412th Test Wing
Civil Engineer Division
Environmental Management
Edwards Air Force Base, California

Environmental Assessment for the Air Force Research Laboratory Security Fence Project

Final

November 2012

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
26 NOV 2012	**Final**	**02 SEP 2011 - 30 NOV 2012**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Environmental Assessment For the Air Force Research Laboratory Security Fence Project Edwards AFB, CA	**W9128F-11-D-0014**
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) **Mary E. McKinnon/Principal Environmental Analyst**	5d. PROJECT NUMBER **EIAP Control No. 10-0706**
	5e. TASK NUMBER **0002**
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Tetra Tech 301 East Vanderbilt Way, Suite 450 San Bernardino, CA 92408**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) **412 Test Wing Civil Engineer Division Environmental Management Branch 5 East Popson Avenue Edwards AFB, California 93524-8060**	10. SPONSOR/MONITOR'S ACRONYM(S) **412 TW/CEV**
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
CA: Air Force Test Center, Edwards AFB, California, The original document contains color images.

14. ABSTRACT
This EA evaluates the potential environmental impacts associated with the installation of a security fence around the boundary of the AFRL facility at Edwards AFB, California. The security fence would consist primarily of vehicle barrier cable fencing with manual vehicle access gates. Additionally, the security fence would include surveillance and detection equipment at key locations to properly monitor the perimeter.

15. SUBJECT TERMS
Air Force Research Laboratory Security Fence Project, Edwards Air Force Base Environmental Assessment

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**170**	

FINDING OF NO SIGNIFICANT IMPACT

AIR FORCE RESEARCH LABORATORY SECURITY FENCE PROJECT EDWARDS AIR FORCE BASE, CALIFORNIA

Pursuant to provisions of the National Environmental Policy Act (NEPA) of 1969, 42 United States Code (USC) 4321 to 4270d, implementing Council on Environmental Quality (CEQ) Regulations, 40 Code of Federal Regulations (CFR) 1500-1508, and United States Air Force Instruction (AFI) 32-7061, The *Environmental Impact Analysis Process* (EIAP), as codified by 32 CFR Part 989, the U.S. Air Force (Air Force) assessed the potential environmental consequences associated with installing a security fence around the Air Force Research Laboratory (AFRL) facility at Edwards Air Force Base (AFB), California.

The security fence is needed to enhance the security of the facilities at the AFRL at Edwards AFB. Currently, the facility is susceptible to theft from the public gaining unauthorized vehicle access to Edwards AFB and, ultimately, gaining access to the AFRL facilities. The project proponent at Edwards AFB is the Security Forces Squadron (412 SFS).

The Environmental Assessment (EA), incorporated by reference into this finding, analyzes the potential environmental consequences of activities associated with installing the security fence and provides environmental protection measures to avoid or reduce adverse environmental impacts. The EA considers all potential impacts of Alternative A (Proposed Action), Alternative B (All Chain Link Fence Alternative), and the No-Action Alternative.

ALTERNATIVE A (PROPOSED ACTION)

The Proposed Action (Alternative A) would be to install an 18-mile vehicle barrier cable fence around the AFRL facility at Edwards AFB that provides for the required level of security while avoiding impacts to significant cultural and natural (biological) resources. The fence layout was also selected to minimize new road construction and eliminate access to potentially hazardous areas. The fence would include manual vehicle access gates as well as surveillance and detection equipment at key locations to properly monitor the perimeter. The Proposed Action supports the Air Force goal of better protecting equipment and resources at the AFRL. Installation of the fencing would enable AFRL managers to better protect valuable assets under their control.

to avoid impacts related to cultural resources, biological resources, hazardous materials and hazardous waste, and public safety and emergency services are provided in Appendix A. Appendix A also provides information on who would be responsible for fulfilling the requirements and the timing for implementation of the measures.

In addition, the Air Force has concluded that no adverse cumulative impacts would result from activities associated with Alternative A (Proposed Action) and Alternative B (All Chain Link Fence Alternative) because there are no known projects that would contribute to cumulative impacts in the area.

FINDING OF NO SIGNIFICANT IMPACT

Based on my review of the facts and analyses contained in the attached EA, conducted under the provisions of NEPA, CEQ regulations, and 32 CFR Part 989, I conclude that Alternative A (Proposed Action) would not have a significant environmental impact at Edwards AFB. Accordingly, an Environmental Impact Statement is not required. The signing of this Finding of No Significant Impact completes the environmental impact process.

Background information that supports the research and development of this FONSI and the EA are on file at Edwards AFB and may be obtained by contacting:

412 TW/PA
Attn: Mr. Gary Hatch
305 East Popson Avenue
Edwards AFB, CA 93524-8060
(661) 277-8707

James E. Judkins

JAMES E. JUDKINS, NH-IV
Base Civil Engineer

26 Nov 12
Date

EXECUTIVE SUMMARY

1.0 INTRODUCTION

This EA evaluates the potential environmental impacts associated with the installation of a security fence around the boundary of the AFRL facility at Edwards AFB, California. The security fence would consist primarily of vehicle barrier cable fencing with manual vehicle access gates. Additionally, the security fence would include surveillance and detection equipment at key locations to properly monitor the perimeter.

This EA was prepared in accordance with all applicable federal, state and local laws and regulations including NEPA, as amended (42 USC 4321 *et seq*.); the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500–1508); and AFI 32-7061, *The Environmental Impact Analysis Process (EIAP)*, as codified in 32 CFR Part 989. The 412th Test Wing (TW) is representing the Department of Defense (DoD) as the lead agency.

2.0 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The project proponent is 412 SFS. The purpose of the Proposed Action is to install a new security fence around the AFRL facility at Edwards AFB to protect equipment and resources there. The AFRL mission at Edwards AFB is to develop air and space vehicle propulsion and power technologies. Areas where turbine and rocket engines and propulsion systems are tested contain valuable materials. Portions of the AFRL facilities are fenced but the entire facility is not.

The Proposed Action is needed to enhance the security of the facilities at the AFRL at Edwards AFB. Currently, the facility is susceptible to theft from the public gaining unauthorized vehicle access to Edwards AFB and, ultimately, gaining access to the AFRL facilities.

3.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

The Proposed Action (Alternative A) would be to install an 18-mile vehicle barrier cable fence around the AFRL facility at Edwards AFB that provides for the required level of security while avoiding impacts to significant environmental resources. Installation of the fencing would provide managers at the AFRL with a better ability to protect valuable assets under their control.

Under the All Chain Link Fence Alternative (Alternative B), the boundary fence would consist entirely of chain link, rather than primarily of the vehicle barrier cable fence. While this would make it more difficult

for unauthorized pedestrian access, it would not preclude unauthorized vehicles from forcibly gaining access through a chain link fence. This fence would follow the same configuration as for the Proposed Action and, therefore, would also be sited to avoid significant environmental resources. While this fence could be a barrier to the movement of some wildlife, including desert tortoise, it would include some design features to allow for relatively unrestricted movement of desert tortoise. This would include either raising the bottom of the chain link to 18 inches off the ground or creating a three-foot wide gap in the fence approximately every 0.25 mile.

Under the No-Action Alternative (Alternative C), the vehicle barrier cable fence and other security features and surveillance equipment would not be installed. The existing fencing at the AFRL, which does not enclose the entire facility, would remain as is. As a result, unauthorized access to valuable resources at the AFRL would still be possible.

4.0 SUMMARY OF ENVIRONMENTAL IMPACTS AND ENVIRONMENTAL PROTECTION MEASURES

The analysis indicates that none of the impacts individually or collectively would be significant. Measures to protect the various resource areas have been incorporated into the description of each action alternative and environmental protection measures have been included to further address any potential effects on the environment. A brief summary of project impacts and environmental protection measures are provided here. The specific environmental protection measures identified here are provided in the appropriate resources sections of the EA and are compiled in Appendix A.

- **Air Quality.** Air quality impacts associated with the project are related to emissions that would occur during construction and subsequent operation of the security fence. Construction would result in temporary, minor emissions from fugitive dust and vehicles associated with construction. Operation of the project and all alternatives would not contribute any emissions that could adversely impact the air quality in the region or harm human health. The completion of the fence would not lead to an increase in installation traffic or security patrols, nor would the action result in associated mobile or stationary air emissions sources. Thus, the long-term contribution of air emissions for this project and its alternatives would be negligible.
- **Cultural Resources.** As a result of the Proposed Action, some ground would be disturbed in areas within the Area of Potential Effect (APE) of known archaeological resources, some unevaluated. The entire APE for the Proposed Action has been previously surveyed and the layout of the proposed 18-mile security fence and the improvement of (or creation of) the 10-foot

wide dirt road that would be constructed next to the fence have been sited to avoid known sensitive cultural resources.

The Section 106 process will be completed and documented consistent with the provisions of the Programmatic Agreement (PA) in order to avoid adverse effects on historic properties (Edwards Air Force Base 2009). However, impacts could still occur during the construction and operation of the Proposed Action on cultural resources within the APE from destruction or alteration of an unknown cultural resources site from construction activities or at the staging and stockpile areas of the Proposed Action as well as from underground installation of ground sensors for cameras and monitoring systems.

Through completion of the Section 106 process and implementation of the environmental protection measures, significant impacts on cultural resources are not anticipated as a result of this project.

***Environmental Protection Measure CR-1*:** The avoidance measures listed below are found in Section 2.4 *Treatment of Archaeological Properties*, Avoidance Measures, in the PA (Edwards Air Force Base 2009):

- All vehicles are required to stay on established roads or within an established training area;
- Unauthorized collection of archaeological materials is prohibited;
- Unauthorized digging is prohibited;
- Archaeological sites in high-use or high-risk areas are posted with archaeological site protection signage;
- Where historic properties may or may not be at risk of inadvertent effect by an undertaking, Edwards AFB will provide for archaeological monitoring of ground-disturbing activities;
- Edwards AFB has determined that inadvertent site disturbances from vehicles and other ground-disturbing activities are more likely to occur along road corridors and in other high-use areas; and

- In order to avoid potential adverse effects from vehicles and other ground-disturbing activities, Edwards AFB shall continue to implement the site protection strategy of protective signage of archaeological sites on Edwards AFB.

***Environmental Protection Measure CR-2*:** Edwards AFB cultural resources staff shall determine the scope of the archaeological monitoring program before any project-related soil-disturbing activities begin and shall determine what project activities shall be monitored. The monitor shall be a qualified archaeologist who meets the professional requirements under the Secretary of the Interior's standards and will conduct the following activities:

- The archaeological monitor shall train all project construction personnel who could reasonably be expected to encounter archaeological resources how to identify the evidence of the expected resources and the appropriate protocol in the event of apparent discovery of an archaeological resource;

- The archaeological monitor(s) shall be present on the project site according to a schedule agreed on by the Edwards AFB cultural resources staff; and

- The archaeological monitor shall record and be authorized to collect soil samples and artifactual/ecofactual material as warranted for analysis.

***Environmental Protection Measure CR-3**:* Although much of the APE for the Proposed Action has been surveyed for the presence of cultural resources and the new fence would be routed mostly along existing roads and fences so that known cultural resources are avoided, there is the possibility that unknown subsurface archaeological sites are located within the APE. The monitor should be present for all excavations within high site probability areas and be available in the event that unanticipated discoveries are made during construction. If, during the performance of the undertaking, historic properties are discovered or unanticipated effects are found, the procedures in Section 2.5 of the PA *Inadvertent Discoveries and Emergencies* shall be followed. These are:

- The activity will be immediately stopped in the vicinity of the discovery and the Base Historic Preservation Officer (BHPO) will be immediately notified;

- Contractors and authorized agents at Edwards AFB are also required to stop work in the vicinity of any discovered archaeological deposits and immediately contact the BHPO and await for review by the BHPO and direction from the Installation Commander or Base Civil Engineer; and

- Excavations in the area of the discovery must remain halted until a qualified archaeologist who meets the professional requirements under the Secretary of the Interior's standards can determine the nature, extent and age of the archaeological deposit. Excavations outside of the find location may proceed with continued monitoring.

- **Geology and Soils.** Construction and operation of the proposed security fence and surveillance equipment would not expose structures or facilities suitable for occupation to potential geologic hazards associated with the region. A seismic event and potential damage to the fence would not likely cause injury or death. No adverse geologic or seismic effects would occur.

  Soils found in the AFRL area are sandy in texture and, as a result, are susceptible to wind erosion. Construction of the security fence, surveillance equipment and road improvements have the potential to increase soil erosion in the area. However, the total area to be disturbed during construction is expected to be minimal. In addition, only small amounts of area would be exposed at one time, thereby reducing impacts. As a result, no adverse effects to soils or from soils would result from construction of the fence. There would be no impacts associated with operation of the fence and associated surveillance equipment.

- **Hazardous Materials and Hazardous Waste.** Construction of the proposed fence, surveillance equipment and road improvements would require use of minor amounts of hazardous materials such as fuels and lubricants for construction equipment. The selected construction crew would require the use and storage of hazardous materials. The Proposed Action would generate minimal wastes during construction and there would be a limited amount of hazardous materials stored or used on site during construction. Storage of these materials during construction would be likely in an identified area near the project. Hazardous materials necessary for project implementation that require temporary storage within the AFRL and any hazardous waste generated will be stored and managed in compliance with AFI 32-7042, *Waste Management*, and any other Edwards AFB requirements.

Construction of the Proposed Action fence and security features and surveillance equipment would not mobilize existing contaminants associated with Operable Unit (OU) 4 and OU9 sites found within the AFRL in groundwater or soil, or expose workers to contaminated soils or groundwater at levels in excess of those permitted by federal and state law. The fence configuration has been designed to allow access to Environmental Restoration Program (ERP) wells. No impacts to existing ERP wells would occur.

To ensure worker safety within the AFRL, the following environmental protection measure will be implemented:

Environmental Protection Measure HAZ-1: Prior to construction activities, a health and safety plan in compliance with 29 CFR 1910.120 will be prepared and approved by Edwards AFB. All construction workers used for installation of the fence, security features and surveillance equipment will have received 40-hour Hazardous Waste Operations and Emergency Response Standards (HAZWOPER) training and be current with 8-hour refresher training. The site-specific health and safety plan will address all site-specific safety and environmental hazards that have the potential to be encountered during construction and installation of the fence, including physical hazards, biological hazards, and general safety hazards. Any training required by construction personnel will be identified.

- **Infrastructure.** Construction of the proposed security fence would require a negligible amount of gasoline or diesel to power the construction equipment. During the lifetime of the fence, a negligible amount of electricity would be needed for the security cameras and other surveillance equipment. Neither of these would result in a significant impact to energy resources at Edwards AFB.

  Construction of the proposed security fence and associated road improvements would result in a small, temporary increase in water use for dust control. This would not result in a significant increase in water demand at Edwards AFB. No water would be needed for the operation and use of the fence during its lifetime.

  Construction and operation of the proposed security fence would not result in any increased use of the wastewater or stormwater systems at Edwards AFB.

Construction of the proposed security fence would not result in any increased use of the communication system at Edwards AFB. Once the fence is constructed, the proposed surveillance system would include camera and fiber cable installation, and communication connectivity with the 412 SFS Emergency Control Center (ECC). The planning and installation of the surveillance equipment would need to be coordinated with the Communications Squadron. This is not considered a significant impact.

- **Natural Resources.** For the purposes of this analysis, all ground disturbance activity is considered a permanent impact as a result of the long time period for natural revegetation to occur in the desert. Temporary impacts were assumed to be areas where vegetation might be driven over a limited number of times during the installation of the fence, but not removed or the ground surface disturbed. Direct impacts on vegetation include disruption, trampling, or removal of rooted vegetation resulting in a reduction in the total acres of native vegetation, or the direct injury or death of individual plants or animals. Indirect impacts occur later in time or are farther removed in distance while still being reasonably foreseeable and related to the project. Potential indirect impacts include introduction of invasive species that compete with native species and can result in habitat degradation.

  Construction of the fence would result in the removal of approximately 5.4 acres of native vegetation communities as a result of permanent and temporary disturbance during construction activities. Of the 5.4 acres, 2.2 acres would result in permanent disturbance, which would count towards the 16-acre habitat loss allowed under the existing Programmatic Biological Opinion (BO) for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (1-8-97-F-10) (United States Fish and Wildlife Service 1997). To date, 3.5 acres have been disturbed. With the additional 2.2 acres required for this project, total allowed disturbance would be 5.7 acres, leaving 10.3 acres for other projects. None of these effects represent a substantial portion of any vegetation community, either on Edwards AFB, or regionally. This impact is expected to be less than significant and requires no avoidance and minimization measures. Indirect impacts that may result from the removal of this vegetation include the increased potential for the spread of non-native invasive plant species. This impact is not expected to be significant with the incorporation of avoidance and the following environmental protection (minimization) measures. These measures include those in the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-1: Provide a worker environmental awareness program (WEAP) to all individuals that will be working on the project in the field (United States Fish and Wildlife Service 1997; Edwards Air Force Base 2008). This program will consist of videos, brochures and briefings and will include information on:

- The role of biological monitors and authority of monitors to stop work;
- Locally known invasive weeds and limiting weed spread and colonization;
- The Migratory Bird Treaty Act (MBTA) and nest avoidance measures;
- Desert cymopterus, Mojave spineflower and Barstow woolly sunflower;
- Desert tortoise history in the project area, desert tortoise ecology, threats to the species, and the protection measures described here and in the BO (United States Fish and Wildlife Service 1997);
- Mohave ground squirrel history in the project area, ecology and the avoidance and minimization measures described in this section for this species;
- Other sensitive species that may be found throughout the construction of the project and the avoidance and minimization measures described in this section for these species; and
- Locations and designations of critical habitat and Desert Wildlife Management Area (DWMA) in the project area.

All personnel will sign a statement that they have received, understand and will follow the regulations and protection measures presented in the program. Copies of signed statements will be on file at the Environmental Management Office. This measure fulfills or exceeds the requirements of Terms and Conditions A.1 in the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-2: Wash all vehicles and equipment prior to bringing them on site if they have been used in areas off base.

Environmental Protection Measure BIO-3: All project-related construction activities will be conducted during daylight hours. If any activities are to disturb native habitat between dusk and dawn, they shall be limited to areas which have already been cleared of desert tortoises by biological monitors and enclosed by a fence to exclude desert tortoises (United States Fish and Wildlife Service 1997). This measure fulfills or exceeds the requirements of Terms and Conditions A.2 of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-4: Ensure that qualified biological monitors are present during all construction-related activities to confirm that compliance with all minimization measures for biological resources is being implemented. These measures include:

- Biological monitors will be available during site development activities which may result in injury or mortality of desert tortoises. The 412 TW/CEV designated biologist will determine which activities require biological monitoring.

- Any desert tortoises found during construction-related activities will be relocated to nearby safe areas, not more than 100 meters from the point of capture. When the area is considered safe, desert tortoises will be returned to their point of capture.

- When handling desert tortoises, the qualified biologists and environmental monitors will follow the procedures described in *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996).

- Only qualified biologists, as defined by the United States Fish and Wildlife Service (USFWS) and the 412 TW/CEV designated biologist will conduct preconstruction surveys for desert tortoises and remove animals from work areas to nearby suitable habitat.

This measure fulfills the requirements of Terms and Conditions C.1, C.2, C.3 and C.4 of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-5: Limit disturbance areas during fence installation to the minimum needed to perform activities. During construction, activity areas will be clearly fenced, marked and flagged at the outer boundaries to define the limits of work areas. All workers will be instructed to confine their activities to the marked areas (United States Fish and Wildlife

Service 1997). This measure fulfills the requirements of Terms of Conditions B of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-6: Laydown, parking and staging areas will be restricted to previously disturbed areas to the maximum extent practicable (United States Fish and Wildlife Service 1997). This measure fulfills Terms of Conditions D.1 of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-7: Vehicles will, to the maximum extent practicable, remain on established roads. Equipment and vehicle operators will be alert for desert tortoises and other wildlife in and along access routes. When traveling off-road, speed limits will not exceed 5 miles per hour and shrubs will be avoided as much as possible.

Environmental Protection Measure BIO-8: All personnel on the site will check under parked vehicles and equipment for desert tortoises and other wildlife species before moving vehicles. If a desert tortoise is discovered under a parked vehicle, an authorized biologist shall relocate the animal to a nearby, safe location. The authorized biologist shall use his or her best professional judgement to ensure that desert tortoises moved in this manner are not subjected to temperature extremes which could result in injury or death. Alternatively, the vehicle shall be left in place until the desert tortoise moves of its own volition (United States Fish and Wildlife Service 1997). This measure fulfills Terms and Conditions A.3 of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-9: All trash will be placed in closed and covered containers for proper disposal to reduce its attractiveness to desert tortoise predators (e.g., coyotes and common ravens). The containers must not be able to be opened by predators and must be emptied regularly to ensure adequate capacity is maintained (United States Fish and Wildlife Service 1997). This measure fulfills or exceeds Terms and Conditions E of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-10*:* If common raven presence increases locally as a result of the proposed project, perch deterrents will be placed on structures that are supporting perching.

Environmental Protection Measure BIO-11: Pre-construction surveys will be conducted by the biological monitor immediately in front of all equipment. During these surveys, the biological monitor will identify the following resources and complete the following activities:

- Identify active nests that fall under the MBTA, and flag an avoidance area for each nest at a minimum of 50 meters from the nest;

- Identify potential desert tortoise burrows and flag for avoidance, if possible, at a minimum distance of 10 meters to avoid any activities affecting the burrow or any individuals underground. If avoidance of desert tortoise burrows is not possible, individual burrows will be scoped to determine if there is an animal underground. If no tortoise is using the burrow, the burrow will be excavated according to *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996); and

- Avoid the desert tortoise. However, if avoidance is not possible, individuals found aboveground within the project area will be temporarily moved out of harm's way by an authorized biologist according to the USFWS *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996). Desert tortoises shall not be released more than 100 meters from the point of capture (United States Fish and Wildlife Service 1997).

- **Public Safety and Emergency Services.** During construction of the fence, workers may be exposed to existing safety and environmental hazards at the AFRL, including physical hazards such as noise, heat, or cold; biological hazards such as poisonous snakes and scorpions; and general safety hazards such as Environmental Restoration Program (ERP) sites, unexploded ordnance (UXO), and range-related issues.

  Construction of the fence could change current traffic patterns in the AFRL area by restricting access to certain roads although gates would be erected at each major road crossing (three existing and eight new gates). No significant impact to traffic patterns would occur.

  The overall safety to the general public should be improved with this project because unauthorized access to the AFRL should be greatly reduced with completion of the fence. This

would keep the public out of a sensitive area of Edwards AFB and would help to prevent the theft of materials and equipment from the AFRL.

In addition to the public health and safety plan identified in Environmental Protection Measure HAZ-1 from Section 4.4 to ensure worker safety within the AFRL, the following environmental protection measure will be implemented: .

Environmental Protection Measure PS-1*:* Prior to any construction activities, all construction personnel shall complete any training required by Edwards AFB including UXO training, range training and environmental worker awareness training.

- **Water Resources.** No perennial streams or dry lakebeds are located within the project area. The proposed fence project would not affect the wastewater treatment plant (WWTP) ponds located on the AFRL. No impacts to groundwater or surface water resources would occur from the Proposed Project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This EA evaluates the potential environmental impacts associated with the installation of a security fence around the boundary of the AFRL facility at Edwards AFB, California. The security fence would consist primarily of vehicle barrier cable fencing with manual vehicle access gates. Additionally, the security fence would include surveillance and detection equipment at key locations to properly monitor the perimeter.

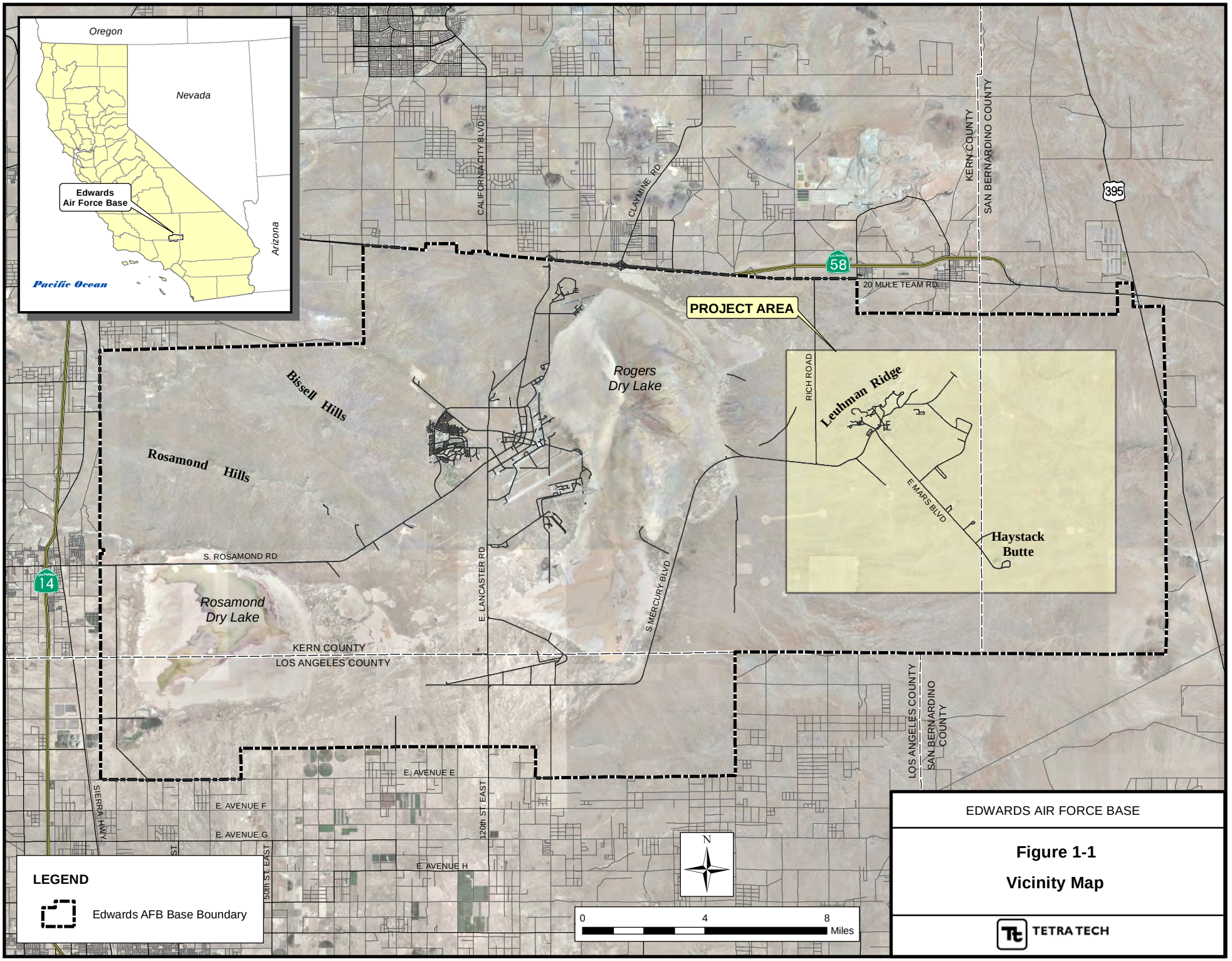
This EA was prepared in accordance with all applicable federal, state and local laws and regulations including NEPA, as amended (42 USC 4321 *et seq*.); the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500–1508); and AFI 32-7061, *The Environmental Impact Analysis Process (EIAP)*, as codified in 32 CFR Part 989. The 412th TW is representing the DoD as the lead agency.

1.2 LOCATION OF PROPOSED ACTION

The Proposed Action would occur on Edwards AFB which is located in the Antelope Valley region of the western Mojave Desert in Southern California, about 60 miles northeast of Los Angeles, California. Portions of Edwards AFB lie within Kern, Los Angeles and San Bernardino counties. Edwards AFB occupies an area of approximately 307,517 acres or 470 square miles and consists of largely undeveloped or semi-improved land that is used predominantly for aircraft test ranges and maintained and unmaintained landing sites (i.e., dry lake beds). The AFRL facility lies within the eastern portion of Edwards AFB situated near and along Leuhman Ridge in the eastern portion of Edwards AFB, covering approximately 10,365 acres (Figure 1-1).

Edwards AFB is bounded by State Highways 14 to the west, 58 to the north, and 395 to the east, with county road Avenue E near the southern boundary of Edwards AFB. The developed portion of Edwards AFB includes approximately six percent of the total Base area and is concentrated on the west side of Rogers Dry Lake and includes North Base, South Base, Main Base and Family Housing areas. In addition, the AFRL, formerly Phillips Laboratory, includes a small developed area primarily used for administration, engineering and testing related to rocket and propellant research.

X:\GIS\EAFB-AFRL\Vicinity.mxd



EDWARDS AIR FORCE BASE

Figure 1-1

Vicinity Map

TETRA TECH

Elevations on Edwards AFB range from approximately 2,270 to 3,404 feet (692 to 1,038 meters) above mean sea level (MSL) with the lowest elevations found in the two major dry lakebeds, Rogers and Rosamond Dry Lakes. Higher elevation areas are found along ridges in the Rosamond and Bissell Hills in the northwest area of Edwards AFB, along Leuhman Ridge in the northeast, and Haystack Butte in the southeast.

1.3 BACKGROUND

The AFRL, with headquarters at Wright-Patterson AFB, Ohio, was created in October 1997. The laboratory was formed through the consolidation of four former Air Force laboratories and the Air Force Office of Scientific Research. The laboratory and its predecessors have overseen more than 80 years of critical research efforts for the Air Force and the DoD. Its technology breakthroughs can be found in all of today's modern aircraft and weapons systems, including the F-117 stealth fighter, B-2 bomber, C-17 airlifter and the F-22 fighter. It has contributed to significant advancements in modern communications, electronics, manufacturing and medical research and products.

The AFRL's mission is leading the discovery, development, and integration of affordable warfighting technologies for America's aerospace forces. It is a full-spectrum laboratory, responsible for planning and executing the Air Force' science and technology program. The AFRL leads a worldwide government, industry and academia partnership in the discovery, development and delivery of a wide range of revolutionary technology. The laboratory provides leading-edge warfighting capabilities keeping our air, space and cyberspace forces the world's best.

Nationwide, the lab employs approximately 5,800 government employees, including about 1,400 military and 4,400 civilian personnel. It is responsible for the Air Force's science and technology budget of nearly $2 billion including: basic research, applied research, advanced technology development and an additional $1.7 billion from AFRL customers.

The AFRL accomplishes its mission through nine technology directorates located throughout the United States, the Air Force Office of Scientific Research and a central staff at Headquarters AFRL. The research facility at Edwards AFB, which is part of the Propulsion Directorate, develops air and space vehicle propulsion and power technologies. Focus areas include turbine and rocket engines, advanced propulsion systems and the associated fuels and propellants for all propulsion systems. The directorate is also responsible for most forms of power technology making it one of the nation's leaders in its field. Programs address both future systems and the need to keep current systems competitive, safe, affordable

and effective. The directorate has contributed technology to more than 130 military and commercial systems.

While portions of Edwards AFB and the AFRL are fenced, members of the public can still gain access to Edwards AFB and the AFRL either on foot or in a vehicle. Unauthorized vehicle access on to AFRL property has resulted in thefts of equipment and materials at the AFRL facility. The current fence is not adequate to prevent unauthorized access and thefts.

1.4 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The project proponent is the 412 SFS. The purpose of the Proposed Action is to install a new security fence around the AFRL facility at Edwards AFB to protect equipment and resources there. The AFRL mission at Edwards AFB is to develop air and space vehicle propulsion and power technologies. Areas where turbine and rocket engines and propulsion systems are tested contain valuable materials. Portions of the AFRL facilities are fenced but the entire facility is not.

The Proposed Action is needed to enhance the security of the facilities at the AFRL at Edwards AFB. Currently, the facility is susceptible to theft from the public gaining unauthorized vehicle access to Edwards AFB and, ultimately, gaining access to the AFRL facilities.

The AFRL is a one of a kind national asset with research capabilities vital to national defense. The AFRL assets include irreplaceable and extremely high dollar value research and test infrastructure along with toxic industrial chemicals/materials and explosives storage. While physically located within the confines of Edwards AFB boundaries, the AFRL is not located behind an installation gate and is open to civilian (public) access. Furthermore, the ability of the installation security forces to protect the AFRL is extremely limited. Based on a standardized AFI 31-101 (*The Physical Security Program*) level of security, 412 SFS is not allocated any manpower to protect the AFRL, leaving nearly all security to be conducted by owner/user personnel. The unique attributes of the AFRL require additional consideration (United States Air Force 2008c).

1.5 ISSUES AND CONCERNS CONSIDERED

During the scoping process, the following issues and concerns were identified as requiring assessment when considering the potential environmental impacts of the alternatives.

- Air Quality. Temporary, minor air pollutant emissions (primarily dust) would be generated during construction of the fence.
- Cultural Resources. Cultural resources could be impacted during construction and operation of the fence.
- Geology and Soils. Construction of the fence and access road improvements would require minor disturbances of soils in the area.
- Hazardous Materials and Waste. Construction of the fence would require the use of minor amounts of hazardous materials and would generate only negligible amounts of hazardous waste. The AFRL contains a number of hazardous waste sites and environmental monitoring wells that would be avoided as part of the project.
- Infrastructure. Installation of the fence would require minor amounts of water for construction and could affect traffic flow in the AFRL area by restricting access in some areas where it is not currently restricted. Gates would be installed at major road crossings.
- Natural Resources. Potential impacts to natural habitat may result during construction of the fence. Potential direct impacts to wildlife may include impacts on the desert tortoise (federal and state listed as threatened) and Mohave ground squirrel (state listed threatened) and the plant communities that support these species.
- Public Safety and Emergency Services. Construction of the fence would protect materials at the AFRL from theft and would prevent the public from gaining unauthorized access to the site, thereby eliminating public safety/security concerns. Erecting a fence could change current traffic patterns in the AFRL area by restricting access to certain roads although new gates would be erected at each major road crossing.
- Socioeconomics. Construction of the security fence would generate a small number of temporary jobs.
- Water Resources. Construction of the fence would require a small amount of water for dust suppression during construction.

1.6 ISSUES AND CONCERNS DISCUSSED BUT NOT CONSIDERED RELEVANT FOR FURTHER ANALYSIS

The following issues and concerns were initially considered, but subsequently eliminated from analysis in this EA because they are not applicable to this project. Consequently, they will not be addressed in Chapters 3 and 4.

- Airspace. The proposed fencing project would not have any effect on the management or use of the airspace at Edwards AFB or the surrounding area.
- Environmental Justice and Protection of Children. The Executive Orders (EOs) on Environmental Justice and the protection of children require federal agencies to identify and address disproportionately high adverse effects of their activities on minority and low-income populations and children. The proposed activities discussed in this EA were reviewed against EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and EO 13045, *Protection of Children from Environmental Health and Safety Risks*. Given that the renovation/construction activities would occur entirely on Edwards AFB and that there are no minority or low-income populations or children within the project's area of potential effect, the Air Force has determined that this action would have no substantial, disproportionate impacts on minority and low-income populations and/or children.
- Land Use. The fencing project would not change land use at the AFRL or on the Base.
- Noise. Construction of the fence would not result in any noise impacts to sensitive receptors.

1.7 OTHER FUTURE ACTIONS IN THE REGION

Other actions within the region were evaluated to determine whether cumulative environmental impacts could result from implementation of the Proposed Action and Alternatives. Cumulative impacts result from "the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

No other actions within the geographic region of the AFRL facility are anticipated that would have the potential for cumulative effects (Robert Edwards, electronic communication, 2012). In addition, because the proposed fencing project would not change the mission or activities at the AFRL, nor would the fence affect other activities in the area, no cumulative impacts are expected.

1.8 STRUCTURE OF THIS ENVIRONMENTAL ASSESSMENT

This EA analyzes and describes the potential environmental impacts that could result from the Proposed Action and Alternatives. As appropriate, the environmental consequences of the actions are presented in terms of regional and site-specific descriptions.

Chapter 2.0 of this EA describes the Proposed Action and Alternatives, including the No-Action Alternative. In addition to providing project information, this section describes the general parameters associated with the Proposed Action.

Chapter 3.0 provides regional and site-specific information related to air quality, biological resources, cultural resources, geology and soils, infrastructure, public safety and water quality. The regional information included in this section provides the background for understanding the context of the site-specific information that could affect or be affected by the Proposed Action.

Chapter 4.0 addresses the potential effects of the Proposed Action on the resource areas analyzed. Possible impacts of project activities are analyzed, the significance of each impact is identified in each resource area, and environmental protection measures, if required, are so stated.

Chapters 5.0 through 8.0 identify, respectively, report references, persons and agencies that were contacted, preparers, and a list of acronyms and abbreviations used in this EA.

Appendix A contains a table summarizing the environmental protection measures needed for this project; Appendix B contains the relevant BO to be used for the project, and Appendix C includes the Air Quality Calculations used for the air quality analysis.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action and Alternatives, including the No-Action Alternative. The potential environmental impacts for each alternative are summarized in table form at the end of this chapter. The location for the Proposed Action and Alternatives is within the AFRL area of Edwards AFB (Figure 2-1). Figure 2-1 shows the location of the AFRL boundary at Edwards AFB, the AFRL signage perimeter (a boundary marked by signs, rather than fencing), the existing AFRL fence and the proposed AFRL fence.

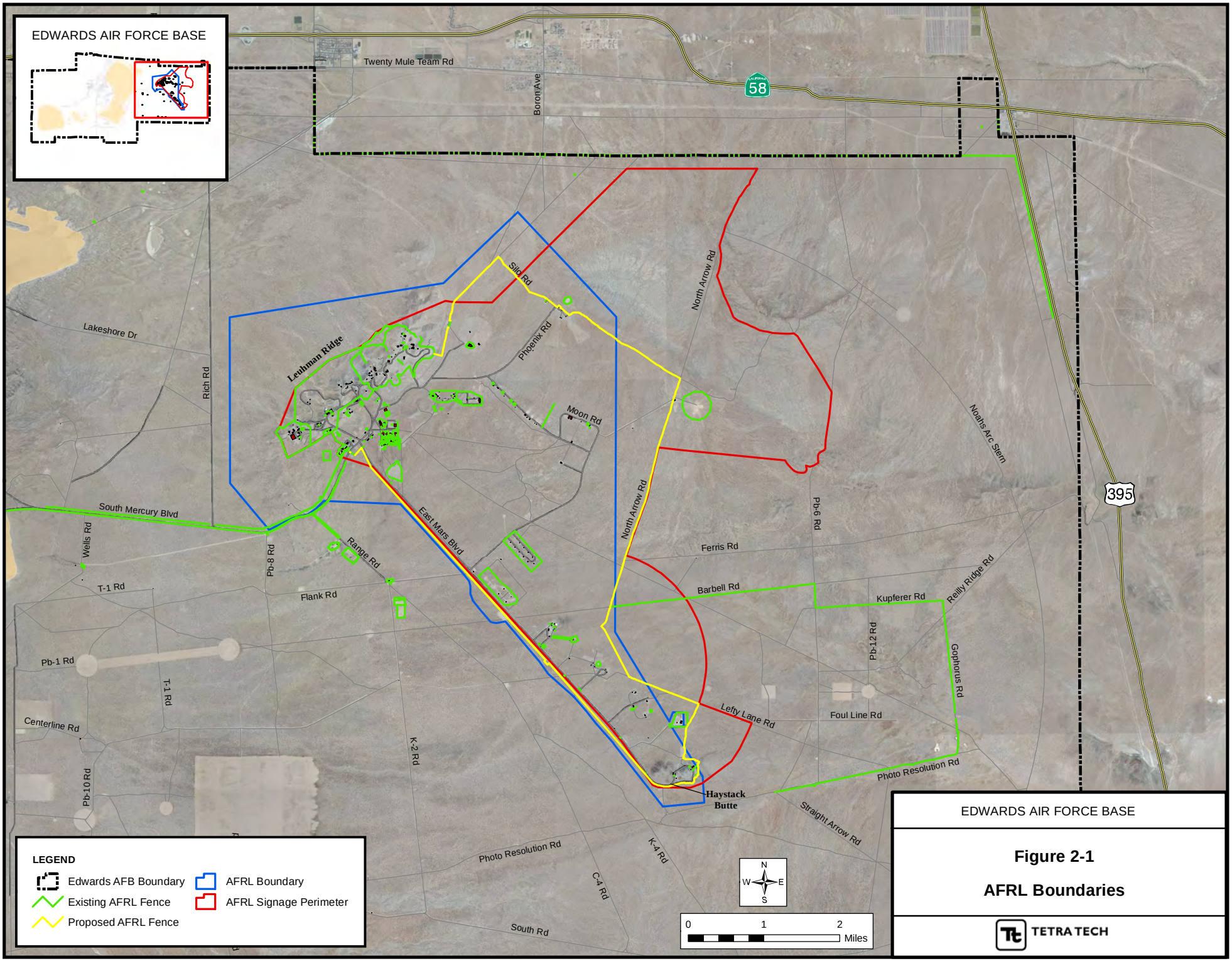
2.1 PROPOSED ACTION (ALTERNATIVE A)

Alternative A, the Proposed Action Alternative, is to install vehicle barrier cable fence around the AFRL facility at Edwards AFB that would provide for the required level of security while avoiding impacts to significant environmental resources. Installation of the fencing would provide managers at the AFRL with a better ability to protect valuable assets under their control. If the alignment changes at a later date, additional reviews may be required under NEPA and the federal Endangered Species Act (ESA).

The fencing would entail installation of 2-inch by 3-inch rectangular steel posts approximately 3 to 4 feet deep, spaced approximately 10 to 15 feet apart, with strands of steel cable strung between the posts, comprising the fence. The final design of the fence has not been determined; however, it is being designed to prevent vehicles from crashing through the fence while also avoiding posing a barrier to desert tortoise and other wildlife movement through the area. The bottom strand of steel cable would need to be 18 inches off the ground to allow for wildlife movement.

The new fence, estimated to be approximately 18 miles in length, would tie into portions of existing chain link fencing to create a 100 percent enclosed perimeter around key facilities at the AFRL (Figure 2-2). Some segments of the boundary would not have fencing because natural terrain barriers exist. Barrier cable connections would be welded to preclude disconnection by would-be intruders. Existing chain link fence, posts, outriggers and gates around site boundary would be repaired. Chain link fencing would be installed into the arroyos on northeast ridge below existing chain link fencing. This would be installed to close large gaps in the fence but would leave enough space to ensure that debris can escape below the fence and be washed down the arroyo. Chain link fencing would be installed to comply with requirements of AFI 31-101, The Physical Security Program, and specifications would be provided to the fence contractor. Eight new manual, double vehicle gates (approximately 20 to 30 feet wide) would be installed at various locations along the boundary to permit Range Squadron access,

X:\GIS\EAFB-AFRL\AFRL Boundaries.mxd



EDWARDS AIR FORCE BASE

Figure 2-1

AFRL Boundaries

TETRA TECH

X:\GIS\EAFB-AFRL\AFRL Prop_Road_Access.mxd

AFRL Test Area 1-100

Double vehicle gate for access to Test Area 1-100

Silo Rd

North Arrow Rd

Noahs Arc Stern

AFRL Test Area 1-90

Phoenix Rd

Leuhman Ridge

Double vehicle gate for access to 1-36D Burn Pit

1-36D Burn Pit

Moon Rd

AFRL Main Entrance Gate

Fenceline without road access: (0.13 miles)

Rich Rd

East Mars Blvd

Range Rd

Pb-8 Rd

Double vehicle gate for Range Squadron access

Flank Rd

Double vehicle gate for Range Squadron access to East PIRA

Ferris Rd

Barbell Rd

Kupferer Rd

Fence to be modified for Monitoring Well (125-MW10)

Fence to be modified for Monitoring Well (125-MW05)

Test Area 1-46

Fenceline without road access: (0.86 miles)

Pb-12 Rd

Double vehicle gate for Range Squadron access

X-33 Site

Lefty Lane Rd

Foul Line Rd

K-2 Rd

Haystack Butte

Vehicle gate for access to EM monitoring wells

Fenceline without road access: (0.30 miles)

Vehicle gate for emergency egress point from AFRL

Photo Resolution Rd

Pb-6 Rd

LEGEND

- Existing Vehicle Gate
- Proposed Vehicle Gate
- Arroyos
- Proposed Camera Location
- Proposed AFRL Fence
- Existing AFRL Fence
- Areas Without Existing Road Access

N

0 2,000 4,000 Feet

EDWARDS AIR FORCE BASE

Figure 2-2

Proposed Action

TETRA TECH

Environmental Management (EM) monitoring wells access, Civil Engineering (CE) access and emergency escape route exits. There are three existing vehicle gates that would become part of the overall boundary fence.

An approximately ten-foot wide dirt road would be created next to, and outside of, the new fence. This road would be used for fence line perimeter inspections and must be wide enough for one vehicle to travel on. In many areas, existing trails and dirt roads would be used and may need to be widened; new roads would be needed in some locations where no road exists. Construction of the road would involve scraping the existing dirt/vegetation alongside the new fence. The Air Force is not planning to pave the road or mow along the edge of the road. Staging and stockpile areas have not been identified yet but would be placed on existing paved areas or dirt areas that have already been disturbed. No new lighting would be installed on the fencing.

Appropriate surveillance equipment to thoroughly monitor perimeter of site would be installed. This would include unattended ground sensors (UGS), cameras, and monitoring systems to include fiber, notification equipment, etc. UGS locations, fiber locations and junction points are to be determined. Proposed camera locations are shown on Figure 2-2. Due to the need for fiber installation and other communication connectivity, the planning and installation of the surveillance equipment would be coordinated with the Communications Squadron.

High resolution cameras at Haystack Butte, west of Test Area 1-120, Test Area 1-125 peak and Test Area 1-36D, would be installed to view the fence line. A camera at 1-42 restricted area would be integrated into the boundary surveillance system. Cameras for this project must be compatible with cameras being installed at the restricted areas and the reporting system at the 412 SFS ECC. Equipment must be compatible with that recommended by the 642nd Electronics System Squadron for the AFRL restricted areas.

The fence layout was modified to avoid sensitive cultural resources, thereby allowing the project to be consistent with the existing PA between Edwards AFB and the SHPO (Edwards Air Force Base 2009). The fence layout was also configured to avoid contaminated sites while allowing access to environmental monitoring wells in the project area. In addition, the fence would be installed to minimize or avoid impacts to sensitive biological resources, including the desert tortoise, Mohave ground squirrel and desert cymopterus. During construction, biological monitors and construction crews may alter the fence line slightly to ensure animal movement and avoidance of resources. All appropriate terms and conditions

from the existing Programmatic BO for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (United States Fish and Wildlife Service 1997) would be included as part of the project.

In addition, "Controlled Area" signage would need to be installed or relocated at the appropriate interval and locations on the new perimeter fencing. "Clear Zone" signs would be created and installed on existing sign posts on the east side of the AFRL site. All required informational/directional signage required for new fencing and vehicle/personnel routes would be installed.

2.2 ALL CHAIN LINK FENCE ALTERNATIVE (ALTERNATIVE B)

Under the all chain link fence alternative, the boundary fence would consist entirely of chain link, rather than primarily of the vehicle barrier cable fence. It would be a standard chain link fence, approximately 6 feet tall, with posts set in concrete every 10 to 12 feet. While this would make it more difficult for unauthorized pedestrian access, it would not preclude unauthorized vehicles from forcibly gaining access through a chain link fence. This fence would follow the same configuration as for the Proposed Action and, therefore, would be sited to minimize impacts to natural resources, and avoid impacts to cultural resources and contaminated sites. In addition, this fence could be a barrier to the movement of some wildlife, including desert tortoise. As such, it would include some design features to allow for relatively unrestricted movement of desert tortoise. These features would either be to raise the bottom of the chain link to 18 inches off the ground or, more likely, to create a three-foot wide gap in the fence (between two posts) approximately every 0.25 mile.

2.3 NO-ACTION ALTERNATIVE (ALTERNATIVE C)

The CEQ regulations require inclusion of a No-Action alternative in an EA. The No-Action alternative serves as a baseline against which the impacts of the Proposed Action and alternatives can be evaluated.

Under the No-Action Alternative (Alternative C), the vehicle barrier cable fence and other security features and surveillance equipment would not be installed. The existing fencing at the AFRL, which does not enclose the entire facility, would remain as is. As a result, unauthorized access to valuable resources at the AFRL would still be possible with the continued potential for theft, loss of property and valuable one of a kind research. This would be an adverse impact from a security standpoint.

2.4 CRITERIA FOR SELECTION OF A REASONABLE RANGE OF ALTERNATIVES

The criteria identified here establish a minimum set of requirements that must be met in order for an alternative to be considered viable. Those alternatives not meeting one or more of the selection criteria have been eliminated from further discussion. The reason(s) why each was eliminated is/are discussed in Section 2.5. Alternatives meeting all selection criteria are retained and each is fully analyzed in Chapter 4 (Environmental Consequences) of this EA.

The criteria used to select the alternatives discussed in this document are described below. They address the need to protect the equipment and resources at the AFRL facility from unauthorized vehicle access while protecting or avoiding environmental resources in the area. Selection criteria have been separated into three categories: technical criteria which address Air Force security requirements; environmental criteria which address environmental considerations in the project area; and operational criteria which address operational considerations for the fence. A viable alternative would meet most, if not all, of these criteria.

Technical Criteria

1. Enhance security requirements, as identified in two memorandums regarding development of a Detachment 7 Security Plan (United States Air Force 2008c, 2009)

2. Adhere to the requirements of AFI 31-101, the Physical Security Program

Environmental Criteria

1. Minimize impacts to federally-listed species

2. Minimize loss of desert tortoise critical habitat

3. Keep total native habitat loss under the 16 cumulative acres allowed in the existing Programmatic BO for the AFRL (United States Fish and Wildlife Service 1997)

4. Eliminate access to potentially hazardous areas

5. Minimize dust emissions during ground disturbance

6. Avoid sensitive biological and cultural resources

Operational Criteria

1. Eliminate the ability of unauthorized vehicles and personnel to access the AFRL boundary area
2. Fully secure/protect government property
3. Eliminate theft of government property
4. Ensure access to existing monitoring wells
5. Minimize new road construction

2.5 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER CONSIDERATION

Two alternatives were considered but eliminated from consideration: (1) install only sensors and cameras for surveillance around the AFRL boundary perimeter and (2) install security fencing and surveillance sensors and cameras around individual AFRL facilities rather than one boundary fence.

One alternative considered but dismissed included installing only sensors and cameras for surveillance around the AFRL boundary perimeter. This would result in minimal disturbances to the surrounding terrain and habitats. However, it would provide an unacceptable, degraded level of security for priority resources at the AFRL because there would be no physical barrier to prevent intruders from entering the site, especially the east side of the AFRL site. In addition, it would require continuous monitoring of cameras and sensors using more SFS manpower. This alternative would not meet either of the technical selection criteria, nor would it meet environmental selection criteria 3, nor operational selection criteria 1, 2, 3 or 4. Therefore, this alternative was eliminated from further consideration.

Another alternative considered included installing security fencing and sensors and cameras for surveillance around individual AFRL facilities, rather than one boundary fence. This would limit disturbance of desert habitats to within 50 feet of each facility, most likely in previously disturbed areas. Utility drops for sensors and cameras would be installed along existing disturbed utility corridors that currently support each facility. However, this would not restrict infiltration of the AFRL site from the east. This would continue to expose resources to external threats and pilferage and would continue to expose civilians and unauthorized intruders to potentially hazardous operations with no restriction. It may also inhibit the free flow of operating personnel due to security controls at each individual facility. In addition, sensors and cameras around each facility would be costly to install and would require extremely labor intensive continuous monitoring of cameras and sensors using more Security Forces manpower

(Bob Edwards, personal communication, 2012). While this alternative would meet all of the environmental selection criteria, it would not meet either of the technical selection criteria, nor would it meet operational selection criteria 1, 2, or 3. Therefore, this alternative was eliminated from further consideration.

2.6 COMPARISON OF ENVIRONMENTAL IMPACTS

Table 2-1 presents a summary of anticipated environmental impacts for each alternative.

Table 2-1
Anticipated Environmental Impacts for the Affected Environment

Issue	Alternative A Proposed Action	Alternative B All Chain Link Fence	Alternative C No Action
Air Quality	Minor	Minor	None
Cultural Resources	Moderate	Moderate	None
Geology and Soils	Minimal	Minimal	None
Hazardous Waste/Hazardous Materials	Minimal	Minimal	None
Infrastructure	Minimal	Minimal	None
Natural Resources	Moderate	Moderate	None
Public Safety/Emergency Services	Minor	Minor	Moderate
Socioeconomics	Beneficial	Beneficial	None
Water Resources	Minimal	Minimal	None
Cumulative Impacts	None	None	None

Notes: **None:** There are no impacts expected.
Beneficial: The impacts are expected to be beneficial.
Minimal: The impacts are not expected to be measurable, or are measurable but are within the capacity of the impacted system to absorb the change, or the impacts can be compensated for with little effort and resources so the impact is not substantial.
Minor: The impacts are measurable, but are within the capacity of the impacted system to absorb the change, or the impacts can be compensated for with little effort and resources so the impact is not adverse.
Moderate: Potentially adverse impacts that are measurable, but do not violate any laws or regulations and are within the capacity of the impacted system to absorb the change, or the impacts can be mitigated with effort and resources so that they are not significant.
Major: Those environmental impacts that individually or cumulatively could be significant. No major environmental impacts are expected to result from the Proposed Action or alternative action.

2.7 ENVIRONMENTAL PROTECTION MEASURES

The analysis indicates that none of the impacts individually or collectively would be significant. Some measures to protect the various resource areas have been incorporated into the description of each action alternative, and other environmental protection measures have been identified to further address any potential effects on the environment. These measures are found in various resource sections in Chapter

4.0 of this EA and are compiled in Section 4.0 of the Executive Summary. In addition, a table summarizing the environmental protection measures, as well as information on who would be responsible for fulfilling the requirements and the timing for implementation of the measures, is provided in Appendix A.

3.0 AFFECTED ENVIRONMENT

This chapter describes existing environmental conditions likely to be affected by the Proposed Action and Alternatives, including the No-Action Alternative. It provides the baseline information that was used to identify and evaluate potential environmental changes resulting from the construction and operation of the proposed security fence. Resources identified that may be affected by the project include: air quality and greenhouse gases, cultural resources, geology and soils, hazardous waste and hazardous materials, infrastructure, natural resources, socioeconomics, public safety and emergency services and water resources.

3.1 AIR QUALITY AND GREENHOUSE GASES

3.1.1 Climate

Hot summers, cool winters, low rainfall, large diurnal ranges in temperature and abundant sunshine characterize the climate at Edwards AFB. The arid climate of the region is mainly due to rain shadow effects of the Sierra Nevada and San Gabriel Mountains; the prevailing westerly winds deposit most of their moisture on the western slopes of these mountain ranges. Data collected at Edwards AFB from 1979 to 1989 are used to describe the climate of the project region (Edwards Air Force Base 2006).

The dominant weather feature in the project region is the Eastern Pacific high-pressure system. This system is most prevalent during the summer, when it occupies a northern position over the Pacific Ocean. Concurrent with the presence of high pressure, a low-level, thermal low-pressure system persists over the desert regions due to intense surface heating. The relative strengths and positions of the high-pressure system and the interior thermal trough are largely responsible for the general climatic conditions of the region.

During the winter, the Eastern Pacific high-pressure system weakens and moves southward, allowing polar storm systems to migrate through the region. Although the systems that reach the region have dried out considerably after traversing the elevated terrain to the west, they are responsible for most of the annual precipitation in the area. The average annual precipitation at Edwards AFB is 4.9 inches. Rainfall during the summer usually occurs from thunderstorms. Moisture from these storms originates from tropical air masses that move into the region from the south-southeast. Snow can occur in the region, although the average total is only about 2 inches per year.

The annual average temperature at Edwards AFB is 62 degrees Fahrenheit (°F). Daily mean high and low temperatures for January are 57° F and 31° F, respectively. Daily mean high and low temperatures for July are 98° F and 66° F, respectively. Extreme temperatures that occurred during the 10-year monitoring period ranged from 4° F to 113° F.

The combination of the Eastern Pacific high-pressure system over the Pacific Ocean and the thermal low over the interior desert produces a prevailing southwest wind in the region. Strong winds occur during the spring and summer, when the pressure gradient between the offshore Pacific High and the interior thermal trough is the greatest. However, extreme wind gusts can also occur with thunderstorms. Calm conditions increase during the fall and winter, when cold continental air replaces the thermal low and produces weak pressure gradients.

3.1.2 Air Quality

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere and is typically expressed in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). By comparing a pollutant concentration in the atmosphere to federal and/or state ambient air quality standards, the significance of its presence can be determined. These standards represent the maximum allowable atmospheric concentrations that may occur while still protecting public health and welfare with a reasonable margin of safety. The federal standards are established by the U.S. Environmental Protection Agency (USEPA) and are termed the National Ambient Air Quality Standards (NAAQS). The NAAQS are defined as maximum acceptable ground-level concentrations that may not be exceeded more than once per year, with the exception of annual standards that may never be exceeded. These standards include concentrations for ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$) and lead. The California Air Resources Board (CARB) has established state standards termed the California Ambient Air Quality Standards (CAAQS). The CAAQS are at least as restrictive as the NAAQS and include pollutants for which there are no national standards. The national and state ambient air quality standards are shown in Table 3-1.

The pollutants considered in the impact analysis of this EA include volatile organic compounds (VOCs), ozone, CO, NO_2, SO_2 and PM_{10}. Conformity guidelines do not present threshold levels for $PM_{2.5}$ and only known negligible sources of lead (Pb) are associated with the proposed project; therefore, $PM_{2.5}$ and airborne emissions of Pb are not considered in this EA.

Table 3-1
National and California Ambient Air Quality Standards

Pollutant	Average Time	California Standards	National Standards[a]	
			Primary[b]	Secondary[c]
Ozone	1-hour 8-hour	0.09 ppm 0.07 ppm	--- 0.075 ppm	--- 0.075 ppm
Carbon Monoxide	1-hour 8-hour	20 ppm 9.0 ppm	35 ppm 9 ppm	--- ---
Nitrogen Dioxide	1-hour Annual (arithmetic mean)	0.18 ppm 0.03 ppm	0.1 ppm 0.053 ppm	--- 0.053 ppm
Sulfur Dioxide	1-hour 3-hour 24-hour	0.25 ppm --- 0.04 ppm	0.075 ppm --- ---	--- 0.5 ppm ---
PM_{10}	24-hour Annual (arithmetic mean)	50 µg/m^3 20 µg/m^3	150 µg/m^3 ---	150 µg/m^3 ---
$PM_{2.5}$	24-hour Annual (arithmetic mean)	--- 12 µg/m^3	35 µg/m^3 15 µg/m^3	35 µg/m^3 15 µg/m^3
Lead	30-day average Quarterly average	1.5 µg/m^3 ---	--- 0.15 µg/m^3	--- 0.15 µg/m^3

Notes:
a – Other than for ozone and those based upon annual averages, standards are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than 1.
b – Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after the USEPA approves the state's implementation plan.
c – Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the USEPA approves the implementation plan.
USEPA – U.S. Environmental Protection Agency
µg/m^3 – micrograms per cubic meter
mg/m^3 – milligrams per cubic meter
$PM_{2.5}$ – particulate matter equal to or less than 2.5 microns in diameter
PM_{10} – particulate matter equal to or less than 10 microns in diameter
ppm – parts per million
Source: California Air Resources Board Website, 2012 (http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm)
United States Environmental Protection Agency Website, 2012 (http://www.epa.gov/air/criteria.html)

Ozone concentrations are generally highest during the summer and coincide with the period of maximum insolation, or the maximum amount of solar radiation striking the earth's surface. Maximum ozone concentrations tend to be regionally distributed due to the homogeneous dispersion of precursor emissions in the atmosphere. Concentrations of inert pollutants, such as CO, tend to be the greatest during the cooler months of the year and are often a product of light wind conditions and nighttime/early morning surface-based inversions. Maximum inert pollutant concentrations are usually found near an emission source.

Evaluating impacts to air quality in the ROI requires knowledge of: (1) the types of pollutants being emitted, (2) emission rates of the pollutant source, (3) the proximity of project emission sources to other emission sources, (4) topography and (5) local and regional meteorological conditions. The area of effect

for emissions of inert pollutants (pollutants other than ozone and its precursors) is generally limited to a few miles downwind from the source. The area of effect for ozone generally extends much further downwind. In the presence of solar radiation, the maximum effect of precursor emissions on ozone levels usually occurs several hours after their release and, therefore, many miles from the source.

The USEPA designates all areas of the United States as having air quality better than (attainment) or worse than (non-attainment) the NAAQS. The criteria for non-attainment designation vary by pollutant. An area is: (1) in non-attainment for ozone if its NAAQS has been exceeded more than three discontinuous times in three years at a single monitoring station and (2) in non-attainment for any other pollutant if its NAAQS has been exceeded more than once per year. Pollutants in an area are often designated as unclassified when there are insufficient ambient air quality data for the USEPA to form a basis for attainment status. The CARB considers an area to be in non-attainment of a CAAQS for a particular pollutant if: (1) the standards for ozone, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, PM_{10} and visibility reducing particles have been exceeded or (2) the standards for the remaining pollutants have been equaled or exceeded.

Air quality regulations were first promulgated with the federal Clean Air Act (CAA). This Act established the NAAQS and delegated the enforcement of air pollution regulations to the states. In areas where the NAAQS are exceeded, the CAA requires preparation of a State Implementation Plan (SIP) that describes how a state will attain the standards within mandated time frames. The CAA Amendments revised the attainment planning process, basing new requirements and compliance dates for reaching attainment upon the severity of the air quality standard violation.

Federal conformity guidelines included in the CAA Amendments state that a federal agency cannot support an activity unless the agency determines that the activity will conform to the state's most recent SIP approved by the USEPA within the region of the proposed action. These guidelines state that federally supported or funded activities must show that the proposed actions will not: (1) cause or contribute to any new air quality standard violation in any area, (2) interfere with programs outlined in any SIP for maintenance of any standard, (3) increase the frequency or severity of any existing standard violation in any area or (4) delay the timely attainment of any standard or any required interim emission reductions or other milestones in any area. The activities proposed herein are considered exempt from this rule as long as there is no increase in emissions above the *de minimis* levels specified in the rule. Therefore, a screening of this project to determine the applicability of the conformance guidelines must be performed.

The *de minimis* levels for conformity screening specified in 40 CFR Part 93.153 are presented in Table 3.2. If a federal action meets the abovementioned criteria and is not a regionally significant project, it is exempt from further conformity analysis.

Table 3-2
Select Conformity Analysis *De Minimis* Thresholds for Non-Attainment Areas

Pollutant (degree of non-attainment)	Non-Attainment Areas (tons/year)
Ozone (VOCs or NO_x)	
Serious NAA	50
Severe NAA	25
Extreme NAA	10
Other ozone NAAs outside an ozone transport region	100
Other ozone NAAs inside an ozone transport region	50 (VOC), 100 (NO_x)
SO_2 or NO_2 (all NAAs)	100
CO (all NAAs)	100
PM_{10}	
Moderate NAA	100
Serious NAA	70
Lead (all NAAs)	25

Notes: CO – carbon monoxide
NO_x – nitrogen oxides
NO_2 – nitrogen dioxide
SO_2 – sulfur dioxide
VOC – volatile organic compound
NAA – non-attainment area
Thresholds for attainment areas are equal to or higher than those for non-attainment areas.
Source: 40 CFR, Chapter I, Subchapter C, Part 51.853

Areas in attainment with the NAAQS are regulated under the Prevention of Significant Deterioration (PSD) program authorized by the CAA Part C, Sections 160–169. PSD areas require owners and/or operators of new or modified sources to obtain a PSD permit prior to construction of a major source (40 CFR Part 5221) in attainment or unclassified areas. A major source is defined by PSD regulations as being a specific type of source listed by the USEPA that has a potential of emitting 100 tons per year of a regulated pollutant. Potential to emit is based on the maximum design capacity of a source and takes into account pollution control efficiency. If the USEPA does not list a source, it may still be considered major if it has the potential to emit 250 tons per year of a regulated pollutant.

In California, the CARB is responsible for enforcing air pollution regulations. The CARB has, in turn, delegated the responsibility of regulating stationary emission sources to local air agencies. The proposed project area is located in southeastern Kern County and western San Bernardino County, which is part of the Mojave Desert Air Basin (MDAB). The MDAB (and the project area), is currently impacted by

fugitive dust emissions (PM_{10}) and ozone. Table 3-3 presents a summary of attainment status of the project area in California. These data show that the majority of the region is in nonattainment of both state and federal standards for PM_{10} and ozone. As such, the screening process to determine the applicability of the conformity guidelines must be used for these pollutants. The area is in attainment or unclassified for the remaining criteria pollutants including CO, NO_2 and SO_2.

The pollutants considered in the impact analysis of this EA include VOCs, ozone, CO, NO_x, SO_x and PM_{10}. Emission of NO_x and VOCs are of particular concern, as they are precursors to the formation of ozone. The project air emissions must be compared against the applicable thresholds for significance in accordance with the attainment classifications. These *de minimis* thresholds are found in 40 CFR 93.153 and are presented in Table 3-2 above. Because this project would only emit minimal, temporary air pollutants from mobile sources during the construction phase and no permanent point or mobile sources would result from it or any of the alternatives, a direct comparison to the installation emissions inventories was not conducted, nor deemed necessary.

Table 3-3
National/California Ambient Air Quality Standards
Attainment Designations for the Project Area

County	Ozone	CO	NO2	SO2	PM10
Kern/MDAB[(a)]					
National	N	U	U/A	U	N
California	N	U/A	A	A	N
San Bernardino/MDAB[(b)]					
National	N	U/A	U/A	U	N
California	N	A	A	A	N

Notes: Designation status: A=attainment, N=non-attainment, U=unclassified, and U/A=unclassified/attainment.
CO – carbon monoxide
MDAB – Mojave Desert Air Basin
NO_2 – nitrogen dioxide
PM_{10} – particulate matter equal to or less than 10 microns in diameter
SO_2 – sulfur dioxide
Source: California Air Resources Board 2011.

3.1.3 Greenhouse Gas Emissions

The temperature of the earth is regulated by a system commonly known as the "greenhouse effect." Greenhouse gases (GHGs) absorb heat radiated from the earth's surface and as the atmosphere warms, it radiates heat back to the surface to create the greenhouse effect. A GHG is any gas that absorbs infrared

radiation in the atmosphere. In California, Assembly Bill (AB) 32 requires that greenhouse gas emissions be reduced to 1990 levels by the year 2020. Senate Bill (SB) 375 requires the CARB to develop regional greenhouse gas emission reduction targets to be achieved for passenger cars. California Environmental Quality Act (CEQA) Guidelines and AB 32 define the following six compounds as GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons and perfluorocarbons (PFCs). In 2009, nitrogen trifluoride was listed by California as a high global warming potential GHG that would be listed and regulated under AB. Greenhouse gases are both naturally occurring and derived from anthropomorphic (e.g., man-made) sources. Natural sources of GHGs include decomposition of organic matter, volcanic activities and wildfire. Human activities that contribute to GHGs include burning of solid waste, fossil fuels (oil, natural gas and coal); and wood and wood products. Carbon dioxide and nitrous oxide are two GHGs released in the greatest quantities from mobile sources burning gasoline and diesel fuel. Methane results from releases associated primarily with agriculture practices and landfills.

On April 2, 2007, the United States Supreme Court found that GHGs are pollutants that must be covered by the federal CAA. In response, on September 30, 2009, the USEPA proposed to apply PSD requirements to facilities whose CO_2-equivalent emissions exceed 25,000 tons per year. The CEQ published draft guidance on February 18, 2010 for Federal agencies to improve their consideration of the effects of GHG emissions and climate change in their evaluation of proposals for Federal actions under NEPA.

3.2 CULTURAL RESOURCES

3.2.1 Overview

Cultural resources are defined as prehistoric or historic archaeological sites, buildings, structures, districts, artifacts, or other physical evidence of human activity or use considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. For this discussion, cultural resources have been divided into prehistoric, Native American (American Indian), and historic resources.

Prehistoric resources are physical properties resulting from human activities that predate written records and are generally identified as isolated finds or sites. Prehistoric resources are typically archaeological and can include village sites, temporary camps, and lithic scatters, roasting pits/hearths, milling features, petroglyphs, rock features, cremations and burials.

Native American resources are sites, areas and materials important to contemporary Native Americans for religious, spiritual or traditional reasons. Prehistoric resources are often also recognized as ancestral sites by Native Americans. Resources can include villages, internments, petroglyphs, rock features, locations of plant resources and springs.

Historic resources consist of properties, structures or built items resulting from human activities that post-date written records. Historic resources can include archaeological remains and structures. Historic archaeological sites at Edwards AFB include homesites, agricultural or ranching features, mining-related features, refuse concentrations, and features or artifacts associated with early military use of the land. Historic structures can include constructed buildings, hangars, runways and test facilities.

The management of the cultural resources is subject to a number of laws, regulations, Executive Orders, programmatic agreements and other requirements. Chief among these is the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC, Section 470), and its implementing regulations, Protection of Historic Properties (36 CFR 800). Historic properties are a subset of these kinds of cultural resources that meet specific eligibility criteria found at 36 CFR, Part 60.4, for listing on the National Register of Historic Places (NRHP). The regulations commonly referred to as the Section 106 process describe the procedures for identifying and evaluating historic properties, for assessing the effects of federal actions on historic properties, for project proponents consulting with appropriate agencies and potentially affected Tribes to avoid, reduce or minimize adverse effects, and for involving consulting parties in findings and determinations made during the Section 106 process.. The Proposed Action is a federal undertaking, as defined by 36 CFR 800.3, and is subject to the Section 106 process and consideration under other federal and state requirements.

A PA between the United States Air Force and the California SHPO (Edwards Air Force Base 2009) regarding the implementation of the Integrated Cultural Resources Management Plan (ICRMP) and the Air Force Flight Test Center defines an alternate procedure for completion of the Section 106 process on Edwards AFB (Edwards Air Force Base 2009).

3.2.2 Cultural Setting

3.2.2.1 Prehistoric Period

The proposed action would occur on the AFRL facility at Edwards AFB and is located near Leuhman Ridge at the eastern portion of Edwards AFB. A chronology of the history of Edwards AFB has been

delineated in its ICRMP (Edwards Air Force Base 2010b), and through a number of specialized and thematic studies on historic land use.

Edwards AFB has two lakebeds which, prior to the twentieth century, would retain water after storms. These lakebeds, along with natural surface water which was abundant in the area, drew prehistoric people to the area.

Pleistocene Period (pre-12,000 BP [Before Present]). Late Pleistocene sites of the Lake Manix Lithic Industry have been recorded in the northern half of the Manix Basin in the central Mojave Desert east of Edwards AFB (Tetra Tech 2009). Artifacts include large oval bifaces, scrapers, tools, choppers, chopping tools, stout picks, rotational tools, gravers, cutting tools, and flakes, as well as cores, anvils and hammerstones.

Late-Pleistocene/Early-Holocene Prehistory (12,000 to 7,000 BP). The Lake Mojave Period in the southwestern Great Basin comprises a regional manifestation of the Paleoindian tradition, the complex including robust, stemmed projectile points, leaf-shaped bifaces, crescentics, step-edged unifacial scrapers and small numbers of heavier core-cobble implements (Tetra Tech 2010).

Lake Mojave components remain comparatively uncommon in the southwestern Great Basin. A tendency for early Holocene archaeology to occur along the margins of extinct lakes has led a generation of researchers to equate early adaptive patterns with focal exploitation of such habitats (Tetra Tech 2010).

Middle-Holocene Prehistory (8,000 to 4,000 BP). Succeeding Lake Mojave in the regional sequence is a complex of materials referred to as Pinto. These assemblages contain a variety of weakly shouldered, indented base, stemmed points (such as Pinto series, including Little Lake, Bare Creek and Gatecliff types), large and small leaf-shaped bifaces, domed and keeled unifaces, flake tools and substantial numbers of core-cobble tools (Tetra Tech 2010).

Pinto subsistence patterns have been portrayed as having greater breadth than during the Lake Mojave period. Large game hunting continued as the subsistence focus, but vegetal use and small animal exploitation increased as environmental conditions deteriorated (with the Altithermal) and artiodactyl productivity decreased (Tetra Tech 2010). Found in all known major Pinto components, groundstone frequencies are comparable to those of later periods, implying that middle Holocene populations across the Mojave Desert were full-fledged broad-spectrum foragers.

Late Holocene Prehistory (4,000 to Contact). With return to more "favorable" environmental conditions soon after the Pinto period, there was an increase in large game hunting as an economic focus but the intensification of plant exploitation (especially mesquite) continued (Tetra Tech 2010). During the Gypsum Period (4,000 to 1,500 BP) there was a thousand-year-long moist period between ca. 4,000 BP and 3,000 BP and was a time when people diversified their subsistence-settlement strategies (Tetra Tech 2010), as manifest in the appearance of the mortar and pestle, and introduction of the bow and arrow near the close of the period. Increased trade also played a role in this desert adaptation, as did participation in magico-religious hunting rituals.

Other artifacts include leaf-shaped projectile points, knives with rectangular bases, drills, scrapers, large scraper planes, choppers, shaft smoothers, incised sandstone and slate pendants and tablets, drilled slate tubes that may have served as pipes and hammerstones. Manos and metates are common during this period, suggesting a greater reliance on hard seeds. The mortar and pestle were first introduced into the Mojave Desert during the Gypsum Period, likely for mesquite processing. Shell beads of *Haliotis* and *Olivella* indicate interaction with coastal populations.

The Saratoga Springs Period (1,500 to 800 BP). Assemblages of this period are characterized by small arrow points that are corner notched, abundant ground and battered stone, and a variety of bead and ornament types. Southwestern pottery types appeared in the eastern Mojave Desert between 1,500 and 800 BP (Tetra Tech 2010).

The Protohistoric Period (800 BP to Contact). Defining characteristics in the Mojave Desert are Desert Side-notched projectile points and various types of Brown Ware pottery, including Owens Valley Brown (Tetra Tech 2010). Important sites and components of this age include the Cottonwood Creek site in Owens Valley, the upper component at Rose Spring, Colville Rockshelter, several sites in the Indian Ranch area of Panamint Valley, Chapman II phase components of sites in the Coso Range, Death Valley IV sites, China Ranch, and Shoshone and Rustler's Rockshelters. Marker artifacts include Desert Side-notched and Cottonwood series projectile points, along with small steatite disk beads and Owens Valley Brown Ware pottery. The consensus is that Paiute populations used such artifacts. Assemblages of the eastern Mojave Desert are broadly similar, suggesting that Paiute groups were moving into the region by 900 BP (Tetra Tech 2010).

The protohistoric pattern is somewhat different in the southern Mojave Desert. The Mojave River Valley became increasingly important during this period as a trade route. Sites firmly attributed to the

Shoshonean-speaking Serrano of historic times manifest attributes of Yuman-speaking cultures to the east. Brown and buff pottery that first appeared in the Lower Colorado River region about *Anno Domini* (AD) 800 also occurs in the southern Mojave Desert during this period.

3.2.2.2 Historic Period

The geographical location and unique environmental and natural resources of the Mojave Desert drew settlers, prospectors, trappers, traders and entrepreneurs into the region as early as the 1760s. Toward the end of the 1830s, the decline in demand for beaver furs and the "trapping out" of many streams brought an end to this trade. Traders continued to travel across the Mojave Desert, along the Old Indian Trail, for the next few decades (between California and New Mexico) and between Salt Lake City and coastal southern California along the Mormon Trail. Trade in horses and blankets was very common.

Between 1849 and 1850, more than ten thousand emigrants entered California from the east, along the Old Spanish Trail (Tetra Tech 2010). Agitation for a transcontinental railway led to a number of official scientific and geographic expeditions into the region during the 1850s, headed by Captain L. Sitgreaves (1851), Lieutenant Whipple (1853-1854) and Edward Fitzgerald Beale (1857). Between 1855 and 1857, most of the Mojave Desert was surveyed into townships and sections under the supervision of the Government Land Office (GLO) (Tetra Tech 2010). After 1857, the landscape of the Mojave Desert changed, as army posts, way stations, settlements, ranches, and mining camps were established; settlement increased incrementally after the construction of the Atlantic and Pacific Railroad in 1883.

The Establishment of the Railroads and the early colonization of the Antelope Valley. Railroad land grants issued to the Atlantic and Pacific Railroad (1866) and Southern Pacific Railroad (1871) transformed the historic landscape of the Antelope Valley in the last three decades of the nineteenth century. These railroads established routes from Los Angeles to San Francisco, Mojave to Needles and San Diego to Barstow. The Southern Pacific Railroad finished its line from San Francisco to Los Angeles via the Antelope Valley in 1876. By 1930, more than 80 towns had been built in the Antelope Valley.

The sale of land (and publicity around such sales) by real estate arms of the railway encouraged a small steady stream of settlers into the valley throughout the 1880s and 1890s. However, settlement in the Antelope Valley during the late nineteenth and early twentieth century was profoundly impacted by climatic fluctuations between 1880 and 1920 that produced seasons of heavy flooding and years of drought.

Mining. The exploitation of the natural resources in the Antelope Valley drew settlers to the area of modern-day Edwards AFB. The development of mining in this region was facilitated by market demand, the development of mining technology and the availability of the railroads. Three classes of mining occurred in the Antelope Valley between 1880 and 1950: locatable minerals (gold and silver), common mineral extraction (clay, mud, and borate) and leasable resources (oil) (Tetra Tech 2010).).

Between 1880 and 1920, several rushes brought miners into the Antelope Valley, first for copper and later for silver and gold (Tetra Tech 2010). Large camps of prospectors were established near Kramer railroad station and Kramer Hills, an area enclosed in the Kramer and Kramer Hills Mining District. Other mining districts in the valley included El Paso, Mojave, Oro Grande, Randsburg and Rosamond. Land available for homesteading had to be nonmineral (i.e., land with insufficient quantities of minerals to make extraction economically viable).

Homesteading. Large cattle ranches emerged in the Antelope Valley during the 1870s and 1880s (Tetra Tech 2010). However, the primary agricultural settlement of the Western Mojave Desert occurred after 1910. The numbers of desert homesteaders in the area increased each decade until 1934, when the Taylor Grazing Act was enacted. This shifted the emphasis of federal policy from disposing of lands in the public domain to preserving the nation's finite resources. It is unclear if settlers were drawn to the central Antelope Valley because of the availability of federal land at inexpensive costs per acre, or whether settlers moved to the area primarily for employment at the local mines and homesteaded as a secondary economic endeavor. While the western Mojave Desert did not spur the kind of land rushes that occurred farther east, the development of dry farming techniques created a noticeable boom in settlement between 1910 and 1930. This boom also was spurred by amendments to the Desert Land Act, which allowed for a nominal acreage to be irrigated and for absentee ownership, and amendments to the Homestead Act, which reduced the required residency period and requisite cultivated acreage. The boom also was partly driven by the rising cost of land in urban outreaches of southern California. With regard to Edwards AFB, many homesteads remained active until the final acquisition of land by the military in the 1940s and 1950s.

Military. In the three generations since the establishment of the Muroc Lake Bombing and Gunnery Range in 1933, the military facility of Edwards AFB has evolved into a vast aerospace complex. Most of the standing structures and buildings on Edwards AFB are associated with the military occupation of the region. Though this occupation spans over 70 years, most buildings on Edwards AFB are less than 50 years old (Tetra Tech 2010).

Edwards AFB and the Cold War. It was during this era of the Cold War that the United States recognized the need to greatly improve and develop its defense technologies. A new type of military installation evolved for this technological battlefield on which to wage the Cold War, and Edwards AFB was a prime example. Its basic components were established during World War II, when Edwards' South Base served as an Army airfield, while a secret testing complex was built at North Base to test new, top secret, American jets and weaponry. These two areas were consolidated in 1947 to form a single flight test center. The Muroc/Edwards Facility of Jet Propulsion Laboratory of the Guggenheim Aeronautical Laboratory, California Institute of Technology was officially established near North Base in 1945.

Edwards AFB and Man-in-Space. The Man-in-Space historical theme includes the pre-1958 technical foundations, as well as the concerted effort to land a man on the moon from 1958 to 1969. The facilities at Edwards AFB played an integral role in testing and developing propulsion systems and vehicles essential for both manned and unmanned space exploration. These facilities include the Air Force Flight Test Center, National Aeronautics and Space Administration, Jet Propulsion Laboratory and the Rocket Propulsion Laboratory. The AFRL was created in October 1997 through the consolidation of four former Air Force laboratories and the Air Force Office of Scientific Research. Its mission is the discovery, development and delivery of war fighting technologies.

3.2.3 Cultural Resources within the Proposed Project Area

Archaeological inventories have been conducted on Edwards AFB since 1979. Over 194,400 acres of Edwards AFB have been surveyed since then and more than 3,100 sites have been recorded (Edwards Air Force Base 2010b). The most common prehistoric sites found on Edwards AFB are lithic scatters, temporary camps, hearth features and milling stations. Common historic-period archaeological sites are refuse scatters, homestead sites, mining sites and agricultural features.

The extent of the cultural resources APE for this Proposed Action is defined to include all areas of surface and subsurface disturbance, any associated laydown or staging areas, and a 25-meter buffer around the proposed fenceline. If any part of an archaeological site falls within the defined APE, the entire extent of the sites is included in the APE (Edwards Air Force Base 2009).

Portions of the APE for the Proposed Action have not been surveyed for cultural resources, although other portions have been surveyed. Table 3-4 lists cultural resources surveys that have been conducted within the APE.

Table 3-4
Cultural Resources Surveys Conducted within the APE for the Proposed Action

GID	AUTHOR	DATE	PROJECT ID	AREA SIZE	NARRATIVE
5575	CSC	None listed	1998-C	164.140	Survey area does not match acreage description
5731	CSC	None listed	1998-C	162.335	Survey area does not match acreage description
5871	CH	2006	2006-0330	8.715	None listed
5597	CSC	None Listed	1999-D	160.253	Survey area does not match acreage description
5599	CSC	None listed	1999-D	166.206	None listed
5734	CSC	2001	2001-798	8.288	No cultural resources present
5613	AE	None listed	1996-E	159.006	None listed
5621	RAD	None listed	1996-F	13.807	None listed
5421	CSC	None listed	1999-D	162.751	None listed
5638	CSC	None listed	1996-065	31.764	None listed
5645	CSC	None listed	1996-065	75.935	None listed
5785	CH	2005	2005-0853	0.617	None listed
5478	CSC	None listed	1998-C	164.014	Survey area does not match acreage description
5812	CSC	1993	1991-110	5.027	No historic properties located
5950	AE	None listed	1996-E	162.722	None listed
5519	CSC	None listed	1998-C	164.709	Survey area does not match acreage description
5831	CSC	None listed	2001-237	79.292	See 2001-F
5693	CH	2006	2006-0330	17.054	None listed
5701	CSC	2000	2000-161	2.114	None listed
5968	CSC	None listed	1992-078	364.654	None listed
5555	AE	None listed	1996-E	162.661	None listed
5705	CH	2004	2004-0782	1.937	No cultural resources found
5847	TT	None listed	1993-038	348.774	None listed
7161	CSC	1997	1997-042	162.572	21 new sites and 21 new isolates

GID	AUTHOR	DATE	PROJECT ID	AREA SIZE	NARRATIVE
6814	GAA	None listed	1980-A	89.349	None listed
6661		None listed	1993-038	78.613	None listed
6662	ET TT	None listed	1993-038	226.991	None listed
6664	BHPO	1984	1984-029	7.460	No cultural material observed.
7011	CH	None listed	2010-D	18.600	PIRA Survey FY10 for PB11 and PB12
6688	TT	None listed	1993-038	292.818	None listed
6543	ET	None listed	1994-V	69.493	None listed
6551	ET TT	None listed	1993-038	124.424	None listed
6718	CSC	1989	1989-175	10.962	One previously unrecorded cultural resource found
6722	CSC	None listed	1998-C	162.860	Survey area does not match acreage description
7049	CSC	1992	1991-110	70.671	Two prehistoric sites
6566	BHPO	None listed	1985K-JUD	113.482	None listed
6732	CSC	1990	1990-C	6.561	No historic resources located
6886	CSC	1991	1989-175	18.545	No historic properties within the APE
7115	CSC	2000	2000-320	10.410	None listed
6630	None listed	None listed	1993-038	1079.187	None listed
7144	ET	None listed	1994-V	4.056	None listed
7145	ET	None listed	1994-V	298.062	None listed
6633		None listed	1993-038	103.448	None listed
6111	RAD	None listed	1996-F	153.631	None listed
6115	CSC	1992	1991-110	107.041	One isolated flake
6514		None listed	1993-038	175.880	None listed
6126	CSC	None listed	1997-F	199.089	None listed
6244	CH	None listed	AFRL Sign Installation	0.000	None listed
6245	CH	None listed	2011-0739	0.000	None listed

GID	AUTHOR	DATE	PROJECT ID	AREA SIZE	NARRATIVE
6524	CH	2006	2006-0330	0.513	None listed
6145	CSC	1995	1991-102	29.855	None listed
6536	CH	2006	2006-0330	14.782	None listed
6274	BHPO	1988	1988-K	2.497	None listed
6276	CSC	2001	2001-627	0.720	No cultural resources identified
6167	CH	2006	2006-0330	10.984	None listed
6174	ET TT	None listed	1993-038	125.715	None listed
6053	BHPO	1986	1987-003	28.602	None listed
6054	CSC	None listed	1996-C	109.502	None listed
6055	CSC	1996	1995-078	44.579	3 previously recorded sites and one isolate found within the APE
6198	CH	2002	2002-444	19.279	3 historic sites and one historic isolate
6073	CSC	None listed	1996-065	190.897	None listed
6078	CSC	2001	2000-883	8.795	Two eligible sites
6336	CSC	None listed	1998-C	162.074	Survey area does not match acreage description
6219	CSC	2001	2001-798	14.801	No cultural resources present
6348	ET	None listed	1992-056	75.008	None listed
6359	CSC	None listed	1989-175	68.044	35 m north of Mars, offshoots 35 m each side
6360	CSC	None listed	1989-058	12.314	None listed
6479	CSC	8/1/1991	1991-030	17.024	2 isolated flakes found

Notes: CSC=Computer Sciences Corporation
CH=CH2M Hill
AE=Ancient Enterprises
RAD=Radian
TT=Tetra Tech
GAA=Greenwood and Associates
ETTT=Earth Tech and Tetra Tech
BHPO=Base Historic Preservation Officer
ET=Earth Tech

Source: Edwards Air Force Base GIS 2012

The fence line and associated disturbance areas were sited to avoid directly impacting known cultural resources. However, within the cultural resources APE for this project, there are numerous sites from the prehistoric and historic period. These sites are listed in Table 3-5 below (Edwards Air Force Base 2012).

Table 3-5
Known Cultural Resources Sites within the APE for the Proposed Action

GID	EAFB ID	Site Type	Description	Components	BHPO Eligibility Status	Notes
94	1058	2	Temporary Camp	Prehistoric/Historic or Military	Not Evaluated	None Listed
2692	301	5	Lithic Deposit	Prehistoric Only	Not Evaluated	None Listed
283	1206	15	Roasting Pit/Hearth	Prehistoric Only	Not Evaluated	None Listed
321	1233	2	Temporary Camp	Prehistoric/Historic or Military	Eligible	None Listed
15974	3909	80	Military Bldg/Facility Inactive	Historic Period or Military Only	Not Evaluated	Not Field Checked
15922	3937	80	Military Bldg/Facility Inactive	Historic Period or Military Only	Not Evaluated	Not Field Checked
922	168	55	Mining-Related Site	Historic Period or Military Only	Eligible	Locus Of 2615
15634	3850	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
15552	3859	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
15612	3876	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
15586	3880	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
15918	3957	80	Military Bldg/Facility Inactive	Historic Period or Military Only	Not Evaluated	Not Field Checked
2697	3011	50	Refuse Deposits	Prehistoric/Historic or Military	Not Evaluated	Not Found By JS
15584	3867	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
15576	3888	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked
2688	3006	50	Refuse Deposits	Prehistoric/Historic or Military	Not Evaluated	None Listed
1756	2319	5	Lithic Deposit	Prehistoric Only	Not Eligible	None Listed
15417	3849	58	Roads & Trails	Historic Period or Military Only	Not Evaluated	Not Field Checked

GID	EAFB ID	Site Type	Description	Components	BHPO Eligibility Status	Notes
16014	3931	80	Military Bldg/Facility Inactive	Historic Period or Military Only	Not Eligible	Aerial Test Range;10 Targets; MIL; 2005-L:Final Inventory of Historic Period Archaeological Sites (Volumes I And II)

Source: Edwards Air Force Base GIS 2012

3.3 GEOLOGY AND SOILS

Geologic resources consist of naturally formed minerals, rocks and unconsolidated sediments. Soil refers to the uppermost layers of surficial geologic deposits and the weathering of those deposits. Concerns associated with the geologic setting, which could either affect or be affected by a proposed project, include topography and soil erosion.

3.3.1 Topography

Edwards AFB is located in the Antelope Valley, a broad alluvial plain lying southwest of the Tehachapi Mountains and north of the San Gabriel Mountains. Low ranges of bedrock hills occasionally interrupt the generally flat terrain of the valley floor; the lowest flanks of the hills are blanketed by Quaternary-aged alluvial fans consisting of water-laid sand and gravel deposits. The valley floor is composed of several closed topographic depressions that contain three major playas: Rogers, Rosamond and Buckhorn Dry Lakes. Playa deposits consist of thick, bedded clay and sand, interfingered with the encroaching alluvial fan deposits. Playa margins have shoreline sand deposits from the wetter middle and late Pleistocene climates when the lakes were filled with water. In the lower elevations, wind-laid deposits form in the dunes and hummocks (United States Air Force 2008b).

Edwards AFB can be characterized by having the following three physiographic regions:

- An upland area located in the northwest portion of Edwards AFB north of Rosamond and west of Rogers Dry Lake. The area is characterized by low, rounded hills, including Bissel and Rosamond Hills, with elevation ranges between 2,270 and 3,200 feet above MSL.

- A lowland area occupying the central and southwestern portions of Edwards AFB. The lowland area includes Rosamond, Buckhorn and Rogers Dry Lakes and the intervening area. It extends from the northern boundary of Edwards AFB to the southern boundary and has a relief of approximately 400 feet, with elevations ranging from 2,270 to 2,675 feet above MSL.
- An upland area that extends east of Rogers Dry Lake to the eastern boundary of Edwards AFB. Leuhman Ridge and Haystack Butte, both over 3,400 feet above MSL are the two prominent relief features in this area. Elevations in this area range from approximately 2,400 to over 3,400 feet above MSL and are the highest of the three physiographic areas on Edwards AFB. The project area located on the AFRL has slope and relief that varies from flat to gently sloping plains interspersed with broad domes and hills. Slopes range from zero percent near Rogers Dry Lake to greater than 30 percent near Kramer Hills.

3.3.2 Geology

The subsurface geology of the AFRL is characterized as a crystalline granitic bedrock complex overlain in areas by a thin veneer of unconsolidated alluvium that increases down slope from the crest of Leuhman Ridge (Dibblee 1960). Alluvial materials found on the surface originate from the erosion and weathering of exposed and shallow-buried bedrock, wind-blown sands and gravel deposits.

The underlying bedrock consists of pre-Tertiary plutonic crystalline rock. Leuhman Ridge is predominately composed of quartz monzonite and intruded granite. Haystack Butte located southeast of Leuhman Ridge is composed of dacite, a Tertiary volcanic rock. The bedrock types are relatively homogenous in mineral composition, varying only in relative proportions of quartz, plagioclase and potassium feldspar. The intrusive granite that forms Leuhman Ridge is distinguished from quartz monzonite by an increase in the relative potassium feldspar content and a decrease in the relative plagioclase fraction to near zero (Dibblee 1960). During the Tertiary period, volcanic activity produced a dacite plug that forms Haystack Butte. The dacite is described as a fine-grained holocrystalline groundmass with small, scattered phenocrysts of plagioclase, quartz and biotite. Scattered quartz latite and pegmatite-aplite dikes also occur in the AFRL area.

3.3.3 Soils

Soils at Edwards AFB are typically alkaline in nature with pH values ranging from 7 to 8 for most soils. Soils at the AFRL have textures that are typically sandy and are susceptible to wind erosion and flooding.

Soil types by series have been determined by landforms within the AFRL and are detailed as follows (United States Air Force 2008a):

- Alluvial fans in the AFRL and proposed fence project area primarily consist of Norob sandy loam and Norob Complex fine sands (United States Department of Agriculture 1996). Slopes range from 0 to 5 percent. These soils are saline and sodic in nature and are subject to wind erosion and flooding.
- Dunes and sand sheets within the AFRL and the proposed fence project area have been mapped as Cajon loamy sands (United States Department of Agriculture 1996). Slopes range from 0 to 15 percent. These soils are deep, moderately-well to excessively and are subject to wind erosion.
- Fan piedmonts found with the AFRL and project area contain mostly Helendale series loamy sands with minor amounts of Lavic and Cajon soils. Slopes range from 0 to 9 percent and are subject to wind erosion and occasional flooding.
- Rock pediments and hills found at the AFRL and the project area contain Randsburg sandy loam and gravel soils interspersed with rock outcrops. Slopes range from 2 to 50 percent and are subject to wind and water erosion.

3.3.4 Seismicity

Few earthquakes have been recorded within the triangle area formed between the San Andreas and Garlock Faults that include Edwards AFB. Seismic activity in the Antelope Valley is most prevalent along, and northwest of, the Garlock Fault and along, and southwest of, the San Andreas Fault. Like much of Southern California, Edwards AFB is subject to earthquake activity and associated seismic hazards. Four earthquakes have been recorded with epicenters within or near the Edwards AFB boundary, and all had Richter magnitudes less than 4.4. Another earthquake with a measured magnitude between 4.5 and 6.4 occurred at Bissell, located approximately two miles northwest of Edwards AFB (Edwards Air Force Base 2006). At least eight minor faults are known, or are suspected because of their trends, to be present within the boundaries of Edwards AFB. Two faults, the Leuhman Fault and Spring Fault, are found within the AFRL. The Leuhman Fault is an inferred northwest-trending fault that may pass under Quaternary alluvium northeast of Leuhman Ridge and east of Haystack Buttes. Spring Fault is east and parallel to the Leuhman Fault. These two faults bound a supposed shallow graben block between the Kramer Hills and Leuhman Ridge and granitic highlands to the west (Dibblee 1960).

3.4 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

For purposes of this study, the terms "hazardous material" and "hazardous waste" are those substances defined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Resource Conservation and Recovery Act (RCRA). A hazardous material is any material whose physical, chemical or biological characteristics, quantity, or concentration may cause or contribute to adverse effects in organisms or their offspring; pose a substantial present or future danger to the environment; or result in damage to or loss of equipment, property or personnel. Hazardous wastes are substances that have been "abandoned, recycled, or are inherently waste like," and due to their quantity, concentration and/or characteristics, may cause increases in mortality or serious irreversible illness, or pose a substantial hazard to human health or environment if improperly treated, stored, transported or disposed of.

3.4.1 Hazardous Materials and Hazardous Waste

Current use of hazardous materials by facilities in the AFRL is addressed in Title 22 California Code of Regulations (CCR) 66266.1-66266.130, AB 3474 and the California Health and Safety Code, Section 26143.2. All organizations and contractors are required to maintain strict inventories of all hazardous materials. Organizations are also required to reduce the quantity of hazardous materials used or replace them with non-hazardous material, if possible, as part of the Edwards AFB Pollution Prevention Program.

Hazardous materials are used to support rocket propulsion research and development at the AFRL. Typical hazardous materials include liquid and solid rocket propulsion, batteries, antifreeze, cleaning/degreasing solvents, and machinery lubricants, which are used in component fabrication, repair maintenance and assembly operations (Air Force Flight Test Center 2010).

The use of hazardous materials results in generation of hazardous waste that requires proper handling and disposal. Environmental Management at Edwards AFB manages hazardous waste accumulation. Guideline used by Edwards AFB for managing hazardous waste has been prepared in accordance with AFI 32-7042, *Waste Management*.

3.4.2 Environmental Restoration Program

The Installation Restoration Program (IRP) was established to identify, investigate, assess and clean up hazardous waste at former disposal sites on federal facilities through the Defense Environmental Restoration Program (ERP) in compliance with CERCLA. As part of past practices at Edwards AFB that

included aircraft research and development, a number of waste disposal sites have been identified. The Main/South Base at the western edge of Rogers Dry Lake is primarily used for maintaining and refueling aircraft. The North Base, located five miles northeast of the Main Base area, has a drum storage site at the northern end of Rogers Dry Lake and three unlined surface impoundments where wastes were poured during the 1960s and 1970s. In the past, large amounts of fuel and solvents have been spilled and poor disposal practices have resulted in the release of volatile organic compounds (VOCs), metals and other chemicals to the ground. The AFRL and Leuhman Ridge where rocket engine testing activities resulted in four major and extensive groundwater contamination plumes containing perchloroethene (PCE), trichloroethene (TCE), and perchlorate plus dense, non-aqueous phase liquids (DNAPLs) in fractured bedrock, an abandoned sanitary landfill containing heavy metals and an area where electroplating wastes were dumped (United States Environmental Protection Agency 2012).

The Edwards AFB investigation into the nature and extent of contamination is currently approaching a completion point. Ten Operable Unit (OU) areas have been identified by the Air Force and seven are currently still in the Remedial Investigation/Feasibility Study (RI/FS) phase. One or more Records of Decision (RODs) will be prepared for each OU area and a total of 18 are projected by the Air Force for completion from 2003 through 2019. The following summarizes the OUs found within the AFRL and project area.

AFRL Sites (OU 4 and OU 9): OU 4 and OU 9 are located within the AFRL and project area. Figure 3-1 identifies the ERP sites that are associated with OU4 and OU9 that are found in proximity to the project site. The Air Force tested rocket engines at this remote ridge in the middle of the eastern part of Edwards AFB. These OUs are grouped together due to the similar geology at these areas. Four major plume areas containing TCE, PCE and perchlorate have been identified in addition to a number of soil and debris sites associated with the operations. Table 3-6 summarizes site contamination by installation restoration site within the two OUs associated with the AFRL. The potential for exposure to contaminants in the project area is extremely low because the depth to groundwater is greater than 20 feet (well below the three- to four-foot depth needed for fence posts) and the limited soil contamination is at levels requiring no further action.

X:\GIS\EAFB-AFRL\IRP.mxd

58

20 MULE TEAM RD.

BORON

OU7-371-A
OU7-439-CWM
OU7-265-A
OU4A-319-A
OU4A-320-A
OU4A-318-A
OU4A-169-A
OU4A-32-A
OU4A-317-A
OU4A-461-A
OU4A-316-A
OU4A-164-A
OU4A-12-A
OU4A-165-A
OU9-183-A
OU9-325-A
OU9-362-A
OU9-115-A
OU9-376-A
Silo Rd
OU9-39-A
OU9-305-A
OU9-114-A
OU9-337-A
OU9-338-A
OU9-6-A
OU9-113-A
OU4A-168-A
OU4A-361-A
OU4A-315-A
OU4A-147-A
OU4A-140-A
OU4A-336-A
OU4A-407-A
OU4A-374-A
OU4A-335-A
OU4A-314-A
OU9-142-A
Phoenix Rd
OU4A-156-A
OU4A-355-A
OU4A-404-A
OU4A-162-A
OU4A-160-A
OU4A-143-A
OU4A-158-B
OU4A-161-A
OU4A-163-A
OU4A-157-A
OU4A-158-A
OU4A-312-A
OU4A-143-B
OU4A-155-A
OU4A-313-A
OU4A-36-A
OU4A-35-A
OU4A-159-A
OU4A-359-A
OU4A-139-A
OU4A-138-A
OU4A-406-A
OU4A-171-A
OU4A-40-A
OU4A-170-A
OU4A-173-A
OU4A-175-A
OU4A-172-A
OU4A-174-A
OU4A-144-A
OU4A-177-A
OU4A-326-A
OU9-328-A
OU9-178-B
OU9-375-A
OU4A-327-A
OU9-328-B
OU9-332-A
OU9-118-A
OU4A-185-A
OU4A-150-A
OU4A-149-A
OU4A-151-A
OU4A-153-C
OU4-150-B
OU4A-373-A
OU9-178-A
OU9-179-A
Moon Rd
OU9-116-A
OU9-117-A
OU9-330-A
OU9-331-A
OU4A-26-A
OU4A-152-A
OU4A-357-A
OU4A-37-A
OU4A-354-A
OU4A-184-A
OU4A-166-A
OU4A-145-A
OU4A-186-A
OU4A-135-A
OU4A-136-A
OU4A-133-A
OU4A-146-A
OU4A-134-A
OU4A-137-A
OU4A-153-B
OU4A-396-A
OU4A-372-A
OU4A-405-A
OU4A-153-A
OU4A-154-A
OU4A-358-A
OU4A-148-A
OU4A-356-A
OU4A-13-A
Moon Rd
OU9-122-A
OU9-324-A
OU9-123-A
North Arrow Rd
OU4A-119-A
OU4A-121-A
OU4A-120-A
OU7-271-A
OU7-266-A
OU7-443-CWM
OU9-360-A
OU9-176-A
OU9-321-A
OU9-38-A
OU9-322-A
OU9-323-A
E MARS BLVD
OU7-442-CWM-B
OU7-442-CWM-A
OU7-CWM-431
OU9-124-A
OU9-125-A
OU9-126-A
OU4B-7-A
EHSITIRP01499
OU4B-333-B
OU4A-333-A
OU7-447-CWM
OU4B-329-B
OU4A-329-A
OU4C-329-C
OU9-132-A
OU9-131-A
OU9-130-A
OU9-129-A
OU9-334-A
OU9-127-A
OU9-128-A
OU9-181-A
Haystack Butte
OU9-27-A
OU9-180-A
OU9-182-A
OU7-442-CWM-C
OU7-442-CWM-D
OU7-457-CWM
OU7-434-CWM

LEGEND

- Proposed AFRL Fence
- Environmental Restoration Site
- AFRL Boundary
- Edwards AFB Boundary

N

0 3,000 6,000 Feet

EDWARDS AIR FORCE BASE

Figure 3-1

Environmental Restoration Sites

TETRA TECH

Table 3-6
Summary of Environmental Restoration Program Sites for Operable Units 4 and 9

	Environmental Restoration Site	Site Contaminants
Operable Unit 4		
	Site 120	Percholorethene (PCE) contamination groundwater.[1]
	Site 37	PCE contamination of groundwater.[1]
	Site 162	Chlorinated volatile organic compounds (VOCs), perchlorate and N-nitrosodimethylamine (NDMA) in groundwater; No Further Action (NFA) for soil and for inorganics in groundwater. [2]
	Site 461	Chlorinated VOCs, 1,4-dioxane and NDMA in groundwater; NFA for soil and for inorganics in groundwater.[2]
	Site 318	Polyaromatic hydrocarbon contamination of soils (benzo(a)pyrene, benzo(k)pyrene, benzo(a)anthracene, dibenz(a,h)anthracene) and volatile organic compound contamination of groundwater.[3]
	Site 133	Tricholoroethene (TCE), PCE, 1,4-dioxane and NDMA contamination of groundwater.[1]
	Site 333	TCE and NDMA in groundwater; Feasibility Study (FS) required to select final remedy alternative.[2]
Operable Unit 9		
	Site 325	TCE, PCE, cis-1,2-Dicholroethene (DCE), NDMA and perchlorate contamination of groundwater[4]
	Site 115	Elevated levels of iron in soil but not considered a contaminant of concern. Potentially explosive debris in silo. Groundwater contamination not clearly related to hazardous debris in silos.[3]
	Site 177	Chlorinated VOCs, perchlorate and NDMA in groundwater; NFA for soil and for inorganics in groundwater.[2]
	Site 178A	TCE and perchlorate contamination of groundwater.[4]
	Site 178B	TCE and perchlorate contamination of groundwater.[4]
	Site 116	Perchlorate and NDMA contamination of groundwater.[4]
	Site 321	PCE and TCE contamination of groundwater.[1]
	Site 127	NDMA, TCE and cis-1,2-DCE contamination of groundwater.[4]
	Site 125	Chlorinated VOCs, perchlorate, NDMA and 1,4-dioxane contamination of groundwater.[4]
	Site 27	NDMA and TCE contaminated groundwater.[4]

[1]U.S. Air Force, 2007, Final Record of Decision, South Air Force Research Laboratory Operable Units 4 and 9, Edwards Air Force Base, California

[2] U. S. Air Force, 2005, Final Remedial Investigation Summary Report Air Force Research Laboratory Operable Unit 4, Edwards Air Force Base, California

[3]U.S. Air Force, 2011, Final Feasibility Study Report, Soil and Debris Sites, Air Force Research Laboratory Operable Units 4 and 9, Edwards Air Force Base, California, August 2006

[4]U.S. Air Force, 2006, Final Remedial Investigation Summary Report East Air Force Research Laboratory Operable Unit 4, Edwards Air Force Base, California

Five RODs that detail remedies for contamination clean up, additional characterization of contamination are organized as follows:

- **South AFRL Groundwater ROD.** The remedy does not involve ongoing cleanup, although the Air Force will continue monitoring eventual containment of the solvent and perchlorate contaminated plumes by natural attenuation and will continue maintaining land use controls within the Containment Zone. Monitoring of plume migration is also used to determine where land use controls need to be applied to protect buildings from vapor intrusion into indoor air. A final Remedial Design/Remedial Action (RD/RA) Work Plan was approved by USEPA in June 2009. Groundwater monitoring is already underway from the pre-ROD program and will be refined per RD/RA Work Plan specifications. A vapor intrusion sampling program was designed as part of the above RD/RA Work Plan. Upon completion of the Interim RA Report in October 2009, the long-term operation and maintenance (O&M) phase officially began. The first five-year review of this remedy is due in September 2012.
- **AFRL Soil and Debris Sites ROD.** Cleanup work in the field was begun voluntarily by the Air Force before the ROD was signed. All eight of the action sites associated with this ROD are being addressed by implementation of the September 2009 Work Plan. The first five-year review of this remedy is due in August 2013. Contaminated groundwater associated with these sites will be studied and addressed by one of the four other AFRL RODs.
- **Arroyos Groundwater ROD (OU4).** This co-mingled plume area is located in the steep northwest part of OU 4. The RI and FS reports were completed in March 2005 and December 2008, respectively. In the August 2009 Proposed Plan, the Air Force proposed a technical impracticability Applicable or Relevant and Appropriate Requirements (ARAR) waiver remedy similar to that of the South AFRL ROD, but possibly including a contingency for active groundwater extraction and treatment in the future event of plume migration outside containment zone boundaries. The draft final ROD is currently under review. However, some additional characterization of potential containment zone boundary areas might necessitate a revised draft final. USEPA anticipates the ROD will be signed by 2013 after final issues are resolved.
- **Northeast AFRL Groundwater ROD (OU 9).** Two separate plume areas in OU 9 have slightly different hydrogeological conditions, and in 2010 the Air Force split them into separately planned RODs. Based on the January 2006 RI Report, the northeast AFRL plume is being evaluated for a technical impracticability waiver in a draft feasibility submitted in 2011. The Air Force will offer a Proposed Plan for public comment in 2015. USEPA anticipates the ROD will be signed in 2016.

- **Mars Boulevard Groundwater ROD (OUs 4 and 9).** Originally part of the northeast AFRL RI/FS project (RI Report completed in January 2006), the slightly different hydrogeology for this plume area caused the Air Force in 2010 to break it out for a separate FS and ROD. This area will be evaluated for a technical impracticability ARAR waiver in an FS to be submitted in 2013. The Air Force will offer a Proposed Plan for public comment in 2016. USEPA anticipates the ROD will be signed in 2017.

3.5 INFRASTRUCTURE

Infrastructure refers to the physical components that are used to deliver something (e.g., electricity, traffic) to the point of use. Elements of infrastructure typically include energy, water, wastewater, electricity, natural gas, liquid fuel distribution systems, communication lines (e.g., telephone, computer) and circulation systems (streets and railroads).

3.5.1 Energy Resources

Edwards AFB uses electricity, solar power (e.g., photovoltaic panels to run traffic lights and heat water), and natural gas/propane and other petroleum-based products (gasoline, jet fuel, and diesel) as sources of energy to operate facilities, vehicles, equipment and aircraft (Edwards Air Force Base 2006).

Southern California Edison provides electricity to Edwards AFB. Edwards AFB uses this energy source to operate a variety of systems including lighting, heating and cooling, computers, and pumps for gas and water. Pacific Gas & Electric supplies natural gas to Edwards AFB. Edwards AFB uses natural gas to run boilers, furnaces and two standby generators. Propane is used in areas where natural gas services are unavailable and is used to operate one standby generator. Edwards AFB uses solar energy for hot water and forced air heating systems; to provide light (i.e., skylights); and to operate the emergency phone system on major portions of Rosamond, Lancaster and Mercury Boulevards (Edwards Air Force Base 2006).

Edwards AFB is responsible for approximately 13.4 miles of petroleum pipeline used to transport jet fuel to various locations throughout the installation. The supply pipeline for Edwards AFB is the CalNev Pipeline. Edwards AFB receives jet fuel from a spur line from the George AFB terminal (Edwards Air Force Base 2006).

3.5.2 Water Distribution System

Edwards AFB obtains potable water from two primary sources: the Antelope Valley East Kern (AVEK) Water Agency and groundwater from on-base water wells. There are three independent water distribution systems at Edwards AFB. One serves the Main Base, North Base, and South Base; the second serves the AFRL; and the third serves the Gun Club area. The first two systems are served by on-base groundwater wells and surface water from AVEK via water lines along Highway 58 at Rosamond Boulevard and north of the AFRL, respectively. The third system is a small distribution system serviced only by groundwater wells (United States Air Force 2010).

The AFRL water system consists of piping, valves, four water wells located on the Precision Impact Range Area (PIRA) along Mercury Boulevard, 13 ground-level storage tanks spaced out on Leuhman Ridge, four booster stations and one chlorination facility (United States Air Force 2010).

3.5.3 Wastewater/Storm Water

The wastewater collection and treatment system at Edwards AFB provides wastewater collection, onsite treatment and onsite disposal of treated wastewater and sludge (which is disposed of offsite) for all Base facilities. There are two independent wastewater collection and treatment systems at Edwards AFB. The first wastewater collection and treatment system serves the Main Base, North Base and the South Base areas. The second wastewater collection and treatment system serves the AFRL (United States Air Force 2010).

The AFRL wastewater collection system consists of gravity collection pipes and a 125,000-gallon-per-day wastewater treatment facility, although approximately 50 percent of the AFRL wastewater is collected in septic tanks and septic tanks are not included with the wastewater system. The AFRL WWTP produces a tertiary effluent. The treatment processes include mechanical screening, complete-mixed aerated lagoon with integral clarifier, activated sludge process and sand filters. After treatment, the effluent is pumped to one of four 100-foot by 200–foot evaporation ponds for disposal. Sludge produced at the AFRL is combined with the sludge from the Main Base Treatment Plant and disposed of off-site at a licensed facility. The AFRL WWTP is regulated by the California Regional Water Quality Control Board, Lahontan Region, under Board Order No. 6-99-33, and Waste Discharge Identification (WDID) No. 6B150700002. The current permit has been in effect since March 9, 1995. The AFRL WWTP requires operator certification from the California State Water Resources Control Board for a class III facility (United States Air Force 2010).

The storm water distribution system at Edwards AFB consists of conveyance structures and drainage ditches (unpaved). Storm water conveyance structures include channels, gutters, drains and sewers (not tied into the sanitary sewer system) that collect storm water runoff and direct its flow. The storm water system at Main Base conveys storm water to a pretreatment facility, which consists of an oil-water separator and an evaporation pond. Storm water from the undeveloped portions of Edwards AFB flows into the nearest dry lake (Edwards Air Force Base 2006).

3.5.4 Communication Systems

Communication systems on Edwards AFB include telephone, microwave and local area networks. The distribution system for these networks generally consists of copper-pair cable, fiber-optic cable and a communication manhole/conduit system (Edwards Air Force Base 2006).

3.5.5 Transportation Systems

One U.S. highway and two state highways connect Edwards AFB to local communities and the interstate highway system. U.S. Highway 395 parallels the eastern boundary of Edwards AFB, California State Route (SR) 58 parallels the northern boundary, and SR-14 parallels the western boundary. SR-14 intersects SR-58 at Mojave, at the northwest corner of the installation (Edwards Air Force Base 2006).

Edwards AFB is accessed by way of Rosamond Boulevard from the west or north (from SR-14 and SR-58, respectively), and by Lancaster Boulevard/120th Street East from the south. Primary access to Edwards AFB from the adjacent roadways is by way of North Gate, West Gate, and South Gate, each of which is in operation 24 hours a day, 7 days a week. The AFRL area of the Base can also be accessed from the north by way of Rich Road, near the community of Boron. This road is not controlled by a gate, although access to the AFRL via Mercury Boulevard is controlled with a gate (Edwards Air Force Base 2006).

Internal circulation is by way of paved and unpaved primary, secondary, and tertiary roads. Primary roads connect Edwards AFB components such as the flightline, Engineering and Administration, and support areas to entry points. Secondary roads connect Edwards AFB components to one another and support facilities such as commercial or housing areas. Tertiary roads are unpaved access roads or residential streets within the housing area (Edwards Air Force Base 2006).

Traffic consists of government, contractor and privately owned vehicles belonging to those who live and/or work on Edwards AFB. In addition, commercial vehicles deliver material to businesses and

facilities in the area. Commercial and Air Force vehicles are used for service and construction work done in the area. Emergency vehicles require access to all buildings and roads. In addition to the paved roadways, an extensive network of unimproved dirt roadways exists, essentially equivalent to the paved network. These roads have posted speed limits and provide access to various installation facilities and sites (Edwards Air Force Base 2006).

Two railroads are adjacent to Edwards AFB. The Union Pacific line runs parallel to the west boundary and adjacent to Sierra Highway. The north/south main line does not provide service to Edwards AFB. The Burlington Northern Santa Fe Railroad mainline is located south of SR-58 and parallel to the northern boundary of Edwards AFB. Two rail spurs, one at Edwards Station and the other at Boron Station connect to the Main Base and the AFRL, respectively (Edwards Air Force Base 2008).

3.6 NATURAL RESOURCES

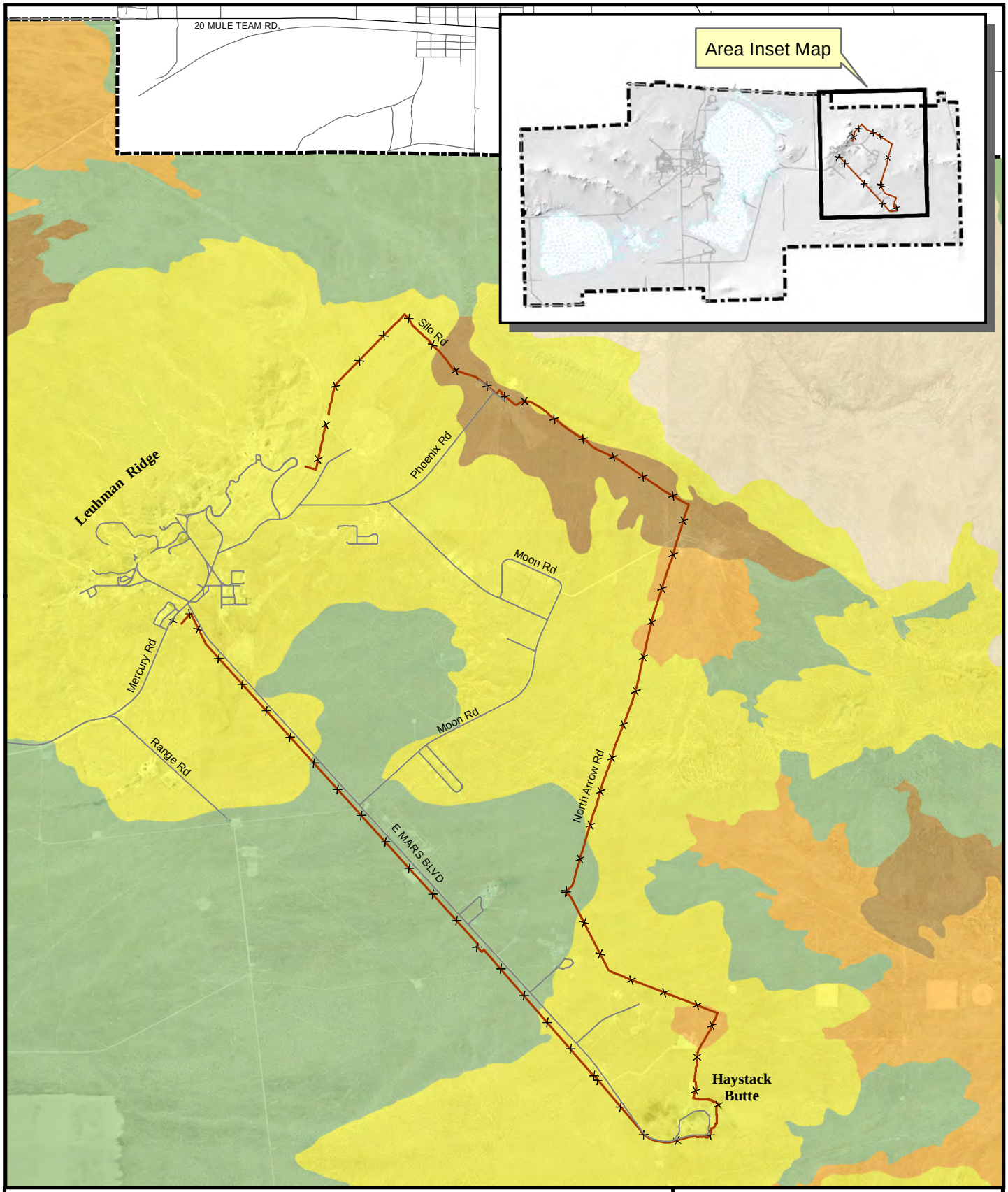
Edwards AFB lies in the southwestern Mojave Desert. The Mojave Desert is located within the intermountain Semidesert and Desert Province and forms its own ecoregion (Bailey 1994). The Mojave Desert ecoregion is bounded by other ecoregions; these include the Great Basin to the north, Apache Highlands to the East, Sierra Nevada and South Coast to the west, and the Sonoran Desert to the south and southeast. The Mojave Desert is situated within the borders of four western states, and extends from southwestern Utah across to southern Nevada to southeastern California, and over to western and northwestern Arizona (Edwards Air Force Base 2008; The Nature Conservancy 2001).

3.6.1 Vegetation

Edwards AFB vegetation communities are described in the 2008 Integrated Natural Resources Management Plan (INRMP) for the Base in terms of zonal and azonal communities (Edwards Air Force Base 2008). Upland zonal plant communities include creosote bush scrub and Joshua tree woodland. Lowland communities consist of the alkali sink and saltbush communities. Edwards AFB also supports azonal (isolated) habitats such as claypan, dunes, and mesquite woodlands. Comprehensive lists of plant species found on the Base are located in Appendix B of the INRMP.

Vegetation communities on the portions Edwards AFB proposed for fence installation are shown on Figure 3-2 and include Joshua tree woodland, creosote bush scrub, saltbush scrub, creosote bush scrub/saltbush scrub transition and burrobush scrub. Joshua tree woodland occurs in the higher elevations of the east side of Edwards AFB, and covers approximately 20 percent of the linear area of the proposed fence project. The Joshua tree woodland found in this area supports Joshua trees (*Yucca brevifolia*) with an understory of creosote bush scrub as described below.

X:\GIS\EAFB-AFRL\Vegetation.mxd



LEGEND

Plant Community

- Burrobush Scrub
- Creosote Bush Scrub
- Creosote Bush Scrub/Saltbush Scrub Transition
- Joshua Tree Woodland
- Saltbush Scrub

Proposed AFRL Fence

N

0 3,000 6,000 Feet

EDWARDS AIR FORCE BASE

Figure 3-2

Vegetation Communities

TETRA TECH

Creosote bush scrub is found along approximately 45 percent of the linear area of the proposed fence project and supports creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), Mormon tea (*Ephedra nevadensis*), winterfat (*Krasheninnikovia lanata*), spiny hopsage (*Grayia spinosa*), goldenheads (*Acamptopappus sphaerocephalus*), felt-thorn (*Tetradymia stenolepis*), Cooper's goldenbush (*Ericameria cooperi*), Mojave aster (*Xylorhiza tortifolia*), round-leaf rabbitbrush (*Chrysothamnus teretefolius*) and desert tomato (*Lycium andersonii*).

Saltbush scrub communities are found along approximately 30 percent of the linear area of the proposed fence project and are dominated by four-winged saltbush (*Atriplex canescens*). Other species frequently found in this community on the Base include goldfields (*Lasthenia gracilis*) and the non-native red brome (*Bromus rubens*) and devil's lettuce (*Amsinckia tesselata*).

Creosote bush scrub/saltbush scrub transition supports characteristics and species from both communities described above. This transitional community is not recorded along the proposed fence line, but near the northeastern boundary as shown on Figure 3-2.

Burrobush scrub communities are found along approximately 5 percent of the linear area of the proposed fence project and are comprised of a shrub structure of burrobush (*Ambrosia dumosa*) with few to no other shrub species. Other species typically found in this community include goldfields and devil's lettuce.

3.6.2 Wildlife Communities

Wildlife in the area of the proposed fence project includes insects, amphibians, reptiles, birds and mammals. No fish occur naturally on Edwards AFB and none are likely to be found in the area of the proposed fence project. Amphibians are not likely to be found at or adjacent to the proposed fence project because no permanent water sources are located in these areas. Lists of wildlife species found on the Base are found in Appendix C of the INRMP.

Arthropods and insects commonly found include fairy, clam and tadpole shrimp in claypan areas (not present in the fence project area); coleoptera (beetles), diptera (flies), hymenoptera (ants, bees, and wasps), Lepidoptera (moths and butterflies), and orthoptera (grasshoppers).

Reptiles common to Edwards AFB and likely to be found in the area of the proposed fence project include the desert horned lizard (*Phrynosoma platyrhinos*), desert iguana (*Dipsosaurus dorsalis*), long-nosed leopard lizard (*Gambelia wislizenii*), side-blotched lizard (*Uta stansburiana*), western whiptail

(*Cnemidophorus tigris*), zebra-tailed lizard (*Callisaurus draconoides*), coachwhip (*Masticophis flagellum*), gopher snake (*Pituophis melanoleucus*), Mojave green rattlesnake (*Crotalus scutulatus*), sidewinder (*Crotalus cerastes*) and the desert tortoise (*Gopherus agassizii*) (discussed further in Section 3.6.3.1 below).

Bird species expected to be observed in the area of the proposed fence project include California quail (*Callipepla californica*), red-tailed hawk (*Buteo jamaicensis*), turkey vulture (*Cathartes aura*), American kestrel (*Falco sparverius*), burrowing owl (*Athene cuncicularia)* (discussed further in Section 3.6.3.1 below), mourning dove (*Zenaida macroura*), greater roadrunner (*Geococcyx californianus*), Anna's hummingbird (*Calypte anna*), ladder-backed woodpecker (*Picoides scalaris*), horned lark (*Eremophila alpestris*), common raven (*Corvus corax*), cactus wren (*Campylorhynchus brunneicapillus*) and white-crowned sparrow (*Zonotrichia leucophrys*).

Mammal species common to the area of Edwards AFB where the fence is proposed include bats such as the California myotis (*Myotis californicus*) and Townsend's western big-eared bat (*Plecotus townsendii townsendii*); carnivores such as the coyote (*Canis latrans*) and desert kit fox (*Vulpes macrotis*); and rodents, rabbits and hares including the black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), desert woodrat (*Neotoma lepida*), long-tailed pocket mouse (*Perognathus longimembris*), Merriam's kangaroo rat (*Dipodomys merriami*), white-tailed antelope ground squirrel (*Ammospermophilus leucurus*) and Mohave ground squirrel (*Xerospermophilus mohavensis)* (discussed further in Section 3.6.3.1 below).

3.6.3 Sensitive Species and Habitats

Sensitive species included in this document are those listed by the federal, state or local governments or planning processes as endangered, threated, or otherwise of conservation concern, including:

- Species listed by the California Native Plant Society (CNPS);
- Species designated as either rare, threatened, or endangered by California Department of Fish and Game (CDFG) or the USFWS, and are protected under either the California or Federal Endangered Species Acts;
- Candidate species or species being considered or proposed for listing under these same Acts;
- Species listed as birds of conservation concern (BCC) by USFWS;
- California species of concern listed by CDFG; and/or
- Species addressed in the West Mojave Plan (WEMO).

Sensitive habitats include those listed by federal, state, and/or local planning processes as being of local or regional conservation concern, including:

- Areas of designated critical habitat;
- Desert Wildlife Management Areas (DWMAs) and other Areas of Critical Environmental Concern (ACECs) designated by the US Department of the Interior, Bureau of Land Management (BLM);
- Plant communities listed as sensitive by CDFG and other resources agencies;
- Plant communities rare or declining and of concern to agencies or local jurisdictions;
- Potential wildlife movement corridors; and
- Potential wetlands or other jurisdictional waters.

3.6.3.1 Sensitive Species

Edwards AFB supports approximately 12 species of sensitive plants, and 45 species of sensitive wildlife (Edwards Air Force Base 2008), but not all of these species have the potential to be present in the project area based on habitats present at the proposed project site. Within the area of the proposed fence installation, there have been recent records of two sensitive plants and two federally and/or state sensitive wildlife species. In addition, habitats present in the proposed project area could support a number of additional species which are discussed in this section.

Sensitive species with the potential to occur at the project site are presented in Table 3-7 for plants and Table 3-8 for wildlife. Each species has been given a potential to occur based on the following criteria:

Present	Species was observed during a survey in the past five years.
High	Both a historical record exists of the species within the boundaries of the site or its immediate vicinity (approximately one mile) and the environmental conditions (including vegetation, soil type and elevation factors) associated with the species are found at the site.
Moderate	Either a historical record exists of the species within the immediate vicinity of the site or the environmental conditions associated with species are found at the site.
Low	No records exist of the species occurring within the site or its immediate vicinity and/or the environmental conditions associated with species presence are marginal within the site.
Absent	Species was not observed during focused surveys conducted within the site at an appropriate time and/or the environmental conditions associated with species presence do not exist on or adjacent to the site.

Table 3-7
Special Status Species Potential for Occurrence – Plants

Scientific Name Common Name	Status	Flowering Period/ Habitat	Potential for Occurrence
Astragalus preussii Lancaster milkvetch	Federal: none State: none CNPS: 1B.1	April – July Areas of high water table in saltbush scrub; found south of the Base	Low
Calochortus striatus Alkali mariposa lily	Federal: none State: none CNPS: 1B.2	April – June Claypans and sand dunes in saltbush scrub	Low
Canbya candida Pygmy poppy	Federal: none State: none CNPS: 4.2	March – June Joshua tree woodlands, Mojave Desert scrubs	Moderate
Chorizanthe spinosa Mojave spineflower	Federal: none State: none CNPS: 4.2	March – July Joshua tree woodlands, Mojave Desert scrubs	Moderate
Cymopterus deserticola Desert cymopterus	Federal: none State: none CNPS: 1B.2	March – May Joshua tree woodlands, Mojave Desert scrubs	Present
Eriastrum hooveri Hoover's woollystar	Federal: none State: none CNPS: 4.2	April – July Saltbush scrubs in Central Valley of California – occasionally in Antelope Valley near Base	Low
Eriophyllum mohavense Barstow woolly sunflower	Federal: none State: none CNPS: 1B.2	March – May Gravelly soils in Mojave Desert scrubs	Present
Escholtzia minutiflora ssp. *twisselmannii* Red Rock poppy	Federal: none State: none CNPS: 1B.2	March – May Found north of the Base in Rand Mountains	Low
Goodmania luteola Yellow spiny cape	Federal: none State: none CNPS: 4.2	April – August Dunes in saltbush scrub	Low
Loeflingia squarrosa var. *artemisiarum* Sage-like loeflingia	Federal: none State: none CNPS: 2.2	April – May Dunes in saltbush scrub	Low
Muilla coronate Crowned onion	Federal: none State: none CNPS: 4.2	March – May Water saturated soils in saltbush scrub	Absent
Nemacladus gracilis Slender threadstem	Federal: none State: none CNPS: 4.3	March – May Inland woodlands	Absent

Source: INRMP 2008; CNPS 2012

CNPS Status

1B.1: Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California
1B.2: Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California
4.2: Plants of limited distribution, a watch list; fairly threatened in California
4.3: Plants of limited distribution, a watch list; not very threatened in California

Each species with a potential to occur of moderate, high or present are discussed in further detail below. Those of low potential for occurrence are not discussed further.

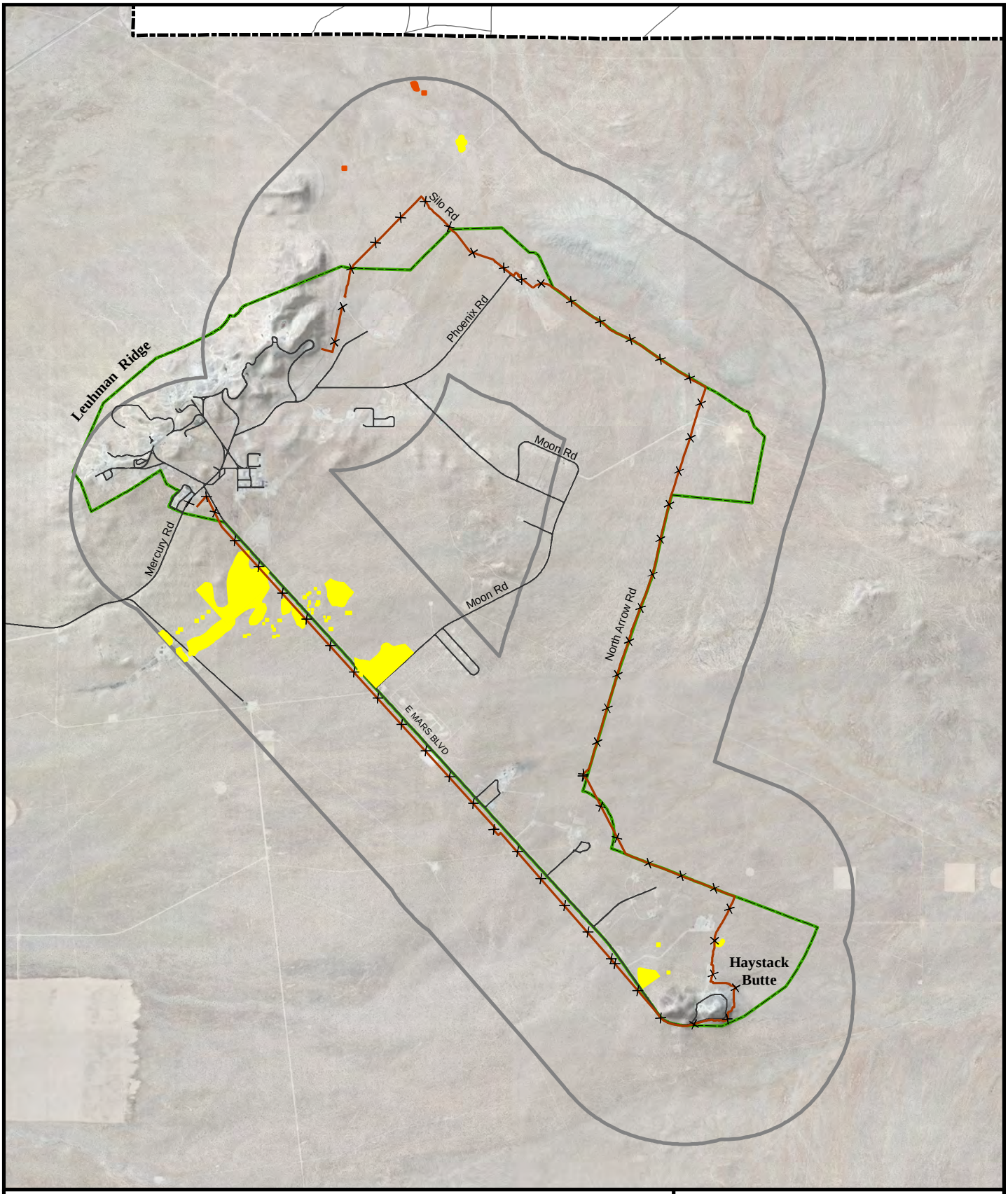
Pygmy poppy is an annual herb belongs to the papaveraceae (poppy) family found at elevations between approximately 2,000 to 4,800 feet above MSL (600 to 1,460 meters above MSL). The pygmy poppy is widespread in sandy soils of the western Mojave Desert and found mostly during years with above average rainfall. Plants have clusters of several flowers and a small tuft of inconspicuous, highly dissected, gray-green leaves.

Mojave spineflower is an annual herb belonging to the polygonaceae (buckwheat) family and found between elevations of approximately 20 to 4,300 feet above MSL (6 to 1,300 meters above MSL). The Mojave spineflower occurs primarily in bare areas in the saltbush scrubs of the Antelope Valley. It does well in disturbed soils and will grow in utility corridors and abandoned roads in saltbush scrub habitat. It occurs primarily southwest of Rogers Dry Lake and near the proposed fence alignment in a similar habitat preferred by the Barstow woolly sunflower, which has been observed along the proposed fence corridor.

Desert cymopterus is a perennial herb belonging to the apiaceae (parsley) family and found between elevations of approximately 2,100 to 5,000 feet above MSL (630 to 1,500 meters above MSL). Desert cymopterus is endemic to the western and central Mojave Desert in California. Cymopterus is a perennial with a long tap root on a caudex. Leaves are highly dissected and gray-green with a silver tint. Flowers are spherical and maroon with golden anthers. Plants have 3 to 25 leaves per plant and from 0 to over 5 flowering heads per plant. Population boundaries for this species on Edwards AFB have been expanded as more intensive surveys were completed, but few new populations have been found. The plant is associated with Joshua tree woodland because plant diversity in general increases in sandy sites. There are 54 documented populations of cymopterus on Edwards AFB. This species often occurs in microtopography of swales in sand fields or where very weak drainages intersect. Cymopterus has rarely been observed in heavy or rocky soils at the base of hillsides. This species has been recorded within one mile of the proposed fence alignment in the past five years as shown on Figure 3-3.

Barstow woolly sunflower is a perennial herb belonging to the asteraceae (sunflower) family and found between elevations of approximately 1,650 to 3,150 feet above MSL (500 to 960 meters above MSL). All populations on Edwards AFB are limited to the edges of bare areas in saltbush scrub. The Barstow woolly sunflower is one of several species of woolly daisies occurring on Edwards AFB. It is the smallest and most compact. It is usually less than one inch in diameter and prostrate, with heads only one-sixteenth of

X:\GIS\EAFB-AFRL\Sens_Plants.mxd



LEGEND

- Proposed AFRL Fence
- Barstow Woolly Sunflower Population
- Desert Cymopterus Population
- AFRL Boundary
- 1-mile Buffer from Proposed AFRL Fence

N

0 3,000 6,000 Feet

EDWARDS AIR FORCE BASE

Figure 3-3

Sensitive Plant Locations

TETRA TECH

an inch across. Heads are yellow; there are no ray flowers. Plant stems are densely hairy. A total of 47 populations are located on Edwards AFB, with known populations found along several areas of the proposed fence project (Figure 3-3).

Of the 33 species of sensitive birds recorded on Edwards AFB, 12 are species associated with open bodies of permanent water, found in the southwestern part of Edwards AFB over 20 miles from the proposed fence project. Additional bird species migrate through the installation but do not nest or linger in the area and are also unlikely to be found on or near the proposed fence alignment. The remaining bird species are addressed in Table 3-8, along with all sensitive reptile and mammal species previously identified through exhaustive surveys conducted on Edwards AFB over the past several decades.

Table 3-8
Special Status Species Potential for Occurrence – Wildlife

Scientific Name Common Name	Status		Flowering Period/ Habitat	Potential for Occurrence
Reptiles				
Gopherus agassizii desert tortoise	Federal: State:	threatened threatened	Desert scrubs and wash vegetation with friable soils	Present
Sauromalus obesus chuckwalla	Federal: State:	BLM sensitive none	Rocky hillsides	Moderate
Birds				
Aquila chryseatos golden eagle (nesting and wintering)	Federal: State:	Bald and Golden Eagle Protection Act (BGEPA); Birds of Conservation Concern (BCC) Fully protected	Nesting on cliff faces; foraging in most habitats	Nesting low, foraging high
Falco mexicanus prairie falcon (nesting)	Federal: State:	BCC none	Nesting on cliff faces; foraging in most habitats	Nesting moderate, foraging high
Asio otus long-eared owl (nesting)	Federal: State:	none Species of Special Concern (SSC)	Nesting in large trees; foraging in most habitats	Nesting moderate, foraging high
Athene cunicularia burrowing owl (burrows and wintering)	Federal: State:	BCC SSC	Nesting in burrows in the ground or open holes, pipes, etc. foraging in most open habitats	Burrowing high, foraging high
Toxostoma lecontei LeConte's thrasher	Federal: State:	BCC SSC	Resident in areas with desert shrubs and cactus; often associated with washes	High
Lanius ludovicianus loggerhead shrike (nesting)	Federal: State:	BCC SSC	Nesting in dense desert shrubs and cactus; foraging in same areas	Nesting high, foraging high

Scientific Name Common Name	Status	Flowering Period/ Habitat	Potential for Occurrence
Mammals			
Antrozous pallidus pallid bat	Federal: BLM sensitive State: SSC	Roosts in caves and human developments such as mines and large buildings; forages on the ground	Moderate
Corynorhinus townsendii Townsend's western big-eared bat	Federal: BLM sensitive State: SSC	Roosts in caves and human developments such as mines and large buildings	Moderate
Euderma maculatum spotted bat	Federal: BLM sensitive State: SSC	Occurs rarely; feeds on moths and other insects	Low
Eumops perotis californicus California mastiff bat	Federal: BLM sensitive State: SSC	Roosts in cliffs and rock crevices	Moderate
Nyctimops femerosacca pocketed free-tailed bat	Federal: none State: SSC	Roosts in rock crevices and on cliffs	Moderate
Nyctimops macrotis big free-tailed bat	Federal: none State: SSC	Roosts in rock crevices and on cliffs	Moderate
Taxidea taxus American badger	Federal: none State: SSC	Open dry habitats with friable soils and rodents for prey	High
Xerospermophilus mohavensis Mohave ground squirrel	Federal: none State: threatened	Most desert habitats with sandy or gravelly soils	High

Source: INRMP 2008; CDFG 2011

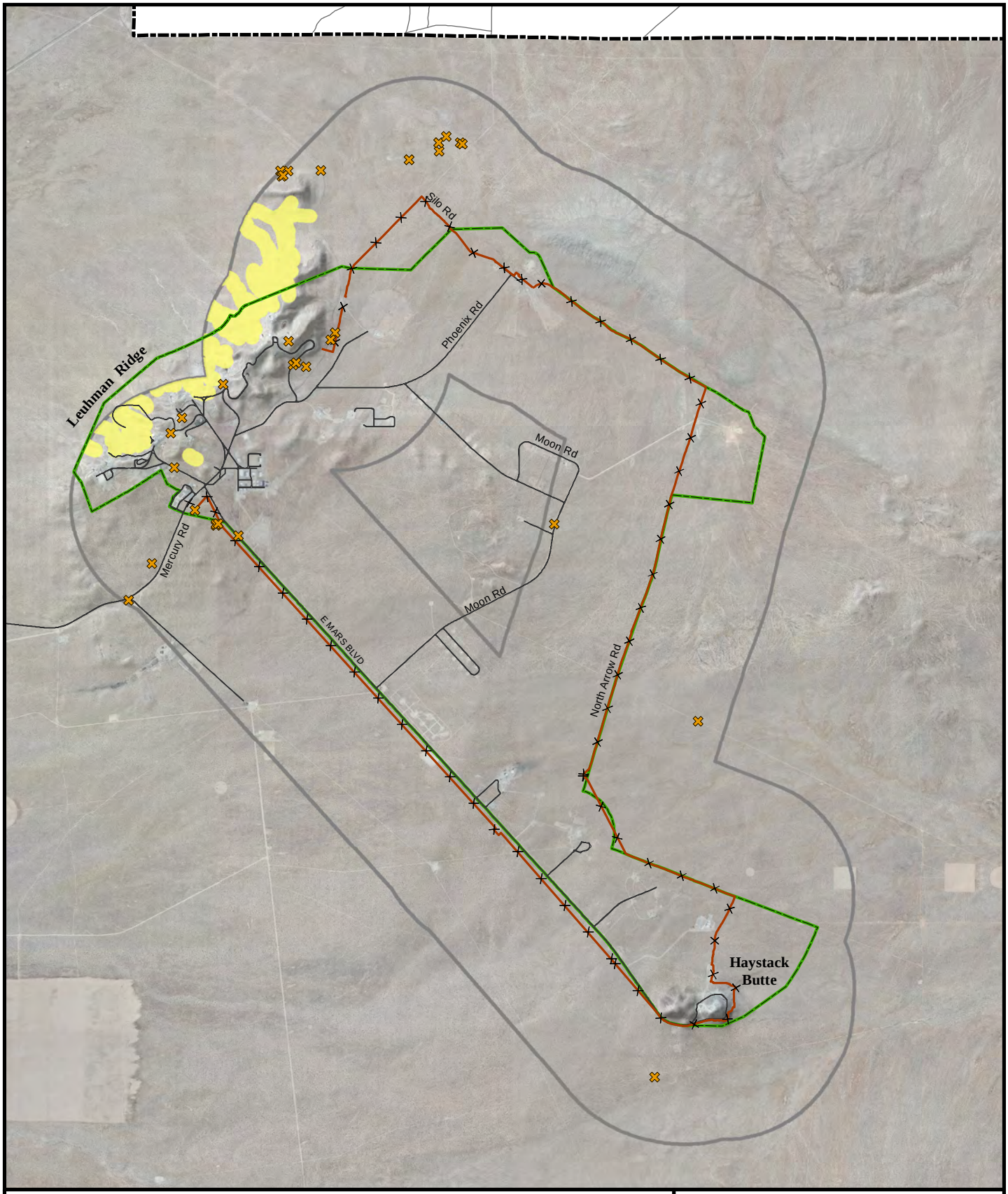
Each species with a potential to occur of moderate, high or present are discussed in further detail below. Those of low potential for occurrence are not discussed further.

Desert tortoises are found throughout Edwards AFB in low to moderate densities. The proposed fence alignment slightly overlaps the Fremont-Kramer Critical Habitat Unit for this species. In the past five years, a number of desert tortoise sightings have been recorded within one mile of the proposed fence alignment (Figure 3-4), particularly along Leuhman Ridge and in areas to the north and northeast of the ridge. In recent habitat modeling completed by the U.S. Geological Survey (USGS), the proposed project area is modeled as having moderate to high potential to support desert tortoise (Figure 3-5).

Chuckwallas prefer very rocky areas, usually boulder piles along the edges of the base of mountains. Suitable habitat exists in the rocky areas around Leuhman Ridge and Haystack Butte, very near the proposed fence alignment.

Golden eagles are protected under the federal Bald and Golden Eagle Protection Act and inhabit a wide range of habitats ranging from arctic to desert. Urbanization and human-population growth have made

X:\GIS\EAFB-AFRL\Tortoise_Loc.mxd



LEGEND

- Desert Tortoise Location
- Proposed AFRL Fence
- Sensitive Tortoise Area
- AFRL Boundary
- 1-mile Buffer from Proposed AFRL Fence

N

0 3,000 6,000 Feet

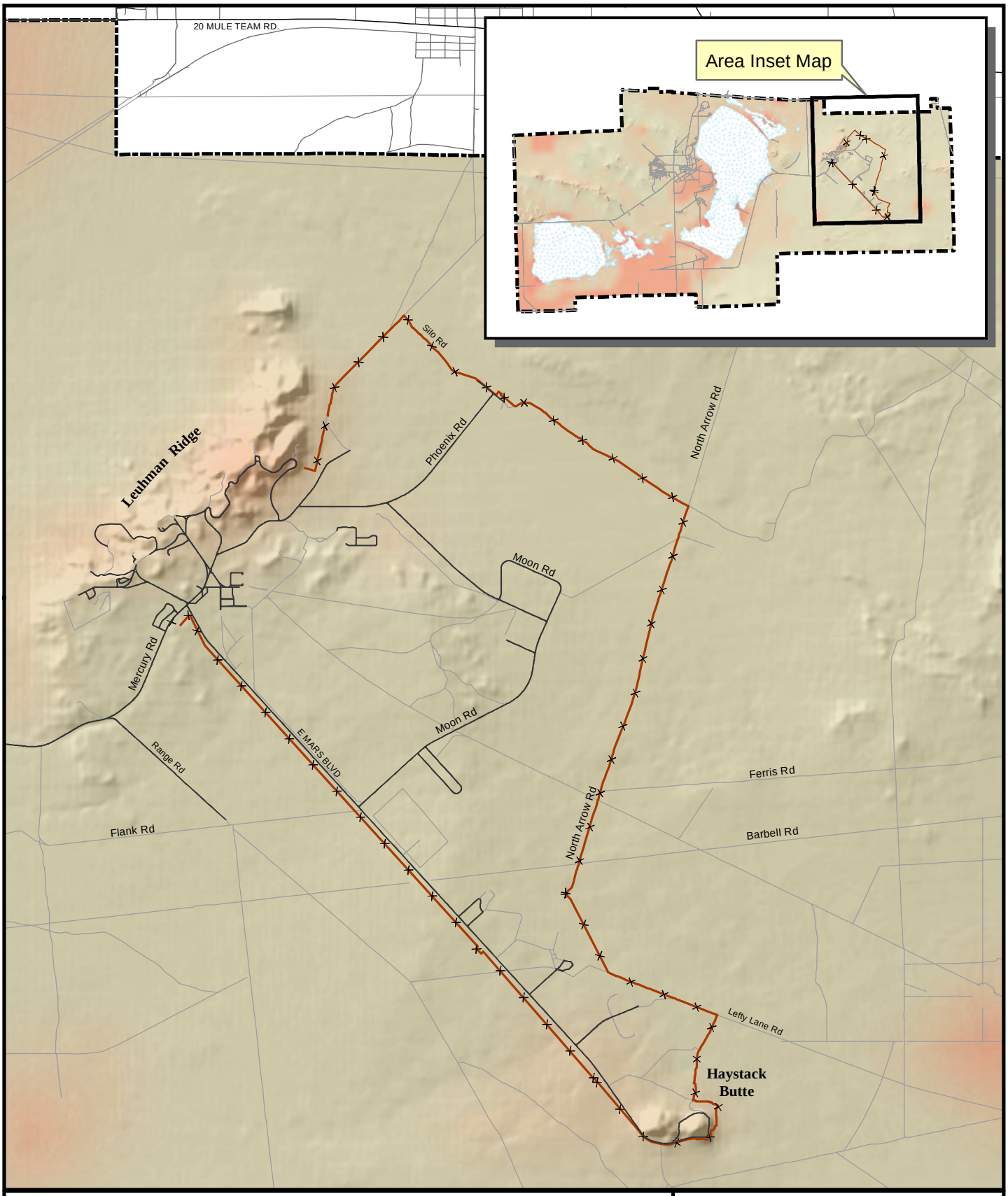
EDWARDS AIR FORCE BASE

Figure 3-4

Desert Tortoise Locations (2008 - 2011 Surveys)

TETRA TECH

X:\GIS\EAFB-AFRL\Tort_Habitat_Model.mxd



LEGEND

- Base Boundary
- Proposed AFRL Fence

Potential Habitat Predictive Model

High

Low

N

0 3,000 6,000 Feet

EDWARDS AIR FORCE BASE

Figure 3-5

Desert Tortoise Model

TETRA TECH

areas historically used by eagles unsuitable, particularly in Southern California. Extensive agricultural development reduces jackrabbit populations and makes areas less suitable for nesting and wintering eagles. Recreation and other human activity near nests can cause breeding failures. There has been no documented nesting of golden eagles in this area and human activity levels in these areas are likely to have reduced the attractiveness of these areas as potential nest sites.

Prairie Falcons are permanent residents in California within habitats that support open, dry, level or hilly terrain. They breed on cliffs and forage extremely large distances. Prairie falcons are an efficient and specialized predator of medium-sized desert mammals and birds. They seem to persist despite agricultural development, livestock-grazing, energy development, off-road vehicle use and military training. There has been no documented nesting of prairie falcons in this area and human activity levels in these areas are likely to have reduced the attractiveness of these areas as potential nest sites.

Long-eared owls are found throughout North America and nest in trees, cavities, cliffs, and occasionally on the ground, but hunt in open habitats. Long-eared owls have been recorded in the past near Haystack Butte in the southern portion of the proposed fence project and may forage throughout the project area.

Burrowing owls are small ground-dwelling owls that live in modified rodent holes and have been observed throughout Edwards AFB. They live primarily in dry, open scrub or grassland and are active day and night and frequently nest in loose colonies. Burrowing owls feed on a wide variety of prey, including small mammals, especially mice and rats, reptiles and amphibians, scorpions, bats and small birds. Burrowing owls may be present along and adjacent to the proposed fence alignment.

LeConte's thrashers are endemic to the Mojave and Sonoran Deserts and are found throughout Edwards AFB in Joshua tree woodland, saltbush scrub and dense creosote bush scrub. This species requires an undisturbed soil surface under desert shrubs. Agriculture and urban development have eliminated much of its habitat. They feed on any ground-dwelling insect, small reptiles and some seeds.

Loggerhead shrikes are small predatory birds that occur throughout Edwards AFB and the Mojave Desert. It is a resident in most of California, particularly roadsides, grasslands, agricultural fields, golf courses and riparian areas. The bird is often seen perching on Joshua trees on Edwards AFB. Its primary food includes lizards, small rodents, large insects, amphibians, road-killed animals and carrion.

Six sensitive **bat species** have been recorded during surveys at Edwards AFB. Most of these species prefer rocky areas with crevices in high cliffs or rock outcrops, caves, mines and large buildings for

roosting and a permanent water source in order to provide insects for foraging. The pallid bat occurs across much of western North America, along the coast from Mexico to Canada. Pallid bats are probably migratory, although occasional individuals have been reported in the U.S. during the winter. Townsend's western big-eared bats feed entirely on moths. Townsend's big-eared bats hibernate in tight clusters throughout their range during winter months. Spotted bats feed mostly on moths, are considered to be one of North America's rarest mammals, and have been found at a small number of localities, mostly in foothills, mountains and desert regions of southern California. Western mastiff bats are the largest North American bat and range from southern California and Arizona, south into Mexico. Just before flight, and during flight, the bats utter a series of loud, shrill, chattering calls that can be heard for a considerable distance. Roosts are sometimes alternated throughout the year. Pocketed free-tailed bats may be year-long residents on Edwards AFB and are swift, high-flying animals that feed primarily on moths, ants, wasps and other insects. Big free-tailed bats probably do not breed in California, but are residents.

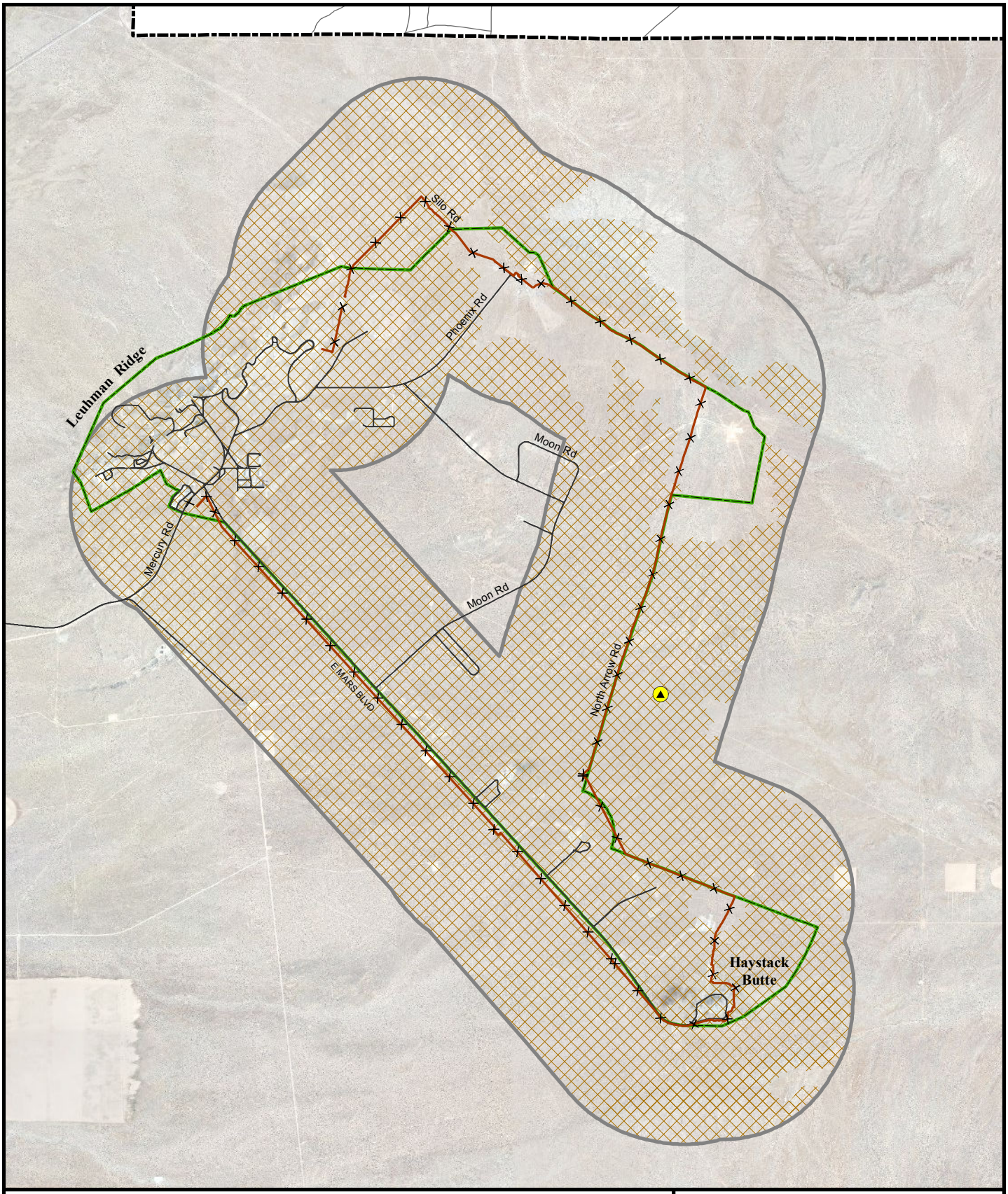
American badgers are a widespread but uncommon burrowing animal throughout their range. Their primary prey is rodents and they commonly avoid people and urban or developed areas. The area near the proposed fence project is known to have relatively high densities of American badgers (Lowrey, personal communication, 2009).

Mohave ground squirrels are small squirrels that are active only during the spring and early summer, staying underground the remainder of the year to avoid periods of extreme heat and cold. Mohave ground squirrels have been found throughout Edwards AFB, with the highest densities southwest from the proposed fence alignment. The area of the proposed fence is known to support habitat for this species (Figure 3-6).

3.6.3.2 Sensitive Habitats

The Fremont-Kramer desert tortoise critical habitat unit (a USFWS designation) and Desert Wildlife Management Area (DWMA, a BLM designation) were created for the protection of the federally- and state-threatened desert tortoise and overlap portions of the eastern area of the proposed fence project (Figure 3-7). The Mohave Ground Squirrel Conservation Area was developed through the West Mojave Plan (Bureau of Land Management 2005), located on non-military lands adjacent to Edwards AFB in the area of the proposed fence project, and is managed by the BLM for the protection of habitat for this

X:\GIS\EAFB-AFRL\MGS.mxd



LEGEND

- Mohave Ground Squirrel Sighting (2009)
- Proposed AFRL Fence
- Mohave Ground Squirrel Habitat
- AFRL Boundary
- 1-mile Buffer from Proposed AFRL Fence

N

0 3,000 6,000 Feet

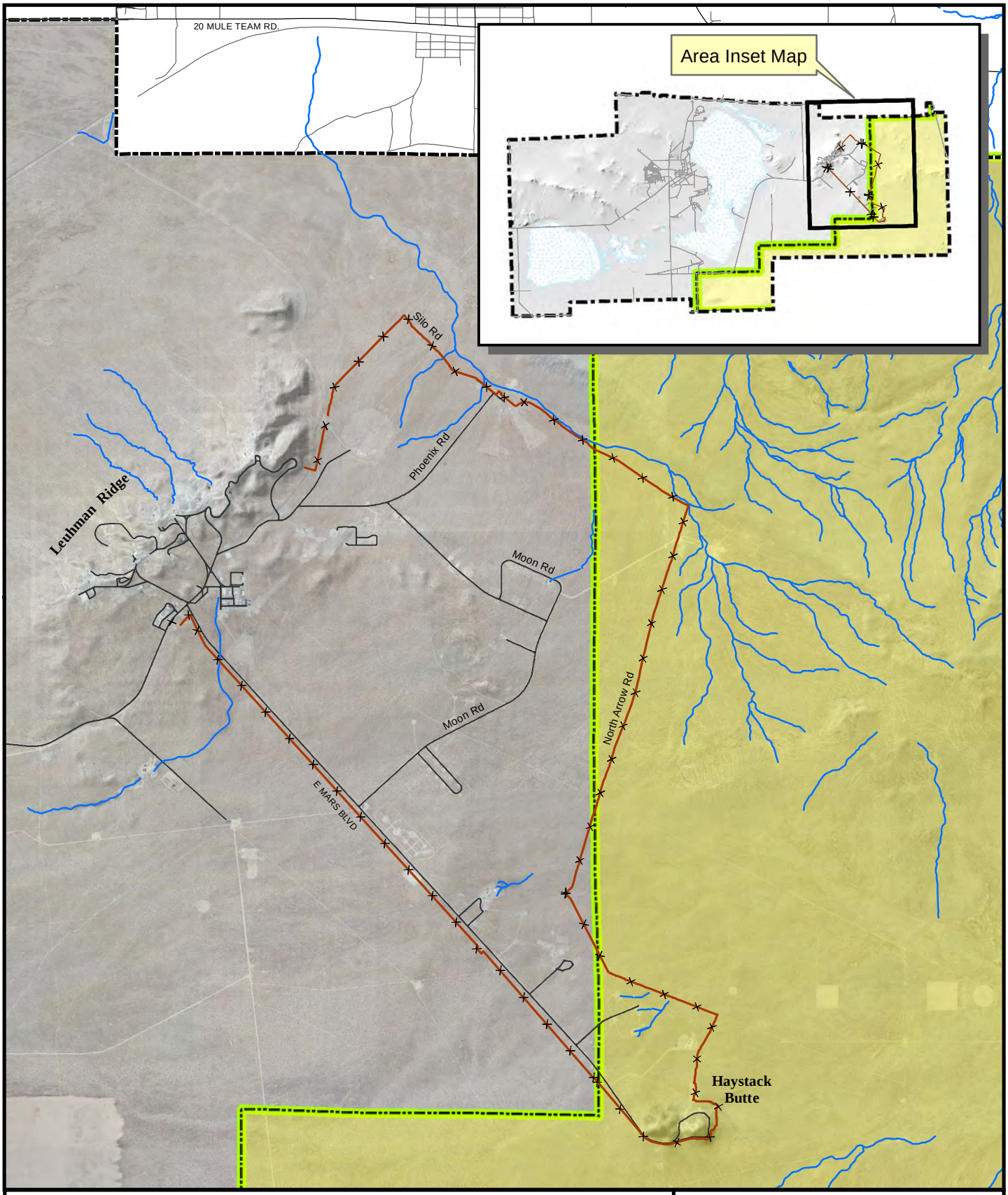
EDWARDS AIR FORCE BASE

Figure 3-6

Mohave Ground Squirrel Suitable Habitat

TETRA TECH

X:\GIS\EAFB-AFRLIDWMA.mxd



LEGEND

- Proposed AFRL Fence
- USGS 7.5' Topographic Map Blue Line Watercourse
- Desert Tortoise Critical Habitat
- Fremont-Kramer Desert Wildlife Management Area (DWMA)

N

0 3,000 6,000 Feet

EDWARDS AIR FORCE BASE

Figure 3-7

Sensitive Habitats

TETRA TECH

state-threatened species. No additional ACECs are found on or adjacent to the proposed fence alignment. No sensitive plant communities are found on or adjacent to the proposed fence project. No wildlife movement corridors are likely to be located in the immediate area of the proposed fence.

Figure 3-7 also shows a number of drainages that likely cross the alignment for the proposed fence. These drainages are not subject to the jurisdiction of the U.S. Army Corps of Engineers because they flow to either Rogers Dry Lake to the east, or isolated smaller dry lakebeds to the north.

3.7 SOCIOECONOMICS

Socioeconomic resources are the economic, demographic and social assets of a community. Key elements include fiscal growth, population, labor force and employment, housing stock and demand and school enrollment.

Edwards AFB makes a substantial contribution to the economic status of the surrounding communities within the Antelope Valley. The Antelope Valley has a labor force of approximately 157,900 persons with an unemployment rate of 14.1 percent. The labor force is employed in a variety of industries including services, manufacturing, construction/mining, retail, government and agriculture (Greater Antelope Valley Economic Alliance 2010). As of December 10, 2010, Edwards AFB employed approximately 11,285 military, civilian and contractor personnel (City of Lancaster 2012).

Edwards AFB provides permanent party housing for military members in the form of dormitories, military family housing and mobile home park spaces. Edwards AFB has over 1,700 housing units with an occupancy rate goal of 98 percent. The number of housing units fluctuates due to the demolition of older units and construction of new units. Housing is also available in the surrounding communities, including Lancaster, Palmdale, California City and Tehachapi.

There are 12 school districts within 100 miles of Edwards AFB. The one that services Edwards AFB, North Edwards, and Boron is the Muroc Unified School District which has two Kindergarten through 6th Grade elementary schools and two comprehensive junior/senior high schools with a total enrollment of about 2,000 students (Edwards Air Force Base 2012b).

3.8 PUBLIC SAFETY AND EMERGENCY SERVICES

3.8.1 Public Safety

Safety is defined as the protection of workers and the public from hazards. The total accident spectrum encompasses not only injury to personnel, but also damage or destruction of property or products. For worker safety, the boundary of the immediate work area defines the ROI. For public safety, a larger area must be considered.

For the proposed security fence project, public safety issues at the AFRL are mostly related to unauthorized vehicle access to the area for the purpose of stealing materials and equipment from the AFRL, thereby resulting in the destruction of property. This also may result in the public being exposed to hazards at the AFRL, including propellants used and stored at the AFRL, and range-related issues because of the proximity to the PIRA. The current fence at the AFRL is not adequate to prevent unauthorized access and thefts.

Worker safety for construction of the security fence is related to existing safety and environmental hazards at the AFRL, including physical hazards such as noise, heat, or cold; biological hazards such as poisonous snakes and scorpions; and general safety hazards such as ERP sites, UXO and range-related issues.

The 412th Medical Group/Bioenvironmental Engineering is responsible for industrial hygiene and occupational health. Bioenvironmental Engineering blends engineering and preventive medicine by evaluating and identifying environments that could harm Air Force members, employees and families. Data from these evaluations are used to help design measures that prevent illness and injury (Edwards Air Force Base 2006).

The Air Force Test Center's (AFTC) institutional occupational safety program is intended to minimize accidental injury, illness, and loss of property. AFTC's Safety Office is responsible for monitoring the safety programs through a system of inspections, surveys, audits and follow-up investigations. Elements of the safety program include accident and injury prevention and reporting, fire prevention and protection, emergency preparedness, and hazardous material and waste management. An Emergency Response Plan is in place to address emergencies such as earthquakes, aircraft accidents, fires and explosions, bomb threats, civil disturbances, nuclear emergencies, and toxic vapor releases or chemical spills. A Base-wide

safety reporting system encourages employees to report their concerns about workplace safety (Edwards Air Force Base 2006).

The AFTC's occupational health program is intended to recognize, evaluate and control workplace factors or stresses that may cause sickness, impaired health or significant discomfort to employees. To protect AFTC personnel from noise hazards, hearing protection is required if personnel are exposed to noise levels exceeding 85 dBA, with dBA referring to the "A-weighted" decibel scale normally used to approximate human hearing response to sound. The program identifies and quantifies worker exposure to hazardous chemicals, noise, and radiation. Through AFTC's Hazardous Communication Program, employees are educated regarding proper chemical management principles and procedures (Edwards Air Force Base 2006).

The national range system, established by Public Law (PL) 81-60, was originally sited based on two primary concerns: location and public safety. Thus, range safety, in the context of national range activities, is rooted in PL 81-60 and Department of Defense Directive 3200.11, *Use Management, and Operation of Department of Defense Major Range and Test Facilities*; both provide the framework under which the national ranges operate and provide services to range users. To provide for the public safety, the ranges, using a Range Safety Program, ensure that the weapons delivery testing presents no greater risk to the general public than that imposed by overflight of conventional aircraft (Edwards Air Force Base 2006).

It is the policy of the Edwards AFB Range to ensure that the risk to the public, military personnel, government civilian workforce, contractors, and national resources is minimized to the greatest degree possible. This policy is implemented by using risk management in the areas of public safety, launch area safety and landing area safety. Range users are required by Edwards AFB to demonstrate, through risk modeling, that the lowest possible risk is achieved, consistent with AFTC mission requirements and risk guidance (Edwards Air Force Base 2006).

Explosives and propellants are used and stored in a number of locations throughout Edwards AFB, including the AFRL. An inhabited building separation distance (or clear zone) has been established around each of the existing explosives and/or propellant use/storage locations. The size of the clear zone varies based on the quantity and type of explosive used, or propellant stored. Clear zones ensure the safety of all personnel in the area from the potential overpressure hazard associated with use and storage of these materials (Edwards Air Force Base 2006).

3.8.2 Emergency Services

Emergency services refer to the capability of ensuring protection of people and property. Emergency services at Edwards AFB ensure the protection of personnel and property. The Emergency service umbrella at Edwards AFB consists of the Fire Department, Security Forces and the Medical Group.

3.8.2.1 Fire Protection/Prevention

Fire protection on Edwards AFB includes trained personnel and equipment organized to respond to a series of emergencies. Guidance for implementing the fire protection and prevention program is outlined in Edwards AFB Instruction 32-11, *Fire Prevention and Protection Program*. The emergency response time of the Fire Protection Division is contingent upon the distance to the emergency site and the availability of personnel, support equipment and supplies. All areas of Edwards AFB are currently covered (Edwards Air Force Base 2006).

3.8.2.2 Security

Security forces provide general law enforcement on Edwards AFB. Law enforcement duties include traffic stops, domestic disputes and police investigations. Security forces (police) include personnel and equipment organized and trained to respond to a series of emergencies, as well as to provide a daily security presence. Security programs provide the means to counter threats during peacetime, mobilization, or wartime. The SFS is the project proponent for the proposed security fence project (Edwards Air Force Base 2006).

3.8.2.3 Medical Services

Medical services at Edwards AFB include personnel and equipment that are organized and trained to respond to a series of emergencies. AFI 41-106, *Medical Readiness Planning and Training*, establishes procedures for medical readiness, planning, and training during peacetime and wartime operations (Edwards Air Force Base 2006).

3.9 WATER RESOURCES

3.9.1 Playa Lakebeds

Edwards AFB is situated at the bottom of Antelope Valley, a 2,400-square mile watershed that drains into four playa lakebeds: Buckhorn, Rich, Rogers and Rosamond Dry Lakes. They all receive water and sediment from the upper watersheds and its tributaries and slopes. In the past, these playas were

permanent lakes that were constantly inundated by perennial streams. As the regional climate became drier over the last few thousand years, these permanent lakes and perennial streams became dry lakebeds and ephemeral washes.

These dry lakes, or playas, made up the floodplain and receive water during the winter months where it left to evaporate during the spring and early summer months. During less than average rainfall periods where less than 5 inches of rain may fall, the playas remain dry for most of the year. Where occasional rainfall is above average or 10 inches, the playas contain water through the winter months and do not evaporate until summer (United States Air Force 2008b)

3.9.2 Surface Water

The largest surface water on Edwards AFB is Piute Ponds, which is an impoundment area for secondary-treated water and comprises 400 acres in the southwest corner of Edwards AFB. This is located 20 miles southwest of the AFRL. Branch Memorial Park pond is found in the south-central portion of Edwards AFB, south-southwest of the AFRL. This pond was constructed in the late 1960s as a fishpond. There are constructed detention basins along the flight-line to keep stormwater from flooding the runway and taxiways. There are two major WWTPs found at Edwards AFB (discussed in Section 3.5.3) that include a number of evaporation ponds, including four small evaporation ponds at the AFRL.

3.9.3 Groundwater

Edwards AFB overlies portions of three sub-basins of the Antelope Valley groundwater basin: the North Muroc sub-basin, the Lancaster Sub-basin and the Gloster sub-basin (United States Air Force 2008a). In addition, Edwards AFB encompasses two areas of shallow bedrock and low groundwater yield, known as the Rosamond-Bissel and Hi Vista Areas. The AFRL is located within the Hi Vista area, which provides groundwater recharge to the North Muroc and Lancaster sub-basins. The AFRL has not been designated as a critical recharge area (United States Air Force 2008a). Groundwater below the AFRL occurs within fractures in both the weathered and competent granitic bedrock. Groundwater flow rates in monitoring wells screened across first water contact are generally low typically less than 1 gallon per minute but well production rates as high as 8 gallons per minute are found locally (United States Air Force 2008a).

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential environmental consequences or impacts associated with the Proposed Action and Alternatives. Changes to the natural and human environment that could result from Alternatives A, B or C were evaluated relative to the existing environmental conditions described within Chapter 3.0. If necessary, environmental protection measures recommended to mitigate adverse impacts are provided. In addition, this chapter provides a discussion of cumulative impacts, unavoidable adverse effects, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity and the irreversible and irretrievable commitment of resources.

4.1 AIR QUALITY AND GREENHOUSE GASES

4.1.1 Alternative A – Proposed Action

4.1.1.1 Air Quality Emissions

The Proposed Project entails the construction of a security fence, associated gates, and surveillance equipment around the AFRL, as described in Chapter 2.0. Air quality impacts associated with the project are related to emissions that would occur during construction and subsequent operation of the security fence. Construction would result in temporary emissions from fugitive dust and vehicles associated with construction. Once project construction is complete, the emission of airborne pollutants is also complete. Operation of the project and all alternatives would not contribute any emissions that could adversely impact the air quality in the region or harm human health. The completion of the fence would not lead to an increase in installation traffic or security patrols, nor would the action result in associated mobile or stationary air emissions sources. Thus, the long-term contribution of air emissions for this project and its alternatives would be minimal to nil.

Air emissions would be generated on a short-term basis during construction activities. It is assumed that this project would be accomplished in less than 1 year. The principal sources of pollutants during construction would be earth-moving activities, construction equipment, trucks bringing materials to the site and construction crew commuting vehicles. A summary of the construction-related air emissions are presented in Table 4-1. The assumptions and calculations used to generate these air emissions are presented in Appendix C.

Table 4-1
Project Construction Air Emissions Summary

Process	NO_X Emissions (tons)	CO Emissions (tons)	SO_X Emissions (tons)	PM_{10} Emissions (tons)	$PM_{2.5}$ Emissions (Tons)	TOC* Emissions (tons)	Pb Emissions (tons)
Trenching	-	-	-	5.7	2.8	-	-
Construction Vehicle Traffic	-	-	-	5.8	0.58	-	-
Construction Vehicle and Equipment Fuel Usage	0.63	0.19	0.04	0.04	-	0.21	9.84 E -06
Soil Scraping	-	-	-	1.1	0.5	-	-
TOTAL	**0.63**	**0.19**	**0.04**	**12.64**	**3.88**	**0.21**	**9.84 E -06**

Notes: * Assumed to be equal to VOCs for the purposes of this assessment
NO_x=nitrogen oxides
CO=carbon monoxides
SO_x=sulfur oxide
PM_{10}=particulate matter 10 microns or less in diameter
$PM_{2.5}$= particulate matter 2.5 microns or less in diameter
TOC=total organic carbon
Pb=lead
VOC=volatile organic compound

The short-term emissions during the construction phase would not be significant, nor would they result in a violation of air quality standards or contribute substantially to an existing or projected air quality violation. Overall this project has air emissions far below any of the *de minimis* thresholds identified in Table 3-2 in Section 3.1.2. It is, therefore, exempt from conformity analysis per 93 CFR 153 (c)(2), which states that all "actions which would result in no emissions increase or an increase in emissions that is clearly *de minimis*" are exempt from conformity determinations. Furthermore, because there are no emissions sources associated with the project beyond construction, there is no basis or need for comparison with regional and installation emissions levels.

The project would be required to comply with regional rules that assist in reducing air pollutant emissions. In particular, fugitive dust must be controlled with best available control measures, including watering active grading sites and covering all vehicles hauling dirt, sand, soil or other loose materials. Because impacts would not be significant, no additional environmental protection measures are required. In addition, no permit would be required to construct as the emissions would be generated by mobile sources that are either permitted by CARB or exempt from permit requirements.

4.1.1.2 Greenhouse Gas Emissions

The combustion of fossil fuels associated with the construction also generates GHG emissions in the form of CO_2, N_2O and CH_4. These emissions are represented in Table 4-2 in both pounds (lbs) and metric tons of CO_2 equivalent ($MTCO_2e$) which is the standard metric for reporting GHG emissions. To convert to $MTCO_2e$, global warming factors were used from the Intergovernmental Panel on Climate Change's Second Assessment Report. Calculations are provided in Appendix C. The Project site straddles the jurisdiction of two air districts: the Mojave Desert Air Quality Management District (MDAQMD) and the Eastern Kern Air Pollution Control District (EKAPCD). The MDAQMD currently has no established GHG emission threshold of significance. The EKAPCD has an emission threshold of 25,000 $MTCO_2e$. For comparison purposes, the South Coast Air Quality Management District (SCAQMD) emission threshold of 10,000 $MTCO_2e$ GHG emissions produced by the Proposed Action are well below either threshold.

Table 4-2
Project Construction GHG Emissions Summary

Process	CO_2 Emissions (lbs)	CO_2 Emissions ($MTCO_2e$)	N_2O Emissions (lbs)	N_2O Emissions ($MTCO_2e$)	CH_4 Emissions (lbs)	CH_4 Emissions ($MTCO_2e$)	Total GHG Emissions ($MTCO_2e$)
Trenching	2,213.35	1.00	8.72E-02	1.23E-02	2.18E-02	2.08E-04	1.02
Construction Vehicle Traffic	25,994.63	11.79	1.87E-02	2.63E-03	2.52E-02	2.40E-04	11.80
Construction Vehicle and Equipment Fuel Usage	33,387.82	15.14	1.08	1.52E-01	1.14	1.09E-02	15.31
Soil Scraping	516.07	0.23	1.32E-02	1.86E-03	2.96E-02	2.81E-04	0.24
TOTAL GHG EMISSIONS							**28.37**

Notes: GHG=greenhouse gas
CO_2=carbon dioxide
N_2O=nitrous oxide
CH_4=methane
$MTCO_2e$= metric tons of CO_2 equivalent

4.1.2 Alternative B – All Chain Link Fence Alternative

Under the Chain Link Fence Alternative, air quality impacts would be the same as for those under the Proposed Action. There would be no adverse impacts.

4.1.3 Alternative C – No Action Alternative

Under the No Action Alternative, the security fence, surveillance equipment and roads would not be constructed and, therefore, there would be no air quality impacts.

4.2 CULTURAL RESOURCES

Section 106 of the NHPA requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Council a reasonable opportunity to comment on such undertakings. Historic properties are any prehistoric or historic district, site, building, structure or object included in, or eligible for inclusion in the NRHP maintained by the Secretary of the Interior. Section 106 and its implementing regulations state that an undertaking has an effect on a historic property—an NRHP-eligible resource—when that undertaking may alter those characteristics of the property that qualify it for inclusion on the NRHP. An undertaking is considered to have an adverse effect on an NRHP-eligible resource or property when it diminishes the integrity of the location, design, setting, materials, workmanship, aesthetic value or association. Adverse effects include the following:

- Physical destruction, damage or alteration of all or part of the property;
- Isolation of the property or alteration of the property's setting when that character contributes to the property's qualifications for the NRHP;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that may alter its setting;
- Neglect of a property, resulting in its deterioration or destruction; and
- Transfer, lease or sale of a property without adequate provisions to protect its historic integrity.

Factors considered in determining whether an action would have a significant impact on cultural resources include the extent to which its implementation would have an adverse effect on a historic property or traditional cultural property (TCP), as defined under Section 106 of the NHPA, or would violate the provisions of American Indian Religious Freedoms Act (AIRFA), Archaeological Resources Protection act (ARPA) or Native American Graves Protection Repatriation Act (NAGPRA).

An adverse effect on a historic property, as defined by the NHPA, is not necessarily a significant impact under NEPA. While mitigation under the NHPA does not necessarily negate the adverse nature of an effect, mitigation under NEPA can reduce the significance of an impact. NHPA and NEPA compliance

are separate and parallel processes, and the standards and thresholds of the two acts are not precisely the same.

The Programmatic Agreement (Edwards Air Force Base 2009) addresses the methods for assessing potential impacts on cultural resources in Section 2.3 of the PA, *Findings of Effect*. Most of the cultural resources sites within the APE have not been evaluated for eligibility for the NRHP. Under the PA, Edwards AFB prepares an annual report that summarizes all actions that pertain to historic properties. Consultation with the SHPO is only required when adverse effects cannot be avoided. Recognized Native American Tribes who have traditionally inhabited or used the lands within Edwards AFB were given the opportunity to participate in development of the PA and the ICRMP, and will continue to be provided the opportunity to participate in the implementation, review and revision of the ICRMP and, as may be necessary, of the PA.

The PA also states that when eligible or potentially eligible properties are identified within the APE for an undertaking, the BHPO, or qualified personnel under that direction of supervision of the BHPO will review, analyze and document the undertaking's potential for effect, including:

- Assess the undertaking's consistency with avoidance measures outlined in the PA; and
- Make available the documentation of findings to the Council, SHPO and other parties.

4.2.1 Alternative A – Proposed Action

As a result of the Proposed Action, approximately 5.4 acres would be disturbed (permanent and temporary) in areas within the APE of known archaeological resources. The entire APE for the Proposed Action has been previously surveyed although not all resources have been evaluated. The layout of the proposed 18-mile security fence and the improvement of or creation of the 10-foot wide dirt road that would be constructed next to the fence have been sited to avoid known sensitive cultural resources.

The Section 106 process will be completed and documented consistent with the provisions of the PA in order to avoid adverse effects on historic properties. However, impacts could still occur during the construction and operation of the Proposed Action on cultural resources within the APE from destruction or alteration of a previously unknown cultural resources site from construction activities or at the staging and stockpile areas of the Proposed Action and underground installation of ground sensors for cameras and monitoring systems.

In accordance with PA, when an eligible or potentially eligible property is identified within the APE, Edwards AFB will ensure that ground disturbing activities implement measures to protect archeological resources from inadvertent effects. The following environmental protection measures are in place within the PA to ensure that impacts to cultural resources are not significant.

***Environmental Protection Measure CR-1*:** The avoidance measures listed below are found in Section 2.4 *Treatment of Archaeological Properties*, Avoidance Measures, in the PA (Edwards Air Force Base 2009):

- All vehicles are required to stay on established roads or within an established training area;
- Unauthorized collection of archaeological materials is prohibited;
- Unauthorized digging is prohibited;
- Archaeological sites in high-use or high-risk areas are posted with archaeological site protection signage;
- Where historic properties may or may not be at risk of inadvertent effect by an undertaking, Edwards AFB will provide for archaeological monitoring of ground-disturbing activities;
- Edwards AFB has determined that inadvertent site disturbances from vehicles and other ground-disturbing activities are more likely to occur along road corridors and in other high-use areas; and
- In order to avoid potential adverse effects from vehicles and other ground-disturbing activities, Edwards AFB shall continue to implement the site protection strategy of protective signage of archaeological sites on Edwards AFB.

Environmental Protection Measure CR-2: Edwards AFB cultural resources staff shall determine the scope of the archaeological monitoring program before any project-related soil-disturbing activities begin and shall determine what project activities shall be monitored. The monitor shall be a qualified archaeologist who meets the professional requirements under the Secretary of the Interior's standards and will conduct the following activities:

- The archaeological monitor shall train all project construction personnel who could reasonably be expected to encounter archaeological resources, how to identify the evidence of the expected resources, and the appropriate protocol in the event of apparent discovery of an archaeological resource;
- The archaeological monitor(s) shall be present on the project site according to a schedule agreed on by the Edwards AFB cultural resources staff; and

- The archaeological monitor shall record and be authorized to collect soil samples and artifactual/ecofactual material as warranted for analysis.

Environmental Protection Measure CR-3: Although the APE for the Proposed Action has been surveyed for the presence of cultural resources and the new fence would be routed mostly along existing roads and fences so that known cultural resources are avoided, there is the possibility that unknown subsurface archaeological sites are located within the APE. The monitor should be present for all excavations within high site probability areas and be available in the event that unanticipated discoveries are made during construction. If, during the performance of the undertaking, historic properties are discovered or unanticipated effects are found, the procedures in Section 2.5 of the PA *Inadvertent Discoveries and Emergencies* shall be followed. These are:

- The activity will be immediately stopped in the vicinity of the discovery and the BHPO will be immediately notified;
- Contractors and authorized agents at Edwards AFB are also required to stop work in the vicinity of any discovered archaeological deposits and immediately contact the BHPO and await for review by the BHPO and direction from the Installation Commander or Base Civil Engineer; and
- Excavations in the area of the discovery must remain halted until a qualified archaeologist who meets the professional requirements under the Secretary of the Interior's standards can determine the nature, extent and age of the archaeological deposit. Excavations outside of the find location may proceed with continued monitoring.

Implementation of Environmental Protection Measures CR-1, CR-2, and CR-3 from the PA would keep impacts from the Proposed Action on archaeological resources to less than significant levels.

4.2.2 Alternative B – All Chain Link Fence Alternative

Under the Chain Link Fence Alternative, impacts on cultural resources within the APE would be the same as for those under the Proposed Action. The environmental protection measures identified for the Proposed Action (Environmental Protection Measures CR-1, CR-2 and CR-3) would reduce impacts to cultural resources to less than significant levels.

4.2.3 Alternative C – No Action Alternative

Under the No Action Alternative, the security fence and roads would not be constructed and underground security features would not be installed. There would be no impacts on cultural resources in the APE

associated with this undertaking. However, current threats to the integrity of cultural resources from looting, trespassing, vehicle use and other unauthorized ground disturbance on the portions of Edwards AFB that would be protected by a more secure fence and installation of surveillance cameras would continue under the No Action Alternative.

4.3 GEOLOGY AND SOILS

4.3.1 Alternative A – Proposed Action

4.3.1.1 Geology

Construction and operation of the proposed security fence and surveillance equipment would not expose structures or facilities suitable for occupation to potential geologic hazards associated with the region. A seismic event and potential damage to the fence would not likely cause injury or death. No adverse geologic or seismic effects would occur.

4.3.1.2 Soils

Soils found in the AFRL area are sandy in texture and as a result, are susceptible to wind erosion. Construction of the security fence, surveillance equipment, and road improvements have the potential to increase soil erosion in the area. Activities such as the minor trenching needed to set posts and access road construction and improvement has the potential to disturb soils and increase susceptibility to wind erosions. However, the total area to be disturbed during construction is estimated to be a total of 3.2 acres of temporary disturbance and 2.2 acres of permanent disturbance for a total disturbance of 5.4 acres. In addition, only a small amount of soil would be disturbed at one time, thereby reducing impacts. As a result, no adverse effects to soils or from soils would result from construction of the fence. There would be no impacts associated with operation of the fence and associated surveillance equipment.

4.3.2 Alternative B – All Chain Link Fence Alternative

4.3.2.1 Geology

Similar to the Proposed Action, there would be no adverse geologic or seismic impacts resulting from construction and operation of an all chain link fence.

4.3.2.2 Soils

Similar to the Proposed Action, there would be no adverse impacts to soils resulting from construction and operation of an all chain link fence.

4.3.3 Alternative C – No Action Alternative

Under the No-Action Alternative, the fence and security features and surveillance equipment would not be installed and, therefore, there would be no impacts related to geology or soils.

4.4 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

4.4.1 Alternative A – Proposed Action

4.4.1.1 Hazardous Materials and Hazardous Waste

Construction of the proposed fence, surveillance equipment and road improvements would require use of minor amounts of hazardous materials such as fuels and lubricants for construction equipment. The selected construction crew would require the use and storage of hazardous materials. The Proposed Action would generate minimal wastes during construction and there would be a limited amount of hazardous materials stored or used on site during construction. Storage of these materials during construction would be likely in an identified area near the project. Hazardous materials necessary for project implementation that require temporary storage within the AFRL and any hazardous waste generated will be stored and managed in compliance with AFI 32-7042, *Waste Management*, and any other Edwards AFB requirements.

4.4.1.2 Environmental Restoration Program

Construction of the Proposed Action fence and security features and surveillance equipment would not mobilize existing contaminants associated with OU4 and OU9 sites found within the AFRL in groundwater or soil, or expose workers to contaminated soils or groundwater at levels in excess of those permitted by federal and state law. The risk of exposure to contaminated groundwater by construction workers is unlikely as groundwater, which is greater than 20 feet deep in the project area, would not be encountered during construction. In addition, the limited soil contamination is at levels requiring no further action.

The fence configuration has been designed to allow access to ERP wells (Figure 2-2). No impacts to existing ERP wells would occur. The proposed fence alignment would cross across Site OU9-115-A (Figure 3-1). Although this site is a former leach field that remains open, a fuel oil underground storage tank that was on the site has been removed. Sites OU9-362-A, OU9-376-A, OU9-39-A, OU9-305-A and OU9-114-A are located within Site OU9-115-A (Figure 3-1). These sites have had remedial activities and have been closed as part of the ERP process (Edwards Air Force Base 2004). The installation of the

proposed fence would not impact these sites as investigations have been concluded. As there would be minor amounts of soil disturbance, there would not be an increase in exposure of construction workers or the environment to potentially hazardous levels of chemicals due to the disturbance of previously contaminated soils. To ensure worker safety within the AFRL, the following environmental protection measure will be implemented:

***Environmental Protection Measure HAZ-1*:** Prior to construction activities, a health and safety plan in compliance with 29 CFR 1910.120 will be prepared and approved by Edwards AFB. All construction workers used for installation of the fence, security features and surveillance equipment will have received 40-hour HAZWOPER training and be current with 8-hour refresher training. The site-specific health and safety plan will address all site-specific safety and environmental hazards that have the potential to be encountered during construction and installation of the fence, including physical hazards, biological hazards, and general safety hazards. Any training required by construction personnel will be identified.

4.4.2 Alternative B – All Chain Link Fence Alternative

4.4.2.1 Hazardous Materials and Hazardous Waste

Similar to the Proposed Action, there would be no adverse impacts associated with hazardous materials or hazardous waste resulting from construction and operation of an all chain link fence.

4.4.2.2 Environmental Restoration Program

Similar to the Proposed Action, there would be no adverse impacts related to ERP sites resulting from construction and operation of an all chain link fence. Environmental Protection Measure HAZ-1 would still be implemented to ensure worker safety.

4.4.3 Alternative C – No Action Alternative

Under the No-Action Alternative, no hazardous materials would be used and no hazardous waste would be generated to construct the fence, surveillance equipment or road improvements. No impacts would occur. In addition, no impacts related to ERP sites would occur.

4.5 INFRASTRUCTURE

A project may have significant effects on a public utility if it increases demand in excess of utility system capacity to the point that substantial expansion becomes necessary. Significant environmental impacts

could also result from system deterioration due to improper maintenance or extension of service beyond its useful life. Destruction or damage of infrastructure would also be considered a significant impact.

4.5.1 Alternative A – Proposed Action

4.5.1.1 Energy Resources

Construction of the proposed security fence would require a negligible amount of gasoline or diesel to power the construction equipment. During the lifetime of the fence, a negligible amount of electricity would be needed for the security cameras and other surveillance equipment. Neither of these would result in a significant impact to energy resources at Edwards AFB.

4.5.1.2 Water Distribution System

Construction of the proposed security fence and associated road improvements would result in a small, temporary increase in water use for dust control. This would not result in a significant increase in water demand at Edwards AFB. No water would be needed for the operation and use of the fence during its lifetime.

4.5.1.3 Wastewater/Stormwater

Construction and operation of the proposed security fence would not result in any increased use of the existing wastewater or stormwater management systems at Edwards AFB.

4.5.1.4 Communication System

Construction of the proposed security fence would not result in any increased use of the communication system at Edwards AFB. Once the fence is constructed, the proposed surveillance system would include camera and fiber cable installation, and communication connectivity with the SFS ECC. The planning and installation of the surveillance equipment would need to be coordinated with the Communications Squadron. This is not considered a significant impact.

4.5.2 Alternative B – All Chain Link Fence Alternative

Impacts to infrastructure resulting from Alternative B would be the same as for the Proposed Action. There would be no adverse impacts.

4.5.3 Alternative C – No Action Alternative

Under the No Action Alternative, no new security fence would be constructed and, therefore, there would be no impacts to infrastructure.

4.6 NATURAL RESOURCES

For the purposes of this analysis, all ground disturbance activity is considered a permanent impact as a result of the long time period for natural revegetation to occur in the desert. Temporary impacts were assumed to be areas where vegetation might be driven over a limited number of times during the installation of the fence, but not removed or the ground surface disturbed. Table 4-3 summarizes the permanent and temporary impacts. The acreages of impacts are assumed to be the same for the two action alternatives because they result from new or widened roads (where current road width is inadequate to meet the purpose and need in Chapter 2) and the installation of fence posts. The assumptions used to calculate the acreage impacts are as follows:

- The proposed fence line was classified to represent the condition of any adjacent roads/trails. Two classifications were used: Existing Road and No Road;
- Impacts for fence post installation (14,129 posts total) were estimated at 15 square feet per post temporary impacts, from equipment driving between the existing roads and fence post locations, and 1 square foot per post permanent impacts;
- Impacts for the No Road classification were for post installation impacts and the grading of a 10-foot wide new access road;
- Impacts for each road classification were separated into two categories representing areas inside the desert tortoise critical habitat boundary, and areas outside the boundary; and
- The proposed fence is assumed to be close enough to Mars Boulevard to classify this fence segment as Existing Road.

Table 4-3
Temporary vs. Permanent Impacts

Type of Impact	Outside Desert Tortoise Critical Habitat (acres)	Within Desert Tortoise Critical Habitat (acres)	Total Acres
Permanent Impacts	1.5	0.7	2.2
Temporary Impacts	1.9	1.3	3.2
Total Acres	**3.4**	**2.0**	**5.4**

Figure 4-1 shows the status of existing roads along the proposal fence line.

X:\GIS\EAFB-AFRL\AFRL_Acres_Crit_Hab.mxd

CONSTRUCTION RELATED IMPACTS				
	Area in Acres Outside Desert Tortoise Critical Habitat		Area in Acres Inside Desert Tortoise Critical Habitat	
	Temporary	Permanent	Temporary	Permanent
Post Installation	1.9	0.1	1.3	0.1
Existing Road	--	0.0	--	0.0
No Road	--	1.4	--	0.6
Total	**1.9**	**1.5**	**1.3**	**0.7**

AFRL Test Area 1-100

AFRL Test Area 1-90

Leuhman Ridge

1-36D Burn Pit

AFRL Main Entrance Gate

Test Area 1-46

X-33 Site

Haystack Butte

Photo Resolution Rd

LEGEND

Proposed AFRL Fence

Existing AFRL Fence

Desert Tortoise Critical Habitat Boundary

Current Road Conditions Adjacent to Proposed Fence

Existing Road

No Road

N

0 2,000 4,000 Feet

EDWARDS AIR FORCE BASE

Figure 4-1

Existing Roads Along Fence Line

Direct impacts on vegetation include disruption, trampling, or removal of rooted vegetation resulting in a reduction in the total acres of native vegetation, or the direct injury or death of individual plants or animals. Indirect impacts occur later in time or are farther removed in distance while still being reasonably foreseeable and related to the project. Potential indirect impacts include introduction of invasive species that compete with native species and can result in habitat degradation.

Those biological resources included in this analysis are summarized on Table 4-4 and discussed in more detail in Section 3.6. Each resource is further discussed in this analysis.

Table 4-4
Biological Resources Summary for Impact Analysis

Resource of Concern	Potential Impacts
Vegetation Communities	*Direct Impacts*: acreage of habitats affected *Indirect Impacts*: introduction of invasive species
Wildlife Communities Including nests protected under the MBTA	*Direct Impacts*: direct injury or mortality to non-sensitive species; take of a nest protected under the MBTA *Indirect Impacts*: temporary noise and dust impacts during fence installation; degradation of localized vegetation and wildlife communities
Sensitive Species - Plants Pygmy poppy, Mojave spineflower, desert cymopterus, and Barstow woolly sunflower	*Direct Impacts*: direct removal of individual plants *Indirect Impacts*: habitat degradation, introduction of non-native invasive species *Beneficial Impacts*: additional protection for portions of population of desert cymopterus
Sensitive Species – Wildlife *Listed species*: desert tortoise and Mohave ground squirrel *Other sensitive species*: chuckwalla, raptors (golden eagle, prairie falcon, long-eared owl, burrowing owl), LeConte's thrasher, loggerhead shrike, bats, American badger	*Direct Impacts*: direct injury or mortality of individuals *Indirect Impacts*: temporary noise and dust impacts during fence installation; degradation of localized vegetation and wildlife communities *Beneficial Impacts*: additional protection from lessening off-road driving impacts
Sensitive Habitats Desert tortoise critical habitat and DWMA	*Direct Impacts*: direct removal vegetation within critical habitat/DWMA *Indirect Impacts*: degradation of critical habitat/DWMA, introduction of non-native invasive species into critical habitat

Notes: MBTA=Migratory Bird Treaty Act
DWMA=Desert Wildlife Management Area

The proposed project would have a significant impact on biological resources if it meets any of the following criteria:

1. Has a substantial adverse effect on native vegetation or wildlife communities. A substantial adverse effect is defined for this analysis as having the potential to adversely affect more than five percent of any local vegetation or wildlife community.

2. Adversely affects any species listed as endangered or threatened by the federal or state endangered species acts. These effects would also require permitting under the federal and/or state Endangered Species Act(s).

3. Adversely modifies designated critical habitat for any endangered or threatened species. These affects would also require permitting under the federal Endangered Species Act.

4. Result in a violation of the federal MBTA.

5. Has a substantial adverse effect on other sensitive plant or wildlife species as shown in Table 4-4.

6. Has a substantial adverse effect on any sensitive habitat as shown on Table 4-4.

7. Exceed the 16-acre total native habitat loss allowed under the existing Programmatic BO for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (USFWS 1997).

4.6.1 Alternative A – Proposed Action

4.6.1.1 Vegetation Communities

Under the Proposed Action, approximately 5.4 acres of native vegetation communities would be directly removed as a result of temporary and permanent disturbance during construction activities. Table 4-5 summarizes these effects by vegetation community. Of the 5.4 acres, 2.2 acres would result in permanent disturbance (refer to Table 4-3), which would count towards the 16-acre habitat loss allowed under the BO for the AFRL. To date, 3.5 acres have been disturbed. With the additional 2.2 acres required for this project, total allowed disturbance would be 5.7 acres, leaving 10.3 acres for other projects.

Table 4-5
Impacts to Vegetation Communities

Plant Community	Project Impacts (acres)
Burrobush scrub	0.3
Creosote bush scrub	2.4
Joshua tree woodland	1.1
Saltbush scrub	1.6
Total	**5.4**

Overall, none of these effects represent a substantial portion of these vegetation communities either on Edwards AFB, or regionally. This impact is expected to be less than significant and requires no avoidance and minimization measures.

Indirect impacts that may result from the removal of this vegetation include the increased potential for the spread of non-native invasive plant species, as defined by the BLM and California Invasive Plant Council (U.S. Department of the Interior, Bureau of Land Management 1992, 2008; Cal-IPC 2006). This impact is not expected to be significant with the incorporation of avoidance and minimization measures in Section 4.6.4.

4.6.1.2 Wildlife Communities

Wildlife communities associated with the 5.4 acres of vegetation communities may be directly affected, including potential injury and mortality of individuals of local populations of non-sensitive species. None of these effects represent a substantial portion of these wildlife communities either on Edwards AFB or regionally. This impact is expected to be less than significant and requires no avoidance and minimization measures.

Direct impacts associated with the take of a nest protected under the MBTA would be considered a significant impact. Avoidance and minimization measures in Section 4.6.4 will be used to reduce these impacts to a less than significant level.

Indirect impacts associated with the fence installation include temporary effects of locally increased noise and dust. Because the area that surrounds the fence installation currently supports activities that create loud noise (sonic booms, rocket tests, etc.) and dust, the temporary increase of these factors in localized areas for the fence installation is expected to be extremely minimal. This impact is expected to be less than significant and requires no avoidance and minimization measures.

Indirect impacts may also result from the localized degradation of vegetation and wildlife communities, not only in areas directly affected, but in edge areas. Due to the small size of these potential effects, this impact is expected to be less than significant and requires no avoidance and minimization measures.

4.6.1.3 Sensitive Species and Habitats

Sensitive Species - Plants

Direct impacts to individuals and portions of populations of sensitive plants found within the 5.4 acres of disturbance may result from fence installation activities. These impacts may include the removal of less than 0.01 acres of desert cymopterus, which is not expected to represent a substantial portion of individuals or populations either on Edwards AFB or regionally. This impact is expected to be less than significant and requires no avoidance and minimization measures.

Indirect impacts to individuals and populations of sensitive plant that may result from the proposed action include the increased potential for the spread of non-native invasive plant species that can displace native species. This impact is not expected to be significant with the incorporation of the avoidance and minimization measures described in Section 4.6.4.

Beneficial impacts could result from the proposed project by increasing protection of desert cymopterus populations on both sides of the fence by reducing vehicle traffic in these areas. This impact is beneficial and requires no avoidance and minimization measures.

Sensitive Species - Wildlife

Desert Tortoise. Direct impacts to desert tortoise could result from injury or mortality during fence installation due to vehicles crushing individuals or burrows occupied by individuals. Because the desert tortoise is a federally and state listed threatened species, any injury or mortality to a desert tortoise would be considered an adverse impact. This adverse impact would be eliminated by the incorporation of reasonable and prudent measures as described in the Programmatic Biological Opinion for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (United States Fish and Wildlife Service 1997), as outlined in Section 4.6.4.

Indirect impacts to desert tortoise could include temporary effects of locally increased noise and dust. Because the area that surrounds the fence installation currently supports activities that create loud noise (sonic booms, rocket tests, etc.) and dust, the temporary increase of these factors in localized areas for the

fence installation is expected to be extremely minimal. This impact is expected to be less than significant and requires no additional avoidance and minimization measures.

Indirect impacts from the degradation of burrowing and foraging habitat could occur as a result of the proposed action, not only in areas directly affected, but in edge areas. Due to the small size of these potential effects, this impact is expected to be less than significant and requires no additional avoidance and minimization measures.

Additional indirect impacts could occur from providing perches for the common raven (*Corvus corax*), a known predator of juvenile desert tortoise. This impact can be reduced to a less than significant level by the incorporation of reasonable and prudent measures as described in the Programmatic Biological Opinion for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (United States Fish and Wildlife Service 1997), as outlined in Section 4.6.4 and provided in Appendix B.

Mohave Ground Squirrel. Direct impacts include the potential for injury and mortality of Mohave ground squirrels as part of the proposed project. These impacts are considered significant and would be reduced to a less than significant level with the incorporation of avoidance and minimization measures in Section 4.6.4.

Indirect impacts would include the removal of approximately 5.4 acres of potential burrowing and foraging habitat for this species, and impacts that would result from temporary and localized increases in noise and dust. These impacts are expected to be less than significant due to their small size, temporary nature, and the presence of existing noise and dust from other activities in the area. These impacts would require no additional avoidance and minimization measures.

Other Sensitive Wildlife Species. Direct impacts include the potential for injury and mortality of other sensitive species (raptors, passerines, burrowing owls, bats, and American badgers) as part of the proposed project. These impacts are not likely to be significant with the incorporation of avoidance and minimization measures in Section 4.6.4.

Indirect impacts would include the removal of approximately 5.4 acres of potential burrowing and foraging habitat for these species, and impacts that would result from temporary and localized increases in noise and dust. These impacts are expected to be less than significant due to their small size, temporary nature, and the presence of existing noise and dust from other activities in the area.

Beneficial effects may also result from the installation of the proposed fence because local wildlife populations may experience fewer adverse impacts from off-road vehicle activity due to the fence. This impact is beneficial and requires no avoidance and minimization measures.

Sensitive Habitats - Designated Critical Habitat

The Proposed Action would occur within designated critical desert tortoise habitat (Fremont-Kramer Recovery Unit) in an area that also coincides with the Fremont-Kramer DWMA managed for desert tortoise conservation. Approximately 1.0 percent of critical habitat and DWMA for the desert tortoise occurs on Edwards AFB. The proposed fence installation could permanently remove up to 0.7 acres or less than 0.00001 percent of the total designated critical habitat, and would temporarily affect up to 1.3 additional acres. Although very little critical habitat would be affected, any adverse modification of critical habitat could be considered a significant impact and require formal consultation. However, the proposed fence project also has the potential to provide additional protection to areas of critical habitat and DWMA on both sides of the fence by reducing potential off road activities that degrade these areas. For the proposed project, these beneficial impacts are likely to more than offset the removal of approximately 0.00001 percent of critical habitat and no additional avoidance or minimization is required beyond the measures in Section 4.6.4.

4.6.2 Alternative B – All Chain Link Fence Alternative

Natural resources potentially affected by implementing Alternative B would include impacts on plant communities, wildlife communities, sensitive species and habitats as discussed for Alternative A. All impacts likely to occur with Alternative B are likely to be the same as those discussed in Section 4.6.1 for the Proposed Action, with the exception of additional potential impacts to the movement of desert tortoises as described below.

Indirect impacts to desert tortoises could result from restricting movement of individuals due to the design of the fence. Although desert tortoises can dig under chain link fence, an all chain link alternative could restrict movement more than the fence design of Alternative A and could result in altered home ranges and different social structure. This impact could be significant; however, the design as proposed for this alternative includes features to allow for relatively unrestricted movement of this species, and continued maintenance to ensure desert tortoise movement is unimpeded. As a result, impacts to wildlife movement would not be significant.

4.6.3 Alternative C – No Action Alternative

Under the No-Action Alternative, no fence would be installed. There would be no additional impacts on natural resources resulting from the No-Action Alternative, although the beneficial impacts of the action alternative would also not occur.

4.6.4 Environmental Protection Measures

The following measures will be employed to reduce any potential significant impacts to natural resources to less than significant levels, and as best management practices. These measures include those in the BO (United States Fish and Wildlife Service 1997).

***Environmental Protection Measure BIO-1*:** Provide a WEAP to all individuals that will be working on the project in the field (United States Fish and Wildlife Service 1997; Edwards Air Force Base 2008). This program will consist of videos, brochures and briefings and will include information on:

1. The role of biological monitors and authority of monitors to stop work;
2. Locally known invasive weeds and limiting weed spread and colonization;
3. The MBTA and nest-avoidance measures;
4. Desert cymopterus, Mojave spineflower and Barstow woolly sunflower;
5. Desert tortoise history in the project area, desert tortoise ecology, threats to the species, and the protection measures described here and in the BO (United States Fish and Wildlife Service 1997);
6. Mohave ground squirrel history in the project area, ecology and the avoidance and minimization measures described in this section for this species;
7. Other sensitive species that may be found throughout the construction of the project, and the avoidance and minimization measures described in this section for these species; and
8. Locations and designations of critical habitat and DWMA in the project area.

All personnel will sign a statement that they have received, understand and will follow the regulations and protection measures presented in the program. Copies of signed statements will be on file at the

Environmental Management Office. This measure fulfills or exceeds the requirements of Terms and Conditions A.1 in the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-2**:** Wash all vehicles and equipment prior to bringing them on site if they have been used in areas off base.

Environmental Protection Measure BIO-3**:** All project-related construction activities will be conducted during daylight hours. If any activities are to disturb native habitat between dusk and dawn, they shall be limited to areas which have already been cleared of desert tortoises by biological monitors and enclosed by a fence to exclude desert tortoises (United States Fish and Wildlife Service 1997). This measure fulfills or exceeds the requirements of Terms and Conditions A.2 of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-4**:** Ensure that qualified biological monitors are present during all construction-related activities to confirm avoidance and minimization of all biological resources is being conducted to the maximum extent practicable. These measures include:

1. Biological monitors will be available during site development activities which may result in injury or mortality of desert tortoises. The 412 TW/CEV designated biologist will determine which activities require biological monitoring.

2. Any desert tortoises found during construction-related activities will be relocated to nearby safe areas, not more than 100 meters from the point of capture. When the area is considered safe, desert tortoises will be returned to their point of capture.

3. When handling desert tortoises, the qualified biologists and environmental monitors will follow the procedures described in *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996).

4. Only qualified biologists, as defined by the United States Fish and Wildlife Service (USFWS) and the 412 TW/CEV designated biologist will conduct preconstruction surveys for desert tortoises and remove animals from work areas to nearby suitable habitat.

This measure fulfills the requirements of Terms and Conditions C.1, C.2, C.3 and C.4 of the BO (United States Fish and Wildlife Service 1997).

***Environmental Protection Measure BIO-5*:** Limit disturbance areas during fence installation to the minimum needed to perform activities. During construction, activity areas will be clearly fenced, marked and flagged at the outer boundaries to define the limits of work areas. All workers will be instructed to confine their activities to the marked areas (United States Fish and Wildlife Service 1997). This measure fulfills the requirements of Terms of Conditions B of the BO (United States Fish and Wildlife Service 1997).

***Environmental Protection BIO-6*:** Laydown, parking and staging areas will be restricted to previously disturbed areas to the maximum extent practicable (United States Fish and Wildlife Service 1997). This measure fulfills Terms of Conditions D.1 of the BO (United States Fish and Wildlife Service 1997).

***Environmental Protection Measure BIO-7*:** Vehicles will, to the maximum extent practicable, remain on established roads. Equipment and vehicle operators will be alert for desert tortoises and other wildlife in and along access routes. When traveling off-road, speed limits will not exceed 5 miles per hour and shrubs will be avoided as much as possible.

***Environmental Protection Measure BIO-8*:** All personnel on the site will check under parked vehicles and equipment for desert tortoises and other wildlife species before moving vehicles. If a desert tortoise is discovered under a parked vehicle, an authorized biologist shall relocate the animal to a nearby, safe location. The authorized biologist shall use his or her best professional judgment to ensure that desert tortoises moved in this manner are not subjected to temperature extremes which could result in injury or death. Alternatively, the vehicle shall be left in place until the desert tortoise moves of its own volition (United States Fish and Wildlife Service 1997). This measure fulfills Terms and Conditions A.3 of the BO (United States Fish and Wildlife Service 1997).

***Environmental Protection Measure BIO-9*:** All trash will be placed in closed and covered containers for proper disposal to reduce its attractiveness to desert tortoise predators (e.g., coyotes and common ravens). The containers must not be able to be opened by predators and must be emptied regularly to ensure adequate capacity is maintained (United States Fish and Wildlife Service 1997). This measure fulfills or exceeds Terms and Conditions E of the BO (United States Fish and Wildlife Service 1997).

Environmental Protection Measure BIO-10: If common raven presence increases locally as a result of the proposed project, perch deterrents will be placed on structures that are supporting perching.

***Environmental Protection Measure BIO-11*:** Pre-construction surveys will be conducted by the biological monitor immediately in front of all equipment. During these surveys, the biological monitor will identify the following resources and complete the following activities:

1. Identify active nests that fall under the MBTA, and flag an avoidance area for each nest at a minimum of 50 meters from the nest;

2. Identify potential desert tortoise burrows and flag for avoidance, if possible, at a minimum distance of 10 meters to avoid any activities affecting the burrow or any individuals underground. If avoidance of desert tortoise burrows is not possible, individual burrows will be scoped to determine if there is an animal underground. If no tortoise is using the burrow, the burrow will be excavated according to the USFWS Guidelines for Handling Desert Tortoises During Construction Projects; and

3. Avoid the desert tortoise. However, if avoidance is not possible, individuals found aboveground within the project area will be temporarily moved out of harm's way by an authorized biologist according to the *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996). Desert tortoises shall not be released more than 100 meters from the point of capture (United States Fish and Wildlife Service 1997).

4.7 SOCIOECONOMICS

Socioeconomic impacts would be considered significant if they substantially altered the location and distribution of the population within the ROI; caused the population to exceed historic growth rates; decreased jobs so as to substantially raise the regional unemployment rates or reduce income generation; substantially affected the local housing market and vacancy rates; or resulted in the need for new social services and support facilities.

4.7.1 Alternative A – Proposed Action

Construction of the security fence would not create significant impacts to socioeconomics in the on- or off-base region.

The project would, however, generate a very small number of jobs, which would be a beneficial impact on economic conditions in the area. A very slight increase in local revenues would be expected to occur

as a result of money spent for construction materials and daily services. It is not expected that this increase would measurably affect housing or schools in the area.

4.7.2 Alternative B – All Chain Link Fence Alternative

Socioeconomic impacts would be the same as for the Proposed Action (there would be no impacts).

4.7.3 Alternative C – No Action Alternative

Under the No Action Alternative, there would be no socioeconomic impacts.

4.8 PUBLIC SAFETY AND EMERGENCY SERVICES

A safety impact would be considered significant if it created a potential public health hazards, or involved the use, production or disposal of materials that pose a hazard to people. The primary safety and occupational health hazards associated with laser test and evaluation activities are biological changes to the eyes and skin. Indirect, non-beam safety and occupational health hazards include fire, collateral radiation, shock and laser-generated air contaminants.

An impact to public/emergency services would be considered significant if it resulted in slower response times by fire protection services, security services or medical services or if it resulted in failure of these services.

4.8.1 Alternative A – Proposed Action

4.8.1.1 Public Safety

During construction of the fence, workers may be exposed to existing safety and environmental hazards at the AFRL, including physical hazards such as noise, heat, or cold; biological hazards such as poisonous snakes and scorpions; and general safety hazards such as ERP sites, UXO and range-related issues.

The overall safety to the general public should be improved with this project because unauthorized access to the AFRL should be greatly reduced with completion of the fence. This would keep the public out of a sensitive area of Edwards AFB and would help to prevent the theft of materials and equipment from the AFRL.

In addition to the public health and safety plan identified in Environmental Protection Measure HAZ-1 from Section 4.4 to ensure worker safety within the AFRL, the following environmental protection measure will be implemented:

Environmental Protection Measure PS-1: Prior to any construction activities, all construction personnel shall complete any training required by Edwards AFB, including UXO training, range training and environmental worker awareness training.

4.8.1.2 Emergency Services

Construction of the fence could change current traffic patterns in the AFRL area by restricting access to certain roads although gates would be erected at each major road crossing (three existing and eight new gates).

4.8.2 Alternative B – All Chain Link Fence Alternative

Public safety and emergency services impacts resulting from Alternative B would be similar to those for the Proposed Action. However, an all chain link fence may not be adequate for preventing unauthorized vehicle access to the AFRL. This would be an adverse impact for public safety. Offsetting these impacts would require increasing the Security Forces patrol in the area. There would be no adverse impacts to emergency services.

4.8.3 Alternative C – No Action Alternative

Under the No Action Alternative, no new security fence and no surveillance equipment would be constructed. This would be an adverse impact to public safety. Offsetting these impacts would require either building a security fence or increasing the Security Forces patrol in the area. There would be no emergency services impacts.

4.9 WATER RESOURCES

4.9.1 Alternative A – Proposed Action

The Proposed Action would have a significant impact on water resources if it caused substantial flooding or erosion; substantially affect any significant water body such as an ocean, stream, lake or bay; expose people to reasonably foreseeable hydrologic hazards such as flooding; or substantially affect surface or groundwater quality or quantity. No perennial streams or dry lakebeds are located within the project area. The Proposed Action would not affect the WWTP ponds located on the AFRL. No impacts to groundwater or surface water resources would occur from the Proposed Project.

4.9.2 Alternative B – All Chain Link Fence Alternative

As with Alternative A, construction of Alternative B would have a significant impact on water resources if it caused substantial flooding or erosion; substantially affect any significant water body such as an ocean, stream, lake or bay; expose people to reasonably foreseeable hydrologic hazards such as flooding; or substantially affect surface or groundwater quality or quantity. No perennial streams or dry lakebeds are located within the project area. Alternative B would not affect the WWTP ponds located on the AFRL. No impacts to groundwater or surface water resources would occur from implementation of Alternative B.

4.9.3 Alternative C – No Action Alternative

Under the No-Action Alternative, no water resources would be affected.

4.10 CUMULATIVE IMPACTS

The CEQ regulations define "cumulative impact" as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The ROI for cumulative impact analysis includes Edwards AFB.

4.10.1 Past, Present, and Future Projects

There are no known projects in the area that would contribute to cumulative impacts in the area (Robert Edwards, electronic communication, 2012).

4.10.2 Areas with Potential Cumulative Impacts

The only area with potential cumulative impacts would be natural resources, with respect to disturbance of land within the designated desert tortoise critical habitat.

4.11 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts include those that are negative, occurring regardless of any identified environmental protection measures or mitigation measures. All adverse impacts associated with the

Proposed Action and the Alternatives would not be significant or would be reduced to a level that is not significant, as discussed in Sections 4.1 through 4.9.

4.12 SHORT-TERM VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

Examples of short-term uses of the environment include direct, construction-related disturbances and direct impacts associated with an increase in population and activity that occurs over a period typically less than 5 years. Long-term uses of the environment include impacts occurring over a period of more than 5 years, including permanent resource loss.

In the short-term, the project would result in minor, temporary, direct construction-related disturbances but would not result in an increase in population in the area.

Construction of the fence would not result in any other changes in use at the AFRL or anywhere else at Edwards AFB and, therefore, there would be no long-term changes in population or productivity of the environment as a result of this project.

4.13 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

In accordance with NEPA (40 CFR 1502.16), this section includes a discussion of any irreversible and irretrievable commitment of resources associated with the proposed project. Irreversible and irretrievable resource commitments are related to the use of nonrenewable natural resources and the effects that the use of those resources will have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of implementing an action (e.g., extinction of a rare or threatened species, or the disturbance of an important cultural resource site).

Implementation of the proposed fence project would not require an irreversible or irretrievable commitment of resources.

5.0 REFERENCES

Air Force Flight Test Center, 2010. *Edwards Air Force Hazardous Waste Management Plan*. Edwards Air Force Base, California

Baldwin, B., et al. (eds.), 2001. *The Jepson Desert Manual: Vascular Plants of Southeastern California.* University of California Press, Berkeley, California.

Bailey, R,G. 1994. *Ecological Classifications for the United States.* U.S. Department of Agriculture (USDA), Forest Service, Washington D.C.

CalFlora. 2011. Information on California plants for education, research, conservation. Berkeley, California. The CalFlora Database: http://www.calflora.org/

California Burrowing Owl Consortium (CBOC). 1993. *Burrowing Owl Survey Protocols and Mitigation Guidelines*. Prepared for the California Department of Fish and Game. April 1993.

California Department of Fish and Game (CDFG), 2003. Mohave ground squirrel survey guidelines. California Department of Fish and Game, Sacramento, CA, USA.

California Department of Fish and Game (CDFG), 2010. *California Wildlife Habitat Relationships System*. California Interagency Wildlife Task Group. California Department of Fish and Game.

California Department of Fish and Game (CDFG). 2009. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities. November 24, 2009.

California Native Plant Society (CNPS), 2009. The Second Edition of *A Manual of California Vegetation* by John O. Sawyer, Todd Keeler-Wolf, and Julie M. Evens, October 2009

California Native Plant Society Electronic Inventory (CNPSEI), 2012. Inventory of rare and endangered plants of California (online edition, version 7.07c). Accessed at: http://www.cnps.org/inventory

California Natural Diversity Data Base (CNDDB), 2012.

Cal-IPC. (2006). *California Invasive Plant Inventory*. (Cal-IPC Publication 2006-2). Retrieved from: www.cal-ipc.org

Desert Tortoise Council, 1996. *Guidelines for Handling Desert Tortoises During Construction Projects*. Edward L. LaRue, Jr., editor. San Bernardino, California.

Dibblee, T., W., Jr. ,1960. *Geology of the Rogers Lake and Kramer Quadrangles California*. A study of an area in the central part of the western Mojave Desert. Geological Survey Bulletin 1089-B

Edwards Air Force Base, 2004 EH_Environmental_Restoration_Sites Database.

Edwards Air Force Base, 2006. *Environmental Assessment for the Testing and Evaluation of Directed Energy Systems Using Laser Technology at Edwards Air Force Base, California.* August 2006

Edwards Air Force Base, 2008. *Integrated Natural Resources Management Plan (INRMP) for Edwards Air Force Base, California.* Edwards Air Force Base, Air Force Flight Test Center. Volume 1 and Appendices.

Edwards Air Force Base, 2009. *Programmatic Agreement between the United States Air Force and the California State Historic Preservation Office Regarding Implementation of the Air Force Flight Test Center Mission and the Integrated Cultural Resources Management Plan at Edwards Air Force Base, California.* Document on file at Edwards Air Force Base.

Edwards Air Force Base, 2010a. *Final Phase II Evaluation of Selected Damage V Archaeological Sites*, Edwards Air Force Base, California. Prepared by Tetra Tech, Inc.

Edwards Air Force Base, 2010b. *Integrated Cultural Resources Management Plan for Edwards Air Force Base, California. Edwards Air Force Base, Air Force Flight Test Center Plan 32-7065*. Volume 1. Document on file at Edwards Air Force Base.

Edwards Air Force Base, 2012a. GIS Mapping Data. On file at Edwards Air Force Base.

Edwards Air Force Base, 2012b, Force Support Squadron. Edwards Air Force Base School Liaison Program. Accessed in July online at: http://95fss.com/wordpress/school-liaison-office

Greater Antelope Valley Economic Alliance, 2010, *Antelope Valley Labor Market Study*. Accessed in July online at: http://www.aveconomy.org/files/2010%20Labor%20base%20Report.pdf

Holland, R.F. 1986. Preliminary description of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, CA.

Ingles, L.G.1947. *Mammals of the Pacific States, California, Oregon, Washington*. Stanford University Press, Stanford, California.

Nussear, K.E., Esque, T.C., Inman, R.D., Gass, Leila, Thomas, K.A., Wallace, C.S.A., Blainey, J.B., Miller, D.M., and Webb, R.H., 2009. Modeling habitat of the desert tortoise (*Gopherus agassizii*) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona: U.S. Geological Survey Open-File Report 2009-1102, 18 p.

Sawyer, J.O., T. Keeler-Wolf, J. M. Evans 2009. *A Manual of California Vegetation*, Second Edition. Sacramento, CA. California Native Plant Society. 1,300 pp.

Sibley, D.A. 2003. *The Sibley Field Guide to Birds of Western North America*. Chanticleer Press Inc., New York, New York.

Strebbins, R.C. 2003. *Peterson Field Guides: Western Reptiles and Amphibians*. Houghton Mifflin Company, New York, New York

The Nature Conservancy 2001. *Ecoregion-based Conservation in the Mojave Desert.* Nevada Office.

U. S. Air Force, 2005, *Final Remedial Investigation Summary Report Air Force Research Laboratory Operable Unit 4*, Edwards Air Force Base, California

U.S. Air Force, 2006, *Final Remedial Investigation Summary Report East Air Force Research Laboratory Operable Unit 4*, Edwards Air Force Base, California

U.S. Air Force, 2007, *Final Record of Decision, South Air Force Research Laboratory Operable Units 4 and 9*, Edwards Air Force Base, California

United States Air Force, 2008a. *Record of Decision Air Force Research Laboratory Soil and Debris Sites Operable Unit 4 and 9, Edwards AFB, California*. Prepared for U.S. Air Force 95th Air Base Wing, Environmental Restoration Division (95ABW/EMR) and the ERP Program Office, Air Force Center for Engineering and the Environment/Environmental Programs Execution-West, Brooks City-Base, Texas.

United States Air Force, 2008b. *Integrated Natural Resources Management Plan for Edwards Air Force Base, California*. Edwards Air Force Base Plan 32-7064, August 2008

United States Air Force, 2008c. *Memorandum for AFFTC/A6/7 from AFFTC/CC Regarding AFMC Assistance in Development of a Detachment 7 Security Plan*. December 5, 2008.

United States Air Force, 2009. *Memorandum for AFFTC/CC from HQ AFMC/A6/7 Regarding AFMC Assistance in Development of a Detachment 7 Security Plan.* January 26, 2009.

United States Air Force, 2010. *Utilities Privatization Solicitation for Edwards AFB.* Accessed at: https://www.fbo.gov/?s=opportunity&mode=form&id=eb49737c5caf47421681235fc34202be&tab=core&_cview=1

U.S. Air Force, 2011, *Final Feasibility Study Report, Soil and Debris Sites, Air Force Research Laboratory Operable Units 4 and 9*, Edwards Air Force Base, California, August 2006

United States Department of Agriculture, 1996. *Soil Survey of Edwards Air Force Base, California*. Natural Resource Conservation Service in cooperation with the United States Department of Defense, Air Force Flight Test Center, Edwards Air Force Base; National Aeronautics and Space Administration-Dryden Flight Research Center and Regents of the University of California (Agricultural Experiment Station).

United States Department of the Interior, Bureau of Land Management (BLM), Washington Office, Washington, D.C. 1992. *Integrated Weed Management*. (Manual 9015).

United States Department of the Interior, Bureau of Land Management (BLM). 1999. *Current Management Situation of Special Status Species in the West Mojave Planning Area, West Mojave Planning Team*. Prepared March, 1999.

United States Department of the Interior, Bureau of Land Management (BLM) and U.S. Fish and Wildlife Service (USFWS). 2005. *Final Environmental Impact Report and Statement for the West Mojave Plan: A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment (WEMO CMP/FEIS).* Vol 1 and 2.

United States Department of the Interior, Bureau of Land Management (BLM). 2008. *National List of Invasive Weed Species of Concern*. Retrieved from: http://www.blm.gov/co/st/en/BLM_Programs/botany/invasiweed.html

United States Environmental Protection Agency, 2012a. *National Ambient Air Quality Standards*. Accessed February 2012. http://www.epa.gov/air/criteria.html.

United States Environmental Protection Agency, 2012. *Site Overview, Edwards Air Force Base*. Accessed on 04 April 2012, http://yosemite.epa.gov/r9

United States Fish and Wildlife Service (USFWS). 1997. *Programmatic Biological Opinion (BO) for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (1-8-97-F-10)*

United States Fish and Wildlife Service (USFWS). 2000. Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants.The Nature Conservancy, 2001. *Ecoregion-Based Conservation in the Mojave Desert, 2001*. Nevada Office.

United States Fish and Wildlife Service (USFWS). 2010. Preparing for Any Action that may occur within the Range of the Mojave Desert Tortoise (*Gopherus agassizii*). 2010 Field Season.

United States Fish and Wildlife Service (USFWS). 2011. Revised Recovery Plan for the Mojave Population of the Desert Tortoise *(Gopherus agassizii).* Pacific Southwest Region, Sacramento, California.

6.0 PERSONS AND AGENCIES CONTACTED

Bransfield, Ray, 2012. Personal communication. U.S. Fish and Wildlife Service Office, Ventura, California. March.

Cox, Samuel, 2011. Personal and electronic communications. 412 TW/CEV, Edwards AFB, California. December.

Cox, Samuel, 2012. Personal and electronic communications. 412 TW/CEV, Edwards AFB, California. February, March, June and July.

Edwards, Bob, 2012. Electronic communications. USAF AFMC AFRL/RZS, Edwards AFB, California. July and September.

Lowrey, Jim. 2009. Personal communication regarding American badger presence and densities at Edwards AFB.

Morgan, Edward, 2012. Electronic communications. 412 TW/CEV, Edwards AFB, California. March.

Mull, Thomas V., 2012. Personal and electronic communications. 412 TW/CEV, Edwards AFB, California. March, June and July.

7.0 LIST OF PREPARERS

Cyphers, Darrell, Production Supervisor, Tetra Tech, Inc.
B.S., 1984, History, Loma Linda University, California
MHA, 1997, Loma Linda University, California
Years of Experience: 8

Doyle, Kevin, Cultural Resources Specialist, Tetra Tech, Inc.
B.A., Sociology, University of California, Santa Barbara
Years of Experience: 26

Hoerber, Steve, Senior GIS Analyst, Tetra Tech, Inc.
A.A., General Education
Years of Experience: 22

King, Chris, PE, PMP, Chemical Engineer, Tetra Tech, Inc.
B.S., 1999, Chemical Engineering, Illinois Institute of Technology
MBA, 2006, Project Management Aspen University
Years of Experience: 13

Mates, Julia, Historian/Architectural Historian, Tetra Tech, Inc.
B.A., History, University of California, Los Angeles
M.A. History/Public History, California State University, Sacramento
Years of Experience: 13

Mathieu, Jeff, Director, Tetra Tech, Inc.
B.S., date? Chemical Engineering, Maryland University
MLFS, 2008, Maryland University
Years of Experience: 19

McKinnon, Mary, Principal Environmental Analyst, Tetra Tech, Inc.
B.S., 1983, Environmental Earth Science, Stanford University
Years of Experience: 25

Nelson, Shelley, CADD/GIS Specialist, Tetra Tech, Inc.
Certified Auto Cad and GIS Specialist, Credentials in Environmental and Land Use Planning
Years of Experience: 18

Pacheco, Stephanie, Soil Scientist, Tetra Tech, Inc.
B.S., 1985, Environmental Resources in Agriculture, Arizona State University, Tempe, Arizona
M.S., 1989, Soil Science, University of California, Riverside, California
Years of Experience: 22

Poll, Adam, Environmental Scientist, Tetra Tech, Inc.
B.S., 2006, Environmental Studies, University of California, Santa Barbara
M.A.S., 2011, Environmental Policy and Management, University of Denver
Years of Experience: 7

Simon, Kathy, Senior Wildlife Biologist, Tetra Tech, Inc.
B.S. 1989, Biology, University of Redlands
Years of Experience: 22

8.0 ACRONYMS AND ABBREVIATIONS

412 TW	412th Test Wing
412 TW/PAE	412th Test Wing Environmental Public Affairs
412 SFS	412th Security Forces Squadron
AB	Assembly Bill
ABW	Air Base Wing
ACEC	Area of Critical Environmental Concern
AD	*Anno Domini*
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFTC	Air Force Test Center
AFI	Air Force Instruction
AFRL	Air Force Research Laboratory
AIRFA	American Indian Religious Freedoms Act
APE	Area of Potential Effect
ARAR	Applicable or Relevant and Appropriate Requirement
ARPA	Archaeological Resources Protection Act
AVEK	Antelope Valley East Kern
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BHPO	Base Historic Preservation Officer
BLM	Bureau of Land Management
BO	Biological Opinion
BP	Before Present
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
Cal-IPC	California Invasive Plant Inventory
CARB	California Air Resources Board
CBOC	California Burrowing Owl Consortium
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CH_4	methane
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNPSEI	California Native Plant Society Electronic Inventory
CO	carbon monoxide
CO_2	carbon dioxide
dBA	"A-weighted" decibel

DCE	Dichlorethene
DNAPL	dense non-aqueous phase liquids
DoD	Department of Defense
DWMA	Desert Wildlife Management Area
EA	environmental assessment
ECC	Emergency Control Center
EIAP	Environmental Impact Analysis Process
EKAPCD	Eastern Kern Air Pollution Control District
EM	Environmental Management
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
°F	degrees Fahrenheit
FONSI	Finding of No Significant Impact
FS	Feasibility Study
GHG	greenhouse gas
GLO	Government Land Office
HAZWOPER	Hazardous Waste Operations and Emergency Response
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
lb	pound
MBTA	Migratory Bird Treaty Act
MDAB	Mojave Desert Air Basin
MDAQMD	Mojave Desert Air Quality Management District
$\mu g/m^3$	micrograms per cubic meter
mg/m^3	milligrams per cubic meter
MSL	mean sea level
$MTCO_2e$	metric tons of CO_2 equivalent
N_2O	nitrous oxide
NAA	non-attainment area
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection Repatriation Act
NDMA	N-nitrosodimethylamine
NEPA	National Environmental Policy Act
NFA	No Further Action
NHPA	National Historic Preservation Act
NO_x	nitrogen oxides
NO_2	nitrogen dioxide

NRHP	National Register of Historic Places
O&M	operation and maintenance
OU	operable unit
PA	Programmatic Agreement
PAE	Environmental Public Affairs
Pb	lead
PCE	perchloroethene
PFC	perfluorocarbon
PIRA	Precision Impact Range Area
PL	public law
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
PM_{10}	particulate matter 10 microns or less in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROI	Region of Influence
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SF_6	sulfur hexafluoride
SFS	Security Forces Squadron
SIP	State Implementation Plan
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxides
SR	state route
SSC	species of special concern
TCE	trichloroethene
TCP	traditional cultural property
TOC	total organic compound
TW	Test Wing
UGS	unattended ground sensors
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound

WDID	Waste Discharger Identification
WEAP	worker environmental awareness program
WEMO	West Mojave Plan
WWTP	waste water treatment plant

APPENDIX A

ENVIRONMENTAL PROTECTION MEASURES

Table A-1
Environmental Protection Measures and Reporting Information
AFRL Security Fence Project, Edwards AFB

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
Cultural Resources				
CR-1	The avoidance measures listed below are found in Section 2.4 Treatment of Archaeological Properties, Avoidance Measures, in the Programmatic Agreement (PA) (EAFB 2009): • All vehicles are required to stay on established roads or within an established training area; • Unauthorized collection of archaeological materials is prohibited; • Unauthorized digging is prohibited; • Archaeological sites in high-use or high-risk areas are posted with archaeological site protection signage; • Where historic properties may or may not be at risk of inadvertent effect by an undertaking, Edwards AFB will provide for archaeological monitoring of ground-disturbing activities; • Edwards AFB has determined that inadvertent site disturbances from vehicles and other ground-disturbing activities are more likely to occur along road corridors and in other high-use areas; and • In order to avoid potential adverse effects from vehicles and other ground-disturbing activities, Edwards AFB shall continue to implement the site protection strategy of protective signage of archaeological sites on Edwards AFB.	412 TW/CEV and 412 TW/CEV's Cultural Resources Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
CR-2	Edwards AFB cultural resources staff shall determine the scope of the archaeological monitoring program before any project-related soil-disturbing activities begin and shall determine what project activities shall be monitored. The monitor shall be a qualified archaeologist who meets the professional requirements under the Secretary of the Interior's standards and will conduct the following activities:	412 TW/CEV and 412 TW/CEV's Cultural Resources Contractor	Report/memo submitted to USAF AFMC 412 TW/CEV	Prior to and during construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	• The archaeological monitor shall train all project construction personnel who could reasonably be expected to encounter archaeological resources of the expected resources, how to identify the evidence of the expected resources and the appropriate protocol in the event of apparent discovery of an archaeological resource; • The archaeological monitor(s) shall be present on the project site according to a schedule agreed on by the Edwards AFB cultural resources staff; and • The archaeological monitor shall record and be authorized to collect soil samples and artifactual/ecofactual material as warranted for analysis.			
CR-3	Although much of the Area of Potential Effect (APE) for the Proposed Action has been surveyed for the presence of cultural resources and the new fence would be routed mostly along existing roads and fences so that known cultural resources are avoided, there is possibility that unknown subsurface archaeological sites are located within the APE. The monitor should be present for all excavations within high site probability areas and be available in the event that unanticipated discoveries are made during construction. If, during the performance of the undertaking, historic properties are discovered or unanticipated effects are found, the procedures in Section 2.5 of the PA *Inadvertent Discoveries and Emergencies* shall be followed. These are: • The activity will be immediately stopped in the vicinity of the discovery and the Base Historic Preservation Officer (BHPO) will be immediately notified; • Contractors and authorized agents at Edwards AFB are also required to stop work in the vicinity of any discovered archaeological deposits and immediately contact the BHPO and await for review by the BHPO and direction from the Installation Commander or Base Civil Engineer; and • Excavations in the area of the discovery must remain halted until a qualified archaeologist who meets the	412 TW/CEV and 412 TW/CEV's Cultural Resources Contractor	Immediate notification to USAF AFMC 412 TW/CEV	During construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	professional requirements under the Secretary of the Interior's standards can determine the nature, extent and age of the archaeological deposit. Excavations outside of the find location may proceed with continued monitoring.			
Hazardous Materials and Hazardous Waste				
HAZ-1	Prior to construction activities, a health and safety plan, in compliance with 29 Code of Federal Regulations (CFR) 1910.120 will be prepared and approved by Edwards AFB. All construction workers used for installation of the fence, security features and surveillance equipment will have received 40-hour Hazardous Waste Operations and Emergency Response Standards (HAZWOPER) training and be current with 8-hour refresher training. The site-specific health and safety plan will address all site-specific safety and environmental hazards that have the potential to be encountered during construction and installation of the fence, including physical hazards, biological hazards, and general safety hazards. Any training required by construction personnel will be identified.	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Report/memo submitted to USAF AFMC 412 TW/CEV	Prior to construction activities
Natural Resources				
BIO-1	Provide a worker environmental awareness program (WEAP) to all individuals that will be working on the project in the field (USFWS 1997; EAFB 2008). This program will consist of videos, brochures and briefings and will include information on: • The role of biological monitors and authority of monitors to stop work under the Endangered Species Act; • Locally known invasive weeds and limiting weed spread and colonization; • The Migratory Bird Treaty Act (MBTA) and nest avoidance measures; • Desert cymopterus, Mojave spineflower and Barstow woolly sunflower;	412 TW/CEV and 412 TW/CEV's Biological Resources Contractor	Report/memo submitted to USAF AFMC 412 TW/CEV	Prior to construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	• Desert tortoise natural history in the project area, desert tortoise ecology, threats to the species, and the protection measures described here and in the Biological Opinion (BO) (USFWS 1997); • Mohave ground squirrel history in the project area, ecology and the avoidance and minimization measures described in this section for this species; • Other sensitive species that may be found throughout the construction of the project and the avoidance and minimization measures described in this section for these species; and • Locations and information on designations of critical habitat and Desert Wildlife Management Area (DWMA) in the project area. All personnel will sign a statement that they have received, understand and will follow the regulations and protection measures presented in the program. Copies of signed statements will be on file at the Environmental Management Office. This measure fulfills or exceeds the requirements of Terms and Conditions A.1 in the BO (USFWS 1997).			
BIO-2	Wash all vehicles and equipment prior to bringing them on site if they have been used in areas off base (BLM 1992; 2005).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-3	All project-related construction activities will be conducted during daylight hours (BLM 2005). If any activities are to disturb native habitat between dusk and dawn, they shall be limited to areas which have already been cleared of desert tortoises by biological monitors and enclosed by a fence to exclude desert tortoises (USFWS 1997). This measure fulfills or exceeds the requirements of Terms and Conditions A.2 of the BO (USFWS 1997).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-4	Ensure that qualified biological monitors are present during all construction-related activities to confirm that compliance with all minimization measures for biological resources is being implemented (USFWS 1997). These measures include: • Biological monitors will be available during site	412 TW/CEV and 412 TW/CEV's Biological Resources Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	development activities which may result in injury or mortality of desert tortoises. The 412 TW/CEV designated biologist will determine which activities require biological monitoring. • Any desert tortoises found during construction-related activities will be relocated to nearby safe areas, not more than 100 meters from the point of capture. When the area is considered safe, desert tortoises will be returned to their point of capture. • When handling desert tortoises, the qualified biologists and environmental monitors will follow the procedures described in *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996). • Only qualified biologists, as defined by the USFWS and the 412 TW/CEV designated biologist will conduct preconstruction surveys for desert tortoises and remove animals from work areas to nearby suitable habitat. This measure fulfills the requirements of Terms and Conditions C.1, C.2, C.3 and C.4 of the BO (USFWS 1997).			
BIO-5	Limit disturbance areas during fence installation to the minimum needed to perform activities. During construction, activity areas will be clearly fenced, marked, and flagged at the outer boundaries to define the limits of work areas. All workers will be instructed to confine their activities to the marked areas (USFWS 1997). This measure fulfills the requirements of Terms of Conditions B of the BO (USFWS 1997).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-6	Laydown, parking and staging areas will be restricted to previously disturbed areas to the maximum extent practicable (USFWS 1997). This measure fulfills Terms and Conditions D.1 of the BO (USFWS 1997).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-7	Vehicles will, to the maximum extent practicable, remain on established roads. Equipment and vehicle operators will be alert for desert tortoises and other wildlife in and along access routes. When traveling off-road, speed limits will not exceed 5	412 TW/CEV and 412 TW/CE's Designated Construction	Daily notifications and monitoring reports submitted to USAF AFMC	During construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	miles per hour and shrubs will be avoided as much as possible.	Contractor	412 TW/CEV	
BIO-8	All personnel on the site will inspect under parked vehicles and equipment for desert tortoises and other wildlife species before moving vehicles. If a desert tortoise is discovered under a parked vehicle, an authorized biologist shall relocate the animal to a nearby, safe location. The authorized biologist shall use his or her best professional judgment to ensure that desert tortoises moved in this manner are not subjected to temperature extremes which could result in injury or death. Alternatively, the vehicle shall be left in place until the desert tortoise moves of its own volition (USFWS 1997). This measure fulfills Terms and Conditions A.3 of the BO (USFWS 1997).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-9	All trash and litter will be placed in closed and covered containers for proper disposal to reduce its attractiveness to desert tortoise predators, such as coyotes and common ravens. The containers must not be able to be opened by predators and must be emptied regularly to ensure adequate capacity is maintained (USFWS 1997). This measure fulfills or exceeds Terms and Conditions E of the BO (USFWS 1997).	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Daily notifications and monitoring reports submitted to USAF AFMC 412 TW/CEV	During construction activities
BIO-10	If common raven presence increases locally as a result of the proposed project, perch deterrents will be placed on structures that are supporting perching.	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Immediate notification to USAF AFMC 412 TW/CEV	During and after construction activities
BIO-11	Pre-construction surveys will be conducted by the biological monitor immediately in front of all equipment. During these surveys, the biological monitor will identify the following resources and complete the following activities: • Identify active nests that fall under the MBTA and flag an avoidance area for each nest at a minimum of 50 meters from the nest; • Identify potential desert tortoise burrows and flag for avoidance, if possible, at a minimum distance of 10 meters to avoid any activities affecting the burrow or any individuals underground. If avoidance of desert tortoise burrows is not possible, individual burrows will	412 TW/CEV and 412 TW/CEV's Biological Resources Contractor	Report/memo submitted to USAF AFMC 412 TW/CEV	Prior to and during construction activities

Resource and Measure Number	Environmental Protection Measure	Responsible Organization	Deliverable/ Report	Compliance Schedule
	be scoped to determine if there is an animal underground. If no tortoise is using the burrow, the burrow will be excavated according to the USFWS *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996); • Avoid the desert tortoise. However, if avoidance is not possible, individuals found aboveground within the project area will be temporarily moved out of harm's way by an authorized biologist according to the USFWS *Guidelines for Handling Desert Tortoises During Construction Projects* (Desert Tortoise Council 1996). Desert tortoises shall not be released more than 100 meters from the point of capture (USFWS 1997).			
Public Safety and Emergency Services				
PS-1	Prior to any construction activities, all construction personnel shall complete any training required by Edwards AFB, including UXO training, range training and environmental worker awareness training.	412 TW/CEV and 412 TW/CE's Designated Construction Contractor	Report/memo submitted to USAF AFMC 412 TW/CEV	Prior to construction activities

References:

Desert Tortoise Council, 1996. *Guidelines for Handling Desert Tortoises During Construction Projects.* Edward L. LaRue, Jr., editor. San Bernardino, California.

EAFB 2009 = Edwards Air Force Base, 2009. *Programmatic Agreement between the United States Air Force and the California State Historic Preservation Officer Regarding Implementation of the Air Force Flight Test Center Mission and the Integrated Cultural Resources Management Plan at Edwards Air Force Base, California.* Document on file at Edwards Air Force Base.

EAFB 2008 = Edwards Air Force Base, 2008. *Integrated Natural Resources Management Plan (INRMP) for Edwards Air Force Base, California.* Edwards Air Force Base, Air Force Flight Test Center. Volume 1 and Appendices.

BLM 1992 = United States Department of the Interior, Bureau of Land Management (BLM), Washington Office, Washington, D.C. 1992. *Integrated Weed Management*. (Manual 9015).

BLM 2005 = United States Department of the Interior, Bureau of Land Management (BLM) and U.S. Fish and Wildlife Service (USFWS). 2005. *Final Environmental Impact Report and Statement for the West Mojave Plan: A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment (WEMO CMP/FEIS).* Volumes 1 and 2.

USFWS 1997 = United States Fish and Wildlife Service (USFWS). 1997. *Programmatic Biological Opinion (BO) for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards AFB (1-8-97-F-10)*

APPENDIX B

PROGRAMMATIC BIOLOGICAL OPINION FOR A ROCKET TESTING PROGRAM AND SUPPORT ACTIVITIES AT PHILLIPS LABORATORY, EDWARDS AIR FORCE BASE, CALIFORNIA (1-8-97-F-10)

EMX File: 17M-6 126H 166H

CV (1) (6)
EMX ELR (13)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

What is the meaning by comment on pg 2. Need to respond to Col D. 126H

July 30, 1997

EMXC ____ ACT/C
prepare note for EM
Sig ELR (29)

Colonel James H. Doolittle III
Vice Commander
AFFTC/CV
Edwards Air Force Base, California 93524-1031

Subject: Programmatic Biological Opinion for a Rocket Testing Program and Support Activities at Phillips Laboratory, Edwards Air Force Base, California (1-8-97-F-10)

Dear Colonel Doolittle:

This biological opinion responds to the Air Force Flight Test Center's (AFFTC) request for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7(a) of the Endangered Species Act of 1973, as amended (Act). Your request was dated November 24, 1996, and received by the Service on November 29, 1996. This consultation will consider the effects that propellant disposal at area 1-100 and routine testing of rocket motors and their components at test areas 1-14, 1-32, 1-36, 1-42, 1-52, 1-56, 1-120 and 1-125 within Phillips Laboratory, Edwards Air Force Base (Base), California may have on the desert tortoise (*Gopherus agassizii*), a federally threatened species, and its critical habitat. It also considers the effects of the construction of a waste water treatment plant which will support Phillips Laboratory, located in the Precision Impact Range Area (PIRA) adjacent to the Phillips Laboratory, and installation of above-ground gas lines.

This biological opinion also responds to the AFFTC's request for formal consultation with the Service regarding the disposal of pentaborane at site 1-36D. The request for consultation on pentaborane disposal was dated May 20, 1997, and received by the Service on May 29, 1997.

This biological opinion was prepared using information in your November 24, 1996 and May 20, 1997 requests for consultation regarding the proposed actions, Mitchell et al. (1993), previous biological opinions on rocket testing (1-8-97-F-7 and 1-8-95-F-9), conversations and electronic mail with your staff, and our files.

Biological Opinion

It is the opinion of the Service that the proposed action is not likely to jeopardize the continued existence of the desert tortoise or adversely modify its critical habitat.

Consultation History

After receiving the request for formal consultation on the rocket testing program, discussions with the AFFTC resulted in the conclusion that certain components of the routine rocket testing program would not affect the desert tortoise. Consequently, tests conducted at the Solar Propulsion Facility (Building 9626), Experimental Areas 1-21, 1-30, 1-40, 1-46, and 1-90, Propulsion Sciences Division (Buildings 8451 and 8424), and Electric Propulsion Laboratory (Building 8417) are not considered further in this biological opinion because the work occurs entirely inside buildings or the firings are so small that the explosive force and amount of emissions would be unlikely to adversely affect desert tortoises.

On January 29, 1996, the AFFTC submitted a request for formal consultation on the disposal of pentaborane. The AFFTC requested that the Service expedite the completion of the biological opinion because of the unstable condition of several containers and the highly explosive nature of this material. Because sufficient information on the extent of damage to the habitat of the desert tortoise and of the potential effects on individual animals of the explosion and possible emissions was not readily available to it, the Service declined to complete the biological opinion without supporting information. In a letter dated February 27, 1996, the Service recommended that the AFFTC destroy the canisters of pentaborane which were the most unstable and request consultation under the emergency provisions of the Act (50 CFR 402.05). The Service reasoned that destruction of a limited number of canisters would reduce potential effects on the desert tortoise from that expected with disposal of all the material and that information gained during these disposal actions could be used to support a consultation request for destruction of the remaining cylinders.

The AFFTC agreed with the approach recommended by the Service and destroyed eight canisters of pentaborane in March, April, and June, 1996. However, the AFFTC did not follow its verbal request for emergency consultation with a written post-event report, as required by the implementing regulations for section 7 (50 CFR 402.05) until it submitted the current request for consultation.

In the May 20, 1997 request for formal consultation on the disposal of pentaborane, the AFFTC concluded that desert tortoises and their critical habitat would not be adversely affected by explosions, burning, or emissions resulting from any single disposal action. This conclusion was based on information gained during the previous disposals. The AFFTC acknowledged that disposal of the entire stockpile of pentaborane and pre- and post-test monitoring and clean-up operations could adversely affect desert tortoises as workers drive through habitat to retrieve test equipment or remove debris.

At a meeting on May 22, 1997, Service and AFFTC staff concurred that the most expeditious manner in which to conclude the pentaborane consultation was to include it in the biological opinion for the Phillips Laboratory rocket testing. This strategy was deemed to be appropriate because the pentaborane would be burned at site 1-36D; the activities at this site were already being evaluated in the Phillips Laboratory biological opinion. This course of action would also allow for the incidental take of desert tortoises that may occur during the disposal of pentaborane through either accidental injury or death or the intentional removal of these individuals from harm's way and for a more expeditious completion of formal consultation on the disposal of pentaborane. The AFFTC presented these conclusions to the Service in a letter dated June 9, 1997; the June 9 letter also requested that the formal consultation that was initiated by the May 20, 1997 correspondence be terminated. The Service acknowledges and agrees with this request through this biological opinion.

The Service provided a draft biological opinion to the Air Force on July 8, 1997. The Air Force commented on the draft document via electronic mail on July 17, 1997 (Hagan pers. comm. 1997).

Description of the Proposed Action

A summary of the operating capabilities of the Phillips Laboratory experimental and test facilities was provided by the AFFTC and is enclosed.

Rocket testing activities

Under the proposed action, the AFFTC would undertake a program of rocket tests at eight existing facilities designated as test areas 1-14, 1-32, 1-36, 1-42, 1-52, 1-56, 1-120 and 1-125 on the Phillips Laboratory portion of Edwards Air Force Base. These tests would include performance testing of a wide variety of rocket motors and propellant formulations, functional assessments of individual motor components, and safety and detonation testing of rocket motors and propellants. Given the volume of exhaust plumes generated by tests and the effects of planned or potential detonation of propellants and rocket motors, the test facilities are widely spaced throughout Phillips Laboratory lands for both logistical and safety purposes.

The continued use of area 1-100, designated by the AFFTC as the "Propellant Waste Disposal Area," is ancillary to the proposed rocket test program. Waste propellants and their ingredients generated at other sites during mixing, machining, and testing. These waste materials are disposed by burning. Interim permits issued to the Department of Defense limit the amount of burns to no more than 400 pounds of materials per month or 5,000 pounds per year.

The proposed testing program would make use of existing facilities at the eight test areas and the propellant disposal area. Should additional site developments prove necessary, the AFFTC proposes to limit such activity to previously disturbed areas that do not support native vegetation. Test areas are usually composed of one or more test pads, each of which is designed to

accommodate specific test conditions. With the exception of the test pad in area 1-36, designed for medium to large scale (5,000 to 1,000,000 pounds of TNT equivalent) detonation tests, the surfaces of test pads are constructed of heat-resistant, hardened, or reinforced concrete. The working surfaces in areas 1-36 and 1-100 are decomposed granite and graded soil, respectively. The working areas of areas 1-125 and 1-42 are not described in the consultation request.

The types and amounts of propellants that would be used in the test program, the purpose and frequency of the tests, and the type and amount of emissions that would result from the use of the various propellants are described in the enclosed summary of site facilities provided by the AFFTC. The test areas include the following facilities:

Test area 1-14 consists of five outside test cells located on the northwest side of Building 8620. Each cell is constructed of reinforced concrete.

Test area 1-32 includes pads 1 and 2 which are constructed of concrete pads measuring 30 by 45 feet with an additional 50 feet of paving and cleared ground 300 feet "downwind" (180 to 280 degrees). Test pads 3A, 3B, 3C, and 3D are concrete pads measuring 18 by 20 feet surrounded by a cleared area measuring 500 by 700 feet. Test pad 4 is described in the consultation request as "damaged". Test pads 5A, 5B, and 5C are concrete pads measuring 10 by 20 feet (5A, 5B), and 20 feet by 25 feet (5C) with an additional 40 feet of apron, 25 feet of paved road, and 250 feet of cleared ground downstream of the exhaust.

Test area 1-36 supports the Motor Behavior Complex which includes test pad 1-36D, a decomposed granite pad 300 feet in diameter.

Test Area 1-52 includes test pads A, B, and C/D which measure 100 by 100 feet with a blast wall to separate rocket motors from propellant tanks. An additional area of 300 feet is cleared downwind from the pads.

Test area 1-56 consists of a 150- by 80-foot concrete pad with a blast wall.

Test Area 1-42, the Space Environment Propulsion Complex, includes test pads A through E. Pads A and D are horizontal vacuum test stands on a common concrete test pad which measures 100 by 50 feet. Test pad B is a vertical vacuum test stand on a 50 by 50 foot concrete pad. Test pad C is a vacuum chamber known as the Space Experimental Facility. Test stand E is a horizontal test stand located inside a building.

Test area 1-120, the Large Engines and Components Test Complex, includes test stands 1A, 1B, and 2A. Each test stand is located on the side of a hill (Leuhman Ridge). A fence to exclude desert tortoises has been installed at the bottom of the hill from test stands 1A and 2A. Test stand 1B is currently deactivated.

Test area 1-125, the Large Systems Complex, includes test stands 1C, 1D, and 1E. Each test stand is located on the hillsides of Leuhman Ridge. A fence to exclude desert tortoises has been installed at the bottom of the hill from test stand 1C. Test stands 1D and 1E are currently deactivated. The National Hover Test Facility is located next to test stand 1E where tests are conducted inside the facility.

Disposal of Pentaborane

Pentaborane would be burned at test site 1-36D. Other facilities located at the burn site include a 2,000-gallon decontamination tank with a pump containing a three percent ammonia and water solution for wetting down the burn residue after each burn, a reinforced concrete bunker located 1,700 feet upwind to provide shelter for the operations crew during the burn, a tower to enhance ability to verify meteorological criteria required for the burn, and video cameras which document the operation.

The cylinders are transported to the burn site in a specially constructed container designed for maximum safety over a short distance. This container is secured on the bed of a low boy trailer and transported by truck to the burn area. A forklift truck is used to load the cylinders and transfer them from the transport vehicle to the burn pads. Explosive charges are used to cut through the cylinder wall and act as the primary ignition source. Approximately ½ to 3/4 pounds of 600 grain flex explosives are placed on each cylinder.

The 402 cylinders of pentaborane would be burned on two concrete burn pads constructed within the existing bladed area. The pads would be approximately 50 feet square, with a 12-inch high containment wall on all sides. The floor of the pad would slope toward the center. Access to the pad for cylinder positioning would be via ramps on the outside and inside of the concrete pad. The two pads would be constructed approximately 150 feet apart and aligned parallel with the wind corridor. The design would permit destruction of ten cylinders, five on each pad, during each burn operation. Each cylinder contains 500 pounds of pentaborane; therefore, 5,000 pounds of pentaborane would be destroyed during each burn operation. Ignition time for the two pads would be staggered by 15 to 20 minutes so combustion products of the second plume would not add to those of the first. The open concrete pad would improve safety conditions for workers by providing better emergency egress, further reduce the risk of cylinder lifting and handling, and provide better visibility of conditions after the burn. The open pad would also enhance combustion by allowing better air mixing. The concrete pads would be large enough to contain any spills of uncombusted pentaborane.

The ammonia and water solution is used to decontaminate the burn pad after each burn and before operating personnel are permitted on the burn pad without personal protective equipment. The area is not re-entered for 24 hours after the burn. Then the cylinder remains are collected and deposited in a 10 percent ammonia and water solution for 24 hours. All decontamination fluids are contained and sampled to determine if they are environmentally safe for disposal.

The disposal of the pentaborane is expected to require approximately 41 burn events. Because specific weather conditions are needed for each disposal, the pentaborane would be burned over a period of 18 months. These conditions include an air temperature greater than 50 degrees F, no inversion below 2,000 feet, and wind at 5 to 15 miles per hour blowing into a plume corridor defined at compass bearing 60 degrees to 180 degrees.

To monitor the effects of the pentaborane burning that occurred in 1996 on desert tortoises and the general environment, the AFFTC installed test equipment in the area downwind from the disposal site. One Toxic Gas Monitor (TGM) and three Fourier Transform Infrared Spectrometers (FTIR) were used to measure for pentaborane concentrations downwind. The TGM has eight sampling ports and is located in the plume corridor during and after each burn. Twelve Total Solid Particulate (TSP) monitors were used to measure concentrations of boron downwind. In addition, a remote controlled aircraft was flown into the plume to collect samples.

The following information on the revised sampling protocol was provided by the AFFTC during the consultation (W. Deal pers. comm. 1997). Due to logistical problems, fewer FTIRs are available for the proposed disposal of pentaborane than were used during the burning in 1996. Therefore, the Air Force will conduct air sampling with one TGM in the near field area, one mobile TGM along Highway 395, and one FTIR in the projected plume corridor. TSP sampling for airborne boron will no longer be conducted because it was not providing useful data; also, increased sampling will be conducted for boron deposited in the soil. Remote controlled aircraft would not be used.

Air samples would be taken during the first two burns to validate the health risk assessment and dispersion model it developed from the 1996 burns would be focused on determining if significant changes in pentaborane levels were occurring due to the increase in the number of cylinders. If no significant changes occur in the data, air sampling would be discontinued. During the first six burn events, Phillips Laboratory will continue to work to determine the identity of the unknown spike that was detected in previous air sample results in 1996. Based on discussions with the Service, the AFFTC proposes to institute a redesigned soil sampling procedure (attachment 11 of the request for consultation). A key component of the soil sampling, which was discussed with the Service during informal consultation, is that collection of soil would be limited to the top 0.25 inch or less. Sampling at this depth should ensure that only the most recently deposited born compounds are measured.

Based on the results of the soil and air analysis and the levels of boron accumulation required to affect wildlife and vegetation, the AFFTC concluded that the pentaborane burns conducted in 1996 did not affect desert tortoises or critical habitat for desert tortoise. The AFFTC concluded that insufficient data are available at this time to determine the cumulative effects of the remainder of the burn campaign. However, the AFFTC committed, in its request for consultation (attachment 11), to implement measures to minimize the accumulation of boron and reinitiate consultation if the accumulation of boron in the soil reaches levels of 200 parts per million above existing pre-burn conditions.

As with other tests, debris from exploding cylinders may need to be removed from areas of undisturbed habitat. The AFFTC proposes to employ the same measures to protect desert tortoises during the pentaborane burns as it would for other tests and burns. The AFFTC also proposes to continue monitoring the levels of boron that are deposited in the soil from ongoing burns. If boron levels in the soil reach a concentration that could affect desert tortoises, as described in the monitoring plan that accompanied the request for formal consultation on pentaborane disposal, the AFFTC will reinitiate either formal or informal consultation with the Service.

Utility Construction and Maintenance

Various activities, such as the installation of utilities, communication lines, and camera pads, and the repair and construction of roads and rocket motor test pads, may occur in support of rocket tests. Any further site development, including construction or refurbishment of new facilities and installation of equipment, would be limited mostly to previously disturbed areas which do not support native vegetation. Disturbance of areas supporting native vegetation will not exceed two acres for each operational test area.

Gas Lines

Above ground, cross country gas lines may be installed. Gas line corridors would not exceed 20 feet in width and 5 miles in total length. These lines would be constructed of 1.25 inch stainless steel pipes, typically placed 18 to 24 inches above the ground, and would carry nitrogen and helium. The gas lines would be constructed in existing corridors whenever possible, although the AFFTC anticipates that an unknown percentage of the construction would pass through currently undisturbed habitat.

Waste Water Treatment Plant

This facility would provide either secondary or tertiary treatment capacity for 0.5 million gallons of sewage effluent per day. The waste water treatment plant would be located adjacent to the old Imhoff Tanks and existing sewage ponds. The existing ponds are located in a drainage and tend to breach due to flooding from storm events. The total area of disturbance resulting from construction of a waste water treatment plant and sewage disposal ponds would not exceed 25 acres. Of this total, approximately 20 acres of disturbance would occur in previously disturbed habitat. The sides of the ponds would have a slope of 3:1 to allow for egress of desert tortoises. No new buildings are planned as a part of this project; however, one or two lift stations would be built.

The AFFTC proposes to implement the following measures to minimize the effect of the projects on the desert tortoise:

a. All project personnel, including workers, emergency responders, and visitors will attend an education program prior to open burning operations or site development and testing activities. The education program will consist of videos, brochures, and briefings. The education program will provide information on the natural history of the desert tortoise, requirements of the Act, and protection measures to be implemented during site development and testing activities. All personnel will sign a statement that they have received, understand, and will follow the regulations and protection measures presented in the education program. Copies of the signed statements would be on file at the AFFTC Environmental Management Office.

b. Site developments, such as installation of utilities, communication lines, camera pads, road repair and construction, and rocket motor test pads, have already been accomplished for the operational and test areas. Any further development, including construction or refurbishment of facilities and installation of equipment, would be limited, to the maximum extent feasible, to previously disturbed areas that do not support native vegetation. Disturbance of areas supporting native vegetation would not generally exceed two acres for each operational test area.

c. Areas of potential impact would be surveyed by qualified biological monitors prior to site development, each rocket motor test, detonation experiment or open burn operation. The open burns and rocket tests would be observed or videos of these operations would be viewed by qualified biologists. The AFFTC's wildlife biologist will then determine if further prefiring surveys will be required for open burns and the smaller rocket tests. Surveys would not be conducted prior to rocket motor tests conducted at the 1-56 area because firings at this location are not expected to affect desert tortoises or critical habitat. In the event of a test failure at test area 1-56 where materials are deposited down slope, qualified biological monitors will conduct surveys after emergency response personnel render the impact area safe and prior to further clean-up operations.

d. Biological monitors would be available during site development activities which may result in injury or mortality of desert tortoises. The AFFTC's wildlife biologist would determine which activities require biological monitoring. Activities which occur during periods of desert tortoise inactivity, such as during extreme temperatures, will not require biological monitoring. The AFFTC's wildlife biologist would identify qualified personnel to perform biological monitoring, preconstruction and prefiring surveys at the Phillips Laboratory.

e. Any desert tortoises found during preconstruction or prefiring surveys would be relocated to nearby safe areas. If relocation is not possible, desert tortoises would be placed in clean cardboard boxes and held in a temperature controlled building. When the area is considered safe, desert tortoises would be returned to their point of capture.

f. Strict trash and litter control would be implemented at the Phillips Laboratory. All trash and litter would be promptly contained in receptacles that cannot be opened by common ravens (*Corvus corax*). Trash containers would be emptied regularly to ensure adequate capacity is maintained.

g. All pipe and conduit would have both ends capped while stored outdoors. All open pipe and conduit welded in-place would be capped when left unattended. All open excavations which are left unattended would be fenced, unless other methods of excluding desert tortoises are employed.

h. All rocket motor tests, propellant burns, and detonations would be conducted during very specific weather conditions. Weather parameters include specific thresholds for wind speed and wind direction; tests would not occur when thunderstorms are within 25 nautical miles and unstable atmospheric conditions exist. In addition, rocket motor tests, propellant burns, and detonations will not be conducted when precipitation is occurring at the test site.

i. Contingent upon available funds, the AFFTC and Phillips Laboratory will install desert tortoise exclusion fencing around the high impact areas of the 1-32 and 1-52 test sites. Fencing to exclude desert tortoises has been installed around the high impact areas of test site 1-36D.

j. The Phillips Laboratory will submit an annual report to the AFFTC which in turn will submit it to the Service. The report would provide the numbers of desert tortoises handled, relocated, and injured at each of the test sites and open burn site. The annual report would provide the size of tests and project areas.

Effects of the Action on the Listed Species

Species Account

The desert tortoise is a large, herbivorous reptile found in portions of the California, Arizona, Nevada, and Utah deserts. It also occurs in Sonora and Sinaloa, Mexico. In California, the desert tortoise occurs primarily within the creosote, shadscale, and Joshua tree series of Mojave desert scrub, and the lower Colorado River Valley subdivision of Sonoran desert scrub. Optimal habitat has been characterized as creosote bush scrub in which precipitation ranges from two to eight inches, diversity of perennial plants is relatively high, and production of ephemerals is high (Luckenbach 1982, Turner and Brown 1982, Turner 1982, and Schamberger and Turner 1986). Soils must be friable enough for digging of burrows, but firm enough so that burrows do not collapse. In California, desert tortoises are typically associated with gravelly flats or sandy soils with some clay, but are occasionally found in windblown sand or in rocky terrain (Luckenbach 1982). Live desert tortoises have been found in the California desert from below sea level to an elevation of 7,300 feet, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 feet (Luckenbach 1982, Schamberger and Turner 1986).

Desert tortoises are most active in California during the spring and early summer when annual plants are most common. Additional activity occurs during warmer fall months and occasionally after summer rain storms. Desert tortoises spend the remainder of the year in burrows, escaping the extreme conditions of the desert. Further information on the range, biology, and ecology of the desert tortoise can be found in Burge (1978), Burge and Bradley (1976), Hovik and Hardenbrook (1989), Luckenbach (1982), Weinstein et al. (1987), and Service (1994).

On August 4, 1989, the Service published an emergency rule listing the Mojave population of the desert tortoise as endangered. In a final rule, dated April 2, 1990, the Service determined the Mojave population of the desert tortoise to be threatened. The Service designated critical habitat for the desert tortoise in portions of California, Nevada, Arizona, and Utah in a final rule, published February 8, 1994. A final recovery plan for the desert tortoise was published by the Service in June, 1994.

The recovery plan is the basis and key strategy for recovery and delisting of the desert tortoise (Service 1994). The plan divides the range of the desert tortoise into six distinct population segments or recovery units and recommends establishment of 14 Desert Wildlife Management Areas throughout the recovery units. Within each Desert Wildlife Management Area, the recovery plan recommends implementation of reserve level protection of desert tortoise populations and habitat, while maintaining and protecting other sensitive species and ecosystem functions. The design of Desert Wildlife Management Areas should follow accepted concepts of reserve design. As part of the actions needed to accomplish recovery, land management within all Desert Wildlife Management Areas should restrict human activities that negatively affect desert tortoises (Service 1994).

Critical habitat is designated by the Service to identify the key biological and physical needs of the species and key areas for recovery, and focuses conservation actions on those areas. Critical habitat is composed of specific geographic areas that contain the biological and physical attributes that are essential to the species' conservation within those areas, such as space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats. These features are called the constituent elements of critical habitat.

The specific constituent elements of desert tortoise critical habitat are: 1) sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality (59 FR 5820).

Test areas 1-52, 1-56, 1-42 and test pad 1-36D are located in the Fremont-Kramer critical habitat unit (CHU), one of four CHUs designated in the Western Mojave Recovery Unit. CHUs as

defined in the final rule designating critical habitat for the desert tortoise were patterned after the Desert Wildlife Management Area and recovery unit concepts in the recovery plan. The Western Mojave Recovery Unit consists of approximately 4,753,000 acres, located entirely in California. Vegetation within this recovery unit is characterized by creosote bush scrub, big galleta-scrub steppe, desert needlegrass scrub-steppe, and blackbrush scrub (in higher elevations). Topography is varied, with flats, valleys, alluvial fans, washes, and rocky slopes. The Fremont-Kramer CHU covers approximately 518,000 acres in Kern, Los Angeles, and San Bernardino counties, California.

The dominant plant communities within the vicinity of the proposed rocket test sites are Joshua tree woodland and creosote bush scrub. Arid phase saltbush scrub occurs in the vicinity of the propellant disposal area (Mitchell et al. 1993). The most visible member of this community is Joshua tree (*Yucca brevifolia*), with creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), and Mormon tea (*Ephedra nevadensis*) being the dominant "understory" shrubs. Creosote bush scrub is dominated by the creosote bush, burrobush, and goldenhead (*Acamptopappus sphaerocephalus*). Arid phase saltbush scrub is dominated by allscale (*Atriplex polycarpa*).

Transects to determine the relative density of desert tortoises on Phillips Laboratory, based on the methodology developed by the Bureau of Land Management (Bureau), were conducted in November and December, 1992 (Mitchell et al. 1993). Transects were executed on 24 sections chosen at random from all sections entirely or partially within the boundaries of Phillips Laboratory. Three of the sections surveyed for the Mitchell et al. (1993) study included parts of test areas 1-52 and 1-56 and a section immediately north of test pad 1-36D. Estimates of desert tortoise densities from the transects in the vicinity of the test pads ranged from 13 to 28 individuals per square mile. Relative density estimates were derived by relating counts of desert tortoise sign at Phillips Laboratory to sign counts at five Bureau population trend plots. [For details of the calibration methodology see the report by Mitchell et al. (1993).] For the Phillips Laboratory in general, sections generally north and west of test pad 1-36D supported the highest densities of desert tortoises. Creosote bush scrub appeared to support slightly higher densities of desert tortoises than Joshua tree woodland or arid-phase saltbush scrub communities. Given the small sample size, however, the observed small differences in desert tortoise density may be statistically insignificant (Mitchell et al. 1993).

Analysis of Effects

Rocket Testing Activities

The current request for consultation does not include any new information on the possible effects on the desert tortoise of the by-products of the testing on Phillips Laboratory. The following discussion on possible effects is derived from the 1995 biological opinion for a rocket motor testing program at Phillips Laboratory (1-8-95-F-9).

The eight test areas and the disposal area discussed in this biological opinion were built to accommodate the needs of past test programs. Since their completion, several thousand tests of rocket engines and propellants have been conducted at these facilities. As in the past, the proposed tests of rocket engines and propellants or disposal burns of propellant wastes would result in plumes of combustion products or accidental explosions that may propel metal fragments or burning propellant beyond cleared areas into surrounding desert tortoise habitat.

Combustion products of rocket tests, detonations, or disposal burns employing either liquid hydrogen, or RP-1/liquid oxygen formulation would consist primarily of carbon monoxide, carbon dioxide, nitrogen, and water. Combustion products of rocket tests, detonations, or disposal burns would include carbon monoxide, hydrazine, kerosene, carbon dioxide, hydrogen, nitrogen, hydrochloric acid, fluorine oxidizers, helium, methane, and aluminum oxide.

The AFFTC did not provide information on the rates of deposition of combustion products anticipated from the proposed rocket tests. Many of the proposed tests would consume less than 100 pounds of propellant. The AFFTC notes that for tests of 100 pounds of propellant or less exhaust plumes dissipate in less than 100 feet. For tests in this range of magnitude, most combustion products could precipitate within the cleared areas around test pads. Wind and weather conditions, however, are likely to affect the ultimate distribution of exhaust plumes even for tests of small amounts of propellant. Because the AFFTC indicates that tests and burns would be conducted through a range of wind and weather conditions, portions of the exhaust plumes, even those produced by small tests, would likely pass beyond existing cleared areas into desert tortoise habitat and further degrade habitat quality within the project area.

The effects of the deposition of the emissions on the desert community in general and desert tortoises in particular are not well known. However, acidic precipitation from the exhaust plume of a Titan IV test was anticipated to be as low as pH 3 (Oak Ridge National Laboratory 1988), although information collected at the Kennedy Space Center indicated that acidity level in exhaust plumes fell as low as pH 0.5 (Schmalzer et al. 1985). The effects of acid deposition on the herbaceous plant community, particularly the effects of changes in soil pH on seedling germination, are unknown. Preliminary studies at the Edwards Air Force Base indicate that species diversity within areas affected by the Titan IV motor tests is lower relative to areas beyond the influence of acid deposition (Service 1991). Highly acidic precipitation would likely cause damage to the soft tissues of desert tortoises, such as their eyes, lungs, and skin.

The Service recognizes that the tests and propellant burns proposed in this action are not directly comparable with tests of the Titan IV or Titan 34D rocket motors; the individual tests proposed would involve much smaller quantities of propellant than the Titan IV and 34D tests noted above and testing is distributed over a sizeable area and through time. However, the proposed tests could consume up to approximately 400,000 pounds of propellant per year and water deluge systems would not be available to trap combustion products to minimize the distribution of hydrogen chloride.

The Service notes that an unquantified, and perhaps significant, proportion of the propellant consumed each year would consist of formulations that do not produce hydrogen chloride upon combustion. The proposed tests at area 1-56 would consume approximately 91,000 pounds of polybutadiene/liquid oxygen propellant, which does not produce hydrogen chloride upon combustion. For this reason, and because the test site is isolated from desert tortoise habitat by its location on the summit of Haystack Butte, rocket motor tests at this site are less likely to affect desert tortoises.

The AFFTC has installed fencing to exclude desert tortoises from some portions of test areas subject to deposition of significant quantities of hydrogen chloride. This fencing has resulted in an unknown amount of habitat being excluded from use by desert tortoises. However, erecting exclusion fencing and removing desert tortoises from high acid deposition areas has reduced the likelihood of resident individuals sustaining injury from continued rocket testing. Moreover, continued testing could have rendered those areas receiving high rates of acid deposition unfit for the desert tortoises remaining in the area.

In its request for consultation, the AFFTC notes that additional fences to exclude desert tortoises would be constructed around the high impact areas of the 1-32 and 1-52 test sites if funds become available. Fencing to exclude desert tortoises has been installed around the high impact areas of test site 1-36D. Desert tortoises are more likely to be killed or injured if they are able to enter areas immediately adjacent to test pads when burns or tests are being conducted. Conducting pre-test surveys to find and remove desert tortoises from the near field area would likely reduce the number of individuals that may be affected by tests. However, surveys may fail to detect smaller desert tortoises or individuals that are in burrows at the time of the survey. Additionally, handling and translocation of desert tortoises always poses some risk because the individual may void its bladder or be unable to find required habitat requirements in the area to which it is moved. Consequently, although constructing fencing to exclude desert tortoises precludes their use of a relatively small area of disturbed habitat, it is more likely to reduce the potential of injury or mortality to individual animals. Given the depressed numbers of desert tortoises that currently exist in the western Mojave Desert, the conservation of individual animals warrants full consideration.

Effects directly related to further fence installation at test sites could include direct mortality of desert tortoises and further habitat degradation through crushing of burrows and vegetation by off-road vehicle travel. Individual desert tortoises could be taken by predators, such as common ravens, that can be attracted to project sites by human activities. Uninformed workers could also collect or vandalize desert tortoises that they may encounter when in the project area. Increased awareness of the desert tortoise, its status, and appropriate actions to take if a desert tortoise is encountered should reduce the direct and indirect take of the species.

Disposal of Pentaborane

The AFFTC installed a fence to exclude desert tortoises from the vicinity of area 1-36D in February 1996. This fence encircles the site at a 1,000 foot radius. The habitat inside the fence is highly degraded from past activities.

The physical effects of the disposal of pentaborane would be similar to the impacts of other burn and test projects. Although pentaborane is highly toxic, the AFFTC expects it to fully burn under the disposal conditions. The combustion products of pentaborane include carbon monoxide, hydrogen, nitrogen, water, and boron compounds such as boric oxide and boric acid. Carbon monoxide, hydrogen, and nitrogen are expected to vaporize into the atmosphere while the boron compounds and water would settle onto the ground.

The information on the toxic effects of boron compounds on wildlife is inconsistent. Boric acid is highly toxic to many invertebrates. If invertebrate pollinators of plants that are used as forage by desert tortoises are eliminated from an area and the plants consequently are fewer in density and diversity, the long term value of the habitat could be reduced. Boron levels in plants in desert ecosystems are normally higher than in other habitat types (AFFTC 1997). Plants are unable to expel boron; as levels of boron rise, more tolerant species, such as legumes and mustards, may be selected over less tolerant ones, such as grasses and other monocotyledons (Butterwick et al. 1989 in AFFTC 1997.) The AFFTC enclosed two articles on the effects of boron on wildlife with its request for consultation, although neither article specifically addresses the desert tortoise (attachments 9 and 10 in the request for consultation).

The pentaborane is expected to burn at temperatures as high as 2,200 degrees F for approximately 30 to 45 minutes until consumed. The height of the plume is dependent on air temperatures; on cool days the plume tends to remain close to the ground while on warm days the plume may reach 4,000 feet. The plume may travel up to and beyond three miles before dissipating.

The results of soil samples taken up to 3 inches deep from all locations outside the 1,000 foot desert tortoise exclusion fence indicated that the levels of boron, pH, and lead were similar to the preburn samples (attachment 6 in the request for consultation). The results of pentaborane sampling from the FTIRs did not detect pentaborane at levels of concern (attachments 7 and 8 in the request for consultation).

The AFFTC anticipates that desert tortoises would not be killed or injured during this operation. Some risk of accidental injury or mortality of desert tortoises may occur during positioning of sampling equipment outside the exclusion fence around the burn site or if an individual gains access within the fence and is not observed prior to a burn. These risks would be reduced through instruction of workers and inspections of monitoring sites and the area within the fence prior to each burn, if the fence is found to have been damaged.

Utility Construction and Maintenance

The effects of utility construction and maintenance on the desert tortoise and its habitat would generally resemble those described for installation of fences. Restricting new development to previously disturbed areas which do not support native vegetation would reduce the adverse effects on native habitat. The AFFTC noted that disturbance of areas supporting native vegetation would not exceed two acres for each operational test area. Because eight operational test areas are under consideration in this biological opinion, the expected loss of habitat is expected to be 16 acres. This potential loss of habitat should not greatly increase fragmentation of desert tortoise populations.

Gas Lines

Construction of above ground gas lines would disturb a maximum of 12 acres of habitat (20 feet wide multiplied by 5 miles). However, because the gas lines would be constructed in existing corridors whenever possible, the actual acreage of undisturbed habitat that would be affected is likely to be less. During the construction, individual desert tortoises would be subject to injury or death as a result of crushing by construction vehicles or equipment in the project area or by straying of vehicles or equipment into habitat outside the work area.

The AFFTC did not provide specific information regarding the manner in which the lines would be constructed. For example, brushing the areas where gas lines would be constructed through undisturbed habitat would allow the surrounding vegetation to recover more quickly than if the area is graded.

The gas lines would be placed 18 to 24 inches above the ground. The AFFTC did not specify whether these were minimum heights. If lines are installed too close to the ground, desert tortoises may become lodged between the ground and the pipe. If the line travels too close to the ground for a long distance, habitat for desert tortoises could be fragmented if individuals cannot pass under the line. These effects can be avoided by ensuring that the gas line is a minimum height of 18 inches above ground for its entire length when in areas that support desert tortoises. However, some potential exists that, over the length of the gas line, material may be piled against the pipe as a result of winds that move soils, trash, or vegetation in a manner that could trap a desert tortoise or cause fragmentation of habitat. Removal of this material during routine inspections should reduce the potential for this impact to occur.

Waste Water Treatment Plant

Construction of the waste water treatment plant would permanently destroy 25 acres of habitat. Only five acres of the new construction would occur in previously undisturbed habitat (Hagan pers. comm. 1997). Activities associated with the construction of the ponds and ancillary facilities could affect desert tortoises in the same manner as installation of fencing, which was described previously in this biological opinion.

Additionally, desert tortoises could be trapped or drowned in the ponds. Additional information provided by electronic mail from AFFTC staff reports the proposed slope of the new sewage ponds to be 3:1. The Service interprets that to be one unit of rise over three units of run. Such a slope should allow desert tortoise to leave the pond area, provided that the surface of the pond's side is sufficiently rough to provide traction. The Service is aware of instances in which desert tortoises have drowned in wildlife guzzlers with gentle slopes when the animals were unable to exit because of the slippery substrate. Some potential exists that desert tortoises may be able to enter the facility, even though it is fenced, through breaks in the fence caused by weather or through open gates.

Common ravens may be attracted to this water source. However, for a species with the ability to travel long distances, such as the common raven, water is relatively common in this region of the desert; consequently, the ponds may not pose an additional attraction to common ravens.

The Service believes that the effects described above are not likely to jeopardize the continued existence of the desert tortoise or adversely modify its critical habitat. We base this conclusion on the following facts:

1. The project description includes mitigation measures that will reduce the take of individual desert tortoises and degradation of their habitat. Following implementation of similar mitigation measures, many past construction and rocket testing actions proceeded without take of desert tortoises.

2. The area to be affected by the proposed construction, maintenance, and rocket testing actions contains habitat that has already been fragmented to some degree by past projects and rocket tests. Therefore, the proposed action does not increase fragmentation of desert tortoise populations.

3. The approximately 50 acres of potential habitat that may be disturbed as a result of the proposed activities constitutes a very small portion or the range of the desert tortoise.

Cumulative Effects

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur in the project area. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative to the proposed project.

All of the actions that are reasonably expected to occur within the vicinity of the proposed tests and propellant burns will be subject to formal consultation, as mandated by section 7 of the Act, because the AFFTC manages all of the surrounding land or leases it to tenants, such as the National Aeronautics and Space Administration.

Activities occurring on lands adjacent to Edwards Air Force Base that are managed by the Bureau of Land Management will also be subject to the consultant requirements of section 7. However, activities occurring on adjacent private lands, such as off-highway vehicle use, grazing and residential developments, continue to contribute to the degradation of desert tortoise habitat in this region of the desert.

The Service has contacted the counties of San Bernardino, Kern, Riverside, Inyo, and Los Angeles (and the incorporated areas within the desert) regarding the listing of the desert tortoise and its implications for city- and county-permitted activities. Many cities within the range of the desert tortoise in San Bernardino, Los Angeles, and Kern counties have expressed interest in obtaining a section 10(a)(1)(B) incidental take permit from the Service. Regional planning efforts, such as the West Mojave Coordinated Management Plan, could serve as model habitat conservation plans for local governments. Cumulative impacts of future State and private projects will be addressed in regional plans, such as this, and in the section 10(a)(1)(B) incidental take permit process.

Incidental Take

Section 9 of the Endangered Species Act prohibits the take of listed species without special exemption. Taking is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Under the terms of section 7(b)(4) and 7(0)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this incidental take statement. The measures described below as reasonable and prudent measures and terms and conditions to reduce take are non-discretionary, and must be undertaken by the agency or made a binding condition of any grant or permit, as appropriate. This biological opinion anticipates the following forms of take:

For the rocket test program:

1. One (1) desert tortoise per year through accidental death or injury during project activities.

2. Twenty-five (25) desert tortoises per year in the form of harassment through moving of desert tortoises out of harm's way prior to test firings, propellant burns or construction and maintenance activities.

For the waste water treatment plant:

1. One (1) desert tortoise through accidental death or injury during construction of the waste water treatment plant.

2. Ten (10) desert tortoises in the form of harassment through moving of desert tortoises out of harm's way prior to activities related to the construction of the waste water treatment plant.

3. One (1) desert tortoise per two years in the form of direct mortality through accidental death or injury during activities associated with the operation, maintenance, or repair of the waste water treatment plant.

4. Five (5) desert tortoises per year in the form of harassment through moving of desert tortoises out of harm's way prior to activities related to the operation, maintenance, or repair of the waste water treatment plant.

For the above-ground gas lines:

1. One (1) desert tortoise through accidental death or injury during activities associated with the installation of above-ground gas lines.

2. Ten (10) desert tortoises in the form of harassment through moving of desert tortoises out of harm's way during installation of the above-ground gas lines.

3. One (1) desert tortoise per year in the form of direct mortality through accidental death or injury during activities associated with the operation, maintenance, or repair of the gas lines.

4. Ten (10) desert tortoises per year in the form of harassment through moving of desert tortoises out of harm's way during maintenance of the above-ground gas lines.

This biological opinion does not exempt from section 9 prohibitions any form of take that is not incidental to the AFFTC's activities covered by this biological opinion. If the incidental take anticipated by this biological opinion is met, the AFFTC shall immediately notify the Service in writing. If the incidental take authorized by this biological opinion is exceeded, the AFFTC shall cease activities resulting in take and shall reinitiate formal consultation with the Service.

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental taking authorized by this biological opinion.

1. Worker education programs and well-defined operational procedures shall be implemented to reduce the potential for injury or mortality of desert tortoises during the proposed propellant burns and testing, and construction and maintenance activities.

2. The take of desert tortoises, through injury or death due to the straying of equipment beyond project areas, shall be reduced through establishment of clearly defined work areas.

3. The take of desert tortoises, through injury or death, found within proposed project areas shall be reduced through the temporary removal of these animals to safe areas beyond the influence of exhaust plumes or other project threats.

4. The take of desert tortoises, through injury, death, or harassment, shall be reduced by siting facilities to avoid undisturbed habitat to the maximum extent feasible and by ensuring that desert tortoises do not become trapped under the gas line or in the waste water treatment pond.

5. Attraction of common ravens and other potential desert tortoise predators to project sites shall be reduced to the maximum extent possible.

6. The take of desert tortoises, through injury or mortality associated with elevated levels of boron in the soil, shall be avoided through monitoring during and after burns.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the AFFTC is responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. Several of the following terms and conditions are based on the mitigation measures proposed by AFFTC in its request for formal consultation, which are repeated in the "Description of the Proposed Action" portion of this biological opinion, and are hereby incorporated as terms and conditions of this biological opinion.

A. The following terms and conditions implement reasonable and prudent measure 1:

1. The AFFTC shall ensure that mitigation measures a, g, and h, as described in the request for consultation, are fully implemented.

2. Any activities that have the potential to disturb native habitat which occur between dusk and dawn shall be limited to areas which have already been cleared of desert tortoises by biological monitors and enclosed by a fence to exclude desert tortoises.

3. When working in desert tortoise habitat, all personnel shall inspect under vehicles prior to operating them. If a desert tortoise is discovered under a parked vehicle, an authorized biologist shall relocate the animal to a nearby, safe location. The authorized biologist shall use his or her best professional judgement to ensure that desert tortoises moved in this manner are not subjected to temperature extremes which could result in injury or death. Alternatively, the vehicle shall be left in place until the desert tortoise moves of its own volition.

B. The following terms and conditions implement reasonable and prudent measure 2:

Areas that are subject to ground-disturbing activities, parking of vehicles, and staging of equipment shall have clearly marked boundaries. All workers shall be instructed to confine their activities within the delineated areas.

C. The following terms and conditions implement reasonable and prudent measure 3:

1. The AFFTC shall ensure that mitigation measures c, d, and e, as described in the request for consultation, are fully implemented. The protective procedures defined in mitigation measure d shall also be implemented during repair of the gas line and waste water treatment plant or, if at any time, desert tortoises are found to be at risk during operation of these facilities.

2. Desert tortoises shall not be released more than 100 meters from the point of capture when they are being moved from harm's way.

3. When handling desert tortoises, the qualified biologists and environmental monitors shall follow the procedures described in "Guidelines for Handling Desert Tortoises during Construction Projects" (Desert Tortoise Council 1996).

4. Only "qualified biologists" shall conduct pre-activity surveys for desert tortoises and remove animals from work areas to nearby suitable habitat. The removal may include the excavation of burrows and creation of new burrows, if required.

"Environmental monitors" as defined in the March 24, 1997 letter, may include individuals who are present during implementation of a project and track whether a project is being conducted according to the mitigation program established for the proposed action. Environmental monitors may inspect active work areas, which have already been cleared of desert tortoises by the qualified biologist, to ensure desert tortoises have been effectively excluded and remove desert tortoises that enter work areas.

As noted in the Service's March 24, 1997 letter to Colonel Doolittle, qualified biologists and environmental monitors that have been approved by the Service to handle desert tortoises for a previous biological opinion may serve in these capacities for this biological opinion. If the AFFTC wishes to use additional qualified biologists and environmental monitors, their names and credentials shall be provided to the Service for its review and approval at least 15 days prior to the onset of work activities in which they will participate. The AFFTC may appoint qualified personnel to monitor projects without Service review and approval provided that these individuals do not handle desert tortoises.

D. The following terms and conditions implement reasonable and prudent measure 4:

1. The AFFTC shall ensure that new construction and staging sites for repair and maintenance work are located in previously disturbed areas to the maximum extent feasible. Disturbance of areas supporting native vegetation shall not exceed two acres for each of the eight operational test areas.

2. The AFFTC shall ensure that the gas lines under consideration in this biological opinion are placed at least 18 inches above ground when they traverse habitat of the desert tortoise. If, at any time after installation of the gas lines, the height of the pipes above the ground has been reduced to less than 18 inches, the AFFTC shall either raise the pipe line or remove the materials that caused the reduction in height.

3. The AFFTC shall ensure that desert tortoises do not become trapped in the waste water treatment ponds. Potential means of preventing entrapment include constructing the ponds with side slopes with one unit of rise over three units of run and with a roughened substrate or by installing a fence to exclude desert tortoises.

E. The following term and condition implements reasonable and prudent measure 5:

The AFFTC shall ensure that mitigation measure f, as described in the request for consultation, is fully implemented.

F. The following term and condition implements reasonable and prudent measure 5:

1. The AFFTC shall collect air samples during the first two burns of pentaborane to validate its health risk assessment and dispersion model. After review by the Service of the information collected during the first two burns, the air sampling may be discontinued if significant changes in the data do not occur.

2. The AFFTC shall institute the soil sampling procedure described in attachment 11 in the request for consultation to determine whether the deposition of boron may adversely affect desert tortoises.

Reporting Requirements

The AFFTC shall submit an annual report to the Service which provides information on the number of tests conducted, amount and nature of propellant burned, amount of gas lines installed, the progress of the sewage treatment pond construction, and the amount of habitat disturbed by activities addressed by this biological opinion. The report will also provide information on the number of desert tortoise mortalities and injuries, the number of animals

handled and relocated, the distances these individuals were moved from their points of capture, the fate of the desert tortoises involved in the translocations, and the success of protection measures which have been implemented.

Disposition of Dead or Injured Desert Tortoises

Upon locating dead or injured desert tortoises, initial notification must be made in writing to the Service's Division of Law Enforcement in Torrance, California (370 Amapola Avenue, Suite 114,Torrance, Califomia 90501) and by telephone and writing to Ventura Fish and Wildlife Office in Ventura, California (2493 Portola Road, Suite B, Ventura, California 93003, (805/ 644-1766) within three working days of its finding. The report shall include the date, time, location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

Care shall be taken in handling injured animals to prevent additional injury. Injured animals may be released to the wild after receipt of concurrence from the Service. Care shall be taken in handling dead specimens to preserve biological material in the best possible state for later analysis. The remains of desert tortoises shall be placed with the Biological Resources Division, U.S. Geological Survey, 6221 Box Springs Boulevard, Riverside, California 92507 (Contact: Kristin Berry, [909/697-5361]). Arrangements regarding proper disposition of specimens shall be made with the Biological Resources Division by the project monitor prior to implementation of the action.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service offers the following conservation recommendations:

1. The AFFTC should, in a timely manner, complete and implement a base-wide habitat management and restoration plan. Such a plan could include management guidelines for the protection of entire communities and restoration efforts following Base activities. The plan should include specific recommendations and guidelines for management of the desert tortoise population throughout Edwards Air Force Base. Such an approach to managing the biological resources would help reduce the threat to a number of species of special concern [for example, the alkali mariposa lily (Calochortus striatus) and desert cymopterus (Cymopterus deserticola)] and thereby reduce the need for listing additional species as threatened or endangered.

2. The AFFTC should consider marking desert tortoises moved from maintenance and construction sites and monitoring the survivorship of these individuals. This information would be used to develop more successful techniques for moving desert tortoises from harm's way and to more accurately assess take associated with this type of activity. These individuals may be marked using the acrylic epoxy method described in Guidelines for Handling Desert Tortoises During Construction Projects (Desert Tortoise Council 1996). Notching of shells is not authorized.

3. The AFFTC should install fencing around the high impact areas at test sites 1-32 and 1-52 to preclude the entry of desert tortoises.

4. The AFFTC's wildlife biologist should assist in the placement of the proposed waste water treatment ponds to ensure that to the greatest extent possible, populations of desert cymopterus, a species of special concern, are protected from disturbance .

The Service requests notification of the implementation of any conservation recommendations so we can be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats.

Conclusion

This concludes formal consultation on the AFFTC's proposal for rocket testing, waste burning, and support activities at the Phillips Laboratory on Edwards Air Force Base. Reinitiation of formal consultation is required if- 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner not considered in this biological opinion; 3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action (50 CFR 402 § 16). As agreed by the Service and the Air Force, formal consultation would be reinitiated if any individual activity within Phillips Laboratory exceeds two acres of habitat disturbance for any operational test area. Any comments or questions should be directed to Doug Laye of the Service's Barstow Office at (760) 255-8844.

Sincerely,

Diane K. Noda

Diane K. Noda
Field Supervisor

Enclosure

Literature Cited

Air Force Flight Test Center. 1997. [Request for formal consultation, pursuant to section 7 of the Endangered Species Act, on disposal of pentaborane.] Letter to Diane Noda, U.S. Fish and Wildlife Service, from Colonel James F. Doolittle III, U.S. Air Force, dated May 19. Edwards Air Force Base, California.

Burge, B.L. 1978. Physical characteristics and patterns of utilization of cover sites by Gopherus agassizii in southern Nevada. Proc. 1978 Symp., The Desert Tortoise Council. pp. 80-ill.

Burge, B.L., and W.G. Bradley. 1976. Population density, structure and feeding habits of the desert tortoise, Gopherus agassizii, in a low desert study area in southern Nevada. Proc. 1976 Symp., The Desert Tortoise Council. pp. 51-74.

Deal, W. 1997. Personal communication through electronic mail, dated July 22. Wildlife biologist, Air Force Flight Test Center. Edwards Air Force Base, California.

Desert Tortoise Council. 1996. Guidelines for Handling Desert Tortoises During Construction Projects. Edward L. LaRue, Jr., editor. San Bernardino, California.

Hagan, M. 1997. Personal communications through electronic mail and telephone conversations. Wildlife biologist, Air Force Flight Test Center. Edwards Air Force Base, California.

Hovik, D.C., and D.B. Hardenbrook. 1989. Summer and fall activity and movements of desert tortoises in Pahr-ump Valley, Nevada. Abstract of paper presented at Fourteenth Annual Meeting and Symposium of the Desert Tortoise Council.

Luckenbach, R.A. 1982. Ecology and management of the desert tortoise (Gopherus agassizii) in California. In: R.B. Bury (ed.). North American Tortoises: Conservation and Ecology. U.S. Fish and Wildlife Service, Wildlife Research Report 12, Washington, D.C.

Mitchell, D., D.M. Laabs, M.L. Allaback, and R.C. Arnold. 1993. Potential impacts of Installation Restoration Program activities on desert tortoise (Gopherus agassizii) with notes on other sensitive species, operable unit no. 4, Edwards Air Force Base, California. Prepared for the Air Force Flight Test Center, Environmental Management Office. Contract DACA05-C-91-0130.

Schamberger, M., and F.B. Turner. 1986. The application of habitat modeling to the desert tortoise (Gopherus agassizii). Herpetologica 42(l):134-138.

Schmalzer, P.A., C. R. Hinkle, and D. Breininger. 1985. Effects of space shuttle launches STS-1 through STS-9 on terrestrial vegetation of John F. Kennedy Space Center, Florida. The Biontics Corporation, Kennedy Space Center, Florida.

Turner, R.R. 1982. Mohave desertscrub. In: D.E. Brown (ed), Biotic communities of the American Southwest - United States and Mexico. Desert Plants 4(1-4):157-168.

Turner, F.B. and D.E. Brown. Sonoran desertscrub. In: D.E. Brown (ed.). Biotic communities of the American Southwest - United States and Mexico. Desert Plants 4(1-4):181-222.

U.S. Fish and Wildlife Service. 1991. Preliminary report, biological monitoring studies for the Titan IV rocket motor test program. U.S. Fish and Wildlife Service, Laguna Niguel, California.

U.S. Fish and Wildlife Service. 1992. Biological Opinion for the Titan IV Solid Rocket Motor Upgrade, Kem County, California (File number 1-6-91-F-16R). U.S. Fish and Wildlife Service, Laguna Niguel, California.

U.S. Fish and Wildlife Service. 1994. Desert Tortoise (Mojave Population) Recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 73 pp. plus appendices.

Weinstein, M., K.H. Berry, and F.B. Turner. 1987. An analysis of habitat relationships of the desert tortoise in California. A report to Southern California Edison Company.

PHILLIPS LABORATORY EXPERIMENTAL AND TEST FACILITIES

TYPICAL OPERATING CAPABILITIES

(22 October 1996)

1. Experimental Area 1-14, Satellite Propulsion Complex and Experimental Area 1-15, Centrifuge

TEST REQUIREMENTS: Liquid propellant operations (test firings) may occur 5 times a day (60 sec firings), 10 times a day (30 sec firings) to once a week (120 sec firings).

PROPELLANTS: Liquid Oxygen - 2,000 gals (19,070 lbs), Hydrogen - 1,000 lbs, kerosene - 2,000 gals (13,520 lbs), hydrazine - 50 gals (426 lbs), nitrogen tetroxide - 75 gals (920 lbs), and fluorine 0.1 lbs/test.

EMISSIONS:

LOX/LH2: Water - 96% and H2 -4%
Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
LOX/Kerosene: CO2 - 42%, CO -28%, Water - 28% and H2/N2 - 2%
Fluorine oxidizers: Cl - 40% and Fl - 60%.
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.

2. Solar Propulsion Facility, Bldg 9626:

TEST REQUIREMENTS: Typical firing duration's range from 15 to 30 minutes duration. It is anticipated that there would be no more than four firings at this duration per day with a total of 50 firings a year.

PROPELLANTS: Hydrogen, helium, methane, and nitrogen at 10 lbs/test.

EMISSIONS: 100% Hydrogen, helium, methane and nitrogen are released to the atmosphere.

3. Experimental Area 1-21, Propellant Preparation Laboratory

TEST: Propellant cutting, cutting and shaping of solid propellant pieces for mechanical behavior testing and propellant ingredient studies is performed daily. Propellant grains are sawed, milled, or turned on lathes to produce specific shapes and sizes.

PROPELLANTS: The facility is capable of machining up to 425 lb of Class 1.1 solid propellant samples. The amount of Class 1.3 propellant samples (approximately 10,000 lb) are limited by available working space. Liquid propellants are no longer used at this area.

EMISSIONS: Propellant shavings and dust generated by the machining operations are vacuumed into a wet scrubber tank and washed to a collection tank, where they are regularly collected and turned in to the Thermal Treatment Facility at Area 1-100.

4. **Experimental Area 1-30, Propellant Laboratory**

TESTS: Propellant mixing, conditioning, aging, and testing the chemical and physical properties of solid propellant formulations is done daily. Propellant physical and chemical properties are tested regularly through tensile tests, strand burner tests, friction tests, impact tests, card gap tests and static firings of small solid motors at ambient conditions. Approximately 300 operations of various types are conducted per year.

PROPELLANTS: Solid propellant burnt during PI-K motor tests (4 per month at 5 lbs each), 2X4 testing (15 per month at 0.5 lbs each), and card gap tests (30 per month at 2 lbs each), etc.

EMISSIONS: Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%. The total annual atmospheric emissions from the area are approximately 500 lb (225 kg).

5. **Experimental Area 1-32, Motor and Components Operations Complex**

TESTS: Area 1-32 is used for Ballistics Test and Evaluation System (BATES) test, a developmental standard for air-launched missile, ballistic missile, solid rocket motor hardware, and studies of the combustion characteristics of solid propellant. Operations consists primarily of 15- and 70-lb BATES (4 a day) motor firings with an occasional 300- or 800-lb (135- or 360-kg) SuperBATES motor firing (one a week). Larger motors up to 50,000 lbs are occasionally fired on Pad 1 or Pad 2 (one a month). PI-K motors are also tested at Pad 5 (1 a day). Pad 3 is used for small-scale hazard testing up to 50,000 lbs one a quarter. LOX/LH2 and LOX/kerosene rocket engines may be tested once a year.

PROPELLANTS: Solid propellants are predominately tested at this facility. However, a variety of liquid propellants may rarely be tested. A one time test of a LOX (100,000 lbs)/kerosene (50,000 lbs) rocket engine may be tested in this area.

EMISSIONS:

Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.
LOX/LH2: Water - 96% and H2 -4%
LOX/Kerosene: CO2 - 42%, CO -28%, Water - 28% and H2/N2 - 2%

6. **Experimental Area 1-36, Motor Behavior Complex**

TESTS: Tests consist of destruction of rocket motors or propellant testing up to 100,000 lbs. Test Area 1-36D is used to evaluate the hazards associated with solid propellants and liquid propellants or combinations of the two. Tests are conducted approximately twice a month.

PROPELLANTS: Tests could include solid propellants (100,000 lbs) and liquid propellants (normally, hydrazine - 100 gals, 852 lbs, and nitrogen tetroxide - 150 gals, 1,840 lbs).

EMISSIONS:

Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.

7. **Experimental Area 1-40, Propellant Storability Complex**

TESTS: Storability tests are being conducted. Periodically, samples are drawn from the tanks when tanks are emptied for analysis. Propellant transfer operations are a source of emissions (purging lines), occurs 10 times per year.

PROPELLANTS: Typical propellants tested for storability at Area 1-40 are N_2O_4, chlorine Trifluoride (ClF_3) and chlorine pentafluoride (ClF_5).

EMISSIONS: During purging, approximately 3 lbs of each N_2O_4, ClF_3, and ClF_5. are released .

8. **Experimental Area 1-42, Space Environment Propulsion Complex**

TESTS: Solid rocket motors (15 lb bates to 15,000 lb Minuteman Rocket Motors) are tested 5 times a year and liquid propellant tests are conducted about four times a year. Typical liquid propellants used are hydrazine and nitrogen tetroxide, liquid oxygen and liquid hydrogen, and liquid oxygen and kerosene.

PROPELLANTS: Solid propellant 15,000 lbs per test, liquid oxygen - 85,000 lbs, liquid hydrogen - 15,000 lbs, kerosene - 33,000 lbs, hydrazine - 33,000 lbs, and nitrogen tetroxide - 66,000 lbs.

EMISSIONS:

LOX/LH2: Water - 96% and H2 -4%
Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
LOX/Kerosene: CO2 - 42%, CO -28%, Water - 28% and H2/N2 - 2%
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.

EMISSIONS:

LOX/LH2: Water 96% and uncombusted hydrogen - 4%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, H20 - 28%, and H2/N2 - 2%.
Flare Stack: CO2 - 11.7%, Water - 88.1%, and NOx - 0.2%

b. Test Stand 1B:

TEST REQUIREMENTS: Test firings up to 500 seconds is expected, approximately twice a month.

PROPELLANTS: Liquid Oxygen - 60,000 gals (573,000 lbs), Liquid Hydrogen - 90,000 (53,000 lbs), and kerosene - 32,000 (216,500 lbs).

EMISSIONS:

LOX/LH2: Water 96% and uncombusted hydrogen - 4%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, H20 - 28%, and H2/N2 - 2%.

c. Test Stand 2A:

TEST REQUIREMENTS: Test firings up to 500 seconds is expected, approximately twice a week for the next three years. A flare stack will be used to burn the hydrogen gas (2,240 lbs/tank). The hydrogen gas will be ignited using propane (959 lbs/tank) and air (21,404 lbs). The flare stack will be operated about 200 times a year.

PROPELLANTS: Liquid Oxygen - 2,000 gals (19,100 lbs), Liquid Hydrogen - 3,800 gals (2,240 lbs), and kerosene - 300 (2,050 lbs).

EMISSIONS:

LOX/LH2: Water 96% and uncombusted hydrogen - 4%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, H20 - 28%, and H2/N2 - 2%.
Flare Stack: CO2 - 11.7%, Water - 88.1%, and NOx - 0.2%

16. **Experimental Area 1-125, Large Systems Complex**

a. Test Stand 1C:

TEST REQUIREMENTS: Test Stand 1C is to be used for large solid rocket motor testing (such as the Titan IV SRMU), approximately 4 times a year. Rocket motor engines (LOX/LH2 and LOX/kerosene) may also be fired from this test stand approximately twice a month (maximum of 6 a month).

12. **Propulsion Sciences Division (Bldg 8451 and 8424)**

TESTS: The Propulsion Sciences Division consists of Chemical Laboratory, Combustion Laboratory and Carbon Research Laboratory. Analytical laboratories and small scale test cells support a wide variety of chemical, metallurgical and laser analysis. Laboratories are equipped with exhaust hoods for venting chemical experiments.

EMISSIONS: A variety of analytical chemicals, gases, liquid and solid propellants are stored and used in laboratory scale quantities in all of these laboratories. Minute quantities of toxic gases are vented through exhaust hoods at levels well below the low threshold value (LTV).

13. **Experimental Area 1-90, Spacecraft Integration Facility**

TESTS: Area 1-90 is used to support the Miniature Sensor Technology Information Program including satellite component design, construction, assembly, integration and evaluation under various conditions. Some tests include temperature conditioning, vibration, and electromagnetic testing. Area 1-90 is currently not approved for explosives or liquid propellant operations. There are no plans in the immediate future to reactivate any of the old test pads.

EMISSIONS: Nitrogen gas (1000 lbs).

14. **Experimental Area 1-100, Silo Complex**

TESTS: Area 1-100 is currently used to dispose (open burning) of scrap solid propellant generated at Areas 1-21 and 1-30. Normally, about one burn of approximately 400 lb (180 kg) is accomplished per month. There are no immediate plans to reactivate the silos but there has been discussions about using them in the distant future.

PROPELLANTS: Solid propellant scraps, 400 lbs per burn.

EMISSIONS: HCL - 20%, CO - 25%, CO2 - 15%, Water - 5%, N2 - 5%, H2 - 5%, and AlO2 - 25%.

15. **Experimental Area 1-120, Large Engine and Components Test Complex**

a. Test Stand 1A:

TEST REQUIREMENTS: Test firings up to 500 seconds is expected, approximately twice a week for the next three years. A flare stack will be used to burn the hydrogen gas (78,000 gals or 45,942 lbs/tank). The hydrogen gas will be ignited using propane (19,633 lbs/tank) and air (438,996 lbs). The flare stack will be operated about 12 times a year.

PROPELLANTS: Liquid Oxygen - 60,000 gals (573,000 lbs), Liquid Hydrogen - 90,000 (53,000 lbs), and kerosene - 32,000 (216,500 lbs).

9. **Experimental Area 1-46, Chemical Handling and Disposal Research Facility**

TESTING: Parts of Area 1-46 have been determined to be contaminated with beryllium. The area is currently listed as an Installation Restoration Program (IRP) site and is off limits except for the use of an industrial waste evaporation pond. No explosives are permitted in the area at this time.

10. **Experimental Area 1-52, Large Motor Operations Complex, Test Pads A, B, and C:**

TESTS: Solid rocket motors (15 lb bates to 150,000 lb rocket motors) are tested 5 times a year and liquid propellant tests are conducted about four times a year. Typical liquid propellants used are hydrazine and nitrogen tetroxide, liquid oxygen and liquid hydrogen, and liquid oxygen and kerosene. Hydrostatic bearing tests using liquid hydrogen will be accomplished for up to 500 secs. A flare stack will be used to burn the hydrogen gas (707 lbs/tank). The hydrogen gas will be ignited using propane (303 lbs/tank) and air (6,756 lbs). The flare stack will be operated about 200 times (no more than twice a day) during the year.

PROPELLANTS: Solid propellants up to 150,000 lbs per test, Liquid Oxygen - 60,000 gals (573,000 lbs), Liquid Hydrogen - 90,000 (53,000 lbs), and kerosene - 32,000 (216,500 lbs).

EMISSIONS:

LOX/LH2: Water - 96% and H2 -4%
Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
LOX/Kerosene: CO2 - 42%, CO -28%, Water - 28% and H2/N2 - 2%
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.
Flare Stack: CO2 - 11.7%, Water - 88.1%, and NOx - 0.2%

11. **Experimental Area 1-56, High Thrust Rocket Research Facility**

TESTS: Solid rocket motors (15 lb bates to 150,000 lb rocket motors) are tested 5 times a year and liquid propellant tests are conducted about four times a year. Typical liquid propellants used are hydrazine and nitrogen tetroxide, liquid oxygen and liquid hydrogen, and liquid oxygen and kerosene.

PROPELLANTS: Solid propellants up to 500,000 lbs per test, Liquid Oxygen - 60,000 gals (573,000 lbs), Liquid Hydrogen - 90,000 gals (53,000 lbs), kerosene - 32,000 (216,500 lbs), hydrazine - 9,000 gals (76,680 lbs), and nitrogen tetroxide - 12,000 gals (147,000 lbs).

EMISSIONS:

LOX/LH2: Water - 96% and H2 -4%
Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
LOX/Kerosene: CO2 - 42%, CO -28%, Water - 28% and H2/N2 - 2%
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.

PROPELLANTS: Solid rocket propellant, up to 900,000 lbs of 1.3. LOX - 600,000 lbs, hydrogen - 100,000 lbs and kerosene - 200,000 lbs.

EMISSIONS:

Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, Water 28%, and Hydrogen/Nitrogen 2%.
LOX/LH2: Water 96% and uncombusted hydrogen 4%.

b. Test Stand 1D:

TEST REQUIREMENTS: This test stand may be reactivated to conduct rocket motor engines (LOX/LH2 and LOX/kerosene) testing approximately twice a month (maximum of 6 a month).

PROPELLANTS: Solid rocket propellant, up to 900,000 lbs of 1.3. LOX - 600,000 lbs, hydrogen - 100,000 lbs and kerosene - 200,000 lbs.

EMISSIONS:

LOX/LH2: Water 96% and uncombusted hydrogen 4%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, Water 28%, and Hydrogen/Nitrogen 2%.

c. Test Stand 1E (Building 8840) has been converted into the National Hover Test Facility, where small space vehicle flight characteristics are studied. Tests are conducted four times a year. The space vehicles are propelled by liquid rocket engines using N_2H_4 /MMH and N_2O_4 or solid propellants. The maximum quantity of liquid fuel and oxidizers required for testing is about 20 lb. Small (15-70 lb) BATES may be fired at the guillotine or at the small test stand near 1B about twice a year. TS-1E could also be reactivated to test rocket motor engines (LOX/LH2 and LOX/kerosene) approximately twice a month (maximum of 6 a month).

PROPELLANTS: Hydrazine and nitrogen tetroxide (20 lbs). Solid rocket motors (10 lbs) and 15-70 lb BATES motors. LOX - 600,000 lbs, hydrogen - 100,000 lbs and kerosene - 200,000 lbs.

EMISSIONS:

LOX/LH2: Water 96% and uncombusted hydrogen 4%.
Hydrazine/N2O4: CO - 7%, C02 - 10%, Water - 40%, N2 - 33%, and H2 - 10%
Solids: HCL - 22%, CO - 21%, CO2 - 5%, Water - 12%, N2 - 9%, H2 - 2%, and AlO2 - 29%.
LOX/Kerosene: Carbon dioxide - 42%, Carbon Monoxide - 28%, Water 28%, and Hydrogen/Nitrogen 2%.

17. **Electric Propulsion Laboratory, Bldg 8417:**

TEST REQUIREMENTS: Test firings up to 60 seconds is expected, approximately twice a week.

PROPELLANTS: Propellants used are typically NH3 (5 lb/test) and noble gases (0.5 lb/test).

EMISSIONS: 100% NH3 and noble gases.

APPENDIX C

AIR QUALITY CALCULATIONS

Fuel Usage Emissions

Vehicle	Number	Days	Hours per day	Miles/Day	mile/gal	gal/hour	Total Fuel (gal)	Fuel Type	Fuel Energy Rating (Btu/gal)	Total Energy (MMBTU)	NOx Emissions (lb)	Co Emissions (lb)	SOx Emissions (lb)	PM10 Emissions (lb)	TOC Emissions (lb)	Pb Emissions (lb)
Truck (F-150)	2	70	-	66	19	-	486	Gasoline	125,000	60.79	99.09	60.18	5.11	6.08	127.66	-
Truck (Flatbed)	1	70	-	53	5	-	742	Diesel	138,999	103.14	168.11	102.11	8.66	10.31	216.59	0.01
Skidsteer (Caterpillar 246C)	1	70	4	-	-	2.74	767.2	Diesel	139,000	106.64	470.29	101.31	30.93	33.06	37.32	0.01
Scraper (Caterpillar 120M Motor Grader)	1	5		21	4.5		23.33333	Diesel	139,000	3.24	14.30	3.08	0.94	1.01	1.14	0.00
26hp Generator for Pneumatic Pounder	1	70	8	-	-	1.3	728	Diesel	139,000	101.19	446.26	96.13	29.35	31.37	35.42	0.01
RT95 Ditch Witch Trencher	1	3	8			4.13	99.12	Diesel	139,001	13.78	60.76	13.09	4.00	4.27	4.82	0.00
											1,258.81	**375.90**	**78.98**	**86.10**	**422.95**	**0.02**

Assumptions:

a) Personnel trucks are Ford F-150 with a standard cab and a V-6 are 302HP gasoline engine, average 18 miles to the gallon. Estimate 66 miles per day for project duration

b) Flatbed Truck is estimated at 25,000 pounds and is estimated to get 5 MPG, diesel engine. Estimate 53 miles per day for project duration

c) Scraper is a Caterpillar 120M Motor Grader. It weighs 45,000 pounds. 4.5MPG Diesel per manufacturer

d) 25 HP compressor using 1.3 gallons per hour of diesel, 8 hours per day

e) Skidsteer estimated as a Caterpillar Model 246C, 75 HP engine using 2.74 gal/hr of diesel, 8 hours per day

Pollutant	Gasoline Emission Rate (lb/MMBTU fuel)	Diesel Emission Rate (lb/MMBTU fuel)
NOx	1.63	4.41
CO	0.99	0.95
SOx	0.084	0.29
PM10	0.1	0.31
TOC	2.1	0.35
Pb	-	0.00006

Assumptions:

a) emissions factors taken from EPA AP 42, 3.3 Gasoline and Diesel Industrial Engines, Table 3.3-1

Example Calculation:

Emissions = Fuel Usage X Fuel Energy Rating X Emissions Factor

PM-10 Emission Estimates

Scraper Activity

Vehicle Type	Number	Weight (lb)	Total Weight (W)	Total Miles	Emission Rate (lb/VMT) (PM10)	Emission Rate (lb/VMT) (PM2.5)	PM10 (lb)	PM10 (ton)	PM2.5 (lb)	PM2.5 (ton)
Scraper (Caterpillar 120M Motor Grader)	1	13500	13500	104	20.2	10.1	2100.8	1.1	1050.4	0.5

Assumptions:
a) four passes are required to develop road, requiring 104 miles of travel
b) emissions rates for scrapers removing topsoil obtained from AP42, Table 13.2.3-1, row II(4), which states 20.2 lb of PM10 for every mile traveled
c) emissions rate for PM2.5 assumed to be 50% of the PM10 rates. AP 42 model contained no factors for PM2.5

Travel Over Dirt Road

Vehicle Type	Number	Weight (ton)	Total Weight (W) (tons)	Days On Site	Miles/Day	Total Miles	Fuel Type	Emission Rate (lb/VMT) (PM2.5)	Emission Rate (lb/VMT) (PM10)	PM2.5 (lb)	PM10 (lb)	PM2.5 (ton)	PM10 (ton)
Truck (F-150)	2	4500	4.5	70	26	1820	Gas	0.2	2.5	448.28	4,482.75	0.22	2.24
Truck (Flatbed)	1	25000	12.5	70	18	1260	Diesel	0.4	3.9	491.48	4,914.82	0.25	2.46
Skidsteer (Caterpillar 246C)	1	7500	3.75	70	10	700	Diesel	0.2	2.3	158.83	1,588.33	0.08	0.79
Scraper (Caterpillar 120M Motor Grader)	1	45000	22.5			104	Diesel	0.5	5.1	52.85	528.50	0.03	0.26
										1,151.44	11,514.40	0.58	5.8

Assumptions:
a) Personnel trucks are Ford F-150 with a standard cab and a V-6 are 302HP gasoline engine
b) Flatbed Truck is estimated at 25,000 pounds and is estimated to get 5 MPG, diesel engine
c) Scraper is a Caterpillar 120M Motor Grader. It weighs 45,000 pounds. Estimated 5 MPG Diesel
d) Silt (S) is local soils is 17% - mean found in AP42, Table 13.2.2-1
e) For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation obtained from AP42 Section 13.2.2., equation 1a

E=k*[(S/12)^a]*[(W/3)^b], where E = size-specific emission factor (lb/VMT)
k = 0.15 for PM2.5 and 1.5 for PM10
a = 0.9
b = 0.45

Example Calculation:
Emissions = Total Miles X Emissions Factor

Trench Digging

Distance (mile)	Width (ft)	Area (ft^2)	Area (Acre)	PM10 Emission Rate (ton/acre/month)	PM2.5 Emission Rate (ton/acre/month)	Duration (Mo)	PM10 (ton)	PM2.5 (ton)
26	3	411840	9.5	1.2	0.6	0.5	5.7	2.8

Assumptions:
a) use AP42 emissions factor from Section 13.2.3.3 for general heavy construction
b) work will require 2 week of activity
c) work is to install simple power and communications cables. Width of trench less than 3 feet
d) emissions rate for PM2.5 assumed to be 50% of the PM10 rates. AP 42 model contained no factors for PM2.5

Example Calculation:
Emissions = Area X Duration X Emission Factor

GHG Emissions

Equipment	Fuel Type	Manufacturer	Model	Horsepower	Total Hours Operated	Fuel Consumption Rate (gallons/hour)	Total Miles Driven	Fuel Consumption Rate (miles per gallon)	Fuel Consumed (gallons)	CO_2 Emissions (lb)	CO_2 Emissions ($MTCO_2e$)	N_2O Emissions (lb)	N_2O Emissions ($MTCO_2e$)	CH_4 Emissions (lb)	CH_4 Emissions ($MTCO_2e$)	Total GHG Emissions ($MTCO_2e$)
Generator for Pneumatic Pounder	Diesel	Kohler	KDW1003	26	560	1.3			728	16,256.24	7.37	6.41E-01	9.01E-02	1.60E-01	1.53E-03	7.47
Skid Steer	Diesel	Caterpillar	246C	75	280	2.74			767.2	17,131.58	7.77	4.40E-01	6.18E-02	9.81E-01	9.34E-03	7.84
Pickup Truck	Gasoline	Ford	F-150	302			9240	19	486.315789	9,425.77	4.28	1.08E-02	1.52E-03	1.68E-02	1.60E-04	4.28
Flatbed Truck	Diesel	Ford	F-550	330			3710	5	742	16,568.86	7.52	7.85E-03	1.10E-03	8.34E-03	7.95E-05	7.52
Surface Scraper	Diesel	Caterpillar	120M Motor Grader	138			104	4.5	23.1111111	516.07	0.23	1.32E-02	1.86E-03	2.96E-02	2.81E-04	0.24
Trencher	Diesel	DitchWitch	RT-95	88	24	4.13			99.12	2,213.35	1.00	8.72E-02	1.23E-02	2.18E-02	2.08E-04	1.02
													Total GHG Emissions ($MTCO_2e$)			**28.35**

Emission Factors				
diesel	10.15	kg CO_2/gallon	22.33	lb CO_2/gallon
gasoline	8.81	kg CO_2/gallon	19.382	lb CO_2/gallon
gasoline on-highway light trucks	0.0101	g N_2O/mile	2.22668E-05	lb N_2O/mile
	0.0157	g CH_4/mile	3.46128E-05	lb CH_4/mile
Diesel Heavy Duty Highway Vehicles	0.0048	g N_2O/mile	1.05822E-05	lb N_2O/mile
	0.0051	g CH_4/mile	1.12436E-05	lb CH_4/mile
Diesel Heavy Duty Non-Highway Vehicles	0.26	g N_2O/mile	0.000573205	lb N_2O/mile
	0.58	g CH_4/mile	0.001278688	lb CH_4/mile
combustion	0.0004	kg N_2O/gallon	0.00088	lb N_2O/gallon
	0.0001	kg CH_4/gallon	0.00022	lb CH_4/gallon
	453.59	g/lb		
GWP	21	CH_4		
	310	N_2O		

Note: Emission factors were taken from Tables C1 through C8 from the California Climate Action Registry General Reporting Protocol, Version 3.1.

Example Calculation:
Emissions = Fuel Consumed X Emission Factor