8-HPCDF																				X	X			
1,2,3,4,6,7,8-HPCDD																				X	X			
1,2,3,4,7,8,9-HPCDF																				X	X			
1,2,3,4,7,8-HPCDF																				X	X			
1,2,3,4,7,8-HXCDD																				X	X			
1,2,3,6,7,8-HXCDF																				X	X			
1,2,3,6,7,8-HXCDD																				X	X			
1,2,3,7,8,9-HXCDF																				X	X			
1,2,3,7,8,9-HXCDD																				X	X			
1,2,3,7,8-PCDF																				X	X			
1,2,3,7,8-PCDD																				X	X			
2,3,4,6,7,8-HXCDF																				X	X			
2,3,4,7,8-PCDF																				X	X			
2,3,7,8-TCDD																				X	X			
OCDF																				X	X			
OCDD																				X	X			

Definitions:

ft - feet below ground surface
COPEC - chemical of potential ecological concern
HPCDD - Heptachlorodibenzo-p-Dioxin
HPCDF - Heptachlorodibenzofuran
HXCDD - Hexachlorodibenzo-p-Dioxin
HXCDF - Hexachlorodibenzofuran
PCDD - Pentachlorodibenzo-p-Dioxin
PCDF - Pentachlorodibenzofuran
OCDD - Octachlorodibenzo-p-Dioxin
OCDF - Octachlorodibenzofuran
TCDD - Tetrachlorodibenzo-p-Dioxin

Notes:

COPECs identified by depth (feet) below ground surface
X - identified as a chemical of potential concern, either statistically or qualitatively
*Metals identified as COPEC based on comparison to background concentration (see Appendix A.6).
A detailed description of the background comparison is provided in the Dynamic Site Investigation Report (Tetra Tech 2009).
Any metal identified as potentially elevated above background in an area of concern, regardless of soil type, was identified as a COPEC.

Table 2-10
Chemicals of Potential Ecological Concern in Soil Vapor in Each of the Operational Areas

	Operational Area A		Operational Area B		Operational Area C		Operational Area D		Operational Area F		Operational Area G		Operational Area H		Operational Area I	
Chemical	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**	**0-5**	**>5-10**
Volatile Organic Compounds (VOCs)																
1,1,1-Trichloroethane				X	X	X										
1,1,2-Trichloro-1,2,2-Trifluoroethane						X		X		X						
1,1,2-Trichloroethane					X	X										
1,1-Dichloroethane					X	X			X							
1,1-Dichloroethene				X	X	X				X						
1,2,4-Trimethylbenzene						X		X				X				
1,3,5-Trimethylbenzene								X								
2-Butanone				X		X				X		X				
Acetone				X		X		X		X		X				
Benzene			X	X		X		X		X		X				
c-1,2-Dichloroethene									X							
Carbon Disulfide				X		X		X	X	X		X				
Chloroform				X		X										
Dichlorodifluoromethane						X										
Ethylbenzene						X		X		X		X				
m,p-Xylenes				X		X		X		X		X				
Methyl tert-butyl ether (MTBE)			X													
Methylene Chloride				X		X		X		X		X				
o-Xylene						X		X				X				
Styrene						X				X		X				
Tetrachloroethene				X	X	X		X		X		X				
Toluene			X	X		X		X		X		X				
Trichloroethene			X	X	X	X			X	X						
Trichlorofluoromethane						X			X	X						
Xylene, Total			X													

Definitions:

ft - feet below ground surface

COPEC - chemical of potential ecological concern

Notes:

COPECs identified by depth (feet) below ground surface

X - identified as a chemical of potential concern, either statistically or qualitatively

A statistical summary of the detected chemicals for each depth interval in each AOC is provided in Appendix A, including the number of samples, number of detected values, percent detected, minimum and maximum detected values, and the range of detection limits for each COPEC.

2.5.3 Shallow Groundwater COPECs

All organics detected in shallow groundwater (25 feet bgs or less) are identified as COPECs in this SERA. Metals occur naturally in groundwater; ambient concentrations have not been determined for metals in groundwater at this Site. Plant roots are typically considered to uptake only those metals dissolved in groundwater. However, for this SERA metals reported as totals (unfiltered) were identified as COPECs, since dissolved (filtered) metals have not been analyzed for in shallow groundwater. A list of the COPECs identified in shallow groundwater is summarized in Table 2-11 and includes 14 metals, perchlorate, 14 VOCs, and 1,4-dioxane.

A statistical summary of the chemicals detected in shallow groundwater by sampling event is provided in Appendix A, including the number of samples, number of detected values, percent detected, minimum and maximum detected values, and the range of detection limits for each COPEC.

2.5.4 Surface Water COPECs

All organics detected in surface water are identified as COPECs in the 4 riparian AOCs. Depending on the receptor, metal exposures may either occur as a result of ingestion or contact. To address these various exposure pathways, the metals identified as COPECs include both totals (unfiltered) and dissolved metals. A list of the COPECs identified in surface water is summarized in Table 2-12 and includes 13 metals as totals, 7 dissolved metals, perchlorate, 14 VOCs, and 2 SVOCs (including 1,4-dioxane). All but 1 (methylene chloride) of the organics were detected in the groundwater discharge pond, while only 2 to 7 organics were detected in surface water in the other riparian AOCs.

A statistical summary of the chemicals detected in surface is provided in Appendix A, including the number of samples, number of detected values, percent detected, minimum and maximum detected values, and the range of detection limits for each COPEC.

2.5.5 Sediment COPECs

All organics detected in sediment are identified as COPECs. Metals occur naturally in sediment. However, for this SERA all detected metals were identified as COPECs, since ambient metal concentrations in sediments have not been determined. A list of the COPECs identified in sediment is summarized in Table 2-13 and includes 14 metals and 7 VOCs. From one to 5 VOCs were detected in sediments in three AOCs. No VOCs were detected in sediments from the ephemeral creeks.

Table 2-11
Chemicals of Potential Ecological Concern in Shallow Groundwater

Chemical	Shallow Groundwater Wells (<25 ft bgs)
Inorganics	
Antimony, total	X
Arsenic, total	X
Barium, total	X
Cadmium, total	X
Chromium, hexavalent	X
Chromium, total	X
Iron, total	X
Lead, total	X
Molybdenum, total	X
Nickel, total	X
Perchlorate	X
Selenium, total	X
Thallium, total	X
Vanadium, total	X
Zinc, total	X
Volatile Organic Compounds (VOCs)	
1,1,1-Trichloroethane	X
1,1,2-Trichloroethane	X
1,1-Dichloroethane	X
1,1-Dichloroethene	X
1,2-Dichloroethane	X
c-1,2-Dichloroethene	X
Acetone	X
Carbon Disulfide	X
Chloroform	X
Tetrachloroethene	X
Toluene	X
Trichloroethene	X
Trichlorofluoromethane	X
Vinyl Chloride	X
Semi-Volatile Organic Compounds (SVOCs)	
1,4-Dioxane	X

Definitions:

bgs - below ground surface

ft - feet

Note:

X - identified as a chemical of potential ecological concern

Table 2-12
Chemicals of Potential Ecological Concern in Surface Water

Chemical	Ephemeral Ponds	Ephemeral Creeks	Groundwater Discharge Ponds	Potrero Creek
Inorganics				
Arsenic, total	X		X	X
Arsenic, dissolved	X			X
Barium, total	X	X	X	X
Barium, dissolved	X	X	X	X
Beryllium, total		X	X	
Chromium, total		X		
Chromium, Hexavalent	X		X	X
Cobalt, total		X		X
Copper, total	X	X	X	X
Lead, total	X	X	X	X
Lead, dissolved			X	X
Mercury, total				X
Mercury, dissolved			X	
Molybdenum, total	X		X	X
Molybdenum, dissolved				X
Nickel, total		X		
Perchlorate	X	X	X	
Vanadium, total	X	X	X	X
Vanadium, dissolved	X	X	X	X
Zinc, total	X	X	X	X
Zinc, dissolved	X	X	X	X
Volatile Organic Compounds (VOCs)				
1,1,1-Trichloroethane			X	
1,1-Dichloroethane			X	
1,1-Dichloroethene		X	X	X
1,2,4-Trimethylbenzene			X	
2-Butanone			X	
Acetone	X	X	X	X
c-1,2-Dichloroethene		X	X	
Carbon Disulfide			X	
Methylene Chloride	X			X
p-Isopropyltoluene			X	
Styrene			X	X
Toluene			X	X
Trichloroethene		X	X	X
Vinyl Chloride			X	
Semi-Volatile Organic Compounds (SVOCs)				
1,4-Dioxane		X	X	X
4-Methylphenol (p-Cresol)			X	

Notes:

X - identified as a chemical of potential ecological concern

Table 2-13
Chemicals of Potential Ecological Concern in Sediment

Chemical	Ephemeral Ponds	Ephemeral Creeks	Groundwater Discharge Ponds	Potrero Creek
Inorganics				
Arsenic	X	X	X	X
Barium	X	X	X	X
Beryllium	X		X	
Chromium	X	X	X	X
Cobalt	X	X	X	X
Copper	X	X	X	X
Lead	X	X	X	X
Mercury	X			
Molybdenum	X		X	
Nickel	X	X	X	X
Selenium	X	X	X	
Thallium	X	X	X	X
Vanadium	X	X	X	X
Zinc	X	X	X	X
Volatile Organic Compounds (VOCs)				
1,1-Dichloroethene			X	
2-Butanone	X		X	
Acetone	X		X	X
Benzene	X			
c-1,2-Dichloroethene			X	
Carbon Disulfide			X	
Toluene	X			

Notes:
X - identified as a chemical of potential ecological concern

A statistical summary of the chemicals detected in sediment is provided in Appendix A, including the number of samples, number of detected values, percent detected, minimum and maximum detected values, and the range of detection limits for each COPEC.

3.0 BIOLOGICAL CHARACTERIZATION

This biological characterization describes the habitats and plant and animal species that are known to occur or may occur at the Site. Since the habitats and their resident species are critical components of the risk assessment process, this characterization was based on an extensive review of background materials and a site-specific biological survey. The final product of the biological characterization is a preliminary list of ecological receptors of concern that will be evaluated in Section 4.0 to determine which exposure pathways are potentially complete at the Site. Ultimately, this information will be applied in the PERA to provide quantitative risk estimates.

3.1 Overview

The 9,100-acre Site is classified within the Cahuilla Mountains Ecological Subregion (M262Bl) in the California Ecological Subregions classification system (USDA 1997). The Site is mostly undeveloped and is dominated by five general habitat types: (1) grassland, (2) scrub (including coastal sage scrubs), (3) chamise/chaparral, (4) riparian, and (5) aquatic. The habitats are distributed as a function of slope, aspect, elevation, moisture, soil type, and past disturbance history.

The Site includes a north-south trending canyon in the north (upper Potrero Creek) and an east-west trending drainage in the southeast (Bedsprings Creek). Below their confluence these drainages continue to the west as Potrero Creek within Massacre Canyon. The eastern part of the Site includes extensive flat terrain along the lower elevations. In the western part of the Site, lower Potrero Canyon and Massacre Canyon contain a narrow drainage channel and rugged topography. The hillsides above the canyons include rugged, steep, and heavily eroded slopes, particularly in the southern section of the Site. Throughout the Site, most of the features where releases occurred are located on relatively flat terrain or moderate slopes.

A total of nine terrestrial AOCs were identified for the SERA, consisting of Operational Areas A through I (excluding Operational Area E) and the Entire Site AOC for wide-ranging receptors (see Figure 2-2 and Table 2-2). In addition, 4 surface water AOCs were defined to allow assessment of risks to aquatic receptors (see Figure 2-3 and Table 2-2).

3.2 Approach

A total of 37 plant communities are known to occur at the Site based on plant community mapping conducted for the Riverside County Multiple Species Habitat Conservation Plan (MSHCP) (Riverside

County 2006) (Table 3-1). These plant communities were grouped into 4 main habitat types, each incorporating multiple plant communities, and an aquatic habitat (Table 3-1):

- Grassland,
- Scrub (including coastal sage scrubs);
- Chamise/chaparral,
- Riparian, and
- Aquatic habitat.

The first 3 habitats are generally characterized as terrestrial (i.e., grassland, scrub, and chamise/chaparral) and are comprised of broadly similar vegetation and terrestrial wildlife associations. Riparian habitat occurs in areas with shallow groundwater and may have long-standing or ephemeral surface water. Riparian areas near long-standing surface water may also include freshwater emergent vegetation. The distribution of each terrestrial habitat, including riparian, within the Site is shown in Figure 3-1. Aquatic habitat consists of the surface water component of ponds and streams at the Site, which include both long-standing/perennial and ephemeral water as described in Section 2.3.10 (see Figure 2-3). Aquatic habitat at the Site is typically associated with the presence of riparian vegetation.

This biological characterization focuses primarily on the four terrestrial habitat types. Aquatic habitat and species are described generally, with greater detail provided on amphibians. The relative areas, plant community compositions, and general ecological features of each habitat type are briefly described in Section 3.3.1.

The 4 terrestrial and semi-terrestrial habitat types were mapped using the plant community maps described above (Riverside County 2006), supplemented by the 2008-2009 biological surveys and previous background biological information compiled by Tetra Tech (Appendix C). The occurrence of these habitat types formed the basis for the list of plant and animal species that are potentially present within each AOC at the Site.

The plant and animal species lists for each habitat and AOC were compiled by identifying species that:

- Were observed at the Site during the 2008-2009 biological surveys;
- Have been previously recorded at the Site; and/or
- Have a reasonable potential to occur at the Site based on known habitat associations.

Appendix C provides a complete description of the approach for developing species lists for the Site.

Table 3-1
Terrestrial Plant Communities and Habitats at Site 1

Habitats Evaluated	Plant Communities Based on MSHCP Classifications[1]	Areas of Concern							
		A	B	C	D	F	G	H	I
Grassland[2]	California annual grassland alliance (4)	X	X	X	X	X	X		X
	Coast live oak/annual grass-herb association (18)								
	Agricultural mapping unit (1)								
	Exotic trees mapping unit (21)								
Scrubs (including coastal sage scrubs)	Brittlebush - California buckwheat mapping unit (2)	X	X	X	X	X	X	X	X
	California buckwheat - sugarbush association (5)								
	California buckwheat - white sage mapping unit (6)								
	California buckwheat alliance (7)								
	California sagebrush - California buckwheat mapping unit (8)								
	Disturbed shrub and herb coastal sage scrub unit (20)								
	Interior live oak shrub alliance (27)								
	Sscalebroom (California buckwheat-Mexican elderberry-mulefat) (30)								
	Scalebroom - California buckwheat association (31)								
	Scalebroom - mulefat association (32)								
	Scalebroom/Menzies' fiddleneck association (33)								
	Sugar bush alliance (38)								
	Yerba santa alliance (44)								
Chamise/chaparral	Chamise - bigberry manzanita mapping unit (10)	X	X	X	X	X	X	X	X
	Chamise - bigberry manzanita alliance (11)								
	Chamise - black sage alliance (12)								
	Chamise - coastal sage scrub disturbance mapping unit (13)								
	Chamise - cupleaf ceanothus alliance (14)								
	Chamise - hoaryleaf ceanothus alliance (15)								
	Chamise alliance (16)								
	Chamise pure association (17)								
	Coast live oak/chaparral association (19)								
	Scrub oak - chamise alliance (34)								
	Scrub oak - southern mixed chaparral association (35)								
	Toyon - scrub oak - birchleaf mountain-mahogany - California ash association (39)								
	Toyon alliance (40)								
	Toyon alliance (40)								

Definitions:

AOC - Area of concern

Notes:

[1] Classifications used in the Riverside County Multiple Species Habitat Conservation Plan (Riverside County 2006). Numbers in parentheses indicate community identification number.

[2]Grassland may include isolated areas with a tree overstory.

Table 3-1 (continued)
Terrestrial Plant Communities and Habitats at Site 1

Habitats Evaluated	Plant Communities Based on MSHCP Classifications[1]	Areas of Concern							
		A	B	C	D	F	G	H	I
Riparian	Bulrush-cattail alliance (3) California sycamore alliance (9) Fremont cottonwood-black willow/mulefat association (22) Fremont Cottonwood-Red Willow association (23) Fremont cottonwood-willow mapping unit (24) Fremont cottonwood/mulefat association (25) Fremont cottonwood dry mapping unit (26) Willow mapping unit (43) Open water (50) where surface water is present	X	X		X	X	X		X

Definitions:

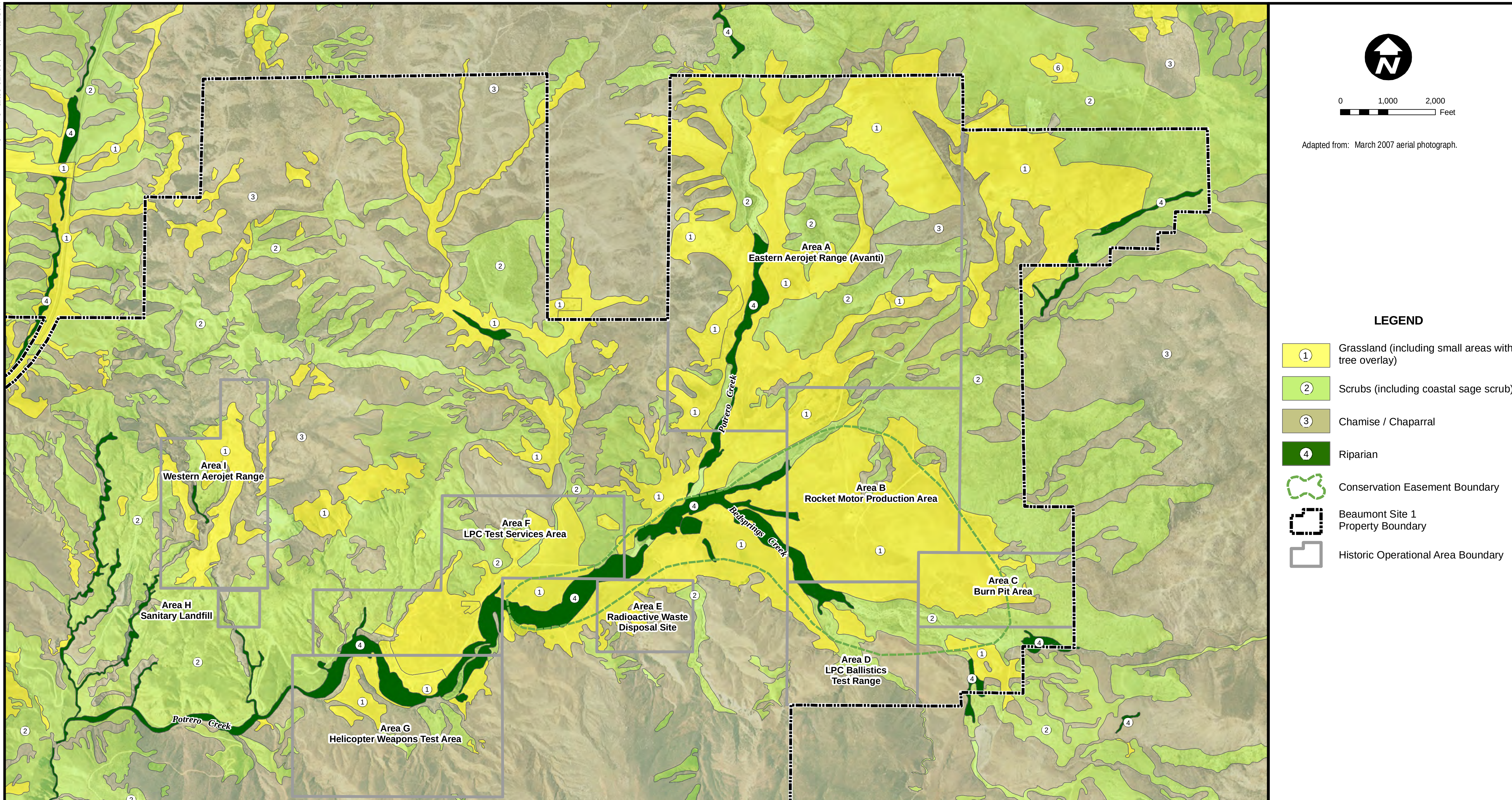
AOC - Area of concern

Notes:

[1] Classifications used in the Riverside County Multiple Species Habitat Conservation Plan (Riverside County 2006). Numbers in parentheses indicate community identification number.

[2]Grassland may include isolated areas with a tree overstory.

X:\GIS\Lockheed 23473-02\Fig 3-1.mxd



Beaumont Site 1

Figure 3-1

Habitats and Areas of Concern at Site 1

TETRA TECH

3.2.1 Past Observations and Potential Presence

Species that were previously observed or have a potential to occur at the Site based on habitat affinity were identified based on an exhaustive search of background biological information. To determine the common and special status species that have been previously observed or have a potential to occur at the Site, the following primary resources were consulted:

- California Department of Fish and Game's California Natural Diversity Database (CNDDB) (CDFG 2008);
- California Native Plant Society's online *Inventory of Rare and Endangered Plants* (CNPS 2008);
- Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP; Riverside County 2007);
- Vegetation maps in the Western Riverside County MSHCP (Riverside County 2006);
- Eastside Reservoir Project Environmental Planning Technical Report (Metropolitan Water District 1991); and
- Internal species lists compiled during biological support for LMC.

Species lists compiled by Tetra Tech and other contractors include site-specific observations during surveys in support of LMC's characterization activities within localized areas. With the exception of surveys related to LMC activities and those performed by the MSHCP, relatively few surveys were conducted within the past 5 years. Species observed during these older surveys were recorded as being historically observed at the Site.

The following definitions of sensitive species developed by regulatory agencies were used to identify special status species that could be present at the Site:

- Endangered Species: Any species that is in danger of extinction throughout all or a significant portion of its range, as defined in the Endangered Species Act (16 United States Code 1532) or the California Endangered Species Act. Both federal and California state endangered species were included.
- Threatened Species: Any species that is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range, as defined in the Endangered Species Act (16 United States Code 1532) or the California Endangered Species Act. Both federal and California state threatened species were included.

- Species listed by the CDFG as California Species of Special Concern (CSC).

Using the above information, species lists were created for common and sensitive plants, amphibians, reptiles, birds and mammals that have been historically observed at the Site, or have the potential to inhabit the Site (i.e., based on habitats found at the Site and known species range and habitat preferences). A more limited general list of invertebrates was also compiled. Species with a reasonable potential to occur on the Site based on habitat associations were determined through a combination of recent habitat mapping (e.g., Riverside County 2006) and investigations of habitats as part of the 2008-2009 biological surveys (see below).

3.2.2 Biological Surveys

Biological field surveys were conducted between September 2008 and April 2009 to determine species present at the Site. The study included locations that were not previously surveyed at the Site. These data were a key source of information used to compile the species lists.

The field surveys were conducted at sampling locations chosen to represent the habitat types at the Site, as well as the nine AOCs defined for the Site. A complete description of the selection of survey locations and the survey methodology is provided in Appendix C. Surveys for each species group (i.e., plants, amphibians, birds, small mammals, and large mammals) used standardized and commonly accepted methodologies for that species group and were designed to maximize the number of species observations. No surveys for reptiles were conducted during 2008 or 2009, since reptiles are relatively labor intensive to sample, and they were considered lower priority for the information needs of the SERA.

3.3 Habitats and Species

This section presents the results of the biological characterization for the Site assembled from the background data reviews and site-specific surveys.

3.3.1 Habitats

As described in Section 3.2, the four primary upland habitat types at the Site are grassland, scrub (including coastal sage scrub), chamise/chaparral, and riparian. These habitats were identified from a larger set of 37 plant communities shown in Table 3-1. Grassland, scrub, and chamise/chaparral are expected to contain broadly similar vegetation and support similar wildlife species, while additional species may occur in riparian habitat. The spatial distributions of these habitats at the Site are shown in Figure 3-1.

Extensive areas of Site 1 burned in a 2006 fire. Although distributions of plant communities may have changed since the fire, particularly with early successional vegetation increasing in coverage, this evaluation used the most recent available vegetation maps developed before the fire (Riverside County 2006) to provide a characterization of the post-succession communities.

The relative areas, plant community compositions, and general ecological features of each habitat type are briefly described below.

Grassland

Grasslands at the Site primarily consist of nonnative annual grassland. Herbaceous, shallow-rooted grasses and forbs characterize annual grassland habitat, and are normally less than 1 meter tall (Mayer and Laudenslayer 1988). Dominant non-native species include slender oat (*Avena barbata*), wild oat (*Avena fatua*), fox tail chess (*Bromus madritensis* spp. *rubens*), and ripgut (*Bromus diandrus*), and native characteristic species include yellow fiddleneck (*Amsinckia menziesii* var. *intermedia*), splendid mariposa lily (*Calochortus splendens*), blue-eyed grass (*Sisyrinchium bellum*), and popcorn flower (*Plagiobothrys stipitatus* var. *micranthus*). Grasslands dominate the valley floors of Potrero Canyon including the Bedsprings Creek drainage (Figure 3-1). Within each AOC, nonnative grassland is found at many of the Site locations where past releases of contamination occurred (e.g., burn pits, RMPA).

Scrub (including coastal sage scrub)

Scrub (including coastal sage scrub) is a broad assemblage of 15 plant communities at the Site (Table 3-1). It is dominated by perennial shrubs adapted to semi-arid environments. Within the AOCs, the lower elevations of hills above Bedsprings Creek, Potrero Canyon, and Massacre Canyon are dominated by scrub vegetation (Figure 3-1). Coastal sage scrub is a major component of the scrub habitat. Coastal sage scrub vegetation is considered a sensitive habitat in southern California (EDAW 2002), and is dominated by California sagebrush (*Artemisia californica*), California buckwheat (*Artemisia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), elderberry (*Sambucus nigra caerulea*), and Mexican elderberry (*Sambucus mexicana*).

Chamise/Chaparral

Chamise/chaparral is a broad assemblage of 14 plant communities at the Site (Table 3-1). It is dominated by perennial shrubs that tolerate drier conditions than scrub vegetation. Chamise/chaparral dominates the higher elevations, particularly the north-facing slopes of mountains (Figure 3-1). Chaparral plant communities are diverse and are characterized by a dense growth of evergreen, thick-leafed, and extensively rooted shrubs. The dominant shrubs in chaparral commonly range up to 1 to 3 meters in height. Chaparral plants are adapted to summer drought following a moderate and moist winter by their sclerophyllous, thick, heavily cutinized, and sometimes hairy leaves. Dominant chaparral species in mature stands include chamise (*Adenostoma fasciculatum*), wild lilac (*Ceanothus* spp.), redberry

(*Rhamnus crocea*), and manzanita (*Arctostaphylos* spp.). Mature assemblages of chaparral are dense and support a sparse herbaceous understory due to the lack of light penetration (Mayer and Laudenslayer 1988). However, herbaceous plants are often prevalent in areas that are disturbed or contain early successional chaparral. Although mature stands of chaparral are characterized by the accumulation of dead standing material and fine litter accumulation, soils in these communities are thin and contain little organic matter (Mayer and Laudenslayer 1988). As a result, chaparral may not support as rich of a soil invertebrate community as other habitats on the Site.

Riparian

Riparian habitat at the Site includes seven forest/woodland-type plant communities which are dominated by trees such as Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), and California sycamores (*Platanus racemosa*) (Table 3-1). Riparian habitat at Site 1 also includes freshwater emergent plant communities (e.g., bulrush-cattail alliance) (Table 3-1). Overall, the plant and wildlife species composition, vegetation structure, and ecological function are similar among riparian habitats at the Site.

Riparian habitat is distributed along Potrero and Bedsprings Creeks (Figure 3-1). The distribution and seasonal persistence of surface water occurring with riparian habitat varies along a general gradient at the Site. Riparian habitat along Bedsprings Creek, upper Potrero Creek north of the confluence, and Potrero Creek upgradient of the FSW (Figure 2-3) generally occurs in areas with only ephemeral surface water. Shallow groundwater is likely to be present in these areas. Near the confluence of Bedsprings and Potrero Creeks, riparian habitat fringes a man-made pond and two perennial seeps where groundwater discharges to the surface. Surface water in these seeps and pond is long-standing or perennial. In the lower elevations of the watershed (i.e., below FSW), the riparian habitat of Potrero Creek is associated with long-standing or perennial surface water, and is primarily fed by the discharge of groundwater, which occurs at or near the surface in many areas. Riparian habitat is also present at several other ponds where surface water varies in seasonal duration.

Riparian vegetation associated with persistent surface water or shallow groundwater is generally denser and more structurally complex than riparian vegetation in drier areas of the Site. The tree canopy is typically greater in height and more continuous along the lower portions of Potrero Creek with long-standing or perennial surface water. Even in these areas, the distribution of riparian vegetation is patchy, with intervening areas of grassland, scrub, or bare washes. Freshwater emergent vegetation (e.g., cattails, bulrush) also may occur where persistent surface water is present.

Riparian habitat provides valuable nesting, roosting, and feeding habitat for a diverse assemblage of birds, mammals, and other wildlife. The canopy provides refuge from the heat, and associated streams and ponds provide an important source of drinking water. In particular, many passerine birds, including sensitive species, depend on riparian habitat. The forest canopy also provides important corridors for wildlife movement. The composition of wildlife species may vary somewhat within riparian habitats at the Site due to differences in the canopy structure and availability of surface water. Overall, riparian habitats at the Site are likely comprised of wildlife species that may not be found in other terrestrial habitats.

Aquatic Habitat

Isolated and limited areas with long-standing or perennial surface water support aquatic habitat at the Site. This habitat is primarily found along lower Potrero Creek west of the first surface water and in the seeps and ponds in the Groundwater Discharge Ponds AOC (Figure 2-3). Vegetation associated with these aquatic habitats, including emergent plants such as cattails and bulrushes, is grouped within the riparian habitat discussed above. Biota occurring in the water column of ponds and streams may include phytoplankton, algae, free-floating aquatic plants, aquatic invertebrates (e.g., zooplankton, aquatic insects), and amphibians. Aquatic habitat provides important breeding and feeding sites for amphibians (i.e., salamanders, frogs, and toads). Sediments in aquatic habitat may support benthic invertebrates such as freshwater insects, snails, and amphipods. Water in aquatic habitat also provides important drinking water for wildlife in the adjacent riparian and other terrestrial habitats.

3.3.2 Species Lists by Habitat and AOC

This section presents comprehensive lists of common and special status species observed during the 2008-2009 biological surveys, previously recorded at the Site, or identified as potentially present.

The total numbers of plant and animal species observed or potentially present in each habitat are summarized in Table 3-2. The presence of habitats within each AOC is shown in Table 3-1.

The species lists for the individual AOCs are provided in Table 3-3 (plants), Table 3-4 (invertebrates), Table 3-5 (amphibians and reptiles), Table 3-6 (birds), and Table 3-7 (mammals).

Table 3-2
Summary of Species Observed and Potentially Present in Each Habitat

Species	Grassland[1]	Scrubs (Including Coastal Sage Scrub)	Chamise/ Chaparral	Riparian[1]
Plants				
Observed	12	0	0	27
Potential	118	145	114	71
Total	**130**	**145**	**114**	**98**
Invertebrates				
Observed	12	0	0	1
Potential	3	11	11	9
Total[2]	**15**	**11**	**11**	**10**
Amphibians				
Observed	1	0	0	3
Potential	3	2	2	4
Total	**4**	**2**	**2**	**7**
Reptiles				
Observed	6	3	0	2
Potential	7	15	18	16
Total	**13**	**18**	**18**	**18**
Birds				
Observed	49	1	0	62
Potential	53	46	44	38
Total	**102**	**47**	**44**	**100**
Mammals				
Observed	20	0	0	14
Potential	18	27	27	20
Total	**38**	**27**	**27**	**34**

Notes:

[1] All survey locations were assigned to grassland and riparian habitats.

[2] The numbers of invertebrate species are undetermined but exceed the indicated numbers of species.

Table 3-3
Comprehensive List of Plants in Each Area of Concern

Species		Operational Area									Conservation Easement (outside OAs)	Lower Massacre Canyon
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
NON-NATIVES												
Amaranthus albus	white pigweed	X	X	X	X	X	X	X		X	X	
Anthemis cotula	dog mayweed	X	X	X	X		X	X	X	X	X	
Artemisia biennis	biennial sagewort	X	X	X	X		X	X	X	X	X	X
Avena barbata	slender oat	O	O	O	O	O	O	O	O	O	O	O
Avena fatua	wild oat	O	O	O	O	O	O	O	O	O	O	O
Avena sativa	wild oats	O	O	O	O	O	O	O	O	O	O	O
Bromus diandrus	ripgut grass	O	O	O	O	O	O	O	O	O	O	O
Bromus mollis	brome	X	X	X	X	X	X	X	X	X	X	X
Bromus rubens	red brome	O	O	O	O	O	O	O	O	O	O	O
Bromus tectorum	cheat-grass brome	X	X	X	X	X	X	X	X	X	X	X
Capsella bursa-pastoris	shepard's-purse	X	X	X	X	X	X	X	X	X	X	X
Carya illinoinensis	pecan	X	X	X	X	X	X	X		X	X	
Centaurea melitensis	tocalote	X	X	X	X	X	X	X		X	X	
Chenopodium album	lamb's quarters	X	X	X	X	X	X	X	X	X	X	
Chenopodium murale	nettle-leaf goosefoot	X	X	X	X	X	X	X	X	X	X	
Cnicus benedictus	blessed thistle	X	X	X	X	X	X	X	X	X	X	
Eleagnus angustifolia	Russian olive	X	X	X	X	X	X	X		X	X	
Erodium cicutarium	filaree	X	X	X	X	X	X	X		X	X	
Erodium moschatum	white-stem filaree	X	X	X	X	X	X	X		X	X	
Eucalyptus sp.	eucalyptus	X	X	X	X	X	X	X		X	X	
Heterotheca incana	field mustard	X	X	X	X	X	X	X	X	X	X	
Hordeum murinum ssp. *leporinum*	hare barley	X	X	X	X	X	X	X		X	X	
Lactuca serriola	prickly lettuce	X	X	X	X	X	X	X		X	X	
Lamarckia aurea	goldentop	X	X	X	X	X	X	X		X	X	
Marrubium vulgare	horehound	X	X	X	X	X	X	X		X	X	
Medicago polymorpha	California bur-clover	X	X	X	X	X	X	X		X	X	
Melilotus albus	sweet clover	X	X	X	X	X	X	X	X	X	X	
Melilotus indicus	indian sweet clover	X	X	X	X	X	X	X	X	X	X	
Nicotiana glauca	tree tobacco	X	X	X	X	X	X	X	X	X	X	X
Olea europea	mission olive	X	X	X	X	X	X	X		X	X	
Piptatherum miliaceum	millet ricegrass	X	X	X	X	X	X	X		X	X	
Poa annua	annual bluegrass	X	X	X	X	X	X	X		X	X	
Polypogon monspeliensis	rabbit's foot grass	X					X	X			X	X
Raphanus sativus	wild radish	X	X	X	X	X	X	X	X	X	X	
Robinia pseudo-acacia	locust	X	X	X	X	X	X	X		X	X	X
Rumex crispus	curly dock	X	X	X	X	X	X	X		X	X	X
Salsola australis	Russian-thistle	X	X	X	X	X	X	X		X	X	
Schismus barbatus	Mediterranean grass	O	O	O	O	O	O	O	O	O	O	
Senecio vulgaris	common groundsel	X	X	X	X	X	X	X	X	X	X	
Silene gallica	common catchfly	X	X	X	X	X	X	X		X	X	
Sisymbrium altissimum	tumble-mustard	X	X	X	X	X	X	X		X	X	

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		**Operational Area**									**Conservation Easement (outside OAs)**	**Lower Massacre Canyon**
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
NON-NATIVES (continued)												
Sisymbrium irio	London rocket	X	X	X	X	X	X	X		X	X	
Sonchus oleraceus	common sow-thistle	X	X	X	X	X	X	X		X	X	
Sorghum halepense	Johnson grass	X	X	X	X	X	X	X		X	X	
Tamarix parviflora	tamarisk	X	X	X	X		X	X	X		X	X
Tamarix ramosissima	tamarisk	X	X	X	X		X	X	X		X	X
Urtica urens	nettle						X	X			X	X
NATIVES												
<u>Ferns and Fern Allies</u>												
Azolla filiculoides	Pacific mosquitofern	X					X	X			X	X
Pellaea mucronata	bird's foot cliff-brake	X	X	X	X	X	X	X	X	X	X	
Pentagramma triangularis	goldenback fern	X	X	X	X	X	X	X	X	X	X	
<u>Perennial Grasses, Sedges, and Rushes</u>												
Distichlis spicata ssp. stricta	desert salt-grass	X					X	X			X	X
Juncus balticus	baltic rush	X					X	X			X	X
Juncus dubius	dubious sedge	X					X	X			X	X
Juncus mexicanus	Mexican rush	X					X	X			X	X
Juncus textilis	Basket rush	X					X	X			X	X
Juncus xiphioides	iris-leaf rush	X					X	X			X	X
Leymus condensatus	giant rye	X	X	X	X	X	X	X	X	X	X	
Leymus triticoides	beardless wild rye	X	X	X	X	X	X	X	X	X	X	
Melica imperfecta	coast range melic	X	X	X	X	X	X	X	X	X	X	
Muhlenbergia asperifolia	common snatchgrass	X	X	X	X	X	X	X	X	X	X	X
Muhlenbergia rigens	California deergrass	X	X	X	X	X	X	X	X	X	X	X
Poa scabrella	scabby bluegrass	X	X	X	X	X	X	X	X	X	X	
Scirpus americanus	American sedge	X					X	X			X	X
Stipa coronata	giant stipa	X	X	X	X	X	X	X	X	X	X	
Stipa lepida	foothill needlegrass	X	X	X	X	X	X	X	X	X	X	
<u>Annuals</u>												
Amaranthus blitoides	bilious pigweed						X	X			X	X
Ambrosia acanthicarpa	bur-weed						X	X			X	X
Amsinckia intermedia	rancher's fiddleneck	O	O	O	O	O	O	O	O	O	O	O
Apiastrum angustifolium	wild-celery	X	X	X	X	X	X	X	X	X	X	X
Calandrinia ciliata var. menzlesii	red maids	X	X	X	X	X	X	X		X	X	
Caulanthus simulans	**Payson's jewel flower**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Centromadia pungens ssp. laevis	**smooth tarplant**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Chaenactis glabriuscula var. tenuifolia	San Diego pincushion	X	X	X	X	X	X	X	X	X	X	
Chaenactis parishii	**Parish's chaenactis**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		Operational Area									Conservation Easement (outside OAs)	Lower Massacre Canyon
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
<u>Annuals</u> (continued)												
Chorizanthe parryi var. parryi	**Parry's spine-flower**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	
Clarckia purpurea ssp. quadrivulnera	four-spot	X	X	X	X		X	X	X	X	X	
Clarckia similis	canyon clarckia	X		X	X	X	X					
Claytonia perfoliata	miner's lettuce	X	X	X	X	X	X	X	X	X	X	X
Conyza canadensis	horseweed	X	X	X	X	X	X	X	X	X	X	
Cryptantha micrantha ssp. lepida	hairy purpleroot cryptantha	X	X	X	X		X	X		X	X	
Cryptantha micromeres	minute-flower cryptantha	X			X	X	X	X			X	
Cuscuta californica	dodder	X	X	X	X	X	X	X	X	X	X	
Daucus pusillus	rattlesnake weed	X	X	X	X	X	X	X	X	X	X	
Dodecahema leptoceras	**slender-horned spineflower**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Emmenanthe penduliflora	whispering bells	X	X	X	X	X	X	X	X	X	X	
Eremocarpus setigerus	doveweed	X	X	X	X	X	X	X		X	X	
Eriastrum densifolium ssp. santorum	**Santa Ana woolly star**						**X**	**X**			**X**	**X**
Eriogonum davidsonii	Davidson's buckwheat	X	X	X	X		X	X	X	X	X	X
Eriogonum gracile	slender buckwheat	X	X	X	X	X	X	X	X	X	X	
Galium aparine	common bedstraw	X	X	X	X	X	X	X	X	X	X	
Galium californicum ssp.primum	**California bedstraw**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Gilia angelensis	grassland gilia	X	X	X	X	X	X	X		X	X	
Githopsis diffusa ssp. filicaulis	**Mission Canyon bluecup**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Gnaphalium bicolor	bicolor cudweed	X	X	X	X	X	X	X	X	X	X	
Gnaphalium palustre	lowland cudweed	X	X	X	X	X	X	X	X	X	X	
Guillenia lasiophylla	mouse-leafed mustard	X	X	X	X	X	X	X	X	X	X	
Helianthus annuus ssp. lenticularis	western sunflower	X	X	X	X	X	X	X		X	X	
Hemizonia fasciculata	fascicled tarweed	X	X	X	X	X	X	X	X	X	X	
Hemizonia pungens	smooth tarweed	X	X	X	X	X	X	X	X	X	X	
Heterotheca grandiflora	telegraph weed	X	X	X	X	X	X	X		X	X	
Hypochoeris glabra	smooth cat's-ears	X	X	X	X	X	X	X		X	X	
Lasthenia californica	goldfields	X	X	X	X	X	X	X	X	X	X	
Lasthenia glabrata ssp. coulteri	**Coulter's goldfields**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Layia platyglossa ssp. campestris	common tidy-tips	X	X	X	X	X	X	X	X	X	X	
Lepidium virginicum var. robinsonii	**Robinson's pepper-grass**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Lupinus bicolor ssp. microphyllus	lupine	X	X	X	X	X	X	X	X	X	X	
Lupinus hirsutissimus	stinging lupine	X	X	X	X	X	X	X	X	X	X	
Lupinus sparsiflorus	six-finger mouse-nose	X	X	X	X	X	X	X	X	X	X	
Matricaria matricarioides	pineapple weed	X	X	X	X	X	X	X		X	X	
Navarretia hamata	skunkweed	X	X	X	X	X	X	X	X	X	X	
Nemophila menziesii ssp. Integrifolia	baby blue-eyes	X	X	X	X	X	X	X	X	X	X	
Nicotiana bigelovii	Bigelow's tobacco	X	X	X	X	X	X	X	X	X	X	
Pectocarya linearis	slender pectocarya	X	X	X	X	X	X	X	X	X	X	
Phacelia cicutaria ssp. hispida	caterpillar phacelia	X	X	X	X	X	X	X	X	X	X	

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		**Operational Area**									**Conservation Easement (outside OAs)**	**Lower Massacre Canyon**
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
<u>Annuals</u> (continued)												
Phacelia distans	wild-heliotrope	X	X	X	X	X	X	X	X	X	X	
Phacelia minor	wild canterbury-bell	X	X	X	X	X	X	X	X	X	X	
Phacelia parryi	Parry's phacelia	X	X	X	X	X	X	X	X	X	X	
Plagiobothrys californicus	california popcornflower	X	X	X	X	X	X	X	X	X	X	
Plagiobothrys canescens	fuzzy popcornflower	X	X	X	X	X	X	X	X	X	X	
Plagiobothrys nothofulvus	rusty popcornflower	X	X	X	X	X	X	X	X	X	X	X
Plantago erecta	dot-seed plantain	X	X	X	X	X	X	X	X	X	X	
Polygonum lapathifolium	knotweed	X					X	X			X	X
Pterostegia drymarioides	fairy mist	X	X	X	X	X	X	X	X	X	X	
Salvia columbariae	chia	X	X	X	X	X	X	X	X	X	X	
Stephanomeria exigua	small wreath-plant	X	X	X	X	X	X	X	X	X	X	
Stephanomeria virgata	virgate wreath-plant	O	O	O	O	X	X	X	O	O	O	
Symphyotrichum defoliatum	**San Bernardino aster**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Trifolium tridentatum	tomcat clover	X	X	X	X	X	X	X	X	X	X	
Urtica holosericea	stinging nettle						X	X			X	X
Veronica peregrina	Mexican speedwell	X	X	X	X	X	X	X	X	X	X	
Vulpia myuros	annual fescue	X	X	X	X	X	X	X	X	X	X	
Vulpia octoflora	slender fescue	X	X	X	X	X	X	X	X	X	X	
Xanthium strumaruim var. canadense	cocklebur	X					X	X			X	X
<u>Non-Woody Perennials</u>												
Acourtia microcephala	purpleheads	X			X	X	X	X				
Allium marvinii	**Yucaipa onion**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Allium peninsulare	red-flower onion	X	X	X	X	X	X	X		X	X	
Ambrosia psilostachya	western ragweed	X	X	X	X	X	X	X	X	X	X	X
Artemisia douglasiana	mugwort	X					X	X			X	X
Artemisia dracunculus	dragon sagewort	X	X	X	X	X	X	X	X	X	X	
Astragalus pomonensis	Pomona locoweed	X	X	X	X	X	X	X	X	X	X	
Calchortus plummerae	**Plummer's mariposa lily**	**X**			**X**	**X**	**X**	**X**				
Calochortus splendens	splendid mariposa-lily	X			X	X	X	X				
Calochortus weedii var. intermedius	**Intermediate mariposa lily**	**X**			**X**	**X**	**X**	**X**				
Calystegia macrostegia ssp. arida	finger-leaf morning-glory	X	X	X	X	X	X	X	X	X	X	X
Cardamine californica	milkmaids	X	X	X	X	X	X	X	X	X	X	X
Chenopodium californicum	Caifornia goosefoot	X	X	X	X	X	X	X	X	X	X	
Cirsium occidentale	cobweb thistle	X	X	X	X	X	X	X	X	X	X	
Clemantis pauciflora	virgin's bower	X		X	X	X	X	X			X	
Crassula erecta	dwarf stonecup	X	X	X	X	X	X	X	X	X	X	X
Croton californicus	California soup-plant	X	O	X	X	X	X	X	X		X	
Cucurbita foetidissima	calabazilla	X	X	X	X	X	X	X		X	X	
Datisca glomerata	Durango-root	X			X	X	X	X			X	

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		Operational Area									Conservation Easement (outside OAs)	Lower Massacre Canyon
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
<u>Non-Woody Perennials</u> (continued)												
Datura wrightii	western jimsonweed	X	X	X	X	X	X	X	X	X	X	
Delphinium parryi	Parry's larkspur	X	X	X	X	X	X	X	X	X	X	
Dichelostemma pulchellum	wild-hyacinth	X	X	X	X	X	X	X	X	X	X	
Dudleya abramsii	Abram's dudleya	X			X	X	X	X			X	
Dudleya pulverulenta	chalk-lettuce	X	X	X	X	X	X	X	X	X	X	
Dudleya saxosa	shoe-lace dudleya	X			X	X	X	X			X	
Epilobium adenocaulon var. parishii	Parish's fireweed	X					X	X			X	X
Epilobium canum ssp. mexicanum	Mexican fireweed	X	X	X	X	X	X	X	X	X	X	
Eriogonum elongatum	tall buckwheat	X	X	X	X	X	X	X	X	X	X	
Euphorbia polycarpa	fairy mats	X	X	X	X	X	X	X	X	X	X	
Galium andrewsii	moss bedstraw	X	X	X	X	X	X	X	X	X	X	
Galium angustifolium	narrow-leaf bedstraw	X	X	X	X	X	X	X	X	X	X	
Galium nuttallii	Nuttall's bedstraw	X	X	X	X	X	X	X	X	X	X	
Gnaphalium californicum	california everlasting	X	X	X	X	X	X	X	X	X	X	
Gnaphalium canescens beneolens	fragrant everlasting	X	X	X	X	X	X	X	X	X	X	
Helianthus gracilentus	slender sunflower	X	X	X	X	X	X	X	X	X	X	
Heliotropium curvassavicum var. oculatum	salt heliotrope	X	X	X	X	X	X	X		X	X	
Lemna minor	duckweed	X					X	X			X	X
Marah macrocarpus	manroot, wild-cucumber	X	X	X	X	X	X	X		X	X	
Mimulus guttatus	seep monkey flower	X					X	X			X	X
Mirabilis californica	wishbone plant	X	X	X	X	X	X	X	X	X	X	
Muilla maritima	rough muilla	X	X	X	X	X	X	X	X	X	X	
Oenothera elata ssp. venusta	evening primrose	X	X	X	X	X	X	X	X	X	X	X
Opuntia basilaris	beaver-tail cactus	X	X	X	X	X	X	X	X	X	X	
Opuntia littoralis var. vaseyi	hillside opuntia	X	X	X	X	X	X	X	X	X	X	
Opuntia parryi ssp. parryi	valley cholla	X	X	X	X	X	X	X	X	X	X	
Pedicularis densiflora	indian warrior	X			X	X	X	X		X	X	
Penstemon spectabilis	showy penstemon	X	X	X	X	X	X	X	X	X	X	
Phacelia ramosissima	Serengeti phacelia	X			X	X	X	X		X	X	
Rorippa gambelii	**Gambel's watercress**	**X**					**X**	**X**			**X**	**X**
Rorippa nasturtium-aquaticum	watercress	X					X	X			X	X
Rumex hymenosepalus	wild-rhubarb	X	X	X	X	X	X	X		X	X	X
Rumex salicifolius	willow-leaf dock	X	X	X	X	X	X	X		X	X	X
Scrophularia californica var. floribunda	California bee plant	X	X	X	X	X	X	X	X	X	X	X
Selanginella bigelovii	spike-moss	X					X	X			X	X
Sibaropsis hammittii	**Hammitt's clay-cress**	**X**					**X**	**X**			**X**	**X**
Sisyrinchium bellum	blue-eyed grass	X	X	X	X	X	X	X	X	X	X	
Tauschia arguta	yellow-vein waspweed	X	X	X	X	X	X	X	X	X	X	
Tortula californica	**California screw-moss**	**X**					**X**	**X**			**X**	**X**
Typha latifolia	cat-tail						O	X			X	X

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		**Operational Area**									**Conservation Easement (outside OAs)**	**Lower Massacre Canyon**
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Non-Woody Perennials (continued)												
Urtica sp.	hedge nettle						X	X			X	X
Vicia americana	American vetch	X	X	X	X	X	X	X	X	X	X	
Yucca whipplei	our lord's candle	X	X	X	X	X	X	X	X	X	X	
Shrubs												
Adenostoma fasciculatum	chamise	O			X	X	X	X				
Amorpha fruticosa var. occidentalis	western false indigo	X	X	X	X	X	X	X	X	X	X	X
Arctostaphylos glandulosa	Eastwood manzanita	X			X	X	X	X				
Arctostaphylos glandulosa ssp. adamsii	Laguna manzanita	X			X	X	X	X				
Arctostaphylos glauca	big-berry manzanita	X			X	X	X	X				
Artemisia californica	California sagebrush	X	X	X	X	X	X	X	X	X	X	
Astragalus pachypus var. jaegeri	**Jaeger's locoweed**	**O**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Atriplex canescens	four-wing saltbush	X	X	X	X	X	X	X	X	X	X	
Atriplex coronata var. notatior	**San Jacinto valley saltbush**	**X**					**X**	**X**			**X**	**X**
Baccharis emoryi	Emory's baccharis	X	X	X	X		X	X		X		
Baccharis salicifolia	mulefat	X	X	X	X		X	X	X		X	X
Brickellia desertorum	desert brickellbush	X	X	X	X		X	X		X	X	
Ceanothus cuneatus	buckbrush	X			X	X	X	X				
Ceanothus greggii	white wild-lilac	X			X	X	X	X				
Dendromecon rigida	tree poppy	X	X	X	X		X	X		X	X	
Encelia farinosa	brittlebush	X	X	X	X		X	X		X	X	
Ericameria palmeri	Palmer's goldenbush	X	X	X	X		X	X		X	X	
Eriodictyon crassifolium	yerba santa	X	X	X	X		X	X	X	X	X	X
Eriogonum fasciculatum	flat-top buckwheat	O	O	O	O	O	O	O	X	X	X	
Eriophyllum confertiflorum	golden-yarrow	X	X	X	X		X	X	X	X	X	
Forestiera neomexicana	desert olive	X	X	X	X	X	X	X	X	X	X	
Hazardia squarrosa ssp. grindelioides	sawtooth goldenbush	X	X	X	X	X	X	X	X	X	X	
Helianthemum scoparium	sun-rose	X			X	X	X	X		X	X	
Heteromeles arbutifolia	toyon	O	X	X	X	X	O	X	X	X	X	
Isocoma veneta var. vernonioides	coastal goldenbush	X	X	X	X	X	X	X	X	X	X	
Kackiella antirrhinoides ssp. microphylla	desert bush penstemon	X			X	X	X	X		X	X	
Keckiella antirrhinoides	bush penstemon	X			X	X	X	X		X	X	
Keckiella cordifolia	climbing penstemon	X			X	X	X	X		X	X	
Lepidospartum squamatum	scale broom	X			O		X	X			X	X
Leptodactylon californicum	prickly phlox	X			X	X	X	X		X	X	
Lonicera interrupta	honeysuckle	X	X	X	X	X	X	X	X	X	X	
Lonicera subspicata var. denudata	San Diego honeysuckle	X	X	X	X	X	X	X	X	X	X	
Lotus salsuginosus	alkali lotus	X	X	X	X	X	X	X	X	X	X	
Lotus scoparius ssp. brevialatus	deerweed	X	X	X	X	X	X	X	X	X	X	
Lupinus latifolius ssp. parishii	Parish's stream lupine	X	X	X	X	X	X	X	X	X	X	X

Table 3-3 (continued)
Comprehensive List of Plants in Each Area of Concern

Species		**Operational Area**									**Conservation Easement (outside OAs)**	**Lower Massacre Canyon**
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Shrubs (continued)												
Malacothamnus fasciculatus	mesa bushmallow	X	X	X	X	X	X	X	X	X	X	
Malacothrix saxatilis	**cliff malacotrhix**						**X**	**X**				**X**
Mimulus aurantiacus	salmon monkey flower	X	X	X	X	X	X	X	X	X	X	
Nama stenocarpum	**mud nama**		**X**	**X**	**X**		**X**	**X**			**X**	
Pulchea sericea	arrowweed	X					X	X			X	X
Rhamnus crocea	spiny redberry	X	X	X	X	X	X	X	X	X	X	
Rhamnus ilicifolia	hollyleaf redberry	X	X	X	X	X	X	X	X	X	X	
Rhus ovata	sugarbush	O	X	X	X	X	X	O	X	X	X	
Rhus trilobata	pubescent basket bush	X	X	X	X	X	X	X	X	X	X	
Ribes indecorum	winter currant	X	X	X	X	X	X	X	X	X	X	
Rosa californica	California rose	X	X	X	X	X	X	X		X	X	X
Salvia apiana	white sage	O	O	O	X	X	X	X	X	X	X	
Salvia mellifera	black sage	O	O	O	X	X	X	X	X	X	X	
Sambucus mexicana	elderberry						O	X			X	X
Solanum parishii	Parish's nightshade	X	X	X	X	X	X	X	X	X	X	
Tetradymia comosa	cotton-thorn	X	X	X	X	X	X	X	X	X	X	
Toxicodendron radicans ssp. diversilobum	poison-oak	X	X	X	X	X	X	X	X	X	X	
Trichostema parishii	mountain blue-curls	X	X	X	X	X	X	X	X	X	X	
Trichocoronis wrightii var. wrightii	**Wright's trichocoronis**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Trees												
Acer negundo ssp. californicum	box elder						X	X			X	X
Alnus rhombifolia	white alder						X	X			X	X
Platanus racemosa	sycamore	X	X	X	X		X	X	X		X	X
Populus fremontii	cottonwood	X				O	O	X			X	X
Prunus ilicifolia	holly-leaf cherry	X			X	X	X	X		X	X	
Quercus agrifolia	live oak	X	X	O	X	X	X	O		X	X	
Quercus berberidifolia	scrub oak	X	X	X	X	X	X	X		X	X	
Quercus dumosa	**Nutall's scrub oak**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Quercus engelmannii	**Engelmann oak**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	
Quercus wislizenii ssp. frutescens	Wislizenus scrub oak	X	X	X	X	X	X	X		X	X	
Salix exigua	narrow-leaf willow						X	X			X	X
Salix gooddingii var. variabilis	black willow						O	O			X	X
Salix hindsiana	sandbar willow						X	X			X	X
Salix laevigata var. araquipa	large-leaf willow						X	X			X	X
Salix lasiolepis	arroyo willow						O	O			X	X

Notes:
O = Observed (or detected by sign)
X = Potentially present
Bold = Sensitive species

Table 3-4
List of Invertebrates in Each Area of Concern

Species Groups and Species		Areas of Concern								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Fairy shrimp										
Branchinecta lindahli	fairy shrimp	X	O*	X	O*	X				
Branchinecta lynchi	**vernal pool fairy shrimp**	**X**	**X**	**X**						
Streptocephalus dorothae	fairy shrimp	X	X	X						
Streptocephalus woottoni	**Riverside fairy shrimp**	**X**	**X**	**X**						
Dragonflies and damselflies										
Enellagma sp.	blue damselfly	X	O	O	O	X	O	O	X	X
Crickets, Grasshoppers, and Katydids										
Melanoplus differentialis	differential grasshopper	O	O	X	X	X	X	X	X	X
Spharagemon collare	mottled sand grasshopper	O	O	X	X	X	X	X	X	X
Beetles										
Dinacoma marginata	scarab beetle	X	X	X	X	X	X	X	X	X
Eleodes sp.	stink beetle	O	O	O	O	O	O	O	O	O
Ants, Wasps, and Bees										
Apis mellifera	honey bee	X	X	X	X	X	O	X	X	X
Camponotus sp.	carpenter ant	O	O	O	O	O	O	O	O	O
Dasmutilla sp.	velvet ant	O	O	O	O	O	O	O	O	O
Hemipepsis sp.	tarantula wasp	X	O	O	O	X	O	O	X	X
Solenopsis invicta	fire ant	X	X	X	X	X	O	X	X	X
Spiders										
Latrodectus hesperus	black widow spider	O	O	X	X	O	O	X	X	X
Butterflies and Moths										
Danaus plexipup	monarch butterfly	X	X	X	X	X	O	X	X	X

Notes:
O = Observed (or detected by sign)
O* = Observed (or detected by sign) in 2008 or 2009
X = Potentially present

Table 3-5
Comprehensive List of Amphibians and Reptiles in Each Area of Concern

Species Groups and Species		**Operational Area**								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
AMPHIBIANS										
Salamanders										
Aneides lugubris	arboreal salamander	X	X	X						
Batrachoseps pacificus major	garden slender salamander	X	X	X	X	X	X	X	X	X
Frogs and Toads										
Bufo boreas halophilus	California toad	O	O	X	X	X	O	O	X	X
Bufo microscaphus californicus	**arroyo toad**		**X**		**X**		**X**	**X**		
Pseudacris cadaverina	California treefrog	O*	X	X	X	X	X	X	X	X
Pseudacris regilla	pacific treefrog	O*	X	X	X	X	O	O	X	X
Spea hammondii	**western spadefoot**	**O***	**X**	**X**	**O**	**X**	**O***	**O***	**X**	**X**
REPTILES										
Skinks										
Eumeces skiltonianus interparietalis	**Coronado Island skink**	**X**	**X**		**X**		**X**	**X**		
Lizards										
Anniella pulchra pulchra	**silvery legless lizard**		**X**		**X**		**X**	**X**		
Cnemidophorus hyperythrus beldingi	**orange-throated whiptail**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Cnemidophorus tigris multiscutatus	coastal whiptail	X	X	X	X	X	X	X	X	X
Elgaria multicarinata webbi	southern alligator lizard	X	X	X	X	X	X	X	X	X
Phrynosoma coronatum blainvillii	**coast (San Diego) horned lizard**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Sceloporus occidentalis	fence lizard	X	X	X	X	X	X	X	X	X
Sceloporus orcutti	granite spiny lizard	X	O	X	X	X	X	X	X	X
Uta stanisburiana	side-blotched lizard	X	X	X	X	X	X	X	X	X
Xantusia henshawi	granite night lizard		X		X		X	X		
Snakes										
Charina bottae	rubber boa	X	X	X	X	X	X	X	X	X
Crotalus viridis helleri	southern Pacific rattlesnake	X	X	X	X	X	X	X	X	X
Crotalus ruber ruber	**northern red diamond rattlesnake**	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Crotalus viridis	western rattlesnake	X	X	X	X	X	X	X	X	X
Lampropeltis getula	California kingsnake	X	X	X	X	X	X	X	X	X
Leptotyphlops humilis	western blind snake		X		X		X	X		
Lichanura trivirgata	**rosy boa**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Masticophis flagellum	coachwhip	X	X	X	X	X	X	X	X	X
Masticophis lateralis	California striped racer	X	X	X	X	X	X	X	X	X
Pituophis catenifer annectens	San Diego gopher snake	X	X	X	X	X	X	X	X	X
Pituophis melanoleucus	gopher snake	X	X	X	X	X	X	X	X	X
Salvadora hexalepis virgultea	**coast patch nosed snake**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Thamnophis hammondi	**two-striped garter snake**		**X**		**X**		**X**	**X**		

Notes:
O = Observed (or detected by sign)
O* = Observed (or detected by sign) in 2008 or 2009
X = Potentially present
Bold = Sensitive species

Table 3-6
Comprehensive List of Birds in Each Area of Concern

Species Groups and Species		**Operational Area**								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Herbivores										
Carduelis tristis	American goldfinch	O	X	O	X	X	O	O*	X	X
Calypte anna	Anna's hummingbird	O*	X	O			O*	O*	O*	X
Archilochus alexandri	black-chinned hummingbird	X	X	O	X	X	O	X	X	X
Spizella atrogularis	**black-chinned sparrow**	**X**	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**X**
Pheucticus melanocephalus	black-headed grosbeak	O	X	X	O	X	O	X	X	X
Guiraca caerulea	blue grosbeak	X	X	X	X	X	O	X	X	X
Icterus bullockii	Bullock's oriole	O	X	O	O	X	X	X		X
Eremophila alpestris	**California horned lark**	**X**	**X**	**O***	**O***		**O***	**X**		**X**
Callipepla californica	California quail	X	X	O	O	X	O*	O*	X	X
Stellula calliope	calliope hummingbird	X	X	X	X	X	X	X		X
Spizella passerina	chipping sparrow	O*	X	X	X	X	X	O*		X
Calypte costae	**Costa's hummingbird**	**O***	**X**	**O**	**O**	**X**	**X**	**X**	**X**	**X**
Passerella iliaca	fox sparrow	X	X	X	X	X	X	X		X
Zonotrichia atricapilla	golden-crowned sparrow	X	X	X	X	X	O*	O*		X
Carpodacus mexicanus	house finch	O*	O*	O	O*	X	O*	O*	O*	X
Vireo huttoni	Hutton's vireo	X	X	X	X	X	X	X		X
Carpodacus grammacus	lark sparrow	O*	O*	O	X	X	O*	O*	O*	X
Carduelis lawrencii	**Lawrence's goldfinch**	**X**	**X**	**O**	**O**	**X**	**X**	**X**		**X**
Vireo bellii pusillus	**least Bell's vireo**	**X**	**X**	**X**	**X**		**O**	**O**		
Carduelis psaltria	lesser goldfinch	O*	O*	O	O*	X	O*	O*	O*	X
Melospiza lincolnii	Lincoln's sparrow	X	X	X	X		X	X		
Anas platyrhynchos	mallard	X			X		X	X		
Sialia currucoides	mountain bluebird	X	X	X	X	X	X	X		X
Oreortyx pictus	mountain quail	X	X	X	X	X	O	X	X	X
Icterus galbula	northern oriole	X	X	X	X		X	X		
Contopus cooperi	**olive-sided flycatcher**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Phainopepla nitens	phainopepla	O	X	O	O*	X	O	X		X
Parus inornatus	plain titmouse	X	X	X	X	X	X	X		
Sphyrapicus ruber	red-breasted sapsucker	X	X	X	X	X	X	X		X
Stelgidopteryx ruficollis	rough-winged swallow	X	X	X	X		X	X		
Selasphorus rufus	**rufous hummingbird**	**X**	**X**	**X**	**X**		**O***	**X**	**X**	**X**
Aimophila ruficeps	rufous-crowned sparrow	X	X	X	X	X	X	X		X
Pipilo erythrophthalmus	rufous-sided towhee	X	X	X	X	X	X	X		X
Melospiza melodia	**song sparrow**	**X**	**X**	**X**	**X**	**X**	**O***	**O***		**X**
Aimophila ruficeps canescens	**Southern California rufous-crowned sparrow**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Pipilo maculates	spotted towhee	O	O*	O	O*	X	O	O*		X
Catharus ustulatus	Swainson's thrush						O	X		
Tachycineta thalassina	violet-green swallow	X	X	X	X	X	X	X		X
Sialia mexicana	western bluebird	O	X	X	X	X	O	X		X
Piranga ludoviciana	western tanager	X	X	X	X	X	O	X		X
Aeronautes saxatalis	white-throated swift	X	X	X	X	X	X	X	X	X
Chamaea fasciata	wrentit	X	X	O	X	X	O	X	X	X
Insectivores										
Anthus spinoletta	american pipit	X	X	O*	O*	X	X	X		X
Myiarchus cinerascens	ash-throated flycatcher	O	X	O	O	X	O	X	X	X
Hirundo rustica	barn swallow	X	X	X	X	X	X	X	X	X
Thryomanes bewickii	Bewick's wren	O	X	O	O*	X	O	O*	O*	X
Sayornis nigricans	black phoebe	O	O*				X	O*		
Dendroica nigrescens	black-throated gray warbler	X	X	X	X	X	X	O*	X	X
Polioptila caerulea	blue-gray gnatcatcher	X	X	X	X	X	X	O*	X	X

Table 3-6 (continued)
Comprehensive List of Birds in Each Area of Concern

Species Groups and Species		Operational Area								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Insectivores (continued)										
Psaltriparus minimus	bushtit	O*	O*	O	O	X	O*	O*		X
Polioptila californica californica	**coastal California gnatcatcher**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Catherpes mexicanus	canyon wren	X	X	X	X	X	X	X	X	X
Tyrannus vociferans	Cassin's kingbird	X	X	O	X	X	X	X	X	X
Hirundo pyrrhonota	cliff swallow	X	X	X	X	X	X	X	X	X
Columbina passerina	common ground-dove	X	X	X	X	X	X	X	X	X
Phalaenoptilus nuttallii	common poorwill	X	X	X	X		X	X		
Geothlypis trichas	common yellowthroat	X					X	X		
Ammodramus savannrum	**grasshopper sparrow**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Tringa melanoleuca	greater yellowlegs	X					X	X		
Catharus guttatus	hermit thrush	X	X	X	X	X	X	X		
Troglodytes aedon	house wren	O	O*	O	O	X	O	O*	X	X
Charadrius vociferus	killdeer	X	X	X	X	X	X	X		
Chordeiles acutipennis	lesser nighthawk	X	X	X	X	X	X	X	X	X
Cistothorus palustris	marsh wren	X					X	X		
Zenaida macroura	mourning dove	O*	X	O*	O*	X	O*	O*	X	X
Vermivora ruficapilla	Nashville warbler	X	X	X	X		X	X		
Colaptes auratus	northern flicker	O*	X	X	O	X	O*	X		X
Stelgidopteryx serripennis	northern rough-winged swallow	O	X	X	O*	X	O	O*	X	X
Picoides nuttallii	**Nuttall's woodpecker**	**O**	**O***	**X**	**O**	**X**	**O***	**O***		
Baeolophus inornatus	**oak titmouse**	**X**	**X**	**X**	**X**	**X**	**X**	**O***		
Vermivora celata	orange-crowned warbler	O	X	O	O		X	X		
Empidonax difficilis	Pacific-slope flycatcher	X	X	X	X	X	O	X		
Agelaius phoeniceus	red-winged blackbird	X					X	X		
Salpinctes obsoletus	rock wren	O*	X	X	O*		X	X		
Regulus calendula	ruby-crowned kinglet	X	X	X	X	X	O*	X		X
Oreoscoptes montanus	sage thrasher	X	X	X	X	X	X	X		
Sayornis saya	Say's phoebe	X	X	X	X	X	X	X	X	X
Empidonax traillii extimus	**southwestern willow flycatcher**						**O**	**X**		
Agelaius tricolor	**tri-colored blackbird**	**X**					**O**	**X**		
Vireo gilvus	warbling vireo	X					X	X		
Anthus spinoletta	water pipit	X					X	X		
Sturnella neglecta	western meadowlark	O*	X	O*	O*	X	O*	O*	O*	X
Contopus sordidulus	western wood-pewee	X	X	X	X	X	X	X		
Sitta carolinensis	white-breasted nuthatch	X	X	X	X	X	X	X		X
Dendroica petechia	**yellow warbler**	**O**	**O***				**X**	**X**		
Sphyrapicus varius	yellow-bellied sapsucker	X	O*	X	X	X	X	X		
Icteria virens	**yellow-breasted chat**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Omnivores										
Melanerpes formicivorus	acorn woodpecker	X	X	X	X	X	X	X		
Corvus brachyrhynchos	American crow	X	X	O	X	X	O	X		
Passerculus sandwichensis beldingi	**Belding's savannah sparrow**	**X**					**X**	**X**		
Amphispiza belli belli	**Bell's sage sparrow**	**X**		**X**						
Euphagus cyanocephalus	Brewer's blackbird	X	X	X	X	X	X	X		X
Molothrus aster	brown-headed cowbird	X	X	X	X	X	X	X		X
Passerculus sandwichensis alaudinus	**Bryant's savannah sparrow**	**X**					**X**	**X**		
Toxostoma redivivum	California thrasher	O*	O*	O*	O*	X	O*	O*	O*	X
Pipilo crissalis	California towhee	O			O		X	X		
Corvus corax	common raven	O	X	X	O	X	O	X		
Junco hyemalis	dark-eyed junco						X	O*		

Table 3-6 (continued)
Comprehensive List of Birds in Each Area of Concern

Species Groups and Species		Operational Area								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Omnivores (continued)										
Picoides pubescens	downy woodpecker	O		X	X		O	X		
Sturnus vulgaris	European starling	O*	O*	X	O	X	O*	O*		
Geococcyx californianus	greater roadrunner	X	X	X	X	X	O	X	X	X
Picoides villosus	hairy woodpecker	X		X	X		X	X		
Passer domesticus	house sparrow	O	X	X	X	X	X	X	X	X
Passerculus sandwichensis rostratus	**large-billed savannah sparrow**	**X**					**X**	**X**		
Passerina amoena	lazuli bunting	O		X	O	X	O	X	X	X
Melanerpes lewis	**Lewis' woodpecker**	**X**		**X**	**X**		**X**	**X**		
Mimus polyglottos	northern mockingbird	X	X	X	X	X	X	X		X
Columba livia	rock pigeon	X	X	X	X	X	X	O*		X
Amphispiza belli	sage sparrow	X	X	X	X	X	X	X	O*	X
Passerculus sandwichensis	savannah sparrow	X	O*		O*		O*	X		
Pooecetes gramineus	vesper sparrow	X	X	X	X	X	O*	X	X	X
Tyrannus verticalis	western kingbird	X	X	O	X	X	X	X		X
Aphelocoma californica	western scrub-jay	X		X	X	X	O	X	X	X
Zonotrichia leucophrys	white-crowned sparrow	O*	X	O*	O*	X	O*	O*	O*	X
Wilsonia pusilla	Wilson's warbler	O	O	O	O		X	X		
Dendroica coronata	yellow-rumped warbler	O*	O*	X	X		O*	O*		
Carnivores										
Falco sparverius	American kestrel	O*	X	X	O	X	X	X	X	X
Falco pregrinus	**American peregrine falcon**						**X**	**X**		
Pelecanus erythrorhynchos	American white pelican (not nesting)						X	X		
Tyto alba	barn owl	X			O		O*	X		
Athene cunicularia	**burrowing owl**	**O**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Accipiter cooperii	**Cooper's hawk**				**O**		**O**	**X**		
Buteo regalis	**ferruginous hawk**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
Aquila chrysaetos	**golden eagle**	**O***	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Bubo virginianus	great horned owl				O		X	X		
Lanius ludovicianus	**loggerhead shrike**	**X**	**X**	**O***	**O***	**X**	**X**	**X**		
Asio otus	**long-eared owl (nesting)**			**X**			**X**	**X**		
Falco columbarius	**merlin**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
Circus cyaneus	**northern harrier**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
Falco mexicanus	**prairie falcon**	**X**	**X**	**X**	**O***	**X**	**O**	**X**		**X**
Buteo lineatus	red-shouldered hawk	O					X	X		
Buteo jamaicensis	red-tailed hawk	O*	X	X	O	X	O*	O*	O*	X
Accipiter striatus	**sharp-shinned hawk**						**X**	**X**		
Asio flammeus	**short-eared owl (nesting)**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Buteo swainsonii	**swainson's hawk**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Cathartes aura	turkey vulture	X	X	X	X	X	X	X	X	X
Otus kennicottii	western screech owl						X	X		
Plegadis chihi	**white-faced ibis**	**X**					**X**	**X**		
Elanus caerulus	**white-tailed kite**	**O**	**X**	**O**	**X**	**X**	**O**	**O**		**X**

Notes:
O = Observed (or detected by sign)
O* = Observed (or detected by sign) in 2008 or 2009
X = Potentially present
Bold = Sensitive species

Table 3-7
Comprehensive List of Mammals in Each Area of Concern

Species Groups and Species		Operational Area								
Scientific name	**Common Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Small herbivores										
Chaetodipus fallax	Dulzura pocket mouse	O*	X	X	O*	X	O*	O*	X	X
Chaetodipus fallax fallax	**San Diego pocket mouse**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Dipodomys agilis	Pacific kangaroo rat	X	X	X	X	X	X	X	X	X
Dipodomys merriami parvus	**San Bernardino kangaroo rat**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Dipodomys simulans	Dulzura kangaroo rat	O*	O*	O	O*	O	O*	O*	O*	O
Dipodomys stephensi	**Stephens' kangaroo rat**	**O***	**O**	**O**	**O**	**X**	**O***	**O***	**O**	**X**
Lepus californicus	black-tailed jackrabbit	O	O	O	O	O	O	O	O	O
Lepus californicus bennettii	**San Diego black-tailed jackrabbit**	**X**	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**X**
Mus musculus	house mouse		X				X			
Neotoma lepida	desert woodrat	X	X	X	X	X	X	O	X	X
Neotoma lepida intermedia	**San Diego desert woodrat**	**X**	**X**	**X**	**X**	**X**	**X**			**X**
Neotoma macrotis	big-eared woodrat		X	X	X		O*	X		
Perognathus longimembris brevinasus	**Los Angeles pocket mouse**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Peromyscus maniculatus	deer mouse	O	X	O	X	X	O*	O*	O*	X
Peromyscus boylii	brush mouse	X	X	X	X	X	X	X	X	X
Peromyscus californicus	California mouse	X	X	X	X	X	O*	O*	X	X
Peromyscus eremicus	cactus mouse	X	X	X	X	X	O*	O*	O*	X
Reithrodontomys megalotis	western harvet mouse	O	X	X	X	X	O*	O*	X	X
Spermophilus beecheyi	California ground squirrel	O	O	O	O	O	O	X	X	X
Sylvilagus audubonii	desert cottontail	O	O	O	O	O	O	X	X	X
small insectivores										
Antrozous pallidus	**pallid bat**	**X**	**X**		**O**		**O**	**X**		
Eptesicus fuscus	big brown bat	X	O	X	X		X	X		
Eumops perotis	**western mastiff bat**	**X**	**X**	**X**	**X**		**O**	**X**		
Lasiurus blossevillii	**western red bat**	**X**	**X**	**X**	**X**		**O**	**X**		
Myotis ciliolabrum	**small-footed myotis**	**X**	**X**	**X**	**X**		**O**	**X**		
Myotis yumanensis	**Yuma myotis**	**X**	**X**	**X**	**X**		**O**	**X**		
Nyctinomops femerosaccus	**pocketed free-tailed bat**	**X**	**X**	**X**	**X**		**O**	**X**		
Thomomys bottae	Botta's pocket gopher	O	O	O	O	X	O	X	O	O
Large herbivores										
Bos taurus	domestic cattle		O	O	O					
Odocoileus hemionus	mule deer	O*	O	O	O	O	O	O*	O	O
Carnivores										
Bassariscus astutus	ringtail		X		X		X	X		
Canis familiaris	domestic dog	O	O							
Canis latrans	coyote	O	O	O	O	O	O	O	O	O
Felis rufus	bobcat	O*	O*	O*	O*	X	O	O*	O*	O
Mustela frenata	long-tailed weasel	X	X	X	X		X	X		
Onychomys torridus ramona	**southern grasshopper mouse**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Procyon lotor	raccoon	O*	X	X	X	X	X	O*		
Puma concolor	mountain lion (foraging only)	X	X	X	X	X	X	X	X	X
Taxidea taxus	**American badger**	X	X	X	X	X	X	X	X	X
Urocyon cinereoargenteus	gray fox	X	X	X	X	X	X	X	X	X

Notes:
O = Observed (or detected by sign)
O* = Observed (or detected by sign) in 2008 or 2009
X = Potentially present
Bold = Sensitive species

Special Status Species

Special status species were identified from the lists of species observed or potentially present at the Site. Special status species were defined on the basis of federal or State endangered or threatened status, or California Species of Special Concern. The species below have been identified at or in the vicinity of the Site based on sources including CDFG (2008).

Plants

Four State- or federally-listed endangered plants were identified as potentially present at the Site Gambel's water cress (*Rorippa gambelii*), San Jacinto Valley crownscale (*Atriplex coronata* var. *notatior*), Santa Ana River woolly star (*Eriastrum densifolium* ssp. *sanctorum*), and slender-horned spineflower (*Dodecahema leptoceras*) (Table 3-8). None of these plants have been observed at the Site. A number of plants classified as sensitive by the California Native Plant Society (CNPS 2008) were identified as potentially present at the Site (Appendix C, Attachments C.3.1 and C.3.2). However, a listing by the CNPS does not confer a legal standing or obligation. Nonetheless, the California Department of Fish and Game considers the CNPS listings in its determination of listings for endangered and threatened species.

Invertebrates

Two federal endangered or threatened invertebrates were identified as potentially present at the Site, the vernal pool fairy shrimp (*Branchinecta lynchii*) and Riverside fairy shrimp (*Streptocephalus woottoni*) (Table 3-8). These fairy shrimp occur in vernal pools containing seasonal surface water. Neither of these species has been observed at the Site.

Amphibians and Reptiles

Two sensitive amphibian species may occur at the Site (Table 3-8). The Arroyo toad (*Bufo microscaphus californicus*) (FE, CSC) is considered potentially present in several AOCs, and the western spadefoot (*Scaphiopus hammondi*) (CSC) has been observed in five of the AOCs (Table 3-5). The western spadefoot can occur in grasslands, coastal sage scrub near rain pools, and riparian habitats.

Seven sensitive reptile species were identified as potentially present at or near the Site, due to habitat suitability or recorded sightings (Table 3-5 and Table 3-8). Of these, the northern red diamond rattlesnake (*Crotalus ruber ruber*) (CSC) was observed incidentally during a previous survey in one AOC (Operational Area B) (Table 3-5). Three other sensitive reptile species have been observed at the Site, but not in any of the AOCs: orange-throated whiptail (*Aspidoscelis hyperythra beldingi*), San Diego (coast) horned lizard (*Phrynosoma coronatum blainvillii*), and silvery legless lizard (*Anniela pulchra pulchra*).

Table 3-8 (continued)
Special Status Animals Potentially Present within Areas of Concern

Common Name	Scientific Name	Status	Observed Onsite
Birds (continued)			
White-faced ibis (rookery site)	*Plegadis chihi*	CSC	No
Yellow warbler	*Dendroica petechia*	CSC	Yes
Yellow-breasted chat	*Icteria virens*	CSC	Yes
Mammals			
American badger	*Taxidea taxus*	CSC	No
Los Angeles pocket mouse	*Perognathus longimembris brevinasus*	FS, CSC	No
Northwestern San Diego pocket mouse	*Chaetodipus fallax fallax*	CSC	No
Pallid bat	*Antrozous pallius*	CSC	Yes
Pocketed free-tailed bat	*Nyctinomops femerosaccus*	CSC	Yes
San Bernardino kangaroo rat	*Dipodomys merriami parvus*	FE, CSC	No
San Diego black-tailed jackrabbit	*Lepus californicus bennettii*	CSC	No
San Diego desert woodrat	*Neotoma lepida intermedia*	CSC	Yes
Small-footed myotis	*Myotis ciliolabrum*	CSC	Yes
Southern grasshopper mouse	*Onychomys torridus ramona*	CSC	No
Stephens' kangaroo rat	*Dipodomys stephensi*	FE, ST	Yes
Western mastiff bat	*Eumops perotis*	CSC	Yes
Western red bat	*Lasiurus blossevillii*	CSC	Yes

Definitions:
CSC: California Species of Special Concern
FE: Federally endangered
FT: Federally threatened
SE: California State endangered
ST: California State Threatened

Birds

A total of 26 sensitive bird species have the potential to be present at the Site (Table 3-8). Of these, 13 species (i.e., endangered, threatened, or CSC) were observed during past or recent surveys (Table 3-6).

Mammals

A total of 13 sensitive mammal species (i.e., endangered, threatened, or CSC) have the potential to be present at the Site (Table 3-8). Of these sensitive mammals, eight species have been observed during past or recent surveys: Stephens' kangaroo rat (*Dipodomys stephensi*), San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), pallid bat (*Antrozous pallidus*), pocketed free-tailed bat (*Nyctinomops femerosaccus*), small-footed myotis (*Myotis ciliolabrum*), western mastiff bat (*Eumops perotis*), western red bat (*Lasiurus blossevillii*), and Yuma myotis (*Myotis yumanensis*) (Table 3-7).

The Stephens' kangaroo rat (FE, ST) has been live trapped and its burrows have been observed in a number of areas at the Site. The Stephens' kangaroo rat occurs in areas with disturbed annual grassland and other early successional plant communities, including near the burn pits in Operational Area C. This species prefers open areas with sparse perennial cover, and loose soil with a depth of at least 0.5 meter. It will also use burrows of other animals such as pocket gophers and the California ground squirrel. Overall, the Stephens' kangaroo rat has been observed in Operational Areas A, B, C, D, F, G, H, and other areas of the Site (Table 3-7). The San Bernardino kangaroo rat (*Dipodomys merriami parvus*) (FE, CSC), although potentially present, has not been observed at the Site. The San Diego black-tailed jackrabbit (CSC) has been observed only in Operational Area C. Several of the 6 special status bat species observed at the Site have been sighted or captured in Operational Area F (Table 3-7).

3.3.3 Sensitive Habitats

Sensitive habitats at the Site consist of habitats or plant communities that are unique, of relatively limited distribution, of particular value to wildlife, or provide habitat linkages or wildlife corridors. Sensitive habitats at the Site also include areas which may support the special-status Stephens' kangaroo rat, which has been observed at the Site; and the San Bernardino kangaroo rat (*Dipodomys merriami parvus*) and coastal California gnatcatcher (*Polioptila californica*), which have the potential to be present at the Site. Such habitats and native plant communities found on Site include coastal sage scrub, chamise chaparral, mixed chaparral, scrub oak chaparral, grasslands, riparian scrub, woodland, and forest.

3.4 Identification of Potential Ecological Receptors

As it is impractical to evaluate all ecological receptors at a site, this SERA evaluates potential exposures to representative ecological receptors at the Site. Representative ecological receptors will be used subsequently to infer the potential for adverse impacts to taxonomically and functionally related species.

Using the information presented above (see Section 3.3), representative ecological receptor groups were selected to fulfill as many of the following criteria as possible:

- Species that have been observed or are potentially present at the Site;
- Species that are likely to be maximally exposed to the COPECs;
- Species that are known to play an integral role in the ecological community structure at the Site; and
- Species that are representative of specific foraging guilds or serve as food items for higher trophic levels.

The representative ecological receptor groups selected for the Site are:

- Terrestrial plants (i.e., herbaceous plants, shrubs, and trees);
- Emergent plants (i.e., associated with sediments in riparian or aquatic habitats);
- Terrestrial invertebrates;

Table 3-8
Special Status Animals Potentially Present within Areas of Concern

Common Name	Scientific Name	Status	Observed Onsite
Plants			
Gambel's water cress	*Rorippa gambelii*	SE, FE	No
San Jacinto Valley crownscale	*Atriplex coronata* var. *notatior*	FE	No
Santa Ana River woolly star	*Eriastrum densifolium* ssp. *sanctorum*	SE, FE	No
Slender-horned spineflower	*Dodecahema leptoceras*	FE, SE	No
Invertebrates			
Vernal pool fairy shrimp	*Branchinecta lynchii*	FT	No
Riverside fairy shrimp	*Streptocephalus woottoni*	FE	No
Amphibians			
Arroyo toad	*Bufo microscaphus californicus*	FE, CSC	No
Western spadefoot	*Spea hammondii*	CSC	Yes
Reptiles			
Coast patch-nosed snake	*Salvadora hexalepis virgultea*	CSC	No
Coronado island skink	*Eumeces skiltonianus interparietalis*	CSC	No
Northern red-diamond rattlesnake	*Crotalus ruber ruber*	CSC	Yes
Orange-throated whiptail	*Aspidoscelis hyperythra beldingi*	CSC	Yes
San Diego (coast) horned lizard	*Phrynosoma coronatum blainvillii*	CSC	Yes
Silvery legless lizard	*Anniela pulchra pulchra*	CSC	Yes
Two-striped garter snake	*Thamnophis hammondi*	CSC	No
Birds			
American peregrine falcon	*Falco peregrinus anatum*	SE	Yes
American white pelican	*Pelecanus erythrorhynchos*	CSC	No
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*	SE	No
Bell's sage sparrow	*Amphispiza belli belli*	CSC	No
Bryant's savannah sparrow	*Passerculus sandwichensis alaudinus*	CSC	No
Burrowing owl	*Athene cunicularia*	CSC	No
Coastal California gnatcatcher	*Polioptila californica*	CSC, FT	No
Cooper's hawk (nesting)	*Accipiter cooperii*	CSC	Yes
Ferruginous hawk	*Buteo regalis*	CSC	Yes
Golden eagle (nesting & wintering)	*Aquila chrysaetos*	CSC	Yes
Large-billed savannah sparrow	*Passerculus sandwichensis rostratus*	CSC	No
Least Bell's vireo	*Vireo bellii pusillus*	FE, SE	Yes
Loggerhead shrike	*Lanius ludovicianus*	CSC	Yes
Long-eared owl (nesting)	*Asio otus*	CSC	Yes
Northern harrier	*Circus cyaneus*	CSC	Yes
Olive-sided flycatcher	*Contopus cooperi*	CSC	Yes
Sharp-shinned hawk (nesting)	*Accipiter striatus*	CSC	Yes
Short-eared owl (nesting)	*Asio flammeus*	CSC	No
Song sparrow	*Melospiza meolodia*	CSC	Yes
Southern California rufous-crowned sparrow	*Aimophila ruficeps canescens*	CSC	No
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE, SE	Yes
Swainson's hawk	*Buteo swainsoni*	ST	No
Tricolored blackbird	*Agelaius tricolor*	CSC	Yes

Definitions:
CSC: California Species of Special Concern
FE: Federally endangered
FT: Federally threatened
SE: California State endangered
ST: California State Threatened

- Terrestrial invertebrates;
- Benthic invertebrates (i.e., insects and other invertebrates associated with sediments in aquatic habitats);
- Aquatic biota (i.e.., free-floating aquatic plants and invertebrates in the water column of aquatic habitats);
- Amphibians;
- Reptiles;
- Herbivorous birds;
- Insectivorous birds;
- Omnivorous birds;
- Carnivorous birds and raptors;
- Small herbivorous mammals;
- Small insectivorous mammals;
- Large herbivorous mammals; and
- Carnivorous mammals.

The plant species comprising terrestrial plants and their known or potential occurrence in specific AOCs are shown in Table 3-3. The animal species comprising each of the receptor groups given above, and their known or potential occurrence in AOCs, are provided in Table 3-4 to Table 3-7.

All of the terrestrial plant and animal receptor groups listed above are expected to occur in all terrestrial AOCs. It is notable that the Stephens' kangaroo rat has been observed in all AOCs except Operational Area I, where it is potentially present. Adult amphibians also may occur in all terrestrial AOCs. Receptors associated with aquatic habitats (i.e., emergent plants, benthic invertebrates, aquatic biota, and the larval life stages of amphibians) are likely restricted to creeks and ponds in AOCs identified for surface water and sediments (Figure 2-3).

3.5 Land Use and Resource Management

Except for the ongoing soil and groundwater investigations performed under the supervision of the DTSC, the portion of the Site owned by LMC is inactive. As part of the groundwater investigation activities, quarterly groundwater and surface water monitoring events are conducted at the Site. The CDFG operates its portion of the Site as a state wildlife park and nature preserve.

4.0 PATHWAY ASSESSMENT

A pathway assessment was conducted to evaluate the potential for ecological receptors at the Site to be exposed to the COPECs identified in soils, soil gas, groundwater, surface water, and sediments at the Site. An exposure pathway is considered potentially complete if all of the following elements are present:

- A source and mechanism of COPEC release to the environment (e.g., soil, water, tissue)
- A point or area where receptors of concern may be exposed to COPECs, and
- An exposure route through which COPEC uptake occurs (e.g., ingestion, inhalation, or dermal contact).

Potential exposure pathways are qualitatively evaluated in a SERA to determine whether or not they are complete.

A conceptual site model (CSM) was developed that identifies the sources of the releases, the impacted media, the transport mechanisms, the potential receptors, and the exposure pathways at the Site (Figure 4-1). Food web relationships among potential receptors (e.g., plants, herbivores, and carnivores) are shown in Figure 4-2. This generalized food web is applicable to all terrestrial AOCs at the Site.

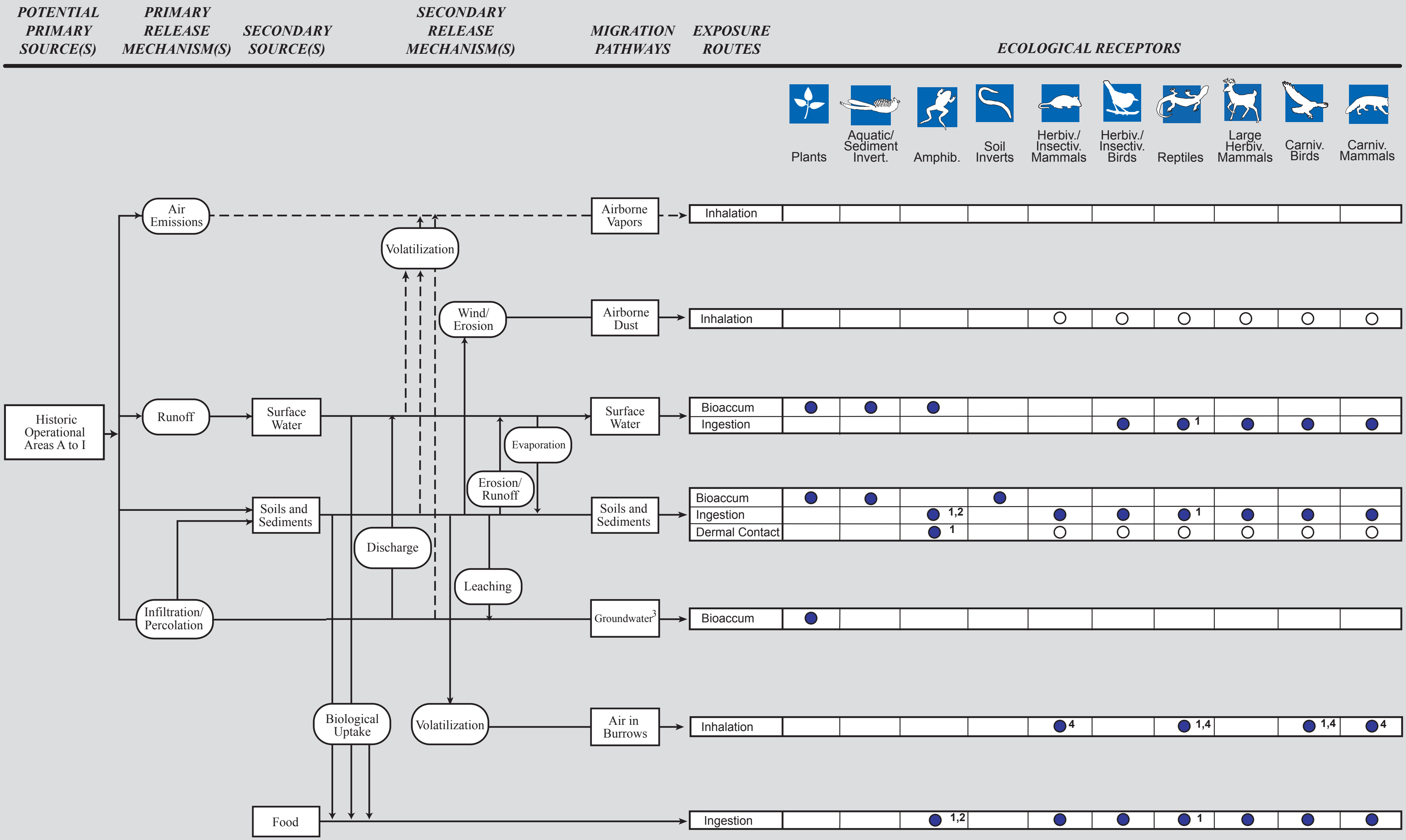
Off-site transport of contaminated soil or water is also considered when evaluating potentially complete exposure pathways. Off-site transport refers to any contaminants occurring in (1) surface soil that can travel off-site as windblown dust, (2) surface water runoff via surface flow or in creek channels, or (3) groundwater less than 25 feet below the surface.

4.1 Exposure Pathways

The exposure pathways considered in this SERA include:

4.1.1 Soil

- Uptake of COPECs in soil by plants and soil invertebrates;
- Incidental ingestion of COPECs in soils by terrestrial wildlife; and
- Dermal absorption of COPECs in soils by terrestrial wildlife.



Legend

——→	Potentially complete exposure pathway
– – – →	Potentially incomplete exposure pathway
– – ✕ – →	Incomplete exposure pathway
●	Potentially complete exposure route
○	Potentially complete exposure route but insignificant and not evaluated

1 Not evaluated quantitatively
2 Ingestion by adult frogs
3 Shallow groundwater (less than 25 feet bgs)
4 Evaluated for burrowing animals only

Figure 4-1
Conceptual Site Model for Ecological Receptors.

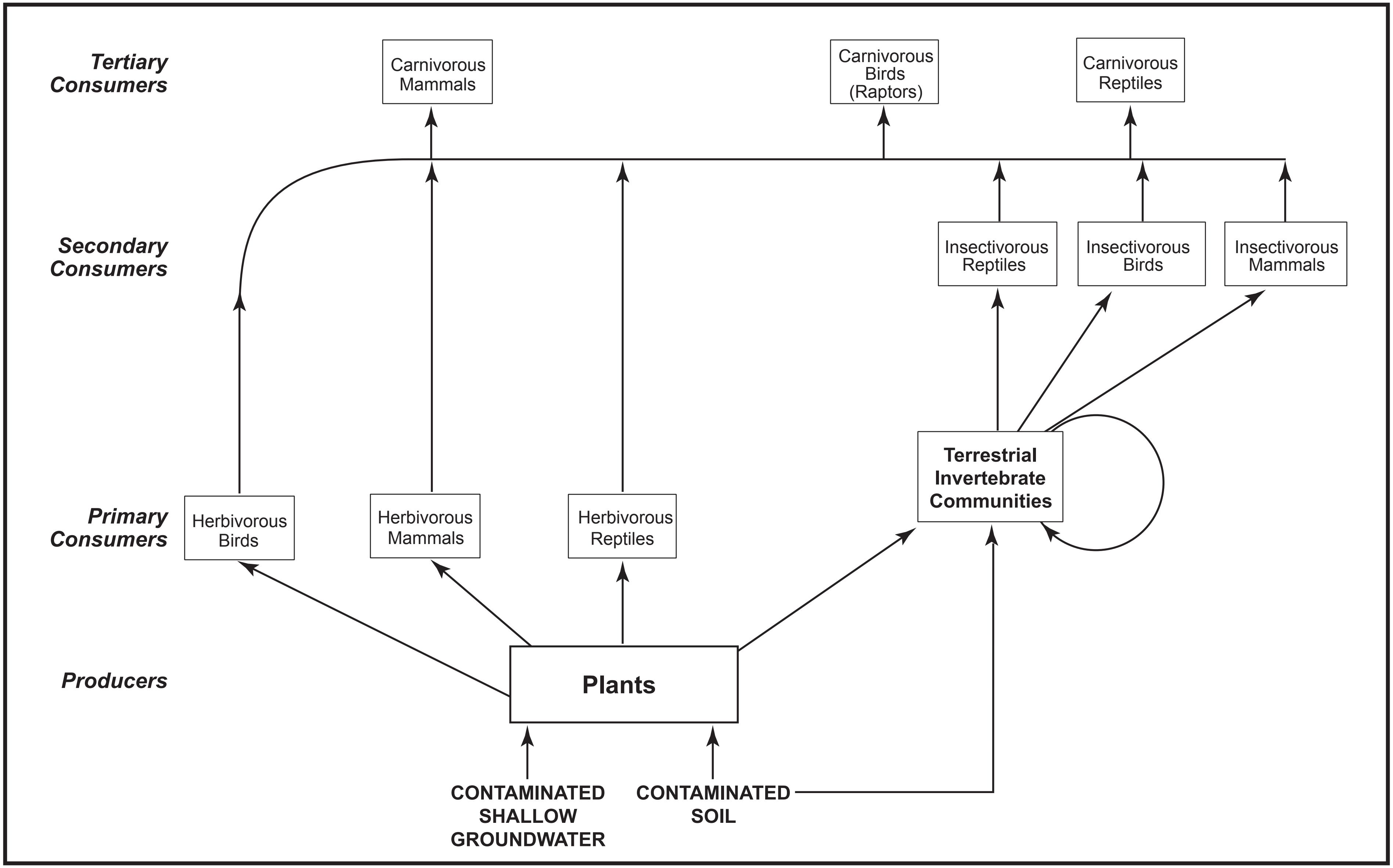


Figure 4-2
Simplified Food Web for Grassland, Scrubs, Chamise/Chaparral, and Riparian Habitats

4.1.2 Air

- Inhalation of volatile COPECs in burrows by burrowing animals;
- Inhalation of volatile COPECs in ambient air by wildlife; and
- Inhalation of COPECs in dusts by wildlife.

4.1.3 Groundwater

- Uptake of COPECs in shallow groundwater (i.e., less than 25 feet bgs) by plants.

4.1.4 Surface Water

- Uptake of COPECs in surface water by free-floating aquatic plants, aquatic invertebrates, and amphibians; and
- Ingestion of COPECs in surface water by terrestrial wildlife.

4.1.5 Sediment

- Uptake of COPECs in sediments by emergent plants and benthic invertebrates;
- Incidental ingestion of COPECs in sediments by amphibians; and
- Dermal absorption of COPECs in sediments by amphibians.

4.1.6 Food Items

- Ingestion of bioaccumulated COPECs in food items by wildlife.

Each potential exposure pathway is discussed below.

4.2 Potentially Complete Exposure Pathways

The information presented in Sections 2 and 3 is used below to determine which exposure pathways are complete and which are incomplete. This evaluation is presented below and is summarized for the receptor groups at the Site in Figure 4-1.

4.2.1 Soils

COPECs were identified in soils at the Site at relatively shallow depths where terrestrial receptors may contact them (Table 2-9). This depth interval includes the rooting zone of terrestrial plants; therefore, terrestrial plants may take up contaminants from the soil via their roots. Terrestrial invertebrates burrow in the soils at these depths and may be exposed to COPECs via direct ingestion or absorption. Additionally, wildlife (both burrowing and non-burrowing) may be exposed to COPECs in soils by direct ingestion.

The dermal exposure route is considered potentially complete for burrowing animals, as they are in close contact with soils most of their lives. Although dermal contact may be a potentially complete exposure route for burrowing animals, it is likely a relatively minor exposure route for most because:

- Dense undercoats or down could significantly reduce the total surface area of exposed skin (Peterle 1991; U.S. Army Corps of Engineers [U.S. ACE] 1996);
- Results of exposure studies indicate that exposures to many COPECs such as metals, VOCs, and SVOCs due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (Peterle 1991); and
- Grooming removes some particulates from fur and feathers. Incidental soil ingestion incorporates exposures from grooming.

Dermal absorption of soil COPECs by adult spadefoot toads aestivating in burrows is a potentially complete exposure route. For non-burrowing wildlife, dermal absorption from soils is considered to be insignificant (USEPA 2003) and is assumed to be an incomplete exposure route.

4.2.2 Groundwater

Shallow groundwater is defined as groundwater occurring at depths of less than 25 feet bgs, which approximates the depth that is accessible to the roots of deep-rooted trees and shrubs including those in riparian habitat. The minimum depths to groundwater range from 23.59 to 0.56 feet bgs within Operational Areas B, F, G, and in the north Potrero Creek area (Table 2-5). At some locations (e.g., along Potrero Creek in Operational Area F and in the north Potrero Creek area), groundwater occurs at or just below the ground surface at certain times of the year. Thus, uptake of COPECs from groundwater into plants (e.g., deep-rooted trees and shrubs) is a potentially complete exposure pathway.

4.2.3 Surface water

Surface water at the Site ranges from ephemeral stormwater along drainages to long-standing or perennial surface water in creeks, ponds, and seeps. Surface water was grouped into the following AOCs of relevance to ecological receptors: Ephemeral Ponds, Ephemeral Creeks, Groundwater Discharge Pond, and Potrero Creek (see Section 2.3.10). Potentially complete exposure pathways include uptake of COPECs in surface water by free-floating aquatic plants, aquatic invertebrates, and amphibians in these aquatic habitats. Ingestion of COPECs in surface water by terrestrial wildlife is also a potentially complete pathway. The temporal duration of surface water in each AOC will be considered in evaluating risks to each receptor group in the PERA.

4.2.4 Sediment

Sediments at the Site are present in ephemeral ponds and creeks, as well as in long-standing or perennial creeks, ponds, and seeps. As with surface water, sediments are categorized into four AOCs: Ephemeral Ponds, Ephemeral Creeks, Groundwater Discharge Pond, and Potrero Creek (see Section 2.3.10). Uptake of COPECs in sediments by emergent plants and benthic invertebrates in these aquatic habitats are considered a potentially complete pathway. The approximate amount of time each year that sediments are wet in a given AOC will be considered in evaluating risks to emergent plants and benthic invertebrates in the PERA. Additionally, wildlife including amphibians may be exposed to COPECs through incidental ingestion of sediments. Amphibians may also be exposed to COPECs through dermal absorption from sediments.

4.2.5 Air

Volatile COPECs were detected in soil gas at five AOCs (Table 2-10). Volatile COPECs may be emitted to the atmosphere, as well as accumulate in animal burrows. Inhalation of volatile COPECs in the atmosphere is not considered a complete pathway for non-burrowing species because volatile COPECs are expected to disperse rapidly above the ground surface following release from soil gas. However, because of the confined air spaces in underground burrows, vapors of volatile COPECs may not be readily dispersed, and volatile COPECs in burrows could be inhaled by burrowing mammals. Therefore, the inhalation exposure route is potentially complete for burrowing animals exposed to volatile COPECs within their burrows. The burrowing depths of receptors will be considered in evaluating depth-specific exposures in the PERA.

Non-volatile COPECs in soils may become entrained in the atmosphere as dusts via wind erosion. However, the respirable fraction of airborne dust is believed to be a relatively insignificant portion of the total risk (Carlsen 1996). Therefore, inhalation of dust is considered a potentially complete but insignificant pathway for wildlife.

4.2.6 Food Items

Uptake is defined as the absorption and retention of chemicals by organisms (e.g., plants, soil invertebrates) from the surrounding medium. Biological uptake of COPECs in soils by soil invertebrates and plants results in COPECs in food items, a secondary source for higher level consumers (Figure 4-1). Plants utilize roots to perform uptake and retention of water and nutrients in soil as well as chemicals in soils. Bioaccumulation is defined as the uptake or transfer of a chemical into plant or animal tissues. Bioaccumulation can occur as uptake from abiotic media (e.g., soil, sediment), but also can occur via exposures through the food chain.

Bioaccumulation of COPECs in plant or invertebrate tissues is a potential source of exposure for the herbivorous or insectivorous animals that ingest them. Likewise, bioaccumulation may occur in other prey including small mammals due to their ingestion of COPECs in plant tissues, soil invertebrate tissues, and soils. Bioaccumulation of COPECs in prey tissues such as those of small mammals is a potential source of exposure for higher-level carnivorous birds and mammals that ingest them.

4.3 Complete Exposure Pathway Summary

As a result of the evaluations presented above, the following exposure pathways are considered to be potentially complete at the Site:

4.3.1 Soil

- Uptake of COPECs in soil by plants and soil invertebrates;
- Incidental ingestion of COPECs in soils by terrestrial wildlife; and
- Dermal absorption of COPECs in soils by burrowing wildlife.

4.3.2 Groundwater

- Uptake of COPECs in shallow groundwater (i.e., less than 25 feet bgs) by plants.

4.3.3 Surface Water

- Uptake of COPECs in surface water by free-floating aquatic plants, aquatic invertebrates, and amphibians; and
- Ingestion of COPECs in surface water by terrestrial wildlife.

4.3.4 Sediment

- Uptake of COPECs in sediments by emergent plants and benthic invertebrates;
- Incidental ingestion of COPECs in sediments by amphibians; and
- Dermal absorption of COPECs in sediments by amphibians.

4.3.5 Air

- Inhalation of volatile COPECs in burrows by burrowing animals.

4.3.6 Food Items

- Ingestion of bioaccumulated COPECs in food items by wildlife.

This evaluation is also summarized in Figure 4-1.

Trophic level interactions among potential receptors (e.g., plants, herbivores, insectivores, and carnivores) are shown in Figure 4-2. This generalized food web is applicable to all terrestrial AOCs at the Site. Bioaccumulation of COPECs into plants and terrestrial invertebrates and trophic transfer of COPECs to higher level consumers (e.g., small mammals) are key components of the conceptual site model and ecological exposure pathways discussed above.

5.0 SCOPING ECOLOGICAL RISK ASSESSMENTS FOR SITE 1

This investigation has found that there are COPECs in soil, groundwater, surface water, sediment, and soil gas at the Site, ecological receptors are present in these areas, and that the ecological receptors in 1 or more AOCs at the Site may be exposed to the COPECs. Therefore, it is recommended that a PERA be performed for all AOCs at the Site.

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