412th Test Wing

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN FOR EDWARDS AIR FORCE BASE

412 TW INRMP Plan 32-7064

(See INRMP signature pages for plan approval date)

412th Civil Engineer Group
Environmental Management Division
OPR: 412 CEG/CEV
Edwards Air Force Base, CA

ABOUT THIS PLAN

This installation-specific Environmental Management Plan (EMP) is based on the U.S. Air Force's (AF) standardized Integrated Natural Resources Management Plan (INRMP) template. This INRMP has been developed in cooperation with applicable stakeholders, which may include Sikes Act cooperating agencies and/or local equivalents, to document how natural resources will be managed. Non-U.S. territories will comply with applicable Final Governing Standards (FGS). Where applicable, external resources, including Air Force Instructions (AFIs); AF Playbooks; federal, state, local and FGS, biological opinion and permit requirements, are referenced.

Certain sections of this INRMP begin with standardized, AF-wide "common text" language that address AF and Department of Defense (DoD) policy and federal requirements. This common text language is restricted from editing to ensure that it remains standard throughout all plans. Immediately following the AF-wide common text sections are installation sections. The installation sections contain installation-specific content to address local and/or installation-specific requirements. Installation sections are unrestricted and are maintained and updated by AF environmental Installation Support Teams (ISTs) and/or installation personnel.

NOTE: The terms 'Natural Resources Manager', 'NRM' and 'NRM/POC' are used throughout this document to refer to the installation person responsible for the natural resources program, regardless of whether this person meets the qualifications within the definition of a natural resources management professional in DODI 4715.03.

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DOCUMENT CONTROL

Record of Review – The INRMP is updated not less than annually, or as changes to natural resource management and conservation practices occur, including those driven by changes in applicable regulations. In accordance with (IAW) the Sikes Act and AFI 32-7064, *Natural Resources Management*, the INRMP is required to be reviewed for operation and effect not less than every five years. Annual reviews and updates are accomplished by the base Natural Resources Manager (NRM), and/or an Installation Support Team Natural Resources Media Manager. The installation shall establish and maintain regular communications with the appropriate federal and state agencies. At a minimum, the installation NRM (with assistance as appropriate from the NR Media Manager) conducts an annual review of the INRMP in coordination with internal stakeholders and local representatives of the United States Fish and Wildlife Service (USFWS), state fish and wildlife agency, and National Oceanic and Atmospheric Administration (NOAA) Fisheries, where applicable, and accomplishes pertinent updates. Installations will document the findings of the annual review in an Annual INRMP Review Summary. By signature to the Annual INRMP Review Summary, the collaborating agency representative asserts concurrence with the findings. Any agreed updates are then made to the document, at a minimum updating the work plans.

INRMP APPROVAL/SIGNATURE PAGES

See Appendix E for Annual Review signatures.

SIGNATURE PAGE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN EDWARDS AIR FORCE BASE, CALIFORNIA

2015-2019

This *Integrated Natural Resources Management Plan* (INRMP) fulfills the requirements of the *Sikes Act* (as amended), Department of Defense Instruction 4715.03, *Natural Resources Conservation Program*, and Air Force Instruction 32-7064, *Integrated Natural Resources Management*. This document was prepared and reviewed in coordination with the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife.

G. Mendel Stewart

Field Supervisor
U.S. Fish and Wildlife Service

3/4/2015
Date

Dean Maustow

Regional Manager
California Department of Fish and Wildlife

7-21-15
Date

MICHAEL T. BREWER
Brigadier General, USAF
Commander, 412th Test Wing

20 Feb 15
Date

LETTER OF INSTRUCTION

This 5-year revision of the *Integrated Natural Resources Management Plan (INRMP)* has been prepared for Edwards Air Force Base (AFB), California, as required by the *Sikes Improvement Act* of 1997 and Air Force Instruction 32-7064, *Integrated Natural Resources Management*. The *INRMP* is based on ecosystem management principles and identifies responsibilities for management of natural resources, land use and mission activities and their potential effects on the environment, descriptions of the physical and ecosystem environments, mission impacts on natural resources, natural resources program management, and management goals and objectives. The *INRMP* also includes specific management methods, schedules of activities and projects, responsibilities of decision makers, monitoring systems, protection and enforcement, land use restrictions, and biological resource and environmental requirements as well as professional and technical manpower.

This *INRMP* will be used by Edwards AFB personnel in support of the management of natural resources. It will be the guiding document integrating natural resources stewardship with the Edwards AFB military mission.

James E. Judkins

JAMES E. JUDKINS, NH-IV
Base Civil Engineer

19 Feb 15
Date

EXECUTIVE SUMMARY

This annual update to the 5-year revision of the Integrated Natural Resources Management Plan (INRMP) has been prepared for Edwards Air Force Base (AFB), California, as required by the *Sikes Act Improvement Act* of 1997 and Air Force Instruction 32-7064; Integrated Natural Resources Management. The INRMP is based on ecosystem management principles and identifies responsibilities for management of natural resources, land use and mission activities and their potential effects on the environment, descriptions of the physical and ecosystem environments, mission impacts on natural resources, natural resources program management, and management goals and objectives. The INRMP also includes specific management methods, schedules of activities and projects, responsibilities of decision makers, monitoring systems, protection and enforcement, land use restrictions, and biological resource and environmental requirements as well as professional and technical manpower.

This INRMP will be used by Edwards AFB personnel in support of the management of natural resources. It will be the guiding document integrating natural resources stewardship with the Edwards AFB military mission. The *Sikes Act Improvement Act* of 1997 (16 United States Code [U.S.C.] 670a–670o) and DoD Instruction (DoDI) 4715.03 require the Department of Defense (DoD) to manage the natural resources of each military reservation within the U.S. and to provide sustained multiple uses of those resources. To guide natural resource management the Sikes Act requires preparation of an *Integrated Natural Resources Management Plan* (INRMP) for most military bases. The INRMP is a tool for managing natural resources on military installations that have natural resources requiring protection and management, such as habitat for protected species, aquatic resources, or any habitat that is suitable for conserving and managing wildlife.

The overall strategy of this INRMP is to sustain and enhance the natural environment or ecosystem through the use of an adaptive management process while integrating the natural resource program with the military mission. The INRMP assists the installation commander with the conservation and rehabilitation of natural resources consistent with the use of the installation to ensure military readiness. This is accomplished by defining and implementing natural resource management goals and objectives that collectively achieve habitat and species sustainability; thereby, ensuring no net loss in the capability of the installation's lands to support the military mission with a realistic testing and training environment.

Management of the ecosystem is enhanced through partnerships with federal and state resource agencies to achieve common goals. Public involvement and communication with the agencies play a role in the implementation of the INRMP. The best available scientific information will aid resource managers in implementing adaptive management strategies by selection of the most applicable technologies for management of natural resources.

The primary areas of focus for natural resources management are:

- Maintain and enhance quality and quantity of habitat that is suitable for management of federally listed species on base;
- Conserve federally listed species;
- Promote and improve education awareness on natural resources and the desert ecosystem;
- Conserve high quality habitat for management of state-listed and other sensitive wildlife and plant species

- Improve water quality and maintain biodiversity of aquatic ecosystems;
- Reestablish native habitat by eradication of exotic and invasive species;
- Improve baseline and other data collection and analysis by using the best available science and proven technologies to track the health of the ecosystem;
- Maintain and improve natural resource recreational opportunities;
- Implement adaptive management projects;
- Improve integration of natural resources management with other base organizations consistent with the military mission;
- Promote regional planning and ecosystem management;
- Conserve natural resources in a manner consistent with the military mission and the Edwards AFB Wildland Fire Management Plan (WFMP) by implementing effective suppression of wildland fires and minimizing fire and damage to biological resources;
- Form partnerships and coordinate with resource agencies and private groups;
- Provide enforcement of applicable natural resource laws; and
- Enhance habitat by restoration of vegetation communities.

Beneficial impacts from implementation of the INRMP are as follows:

1. *Air Quality* – reduce particulate matter emissions (dust) by minimizing ground disturbance to most playas, closure of unneeded roads, and restoration of desert vegetation in previously disturbed areas;
2. *Biological Resources* – sustain or enhance biodiversity of the desert ecosystem and restore/enhance native habitat to preserve native species;
3. *Pest Management* – apply herbicides to prevent spread of invasive plant species in developed areas and reduce the potential of spreading to surrounding desert habitat; and limit chemical pest management by implementing physical and biological control techniques to reduce the potential for harm to non-target species;
4. *Migratory Birds* – enhance the habitat to maintain/increase nesting and foraging habitat;
5. *Geology and Soils* – reduce soil erosion by minimizing ground disturbance and implementing habitat restoration activities; and
6. *Recreation* – increase recreation opportunities (e.g., bird watching, fishing, hunting, and use of designated trails for biking and hiking).

1.0 OVERVIEW AND SCOPE

This INRMP was developed to provide for effective management and protection of natural resources. It summarizes the natural resources present on the installation and outlines strategies to adequately manage those resources. Natural resources are valuable assets of the United States Air Force. They provide the natural infrastructure needed for testing weapons and technology, as well as for training military personnel for deployment. Sound management of natural resources increases the effectiveness of Air Force adaptability in all environments. The Air Force has stewardship responsibility over the physical lands on which installations are located to ensure all natural resources are properly conserved, protected, and used in sustainable ways. The primary objective of the Air Force natural resources program is to sustain, restore and modernize natural infrastructure to ensure operational capability and no net loss in the capability of AF lands to support the military mission of the installation. The plan outlines and assigns responsibilities for the management of natural resources, discusses related concerns, and provides program management elements that will help to maintain or improve the natural resources within the context of the installation's mission. The INRMP is intended for use by all installation personnel. The Sikes Act is the legal driver for the INRMP.

1.1 Purpose and Scope

As part of the DoD critical defense mission, and for reasons of safety and security, military installations often encompass large land areas far from concentrations of civilian populations. Conservation of natural resources is important in maximizing effective military testing and training operations and ensuring military readiness. Realistic testing and training require environments in a natural setting. In addition, federal agencies are subject to compliance with federal regulations that protect and conserve natural resources. To meet these requirements, plans are developed in coordination with the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW), and reflect the mutual understanding of the parties concerning conservation, protection, and management of fish and wildlife resources. Military installations must coordinate with the public on plans for the conservation, protection, management, and monitoring of natural resources on all of the lands that have been entrusted to the DoD.

It is DoD policy, in accordance with DoD Instruction (DoDI) 4715.03, to implement and maintain natural resource conservation programs to ensure access to its land, air, and water resources for realistic military training and testing. The management and conservation of natural resources within DoD control, including planning, implementation, oversight, and enforcement functions are addressed in DoDI 4715.03. This INRMP addresses resource management on all of the lands within the installation, including lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission.

Section 101(b)(1)(I) of the *Sikes Act* states that each INRMP shall, to the extent appropriate and applicable and consistent with the use of the installation to ensure the preparedness of the Armed Forces, provide for "no net loss in the capability of military installation lands to support the military mission of the installation." Mission requirements and priorities identified in this INRMP will be integrated in other environmental programs and policies, as applicable. It is not the intent that natural resources are to be consumed by current mission requirements; they should be sustained for the use of future missions. To achieve this, all environmental programs and policies must have the goal of conserving the environment for the purpose of supporting future missions. Installation lands will be made available to the public for educational or recreational use of natural resources when such access is compatible with military mission activities, ecosystem sustainability, and with other considerations such as security, safety, personnel workload, and

fiscal constraints. Opportunities for such access shall be equitably and impartially allocated after such considerations have been taken into account.

1.2 Management Philosophy

An interdisciplinary approach was used to develop this INRMP, in compliance with the 1997 amendments of the Sikes Act. Military installations are required to develop and implement mutually agreed upon INRMPs through collaborative efforts and voluntary cooperative agreements between the DoD installation, USFWS, and the CDFW. The goal is for all agencies to agree on the INRMP. An INRMP is a planning document that allows DoD installations to manage their natural resources in coordination with the resource agencies and to remain in compliance with applicable laws and regulations. The INRMP is a tool to ensure that military operations and activities are integrated with management of natural resources to achieve good land stewardship and ensure the success of the military mission.

The INRMP focuses on the principles of ecosystem management. The INRMP provides for the management of natural resources, allows multipurpose use of natural resources, and provides for public access, while ensuring no net loss in the capability of the military mission.

The INRMP implements the following principles of ecosystem management for attaining a desired land condition, carefully considering the ecosystem management principles and guidelines stated in DoDI 4715.03 and Air Force Instruction (AFI) 32-7064, *Integrated Natural Resources Management*:

- Maintain and improve the sustainability, and native biological diversity of the ecosystem;
- Maintain or restore ecological units and hydrological processes, including time frames;
- Support sustainable human activities, including outdoor recreation;
- Develop a measurement of ecosystem health;
- Develop priorities and reconcile conflicts;
- Develop regional, coordinated approaches to work toward ecosystem health;
- Use the best science available to maintain or reestablish native populations, and eradicate exotic and invasive species;
- Use adaptive management strategies;
- Revise objectives and goals when necessary, based on measurable data;
- Use benchmarks to monitor and evaluate the success of management strategies; and
- Integrate management with other base installation plans and programs.

The INRMP is also a subcomponent of the *Edwards Air Force Base General Plan* as detailed in AFI 32-7064. The INRMP identifies natural resource features and management activities that need to be considered and incorporated into the *Base General Plan* regarding future development (Edwards AFB 2013).

1.3 Authority

This INRMP has been prepared, in accordance with the *Sikes Act*, as amended, (Section 670a- 670o of title 16, U.S.C). All DoD natural resource conservation program activities shall work to guarantee continued access to its land, air, and water resources for realistic military training and testing and to sustain the long-term ecological integrity of the resource base and the ecosystem services it provides. DoDI 4715.03 requires that INRMPs be developed and implemented for lands that have suitable habitats for conserving and managing natural resources. AFI 32-7064 provides guidance for the proper management of natural resources on Edwards AFB and other installations in order to comply with federal, state, and local laws and regulations.

In addition, the INRMP addresses compliance with the following natural resource legal requirements:

- *Endangered Species Act* (ESA) of 1973; as amended (16 U.S.C. 1531–1544);
- *Migratory Bird Treaty Act* (MBTA) of 1918 (16 U.S.C. 703, et seq.);
- *Bald and Golden Eagle Protection Act* of 1940, as amended (16 U.S>C. 668-668d);
- Federal Noxious Weed Act of 1974; as amended (7 U.S.C. 2801)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1996, as amended (7 U.S.C. 136, et seq.);
- Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, 10 January 2001;
- Soils and Water Resources Conservation Act of 1977, as amended (16 U.S.C. 2001, et seq.); EO 11990, Protection of Wetlands, 24 May 1977;
- EO 13112, Invasive Species, 3 February 1999;
- EO 11988, Floodplain Management, 24 May 1977;
- EO 13148, Greening Government Through Leadership in Environmental Management, 2006.

Per the Supremacy Clause of the Constitution and a long line of court cases starting with McCullough v. Maryland, the United States is not subject to state law unless there is a clear and specific waiver of sovereign immunity. The Endangered Species Act waiver at 16 USC 1536 does not include empowerment of states to impose their own endangered species requirements on the federal government. Thus, there is no requirement to comply with state-listed endangered species. However, AFI 32-7064 states that INRMP's provide similar conservation measures for species protected by state law when such protection is not in direct conflict with the military mission. In other words, protection and conservation measures are provided for by policy in the AFI, not by operation of state law. Per 10 USC 2671(a)(1), state hunting and fishing permits are generally required; a clear and specific waiver of sovereign immunity supported by Air Force policy as provided in AFI 32-7064.

Installation-Specific Policies (including State and/or Local Laws and Regulations)	
NA	

1.4 Integration with Other Plans

The INRMP integrates common goals and objectives, and management considerations with other local, state and federal agency plans, working groups, and programs such as the *Edwards Air Force Base General Plan, Integrated Cultural Resources Management Plan* (ICRMP), *Integrated Pest Management* (IPM) *Plan, Wildland Fire Management Plan* (WFMP), *Bird/Aircraft Strike Hazard* (BASH) *Plan,* and outdoor recreational programs.

2.0 INSTALLATION PROFILE

Office of Primary Responsibility	412 CEG/CEVA has overall responsibility for implementing the Natural Resources Management program and is the lead organization for monitoring compliance with applicable federal, state and local regulations.
Natural Resources Manager/POC	Name: Mr. Larry Zimmerman Phone: (661) 277-1418 Email: larry.zimmerman.3@us.af.mil
State and/or local regulatory POCs (For US-bases, include agency name for Sikes Act cooperating agencies)	U.S. Fish and Wildlife Service: Ray Bransfield California Department of Fish and Wildlife: Victoria Monroe
Total acreage managed by installation	307,517
Total acreage of wetlands	1,410 (biological wetlands, not jurisdictional wetlands)
Total acreage of forested land	0
Does installation have any Biological Opinions? (If yes, list title and date, and identify where they are maintained)	Yes, 1, Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14) dated 11 March 2014
NR Program Applicability (Place a checkmark next to each program that must be implemented at the installation. Document applicability and current management practices in Section 7.0)	☑ Invasive species ☑ Wetlands Protection Program ☑ Grounds Maintenance Contract/SOW ☐ Forest Management Program ☑ Wildland Fire Management Program ☐ Agricultural Outleasing Program ☑ Integrated Pest Management Program ☑ Bird/Wildlife Aircraft Strike Hazard (BASH) Program ☐ Coastal Zones/Marine Resources Management Program ☑ Cultural Resources Management Program

2.1 Installation Overview

2.1.1 Location and Area

Edwards AFB encompasses approximately 307,517 acres in the Antelope Valley in southern California. The installation lies in the western Mojave Desert in portions of Kern, Los Angeles, and San Bernardino counties. The base is approximately 100 miles northeast of Los Angeles, about 90 miles northwest of San Bernardino, and about 80 miles southeast of Bakersfield. Approximately 13,400 military and civilian personnel work on Edwards AFB, many of whom live either on the base or in nearby communities, such as California City, Lancaster, Palmdale, and Rosamond.

The Antelope Valley's first main industry was agriculture. Historically known for its extensive alfalfa fields and fruit crops, farmers now grow a wider variety of crops such as carrots, onions, lettuce, and potatoes.

Major housing tract development and population growth took off in 1983 in the Antelope Valley, substantially increasing the population of Palmdale. Neighboring Lancaster has increased its population

since the early 1980s to around three times its former level. Major retail stores are in the area of the Antelope Valley Mall in Palmdale.

Water use in the Antelope Valley for agricultural and development purposes depends primarily on pumping groundwater from the valley's aquifers and on importing additional water via aqueducts from the Antelope Valley East Kern (AVEK) Water Agency. Long-term groundwater pumping for agriculture, commercial, and residential development has lowered the water table. An AVEK Water Master is mandated to monitor the water basin to assure that no more water is pumped out than the basin can sustain without falling into overdraft.

The aerospace industry includes Air Force Plant 42 in northeast Palmdale, which is home to Lockheed Martin, Boeing Aerospace Engineering, and Northrop Grumman among other aerospace-related companies. Notable projects assembled and or designed there include the Space Shuttle, B-2 Spirit Bomber, F-117 Nighthawk Fighter, F-35 Joint Strike Fighter, and Lockheed L1011 TriStar, a passenger jet aircraft. The newly dedicated Mojave Spaceport is located nearby, north of Palmdale, in the town of Mojave.

Installation/GSU Location and Area Descriptions

Base/GSU Name	Main Use/Mission	Acreage	Addressed in INRMP?	Describe NR Implications
Edwards AFB	Test & Evaluation	307,517	INRMP Section 2.1	NR Management

2.1.2 Installation History

Humans have been frequenting the Antelope Valley for a few thousand years. This amount of time is known generally as the Prehistoric Period, and it is characterized by Native American lifestyles that relied almost exclusively upon hunting and gathering as a means of subsistence. This particular subsistence strategy causes relatively minimal impact to the natural environment; evidence for Native American presence in the area is provided by the stone tools they produced.

The arrival of Europeans into the Antelope Valley marks the end of the Prehistoric Period and the beginning of the Contact/Ethnographic Period (AD 1770 – Present). Spanish expeditions traversed areas that now encompass parts of Edwards AFB, but they recorded no Native American settlements and established none of their own. Instead, the Ethnographic Period is characterized primarily by an increase in man-induced activities and population growth throughout the Antelope Valley.

Starting in the 19th century, the area from present day Lancaster to Buckhorn Springs began attracting mining speculators and road builders. Mining occurred in and around the town of Rosamond, and exploratory/prospect pits and mines were dug by early miners throughout Edwards AFB. Many on-base mining activities occurred in the Kramer Hills and on the lakebeds, especially in the northeast corner of Rogers Dry Lake. The clay mined from the lakebed was used as a sealant and lubricant for oil exploration wells.

In 1911, settlers began establishing homesteads in the area that eventually would encompass Edwards AFB. Those settlers raised livestock and mined the local area for gold, borates, and copper, and traffic became a common sight between the towns of Rosamond and Boron. The early Borate mining brought more settlers and increased travel across the dry lake areas, and settlements slowly grew to accommodate the developing commerce. By the mid-20th Century, crops, livestock grazing, and transportation corridors existed within the boundary that eventually would become Edwards AFB.

In 1931, a military mission established the Muroc Bombing and Gunnery Range on the east side of Rogers Dry Lake. By the end of 1942, the newly named Muroc Army Air Field consisted of 6,300 men, 1,090 temporary hutments, and 383 permanent hangars and support buildings on the western shore of Rogers Dry Lake. At the end of World War II, the facility contained hangars, administrative buildings, barracks, officers' quarters, a hospital, a post exchange and commissary, a library, two mess halls, two chapels, two theaters, two noncommissioned officers' clubs, two officers' clubs, and recreational buildings. In 1947, the government awarded Aerojet Engineering Corporation the contract to construct an Air Force Experimental High-Thrust Rocket Test Station, and the United States Army Corps of Engineers (USACE) began creating the appropriate infrastructures. The Air Materiel Command formed a Rocket Branch on Edwards AFB in 1949 and the USACE constructed support facilities at Leuhman Ridge. In 1951, Aerojet Engineering Corporation began constructing buildings that housed technical operations.

Nearly every aircraft entering the USAF inventory over the past 50 years has been tested and developed at Edwards AFB. Other DoD agencies have historically used Edwards AFB for developmental test and evaluation of fixed- and rotary-wing aircraft. Edwards AFB has also been the site where lifting-body research flights helped NASA develop and design the space shuttle, and the base has played host to space shuttle approach and landing tests, as well as the first shuttle landing from space.

2.1.3 Military Missions

Edwards AFB continues to support technological research that develops, acquires, and evaluates manned and unmanned aerospace vehicles. This research involves every aspect of aerospace vehicle testing, including: flight evaluation and vehicle recovery; development and testing of advanced avionics, range instrumentation, and aircraft aerodynamic decelerators; space and missile test support; and operation and command of the AF Test Pilot School. Edwards AFB also hosts National Aeronautics and Space Administration (NASA) and the Air Force Research Laboratory (AFRL), which provides staff and facilities for manned and unmanned aircraft testing and rocket component and propellant research, respectively.

NASA/Armstrong Flight Research Center: The NASA/Armstrong mission is to plan, conduct, analyze, and report on all aeronautical disciplines associated with a wide variety of aircraft and aerospace vehicle flight research projects. NASA/Armstrong is the nation's preeminent aeronautical research facility, developing new technologies that will lead to improved aircraft flight control components and systems. NASA/Armstrong also helps transfer new concepts to the U.S. aerospace industry for commercial and military applications. Activities in support of this mission have historically included flight research of advanced control concepts. This includes aerospace vehicle handling qualities and flight loads; research on piloting problems, biomedical aspects of low- and high-performance aircraft; and investigations into the problems of takeoff, landing, aircraft noise, low-speed flight, supersonic and hypersonic flight, and aerospace vehicle reentry characteristics. NASA/Armstrong also works to identify and explore unpredicted phenomena encountered in flight, and develops flight testing and in-flight simulation techniques.

Air Force Research Laboratory (AFRL). The mission of the AFRL is to plan, formulate, present, and execute the AF Science and Technology programs. At the Edwards AFB research site, the emphasis is on rocket-propulsion concepts, propellants, components, and systems for both missile and space applications. The Edwards AFB research site also hosts sea level static and altitude test cells for full-scale rocket engine and motor testing. The AFRL acts as the Air Force Materiel Command (AFMC) focal point for information in the assigned technical areas. An integral part of the AFRL mission entails executing assigned projects for, and working closely with, the Army, Navy, NASA/Armstrong, and other government agencies; supporting AFMC programs, ensuring the rapid application of research and technology to advanced systems; and assisting in the evaluation of foreign aerospace technology.

Other DoD Agencies. Department of the Army, Department of the Navy, U.S. Marine Corps, Reserve Components, Coast Guard, and other units may use base facilities to conduct their respective mission activities on Edwards AFB.

Listing of Tenants and NR Responsibility

Tenant Organization	NR Responsibility
NASA/Armstrong Flight Research Center	NASA responsible for lease area; projects outside lease area and within Edwards AFB coordinated with 412 CEG/CEV.
Air Force Research Laboratory (AFRL)	NR responsibility shared between AFRL and 412 CEG/CEVA.

2.1.4 Surrounding Communities

The surrounding communities of Edwards AFB include Boron to the northeast, California City and North Edwards to the north, Lake Los Angeles to the south, Lancaster and Palmdale to the southwest, and Mojave and Rosamond to the west (see Appendix Figures, *Surrounding Communities*)1. Portions of the base boundary share borders with the towns of North Edwards, Boron, Rosamond, Mojave, and Lancaster. Palmdale is located 26 miles southwest of Edwards AFB. Lake Los Angeles and California City are located within 25 miles of the base. Populations of local communities range from approximately 1,250 to 150,000 people. The largest borax open pit mine in the world is located near Boron just northeast of the base boundary.

Urban development is an encroachment threat with local cities surrounding the installation on three sides (see Appendix Figures, *Surrounding Communities*). Even though urban development has slowed due to economic issues, residential developments in the city of Rosamond to the west of Edwards AFB are already up against the base boundary in some places. To the north, California City and small towns such as North Edwards and Boron have expanded during the Southern California housing boom. To the south, the city of Lancaster with an increasing population had approximately 159,000 people in 2012. In 2009, Lancaster initiated a reconsolidation effort to plan for the rezoning of rural areas south of Edwards AFB into commercial zones and the transfer of rural zones to the area west of Highway 14; this is now incorporated into their General Plan (City of Lancaster 2009).

For the most part, there is open desert land surrounding the base with U.S. Highway 395 bordering the eastern boundary and State Route (SR) 58 bordering the northern boundary (see Appendix Figures, *Vicinity Map and Highways*). With these major highways, future development surrounding the base boundary appears inevitable. In recent years, residential development of Rosamond has encroached upon the western boundary of Edwards AFB; this development is not located near any major facilities or developed areas of the base. However, this development provides the opportunity for illegal trespass where off-base personnel cut fences and ride their motorcycles and ORVs onto base property; thereby, establishing new roads and trails adversely affecting the desert ecosystem. These types of development and associated activities reduce the biodiversity of existing plant and wildlife communities; impact sensitive plant populations; threaten the livelihood of the federally threatened desert tortoise, and negatively impact natural resources management.

2.1.5 Local and Regional Natural Areas

There are five parks under the California Department of Parks and Recreation in the area. These include Red Rock Canyon State Park, located 35 miles north of Edwards AFB; Antelope Valley California Poppy Reserve, home to California's state flower, located 15 miles west of Lancaster; Arthur B. Ripley Desert

Woodland State Park, located 20 miles west of downtown Lancaster; and Antelope Valley Indian Museum State Historic Park and Saddleback Butte State Park, both located about 10 miles south of the base.

The Desert Tortoise Research Natural Area is located about five miles north of Edwards AFB. This area is jointly managed by the Bureau of Land Management (BLM), California Department of Fish and Wildlife (CDFW), and the Desert Tortoise Preserve Committee, a nonprofit group established to acquire and manage lands for the protection of the desert tortoise.

There are National Parks or preserves in the southwestern, northern, and eastern floristic provinces. There are no large preserves in the western Mojave Floristic Province.

There are several areas designated by the Los Angeles County General Plan as Sensitive Ecological Areas (SEA). SEA #47, which extends onto Edwards AFB and covers the south- central portion of the base, contains unique botanical features including the only healthy stands of mesquite trees in Los Angeles County. The habitat off-base links with the habitat on-base in the southern and central portion of the base. Off-base development within saltbush habitat interspersed with mesquite trees is permitted by the Los Angeles County General Plan at very low intensities subject to standards providing for the protection of the resource. The General Plan recommends that several of these areas be acquired by an appropriate public agency as permanent ecological reserves (County of Los Angeles Department of Regional Planning 1986).

Another designated SEA is Rosamond Lake (#50), located at the southwestern portion of the base. Areas surrounding Rosamond Lake have the best examples of shadscale scrub and alkali sink biotic communities and contain Piute Ponds, recognized as a valuable, unique wildlife habitat. Other SEAs south of Edwards include Saddleback Butte State Park (#51), Piute Butte (#54), Alpine Butte (#52), Lovejoy Butte (#53), Little Rock Wash (#49), and Fairmont and Antelope Buttes (#57) (County of Los Angeles Department of Regional Planning 1986).

Areas of Critical Environmental Concern (ACEC) are special land designations authorized by Congress in the Federal Land Policy and Management Act of 1976; 85 ACECs are currently identified in BLMs California Desert District and provide special management and protection for cultural, biological, botanical, scenic, and historical sites (BLM 2006). ACECs near Edwards AFB include Mojave fringe-toed lizard (*Uma scoparia*), Fremont-Kramer Desert Wildlife Management Area (DWMA), Harper Dry Lake, Barstow Woolly Sunflower (*Eriophyllum mohavense*), Black Mountain, Desert Tortoise Natural Area, Western Rand Mountains, Red Mountain Springs, Steam Well, and several others (BLM 2011). These areas support Mohave ground squirrel (*Xerospermophilus mohavensis*) and desert tortoise (*Gohperus agassizii*) populations as well as other sensitive plants and animals.

2.2 Physical Environment

2.2.1 Climate

The major climatic conditions which most affect the ecosystem on Edwards AFB are the extremes in wind, rainfall, and day versus night temperatures. Edwards AFB, located within the Mojave Desert, receives primarily winter rainfall in the months from September to April, with the highest rainfall typically occurring in January and February. Snow is a very infrequent event and typically not more than a few inches when it does occur and melts quickly. Summer rainfall is an infrequent event. Rainfall follows a pattern of extremely high and extremely low precipitation years (see Appendix Figures, *Edwards AFB Rainfall Data*). Rainfall effectiveness varies by rainfall event. Two inches of rainfall on the landscape over four days versus two inches of rainfall on the landscape over a period of 60 days produces an entirely different effect on the environment in terms of soil moisture required for germination of seeds. Rainfall timing/pattern is important

to consider when looking at rainfall years with six inches or less to determine if the rainfall for that year was actually effective in adding sufficient moisture to the soils for germination.

Wind has a major impact on evaporation rates in the desert environment. Winds are common up to 30 miles per hour (mph) with gusts as high as 75 mph. Winds blow between 90 and 95% of the time in March through August with May through July typically being the windiest months. Milder winds are typically experienced from September to February with December and January being somewhat calm. Evaporation rates in ponded areas increase during high wind conditions resulting in quicker evaporation of ponded areas that have been inundated by rainfall events. During years of low or trace amounts of rainfall events, high winds will evaporate most ponded water by April or May. During years with high amounts of rainfall, ponding can remain across the landscape until mid-to-late August.

Since 1942, Edwards AFB has been recording rainfall, wind conditions, and temperatures (see Appendix Figures, *Edwards AFB Rainfall Data: Spring and Summer and Fall and Winter Annual Average Temperatures* and Appendix Tables, *Monthly Range in Temperatures by Month per Year 1942 to 2014*). Daytime temperatures during July and August are typically in the low to mid 90's reaching highs of 110 °F or occasionally 115 °F. Night time temperatures will typically drop to between 65 and 75 °F during this time period. The coldest daytime temperatures occur in December and January averaging between 55 and 60 °F. The night time temperatures during these periods range between 25 and 35 °F dropping down on occasion to as low as single digits. The primary issue of extremes in temperature is the day and night time ranges which can change as much as 25 to 30 degrees between night and day (see Appendix Tables, *Monthly Range in Temperatures by Month per Year 1942 to 2014*).

2.2.2 Landforms

The topography of Edwards AFB is marked by broad expanses of flat-to-gently-sloping plains interspersed with broad domes and, in a few places, more resistant hills that rise sharply above the surrounding plains. The domes and hills consist mostly of outcrops of granite and quartz monzonite, with volcanic rock forming some of the smaller features. Elevations on base range from 2,267 feet above mean sea level (MSL) at Rogers Dry Lake to 3,424 feet above MSL at Red Buttes near the eastern boundary.

The base can be characterized as having three distinct physiographic areas. The first is an upland area in the northwest portion of the base north of Rosamond Dry Lake and west of Rogers Dry Lake. This area is characterized by low, rounded hills, including the Rosamond and Bissell Hills, with elevations ranging between 2,270 and 3,200 feet above MSL.

The second physiographic area occupies the central and southwestern parts of the base. These lowland areas include Rosamond, Buckhorn, and Rogers Dry Lakes and the intervening area. This region extends from the southern to the northern boundary of the base and has a relief of approximately 400 feet, with elevations ranging from 2,270 to 2,675 feet above MSL.

The third physiographic area is the highlands east of Rogers Dry Lake and extends to the eastern boundary of Edwards AFB. This upland area is similar to that in the northwestern corner of the base except for two prominent relief features: Leuhman Ridge and Haystack Butte, both over 3,400 feet above MSL. 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 the base.

2.2.3 Geology and Soils

The western Mojave Desert is fairly level with broad valleys and relatively small mountain ranges. Typical topographic features on base include hills, alluvial fans, valley floors, and basins. These features are

inundated by mostly gravel and sandy washes. The alluvial fans and valleys are covered with soil material eroded from the nearby hills. The basins are comprised of clay playas within a saltbush (*Atriplex sp*.) plant community.

Edwards AFB is characterized by three large dry lakebeds, Rosamond, Rogers, and Buckhorn Dry Lakes. Over the years, the lakebeds have started to fill with soil, primarily sand. The sand deposits have been worked by wind and water action to form beach ramps and various types of sand dunes (see Appendix Figures, *Geological Features on Edwards AFB*).

The most common parent material on base is granite. Granite is a coarse-grained rock primarily made up of quartz, feldspar, and ferromagnesian metals. The quartz forms sand and adds rapid drainage characteristics to the soil. The feldspars breakdown and add some fertility to the soil. The ferromagnesian minerals add metallic micronutrients to the soil.

No large faults occur on Edwards AFB; however, the relative motion of the San Andreas and Garlock Faults are responsible for the formation of a series of minor parallel faults in the central Mojave Desert and to a lesser extent in the western Mojave Desert (see Appendix Figures, *Geological Features on Edwards AFB, Norris, 1995*).

Soil Characteristics

Desert soils are generally coarse-textured, light in color, well-drained, and low in organic matter. Except for clay pans and playas, most desert soils are well-drained and are easily eroded. In general, desert soils are low in nutrients, slightly high in dissolved salts and highly alkaline. The soil surface may be entirely or contain sections of biological and nonbiological crust (Pietrasiak et al. 2013; Neal 1968). Both soil crusts are essential for aggregating mineral particles at the soil surface. ecological sites favor certain crust taxa.

Biological soil crusts contain microbial communities of diverse taxa such as bryophytes, lichens, eukaryotic algae, cyanobacteria, fungi and/or bacteria, and their byproducts. The microscopic biocrust communities function ecologically to: stabilize soils, fix nitrogen and carbon, regulate water cycling in an out of soils, capture dust, accumulate organic matter, supply nutrients to vascular plants, enhance and/or reduce seedling establishment, promote chemical and physical weathering, provide wildlife habitat, and regulate soil food web interactions (Belnap et al. 2001; Johansen & Schubert 2001; Shepherd et al. 2002; Williams et al. 2012).

Nonbiological or inorganic soil crusts are common soil surface features in arid and semiarid ecosystems. Physical or chemical processes, or a combination of both, lead to their formation (Belnap et al. 2001). These sealed crust surfaces are associated with reduced water infiltration and increased run off (Valentin 1991). Seedling establishment and root penetration may be impeded (Wood et al. 1982). However, plant growth may be promoted in adjacent non-crusted areas if these areas receive additional water from runoff (Wood et al. 2005).

Physical crusts

In general, these compact soil crusts can be classified into structural and depositional physical crusts (Valentin 1991; Valentin and Bresson 1992). Structural crusts form *in situ* (Valentin and Bresson 1992). They commonly develop after rainsplash breaks up surface aggregates and causes slaking. Often, vesicular porosity can be observed. Depositional crusts form from the settling out of soil particles that were transported to a topographical low point by runoff or by the deposition of particles in standing water (Valentin and Bresson 1992). Fine stratification or platy structure results. Depositional crust formation may be linked to natural wetting and drying events. In addition, anthropogenic land uses such as use of heavy agricultural machinery, irrigation techniques, or livestock can cause a depositional crust to develop. In these cases, the

anthropogenic impacts to the land lead to compaction of the soil surface layers, greater sediment transport in overland flow, and ponding at topographic low points where particles settle out to form a laminar depositional crust (Valentin 1991).

Chemical crusts
The most common chemical soil crusts develop on the surface of soils with high salt content. When saline water evaporates at the soil surface, salt crystals precipitate and are left behind on the surface. At a first sight, salt crusts can closely resemble biocrusts. However, no biological filaments (hyphae or algal filaments) can be detected by viewing a chemical soil crust with a hand lens (Belnap et al. 2001).

Soil characteristics are important for determining flood and erosion hazards. Soil characteristics determine the ability of rainwater to penetrate the soil surface and percolate through the various soil layers. The soil surface of each soil series has an erodibility index based on natural cementing agents such as roots, bacteria, and other microorganisms, organic matter, and natural chemical cementing agents. Soils become more easily eroded when the surface is disturbed. Disturbance may be natural from disasters such as fire, which denudes vegetation, or from human activity (e.g., grading, OHV use, etc.). Once the soil surface is disturbed, the surface is vulnerable to both wind and water erosion. Wind erosion occurs much more frequently on base than water erosion.

Soil Recovery

Recovery from surface disturbance is a long, slow process in the desert. Soils cannot form until vegetation reduces wind speeds and acts as barriers to the movement of soil particles. The size of the disturbance affects the rate of recovery. One of the greatest factors in recovery is the presence of mycorrhiza, a fungi interrelationship with plant roots. Many native species require this relationship for growth and survival. Species that do not require this relationship are usually Eurasian weeds or native pioneering species such as burrobrush (*Ambrosia salsola*), buckwheat (*Eriogonum sp.),* cottonthorn (*Tetradymia sp.),* rabbitbrush (*Ericameria nauseosa*) and rayless goldenhead (*Acamptopappus sphaerocephalus*); these are often the first shrubs to recolonize disturbed soils.

Soil Classification

A preliminary soil survey conducted in 1987 to 1988 delineated soil types in the Main Base, family housing, and NASA/Armstrong areas. Surveys conducted in 1996 by the United States Natural Resource Conservation Service (NRCS) classified 50 soil series or types on the entire base (see Appendix Figures, *Soil Types at Edwards AFB, NRCS, 1996*). Soils at Edwards AFB are typically alkaline (basic), with potential for pH values ranging from seven to eight for most soils and greater than eight on lakebed soils. The high salinity and exchangeable sodium ion content of some soils, particularly soils in the lakebed basins, inhibit plant growth. The Grazing and Cropland Management Plan (NRCS 1996) was a study that identified five groups of landforms ranging from playas at the lowest elevation to hills and rock pediments, based on soil types. These landform groups and associated soils are briefly described in the following paragraphs.

Lakebeds are most often about 95 percent covered by Wherry soils. These areas include Rogers, Rosamond, and Buckhorn Lakes. Wherry soils are deep and poorly drained, with a clay texture and slopes of zero to one percent. The soil is barren with high saline/sodic content, and is subject to wind erosion and flooding.

Alluvial fans in the areas surrounding the lakes are composed primarily of Leuhman, Norob, and Voyager soils. They are deep and moderately-well to well-drained, with textures of fine sand to clay loam. Slopes range from zero to five percent. These soils are saline and sodic, and subject to wind erosion and flooding.

Dunes and sand sheets around the lakes are an intermediate form between the alluvial flats and fan piedmonts. They primarily consist of Cajon soil with smaller proportions of Challenger and other soils. Slopes range from zero to 15 percent. These soils are deep, moderately-well to excessively drained, with textures of sand to loamy sand, subject to wind erosion.

Fan piedmonts contain mostly Helendale soil, with smaller proportions of Lavic, Destazo, Helendale Taxadjunct, and Cajon soils. These soils are deep and moderately-well to well-drained, with textures of loamy coarse sand to fine sandy loam. Slopes range from zero to nine percent. These soils are subject to wind erosion and occasional flooding.

Rock pediments and hills consist of Randsburg, Hi Vista, Machone, Muroc, and Sparkhule soils, interspersed with rock outcrops. These soils can be very shallow to moderately deep and are well-drained, with textures of sandy loam and gravel. Slopes range from two to 50 percent. These soils are subject to wind and water erosion.

2.2.4 Hydrology

Surface Water

Rainfall at Edwards AFB follows the basic desert model of extremes, dry and wet years. The average rainfall is considered to be approximately five inches a year; however, the average is based on totals over several years (see Appendix Figures, *Recent Effective Rainfall Events at Edwards AFB*). Additionally, within those rainfall years there are "effective rainfall events." Effective rainfall events are those which determine the natural hydrology to the landscape. These are the events which cause channels to flow, sheet flow, and water to pool. These are the events which provide enough water for plants to germinate. An effective rainfall event, as intended here, is one in which >1 inch of rain falls over consecutive days (see Appendix Figures, *Recent Effective Rainfall Events at Edwards AFB*). An isolated, one-day rainfall event of less than 0.56 inches will not typically initiate surface flow (NSR 2012). Some local ponding may occur which is highly valuable to the flora and fauna around that ponded area

Edwards AFB is situated at the bottom of Antelope Valley, within a closed basin of approximately 2,400-square miles known as the Antelope Valley Watershed. The Antelope Valley Watershed has been divided into 20 individual watersheds (see Appendix Figures, *Watersheds and Surface Hydrology on Edwards AFB*). For consideration as management areas the watersheds have become a hydrologic unit (see Appendix Figures, *Natural Resource Management Areas*). For floodplain assessments, the Antelope Valley Watershed was split into four primary watersheds: Buckhorn, Rich, Rogers, and Rosamond Lakes Watersheds which drain into four playa lakebeds, Buckhorn, Rich, Rogers, and Rosamond Dry Lakes located on Edwards AFB (French et al. 2004 and 2009). The lakebeds are the remnants of a Pleistocene Lake Thompson. Lake Thompson is considered to have been as deep as 18 meters in the late Quaternary period; stabilizing sometime in the mid-Holocene at a depth of 10 meters (Lichvar et al. 2004). During this period the separate lakebeds of Rogers, Buckhorn, and Rosamond were independent water bodies (Lichvar et al. 2004). Rich Lake was classified as a back-barrier lagoon (Orme 2002) and an individual lakebed and watershed (French et al. 2003). The authors based their classification on three factors: continuous topographic divide, precipitation gradient differences, and differences in vegetation and land use. It is likely that in the past, these playas (Rosamond, Buckhorn, Rogers) were permanent lakes inundated by perennial streams. As the regional climate changed they became dry lakebeds and ephemeral washes.

Since Edwards AFB is at the lowest point in the Antelope Valley it receives surface water flow from numerous washes which flow from the surrounding mountains as well as local surface water flow across the valley floor. Some of these were once perennial waterways, but for at least the last 100 years, due to diversion activities, the washes became ephemeral and now flow on an average of every five years to Edwards AFB depending on the level of rainfall. Desert Research Institute (French et al. 2003 and 2004; Miller and French 2004; French and Miller 2009) and North State Resources (NSR 2012) have hypothesized that there is little connectivity between the upper watershed (above 2,000 to 3,000 feet) and the lower watershed (below 2,000 feet). The lack of connectivity between the upper watershed and the lower watershed was not verified in the DRI or NSR studies. It would be important in understanding the water flow connectivity in order to ensure a healthy ecosystem downstream to test this hypothesis. For example, a significant amount of surface flow still makes its way downstream to the lakebeds, clay pan and dunes, and wetlands on Edwards AFB.

Major wash systems which flow to Edwards AFB are Big Rock Creek, Little Rock Creek, Amargosa Creek, Fairmont Creek, Cottonwood Creek, Oak Creek, and Mojave Creek.

Lichvar and Sprecher (1996) mapped 351 separate ephemeral washes totaling 487 miles traveling from headwaters and local areas to Edwards AFB, an additional ten channels with a total linear footage of 14.1 miles, occur within the main base and housing area. They documented 2,732 clay pans from 0.01 acre to 307 acres in size with most being between 0.01 to 2.5 acres. Besides those documented individually, 11 clay pan zones were created in areas where clay pans were numerous. These zones reflect most of the flood prone areas on the base. Five playas (four of which are the main lakebeds) were documented totaling 45,728 acres.

Rogers Dry Lake (28,160 acres) is primarily fed by Mojave and Big Rock Creeks (ephemeral) along with other small ephemeral unnamed drainages from the north, south, and east. Rosamond Lake Watershed is bounded on the west and south by the San Gabriel Mountains. Rosamond Dry Lake (12,930 acres) receives water flow from Amargosa, Little Rock, Cottonwood, Oak Creeks, and various other unnamed ephemeral drainages. Buckhorn Dry Lake (1,616 acres) receives water flow primarily from Little Rock, Big Rock Creek, and from unnamed ephemeral drainages to the north and south. It is unknown whether Buckhorn Dry Lake receives water from Rosamond Dry Lake. Rich Dry Lake (1,945 acres) receives water flow from the Rich Lake Watershed along the northern base boundary and off-base slopes. In some years during major storms, water in Rich Dry Lake overtops Lakeshore Drive and flows into the northern portion of Rogers Dry Lake (French et al. 2003 and 2004; Miller and French 2004; French and Miller 2009).

The Piute Ponds Complex (excluding Rosamond Dry Lake) encompasses approximately 5,614 acres (see Appendix Figures, *Water Management Areas within Piute Ponds Complex*). These areas are subject to flow from Sanitation District 14 (D14) Lancaster Waste Water Treatment Plant, and depending on the area, are perennially or seasonally flooded. Other seasonally flooded wetlands exist outside of this Water Management Area and receive water from natural ephemeral surface water as it flows to the lakebed.

Branch Memorial Park Pond encompasses approximately 6 acres and is located along Lancaster Boulevard just north of South Gate.

The Edwards AFB Muroc Golf Course contains a pond, approximately 0.6 acres in size.

Two evaporation pond complexes exist on Edwards AFB. The South Base Evaporation Ponds are located on the western edge of Rogers Lake. The other evaporation ponds are located at the Air Force Research Laboratory (AFRL). The AFRL Evaporation Ponds are currently located west of Downfall Road. Both pond

complexes are part of the waste water treatment facilities. Various storm water ponds are and have been in use throughout the main base and AFRL. The total number of storm water ponds is unknown.

All natural flow paths on Edwards AFB are ephemeral; combined with the highly variable precipitation, high evaporation losses, and moderate to very high soil permeability makes them highly unpredictable compared to streams with perennial flow providing little likelihood of developing a model that can reasonably simulate flow for large areas of the base and very little possibility of accurately predicting discharge for flooding frequencies (Bowers and Meyer 2002). Several types of flooding are recognized on base; channels, shallow flooding, and inundation caused by ponding (Bowers and Meyer 2002). Shallow flooding is also referred to as sheet flow; water that overflows the banks of braided channels joining with other overbanking areas and moving across the landscape as a wide flood no longer within a definable channel. Many ephemeral flow paths within the clay pan/dune areas and lakebeds have impermeable clay soil bed and banks which allows for ponding as the water moves through inundating the main hydrologic feature within Edwards AFB (Rosamond, Buckhorn, Rogers, and Rich Dry Lakes). The hydrologic system within Edwards AFB presents challenges to determining reliable floodplains. Over 30 studies have been accomplished on base to try to capture this information (French et al. 2003 and 2004; Miller and French 2004; French and Miller 2009; GRW 1993; NSR 2012).

The surface flow study (NSR 2012) is the only document where individuals were on the ground to measure surface flow real time during a flooding event. This study resulted in documenting the continued hydrologic connection of surrounding washes to the lakebed. NSR (2012) collected surface flow runoff data during a 4-day set of rainstorms between January 18, 2010, and January 23, 2010, that resulted in five days of runoff; these rainstorms constituted a five-year flood event. Over this period, rainfall totaled about 2.5 inches, and between 0.36 inch and 0.56 inch of rainfall in the first 24 hours was required to saturate the soils and initiate surface flow runoff. The total measured volume of flow was 1.17 ± 0.23 meters-km^2 (946 ± 189 acre feet) (NSR 2012). Approximately 946 acre feet of flood water inundated Rosamond Lake. Measurements were taken in the channels leading into the lakebed but all water flowing into the lakebed could not be measured. At the height of the storm the channels were observed over topping their banks at Shuttle Road and Avenue C, joining with adjacent channels and creating a sheet flow across the landscape, no longer enabling the equipment to measure all the water flowing onto the lakebed. It is unknown whether other channels also overtopped but it would be considered a likely scenario.

For management considerations the floodplains delineated by both a geomorphological standpoint and channel geometry are being considered together to provide a better picture of the entire floodplain. Floodplains include the lakebeds and connecting flood prone areas which form a hydrologic unit (French et al. 2003 and 2004; Miller and French 2004; French and Miller 2009; USGS 2002; Lichvar and Sprecher 1996).

Ground Water

The United States Geological Survey (USGS) compiled historic annual water consumption data at Edwards AFB from 1947 through 1996. Consumption peaked at 7,500 acre feet/year (afy) in 1965 and averaged 6,000 afy from 1967 through 1988. From 1989 to 2004, consumption averaged slightly above 5,000 afy. Since that time, consumption has declined somewhat due to a decrease in base population and a reduction in irrigated landscape areas.

The USGS also summarized annual historic water production by well field at Edwards AFB from 1947 to 1996. During the period of maximum water consumption, the North Base well field (now abandoned) and the AFRL well field (and Mary's Wells at that time) were producing in excess of 1,000 afy and 800 afy above their average rates, respectively. These well fields supplied water mainly for industrial uses.

Historically, the Antelope Valley Ground Water Basin was divided into two primary aquifers, an upper unconfined aquifer known locally as the Principal Aquifer and a Deep Aquifer overlain and confined by lacustrine deposits known as the blue clay layer. More recently, the USGS developed a conceptual model that divides the Lancaster and North Muroc subbasins into an Upper, Middle, and Lower Aquifer on the basis of age and permeability (Leigton and Phillips 2003).

The upper aquifer consists of younger alluvium and varies from confined to unconfined depending on the presence and extent of the lacustrine deposits. The upper aquifer is the major source of ground water supply for most municipal and agricultural users in the Antelope Valley. The middle aquifer consists of older alluvium and is generally considered confined below the lacustrine deposits. The middle aquifer is the primary source of ground water supply for Edwards AFB where it extends from about 250 to 750 feet below grade. The lower aquifer consists of continental deposits and is only able to store and transmit small quantities of water as it becomes increasingly consolidated with depth. Ground water quality is generally good throughout the basin with total dissolved solids (TDS) concentrations averaging about 300 milligrams/liter (mg/L). Naturally occurring arsenic in concentrations above the maximum contaminant level (MCL) of 10 micrograms/liter (ug/L) is common. Higher levels of arsenic tend to be found more in groundwater sources than in surface water sources. The demand on groundwater from municipal systems and private drinking water wells may cause water levels to drop and release arsenic from rock formations. Arsenic is an emerging contaminant of concern in the Antelope Valley Region and has been observed in Los Angeles County Waterworks District (LACWWD) 40, Palmdale Water District (PWD), and Quartz Hill Water District (QHWD) wells. Research conducted by the LACWWD and the USGS has shown the problem to reside primarily in the deep aquifer, and it is not anticipated that the existing arsenic problem will lead to future loss of groundwater as a water supply resource for the Antelope Valley Region (AVIRWMP 2013). Groundwater quality within the Antelope Valley Groundwater Basin is excellent within the principal aquifer but degrades toward the north. The main contaminant of concern in the Antelope Valley Region is arsenic (AVIRWMP 2013).

The total storage capacity of the Antelope Valley Ground Water Basin (see Appendix Figures, *Groundwater Basins)* has been reported to be approximately 70 million acre-feet. The basin is recharged mainly by deep percolation of runoff through the alluvial fans of Big Rock, Littlerock, and Amargosa Creeks at the base of the San Gabriel Mountains and Oak Creek and Cottonwood Creek in the Tehachapi Mountains. Little recharge occurs beyond these areas, and surface flows that do reach Rosamond Lake and Rogers Lake are generally lost to evaporation (DWR 2004).

There are several estimates of natural recharge for the Antelope Valley Ground Water Basin. The DWR (2004) reports an average natural recharge rate (48,000 acre feet per year (afy)) and a range (31,200 afy to 59,100 afy). USGS estimates range from 30,300 afy to 81,400 afy (Leigton and Phillips 2003). The Antelope Valley Technical Committee (2008) estimated a long-term average natural recharge of about 60,000 afy, a native sustainable yield (pumping that can be supported by natural recharge) of 82,000 afy, and a total sustainable yield (pumping supported by natural recharge augmented by supplemental water) of 110,000 afy.

Edwards AFB has two public water systems permitted by the California Department of Public Health (CDPH). The Main Base system (#1510701) serves approximately 13,400 people and the AFRL system (#1510702) serves almost 1,200. The Main Base system uses ground water and State Water Project (SWP) water supplied by Antelope Valley East Kern (AVEK) to meet potable (municipal) and non-potable (agricultural and industrial) demands. The AFRL system is currently using ground water to meet total demands. AVEK deliveries to AFRL were discontinued due to the high arsenic concentrations that result when SWP water is delivered through the Boron system.

Edwards AFB began using SWP water supplied by AVEK to supplement demand in 1992. The current annual allotment from AVEK is 2,688 acre-feet; however, only about 70% to 80% of that volume is presently being used. There are 12 active water production wells that serve the Main Base. The wells are located within the following four well fields: Branch Park, Graham Ranch, South Base, and South Track. The well fields are bounded to the north by the El Mirage Fault and to the south by the Willow Springs Fault. The Graham Ranch well field is further isolated to the east by the Antelope Valley Fault Zone. There are three active water production wells at AFRL. The AFRL well field is located east of Rogers Dry Lake and north of the El Mirage Fault. All of the wells are completed in the Middle Aquifer of the Lancaster Sub basin (see Appendix Figures, *Water Management Areas within Piute Ponds Complex*).

The California Department of Public Health (CDPH) recommended that the Main Base and AFRL water supply wells be maintained in operable conditions at all times as part of a Six- Month Contingency Plan to address short- and long-term disruptions of SWP water.

2.3 Ecosystems and the Biotic Environment

2.3.1 Ecosystem Classification

The Mojave Desert lies within the American Semidesert and Desert Province and forms its own Section (Bailey 1995; McNab et al. 2005). A Section, as defined by McNab, is a large land area of relatively homogeneous physical and biological components that interact to form environments of similar productive capabilities, response to disturbances, and potentials for resource management. In the Mojave Desert Section the terrain consists of plains with short ranges, playas, basins, and dunes (McNab et al. 2005).

The Mojave Desert Section is bounded by other Provinces; these include the Intermountain Semi-Desert and Desert to the north, Colorado Plateau Semi-Desert to the east, and California Coastal Range Open Woodland-Shrub-Coniferous Forest-Meadow and Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow to the west. The Mojave Desert lies 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 (USGS 2013).

2.3.2 Vegetation

2.3.2.1 Historic Vegetative Cover

On Edwards AFB, the historic vegetative cover, for the most part, has not changed over the years. The main plant communities of creosote bush scrub, saltbush scrub, Joshua tree, and mesquite bosques are still present within the base. Disturbance to these habitats have occurred from settlers who came to the Antelope Valley in the 1800s to establish small ranches where they could raise cattle and sheep and grow crops for their livelihood.

2.3.2.2 Current Vegetative Cover

The Mojave Desert has been divided into several floristic provinces; these include the western, southwestern, central, eastern, and northern Mojave Desert Floristic Provinces.

The Natural Resources Conservation Service (NRCS) mapped plant associations as part of the soil mapping project of 1996 (NRCS 1996). At that time, 50 plant associations (see Appendix Figures, *Plant Associations*) were identified on Edwards AFB, with approximately half being upland associations.

Plant communities (see Appendix Figures, *Plant Communities on Edwards AFB*) within upland habitats consist of creosote bush scrub, saltbush scrub, and Joshua tree woodland. The table titled Acres of Habitat on Edwards AFB in Appendix Tables, lists plant community acreage. Appendix Tables, *Plants Observed on Edwards AFB*, lists the plants found on Edwards AFB. The plant communities and more common plant species are discussed in the following sections as detailed in several reports (Charlton 1992 and 2006; Holland 1986).

Zonal Habitats

Zonal habitats consist of lakebeds, creosote bush scrub, halophytic saltbush scrub, xerophytic saltbush scrub, and Joshua tree woodland. The zonal plant communities are primarily based on elevation and typically contain drier soils. Vegetation in the upland areas on base consist of two main plant communities: creosote bush scrub and Joshua tree woodland. Lowland communities consist of the alkali sink and saltbush communities. Much of the surface of each of these communities is covered with a thin veneer of sand formed from decomposed granite. This sand arrived by fluvial action from Big and Little Rock Creeks in the south and Mojave Creek from the northwest. The sand was then redeposited locally by wind action. The combination of wind and water has created beach ramps, several kinds of sand dunes; and sand sheets or sand fields.

Past vegetation mapping has divided the various saltbush communities into two plant communities: xerophytic and halophytic communities. The xerophytic communities are dominated by desert saltbush (*Atriplex polycarpa*) and spinescale saltbush (*Atriplex spinifera*) and are generally located north of the lakebeds. Halophytic saltbush communities are dominated by shadscale (*Atriplex confertifolia*), Joshua trees (*Yucca brevifolia*), and bush seepweed (*Suaeda nigra*), and occur south of the lakebeds. Many studies distinguish these two as separate saltbush plant communities.

Joshua Tree Woodland. Joshua trees generally occur in coarse sands, very fine silts, gravel, or sandy loams on gentle alluvial fans, ridges, or gentle to moderate slopes (Sawyer et al. 2009). The largest expanse of Joshua tree woodlands on base occur on the PIRA (Cione 2008b). Joshua tree woodland has an open to intermittent canopy with an open to intermittent shrub layer where Joshua trees are evenly distributed with equal to or over 1% cover (Sawyer et al. 2009). Edwards AFB, however, defines Joshua tree woodlands as areas containing at least 10 trees per acre. The main understory shrub vegetation on Edwards AFB is saltbush or creosote bush. Annual plant diversity in this community is normally high (Cione 2008b). Guilds of wildlife species are specifically attracted to Joshua trees. These vary from insects, such as pollinators, to reptiles and many species of birds.

Annual plant diversity in this community is normally high (Cione 2008b). Guilds of wildlife species are specifically attracted to Joshua trees. These vary from insects, such as pollinators, to reptiles and many species of birds.

Halophytic Saltbush. Halophytic saltbush communities are dominated by shadscale (*Atriplex confertifolia*) or spinescale saltbush (*Atriplex spinifera*), and occur adjacent to lakebeds, clay pans, and drainages. The depth of sand deposits determines the diversity of plant species in the saltbush communities (USACE 2004). The areas nearest the lakebed and areas scoured by floods are dominated by heavy clay soils and contain spinescale. Plants such as alkali sacaton (*Sporobolus airoides*), Joshua trees, and fourwing saltbush (*Atriplex canescens*) are commonly found within this plant community (Cione and Clark 2011).

Xerophytic Saltbush. The xerophytic communities are dominated by desert saltbush (*Atriplex polycarpa*) (Cione 2008c). These plant communities are generally located at slightly higher elevations than halophytic communities.

Creosote Bush. Approximately 40% of the natural vegetation community on Edwards AFB is creosote scrub (Cione 2008c). In general, the creosote scrub community tends to occur on soils that are well drained and range from sandy loam to rock and cobble. Shrub composition within this community varies widely and appears to be dependent on soil type. The creosote scrub community usually tends to have large shrub interspaces with a high density of annuals in the spring.

Azonal Habitats

Azonal habitats are areas within the zonal plant communities. Azonal habitats are determined by soil texture and chemistry and include desert washes, alkaline meadows, mesquite bosques, sand dunes, ruderal, and clay pans.

Desert Washes. The numerous long and narrow sandy washes that occur throughout the base are a unique habitat with specialized plant and animal species associated with them. Also, braided washes can have mixes of wash and alluvial fan species. Shrubs that are more common in wash habitat include Thurber's sandpaper plant (*Petalonyx thurberi*), bladder sage (*Salazaria neomexicana*), rubber rabbitbrush (*Chrysothamnus nauseosus*), and peach thorn (*Lycium cooperi*).

Alkaline Meadows. The main alkaline seep areas are dominated by grasses and grass-like plants and occur on the north side of Piute Ponds and, to a lesser extent, other areas adjacent to the ponds. Seepage and water from the spillway result in a dense carpet of saltgrass (*Distchlis spicata*) and Mexican rush (*Juncus balticus ssp.mexicanus*). During a series of wet years, salt grass also begins growing in cracks on the small playas and clay drainages in the halophytic saltbush scrub. Meadows can also develop near water outfall pipes and ditches along Main Base and in the housing areas. The bunch grass, alkali sacaton, may also be locally common in meadows and at springs. Another species common in the meadows is common tarweed (*Centromadia pungens ssp. pungens*).

Mesquite Bosques. Western honey mesquite (*Prosopis glandulosa*) visually dominates some of the largest drainages along Big and Little Rock Creeks as they approach Rogers Dry Lake. The treelike spiny shrubs form habitat for some riparian woodland species of wildlife. This habitat is identified by rubber rabbitbrush (*Ericameria nauseosus var. mohavensis*), alkali mariposa lily (*Calochortus striatus*), and the local endemic big sagebrush (*Artemisia tridentata parishii*).

Sand Dunes. Sand dunes occur primarily around the lakebeds within the halophytic and xerophytic saltbush plant communities.

Rock Outcrops. Rock outcrops occur primarily in the Bissell Hills and throughout the AFRL. Smaller rock outcrops occur in various locations throughout the base.

Caves and Mines. There are several mine shafts located on Edwards AFB, primarily on AFRL and the PIRA. There are no known caves on base.

Ruderal. Areas of highly disturbed and weedy vegetation are referred to as ruderal habitats and include locations like bomb targets and solar fields. Several species of shrubs and annuals are common after an area is bladed or cleared of vegetation. Also, many weedy species only occur in previously disturbed areas such as roadsides. Many of the common weeds are not considered noxious but are a management concern on Edwards AFB.

2.3.2.3 Turf and Landscaped Areas

Urban. The cantonment and housing areas have been landscaped with lawns and trees. These areas form grasslands and urban woodland habitat not natural to the Mojave Desert. Native and nonnative ornamental trees include Fremont's cottonwood (*Populus fremontii ssp. fremontii*), Mexican ash (*Fraxinus uhdei*), Aleppo pine (*Pinus halepensis*), and Eucalyptus (*Eucalyptus sp.*). These areas, along with the golf course, ball fields, and school playground areas, constitute the urban habitats. Much of the new housing has xerophytic landscaping including ornamental rock instead of grass lawns. The trees and shrubs planted will also require less water. Xeric landscapes will be expanded to common areas and cantonment areas.

Abandoned Buildings. Abandoned buildings occur throughout the installation. However, past and current efforts have greatly reduced their number.

2.3.3 Fish and Wildlife

Baseline surveys have been conducted for many species on Edwards AFB. Terrestrial macroarthropod surveys were conducted from 1996-1998 (Pratt 2000). Miller and Payne (2000) evaluated aquatic habitats for macroinvertebrates from 1995 to 1996. Several different studies provided data on eubranchiopods (Branchiopod Research Group 1993; Miller and Payne 2000; Perez and Donn 2009). Bird studies were conducted between 2000-2005 (AMEC Earth and Environmental 2006). Surveys were also completed on reptiles and amphibians (AMEC Earth and Environmental 2008) and butterflies (Pratt 2000). Species of Interest on Edwards AFB in the Appendix Tables provides a complete list of fish and wildlife species known or expected to occur Edwards AFB or in its immediate vicinity.

Insects and Arthropods

Approximately 1,500 distinct invertebrate species have been documented on Edwards AFB (Pratt 2000). Commonly observed insect groups include wasps, ants, bees, flies, grasshoppers, moths, butterflies, and beetles. In 1997 and 1998, over 400 new species were added to the EAFB species list. Of these species, over 80 percent belonged to the four major insect orders: Coleoptera, Lepidoptera, Diptera, and Hymenoptera. An additional 14 percent belonged to the next four major insect orders: Orthoptera, Homoptera, Hemiptera, and Neuroptera. At least three new, undescribed species of Gryllacrididae and two Scarabaeidae were found. There may be other unrecognized species. Many range extensions were found during this survey; for example, of the four Cicindela species collected, two were major range extensions for their species (Pratt 2000). Insects are an integral part of all food webs and are a major source of protein for many other wildlife species. One of the main positive roles of insects in the ecosystem is as pollinators. Healthy systems have a diverse pollinator fauna. Pollinators of the rarest plant species occurring on Edwards AFB were not documented. Further surveys for invertebrates are needed. This group of organisms is not well studied and are valuable ecosystem components serving as pollinators of plants and food for animals.

Arthropods are not insects and typically include spiders (tarantulas and wolf spiders), scorpions, and fairy shrimp. The Branchiopod Research Group (1993) found five species of shrimp that occur in the playas and clay pan areas where ponded water collects from rainfall. These included three species of fairy shrimp, *Branchinecta gigas, B. mackini*, and *B. lindahli*; one species of tadpole shrimp, *Lepidurus lemmoni;* and one species of common clam shrimp, *Eocyzicus digue*ti (The Branchiopod Research Group, 1993). Perez and Donn (2009) report these same five species as well as *B. coloradensis*, which were present at just one site, and an unidentified clam shrimp (*Cyzicus sp.*). There are no known threatened or endangered shrimp species on base. Shrimp are a significant food source for migratory birds.

Aquatic macroinvertebrate surveys conducted in the mid-1990s found Chironomids (true flies), Amphipods (small crustaceans), leeches, and Oligochaetes (worms) in Piute Pond, Branch Pond, Scout Road Pond, and another lagoon northeast of this location. Backswimmers (Notonecta and Buenoa), snails, dragonfly nymph, damselfly nymphs, and caddis fly were also found. Macroinvertebrates are typically used to monitor changes in water quality, as several orders are sensitive to pollution. The macroinvertebrate communities in most of the ponds surveyed contained amphipods, cladocerans, and odonates, which tend to be ubiquitous to freshwater habitats that range from acceptable to good water quality. While the number of pollution-sensitive organisms found in the ponds is low, the presence of Trichoptera in Branch Pond and Ephemeroptera in Piute Pond indicates that water quality is adequate to support small populations of these species. Overall ponds on Edwards support a productive but simple aquatic invertebrate community of mostly ubiquitous species. This is to be expected of desert ponds where stressful conditions including moderately high water temperature and slightly brackish water are inherent.

Fish

Fish do not occur in the secondary-treated effluent in Piute Ponds or other aquatic areas on base, except for the ponds at Branch Park, which is stocked with fish, and the golf course. Catfish, bluegill, bass, and trout are stocked in Branch Pond. Goldfish are sometimes placed in the golf course pond. Goldfish are also sometimes placed in ponds at the AFRL and Downfall. These goldfish are usually placed without coordination with natural resource personnel. They do provide some aesthetic value and may help to control insects, such as mosquitoes. During water draw-downs at Branch Pond fish may be taken to the pond at the AFRL fire department. Los Angeles County may put mosquitofish (*Gambusia sp.)* in Piute Ponds to controls mosquitoes; however, they are not expected to survive due to the large population of African clawed frogs.

Amphibians

Based on previous surveys and incidental sightings, at least four species of amphibians occur on Edwards AFB. These include two native species, the Pacific treefrog (*Pseudacris regilla*) and western toad (*Anaxyrus boreas*), and two non-native species, the African clawed frog (*Xenopus laevis*) and American bullfrog (*Lithobates catesbeianus*) (AMEC Earth and Environmental 2008). Tree frogs are common and native to wetlands and wetland areas throughout California. Bullfrogs (found only at Branch Pond) and African clawed frogs (found only at Piute Ponds and surrounding areas) are very aggressive. They can impact many species of native wildlife. Western toads are common in the housing areas and at Piute Ponds. AMEC Earth and Environmental (2008) attempted to document several potential sensitive species, including the federally threatened California red-legged frog and arroyo toad; neither were found.

Reptiles

Reptile surveys were conducted to document the common species observed in the various plant communities (Tetra Tech 1993; AMEC Earth and Environmental 2008). In the first survey, 13 different reptile species were observed. In 2005, AMEC took photographs of several seldom seen nocturnal reptiles such as the glossy snake (*Arizona elegans*) and night snake (*Hypsiglena torquata*). In AMEC 2008, 22 reptiles were observed during field surveys that took place in February and October in 2003 and 2004, one of which was non-native, the Painted turtle (*Chrysemys picta*). Aquatic seining and dip-netting, drift fences, coverboards, and visual surveys were the methods used to survey for reptiles. Specific areas appeared to support relatively higher numbers of individuals and species than may otherwise be expected. Eighteen of the twenty- two, or 82%, of the reptile species known to occur on Edwards AFB were found in Creosote Bush Scrub. Nine species, or 41 %, were found in Halophytic Saltbush, seven species, or 32%, were found in Joshua tree woodland, two species, or 9%, were found in Mesquite Bosques, and six species, or 27%,

were found in Xerophytic Saltbush Scrub (AMEC Earth and Environmental 2008). Four species were found at only a single location. The federally threatened desert tortoise (*Gopherus agassizii*) is a resident species found on base. The desert tortoise is discussed in more detail in the Threatened and Endangered Species and Species of Concern Section below. In general, habitat quality on base is good for reptiles. AMEC (2008) attempted to document presence of several sensitive reptile species, including coast homed lizard (*Phrynosoma coronatum*), two-striped garter snake (*Thamnophis hammondii*), and western pond turtle (*Actinemys marmorata*). One siting of a western pond turtle was reported at Piute Ponds in July of 2015.

Birds

Birds have been surveyed as part of other wildlife studies, focused studies, and recreational birding activity. At least 300 species of birds have been observed on base (see *Fauna Observed on Edwards AFB* and *Checklist of the Birds on Edwards AFB* in Appendix Tables). Most recreational birding occurs at Piute Ponds. A bird checklist for Piute Ponds is available online (www.piuteponds.com). Seasonal sampling of avian population density and movements were conducted between 2000 and 2005 in an effort to compile essential baseline information used to guide management efforts for improved flight safety and resource management (AMEC Earth and Environmental 2006). The study design included point counts, bird banding, and the collection of supplemental data, such as daily bird activity, site habitat characterization, weather, wind speed, and factors thought to influence birds and their behavior. Other information recorded and collected included bird flying altitudes and notable migratory bird pathways, which were analyzed with quantitative data. As a result of the study, and other associated research, a total of 276 bird species were confirmed on the base. Heavily used migration corridors have definable and distinctive boundaries that generally follow visible landmarks such as water, mountain peaks, and trees that were readily visible when seasonal observations were plotted in GIS. Statistical analyses also provided clues about bird behavior, density, and distribution, and factors that influence these parameters such as location, time of year, time of day, temperature, wind speed, and precipitation. Mobile radar units and WSR-88D NEXRAD weather radar were used to track bird migration movements (AMEC Earth and Environmental 2006).

Banding efforts were conducted from fall 2001 through spring 2002; a total of 150 birds were captured and banded (AMEC Earth and Environmental 2006). A total of 286 point count locations were established and surveyed ten times each over a two-year period. Over 15,000 birds were observed during point count surveys. Focused surveys accounted for an additional 64,000 bird observations. Seasonal abundance varied for all species; with increases in the spring and fall. The number of birds detected differed when compared to habitat type. Ponds supported a disproportionately high number of detectable birds (i.e. 74%). Aquatic areas are of special concern because hydrologic areas in the western Mojave Desert are a very limited resource. Piute Ponds, Branch Pond, South Base Sewage, Housing Area, AFRL Fire Station, and AFRL Sewage Ponds can be considered important use areas for waterfowl, shorebirds, and species of marsh environments such as the marsh wren (*Cistothorus palustris*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), sora (*Porzana carolina*), red-winged blackbird (*Agelaius phoenicius*), tricolored blackbird (*Agelaius tricolor*), and western yellow-billed cuckoo (*Coccyzus americanus*). Playas, xerophytic scrub, creosote scrub, and Joshua tree woodlands each supported 2% of the average number of birds observed, while mesquite bosques, urban landscape, and halophytic scrub habitats supported an average of between 6 and 7% of all birds observed. Migratory birds contribute to resident populations during spring and fall causing local population fluctuations (AMEC Earth and Environmental 2006).

Mammals

A total of 30 mammal species have been documented on base. Some of the more common herbivores on base include the desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), and

white-tailed antelope squirrel (*Ammospermophilus leucurus*). Common carnivores include coyote (*Canis latrans*), desert kit fox (*Vulpes macrotis arsipis*), bobcat (*Lynx rufus*), and American badger (*Taxidea taxus*). Mammals suffer mortalities in the Mojave Desert from vehicular traffic, especially at night when animals are most active.

One major bat survey was conducted on base between 1994 and 1996 (Brown-Berry 1998). Seven large areas on base were surveyed by diurnal inspection of potential roosts for bats and guano, acoustic monitoring of echolocation signals, inspection of roosting and foraging areas with night vision equipment, and mist-netting of water sources and potential roost entrances. Five species were confirmed and include California myotis (*Myotis californicus*), western pipistrel (*Parastrellus hesperus*), hoary bat (*Lasiurus cinereus*), pallid bat (*Antrozous pallidus*), and Mexican free-tailed bat (*Tadarida brasiliensis*). At least one maternity roost was detected for California myotis; a pregnant canyon bat was also captured around the AFRL Fire Station pond. Bat activity occurred mostly around water sources but also in occupied and abandoned buildings and rock outcrops. The relatively limited distribution of bat fauna could be a result of the limited amount of appropriate roosting habitat available on the base.

2.3.4 Threatened and Endangered Species and Species of Concern

One federally threatened species, the desert tortoise *(Gopherus agassizii)*, is a year-round resident on Edwards AFB. Two federally endangered species, the California least tern *(Sternula antillarum browni)* and the southwestern willow flycatcher *(Empidonax traillii extimus)*, have been observed on Edwards AFB as migrants. Three other Edwards AFB wildlife species; the Mohave shoulderband snail *(Helminthoglypta greggi)*, tricolored blackbird *(Agelaius tricolor)*, and western pond turtle *(Actinemys marmorata);* were petitioned, resulting in findings that the petitioned listings may be warranted, and thus placed in a 12 month status review. Also, the Joshua tree *(Yucca brevifolia)* was petitioned for listing based on reduced habitat due to climate change, resulting in a finding that the petitioned listing may be warranted, and thus placed in a 12 month status review. Seventeen Birds of Concervation Concern have been identified on Edwards AFB.

Several state listed and sensitive species occur as well, including the state threatened Mohave ground squirrel (*Xerospermophilus mohavensis*), American peregrine falcon (Falco *peregrinus anatum*,), bald eagle (Haliaeetus leucocephalus,), willow flycatcher (*Empidonax trailii,)*, golden eagle (Aquila chrysaetos), Swainson's hawk (*Buteo swainsoni*,), and Townsend's big-eared bat (*Corynorhinus townsendii*,) (California Department of Fish and Wildlife 2013). California State species of concern and California Native Plant Society List IB species consist of approximately 40 species and include burrowing owl, mountain plover, desert cymopterus, Barstow woolly sunflower, and alkali mariposa lily (see Appendix Tables, *Species of Interest on Edwards AFB*). The locations of some of these observed populations and other species-at-risk are mapped in the Edwards AFB GIS; past observations and their distributions on Edwards AFB and within a 10-mile radius of the base are shown in Appendix Figures, *Sensitive Species within 10 miles of Edwards AFB.* A complete list of floral and faunal species of concern is included in the Appendix Tables, *Species of Interest on Edwards AFB.*

California Least Tern (Federally Endangered)

The federally endangered California least tern (*Sternula antillarum browni*) has been observed on Edwards, though fewer than five records were recorded between 2000 and 2005 from March through May. AMEC Earth and Environmental (2006) reported the species as a vagrant; least tern nesting is only known near coastal lagoons and estuaries. eBird data indicates the species is present May through August, with the first record occurring in 1999 and the last in June 2014 (eBird 2014). The species is managed indirectly through Piute Ponds habitat management.

Southwestern Willow Flycatcher (Federally Endangered)

The federal and state endangered southwestern willow flycatcher (*Empidonax traillii extimus*) may occur on Edwards. AMEC Earth and Environmental (2006) reported a state and federally endangered "willow flycatcher" as an "observed migrant not regularly seen" on base from March through November; eBird records indicate willow flycatchers are regularly seen from early May through September. The southwestern willow flycatcher is generally paler than other willow flycatcher subspecies, and also differs in morphology (Unit 1987 and 1997, Browning 1993). These differences require considerable experience and training to distinguish, and are not reliable characteristics for field identification (USFWS 2002). The species is managed indirectly through Piute Ponds habitat management.

Western Snowy Plover (Federally Threatened)

The Pacific Coast population of the western snowy plover (*Charadrius nivosus nivosus*) is listed as threatened by the USFWS. The Pacific Coast Distinct Population Segment is located in California, Oregon, Washington, and Mexico within 50 miles of the Pacific coast (USFWS 2012). Edwards is situated 53 miles east of the coast; therefore, Western snowy plovers on base are not federally protected. This species has no state protection. This species is most commonly observed in August (36% of observations), though records exist for most months of the year between 1978 through August 2014 (eBird 2014).

Desert Tortoise (Federally Threatened)

The desert tortoise (*Gopherus agassizii*) is considered an 'indicator' species with respect to the health of the desert ecosystem (Stebbins 2003). The Mojave population of the desert tortoise, a federal- and state-threatened species, is a large terrestrial, herbivorous reptile found in portions of the California, Arizona, Nevada, and Utah deserts. In general, desert tortoises are most active during the spring and early summer when annual plants are most common. However, tortoises may be found aboveground during other seasons depending on various climatic conditions (e.g., following thunderstorms and warmer winters). Desert tortoises spend much of their existence in burrows to escape extreme desert conditions. Initial biological studies on habitat and soil requirements, food preferences, maturity, reproduction, survivability, and mortality have been published for many years. Further information on the range, biology, and ecology of the desert tortoise can be found in Burge (1978), Burge and Bradley (1976), Hardenbrook and Hovik (1989), Luckenbach (1982), Weinstein et al. (1987), Germano (1992), Turner (1982), Brown and Turner (1982), Morin and Wilbur (1998), Schamberger and Turner (1986), (USFWS 2010), and (USFWS 2011).

The Mojave population of the desert tortoise was listed in response to habitat loss and degradation; increased predation by common ravens, feral dogs, and other natural predators; disease; and collection by humans. The tortoise was listed as threatened on April 2, 1990 (USFWS 1990). The USFWS designated critical habitat for the species in 1994 in all four states where it occurs (USFWS 1994). Designated critical habitat for the tortoise contains the biological and physical features essential to the species' conservation and include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats; these features are called the primary constituent elements of critical habitat (USFWS 2014). Designated critical habitat on Edwards AFB consists of about 65,569 acres located on the eastern and southeastern portion of the base and includes portions of the AFRL and the PIRA (see Appendix Figures, *Desert Tortoise Critical Habitat on Edwards AFB*). Critical habitat generally consists of desert scrub habitat comprised of creosote bush, Joshua trees, mesquite, and saltbush plants. Critical habitat for desert tortoise has not been revised since its original designation in 1994.

The USFWS published a recovery plan in June 1994 (USFWS 1994), a five year status review in 2010 (USFWS 2010), and a revised recovery plan in 2011 (USFWS 2011); the recovery plan is the basis and key strategy for conservation, recovery, and delisting of the desert tortoise.

Mohave Shoulderband Snail (Helminthoglypta (coyote) greggi) (12 Month Status Review)

The Mohave shoulderband snail (Helminthoglypta (coyote) greggi) may occur on Edwards AFB. USFWS was petitioned on January 31, 2014 to list this species. On April 4, 2014, the 90-day finding found that an action may be warranted (80 FR 19259, 2015) resulting in a 12 month status review. The 12 month status review is scheduled to be completed in FY17.

The species was first described by Willet in 1931. It was found in three general locations consisting of rock outcrops and talus slopes in the Rosamond Hills area in the western Mojave Desert. Survey data provided to the USFWS in 2014 reported 15 point locations where the Mohave shoulderband snail had been observed at Soledad Mountain (Curry 2014, pers. comm.). No Mohave shoulderband snails have been found on EAFB. USFWS developed a Draft Species Status Assessment, survey protocol, and initiated additional field surveys in January, 2017. Based on the Draft Species Status Assessment information, an Edwards AFB GIS analysis identified 11.5 acres of potential Mohave shoulderband habitat on a butte in the northwest corner of the base. Environmental Management funded a survey of this location in February 2017. A survey of these areas on 24 February 2017 did not locate any live snails or shells. The soil appears to be more granitic than that of Soledad Mountain.

Tricolored Blackbird (Agelaius tricolor) (12 Month Status Review)

Tricolored blackbirds (*Agelaius tricolor*) occur at Edwards AFB. USFWS was petitioned in 2004 to list this species. The 2006 ninety-day finding found that the petition did not present substantial scientific or commercial information (71 FR 70483, 2006). USFWS was petitioned again on February 3, 2015. On September 18, 2015, the 90-day review found that an action may be warranted (80 FR 23315, 2015) resulting in a 12 month status review. The 12 month status review is scheduled to be completed in FY18.

The tricolored blackbird is a medium-sized blackbird species in which males and females differ in plumage, size, and behavior. It is largely native to California, where more than 95 percent of the population occurs. Tricolored blackbirds are highly colonial and form the largest breeding colonies of any North American passerine (perching) bird species. Breeding colonies can attract thousands of birds to a single site. Tricolored blackbirds have three basic requirements in selecting a breeding colony site: (1) Open and accessible water; (2) a protective nesting substrate, such as flooded, spiny, or thorny vegetation; and (3) a suitable foraging area within a few kilometers of the nesting site to provide adequate food such as insects (71 FR 70483, 2006). Breeding colonies occurred at Branch and Piute Ponds, historically. Breeding tricolored blackbirds were observed at Branch Pond in 2014 and 2015. The Branch Pond colony was abandoned in late April, 2016.

Western Pond Turtle (Actinemys marmorata) (12 Month Status Review)

There has been one confirmed sighting of a western pond turtle at Piute Ponds; it is unclear how the turtle reached Piute Ponds. USFWS was petitioned on July 11, 2012 to list this species. On April 10 2015, USFWS found that an action may be warranted (80 FR 19259, 2015) resulting in a 12 month status review. The 12 month status review is scheduled to be completed in FY21.

Joshua Tree (Yucca brevifolia) (12 Month Status Review)

The Joshua tree (Yucca brevifolia) occurs on EAFB. USFWS was petitioned on September 29, 2015 to list this species. On September 14, 2016, USFWS found that an action may be warranted (81 FR 63160, 2016) resulting in a 12 month status review. The 12 month status review is scheduled to be completed in FY18. Edwards AFB has provided pertinent Joshua tree information to USFWS through AFCEC.

Mohave Ground Squirrel (State Threatened)

The Mohave ground squirrel (MGS, (*Xerospermophilus mohavensis*) is a medium-sized ground squirrel that feeds on a variety of foods, primarily leaves and seeds of forbs and shrubs. Studies on their diet, habitat requirements, biology, and lifestyle have been conducted by Bartholomew and Hudson (1996), Best (1995), Leitner et al. (1995), and Leitner and Leitner (1998). MGS has been observed in creosote bush scrub, saltbush scrub, desert sink scrub, and Joshua tree woodland habitat. The species is found most frequently in sandy, alluvial soils, but is also found in gravely, and occasionally rocky, soils. The range of MGS includes portions of Inyo, Kern, Los Angeles, and San Bernardino counties in the western Mojave Desert. The primary reasons for the decline of the MGS is destruction of habitat by conversion to urban and suburban neighborhoods, agriculture, military uses, past grazing by cattle and sheep, and off highway vehicle (OHV) use (Gustafson 1993).

The status of MGS has been reviewed several times under the auspices of the federal Endangered Species Act. Edwards AFB occupies 5.8% of the known geographic range of MGS. USFWS estimated that 62% of the MGS range is federally owned, and that about 57% of this land is managed, at least in part, for MGS habitat, including Edwards AFB. The MGS is widely distributed on base (see Appendix Figures, *Presence of Mohave Ground Squirrel on Edwards AFB*), and for the most part, is found in more remote undeveloped areas, primarily east, west, and south of Rogers Dry Lake and west of North Base, though the species likely occurs in additional locations.

Willow Flycatcher (State Endangered)

The willow flycatcher (*Empidonax traillii*) was state listed in 1991 and includes all subspecies including the federally endangered southwestern willow flycatcher (*E. t. extimus*, discussed above). Willow flycatchers are rare to locally uncommon, small migratory passerines that historically nested throughout California where the species' primary habitat, riparian willow thickets, occurred (Bombay 2003). The bird most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows (Serena 1982).

Willow flycatchers arrive from Central and South American wintering grounds in May and June, departing in August; transients are noted through mid-September (California Interagency Wildlife Task Group 2005). In the last five or six decades, the breeding populations have been lost from most of the lower elevation riparian areas in the state (Gaines 1974; Serena 1982). As many as 46 sites in the Sierra Nevada occupied by willow flycatchers since 1982 were vacant during their most recent survey (California National Diversity Database 1997, unpublished Forest Service Data). Other willow flycatcher subspecies (*E. t. brewsteri, and E. t. adastus*) are currently known to occupy less than 100 sites in riparian areas throughout central and northern California. The known breeding population is estimated at only 400 individuals (Schlorff 1990, Bombay 2003).

Although the willow flycatcher has a characteristic "fitz-bew" song that distinguishes it from other Empidonax (and other birds in general), willow flycatchers are not vocal at all times of the day or during all parts of the breeding season (Sogge 1997). The willow flycatcher is one of ten Empidonax flycatchers common in North America, all of which look very much alike. Like all Empidonax species, willow flycatchers are nondescript in appearance, making them difficult to see in dense vegetation (Bombay 2003).

The species has been reported on base as an uncommon migrant March through November (AMEC Earth and Environmental 2006); the latest record in eBird is 28 September 2014 at Piute Ponds (eBird 2014); eBird records indicate willow flycatchers are regularly seen from early May through September.

California Species of Concern

Flora

In the past, the base has conducted surveys to locate and map the distribution of California Native Plant Society (CNPS) List 1B species; natural resource personnel also record and map List 2 through List 4 species when observed. A combination of Lists 1, 2, and 4 plant species found on base are located in Appendix Tables, *Species of Interest on Edwards AFB*. Extensive biological surveys and studies have been conducted for three plant species on base. These include the Barstow woolly sunflower, alkali mariposa lily, and desert cymopterus. In the Appendix Figures, *Sensitive Species within 10 miles of Edwards AFB*, it shows the known on-base locations of the CNPS List 1B through List 4 sensitive plants, commonly referred to as CDFW species of concern. These plant populations vary from a few individuals to thousands of individuals within a concentrated area. However, dry years do suppress seed germination resulting in variability in the numbers of plants.

Desert cymopterus populations are found in various places on base; however, small numbers do occur around Main Base away from the developed areas. Edwards AFB has about 54 documented populations of desert cymopterus. These are mostly scattered over 3,384 acres primarily on the PIRA (see Appendix Figures, *Sensitive Species within 10 Miles of Edwards AFB*).

Surveys were conducted for the Barstow woolly sunflower in 1995 on Edwards AFB. These surveys were conducted at three previously known populations and in 47 areas of potential habitat. Surveys detected 98,760 Barstow woolly sunflowers covering 37 acres; many populations were less than 0.06 acre. Ninety-five percent of the populations were found in halophytic phase saltbush scrub, with one population in Joshua tree woodland habitat with halophytic phase saltbush scrub, understory. The most common azonal habitat, claypan, was reported in 85 percent of the survey areas where Barstow woolly sunflower was found. Seventy-five percent of the populations were found in association with alluvial plain geomorphology. Clay and silt soil components were dominant elements in the soil textures.

The alkali mariposa lily blooms as a pink-flower in the drainage areas around the dry lakebeds on base. Surveys for this species were conducted along with other sensitive plant studies. The plants are large and are relatively widespread; germination and flowering are based on rainfall. About 162,000 plants on 63,780 acres have been documented on Edwards AFB (see Appendix Figures, *Sensitive Species within 10 Miles of Edwards AFB*). Populations vary from solitary individuals to large numbers spread out over more than 500 acres.

Eriastrum rosamondense is an annual herb in the Polemoniaceae family that is endemic to a very small area between Rosamond and Lancaster in Los Angeles County. It was recently described by Gowen (2013), and is therefore not included in The Jepson Manual (Patterson 1993). *E. rosamondense* occurs on low hummocks in alkali flats and scalds throughout chenopod scrub that is adjacent to claypans; often on sandy and silty loam soil, and is found near the southwestern boundary of Edwards AFB, both on and off base. Based on the limited information available, *E. rosamondense* was recommended for the rarest status category CNPS Rare Plant Rank 1B.1 and NatureServe and California Natural Diversity Database G1/S1.

Fauna

Burrowing Owls. The burrowing owl is protected under the MBTA. On Edwards AFB, burrowing owls have been observed in colonies on Main Base near the curation facility and museum, at the landfill borrow pit, along the main runway, in the NASA area, as well as other more remote areas such as North Gate, Piute Ponds, and the PIRA where burrows, mining pits or open pipes are present. The largest, densest, and most prominent population occurs between Rosamond and Lancaster Boulevards, adjacent to the Curation Facility (Building 5296) and the golf course. Environmental Management has fenced this area and installed signs to delineate a Burrowing Owl Conservation Area of approximately 184 acres (Figure Burrowing Owl Conservation Area.). This management area has been rezoned as Forest and Wildlife to prevent disturbance to burrows, primarily from OHV use, and ensure the continued presence of vegetation and prey adjacent to the golf course. On Edwards AFB, the potential threat is loss of habitat for nesting, roosting, and sheltering. Burrowing owls depend on a network of small mammal burrows for their survival. Burrowing owls adapt to development and are often found using street drains, open pipes, and rodent burrows in landscape areas as roosting and nesting sites. In the Main Base area, construction projects and pest management activities (e.g., control of ground squirrels and filling in their burrows) may result in a loss of prey and habitat. Occasionally, fire department personnel have entered the Burrowing Owl Conservation Area to suppress spot fires from the annual 4th of July fireworks display.

Western Pond Turtle. One siting of a western pond turtle was reported at Piute Ponds in July of 2015. The western pond turtle is classified as a species of special concern with the state of California and is under federal review for listing by the USFWS (80 FR 19259, 2015). This species will be managed in accordance with other aspects of the INRMP including the Piute Ponds Management Plan.

Tricolored Blackbirds. Tricolored blackbirds (*Agelaius tricolor*) are a California state candidate species.

Other California Species of Concern. Species documented on base include: Sage sparrow, yellow-breasted chat, yellow warbler, virginia's warbler, bank swallow, purple martin, horned lark, gray vireo, loggerhead shrike, vermillion flycatcher, vaux's swift, short-eared owl, long-eared owl, black tern, gull-billed terns, California gull, laughing gull, long-billed curlew, mountain plover, prairie falcon, American peregrine falcon, merlin, golden eagle, ferruginous hawk, cooper's hawk, sharp- shinned hawk, northern harrier, bald eagle, white-tailed kite, osprey, white-faced ibis, least bittern, double-crested cormorant, American white pelican, common loon, and fulvous whistling duck (AMEC Earth and Environmental 2006). Management of these species on Edwards AFB would be minimal due to their migratory status, or they will be managed in accordance with other aspects of the INRMP, such as the Piute Ponds management..

2.3.5 Wetlands and Floodplains

Wetlands, as defined by Executive Order 11990 *Protection of Wetlands*, and AFI 32-7064, are "*areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.*"

Aquatic habitats on Edwards AFB consist of natural and manmade ponds and their associated wetland areas. These habitats are inundated at a sufficient frequency to support aquatic life and vegetation which in turn supports numerous bird species and invertebrates such as freshwater shrimp (Eubranchiopod). Examples on Edwards AFB of aquatic habitats are Piute Ponds Complex and Branch Memorial Park Pond.

Ephemeral systems (natural and modified) including clay pans, playas (lakebeds), storm water and evaporation ponds, washes and seeps are only intermittently wet depending on the infrequent and minimal rainfall that occurs in the Mojave Desert. Documentation of the vegetation found in clay pans and washes

can be found in field notes included as part of the Lichvar and Sprecher report (1996). Invertebrates such as freshwater shrimp can be found in many of the ephemeral systems which contain pools after flooding (The Branchiopod Research Group 1993; Brostoff et al. 2005; Miller et al. 1999; Perez and Donn 2009). Ephemeral systems found on Edwards AFB are not jurisdictional wetlands because they do not have hydrophytic plant species or a dominance of hydric soil types (Cowardin et al. 1979; USACOE 2008 and 2015; USDA-NRCS 1996).

Piute Ponds Complex

The Piute Ponds Complex (see picture below titled *Piute Ponds Complex, October 2013*), located in the southwestern corner of Edwards AFB, is bounded by the western base boundary, Avenue E to the south, and 50th Street East to the east. It contains the largest body of perennial surface water on Edwards AFB and is the largest freshwater marsh in Los Angeles County. The Piute Ponds Complex consists of lower Amargosa Creek, ponds, marshes, wetland meadows, low sand dunes, small clay pans, and Rosamond Dry Lake. The upland and wetland area (excluding Rosamond Dry Lake) of the Piute Complex encompasses approximately 5,614 acres (see Appendix Figures, *Water Management Areas within Piute Ponds Complex*). Of the 5,614 acres, approximately 1,410 acres of ponds, wetlands, wet meadows, and clay pans are in an area where the water flow/levels can be managed (see Appendix Figures, *Water Management Areas within Piute Ponds Complex*). This is considered the Water Management Area (WMA). Other seasonally flooded wetlands exist around the active WMA and are fed from natural ephemeral surface/storm water as it flows to the lakebed. The Rosamond Dry Lake portion of the Piute Ponds Complex is approximately 13,800 acres. Major vegetative components within the Piute Ponds Complex are:

- Floating and Emergent Aquatic Vegetation: exists within and alongside ponds, marshes, and pans such as bulrush (Scirpus sp.) and cattails (Typha sp.).
- Vegetation: occurs along dike edges, beach/island areas within the ponds, and interspersed in meadow areas.
- Wetland Meadow: exists next to ponds, marshes, and pans.
- Alkali Sink: around the wetland areas extending towards Rosamond Dry Lake.
- Desert Scrub with Multiple Distinct Associations: around the alkali sink in drier desert/uplands.
- Riparian: occurs along Clod Creek, Goose Sluice, Avenue C, and dikes; consists of Fremont's cottonwood (Populus sp.), salt cedar (Tamarisk sp.), and willows (Salix sp.) species.
- Sensitive Plant Species: primarily Alkali Mariposa Lily (*Calochortus striatus*) which is within the alkali sink and wetland meadow habitat.

Animals found within the complex include avian species, raccoons (*Procyon lotor*), muskrats (*Ondatra zibethicus*), and non-native African clawed frogs (*Xenopus laevis*).

In the past, the Piute Ponds Complex was supported entirely by surface water flow and artesian springs in a different configuration than what exists now. At this time, the primary annual water flow is from D14, which is supplemented periodically by rainfall and surface water flow from Amargosa Creek, Little Rock Creek, and the Cottonwood Creek system (North State Resources, Inc. 2012). The Piute Ponds Complex is part of the Rosamond watershed (French et al. 2004). Surface water begins to flow within the watershed when rainfall reaches approximately 0.60 inches (North State Resources, Inc. 2012). When this occurs, a major amount of surface flow from the watershed enters the Piute Complex (North State Resources, Inc. 2012). This amount of flow each of four days can dwarf the amount of recycled water supplied to the area for the same time period. With this amount of flow, much of Rosamond Dry Lake will be covered with water. The Piute Complex and the connecting washes/creeks are major features within the hydrologic unit

of Edwards AFB. Much of the natural storm flow has been diverted by the surrounding cities. It is currently unknown how much flooding Rosamond Lake requires for maintaining a healthy and stable pond and wetland environment. Due to the importance and complexity of the Piute Ponds Complex area, a specific component plan has been developed (see Tab 1, *Piute Ponds Complex Management Plan*).

Piute Ponds Complex, October 2013

Branch Memorial Park Pond

Branch Memorial Park Pond (Branch Pond) is a manmade, 6 acre pond established in 1961 to honor Major General Irving Branch after his untimely death in a fighter plane crash while he was Commander of Edwards AFB (Air Force Flight Test Center History Office 2001). The primary purpose of the pond is to fulfill a major quality of life aspect for base residents and personnel (see picture below titled *Branch Memorial Park Pond, August 2012*).

The pond is maintained at various water levels year-round to support nesting habitat in the spring and fish stocking mid-summer; depth ranges from approximately 2 feet to 12 feet. Well C-1 provides water for the pond. This well serves not only the pond but the South Gate access point, restrooms (inoperable since 2013), and a hydrant located adjacent to Branch Road. The pond can also be filled from the south base aboveground red and white water tank; however, the tank is currently inoperable.

The bank of the pond consists of open space, trees (Fremont's cottonwood, mesquite, sandbar willow, mule-fat), and native shrubs (saltbush). Emergent vegetation within the pond is primarily cattail with some bulrush. The pond is managed as a fish pond and supports a stocked fish population (e.g. largemouth bass, catfish, bluegill, and trout). Wildlife uses the vegetation in and around the pond for forage, roosting, cover, and breeding year round and during migration. Tricolored blackbirds have been observed nesting at Branch

Pond. Volunteers with the Tricolored Blackbird Working Group accomplish the statewide Tricolored Blackbird Survey regularly and include Branch Pond.

Northern Harriers have been observed breeding at the pond. Over 50 bird species have been sighted at thepond such as Cooper's hawk, pied-billed grebe, California quail, red-breasted sap sucker, several other woodpecker species, various swallow species, savannah sparrow, osprey, egret, great blue heron, various species of ducks, and American kestrel.

Branch Memorial Park Pond, August 2012

Ephemeral Wash Systems

The Delineation and Characterization of "Waters of the United States" (Lichvar et al. 1996), is the most comprehensive study accomplished to date on the aquatic landscape at Edwards AFB. This report mapped 351 separate dry washes totaling 487 miles (see picture below titled *Mesquite Bosque with Great Basin Sage*).

Mesquite Bosque with Great Basin Sage

Modified Wash Systems

Many of the wash systems within the developed areas are modified. This creates diversion of surface flow from the main portion of the hydrologic unit. Many off-base wash systems have been modified in order to divert them from urban and rural development. These types of wash systems create a different management challenge.

Clay Pans, Playas, Lakebeds

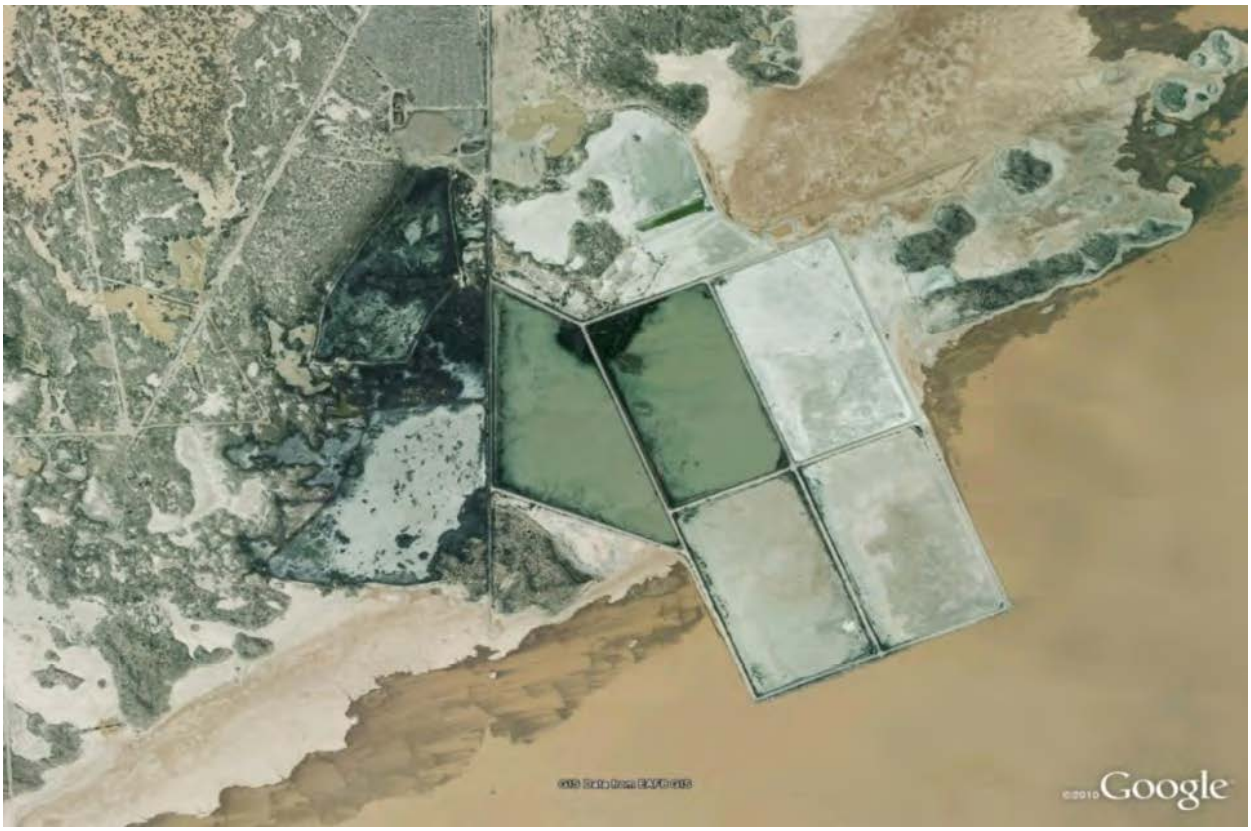
These areas reflect most of the flood prone areas on the base. This clay pan and dune system (including the lakebeds) is a notable resource: Nowhere else in the Mojave Desert is there an ecosystem with the unusual combination of geomorphic and biological conditions that exist in this system (Brostoff et al. 2005) (See picures below labeled *Example of clay pan/low sand dune area, November 2013 and Example of clay pan/low sand dune area, April 2014*). Perhaps the most related biological conditions are those that exist in the Kalahari Desert of South Africa and Botswana (Brostoff et al. 2005).

Example of clay pan/low sand dune area, November 2013

Example of clay pan/low sand dune area, April 2014

Evaporation Pond and Storm Water Ponds

The South Base Evaporation Ponds are located on the southwest portion and western edges of Rogers Lake and consist of five adjacent ponds, approximately 50 acres each, for a total of 250 acres (see picture below titled *Old and current South Base WWTP evaporation ponds*). The South Base Evaporation Ponds once hosted wetland vegetation and were used heavily by waterfowl, shorebirds, land birds, migrants, and residents throughout the year. The ponds were fed by secondary treated effluent and were a popular birding area. In the mid- 1990s the new tertiary treatment plant was constructed diverting most of the water from the ponds to reuse at the golf course for irrigation. Currently, the ponds typically only receive recycled water from the plant during November to January when water requirements at the golf course are low. Approximately 400,000 gallons of water a day are produced at the tertiary treatment plant. An additional 105 acres of relict sewage ponds exist to the south of the South Base Evaporation Ponds and are no longer used. These old ponds were used during the early years of Edwards AFB before effluent was treated. These were used for hunting at one time and remnants of old blinds may still be detected.



Old and current South Base WWTP evaporation ponds

The Air Force Research Laboratory (AFRL) Evaporation Ponds are currently located west of Downfall Road and consist of four ponds, approximately two acres each (see picture below titled *Old and current WWTP evaporations ponds at AFRL*). The AFRL treatment plant supplies secondary treated effluent. This plant was constructed in the mid-1990s. Approximately one acre of ponding occurs within one of the ponds at a time. The previous evaporation ponds consisted of six ponds located linearly within a wash approximately 500 feet to the northwest of the current ponds. The ponds ranged from 0.50 to 0.90 acres. The old ponds were frequently full and abundant with wetland vegetation and used heavily by various birds both resident and migrant.

Old and current WWTP evaporations ponds at AFRL

Various storm water ponds have been in use throughout the base such as those on the flightline and AFRL. The number of storm water ponds is unknown.

Seeps from Unknown Sources

Several seeps have been reported. One seep known to exist based on vegetation, is near the west boundary, one mile north of Rosamond Boulevard, west of the "Division" pole line. Other seeps may exist throughout the base such as at AFRL and within housing, but have not been verified or delineated.

Floodplains

AFI 32-7064 and Executive Order 11988 direct the Air Force to provide leadership in dealing appropriately with floodplains to preserve the natural and beneficial values of floodplains. They further state "Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands, and facilities; (2) providing Federally undertaken, financed, or assisted construction and

improvement; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

Floodplains, as defined by Executive Order 11988 Floodplain Management and AFI 32-7064, are lowland and relatively flat areas adjoining inland and coastal waters that are subject to a one percent or greater chance of flooding in any given year. The 100-year floodplains (one percent or greater chance of flooding) for Rogers Dry Lake, Rosamond Dry Lake, Mojave Creek, and AFRL (see Appendix Figures, *Delineated 100-year Floodplains on Edwards AFB*) have been delineated (French et al. 2003 and 2004: Miller and French 2004; French and Miller 2009). The Mojave Creek delineation is currently not considered to be accurate and will be reaccomplished in FY17 as part of the Management, Wetlands/Floodplain project.

Flood prone areas (see Appendix Figures, *Flood Prone Areas on Edwards AFB*) have also been identified on Edwards AFB (Meyer et al. 2002). The flood prone areas include washes and clay pans adjacent to and connecting the lakebeds, such as those between Rosamond Dry Lake and Buckhorn Dry Lake and the areas between Buckhorn Dry Lake and Rogers Dry Lake. These are areas that have not been included in the 100-year floodplain delineations. Flood events that move across these landscape features fill the defined channels, the clay pans and merge into "channels" thousands of feet to miles wide. This type of flow is common during major storm events.

Rosamond Dry Lake and Rogers Dry Lake are inundated with natural storm flow during wet winters (about every five years). The Rogers Dry Lake drainage pattern is toward the southern end of the lake. Portions of the lakebed can remain inundated until late summer due to the low permeability of the lakebed soils and slow evaporation rate if sufficient surface flow is received. Water on the lakebed contains suspended sediment scoured from beds and banks of channels and tributary to Rogers Dry Lake and from erosion of the lakebed surface (Blodgett and Williams 1992). For both lakebeds, suspended sediment is generated by erosion of the lakebed when the wind causes small waves. The sediment helps fill surface irregularities when the suspended material is deposited on the lakebed as water evaporates. Inundation combined with wind moves sediment across the playa, filling surface cracking and fissures. A study of the geomorphology of the dry lakebeds concluded that periodic flooding of the playas was critical for maintenance of smooth, hard pavement or lakebed surface and appears to be a prerequisite for maintaining a hard, compact lakebed surface (Motts 1970).

Mojave Creek is a relatively well-defined drainage course that connects the approximately 200-square mile Mojave-Soledad Mountain Drainage Area to Rogers Dry Lake. The drainage channel extends through residential areas and parallels Lancaster Boulevard south of the intersection with Rosamond Boulevard. The flow fans out near Rogers Dry Lake creating flood prone areas between Lancaster Boulevard and the lakebed.

2.3.6 Other Natural Resource Information

Edwards AFB is looking for opportunities to improve energy efficiencies. Renewable energy comes in many forms, the most common of which are wind and solar. On AF installations, wind power has taken a back seat to solar energy based on the need to maintain a lower profile due to flying missions; Edwards AFB is no exception. However, in the region surrounding Edwards AFB, developers strive to tap into both the abundant wind and solar generation potentials. Though solar energy development avoids the dangers presented by wind towers in the vicinity of flying operations; they are not free of problems that can impact wildlife and conflict with the mission.

Grazing has not been allowed on Edwards AFB for over 50 years although unauthorized sheep grazing took place occasionally before the base boundary was completely fenced in the late 1990s. Portions of Edwards

AFB are still recovering from past overgrazing practices. In terms of biodiversity and impacts to native plants, grazing in the Mojave Desert has resulted in a change from native annual wildflowers to nonnative exotic weeds. In general, grazing in the desert results in nearly permanent degradation that results in the replacement of a high biodiversity of native annuals with a high biomass of basically three species of introduced weedy annuals, redstem filaree (*Erodium sp*.), cheat grass (*Bromus tectorum*), and red brome (*Bromus rubens*). When grazing is combined with OHV use, it increases loss of native annual diversity and reduces shrub cover. Annual vegetation on Edwards AFB has not recovered from past unauthorized grazing disturbance; however, it has not degraded further, while much of the adjacent western Mojave Desert continues to degrade.

2.4 Mission Impacts on Natural Resources

2.4.1 Natural Resource Constraints to Mission and Mission Planning

Natural Resources are not considered to be a major constraint to the mission at Edwards AFB, and are incorporated with mission capabilities. When Rosamond, Buckhorn, and Rogers Dry Lakes flood, mission operations are delayed until the lakebed surface dries out. However, flooding is essential to the long-term sustainability of the lakebed, as flooding is the only process that can keep the lakebed surfaces smooth and available for aircraft operational mission uses year-round.

Migratory birds flying through the base, especially on the flightline has the potential to delay aircraft takeoff and landings. The base incorporates the use of a Bird Air Strike Hazard Plan and modifies their flights as necessary. Piute Ponds, though it supports numerous migratory birds, also serves as a dependable water source to flood Rosamond Dry Lake if the lakebed deteriorates significantly.

Since the desert tortoise federal listing nearly 25 years ago, not one project on Edwards AFB has been stopped or halted. In 2014, Edwards AFB incorporated training and protection measures from 23 USFWS biological opinions which protected both the species and the missioninto one basewide biological opinion (BO) titled *Biological Opinion for Operations and Activities at Edwards Air Force Base, California* (USFWS 2014).

The base has highly erodible soils which could be seen as a constraint but if kept healthy, these soils have no impact on the mission. Rogers Dry Lake is the only area which has been destabilized due to surface water diversion, primarily from off-base encroachment and some lakebed use by mission and recreational pursuits. Even this has not prevented missions from being accomplished. However, this could become a constraint to the mission.

Edwards AFB takes operational advantage of its resources to pursue test and evaluation of important operational missions. Not every foot of Edwards AFB is available to every possible type of mission, but every foot of Edwards AFB is available for appropriate missions for the particular area. There are open areas, ridge lines, lakebed surfaces, shrubs, trees, and water all which can be used and incorporated into a component of an operational mission.

2.4.2 Land Use

Edwards FB lands can be classified using three land categories: improved, semi-improved, and unimproved (see Appendix Figures, *Land Use Designations*). Of the total area encompassed by the base, 92.5 percent (284,452 acres) is unimproved land. Semi-improved lands account for about 4.5 percent (13,838 acres) of the total, and improved land accounts for about 3.0 percent (9,225 acres).

Improved lands: This classification includes lands occupied by buildings and other permanent structures as well as lawns and landscape plantings on which personnel annually plan and perform intensive maintenance activities. Improved lands include the cantonment area, athletic areas, golf course, and housing areas. Grass in these areas is typically maintained at a height of two to four inches during the growing season. Vegetation on improved lands requires maintenance to ensure survival in the local arid climate.

Semi-improved lands: This classification includes lands where periodic maintenance is performed primarily for operations such as erosion and dust control, bird control, and visual clear zones. Semi-improved lands include areas adjacent to taxiways and aprons, runway clear zones, lateral safety zones, rifle and pistol ranges, weapons firing and bombing ranges (targets and target areas), picnic areas, ammunition storage areas, antennae facilities, and golf course roughs. Semi-improved areas are mowed less often than the maintained turf grass on improved lands.

Unimproved lands: Unimproved lands are areas not classified as improved or semi-improved lands. Unimproved lands include forest lands, croplands and grazing lands, and wetlands. The majority of lands at Edwards AFB are unimproved. These lands are not scheduled for mowing, irrigation, pruning, or insect control. Unimproved lands that occur on base include ponds and any areas where natural vegetation are allowed to grow unimpeded by maintenance activities.

Natural resources issues related to land management on Edwards AFB include maintaining compatible land uses and reducing ground disturbance and erosion, which combats problems related to fugitive dust and loss of habitat.

2.4.3 Current Major Impacts

Mission test and training activities at Edwards AFB have the potential to impact natural resources. Most of the aircraft testing takes place at high altitudes, in designated spin zone test areas, and low- level and supersonic test corridors; these test activities produce few ground impacts on natural resources. Mission test activities associated with impacts to natural resources include: aircraft test flights that utilize the runways on the dry lakebeds, inert bomb scoring, release of flares from aircraft, laser testing, live-fire from aircraft, cargo drops, static testing of rocket motors/engines at AFRL, ground support activities that assist with the flying mission of the AF, training operations, grading existing and new targets and roads, building demolition and construction, installation of utility lines and corridors, landscape maintenance activities, aircraft crashes and clean-up, fires, and OHV travel. Importantly, large areas of the base remain relatively undisturbed, undeveloped, and relatively untouched by the current mission allowing for conservation of natural resources.

The most pressing mission impact to natural resources at present is Rogers Lakebed. Rogers Lakebed is being impacted directly by operational missions, recreational activities (e.g. land speed races, land sailing), and indirectly from surface water diversion by surrounding communities. It is unknown if Rogers Lakebed's deteriorating condition can be reversed. Before embarking upon a resource intensive venture the AF needs to decide what the desired end state for Rogers Lakebed should be. If visibility and aircraft landing missions are important to sustain for future military activities, then immediate and substantial steps may be required.

The condition of the lakebeds, particularly Rogers, has been a subject of continued concern (Motts 1970; DMA 1988; USGS 1998; Orme 2002). These reports are specific to Edwards AFB and some had borings taken of the lakebed surfaces and sub-surfaces. These measurements may be repeatable and could provide insight into the trajectory of lakebed health.

In the early 1990s U.S. Geological Survey (USGS) was contracted to study ground water subsidence due to a large fissure which opened up on the southern portion of the lakebed. Much attention was focused on

the ground water subsidence issue and measurements on the southern end of the lakebed indicated a 3 foot drop in that area (USGS 1998). Polygonal cracks were noted during this study however the focus was on subsidence fissuring.

Both Motts (1970) and the USGS (1998) were contracted in order to respond to concerns about cracking and dust issues on the lakebeds. Once the studies were completed, no long-term conclusions as to the future stability of the lakebeds, mission impacts to the natural resource, or recommended actions to correct issues were made.

It is recognized that lakebed surfaces change over time, sometimes long term, sometimes from year to year. The following quotes from Motts (1970) document the changing landscape.

> "*In the early 1900s it was noted that both Rosamond and Rogers Lakebeds had puffy surfaces when potentiometric surface was higher and large amounts of capillary discharge occurred."*
>
> *"In 1956 both lakebeds were described as having, for the most part, hard compact surfaces with Rogers classified as the "type example" of the hard clay pan class of playas."*
>
> *"In the late 1960s the surfaces were described as a smooth, hard ground where the potentiometric surface has dropped resulting in small amounts of capillary discharge."*

Biological components in conjunction with abiotic features and events operate to provide healthy lakebeds able to withstand both manmade and natural perturbations. A biological soil crust made up of algae, filamentous cyanobacteria, and other living organisms overlay the surface of some playas. This crust binds with the soil grains producing a matrix which holds and stabilizes the surface eliminating or decreasing soil erosion. When left unbroken, this biological crust can survive extremes of temperature and long dry periods. Even so, the crust is fragile and subject to elimination by wind and water erosion. Driving, landing aircraft, and even walking will break an intact crust making it vulnerable to wind removal. When this occurs in small areas such as a footstep or a bicycle tire track, little long term damage is expected. The natural regeneration which takes place when the rains come can cross those narrow impact areas and allow the biological organisms to re-establish the crust matrix. Large disturbances which break the crust structure, allows wide swaths of material to be removed by the winds. This type of impact destabilizes the biotic crusts and combined with high winds leads to large dust storms. Once this occurs, the impact to natural resources can expand, burying adjacent crust areas which destabilize these areas also (Belnap 2013). Large crust disturbance is not easily corrected and requires substantial flooding from surface flow to overcome impacts.

Substantial water must be in contact with the clay surfaces long enough to transform them into a semi-liquid state which can then allow the liquefied clay to resurface the lakebed and move the biological components of the healthy portions of the crust to other areas so there is opportunity to heal from mission impacts (Neal 1968, Motts 1970). Personal observations over the last 25 years have been made of flood waters causing the surface of playas and clay pans to develop a semi-liquid state.

Observations from the 1990s to 2014 suggest that although the lakebed may have water standing on it for a few weeks this may end up causing more damage by creating very thin mud curls. These are easily detached from the surface by winds which then create massive dust storms. The surface of lakebeds needs adequate storm water and wind action to fill in the cracks resulting in a smooth surface for future mission operations and overall health of the lakebed surface. The issue seems to be one of water volume, wind, and duration. It is unknown how much water the lakebeds were receiving when Motts (1970) discussed lakebed healing. It is known that a lot of surface flow has been diverted from the lakebeds, particularly Rogers Dry Lake, since the 1970s.

Review of aerial photography from Google Earth, 1994 to 2012, reveals an increase in the number of polygonal cracks on Rogers Lake. Out of five southern runways, currently only one can be used. In March 2014, increased polygonal cracking occurred on the northwest active lakebed runway and sand dunes appeared on the lakebed. The small sand dunes had not been documented as having occurred historically on the lakebed. These issues indicate an unhealthy desert ecosystem and changing lakebed surface. The impacts do not affect the lakebed surface alone but also affect the quality of the air. The indirect impacts of the blowing dust will be felt in the eastern plant communities over time as the lakebed surface becomes more and more unstable. As this occurs, the biotic crusts in those plant communities are buried causing damage to those habitats in addition to the ongoing damage to the lakebed habitats, a potential downward spiral.

Encroachment and Mission Impacts

In the face of increasing encroachment on installation boundaries, the DoD developed the Readiness and Environmental Protection Integration (REPI) Program. Launched in 2004, REPI is part of the DoD Sustainable Ranges Initiative, a multilevel effort designed to ensure the future use of military training land by addressing issues of potential encroachment on military testing and training. There are five REPI target acquisition areas associated with the joint Air Force/Navy Program and the Air Force Only Program; these include the Black Mountain Supersonic Corridor, Rough One, Cords Road, Hawes Field Operating Area, and the PIRA (see Appendix Figures, *Edwards AFB REPI Project Areas*). The purchase of lands under the REPI Program establishes conservation easements and ensures protection for listed and sensitive species and their habitat. This effort is expected to maintain key wildlife corridors for movement of species and heterogeneity among species. This program emphasizes the need for installations to look outside the boundary to work constructively and creatively with communities and other stakeholders. Critical support is needed for the REPI program at Edwards AFB. The program aims to:

a. Foster partnerships with nongovernment organizations;
b. Preserve test and training space;
c. Provide funding;
d. Acquire conservation easements from willing sellers;
e. Preserve high-value habitat for listed and sensitive species; and
f. Limit incompatible development that threatens to jeopardize military readiness.

Encroachment and Wildlife Habitat Impacts

Urban and commercial development and associated activities reduce the biodiversity of existing plant and wildlife communities, directly impact sensitive plant populations, and threatening the livelihood of the desert tortoise.

Urban encroachment indirectly impacts the mission by degrading habitat adjacent to the base boundary. Loss of habitat surrounding the base could result in an increase in the value of base lands to conservation, biodiversity, and species of special concern. When this occurs, sensitive, threatened, or endangered species may utilize the base as a refuge or travel corridor and establish residency in suitable habitat. In turn, the mission could be impacted by increasingly restrictive requirements due to the need to protect sensitive species and their current occupied habitat. The AF strives to avoid disturbing species and their habitats in and around operating areas, including but not limited to, test/training weapons ranges, airlift drop zones, and spin zones.

Encroachment and Renewable Energy Development

The drive to reduce potential environmental impacts and the effects of climate change along with the rising costs of power and reduced budgets have forced DoD leadership to look at alternative sources of energy.

In 2010, DoD and the U.S. Department of Energy signed a Memorandum of Understanding (MOU) to cooperate in the development of renewable energy technologies. The AF developed the 2010 AF Energy Plan which states, "*Where possible, the AF will develop and utilize renewable and alternative energy to reduce greenhouse gas emissions*." As a result, installations are increasingly looking for opportunities and searching for the right technologies to improve energy efficiencies while minimizing mission impacts.

Renewable energy comes in many forms, the most common of which are wind and solar power plants. On AF installations, wind power has taken a back seat to solar energy based on the need to maintain a lower profile for flying missions. Solar panels avoid the dangers presented by wind towers in the vicinity of flying operations; however, loss of wildlife habitat and cultural resources can occur when areas are graded before the installation of solar voltaic panels.

Both wind and solar facilities near the base boundary can impact the radar test mission at Edwards AFB. Solar power would seem to represent a minimal impact to the mission and on an operational flying installation that would be true in most cases. However, at an installation that operates aircraft/aircraft systems that are in various stages of development, solar power can present some issues. Aside from the mostly minor problem of panel reflectivity, the degree depending on the type of solar panel installed, the primary problem is radar clutter. When performing developmental tests on aircraft radar systems, the intent is to validate the parameters of these systems to ensure they meet required design specifications. In this scenario, the area where the flight test is being conducted is effectively a laboratory where the environment should be as sterile and devoid of ground clutter as possible. Though this type of aircraft radar testing is routinely done off-base in areas such as the Cords Road radar flight test path, these systems are also tested over multiple locations across the installation. Studies are in-progress to specifically quantify the impacts, but general radar systems knowledge enables some preliminary conclusions to be drawn. The base tests synthetic aperture radar (SAR) ground mapping performance on B-1, B-2, F-16, F-22, F-35 and Global Hawk aircraft using reflectors and targets that are located both on and off-base. On base, reflector arrays are located on Rosamond Dry Lake, the Farm Drop Zone, and the east range. In addition the base also uses the AFTC museum aircraft and the reflectors near them. If, for example, solar arrays were constructed near these reflector arrays, there could be potential negative impacts to the ability to test and evaluate the performance of the SAR mapping. This could be due to the reflections of the physical structures as well as the lack of returns due to the reflective nature of the surface versus the diffuse desert background. For example, the lakebeds appear black on maps compared to desert background since there is little energy reflected back to the radar.

The development of renewable energy and other commercial sites have the potential to further constrain the test mission. For example, the PIRA at the southern and eastern boundaries of the base is Edwards primary weapons test area with targets that support both live and inert munitions. In 2005, a critical target area was expanded for use by fully armed, live weapons with warheads in the 500-1,000 lb-class. Such weapons require larger safety zones. Further, newer air-to-ground munitions (missiles, guided munitions, glide-bombs) now have extended ranges that expand the calculated safety zone for test execution. Renewable energy development along the base boundary has the potential to compromise those established and extended safety zones and limit the capabilities of the mission. In addition to the weapons and munitions aspect, aircraft operations on the PIRA include high speed, low altitude flight that would be incompatible with the towers required for some solar plants and the high towers typically associated with wind development. Another area located along Edwards AFB's southern boundary is the Farm Drop Zone which is utilized for test and training air drops of equipment, pallets and personnel; these air drops often stray significantly off target. This could easily result in damage to solar panels and wind towers. Other flight test efforts, such as the X-37 research vehicle tested in 2006, are often confined to a limited maneuver area because of a safety restriction to contain the potential landing zone within the base boundaries.

2.4.4 Potential Future Impacts

The Environmental Impact Assessment Program (EIAP) ensures proper coordination and planning of on-base projects. As required by AFI 32-7061, the preparation and submission of a work request Form 332, Dig Permit, or AF Form 813 triggers the EIAP process. The 412 CEG/CEV staff review Work Request Form 332s and Dig Permits for each proposed project to determine what level of environmental analysis and documentation is required. Project plans and EIAP documentation are reviewed to ensure compliance with the Endangered Species Act and other natural resources regulations. Member organizations of the Environment Safety and Occupational Health Council (ESOHC) review all projects on Edwards AFB to ensure that all environmental impacts are identified and considered early in the project planning process and that appropriate mitigations are developed.

Management of the Environmental Restoration Program (ERP) at Edwards AFB is the responsibility of the Air Force Civil Engineer Center (AFCEC). The DOD established the ERP in 1975 to provide guidance and funding for the investigation and remediation of hazardous waste sites caused by historical disposal activities at military installations. The fundamental goal of the restoration program is to protect human health and the environment. The primary federal laws addressing ERP activities are the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601, et seq.) and the Superfund Amendments and Reauthorization Act (SARA) (Public Law 99-499, 42 U.S.C. 11001, et seq.). CERCLA, passed in 1980, requires the cleanup, or remediation, of hazardous waste sites created by historical disposal practices. The responsibility for cleanup of military installations and lands was given to the DoD. The U.S. Environmental Protection Agency (EPA) and the various states participate in that cleanup effort by identifying the applicable or relevant and appropriate cleanup standards and procedures.

Edwards AFB, the EPA, the California EPA (Cal/EPA) Department of Toxic Substances Control (DTSC), and the Cal/EPA Regional Water Quality Control Board (RWQCB) Lahontan Region entered into a Federal Facility Agreement on 24 September 1990 that specifies the time schedule, manner of remedy selection, and informal and formal dispute processes that are to be used when remediation agreements cannot be reached between the parties.

The ERP areas have been consolidated into ten operable units (OUs), based on location and/or type of facility or contamination (see Appendix Figures, *ERP Operable Units*). Several of the OUs have been combined. Operable Unit 3, Basewide Water Wells, has been closed. OUs 1, 2, 4/9, 5/10, 6, 7, and 8 each have an independent Federal Facility Agreement (FFA) schedule, detailing when primary documents will be issued for regulatory review. As such, each OU has a different schedule for submission of the draft Record of Decision (ROD) to the EPA, Cal/EPA DTSC, and Cal/EPA RWQCB for review and approval. Each ROD will present a discussion of the cleanup alternative(s) selected for the sites contained in each OU. After the RODs are signed, the base will complete the design and construction of all the specific cleanup technologies selected.

Groundwater contamination is present at all open ERP sites. Interim (i.e., Pre-ROD) treatment systems have been installed at sites associated with OUs 1, 4/9, and 5/10 and have been operating to remove groundwater and soil contamination. Final (i.e. Post-ROD) treatment systems have been installed at sites associated with OUs 2 and 6 and have been operating to remove groundwater contamination.

Impacts to natural resources may result from the release of hazardous substances, pollutants, and contaminants into the environment or from CERCLA response actions to clean up those releases. AFCEC, through the ERP process, is responsible for identifying such CERCLA releases, considering ecological risks and natural resource injury issues, and assessing impacts to the environment. The ERP process addresses impacts to threatened and endangered species, migratory birds, and biotic communities, as well as develops and selects response actions when it is likely that a release could result in an unacceptable risk

to ecological receptors. Ecological risk assessments have been completed for all of the OUs. The ERP decision-making process involves communication on natural resource issues, reviews and comments on remedial actions, and ecological risk assessments to ensure that response actions, to the extent practicable, are undertaken in a manner consistent with goals and objectives set forth in the INRMP. Edwards AFB coordinates with Federal and California State regulatory and resource agencies to evaluate and resolve potential natural resource injury issues.

The following are estimates of ground disturbances over the next five years:

- OU1 Main Base: Well Installations - 1.25 acres
- OU2 South Base: Well Installations - 10 acres
- OU4/9 AFRL: Well Installations - 7.5 acres, Well Abandonments - 7 acres
- OU5/10 North Base: No Ground Disturbance
- OU6 NASA/OU8 Site 25: Well Installations - 7 acres
- OU7 Basewide Miscellaneous: No Ground Disturbance
- OU7 Chemical Warfare Materiel: No Ground Disturbance
- OU7 Site 3 Main Base Inactive Landfill: Cover, Stormwater Controls, Fencing - 64 acres
- OU8 Northwest Main Base: No Ground Disturbance
- Compliance Restoration Program: Treatability Studies at Gas Stations - 0.75 acre
- Military Munitions Response Program: No Ground Disturbance

Over time, land use choices made for the sake of supporting renewable energy initiatives and providing the base with alternative sources of power, could result in loss of substantial amounts of habitat. This in turn could result in mission options becoming limited. Future mission site options would be reduced as a result of solar developments on base. For example, in preparation for construction of an actual proposed enhanced use lease solar site at Edwards AFB, a list of potential alternate sites was developed and coordinated across base functional areas to support development of a required Environmental Impact Statement.

2.4.5 Natural Resources Needed to Support the Military Mission

Stable soils and natural vegetation are needed to maintain clear visibility for aircraft flight test missions. Long periods without rainfall and surface flow significantly contribute to drying soils that become erodible and easily blown away during high winds. The reduction in natural flooding may impede the growth of the microorganisms (soil crusts) that may act as soil binders in the lakebed soils, potentially resulting in increased soil erosion and blowing dust. This impact might have a cascading effect as more and more dust builds up within the surrounding vegetated habitats smothering the cryptobiotic crusts within those habitats.

Functional watersheds which will drain sufficient amounts of surface flow from the headwaters into the hydrologic unit are needed to support the military mission into the future. Drainage patterns along the base of the surrounding mountains are being interrupted by development and water harvesting, restricting or eliminating the flow of storm water to the lakebeds. This is projected to continue as communities grow and need flood protection and increased drinking water. Los Angeles County is trying to preserve these drainages through the SEA designation. However the current SEA proposal does not protect the Amargosa Creek drainage only Big Rock and Little Rock Creeks would be protected. The SEA designations are only applicable to Los Angeles County leaving the drainages in Kern and San Bernardino counties with no visible protection. Reductions in stormwater flow could result in impairing mission use of the lakebeds, impair flight visibility from fugitive dust emissions, and fugitive dust impacts to other natural resources.

Piute Ponds Complex is the conduit through which the supplemental water from Sanitation District 14 is delivered to Rosamond Lake. This water source is imperative for surface stability of Rosamond Lake to prevent wind erosion from the lake and provide a usable operational surface. Piute Ponds Complex provides

research capabilities and opportunities. For example, NASA uses Piute Ponds as part of their Air Surface Water Ocean Topography (AirSWOT) research, looking at fresh water and ocean flows and associated climate change impacts.

Both potable and non-potable water are necessary for consumption by the base population and for the industrial demands of various missions. A lack of water for urban and industrial use could limit the quantity and quality of mission activities on base. Potential restrictions on ground water pumping or available SWP water could limit mission activities.

3.0 ENVIRONMENTAL MANAGEMENT SYSTEM

The AF environmental program adheres to the Environmental Management System (EMS) framework and it's Plan, Do, Check, Act cycle for ensuring mission success. Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*, U.S. Department of Defense Instruction (DoDI) 4715.17, *Environmental Management Systems*, AFI 32-7001, *Environmental Management*, and international standard, ISO 14001:2004, provide guidance on how environmental programs should be established, implemented, and maintained to operate under the EMS framework.

The natural resources program employs EMS-based processes to achieve compliance with all legal obligations and current policy drivers, effectively managing associated risks, and instilling a culture of continuous improvement. The INRMP serves as an administrative operational control that defines compliance-related activities and processes.

4.0 GENERAL ROLES AND RESPONSIBILITIES

General roles and responsibilities that are necessary to implement and support the natural resources program are listed in the table below. Specific natural resources management-related roles and responsibilities are described in appropriate sections of this plan.

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
Installation Commander	1. Approve the INRMP by signature on all revised INRMPs. The Installation Commander may re-delegate signature authority to a lower level provided that the signatory has control over all aspects and management objectives addressed within the subject INRMP. 2. Certifiy annual review of the INRMP as valid and current; or delegates the certification of the annual INRMP review authority to no lower than the Civil Engineer Squadron Commander. 3. Provide appropriate staffing to ensure implementation of the INRMP. 4. Control access to and use of installation natural resources. 5. Sign Findings of No Practicable Alternative (FONPA) for actions within a floodplain or wetland. 6. Sign cooperative agreements entered into pursuant to the Sikes Act, 16 U.S.C. § 670c-1, so long as the individual exercising the authority is a General Officer or a member of the Senior Executive Service.

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
	7. Approve and sign the installation Wildland Fire Management Plan (WFMP). The Installation Commander may re-delegate signature authority to a lower level provided that the signatory has control over all aspects of WFMP implementation.
AFCEC Natural Resources Media Manager/Subject Matter Expert (SME)/ Subject Matter Specialist (SMS)	1. Serves as the natural resources program manager and provides technical assistance and guidance to AF on natural resources issues. 2. Advocates for resources required to implement approved installation Integrated Natural Resources Management Plans.
Installation Natural Resources Manager/POC	1. Manages all base natural resources.
Installation Security Forces	1. Protects human safety.
Installation Unit Environmental Coordinators (UECs); see AFI 32-7001 for role description	1. Conducts UEC duties as required.
Installation Wildland Fire Program Manager	1. Manages installation wildland fire management.
Pest Manager	1. Manages installation pest management program.
Range Operating Agency	1. 412 RANS/ENROP manages the Precision Impact Range Area (PIRA). Natural resources issues on the PIRA are mananged by 412 CEG/CEVA.
Conservation Law Enforcement Officer (CLEO)	1. Conducts conservation law enforcement activities.
NEPA/Environmental Impact Analysis Process (EIAP) Manager	1. 412 CEG/CEVA NEPA/EIAP personnel conduct NEPA/EIAP for all Installation projects in coordination with the Natural Resources Manager.
National Oceanic and Atmospheric Administration (NOAA)/ National Marine Fisheries Service (NMFS)	1. NA
US Forest Service	1. NA
US Fish and Wildlife Service	1. Reviews INRMP. 2. Conducts section 7 consultations, including providing biological opinions as required.

5.0 TRAINING

AF installation NRMs/POCs and other natural resources support personnel require specific education, training and work experience to adequately perform their jobs. Section 107 of the Sikes Act requires that professionally trained personnel perform the tasks necessary to update and carry out certain actions required within this INRMP. Specific training and certification may be necessary to maintain a level of competence in relevant areas as installation needs change, or to fulfill a permitting requirement.

Installation Supplement – Training

Natural resource managers are required to take the *DoD Natural Resources Compliance* course, developed by the DoD. Other DoD Environmental Management courses can be found at the Army Logistics Management College and AF Institute of Technology. Environmental Management encourages their natural resource managers to attend appropriate national, regional, and state conferences and training courses to obtain certification or licensing for their related fields, when travel funds area available.

6.0 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

The installation maintains required records IAW Air Force Manual 33-363, *Management of Records*, and disposes of records IAW the Air Force Records Management System (AFRIMS) records disposition schedule (RDS). Numerous types of records must be maintained to support implementation of the natural resources program. Specific records are identified in applicable sections of this plan in the Natural Resources Playbook and in referenced documents.

Installation Supplement – Recordkeeping

Records custodian duties are supported by Natural Resources staff.

6.2 Reporting

The installation NRM is responsible for responding to natural resources-related data calls and reporting requirements. The NRM and supporting AFCEC Media Manager and Subject Matter Specialists should refer to the Environmental Reporting Playbook for guidance on execution of data gathering, quality control/quality assurance, and report development.

Installation Supplement –Reporting

Reporting requirements are supported by Natural Resources staff.

7.0 NATURAL RESOURCES PROGRAM MANAGEMENT

This section describes the current status of the installation's natural resources management program and program areas of interest. Current management practices, including common day-to-day management practices and ongoing special initiatives, are described for each applicable program area used to manage existing resources. Program elements in this outline that do not exist on the installation are identified as not applicable and include a justification, as necessary.

Installation Supplement –Natural Resources Program Management

Natural resources management is accomplished by base civil service staff. The government staff ensures compliance with base policies and regulations, and manages the natural resource programs. Natural resource contractors provide technical support to include specific natural resource expertise. The natural resource contractor accomplishes surveys, wildlife investigations, and monitoring activities; assists with the Desert Tortoise Head Start Program, as required; provides the endangered species awareness education program to base personnel; and works with construction contractors in the field regarding compliance with the terms and conditions of the Basewide BO and other environmental requirements. Off-base contractors conduct the majority of the natural resource field studies, inventories, and surveys, and prepare subsequent biological reports.

The Sikes Act, DoDI 4715.03, and AFI 32-7064 require installations to conserve and rehabilitate natural resources on military installations; provide sustainable multipurpose use of those resources; and, subject to

safety requirements and military security, and allow public access to military installations to facilitate their use.

To address encroachment threats to Edwards AFB missions, the Installation Encroachment Management Team (IEMT) was established. This team is made up of functional experts from across the installation. The membership of the IEMT includes representatives from Airfield Management, Airspace Management, Financial Management, Civil Engineering, Environmental Management, Base Planning/Air Installation Compatible Use Zone Manager, Real Property, Communications, Legal, Manpower, Base Bioenvironmental Engineer, Public Affairs, Military Range Management, Safety, Spectrum Management, Security Forces, Test and Evaluation, and Installation Tenants. These functional representatives provide the subject matter expertise necessary to enable the IEMT to identify and elevate encroachment and sustainment challenges to base leadership. The IEMT also performs Encroachment Assessments. These assessments address the installation encroachment condition relative to four evaluation factors: (a) mission impacts; (b) community impacts; (c) internal management of encroachment and sustainment challenges; and (d) external stakeholder considerations, including community support or opposition, quality of relationships, regulatory protections, and information sharing.6.2.7.

Because of increasing urban and commercial development, causing encroachment on DoD installations, REPI is part of the DoD overall Sustainable Ranges Initiative, designed to ensure the future use of military lands by addressing issues of potential encroachment on military testing and training. This effort emphasizes the need for installations to look outside the boundary to work constructively and creatively with communities and other stakeholders..

Edwards AFB REPI program has been negatively impacted by artificially inflated land prices due to seller expectations of significant land sale profits resulting from renewable energy activity in the region. A joint program with the U.S. Navy might continue into the future to cover REPI acquisitions for lands under the entire R-2508.

There are currently five REPI target acquisition areas associated with the joint AF/Navy Program; these include the Black Mountain Supersonic Corridor, Rough One, Cords Road, the Hawes Field Operating Area, and the PIRA (see Appendix Figures, *Edwards AFB REPI Project Areas*). The purchase of lands under the REPI Program establishes conservation easements and ensures protection for listed and sensitive species and their habitat. It also maintains key wildlife corridors for movement of wildlife and diversity of species.

7.1 Fish and Wildlife Management

Applicability Statement

This section applies to all AF installations that maintain an INRMP. The installation is required to implement this element.

Program Overview/Current Management Practices

Fish and wildlife program management focuses on conserving desert habitat on Edwards AFB. Native wildlife includes a wide variety of invertebrates, reptiles, birds, and mammals adapted to various desert habitats on base. Natural resource management is critical to the maintenance of biodiversity which provides critical support to the military mission by:

- Providing natural resource based outdoor recreation opportunities

- Providing natural landscapes for realistic training and testing conditions and greater flexibility of military operations
- Maintaining compliance with the ESA, AFIs, and other AF directives and environmental laws.

The goal is to fully support the AF mission by establishing conditions that encourage a self- sustaining, healthy ecosystem to function naturally with a minimal amount of human interference. Ongoing and future studies of plants, animals, birds, habitat, and vegetation communities provides critical information that is incorporated into the Geographic Information System (GIS) database for current and future reference and analysis. Over the long term, efforts will focus on assessing and monitoring the health of the base ecosystem to ensure continuation of the various base missions while maintaining the diversity of natural resources. Wildlife conservation through INRMP implementation is conducted to maintain biodiversity in a passive manner whenever possible. The initial HQA study conducted on Edwards AFB in 1992 and 1993 established 60 long-term monitoring plots (Mitchell et al. 1993). These plots provide the baseline and benchmarks to evaluate environmental change (see Appendix Figures, *Habitat Quality Assessment Plots on Edwards AFB*). Since 2004, Edwards AFB has been monitoring some of these plots on an annual basis; the number of plots monitored each year is based on available funding. Long-term monitoring is a fundamental aspect of adaptive management and efforts are underway to evaluate and determine the appropriate indicators that will determine the overall health of the ecosystem and allow a focused and cost-effective monitoring program.

Edwards AFB maintains certain state and federal permits to help manage natural resource programs. These include a state Aquaculture Permit for management of warm-water fishing ponds in designated areas on base identifying the species of fish allowed to be stocked(Bluegill (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), channel catfish (*Ictalurus punctatus*), and largemouth bass (*Micropterus salmoides*));a USFWS migratory bird depredation permit related to activities conducted on the flightline to minimize BASH and throughout the base related to injured or sick birds; and a state CDFW permit required on an as-needed basis to kill wildlife causing crop or property damage. Edwards requires partner federal agencies, universities, and contractors to maintain state and federal permits as necessary to perform their work or studies. For instance, U.S. Geological Survey maintains a USFWS desert tortoise recovery permit for the juvenile head start program at Edwards AFB.

Memorandums of Understanding, Memorandums of Agreement (MOA), and Interagency Agreements (IA) are also maintained with a variety of partners to help manage Edwards AFB natural resource programs. Some of these include a MOU with CDFW regarding collection of dead desert tortoise specimens for educational purposes, a MOU with CDFW to acquire periodic assistance from CDFW state game wardens to enforce state game laws and Sikes Act regulations on Edwards AFB, a MOU with the County Sanitation istrict No. 14 of Los Angeles County concerns water management and maintenance at the Piute Ponds complex, and an IA with the USGS provides support for multi-year studies and research pertaining tho the Destrt Tortoise Heasd Start Program at Edwards AFB.

Aquatic Invertebrates

Several surveys on aquatic invertebrates have been accomplished which documented presence of fairy shrimp, tadpole shrimp, and common clam shrimp. Some concerns were highlighted and recommendations made in these documents to improve management of the sensitive ecosystem occupied by these invertebrate species. Base activities that may be harmful to these species are vehicle traffic on lake beds and clay pan area can crush eggs and break down soil structure, the biodegradable petroleum product used to mark runways, and the inflow of gravel and other elements from areas of concentrated base activities along the flight line which may perturb water chemistry and change soil structure (Branchiopod Research Group

1993). These issues should be documented as further studies are accomplished to determine the extent of impacts on the overall populations of freshwater shrimp within the hydrological unit. The construction of roads and buildings on the base could affect aquatic habitats. Construction could result in fragmentation of natural temporal pools (i.e. playas), fragmentation of populations, disturbances of sites by vehicular traffic, changes in water chemistry (by the addition of pollutants), and transport of animals to other areas of the base. In the event that branchiopods are transported to new areas, they may negatively affect the indigenous animals existing in those areas. This is a concern, particularly for locally rare species on Edwards AFB, such as *B. coloradensis*. Therefore, preservation of these habitats in their natural conditions is important and the following are recommendations for monitoring of these habitats (Perez and Donn 2009).

- Since 31 of the 55 wet-sampled sites had branchiopod crustaceans detected in the dry sampling, but not in the wet, dry season sampling of sites and culturing of eggs should be conducted to determine the presence of rare species.
- Conduct wet sampling of sites in which branchiopods were only detected in the dry samples in order to determine the conditions associated with the hatching of eggs.
- Conduct further surveys in the northwest area of the base and the PIRA. The 2009 survey was the first survey for branchiopod crustaceans in the northwest area and the PIRA. Statistically significant differences were detected in chemicals between areas, and *B. coloradensis* was only found in the northwest area of the base.

Herpetofauna

Future recommended management actions that could be undertaken to benefit native amphibians and reptiles include (AMEC Earth and Environmental 2008):

- Periodic monitoring of sensitive and rare native amphibian and reptilian populations.
- Maintenance or restoration of natural hydrological processes through water table and stream flow maintenance and preservation of natural hydrological regimes, such as inundation and desiccation cycles.
- Protection of natural drainages from degradation through vegetation clearing, erosion, and trampling.
- Restoration and revegetation of disturbed and degraded habitats.
- Enhancement and restoration of aquatic habitat and microhabitat heterogeneity by maintaining waters of varying depths and permanence, setting aside certain areas for establishment of native aquatic vegetation and other areas for open water.
- As appropriate, determination of the need to control non-native amphibian populations and implementation of pest management plans.
- Consideration and evaluation of the potential introduction of native amphibian species in areas from which non-native amphibians are removed.
- Avoidance or minimization of impacts to Haystack Butte to prevent impacts to known common chuckwalla populations.
- Reduction of impacts associated with roads and trails by closing non-essential roads and enforcing speed limits.
- Management of projects to maintain habitat contiguity and to encourage reptile population movement (e.g., providing safe crossings for reptiles on roadway projects).

Bats

Nationally, bats have received increased attention and management due to a known fatal bat disease, white-nose syndrome (WNS), discovered in 2006 in New York. The disease, caused by *Pseudogymnoascus destructans*, a fungus that infects wintering cave roosting bats, has moved throughout the eastern U.S and Canada and as far west as Arkansas. The fungus has killed at least six million bats according to an estimate by the USFWS in 2012. While not expected to be a threat in California in the foreseeable future, several bat species in the west are considered at- risk. Threats generally include loss of habitat (roosting and foraging), which is the main potential impact at Edwards AFB.

Foraging, watering, and natural roosting habitat is stable at Edwards as wetlands and ponds are maintained to support human use and the military mission (Piute Ponds, Branch Pond, and the Golf Course Pond). The Air Force is working to demolish many abandoned and energy- inefficient structures by 2020, a primary roosting habitat for many cave-roosting bat species. To minimize effects to bats, a bat pre-survey will be conducted before the start of demolition activity. If bats are observed, efforts will be made to passively exclude bats prior to demolition. Early coordination and the 2014 surveys should help future activities avoid demolition during the breeding season.

Based on the initial base bat survey (Brown-Berry 1998), bats have been impacted by building demolition. Several buildings noted in the original survey have already been demolished and includes one documented as a bat maternity roost. Care will be taken to assess abandoned buildings being used by bats. Mitigation of lost habitat will be considered, and is typically achieved through the construction of bat houses. A list of suitable buildings would be compiled and the most suitable site would be selected for placement of a bat house. Not all abandoned buildings are being used or are considered suitable as day, night, maternity, or winter roost sites for bats. Creation of alternative artificial roosts would be considered as an adaptive management action for replacement of habitat; however, this is not as beneficial as retaining roosts already suitable. Additional protection of this entire order of wildlife may be needed to protect it from being eliminated inadvertently from the base by removing scarce, suitable habitat.

Migratory Birds

Consistent with military mission requirements, Edwards AFB will encourage incorporation of comprehensive migratory bird management objectives into relevant planning documents, including the INRMP, Integrated Pest Management Plan (IPMP), Installation Master Plans, NEPA analyses, and other relevant documents (DoD 2014). Consistent with current and emerging mission requirements, Edwards AFB will manage base lands in a manner that supports migratory bird conservation, habitat protection, restoration, and enhancement. Edwards AFB will inventory and monitor bird populations on base lands to the extent feasible to facilitate conservation decisions and efforts. Edwards AFB will refer to comprehensive planning efforts for migratory birds to include Partners in Flight Bird Conservation Plans, the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, North American Waterbird Conservation Plan, Sonoran Joint Venture and other associated regional plans.

7.2 Outdoor Recreation and Public Access to Natural Resources

Applicability Statement

This section applies to all AF installations that maintain an INRMP. Edwards AFB is required to implement this element.

Program Overview/Current Management Practices

There are 15 suitable areas for outdoor recreation on base (Appendix Figures, *Outdoor Recreation Areas on EAFB*). These areas include a fishing pond at Branch Memorial Park; three ORV areas, horse stables

and equestrian riding area, model airplane area, Rod and Gun Club; 18-hole golf course and driving range; and a recreation complex (e.g. gym, pool, jogging areas, and track). ORV activity areas on Edwards AFB are limited by the presence of desert tortoise habitat. Most of Edwards AFB is suitable for hiking. There are many designated trails on base for hiking or riding mountain bikes. The following natural resource based recreational activities and areas are managed by professional natural resource employees: hunting, fishing, and the Piute Ponds Complex (see section below, *Hunting, Fishing, Trapping Program Organization and Management*). The remaining recreational areas are overseen by the Services Division.

The Installation Commander is responsible for outdoor recreation management on Edwards AFB. The Services Division, Environmental Management, Civil Engineering, and Security Forces cooperatively execute the outdoor recreation program. Outdoor recreation includes ORV use, camping, equestrian use, golf course, physical activity readiness course, bicycling, jogging, and hiking. Environmental Management works with the Services Division prior to the designation of a recreation area (e.g. ORV use) to determine if there are sensitive natural resources present within such areas.

Management of natural resources provides opportunities for outdoor activities on AF lands as described in AFI 32-7064. This INRMP presents procedures to integrate Outdoor Recreation Management information into the overall base mission and into natural resources planning and management. Providing quality outdoor recreation experiences contributes to an enhanced quality of life for base personnel and contributes to multiple uses of natural resources. Opportunities to increase and enhance recreation without impacting natural resources can be provided through effective management. One key method of implementing this goal is to increase the interpretive and special interest areas for both recreational and educational purposes within the natural environment.

Information on the hunting and fishing program can be found in the section below, *Hunting, Fishing, Trapping Program Organization and Management*. Branch Pond is adjacent to Branch Memorial Park and is always open for use; no reservations are available for exclusive use of the pond at any time. Only fishing is allowed at Branch Pond; no hunting or swimming. Environmental Management manages the pond; Recreation Services manages the park. Upland game hunting is allowed west and northwest of Branch Park and in the northwest portion of the base. Waterfowl hunting is authorized at Piute Ponds.

Regulation and Permitting

Air Force Outdoor Recreation Programs, AFI 34-110, provides guidance for initiating and maintaining outdoor recreation programs at AF installations. The AFI outlines roles and responsibilities, safety considerations, program goals, and funding categories. A number of DoD, federal, and state guidelines and restrictions provide policy guidance for management of specific recreational programs.

Access and Restrictions

There are several outdoor recreation areas available on Edwards AFB that have participant access considerations, which are noted below

- Piute Ponds Complex: Open
- Hunting Areas: Open
- Rod and Gun Club: Open
- Model Airplane Flight Area: Open but limitations in place to prevent mission impacts.
- Branch Pond and Park: Restricted to on-base users, due to its small size.
- ORV Areas: Restricted to on-base users and those using the leased ORV area. This area has to be carefully managed due to desert tortoise presence, the basewide BO which regulates its use, and

the lack of personnel available to manage the area. Greater use in the area would increase the impact to natural resources and further strain limited management availability.

- Golf Course and Driving Range: Open
- Horse Stables and Equestrian Riding Area: Restricted to on-base users. Use is limited due to its size and lack of adequate oversight for off-base user access.
- Recreation Complex (gym, pool, jogging areas, running track): Restricted due to being a limited resource, often used to capacity, and location.

Persons authorized to hunt on base include active duty and retired military members and their dependents, DoD employees, tenant organizations, contractors assigned to Edwards AFB, and their dependents, sponsored guests, and the public. In general, public access to Edwards AFB is restricted in that each person is required to obtain a pass or permit or be escorted to enter the installation.In accordance with AFI 32-7064 a Golf Course Management Plan (GEM) is required. A project to write a new GEM is needed.

The Installation Commander, in consultation with Environmental Management, Security Forces, Safety Office, Service Division, and Judge Advocate, determines the extent of access on all areas designated as suitable for outdoor recreation described in this INRMP. Outdoor recreation use by the general public is allowed when such use is deemed by the Commander to be compatible with the military mission.

Hunting, Fishing, Trapping Program Organization and Management

Edwards AFB Instruction (EAFBI) 32-7064, Management of Hunting and Fishing Program, governs hunting and fishing on Edwards AFB. The CDFW regulations are applied on base and may be further limited by base rules. Information on hunting and fishing is periodically published in the Base newspaper, and may also be provided through the Hunters' Hotline or Security Forces. Environmental Management is responsible for conferring with the USFWS and CDFW to ensure compliance with appropriate federal and state laws. Environmental Management and CDFW game wardens conduct checks of waterfowl bag limits and hunting licenses throughout the hunting season. In addition, Environmental Management is responsible for tracking and managing the funds in the Fish and Wildlife Conservation Account.

The Services Division is responsible for collecting funds generated by the Hunting and Fishing Program. These funds are transferred to the base comptroller for deposit into the Fish and Wildlife Conservation Account.

Flight Scheduling is responsible for providing information to Environmental Management on low- altitude aircraft missions to help prevent conflicts between hunting activities.

Fishing

Environmental Management is responsible for managing Branch Memorial Park Pond; and Civil Engeeringing is responsible for maintaining the restrooms, infrastructure, and the water delivery system at the pond. The water source is from well C-4 and water use is about 270 acre feet per year. A dirt access road forms the perimeter of the pond. Fremont's cottonwoods, willows, mesquite, and mule fat are the dominant plant species found around the pond edges. Cattails and bulrushes are the dominant emergent plants within the pond. Fish structures have been placed within the pond and consist of 55 gallon barrels and rock piles. An aerator system has been installed in the pond. Fish in the pond consist of channel catfish, largemouth bass, bluegill, and carp. Rainbow trout are stocked in the pond during colder winter months.

Branch Pond is managed primarily to support fishing. Fishing is allowed all year IAW Edwards AFB Instruction 32-7064. A state fishing license is not required and public access is not allowed because it is a

limited resource. Funding is derived from the sale of base hunting and fishing permits which are deposited into the 57X5095 account. There is no swimming allowed in the pond.

The purpose is to provide a warm water fishing pond as a source of recreation for base workers and residents. Fish stocked on an annual basis are channel catfish and large-mouth bass. Fish suppliers willing to deliver to Edwards AFB are very limited due to the remote location of the base. Efforts to locate additional fish suppliers will continue to be an ongoing effort. Vegetation and sediment control will be necessary every 5-10 years. Natural pond succession will continue to require the removal of excess cattails, bulrushes and dirt from within the pond. Mechanical removal is the technique that will provide the longest term control. Fire could be used to eliminate some vegetation but mechanical removal of roots and soil would be used in conjunction with this technique. Excavated vegetation and soil will be placed in a designated area adjacent to the pond. Some vegetation will be allowed to remain in the pond to provide oxygen and cover for fish. Some vegetation control may be required around the pond edges. This can be accomplished with hand tools and volunteers. Fish structures and the aerator system will be maintained by volunteer efforts. Equipment and supplies would be purchased on an as needed basis in support of these efforts. An Aquaculture Permit from the State is renewed each year.

Branch pond provides a quality of life for base personnel with opportunities for recreational fishing and bird watching. The pond also provides an aesthetically pleasing environmental setting for walking and enjoying nature. Branch Pond is a vital resource for wildlife; perennial water sources are a significant resource in desert environments. Many species of resident animals rely on the water for survival. Migratory insects, birds, and mammals rely on Branch Pond for reproduction. Branch Pond is a known roosting and nesting location for tricolored blackbirds (*Agelaius tricolor)*, a state candidate species due to declining populations. Patches of cattails and bulrushes will be left in the pond for tricolored blackbird habitat.

Hunting

Hunting for waterfowl occurs at Piute Ponds during the designated hunting season. Access to Piute Ponds is through the use of Avenue C and Shuttle Road. Hunting for upland game species is also limited to specific locations during designated seasons. The base follows California state hunting regulations; however, they may be further limited by Base regulations.

There are designated hunting areas for various species of wildlife (see Appendix Figures, *Outdoor Recreation Areas on EAFB*). Demand for hunting waterfowl at Piute Ponds in the southwestern portion of the base is managed by holding an annual duck blind drawing. Upland game hunting is allowed in Graham Ranch and Mesquite Bosque Hunting Areas (see Appendix Figures, *Outdoor Recreation Areas on EAFB*).

Policy, Regulation, and Fees

The State of California rules and regulations applicable to hunting and fishing are contained in the Fish and Game Regulations of the California Code of Regulations (CCR), Title 14, Division1. The CCR contains state wildlife policies, agency responsibilities, hunting and fishing provisions, trapping provisions, licensing and permit requirements, take restrictions, and penalties for code violations. The Base Instruction (EAFBI 32-7064) provides guidance and policies for the hunting, fishing and volunteer program on Edwards AFB.

The Base Services Division sells base fishing permits, base hunting permits, and duck blinds to eligible base personnel; no state fishing license is required. The money from the sales of these permits is deposited into the Fish and Wildlife Account (57X account). The Service Division also collects a fee for selling the permits; this fee is deposited into a Service Division account. The 57X account is used to periodically fund fish stocking efforts, habitat restoration, and duck blind maintenance.

Disabled Access

There are designated handicap blinds at Piute Ponds for mobility impaired hunters.

Demand

There is a relatively high demand on base to hunt waterfowl at Piute Ponds and fish in the pond at Branch Memorial Park. Demand for upland game hunting is relatively low.

Other Outdoor Recreation

Several parks are located within the cantonment area and are managed by the Recreation Services Division. Hiking, jogging, parcourse fitness trails, swimming pools, skateboard park, and other forms of recreation are managed by the Services Division and are also located within the cantonment area. These forms of recreation are largely independent of natural resources. The Branch Memorial Park, although open for use by all; can be reserved exclusively for large events.

The outdoor recreation areas described in the following sections are suitable to support dispersed recreational activities on unimproved lands (see Appendix Figures, *Outdoor Recreation Areas on EAFB*).

Off Road Vehicle (ORV) Areas

EAFBI 31-280, Motor Vehicle Traffic Supervision, serves as the regulation for the three ORV areas. ORV Area 1 (approximately 100 acres) is for the use of the Desert Wheels Motorcycle Club only. ORV Area 2 (about 15,040 acres), located west of the housing area, is jointly used for equestrian, ORV, and general recreational use. ORV Area 3 (about 4,328 acres with 32 miles of trails), located just north and northwest of NASA/Armstrong, and primarily west of Rosamond Boulevard, is only used for non-motorized mountain biking and jogging. No motorized ORVs are permitted in ORV Area 3.

The Services Division is the Office of Primary Responsibility (OPR) for oversight of the ORV use on base. All ORVs must be registered with the state and operated only within designated areas and trails in the ORV areas. The requirements for compliance with the ESA for these areas are described in the basewide BO. Signs are placed at least every half mile along the boundary to delineate the ORV areas. Interpretive signs that provide rules, maps, and safety information are placed in at least two main access points to ORV Area 2. Security Forces regularly patrol the areas to ensure that riders remain within the boundaries and use existing trails. Edwards AFB requires all riders of motorized vehicles to carry proof of training and receive desert tortoise awareness training.

Equestrian Facilities

Equestrian facilities, including horse stables and arenas, are provided for authorized users in accordance with AFI 34-110, Air Force Outdoor Recreation Programs and Procedures (see Figure 4-15). All horses must be inoculated against local diseases, and a veterinarian must declare them free of infectious diseases. The base equestrian facilities consist of 50 stables (capacity for 100 horses), an exercise and training area, and a large open riding area. Equestrian riders can use the trails within ORV Area 2, which is located adjacent to the stables.

Overnight Camping

FamCamp is an authorized camping location operated by the Services Division and is located next to the bowling alley and Hap Arnold Park. Branch Memorial Park is also a designated campground for primitive camping and can be used through reservations with the Services Division. Camping is limited to the grass landscaped portion of Branch Memorial Park. Ten campsites that are 10’ x 10’ can be used within Branch

Memorial Park. BBQ grills and covered picnic tables are in place for use, therefore no open fires are permitted. Camping is authorized in a designated location at Piute Ponds for use by hunters during the waterfowl season. Camping at Piute Ponds may also be authorized for special events at other times of the year.

Passive Recreation

Piute Ponds is a well-documented bird-watching site for various seasonal bird census inventories, birding groups, and individual birders. School classes visit the site to enhance their understanding of biological sciences and use the area as an outdoor laboratory. Piute Ponds is used extensively by photographers, hikers, bird watchers and nature enthusiasts. Following the Piute Ponds access process is required to enter the base for recreational and educational programs at the Piute Ponds Complex. Use by base residents and workers requires possession of a written letter primarily to ensure the visitors understand the guidelines of visiting the area (such as exclusion times) and allows Environmental Management to stay cognizant of usage pressure on the area.

Bird watching may be authorized, on a limited access basis, at the South Base sewage ponds, Branch Pond, surrounding mesquite bosques and Red Barn Marsh.

Golf Course

AFI 34-116, AF Golf Course Program, provides guidance and procedures for AF golf programs to enhance the mental and physical well-being of AF members and their families. The program's goal is to facilitate the creation of an environmentally friendly golf course facility while supporting the installation mission.

7.3 Conservation Law Enforcement

Applicability Statement

This section applies to all AF installations that maintain an INRMP, as all installations are required to provide a method for enforcement of conservation laws. Edwards AFB is required to implement this element.

Program Overview/Current Management Practices

The Security Forces Squadron (SFS) is the primary law enforcement agency for Edwards AFB. In the performance of its mission, the SFS enforces state and federal laws and base-level regulations. Enforcement of natural resource laws on base is focused primarily on hunting regulations, ORV use, poaching incidents and illegal trespassing. Attention is given to illegal collections of desert tortoise and other wild animals for pets and other purposes.

Edwards AFB submits an annual budget requesting funds to provide wildlife law enforcement support for the installation. The primary purpose of the funds is to augment SFS personnel with USFWS and/or CDFW law enforcement support. Edwards AFB funds CDFW game wardens through a MOU. The primary focus is on enforcing hunting and fishing regulations, ORV regulations, and unauthorized entry onto the installation. Law enforcement efforts also focus on preventing unauthorized grazing, entry, and ORV use for the protection of desert tortoises and associated habitats.

All individuals enforcing fish, wildlife, and natural resources laws on AF lands must receive specialized, professional training on the enforcement of fish, wildlife, and natural resources (AFI 32- 7064). This training may be obtained by acquiring certification as a state fish and wildlife conservation law enforcement officer or by successfully completing the Natural Resources Police Training Program course at the Federal

Law Enforcement Training Center. Correspondence courses and standard Security Forces training do not meet the requirements of the Sikes Act.

Jurisdiction with Regards to Natural Resources Law Enforcement Program

The Edwards AFB Magistrate Court Program has jurisdiction for all misdemeanor violations of federal law committed by civilians on Edwards AFB property. The Installation Commander has administrative jurisdiction for all violations of AF and base regulations committed by civilians on Edwards AFB property. The 412th Test Wing Military Justice Program has jurisdiction for all violations of base regulations and federal and military law committed by military service members on Edwards AFB property. The USFWS Office of Law Enforcement has the authority to enforce the MBTA, ESA, Lacey Act and Archaeological Resources Protection Act on federal property. The CDFW has the authority to enforce state fish and game codes and federal laws on Edwards AFB within their jurisdiction.

Source of Authority for Natural Resources Law

The primary sources of authority include the federal ESA, MBTA, Sikes Act, associated permits and the basewide BO, USFWS and CDFW hunting and fishing regulations other laws and regulations discussed in more detail throughout various sections of this document.

Enforcement Activities and Program Emphasis

Edwards AFB will continue to submit annual budget requests for law enforcement support. The SFS will update the MOA with USFWS Office of Law Enforcement to include CDFW as a signatory.

7.4 Management of Threatened and Endangered Species, Species of Concern and Habitats

Applicability Statement

This section applies to AF installations that have threatened and endangered species on AF property. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

The Sikes Act requires the DoD to provide for the conservation and rehabilitation of natural resources on military installations through the implementation of the INRMP, including enhancement or modification of fish and wildlife habitat. AFI 32-7064 provides guidance via the INRMP for maintaining and improving the sustainability and biodiversity of the terrestrial and aquatic ecosystems. Wildlife habitat improvement requirements also originate from the terms and conditions of the basewide BO

. Currently, habitat improvement is implemented to repair areas damaged by fire or construction and to revegetate roads in remote areas that are not being used for mission operations. Restoration success is difficult to measure in the desert because it takes many years for initial improvements to be observed. Restoration of habitat is an ongoing process. Revegetation will be conducted in accordance with the base revegetation plan (Air Force Flight Test Center 1994

Threatened and endangered species and habitats are managed at the ecosystem level. Ecosystem management at Edwards AFB consists of management on a landscape scale considering short and long-term goals shared by federal and state resource agencies. Goals are expected to minimize impacts to species and their habitats. Goals considered for implementation are expected to be consistent with the military mission. Managing at the ecosystem level is expected to conserve listed and sensitive species as well as common species that are found in the desert environment. Adoption and implementation of shared federal

and state goals are expected to assist with meeting the INRMP goals and objectives and lead to a healthy desert ecosystem.

Status of Threatened and Endangered Species Inventories

Desert Tortoise

Protection and restoration efforts often do not have immediate, observable results, especially in the desert. These efforts require a long-term monitoring program. The resource agencies have had difficulties in estimating population densities for this species throughout its range (USFWS, 2010). Based on the 25-year period of the recovery criteria in the 1994 Recovery Plan (USFWS, 1994), a long-term monitoring program for the desert tortoise was implemented in 2001. Density estimates of adult tortoises varied among recovery units and years. Over the first six years of range-wide monitoring (2001-2005, 2007), relative density estimates in the Western Mojave Recovery Unit – the unit that includes Edwards AFB - ranged from 3.8 - 6.1 tortoises/kilometer An internal Desert Tortoise Recovery Office report dated January 14, 2014 used annual density estimates from 2001-2012 range-wide monitoring to document a 9.8% decrease in desert tortoise within the Western Mojave Recovery Unit (USFWS 2014).

Additional studies also found that the relative number of smaller desert tortoise is about half what it was in 2001 and that the median size of individuals has increased, indicating less recruitment of younger desert tortoises. Analysis in 2009 found that 25% of tortoise habitat is now made up of impervious surfaces (paved or developed areas) in the Western Mojave area (USFWS 2014). Finally, invasive weed species have been found to adversely affect the physiological health of desert tortoises, thus likely reducing long-term reproductive potential of young tortoise (compromised nutrition) (USFWS 2014). These findings along with several other factors have caused the USFWS to conclude that species recovery is a substantial challenge (USFWS 2014).

To gain understanding of the status and trends of base-wide desert tortoise populations and to help Edwards meet the initial goals and objectives of the 2008 INRMP, surveys were conducted to estimate relative densities on Edwards AFB (Blandford et al. 2010). A total of 308 square mile sections were sampled in 1991-1994 and 338 one-mile sections in 2006-2007 using standardized BLM relative density strip transects (see Appendix Figures, *Desert Tortoise Densities*). Relative densities on Edwards AFB ranged from 3 to 69 individuals per square mile (2.6 square kilometers) in 1991-1994 with a mean of 15.9 per square mile (standard deviation = 11.8) and from 0 to 58 individuals per square mile in 2006-2007 with a mean of 7.8 per square mile (standard deviation = 7.8). *Desert Tortoise Density Comparisons on Edwards AFB* in the Appendix Tables shows relative density by zonal habitat separated into west and east of Rogers Dry Lake on Edwards AFB. The southeast corner of the base, the PIRA, and AFRL area contained the highest densities. A comparison of 2006-2007 with 1991-1994 relative densities indicates a substantial decline over the past 10 years (see Appendix Tables, *Desert Tortoise Density Comparisons on Edwards AFB*). However, the technique provides an index of relative density only, and should not be interpreted as absolute density. Sources of inherent error include low sampling intensity (sampled 2.8% of each square mile section), accuracy of the trend plot data obtained from USGS, and observer bias. In addition, sign (scat and tracks) can be easily missed or not detected based on vegetation and angle of the sun, and burrows may have been used or modified by desert kit fox, coyote, or American badger, and may have been mistaken for tortoise burrows. These factors influence the likelihood of encountering tortoise sign and will affect the correlation of sign and estimated densities.

Mohave Shoulderband Snail (MSS)

The Mohave shoulderband snail (*Helminthoglypta* (coyote) *greggi*) is a species first described as a rather small, thin shelled, land snail (Willett 1931). Very little is known about this species other than morphological characteristics, minimal microhabitat preferences, and it has only been found on three sites in the world, each of which is in Kern County, CA; Soledad Mountain, Standard Hill, and Middle Butte (Center for Biological Diversity 2014). Each of these locations is within approximately 8 miles of Edwards AFB northwestern boundary, with Soledad Mountain being the closest at approximately 0.5 mile. In January 2014 the Center for Biological Diversity submitted a petition to list this species as endangered or threatened under the Endangered Species Act. In their 90 day finding the USFWS announced that the petition presented substantial information that listing of this species may be warranted (80 FR 19259, 2015), triggering a status review. North facing rocky or talus slopes, which are a habitat requirement for the Mohave shoulderband snail (Center for Biological Diversity 2014), may exist on an unnamed butte in the extreme northwest corner of the base. A simple digital elevation model analysis was conducted to determine if potential Mohave shoulderband snail habitat exists in this area. Approximately 11.5 acres of potentially suitable habitat was identified (see Appendix Figures, *Mohave Shoulderband Snail Potential Habitat*). Environmental Management is in the process of securing funding for a survey of this area to determine if this species exists on base. If the Mohave shoulderband snail is determined to be present, appropriate management measures would be developed. Because the northwest corner of the base is an area infrequently used for mission activities, there would be little to no impact on the Edwards AFB mission if this species was listed under the ESA.

Mohave Ground Squirrel (MGS)

Monitoring of MGS populations has been conducted on Edwards AFB since the late 1980's (Buescher et al. 1995). Long-term monitoring of locations established in 2003 show that MGSs primarily occur in Joshua Tree Woodland habitats and Halophytic Saltbush Scrub. Only one MGS has been detected (captured or directly/indirectly observed) in Mesquite Bosque and Creosote Bush Scrub, and no detections have occurred in Xerophytic Saltbush Scrub habitat (Perez et al. 2011). Prior to 2009, 50 locations on Edwards AFB were surveyed; MGS were observed or captured at 15 of these locations (Donn et al. 2010). MGS surveys indicate that abundances are greatest on the eastern side of Rogers Dry Lake but that they are also present to the south and just west of Rogers Dry Lake, and occur in low abundances to the north and east of Rosamond Dry Lake (Donn et al. 2010). A new survey protocol was evaluated for MGS on Edwards AFB after the 2009 surveys were completed (Donn et al. 2010). The protocol used two different sampling techniques (trapping and visual methods) in order to determine occupancy and density across all sites.

Surveys in 2010 (based on captures) indicated a total of four MGSs at four of 12 sites, all of which were adult females. Additional visual and auditory surveys detected MGS at 20 locations in proximity to the four capture locations plus one additional trapping location where the species was not captured (Clark et al. 2010). Surveys in 2011 (based on captures) indicated a total of 39 MGS at two of the ten sites surveyed; 5% of captures were juveniles, 66% were subadults, and 25% were adults. Visual surveys detected MGS at one additional site (Perez et al. 2011).

A predominance of juveniles is considered an indication of additional reproductive effort as a result of favorable conditions. A relationship has been hypothesized by Leitner and Leitner (1998) between annual precipitation, reproduction, and juvenile recruitment the following year. If sufficient rainfall has occurred (approximately 30 mm) by January and a standing crop of about 1 gram per square foot of annual forage materials is present, mating will ensue soon after MGS emerge from their burrows between mid-February and mid-March (Wickramasinghe et al. 2004; Harris et al. 1995). The 2011 survey followed an above average rainfall year in 2010. A comparison of the number of captures between 2009 (n = 22; Donn et al. 2010) that followed four years of average-to-below average rainfall, and 2011 (n = 39) indicates that

conditions favored reproduction in 2011. The 2009 survey study was conducted on the east side of Rogers Dry Lake where abundances of MGS are typically high. However, it is interesting to note that 4 out of 10 (40%) of adult MGS trapped in 2011 were non-reproductive.

Clark et al. (2010) reported that live-trapping is a time-intensive and expensive technique, but provided the best data regarding MGS populations. Valuable demographic data can be obtained that is unavailable to other techniques. Given the patchy distribution and relative low abundance of MGS, capturing a sufficient number of individuals to estimate density can be a challenge. Webtrap arrays should be large (>250 traps) in order to ensure sufficient captures that are required when using line-transect models to estimate small mammal density (Wilson et al. 1996). Webtrap arrays surveyed at Edwards included only 96 traps in 2010 and 98 traps in 2011. Additionally, of the twelve randomly chosen sites sampled in 2010, six were moved to areas of suitable habitat within general areas identified by Edwards, due to logistical difficulties of scheduling trapping on the PIRA. Nine established long-term monitoring locations (Habitat Quality Analysis (HQA) sites) were surveyed in 2011 (Perez et al. 2011).

Habitat requirements for the MGS are recorded and integrated into the GIS and ecosystem model to help identify key plant associations that can be used as indicators in habitat predictive modeling efforts. Data from MGS surveys/studies reflect presence or absence within a specific location; numbers of captured males, females, and juveniles; evidence of breeding; and bearing of young. Long-term monitoring will be used to validate the ongoing population viability of the species over time, including the analysis of breeding data.

Ongoing Threatened and Endangered Monitoring Programs

Desert tortoise monitoring is an ongoing process at Edwards AFB. Many projects and AF activities and operations are monitored for desert tortoise based on requirements of thebasewide BOand the presence of suitable habitat.

T&E species programs and activities are being implemented and will continue to be implemented over the next five years, such as releasing desert tortoises into the desert as part of the Head Start Program, closing unused roads to conserve habitat, conducting baseline inventories of plant and animal species, monitoring the changes in biodiversity of the desert plants and animals, repairing and replacing desert tortoise exclusion fence in areas deemed hazardous to desert tortoises, refining existing vegetation maps, habitat restoration, predation studies, monitoring ecological trends in HQA study plots, and long-term monitoring of desert tortoise and other sensitive species using coordinated methodologies with the USFWS and CDFW.

The desert tortoise management program includes implementation of the Edwards Air Force Base Revegetation Plan (AFFTC 1994c) and a desert tortoise ongoing awareness education program. With supporting video material of the desert environment (including other animal and plant species), desert tortoise briefings are given to all Edwards AFB military and base personnel. Additionally, Environmental Management has implemented numerous project surveys for desert tortoise and other sensitive species throughout the base. These surveys have contributed substantial amounts of data on species locations and population distribution; the data are continuously being analyzed for incorporation into a base ecosystem model.

Desert Tortoise Exclusion Fencing

Galvanized metal exclusion fences have been installed to minimize desert tortoise road crossings in critical habitat and other areas deemed hazardous to desert tortoises, such as the AFRL rocket engine/motor test areas and facilities, paved roads where desert tortoises have been observed crossing, and secondary access roads to bombing targets on the PIRA. In addition, exclusion fencing has been used to keep desert tortoises

from falling into open mines, prospect pits with steep banks, and other pitfalls or potential hazards throughout the base. The integrity of the exclusion fence is periodically monitored and repaired or replaced, when necessary, based on available funds.

Desert Tortoise Head Start Program

The Desert Tortoise Head Start Program was established in 2003 in accordance with a USFWS Scientific Collection Permit. The Desert Tortoise Head Start Program is a captive breeding program where adult, wild female tortoises with eggs were captured and placed in specifically designed holding pens safe from predators. The female tortoises were allowed to lay their eggs; the females would be returned to their original capture site and tracked over time. The hatchling tortoises remained in the pens until it was determined they were of adequate size for release. Prior to release of the juvenile tortoises, a monitoring device is attached to their shell; they are tracked to determine their survival. Since 2011, the USGS has been assisting Edwards AFB to improve the success of its Head Start Program, developing a protocol for measuring juvenile tortoise health and tracking of released juveniles. A closure plan for the Head Start Program was submitted to USFWS in October 2013 and approved in April 2014 with the issuance of a new 10(a)(1)(A) Recover Permit. Release of all juvenile tortoises was accomplished in 2013 and 2014; USGS will track their survivability through 2018 to assess the success of the releases.

A total of 35 juveniles were released during the fall 2013 release at Leuhman Ridge (2003-2007 cohorts). As of January 2017: 24 were known to be alive; seven were known to be dead; and four were missing. . A total of 36 juveniles were released during the spring 2014 release at Baker-Nunn (2008 and 2009 cohorts). As of January 2017: six were known to be alive; seven were known to be dead; and 23 were missing. A total of 48 juveniles were released during the fall 2014 release at Leuhman Ridge (2005-2010 cohorts). As of January 2017: 18 were known to be alive; 14 were known to be dead; and 16 were missing. A total of 119 juveniles were released between 2013 and 2014. As of January 2017 the combined survival rate these for these three releases is between 40% and 76%, depending on whether the missing tortoises are alive or not. .

Base Boundary Fence

Installation and maintenance of a base boundary fence has served to limit most trespassing on Air Force land by the general public. Impacts associated with human disturbance such as trash dumping and off-road vehicle use are deterred, which provides a benefit to desert tortoise, other sensitive species, and more common species. Continued maintenance of the base boundary fence is a high priority.

Current Biological Opinions for Threatened and Endangered Species

Since 1991, Edwards AFB has consulted with the USFWS under Section 7 of the ESA on AF project actions and operations where there was a potential to affect the tortoise and its habitat. The USFWS consultations originally resulted in 50 BOs. The 2014 basewide BO consolidated all previous BOs and covers all anticipated AF activities and operations that potentially could impact the tortoise and its habitat on base and in the foreseeable future.

All AF actions are reviewed and evaluated regarding any potential impacts to the desert tortoise and its habitat via the Environmental Impact Analysis Process (EIAP), which is the AF NEPA review process. Surveys, monitoring, and/or environmental protection measures are incorporated into the project prior to, during, and following mission support activities and operations IAW the basewide BO requirements. Adherence to the terms and conditions of the basewide BO minimizes impacts to desert tortoises and their habitat.

For all projects, appropriate mitigation/minimization measures must be undertaken to comply with the terms and conditions of the basewide BO. These measures include restoration and enhancement of disturbed habitat. To ensure successful restoration and revegetation, Environmental Management prepared an Edwards Air Force Base Revegetation Plan (AFFTC 1994). The plan recommends procedures for restoring topography, soils, and native vegetation to pre-disturbance conditions. The base has installed exclusion fences in hazardous areas that may pose potential impacts to tortoises; in addition, some active bombing targets and approximately 150 pitfalls (mines and prospect pits) have been closed (Earth Tech 2000). The closure of unused roads in areas with high tortoise density is also being implemented. A perimeter fence has been installed around the base to conserve tortoise habitat, in particular, designated desert tortoise critical habitat. The Air Force is responsible for conducting regular patrols and repairing damaged sections of perimeter fence. The base manages a desert tortoise adoption program to track captive desert tortoises in the housing area. As military families leave, desert tortoises are adopted out to new families. The purpose of this program is to prevent the collection of wild desert tortoises for pets and to prevent the release of captive desert

Project planning emphasizes maximum reuse of facilities and siting within previously disturbed areas to minimize loss of desert tortoise habitat. Projects are screened to determine the management practices necessary to ensure the protection of desert tortoises and critical habitat.

In discussions with USFWS, much has been learned about these early actions regarding the usefulness of the terms and conditions of the BOs. The AF plans to revisit the terms and conditions of thebasewide BO and evaluate where the limited resources are invested and how successful those terms and conditions have been since their implementation, as well as other protection measures not required under a BO.

Current Consultations

Currently, there are no formal consultations in process with the USFWS.

Health of Existing On-Installation Habitats of Concern

Critical Habitat

Critical habitat on Edwards AFB is located within portions of the AFRL and PIRA and is largely closed to human use due to safety concerns within the weapons testing area. Those mission activities have some effect on habitat, though its locations are relatively static and limited, with little expansion expected. Fire and its associated impacts including invasive species may be the largest risk to habitats in this area of the base. In the past decade, fires have impacted approximately 107 acres of critical habitat.

In the base-wide population survey, the highest relative densities of tortoise were found in creosote bush scrub and xeric saltbush scrub habitats. Substantially less disturbance (i.e. paved roads, dirt roads, dirt tracks, garbage, firearm shells, shooting sites, ordnance, denuded areas, partially denuded areas, buildings) was found across the study area during 2006-2007 than was observed in 1991-1994. Increases were only seen in paved roads (+2.5% change), ordnance (+8.6%), and denuded areas (+3%). Blandford et al. (2010) sites Edward's formal off-highway vehicle (OHV) program started in the mid-1990's, as the likely reason for the 65% decrease in OHV tracks.

In general, critical habitat and other habitat that supports desert tortoise are considered healthy and able to fully support a recovered tortoise population when the primary constituent elements are present: sufficient open space to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and proper soil conditions; suitable substrates for burrowing, nesting, and overwintering; burrows

and shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance.

The major threats to critical and occupied habitat range wide are the same as those for Edwards AFB, which are invasive species, human-related disturbance, common raven predation, and land use. Urban and agricultural development, concentrated use by off-road vehicles, and other activities of this nature completely remove habitat. Surface disturbance causes increased rates of erosion and generation of dust. Increased erosion alters additional habitat outside of the area directly affected by altering the nature of the substrate, removing shrubs, and possibly destroying burrows and other shelter sites. Increased dust affects photosynthesis in the plants that provide cover and forage to desert tortoises. Additionally, major roads like Highway 58 likely disrupt the movement, dispersal, and gene flow of desert tortoises. Grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress on desert tortoise populations, can reduce suitable substrate for burrowing, and sufficient vegetation for shelter. Finally, disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and out-compete native species; the proliferation of weedy species increases the risk of large-scale fires, which further move habitat conditions away from those that are favorable to desert tortoises (USFWS 2014).

Over the long term, management efforts will focus on assessing and monitoring the health of the base ecosystem to ensure continuation of the various base missions while maintaining the diversity of natural resources. Promoting ecosystem health is a primary management strategy for long term population stability in view of potential impending climate change. Healthy ecosystems and stable populations will better enable species to adapt to shifting geographic ranges and habitat changes.

Woodlands

Natural woodlands include Joshua and mesquite trees within desert scrub habitats. The primary intent of managing for this ecosystem is conservation of a limited natural resource for wildlife and T&E species, and to maintain the integrity of the desert ecosystem. The focus is on impact avoidance through project siting and planning, discouragement of unauthorized firewood harvesting of mesquite trees, and removal of exotic tree species such as salt cedar (*Tamarisk sp*.) and giant reed grass (*Arundo donax*). Managing woodlands helps to maintain diverse habitats for wildlife, including migratory birds, native and nongame species; conserve watersheds; and sustain/enhance biodiversity.

Joshua trees and mesquite trees are an important and rare feature of the western Mojave Desert on Edwards AFB. They provide nesting habitat for bird species and increase the habitat diversity by providing a canopy cover that creates mesic microclimates that provide habitat for many annual plants. Dead trees (snags) provide perches for foraging and resting raptors and nest opportunities for cavity nesting birds, while fallen trees provide shelter and food for a diverse assemblage of insects, reptiles, and small mammals.

Joshua trees are the most prominent and widespread naturally-occurring treelike species on base. Joshua trees occur in creosote and saltbush scrub habitats throughout Edwards AFB, but not typically in dense stands. Environmental Management encourages conservation of Joshua trees wherever feasible. The Edwards Air Force Base Revegetation Plan (AFFTC 1994c) recommends replacement or replanting Joshua trees to maintain the diversity of natural habitats on base. Joshua tree restoration efforts will follow the recommendations in the Edwards Air Force Base Revegetation Plan.

Similarly, mesquite trees are a component of specific natural habitats on base and have limited distribution to a small portion southwest of the southern end of Rogers Dry Lake and along Lancaster Boulevard. Mesquite trees are found in close association with saltbush plants (Atriplex sp.) where relatively deep

groundwater is available. The mixed results typical of mesquite restoration efforts and their affinity to mesic areas, make the mesquite trees vulnerable to degradation. Mesquites are a phreatophytic (deep-rooted) species. Their habitat requirements make them difficult and costly to replace. Consequently, mesquite bosque restoration efforts have a poor success rate. Plants come up naturally along roadsides and in ditches in the south central portion of the base. Projects located in areas where mesquite bosques occur will be sited to the maximum extent possible to avoid adverse impacts to the drainages upon which they depend. Unauthorized mesquite harvesting is managed through limited access to the installation. Natural growth has been observed in disturbed ponded areas along roads and at the southern end of Rogers Dry Lake in halophytic saltbush scrub.

Woodland Management Issues and Concerns. The biggest issue with woodland management in the Mojave Desert is the reduction in health caused by loss of soil moisture from past groundwater pumping, watershed degradation, and years of drought in the Mojave Desert. The increased drought stress is affecting both the Joshua and mesquite trees. Previous studies have shown that disturbance within the mesquite bosque is high, based on the percentage of exotic weedy plants that are present today.

Relationship of On-Base Habitats of Concern with Similar Local and Regional Critical Habitat

Desert Tortoise.

Overall, the general health of desert tortoise habitat in the western Mojave Desert is poor**.** Nearly all land west of the base boundary is private land; some lands to the north and substantial lands to the east are managed by the BLM. The region east of the base boundary is a designated Desert Wildlife Management Area (DWMA), and considered the best habitat in the west Mojave for management of desert tortoise populations.

The USFWS and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and to undertake other actions that would reduce subsidies (i.e., food, water, sites for nesting, roosting, and perching). These subsidies increase raven abundance in the California Desert (USFWS 2008).

The optimal reserve size recommended to preserve viable desert tortoise populations is 1000 square miles or 640,000 acres (USFWS 1994); only four of the 12 critical habitat units meet this threshold. The Fremont-Kramer Critical Habitat Unit covers 518,000 acres. Population viability analyses indicate that reserves should contain from 10,000 to 20,000 adult desert tortoises to maximize estimated time to extinction (i.e., approximately 390 years, depending on rates of population change; USFWS 1994a). The Fremont-Kramer and Superior-Cronese Critical Habitat Units share boundaries and form contiguous blocks which contain an estimated abundance of over 10,000 adult desert tortoises (USFWS 2014). The entirety of Edwards AFB is also managed for the conservation of desert tortoise, and overlaps the Fremont-Kramer Critical Habitat Unit, thus further expanding this contiguous open space available for viable tortoise populations.

Mesquite Bosque. Mesquite trees on Edwards AFB constitute a rare habitat within Los Angeles County and have been designated as SEA 47 by the county's SEA Task Advisory Council. Los Angeles County proposes to increase the size of the SEA to encompass the entire ecosystem from the foothills of the mountains to the lakebeds on Edwards AFB. The proposed Los Angeles County General Plan is being updated and if this plan is accepted, the entire watershed, including scattered mesquite trees from forest service boundaries to the base boundaries, will be protected. Regional watershed management includes limiting the density of development allowed within the SEA boundaries (Los Angeles County 2014).

Management of Sensitive Species

A full list of species of interest along with their status and location on base is provided (see Appendix Table, *Species of Interest on Edwards AFB* and Appendix Figure, *Sensitive species within 10 miles of Edwards AFB*). The table does not contain all possible species of interest, only those the base considers most important to manage. Active management for several of the species is described below.

Desert Cymopterus, Barstow Woolly Sunflower, and Alkali Mariposa Lily

Desert cymopterus (*Cymopterus deserticola*, Barstow woolly sunflower (*Eriophyllum mohavense*), and alkali mariposa lily (*Calochortus striatus*) populations are located in areas where ground disturbance occurs primarily by occasional foot traffic to conduct wildlife and plant inventories and inspection of groundwater monitoring wells. There are 54 documented populations of desert cymopterus on base. There are populations scattered over 3,384 acres primarily on the PIRA on the eastern portion of the base. In 1995, the base documented 98,760 Barstow woolly sunflower plants on base. These populations were scattered over 37 acres mostly within halophytic phase saltbush scrub habitat. In 1995, the base documented 162,000 alkali mariposa lily plants either as a solitary plant or population covering over 500 acres. These populations are scattered over 63,780 acres across the base in areas periodically inundated by water in clay pans and within areas adjacent to Rosamond Dry Lake. Alkali mariposa lilies were found in abundance along vegetation transects (estimated 4,800 plants) on the west side of Rosamond Lake (Huddleson and Bratton 2015c).

Lancaster milkvetch

Lancaster milkvetch (*Astragalus preussii* var. *laxiforus*) is a perennial herb native to California, Arizona, Utah, and Nevada. It occurs in alkaline flats around 700m in elevation and flowers between March and May (Wojciechowski and Spellenberg 2014). Lancaster milkvetch is only documented in five locations in California, all of which are on EAFB. Of the five locations reported on EAFB, two are likely duplicate reports. On June 18, 2014, Department staff (Kelly Schmoker, Senior Environmental Scientist, [specialist]), collected and verified with Andy Sanders (University of California, Riverside) that one population of approximately 37 individuals is still extant on EAFB. The other two locations, as well as other potentially suitable habitat, needs to be comprehensively surveyed because this species is extremely rare. A sixth occurrence of this species reported from Coachella Valley listed in the CNDD, is a misidentification (personal communication, Andy Sanders).

Rosamond Eriastrum, Sagebrush Loeflingia, Yellow Spinecape, and Mojave Spineflower

In 2015, Edwards AFB conducted a baseline survey in the southwestern region of the base focusing on Rosamond erastrium (*Eriastrum rosamondense*), but several other sensitive species were found including sagebrush loeflingia (*Loeflingia squarrosa* var. *artemisiarum*), yellow spinecape (*Goodmonia luteola*), and Mojave spineflower (*Chorizathe spinosa*) (Huddleston and Bratton 2015c). Historically, Rosamond eriastrum was classified as Hoover's eriastrum (*Eriastrum hooveri*), but was reclassified in 2013 as its own species based on flower color and length of stamens (Gowen 2013). The survey area is primarily composed of shadscale scrub and spinescale scrub with soil types mainly Leuhman, Challenger, and Cahon. Despite the relatively low amount of precipitation, an estimated 14,000 Rosamond erastrium were observed. These observations occurred in all soil types in the survey area. Several thousand sagebrush loeflingia plants were found on sandy soils and disturbed areas along the southeast side of Piute Ponds. Yellow spinecape was generally widespread and abundant with several thousand plants found near Rosamond erastrium populations. Mojave spineflower was abundant between the western edge of Rosamond Dry Lake and the installation boundary (Huddleston and Bratton 2015c).

Sensitive Plant Mapping and Management

Sensitive plants are found in a wide range of habitats while others are limited to specific habitats. For example, desert cymopterus is found in sandy soils, sandy swales, and Joshua tree woodland habitat. Alkali mariposa lily is found in clay pan areas and sand dunes, along drainages in halophytic saltbush scrub habitat near and adjacent to the lakebeds. Barstow woolly sunflower is typically found in loamy to gravelly soils in saltbush and creosote bush scrub habitats.

In 2003, Edwards AFB developed a habitat model for desert cymopterus. The model was updated in 2004. The model used the habitat attributes of the known occurrences of this species. The purpose of the model was to use attribute data to identify other potential sites where this species might occur. Edwards AFB conducted field surveys to validate the model in 2004. Using the model and ground-truth field surveys, six new small populations of desert cymopterus were found on Edwards AFB and slightly north of the base. These new populations increased the known distribution and abundance of this species within the Rogers Dry Lake basin.

Additional management strategies will be developed based on the results of future inventories and studies. Locations and numbers of sensitive plants are entered into GIS. The GIS is used to ensure that sensitive plants populations are protected during the EIAP. Projects will be sited to prevent impacts to known rare plant populations. Rare plant populations will be delineated during projects that are located in close proximity and might affect them. When appropriate, rare plant topics will be included in briefings given to project personnel.

The location where this species occurs is not used for ground operations, there is no livestock grazing and with the exception of limited recreational activity associated with Piute Ponds, most of the areas are not subject to recreational activity. Therefore, threats associated with anthropogenic and grazing disturbance are considered to be very minimal to non-existent. Currently, there are no plans to conduct extensive ground-disturbing activities in the areas of known populations.

Willow Flycatcher (*Empidonax traillii*) - California State-Endangered Species

Threats to the species on Edwards AFB are minimal. Measures that support Piute Ponds habitat will support willow flycatcher; species-specific goals, objectives, and projects have not been developed at this time. Piute Ponds habitat measures include maintaining a spatial and temporal distribution of different habitat types to meet breeding, feeding and nesting needs for wetland dependent species, increase vertical habitat structure (i.e. trees), and water management.

Tricolored Blackbirds – California Candidate Species

Threats to the species on Edwards AFB are minimal. Management activities include creating or maintaining successional cattail/bulrush marsh at Piute Ponds and Branch Pond and conducting surveys. Branch Pond and Piute Ponds habitat management activities include maintaining a spatial and temporal distribution of different habitat types to meet breeding, feeding and nesting needs for wetland dependent species, increase vertical habitat structure (i.e. trees), and water management. If increasing numbers of tricolored blackbirds are not observed during annual April surveys from 2016-2018, the habitat will be re-evaluated along with water management of that specific habitat to determine if adjustments are required. If that is not an issue, evaluation of the avian predator (primarily black crowned night herons) base will be accomplished. Should it be determined that the area established has in fact become a “sink” for tricolored blackbirds and cannot be corrected to become undesirable to avian predators the habitat will be adjusted to become undesirable for tricolored blackbirds to eliminate a “sink” to the population.

Burrowing Owl – California Species of Concern

Threats to the species are those associated with the desert-urban interface (i.e. stray dogs and human disturbance), and reduced forage due to drought. Management activities include habitat conservation, determination of long-term population stability through annual surveys, and relocation of July 4th fireworks to reduce impacts to the exisiting *Burrowing Owl Conservation Area* (see map in Appendix Figures).

Townsend's Big-eared Bat – California State Candidate Species

Townsend's big-eared bat (*Corynorhinus townsendii*) was recently listed as a State candidate under the California Endangered Species Act (California Department of Fish and Wildlife 2014). This species has not been documented on base. A 2014 study of abandoned buildings did not detect the species or its sign (guano or moth wings). Acoustic surveys also did not detect the species, though it is well known that the low-volume call of a Townsend's big-eared bat is rarely recorded by acoustic devices. If it occurs on base, threats to the species include building demolition and deterioration of mine roosting habitat. Management activities include surveys to look for the species and humane exclusion upon building demolition. Construction of suitable alternative roosting habitat is not a viable mitigation measure for this species as Townsend's big-eared bat is not known to use bat boxes. An experimental roost was constructed at Vandenberg Air Force Base in 2013, which if successful, could provide an alternative design for artificial habitat.

7.5 Water Resource Protection

Applicability Statement

This section applies to AF installations that have water resources. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

Regional Watershed Issues

Water harvesting and diversion is a significant issue that is affecting the installation. Large historical dams were constructed to divert water from developing communities in the past before the importance of water flow to the lakebeds was recognized. A large amount of water is held in the dams surrounding the Antelope Valley. Along with those dams, numerous points of diversions have been constructed as part of community development. The communities have constructed water harvesting areas, further diverting water flow from the downstream resources, and plan more in the near future (Los Angeles Department of Water and Power (LADPW 2013). Water decisions made by surrounding communities do not take into account an understanding of the water needs of the lakebeds. The local communities see all water that stands on the lake bed as lost, having no beneficial value, and therefore should be harvested upstream.

Due to the concern for water shortages in the Antelope Valley there is an increased interest in the tertiary water supplied by D14. This interest has fueled conversations that range from injecting or harvesting all the tertiary water for drinking water to actively trying to develop industry and commercial interest in the recycled water. This may eventually lead to water issues both for the Piute Ponds Complex and Rosamond Lake.

Waste Water Management Issues

Most waste water from the main base tertiary treatment plant is mixed with well water and used to irrigate the golf course from March to October. Golf Course Management indicates the water seems to be high in salts which may be affecting the greens.

Storm Water Management Issues

Storm water ponds adjacent to the active runways in the northern portion of Rogers Lake create habitat which increases the number of water birds. This in turn can potentially increase bird air strikes due to the close proximity to the runway. Projects being constructed in the Rogers Lake drainage system must not build storm water diversions or detention basins. There is one storm water pond next to Pad 7 on the flightline that receives perennial water. Investigations currently underway have yet to reveal the source.

Regional Programs

The Integrated Regional Water Management Plan (IRWMP) is intended to be a vehicle which allows interested parties in the Antelope Valley to submit for grant money to manage surface and ground water. This is the process where many of the water harvesting projects are proposed and submitted for grant funding. This plan is intended to provide the ability for integrated planning and prioritizing within a regional context for water issues. The Piute Ponds Manager participates in these meetings to ensure base surface water issues are highlighted and as appropriate, addressed. The base has been invited to join this team to assist in guiding water management.

Water Quality Monitoring

Seven water wells are used for the base drinking water system and sampled quarterly by the Bioenvironmental Engineering Office. They are sampling one off-line well that is currently not part of the drinking water system. There is one non-potable well which feeds South Gate and Branch Pond. There are two non-potable wells used at the waste water treatment plant to supplement the tertiary water to the golf course.

Piute Ponds Complex is monitored by D14 according to their waste discharge requirements (WDRs) issued by Lahontan Regional Water Quality Control Board. There are currently three sampling points within the ponds and 12 ground water monitoring wells that D14 monitors under these WDRs. Regular review of these reports by Piute Ponds Manager are necessary to stay cognizant of the water flows, water quality results, changes which may occur with the water chemistry, and issues that may affect water flow at the Piute Ponds Complex.

Cooperative Programs

Antelope Valley Integrated Regional Water Management Group is responsible for writing and overseeing the implementation of the IRWMP. Edwards AFB is not a member of this group but base personnel attend meetings to educate community stakeholders on the importance of surface water flow issues to the base, particularly the lakebeds. This would be an important group to have membership in and to support with funding as needed to ensure Edwards AFB interests are seriously considered.

7.6 Wetland Protection

Applicability Statement

This section applies to AF installations that have existing wetlands on AF property. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

There are no jurisdictional wetlands on Edwards AFB regulated under the U.S. Army Corp of Engineers, 404 Clean Water Act (CWA) Program. There are biological wetlands (Piute Ponds) managed as stated in AFI 32-7064, Chapter 3, Section 3.1. “In compliance with Executive Order 11990, Protection of Wetlands,

May 24, 1977, the AF will seek to preserve the natural values of wetlands while carrying out its mission on both AF lands and non-AF lands. To the maximum extent practicable, the AF will avoid actions which would either destroy or adversely modify wetlands."

Health of Existing Wetlands

Piute Ponds Complex

The three main indicators currently used to assess the health of the Piute Ponds Complex are 1) use by avian species, 2) vegetative response/structure, and 3) water quality. A summary is provided here; a more in-depth discussion is available in the Appendix Piute Ponds Complex Management Plan).

Avian Use. The high number of avian species (>200) which use the Complex indicate diversity, high biological importance, and high productivity of the area (Los Angeles County Sanitation District 2004). A popular database (eBird.com) used by most of the birders who visit the Complex documents the observations of 262 avian species. The database spans the years 1979 to present. Harvest data from the hunting season is gathered on a regular basis. The most telling information on use of the Complex by resident waterfowl is considered to be opening day. The full season data is useful for determining migrating waterfowl use. Opening day of 2013/2014 season documented 3.9 birds per hunter.

Vegetation. The most common vegetation within the marsh/pond complex is hardstem bulrush, smartweed (*Persicaria sp.)*, swamp timothy (*Crypsis sp*.), and fivehook bassia (*Bassia hyssopifolia*). Bulrush provides good cover and nesting opportunities. Smartweed and swamp timothy are considered some of the best forage for waterfowl and is abundant within the wetland and pond areas. Bulrush within the Complex has become old and overgrown and is taking up a significant portion of the available marsh and pond areas without providing new growth. While this is good habitat for some species, such as marsh wren and rails, there does appear to be an overabundance of this habitat type which is preventing fresh bulrush growth and healthy marsh habitat for most avian species. A balance of old and decadent bulrush and new bulrush growth must be maintained.

Water. Water quality flowing into the Complex is measured by D14 at sampling site RS2, RS3, and RS4. D14 monthly, quarterly, and annual reports provide results on more than 100 different parameters to include acute toxicity results. Reports are filed with Lahontan Water Quality Control Board in compliance with WDRs and provided to Environmental Management. The following WDRs, as they relate to the Complex, are:

- R6V-2002-0053, Waste discharge and water reclamation requirements for Lancaster Water Reclamation Plant, 11 Sep 2002
- R6V-2002-053A1, amended WDRs including interim effluent ammonia limits, 13 Jul 2005
- R6V-2002-0053, revised, monitoring and reporting requirements, 14 Mar 2007
- R6V-2002-053-A02, corrects references to specific requirements in previous orders, 12 Jan 2011

D14 changed from secondary effluent to tertiary water flow into the Complex in June of 2012.

Restoration work at Piute Ponds is intended to develop several areas to provide more capacity to take water from Los Angeles County Sanitation District 14, provide the base more opportunities to move or hold water off the lakebed when necessary for operational missions, and enhance ecosystem health and function. This restoration work helps us to meet the goals identified in the Piute Ponds Complex Management Plan.

The Piute Ponds Complex is in a period of transition. A major Ducks Unlimited (DU) project accomplished in 2012 increased the number of water control structures from 9 to 25 and added or improved dikes for

three additional ponds and the lakebed channels. This improved the ability to manage the water levels and water flows throughout the complex. A follow-on DU project in 2014 removed overgrowth of vegetation in Little Piute, recut swales, and cleared ponds to provide better water flow, encouraged growth of new vegetation, and reclaimed some capacity for more water.

The overall health of the Piute Ponds Complex is considered good although efforts will continue to improve water flow and vegetation growth. Further information on the health and management of the Piute Ponds Complex is in the Piute Ponds Management Plan.

Branch Memorial Park Pond

The four main indicators currently used to assess the health of the Branch Memorial Park Pond are 1) fish observations, 2) vegetation, 3) visitors, and 4) water availability. Branch Pond is managed primarily to provide fishing opportunities to individuals who work and live on base and others who have access to the base.

Fish. Fish within the ponds have repeatedly spawned and offspring appear to survive. No fish die offs have occurred within the pond. Most of this information is obtained from discussions with various fishermen using the pond on a regular basis.

Vegetation. Vegetative response and bird use is obtained during periodic visual surveys of Branch Pond by Natural Resource personnel noting the health of the vegetation, where it's growing and not growing, what type of vegetation is growing, is it an undesirable species or a species that provides cover or nesting opportunities. Tamarisk was removed more than 15 years ago from around the Pond and the pond remains tamarisk free as of 2014. Although there is a continual seed bank within 600 feet of the pond, only a few small tamarisk have had to be removed since the original type conversion from tamarisk dominated to Fremont's cottonwood, willows, mesquite, and mule-fat. Vegetation within and around the pond appears healthy and provides appropriate structure for this pond. Vegetation structure within Branch Pond provides nesting habitat for tricolored blackbirds. Tricolored blackbirds nested in the bulrush, cattails, and mule-fat in April and May 2014. Tricolored blackbirds use the trees, particularly the honey mesquite, around the pond for fledging cover and feeding perches. The honey mesquite bosque area and saltbush scrub habitat in the vicinity of the pond are used by tricolored blackbirds as foraging areas. The vegetation within and around Branch Pond has been used historically by this species.

Visitors. Visitor use is obtained during periodic surveys at Branch Pond. These visitor checks provide information on amount of use, observations of fish availability, spawning, and survivability. Visitor satisfaction with the pond appears to be high based on occasional interviews.

Water Levels. Water levels are maintained and checked often by the Civil Engineering Water Shop and Natural Resource biologists. Well water supply is turned on and off frequently during nesting season to verify the pond is at the right water level, and adjusted when fish stocking occurs. The health of Branch Memorial Park Pond appears to be in good condition.

Golf Course Pond

The ecosystem health of the Golf Course Pond is currently not being evaluated. There have been two fish die offs at the golf course pond. The exact cause of the die offs have not been determined. A 2014 bat acoustic survey at the Golf Course Pond showed healthy activity (109 bat passes/night), including significant activity by Western red bat (*Lasiurus blossevillii*), a CDFW species of special concern. Bats may be feeding on insects and/or watering at this location. Bat abundance is correlated with insect

abundance and indicates a functional ecosystem (Fenton 1992; Wickramasinghe 2004; Jones et al. 2009; Wilson 2014).

Lakebeds, Clay Pans, and Floodplains

The three main indicators currently used to assess the health of these features are 1) soil stability, 2) surface features, and 3) flooding. Lakebeds are a complicated landscape feature, based on soils, hydrology, biology and other factors.

Soil Stability. The soil surface on Rogers Lake has been severely destabilized by mission uses and water diversion making it subject to a high degree of wind erosion. This impacts air quality and deposits windblown soils onto surrounding habitats. The figures below provide a depiction of the highly destabilized surface of Rogers Lake. Winds the day of the photos were reported as an average of 20 knots with a peak of 40 knots. This was not an atypical event for wind and soil erosion.

Surface Features. Rogers Lake, over the last 20 years, has degraded from a flat hard relatively homogenous surface structure across its length to one which has flat hard surfaces in the northwest portion and then transforms into a rutted, hummocky, cracked surface structure in the northeast and southern portion. Historical subsidence has caused fissures to occur. Creation of fissures seems to have stabilized; however, the appearance of polygonal cracking is increasing. Dewatering of below surface soils may be implicated in causing polygonal cracking to increase. Although over time polygonal cracking is a natural occurrence it is typically healed through flooding and occurs sporadically (Harris and Leitner 2004; Harris et al. 1995). Polygonal cracks on Rogers Lake are no longer sporadic and do not disappear or heal, creating a surface which is no longer flat.

Dust blowing off southern portion of Rogers Lake, May 2014

Dust blowing across Mercury Blvd, May 2014

Flooding. At one time, flooding on the lakebeds would cause standing water for months at a time. Steps were considered to prevent as much water as possible from reaching the lakebeds. Flooding on Rogers Lake rarely lasts much more than a few weeks before drying. Little surface water flow appears to reach the lakebed at this point. Surface water flow may be important to the health of the lakebed and the amount of flooding required to maintain lakebed surfaces has not been documented to date. In addition, the lack of flooding and standing water may cause a breakdown of the. biological crusts, but may promote and stabilize physical soil crusts.

The only delineated FEMA flood zones on base are site specific and address Rogers Dry Lake, Rosamond Dry Lake, Rich Dry Lake, Air Force Research Laboratory (AFRL), and the Mojave Creek watershed south of Forbes Avenue. The lack of FEMA flood zone delineation anywhere else on base does not imply that a FEMA flood zone does not exist, but rather that the area has not been subject to a FEMA flood zone analysis.

Other Lakes

Rosamond Lake is the recipient of supplemental flooding from D14 via Piute Ponds. This has seemingly helped to stabilize the surface soils even though the flooding is currently only enough to cover approximately 5% of the surface. However, since the flooding is annual that may assist in keeping the subsurface moist enough as the surface flow moves below surface laterally or through piping to other areas on the lakebed. Surface features on the lakebed appear to be more natural occurring with a low occurrence of polygonal cracking and or healing of the cracks. Buckhorn Lake is not currently impacted by operational mission issues. It is impacted by the same surface water diversion as Rogers and Rosamond Lakes and has moderate soil instability issues. There is no supplemental flooding of Buckhorn Lake. The health of this system is not being actively evaluated at this time.

Rich Lake has been used to mine clay for Rogers Lake repairs and is considered to be the second most impacted lakebed on Edwards AFB. Rich Lake is the most remote and least studied, no information on its condition is currently known.

Clay Pans

The clay pans in the northwest corner may be at risk due to proposed development of an approximately 3,000 acre solar facility. These clay pans are the only known location of Colorado fairy shrimp (*Branchinecta coloradensis*) on base. This shrimp species has no sensitivity level; however; it is currently considered locally rare.

Other than the above clay pans no real concern has been observed with development or damage to the remaining clay pans. It is not known how much of the clay pan habitat has been historically impacted. Without ongoing impacts, the clay pans are very resilient and heal readily. The clay pan habitat may be deteriorating due to the surface water diversion, though at a slower rate than the lakebeds. Actions taken to correct this issue for the lakebeds would be expected to have a positive impact on clay pans. The health of these clay pans are not being actively evaluated at this time.

Ephemeral Wash Systems

Several large ephemeral wash systems were severely impacted on and off base through diversion and/or maintenance efforts (Mojave Creek, Buckhorn to Rogers Lake wash system, Cottonwood and Oak Creek, etc.). Continual clearing of vegetation within Mojave Creek is accomplished to reduce a potential fire hazard in proximity to Main Base houses and other development. Lancaster Boulevard splits Buckhorn and Rogers Lake; culverts have been added to keep the flow of surface water off Lancaster Boulevard. No information exists on the health of other ephemeral washes or future impacts to them. The health of these systems is not being evaluated at this time.

Mesquite Bosque

The Mesquite Bosque (276 acres) is a rare riparian habitat within Los Angeles County and within the base's southern boundary. This riparian habitat has been impacted – in a manner which is expected to affect the overall health of the system – by water diversion, ground water subsidence, homesteading, base operational actions such as the historical sled track construction, and construction and modifications to the South Gate entrance and the main roads into South Gate. Reproduction is still present within the community and young, mid, and old trees are all represented within the population structure. The health of this mesquite bosque system is unknown at this time. There are plans to evaluate this area over the next five years.

Evaporation Ponds/Storm Water Ponds

No evaluations are being accomplished at this time on these areas.

Seeps

No evaluations are being accomplished at this time on these areas.

Status of Wetland Inventories and Delineations

In 1997, an ACOE jurisdictional delineation was completed by the Los Angeles ACOE whereby the lakebeds, most of the clay pans, and drainages leading to the lakebeds were determined to be Waters of the United States. In 1999, the SWANCC federal court decision ruled that the determination of "Waters of the United States" cannot be linked to migratory birds. Based on the SWANCC federal court decision, the

ACOE reversed its jurisdictional delineation in 2013 and determined that there are no jurisdictional "Waters of the U.S." on Edwards AFB.

Long-Term Monitoring of Wetlands

The annual Audubon Christmas Bird Count is an ongoing event which allows comparison of data from year to year and is used to monitor the Piute Ponds Complex; eBird.com provides an international database of bird sightings which is used by birders from all over. Many of the birders that use the Piute Complex input their data into this database. This database is accessible by the base and is used to analyze avian species presence over time. Hunter bag checks accomplished during the hunting season are also used to monitor changes in avian species presence over time.

Pending Section 404 and 401 Permits

There are no pending Section 404 or 401 permits as no "Waters of the U.S." occur at Edwards AFB.

Wetland Restoration and Enhancement

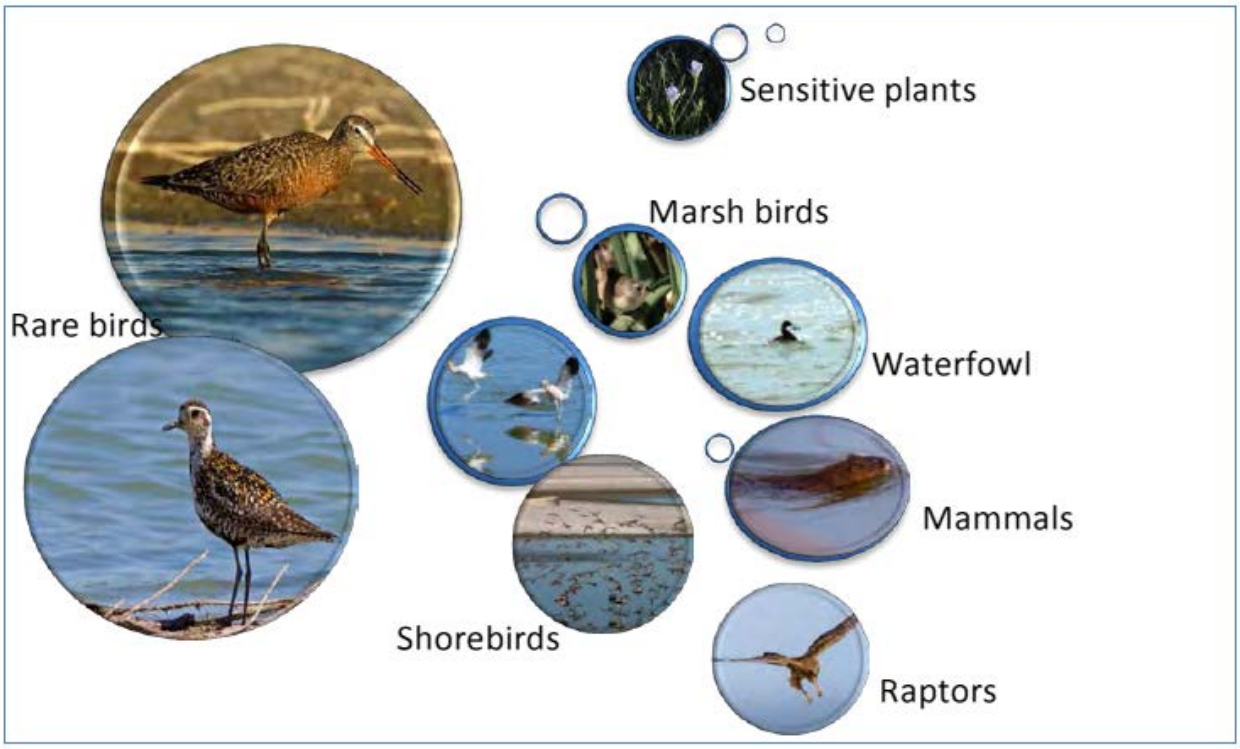
A Memorandum of Agreement (in draft) between DU and EAFB, and agreed to by D14 for the Piute Ponds Complex will be used to increase the ability to use current and historical wetland areas by improving and refurbishing dikes, providing new dikes and water control structures, vegetation control, and various other enhancement and restoration actions. The Piute Ponds Management Plan further discusses the program and plans for restoration and enhancement.

Wetlands Banking

Edwards AFB has no involvement with local or regional wetlands banking.

Current Management Practices Used to Manage Wetland Resources

Piute Ponds Complex management practices are expanded upon within the Piute Ponds Management Plan and only briefly described here. While meeting the mission needs of Edwards AFB and D14; the Piute Ponds Complex will be managed to develop and maintain a healthy mosaic of habitats for many different wetland species (see below). An effort will be made to make the area suitable for species of concern, but the priority will always be to maintain the overall biodiversity of the site.



A sample of species at the Piute Ponds Complex. Photos courtesy of Bob Steele (Bar-tailed Godwit), Larry Sansone (Golden Plover), Pam Vick (Muskrat, Northern Harrier), Rebecca and Bruce Hobbs (Shorebirds), Robert Coley (Ruddy Duck), Don and Jill Davis (American Avocets), Alexander Viduetsky (Marsh Wren)

EAFB will continue to partner with the D14 on a regular basis through the Piute Ponds Complex Manager on water flow, D14 needs, operational mission needs, lakebed, and wildlife needs. Close coordination and ties must be maintained with both D14 and Airfield Management by the Complex Manager to ensure a successful outcome for all the partners. The water flow into the Piute Complex will be continually monitored by the Complex Manager throughout the year through on-site inspections, adjustments, review of D14 water data, and input and observations from users and volunteers.

Day to day maintenance on water control structures, dikes, and roads is accomplished by D14, but major maintenance due to catastrophic failure within the Piute Complex, whether from storm or unknown failure will be a joint effort between D14 and EAFB. A MOU between EAFB and D14 describing each party's responsibilities is being updated to supercede a 1991 MOA and a 1981 Letter of Understanding.

The Complex will be monitored for responses of wildlife to ensure the area remains protective of the wetland species which use the area. This will be accomplished by evaluating the observations sent by birders, reviewing www.ebird.com, and monitoring the harvest data obtained during hunter bag checks. The Piute Ponds Complex Manager will solicit and review information provided by volunteers, visitors, educators, and researchers on the status of the area. It is important to keep an ongoing dialogue with the users; they can be the best source of information for early trends in the Piute Complex. In addition, the Piute Complex will be inspected on a regular basis by the Complex Manager to determine water levels, vegetation and wildlife response to the water levels, invasive species status/extent, and wildlife presence. Although valuable information is obtained from users, volunteers, and contractors, this cannot replace the on-site involvement by government natural resource personnel. This is necessary to ensure the area operates as intended for all parties, and the goals for the area are met given the risk of water issues for both D14 and

Edwards AFB. The Complex Manager will evaluate the management of the Piute Complex, and as warranted, develop projects to address any issues or enhancements. Partnerships with others, such as DU may be expanded with other interested entities to fully utilize available resources and expertise.

Special Initiatives to Address Resource Problem Areas: Vegetation Control

Piute Ponds: Several methods of control such as mechanical manipulation, prescribed burns, and manual removal will be used. Principle concerns include expansion of bulrush, sharp increases in tamarisk growth, planting of desirable tree species, and presence of nonnative perennial pepper weed.

Branch Pond: Several methods of control such as mechanical manipulation, prescribed burns, and manual removal will be used. The principle concern at this time is preventing bulrush and cattails from overtaking the pond and impacting the fishing opportunities, while leaving enough to provide suitable habitat for nesting tricolored blackbirds. Continued inspections will be accomplished to ensure tamarisk is quickly dealt with if they begin to germinate around the pond.

Significant Management Issues Related to Mission

There are issues of concern due to diversion of natural storm flow from the lakebeds and the rest of the hydrologic unit. Currently this concern has been elevated to AF management and leadership. An ongoing partnership between Environmental Management and Airfield Management is assisting with water management on Rosamond Lake. Participation in the Antelope Valley Integrated Water Management Group is an ongoing effort. Membership in this group would further assist in addressing the water needs of the base.

Future Concerns

The recycled water used to support the creation and maintenance of wetlands within the Piute Ponds Complex and flows into Rosamond Lake could become jeopardized as more and more demand for recycled water is seriously considered to be a viable option for the future development of Antelope Valley. Edwards AFB requirement to maintain the natural surface flow through the watersheds creates challenges for the surrounding communities as they strive to increase the amount of available groundwater for development through water harvesting and work towards better community flood control. The Piute Ponds Complex has broad support from the user community, who would likely oppose any decision to reduce or eliminate the flow of water to the ponds.

7.7 Grounds Maintenance

Applicability Statement

This section applies to AF installations that perform ground maintenance activities that could impact natural resources. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

Cantonment Area Natural Resources Management

Base landscapes have not been accomplished in a coordinated manner and would benefit from a coordinated and comprehensive landscape management plan. A base landscape plan needs to be written to guide future landscape efforts. The landscape plan would specify the need to use native plants.

Urban Forest Management

State and community forestry programs seek to encourage and assist municipalities to develop and implement sustainable local urban forestry programs. Grants are designed to encourage communities to actively enhance tree cover along streets and in parks, properly care for and maintain their community trees, develop tree inventories and management plans, and inform their residents of the value and benefits of urban trees.

The program for urban forest management on base is the responsibility of CE in coordination with Natural Resources personnel. Since there are no forests on base, urban forest management primarily consists of managing the use and care of landscape trees in the housing areas and other developed areas of the base. Trees in developed areas include, but are not limited to, mesquite, eucalyptus, pine, cottonwood, palm, ash, elm, and mulberry.

Because the region suffers from water shortages and continuous drawdown of the aquifers, recent landscaping efforts have concentrated on xeric landscaping (i.e., planting species that are native to the desert, thereby requiring less water to maintain). This management decision benefits the desert ecosystem by limiting the amount of pesticide spraying for disease and insects as well as promoting water conservation.

Environmental Management will continue to recommend best management strategies for locations of urban landscape trees to manage and control wildlife in developed portions of the base. Location of tree planting is an important consideration with regards to reducing BASH risks resulting from trees placed near runways and taxiways.

Vegetation Management and Sustainable Landscaping

Green waste is composted and reused on base. The green waste composting facility and grinder operation are located on a four acre parcel of land within the boundaries of the Main Base Landfill. The composting facility accepts green waste including leaves, grass clippings, tree trimmings, other green waste, untreated wood, plywood, pallets, and any wood suitable for grinding.

Lawns are mowed to maintain healthy turf for ball fields, parks, and small landscaped areas. Most turf areas will be converted to bare dirt or rock beds. The golf course turf is maintained by 412 FSS personnel. Trees and bushes within landscaped areas are maintained by CE personnel or contractors. Landscaped common areas and parks within base housing are maintained by the housing project owner.

Road shoulders and associated drainages are mowed and graded on an annual basis. Excess vegetation is removed from drainages within base housing to allow unimpeded water flow.

Nonpoint Source Pollution Issues Associated with Landscape Pesticides and Fertilizers

The potential concerns of nonpoint source pollution are damage to native vegetation and degradation of potable groundwater, health hazards to recreational areas, and harm to fish and wildlife. One objective of the Spill Prevention Control and Countermeasure Plan (SPCCP) (Edwards AFB 2013) and the Hazrdous Substance Incident and Emergency Spill Response Plan (HSIESPP) (Edwards AFB 2010) is to protect the environment, retain natural drainage, manage runoff, and minimize erosion.

Edwards AFB landscaping does not require excessive use of pesticides or fertilizers. Storm water runoff is not connected to any ocean or other body of water; however, major storms do transport storm water runoff to the lakebeds via many desert washes and Mojave Creek. During storms, water can flow from streets and streams onto the lakebeds.

Disease, Insect, and General Maintenance

The base does not spray trees in landscapes to prevent insect or disease outbreaks. Some pesticide applications will be performed to control weeds in rock landscapes.

7.8 Forest Management

Applicability Statement

This section applies to AF installations that maintain forested land on AF property. This section is not applicable to Edwards AFB.

Program Overview/Current Management Practices

N/A.

7.9 Wildland Fire Management

Applicability Statement

This section applies to AF installations with unimproved lands that present a wildfire hazard and/or installations that utilize prescribed burns as a land management tool. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

Threat of Wildland Fire to Mission and Natural Resources

Based on available GIS data since 1998, approximately 849 acres have been impacted by fires (see Appendix Figures, *Fires by Year***)**. The primary cause of wildland fires on base is lightning. Lightning occurs with summer cyclonic storms that can occur from June through October. Primarily, storms with gusty, swirling winds come from the east and south. In addition, the base experiences high winds from fall to spring without the presence of precipitation. There is a potential for wildfires to spread more rapidly and increase in size during periods of high winds. Fires also increase the potential for soil erosion by destroying biological soil crusts and leaving soils exposed to wind and water erosion thus degrading air and water quality.

The second leading cause of fires on base is the release of flares from flying aircraft that land in native habitat just outside of bladed target areas. The PIRA contains about 60,800 acres of designated desert tortoise critical habitat. Based on available GIS data since 1998, approximately 107 acres of critical habitat were impacted by fires. If the frequency of fires increases in tortoise habitat due to mission related activities and fires become larger, a decision to blade a larger buffer area associated with a specific PIRA target may need to be considered. The primary concern with increasing the size of target areas is increased fugitive dust and decreased visibility. It also removes desert tortoise habitat on the PIRA. Mission-related activities usually occur when wind conditions are relatively calm and are thus not conducive to the spread of fires over the landscape. Additionally, such mishaps are restricted to small areas. Any loss of designated desert tortoise critical habitat within the PIRA would be accounted for in the basewide BO. If fires start on the PIRA, the mission stops until the fires are extinguished. The PIRA has changed the chemicals used in spotting charges; phosphorus is not used in ordnance during summer months. PB-13 is the only target approved for live ordnance. Live ordnance is defined by the PIRA as explosive munitions.

Although Edwards AFB has over 200,000 acres of vegetated terrain, the base has not experienced a history of severe wildfires (see Appendix Figures, *Fires by Year*). Wildfires have not caused any physical damage to real property buildings and facilities.

Organizational Structure for Wildland Protection and Response Protocols

Edwards AFB Fire Protection Division has seven functional elements: Management, Administration, Operations, Fire Prevention, Fire Protection Training, Communications, and Logistics. The Wildland Fire Management Plan (WFMP) lists the organizational structure and personnel responsible for wildland fire activities (see Tab 3 - Wildland Fire Management Plan). The WFMP also shows the locations of the five fire stations on base, each with its own defined district boundaries (District 1 through District 5) (see Appendix Figures**,** *Fire District Responsibility Areas*).

Currently, Edwards AFB has trained about 91% of its Fire Protection Branch staff to fight wildland fires; however, training is ongoing as required for new hires. The WFMP discusses certification, training, fitness standards, safety, emergency plans, and standard operating guidelines for wildland fire management personnel. The WFMP assists in determining required suppression resources to respond to installation wildfire hazards. Firefighters maintain a state of readiness for any minor or moderate fire including maintaining firefighting equipment on a daily basis.

To fight or contain a minor, moderate, or major wildland fire within any of the five districts, Fire Protection Branch personnel rely on the Installation Emergency Management Plan (USAF 2014), where specific preparedness activities as actions or tasks are listed along with the responsible person or organization to carry out such actions or tasks involving a wildland fire that appears to be out of control. Fire Protection Branch personnel also rely on Standard Operating Guideline (SOG) to ensure that all necessary trained personnel, equipment, and associated facilities are prepared to respond and suppress a wildland fire. The Installation Emergency Management Plan and SOG are found in the Appendices of the WFMP.

All public relations and media notification affairs are handled by Public Affairs. Any communications provided by Fire Protection Branch personnel is coordinated through the Security Forces Operations Officer and provided to Public Affairs personnel. All communications are reviewed and approved by base leadership prior to release.

Prescribed Fires

Prescribed burns are planned and will be conducted in Branch Pond and the Piute Ponds Complex for training and management purposes. The use of prescribed burns will be implemented in conjunction with other methods of control, i.e. mechanical cutting, chemical removal, and hand pulling. Management strategies for prescribed burns are described in the Piute Ponds Management Plan (Section 12 Tab 1) and are coordinated with the applicable base organizations. On occasion, prescribed burns may be conducted for weed control and training in other areas of the base, and take place infrequently. Any prescribed fires would require prior coordination with Environmental Management.

7.10 Agricultural Outleasing

Applicability Statement

This section applies to AF installations that lease eligible AF land for agricultural purposes. This section is not applicable to Edwards AFB.

Program Overview/Current Management Practices

The USDA NRCS prepared a Grazing and Cropland Management Plan in conjunction with a cooperative soil survey for Edwards AFB (NRCS 1996 and 1997; Section 12 Tab 2). The plan presented recommendations for grazing and agricultural outleases on portions of the base, based on the presence of suitable soils and vegetation, and compatibility with mission use areas.

Because of environmental and mission safety concerns, agriculture and grazing are not allowed on Edwards AFB. The presence of unexploded ordnance in the open desert from past mission operations present a safety hazard for personnel and grazing animals. In addition, the environmental concerns include pumping of groundwater to water crops, major surface disturbance, impacts to sensitive plant communities and animal populations, increased fragmentation of habitat, soil erosion, and storm water pollution issues from use of pesticides and fertilizers associated with farming.

7.11 Integrated Pest Management Program

Applicability Statement

This section applies to AF installations that perform pest management activities in support of natural resources management, e.g. invasive species, forest pests, etc. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

Natural Resources Management Program Support of IPM

Natural resources management supports the IPM Program through coordination with CE and the pest control contractor by:

- Providing information on the biology of plants, animals, and protected species;
- Recommending control options;
- Evaluating effectiveness, costs, and benefits of proposed control actions;
- Assessing potential environmental impacts of chemical pesticide usage;
- Consulting with regulatory agencies to obtain necessary permits for control of pests; and
- Managing revegetation projects.

Household Pests

This group of pests includes cockroaches, flies, ants, crickets, spiders, and other similar organisms. These are usually nuisance pests affecting the morale of personnel; however, some can become health risks. An integrated approach of sanitation, inspection, exclusion (elimination of entry and harborage), and chemical control are used. Sanitation control measures are emphasized and chemicals are used as a last resort. Cockroaches are the primary concern. Inspection of food- handling establishments is conducted monthly. Chemical treatment is conducted, as needed, after sanitation and exclusion control measures have been implemented. The 412th Medical Group, Public Health Office is notified prior to application of pesticides in food-handling facilities or the clinic.

Structural Pests

Termites are the primary structural pests at Edwards AFB. Termites can severely damage a facility and necessitate extensive repairs. Chemical control is the primary method used for termites.

Stored-Product Pests

Stored-product pests include insects that infest boxed cereal and other food. They usually become a problem when food is stored too long. These pests are not a major concern at Edwards AFB. The 412th Medical Group personnel train food facility managers on how to inspect all incoming shipments of produce and meat products to ensure that the food is not contaminated.

Health-Related Pests

This group typically includes bees, wasps, black-widow spiders, fleas, mosquitoes, and similar organisms. At Edwards AFB, health-related pests also include California ground squirrels and other rodents that potentially carry plague, hantavirus, West Nile virus, and other diseases that can be transmitted to humans. These diseases can affect the health of base personnel. Control measures utilized for health-related pests include mechanical traps, exclusion, and chemical control.

Pest Management

The Federal Insecticide Fungicide and Rodenticide Act (FIFRA) (7 U.S.C. 136, et seq.) regulates the manufacture, use, storage, and disposal of chemicals used as pesticides as described in the Code of Federal Regulations, 40 CFR Parts 150–180. A Pest Management Plan is required for Edwards AFB in accordance with DoDI 4150.7, DoD Pest Management Program. DoDI 4150.7 states that it is DoD policy to establish and maintain safe, effective, and environmentally sound IPM programs to prevent or control pests and disease vectors that may adversely impact the readiness of military operations by affecting the health of personnel or damaging structures, material, or property.

The DoD has established three Measures of Merit for pest management at its installations (Office of the Under Secretary of the Defense, 1994). Measure of Merit 1 required all DoD installations to have a Pest Management Plan prepared, reviewed, and updated annually by the end of FY 1997. Measure of Merit 2 set a goal of 50-percent reduction in the amount of pesticides used at DoD installations by FY 2000, compared to a baseline use in FY 1993. Pesticide reduction was implemented as part of the overall pollution prevention program at Edwards AFB. Measure of Merit 3 set a goal of having all DoD installation pesticide applicators properly certified by the end of FY 1998.

The DoDI 4150.7 requires that on-site reviews be conducted using the guidance found in the DoDI and Armed Forces Pest Management Board Installation Pest Management Program Guide, Technical Guide No. 18. Technical Guide 18 provides information and requirements for installation pest management programs and guidance for evaluation of these programs. The Pest Management Plan follows the AF guidance found in AFI 32-1053, Pest Management Program, and describes pest management program operations, management procedures, pest management facilities, health and safety issues with respect to application of pesticides and herbicides, and regulatory compliance issues. AFI 32-1053 provides guidance on pest management with an emphasis on avoiding impacts to the environment. This AFI discusses procedures and identifies responsibilities for pest management programs at AF installations.

CE is the office of primary responsibility for pest management on Edwards AFB. Pest control, as part of any construction project or contract, must be coordinated with CE for scheduling and monitoring of the pest management work. The contractors are required to report pesticide reports via the web-based Integrated Pest Management Information System (IPMIS) and forward a copy of the report to the installation Installation Pest Management Coordinator.

CE implements the Edwards Air Force Base Pest Management Plan in coordination with Environmental Management, Public Health, Bioenvironmental Engineering (BEE), Safety Office, and Security Forces.

IPM is a DoD-mandated approach to pest control that uses routine monitoring to determine if pest control measures are necessary. IPM employs mechanical, physical, cultural, biological, and educational methods to maintain pests at populations low enough to prevent undesirable damage or annoyance. Application of the least-toxic chemical applications is utilized as a last resort. Pest control measures, including chemical control measures, are implemented only when monitoring determines that a pest will cause unacceptable economic, medical, or aesthetic damage if not treated. Treatments are chosen and scheduled to be the most effective and least disruptive to the natural environment.

Wildlife pests or nuisance animals are any wild or domestic animals that cause annoyance, health and safety hazard, landscape or property damage, or compromise mission objectives. These pests primarily include ants, mosquitoes, mice, California ground squirrels, snakes, bobcats and coyotes. Written permission to relocate wildlife species must be received from the Natural Resource Manager prior to trapping activities.

The pest management contractors overseen by CE are responsible for control of pests (e.g., weeds, insects, mice, gophers, rabbits, and California ground squirrels) everywhere except housing which has been privatized. The use of kill-traps is the preferred method for most rodent control. Pesticides are applied only in areas containing major infestations of rodents, such as California ground squirrels. California ground squirrels are nuisance pests in the Military Family Housing (MFH) area, other developed and landscaped areas of Main Base and South Base, including the golf course.

CE develops projects to control pests and manages pest management contract activities. Other tenant organizations provide funding for pesticide applications under their own budgets. All pest control work on Edwards AFB is conducted by contractors that are overseen by the Installation Pest Management Coordinators. The Installation Pest Management Coordinators provide oversight and monitor the contractors who apply pesticides on base property. Regulations concerning the sale, application, and distribution of pesticides in California are reviewed periodically for relevancy to base operations. The Installation Pest Management Coordinators maintains a file of all applicable state, federal, and DoD regulations that pertain to pesticides.

The Edwards AFB self-help store does not currently stock pesticides for household use, but they can make recommendations for store purchase of pesticides.

Pest Species that Interrelate To and Potentially Affect Natural Resource Management

California ground squirrels have spread to all landscape areas within Main Base, the housing area, and South Base. In some cases, they have entered occupied houses on base and have to be removed by the pest contractor. Their foraging and burrowing cause damage to lawns and landscape areas containing grass, shrubs, and trees. If left unchecked California ground squirrels may invade native desert interfaces next to the populated areas causing impacts to antelope and Mohave ground squirrels.

California ground squirrels are classified as nongame mammals by the CDFW. Nongame mammals that are found destroying landscapes or other property may be controlled at any time, in any manner that is legal and humane, by the owner or tenant of the property. They may be controlled by federal, state, or county officers or employees while acting in their official capacity.

An IPM strategy consists of several components that maximize the beneficial effects, with minimal environmental effect and risk to human safety. Benefits are greatest when several strategies are used collectively on a continuous basis. An IPM model is designed to produce long-term sustainable management of California ground squirrel damage and may require a variety of data collection and strategies to control the population, such as:

- Identification of occupied areas,
- Testing and applying control techniques,
- Monitoring effectiveness of control techniques,
- Monitoring changes in population distribution,
- Determining acceptable population thresholds, or
- Determining if California ground squirrels are expanding into native desert areas.

Predator Control and Other Pests

The primary objective of bobcat and coyote management is to protect base personnel. Goals include educating base personnel about bobcats and coyotes, maintaining coyote health and natural behavior, and being prepared to respond to problem animals. The primary method of maintaining bobcat and coyote health and natural behavior is to prevent people from feeding these animals. The first step in this plan is to educate base personnel. The housing and cantonment areas will be monitored and assessed for potential problem animals. Security Forces will use harassment and aversion on bobcats and coyotes. Removal actions will be taken if harassment and aversion does not work. Written permission to relocate wildlife species must be received from the Natural Resource Manager prior to trapping activities. Environmental Management will perform surveys as required to monitor bobcats and coyotes in base housing. Environmental Management will keep a database of sightings and incidents to detect any patterns of animal behavior and/or occurrence. Security Forces will implement aversion and harassment as required. If further assistance is required the base will contact USDA Wildlife Service for support. Security Forces assists pest management personnel by removing other wildlife (e.g., snakes, birds) and stray or feral animals (e.g., dogs and cats) from housing and facilities on Main Base, North Base, and South Base.

Invasive Species Management

Executive Order (EO) 13112, Invasive Species, was signed on 3 February 1999. The purpose of EO 13112 is to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts attributed to invasive species. The spread of exotic species has the potential to replace healthy, diverse ecosystems with biologically impoverished, homogeneous populations.

Although invasive weed species are not numerous, they are increasing and can reach nearly 100 percent of the annual biomass in early rainfall years. Weeds out-compete the native annuals. Weedy annuals of disturbed areas such as redstem filaree (*Erodium cicutarium*), tumble mustard (*Sisymbrium altissimum*), tumbleweed (*Salsola tragus*), red brome (*Bromus rubens*), cheat grass (*Bromus tectorum*), western tansy (*Descurania pinnata*), and Mediterranean grass (*Schismus barbatus*) are common in disturbed portions of natural habitats throughout the base. African rue (*Peganum harmala*) is an A rated pest plant species that occurs along Jones Road.

Edwards AFB has conducted surveys to identify invasive species and their distribution through various plant inventory projects. Weed control has been limited to bladed areas, roadsides, restoration areas, Branch Pond, and the dikes at Piute Ponds. Some weedy species such as salt cedar are not particularly invasive in dry areas of the Mojave Desert, but are found at Piute Ponds, Branch Pond, and other wet areas on base. At present, there is no control for ubiquitous weeds of the Mojave Desert such as redstem filaree, cheat grass, split grass, and red brome. Kern County Agriculture Department has been conducting surveys and applying herbicides to eliminate harmel on Edwards AFB. Environmental Management monitors road shoulder work in the area to prevent spreading the seeds or plants of this species. Tamarisk control is planned for Piute Ponds and Branch Pond. Primary control methods will utilize mechanical and physical control (i.e. water levels). Some herbicide applications will also be necessary to control what is becoming an infestation of tamarisk throughout the ponds. Branch Pond will be surveyed to ensure no tamarisk germinate and grow around the pond. If found they will be removed immediately via mechanical removal and herbicide application.

In 2015, the Air Force conducted a survey and developed a Best Management Plan for tamarisk species on base. Options evaluated include biological control, prescribed burning, mechanical control, grazing, flooding, and chemical control.

An Invasive Species Management Plan will be developed and incorporated into the INRMP. Recommended procedures for the control of noxious exotic plant species include:

- Assess presence and extent of problem species;
- Identify target species and develop management goal and measurable objectives;
- Review and assess various control techniques and restoration methods;
- Develop a base-wide, site-specific, 10-year work plan that lays out the steps required to achieve a long-term desired condition for invasive species on Edwards AFB;
- Implement species-specific control techniques as outlined in the work plan;
- Conduct habitat restoration with native plants where required to provide weed resistence and persistence of native habitats;
- Monitor and assess impacts of control techniques;
- Evaluate effectiveness of control program; and
- Reevaluate and modify objectives and the work plan to meet management goals.

7.12 Bird/Wildlife Aircraft Strike Hazard (BASH)

Applicability Statement

This section applies to AF installations that maintain a BASH program to prevent and reduce wildlife-related hazards to aircraft operations. This section is applicable to Edwards AFB

Program Overview/Current Management Practices

The BASH Plan (Tab 4); AFI 91-204, Safety Investigations and Reports; and AF Pamphlet 91-212, Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques, provide guidance for the BASH Reduction Program. AF Pamphlet 91-212 applies to all AF personnel who plan, support, or are engaged in flying operations. The Flight Safety Office manages the BASH Reduction Program on Edwards AFB.

The Edwards AFB Bird Hazard Working Group consists of representatives from Flight Safety, Airfield Management, Air Traffic Control, flying units, tenant organizations, CE, Environmental Management, and Aircraft Maintenance. These AF personnel work together to assist the Safety Office in drafting and implementing the BASH Reduction Plan to prevent or reduce the potential for BASH.

Edwards AFB is situated within the boundary of the Pacific Flyway, which serves as a migratory route for numerous bird species, including waterfowl. Seasonal migration and daily flight patterns of birds create an increased risk to flight operations. The control tower monitors the movements of birds in the airfield environment and alerts aircraft when there are large numbers of birds near the runway or in flight corridors. Flight Safety maintains records of the types and numbers of birds struck by aircraft.

BASH risks may be controlled and reduced through a variety of methods. The primary method is managing habitats to discourage birds in the runway and flightline environment. Other methods include:

- Revegetating disturbed areas near the runways using native plants to discourage bird populations;
- Preventing accumulations of standing water near the runway;
- Using lighting that does not attract insects and insectivorous birds;
- Continued use of the bird avoidance model to predict times of day, year, and locations when birds are more likely to be active;
- Mechanically securing buildings to deny access to nuisance bird populations;

- Use harassment techniques, such as pyrotechnics and acoustics to move birds away from active flight operational areas;
- Limiting sunrise and sunset takeoffs and landings during severe or moderate bird activity. Flights can also be canceled or delayed depending on the severity of the bird activity and during the presence of large flocks of birds on the flightline; and
- Lethal removal of birds in accordance with the Migratory Bird Depredation Permits issued by the USFWS.

The Security Forces and Airfield Management, in coordination with the Environmental Management natural resource manager or wildlife biologist, are responsible for assisting with the elimination of bird hazards along the flightline, including the hangars. Each year, Environmental Management renews the depredation permit with the USFWS to remove, harass, or depredate migratory birds that are a risk to airport safety. Dispersal methods are implemented for birds posing a hazard to aircraft. One method of dispersing birds is firing a shotgun using pyrotechnic shells, producing a startle effect. Elimination of birds in hangars is also accomplished with exclusion measures such as keeping hangar doors closed. Additionally, Environmental Management has used a trained falcon to discourage birds around the runway. If continuing nonlethal dispersal methods are not successful as the birds become acclimated to applied dispersal methods, lethal methods are used to remove birds. Migratory Bird Depredation Permit annual reports are completed and submitted to the USFWS by the Environmental Management natural resource manager or wildlife biologist.

Existing and Potential Hazards to Aircraft Posed by Wildlife

A low to moderate bird hazard exists at Edwards AFB. Rogers, Rosamond, and Buckhorn Lakes may become inundated with water during the winter and spring months resulting in the presence of aquatic arthropods (shrimp) that become a food source for migratory birds. The BASH risk is minimized by reporting sightings to Airfield Management and implementation of the BASH Plan as appropriate. The BASH risks are minimized on base by the selection and planting of landscape plants that do not attract nesting birds in areas that have had BASH problems in the past, and through building design by limiting the number of favorable sites on the outside of buildings that would attract nesting birds. Environmental Management wildlife biologists and Security Forces work together to remove birds and other wildlife found in hangars and other buildings on base found to pose a risk.

BASH Focal Species and Natural Resource Hazards

The primary pest bird species occurring adjacent to the flightline include sage sparrow, burrowing owl, mourning doves, and horned larks. Horned larks are the primary problem species associated with hazards to aircraft. They are a grassland species that do well in the desert, especially in areas that contain standing water or sparsely vegetated areas (e.g., flightlines and taxiways). Large flocks of horned larks congregate in close vicinity to the Main Base flightline or adjacent to the runways especially in areas that are disturbed through mowing or grading.

In 2014, the Air Force conducted a golden eagle data review and analysis for all of Edwards AFB and within a 10 mile radius. This analysis was conducted in order to assess the necessity of obtaining a federal permit in accordance with 50 CFR 22.27 (Removal of eagle nests). Data was gathered from multiple sources including; Edwards AFB BASH database, Edwards AFB Geographic Information System, Basewide surveys, BLM, the Audubon Society Christmas Bird Count, and eBird. This study showed that sighting-clusters appeared to be associated with habitats such as wetlands and clay pans within scrublands on base (The Sanberg Group 2014). Piute Ponds contained 86% of the reported sightings in this analysis.

Although there are no reported golden eagle BASH incidents on Edwards AFB, the probability of this happening increases in areas such as Piute Ponds and in areas such as the Precision Impact Range Area where low altitude flying is more frequent (The Sanberg Group 2014). It was concluded that based on the lack of any golden eagle BASH incidents on and around Edwards AFB, there is no need to obtain a permit pertaining to 50 CFR 22.27.

The number of rock doves, or pigeons, has been increasing in the housing and flightline areas. The hangars provide roosting and nesting habitat. This species is expected to represent an increased BASH risk in the future. Control actions should be taken as soon as possible while population numbers are still relatively low.

How the Natural Resources Program Supports BASH Plan Objectives

Environmental Management conducts inventories and behavioral studies of the birds on base to develop habitat management measures to discourage or reduce the number of birds using the areas around the runways and taxiways. Environmental Management natural resources staff collects information on bird population densities and movement. Environmental Management provides information to Airfield Management and Flight Safety on bird migrations.

7.13 Coastal Zone and Marine Resources Management

Applicability Statement

This section applies to AF installations that are located along coasts and/or within coastal management zones. This section **IS NOT** applicable to Edwards AFB

Program Overview/Current Management Practices

No coastal zone or marine resources exist on Edwards AFB.

7.14 Cultural Resources Protection

Applicability Statement

This section applies to AF installations that have cultural resources that may be impacted by natural resource management activities. This section is applicable to Edwards AFB.

Program Overview/Current Management Practices

There are no substantial or significant fossil resources known to exist on Edwards AFB. In the event of a paleontological discovery, the natural and cultural resource sections will work together on the protection and management of the resources.

Evidence suggests that the area now known as Edwards AFB has witnessed continual occupation for thousands of years and base operations are only the most recent contributor to that long history. The vast accumulation of cultural materials (known also as cultural resources) that result from human activity hold great significance for our collective heritage as a region and a nation. As such, the National Historic Preservation Act, as amended, directs Edwards AFB to establish policies that conserve, protect, and preserve these cultural resources, whether or not they result from the current military mission.

The Edwards AFB Integrated Cultural Resources Management Plan (ICRMP) presents strategies that ensure compliance with federal, state, and local regulations, and it ensures that Edwards AFB protects resources for the good of the public. In general, the strategies consist of the following categories:

Identification and Evaluation: identification of buildings, landscapes, and artifacts that were (and in some cases still are) used by people throughout time. The data will be analyzed and evaluated, and sites are classified based on where they are located and how they were used.

Determination and Nomination: based on their classification, specialists determine the relative importance of cultural resources by comparing them to other resources found on base, in the region, and around the country. Cultural resource specialists weigh the importance of the resources against predetermined criteria and the exemplary ones are nominated for inclusion on the National Register of Historic Places (NRHP). The NRHP is the official list of the Nation's historic places that are worthy of preservation.

Preservation, Protection and Education: NRHP sites undergo additional study and examination; associated artifacts are removed and preserved in a special on-base curation facility. Aspects of the site that cannot be removed are stabilized and protected against natural and human disturbance. Because Edwards AFB is a steward of resources that ultimately belong to the public, it educates the public when possible about resources that help define the historical development of the area.

It should be noted that the ICRMP is only one aspect of the overall management of the environment. The ICRMP and the INRMP work in tandem to address larger environmental concerns, and cooperation between the goals of the ICRMP and INRMP are coordinated for this purpose. For provisions that address the protection and management of cultural resources on Edwards AFB, please refer to the ICRMP (USAF 2012).

7.15 Public Outreach

Applicability Statement

This section applies to all AF installations that maintain an INRMP. Edwards AFB is required to implement this element.

Program Overview/Current Management Practices

Natural Resources Awareness Program

Natural Resources personnel provide natural resources training to base newcomers, ORV users, building managers, and temporary and permanent workers. This highly successful program has reached more than 12,000 individuals since 1991 and is a USFWS requirement in the basewide BO.

Natural Resources personnel have been actively involved in educating the public at outreach events for many years. At outreach events, they provide live animals (including a live desert tortoise), taxidermy specimens, GIS data collection activities, and information on sensitive plants and animals of the Mojave Desert. These outreach programs are conducted during Earth Day, local elementary and high school career days, Desert Safety Day, Family Day celebrations, and some off-base local community events. Environmental Management hosts an Earth Day event every April.

Wildlife Education and Interpretation

The Natural Resources Education Program centers on desert tortoise and ESA education. All persons working on Edwards AFB are required to attend a desert tortoise awareness briefing. A general awareness briefing is given to personnel that work indoors or within developed areas of the base. Project specific briefings are provided to personnel working outdoors in areas where desert tortoises are known to occur. Tailgate briefings are given to personnel that have received a project specific briefing, but may be working in different areas of the base or under varying conditions, such as season of year, weather, or areas of high desert tortoise density.

A briefing is also provided for personnel and projects that have the potential to impact birds protected under the MBTA. Three types of briefing videos have been produced to target children, contractors, and government personnel.

Environmental Management provides several types of briefings that are aimed at everyone working and living on base, including school children. A primary topic is safety and desert wildlife. Topics include the dangers of rattlesnakes, coyotes, and scorpions; and the importance of not feeding wildlife. Various presentations are provided for general audiences to promote wildlife and nature appreciation. A slide presentation is given to base newcomers and building managers, and includes a discussion on desert safety. Newcomers get a general briefing on natural resources, safety, the desert tortoise, sensitive species, and ecosystem management. Many of the talks are enhanced with brochures, flyers, fact sheets, live animal demonstrations, and a display of taxidermy specimens. Desert tortoise and sensitive plant discussions are also done on a project specific basis.

Environmental Management provides an education program on natural resources during special events such as Earth Day and visits to Piute Ponds. This involves government personnel, contractors, and volunteers who discuss the desert environment and the natural resources that occur on base. The program includes poster boards, live animals, wildlife taxidermy, nature walks; GIS demonstrations, and brochures.

Natural Resources Education Materials

Numerous natural resources stories are published each year in the base newspaper. A desert tortoise video produced by NASA/Armstrong in the mid-1990s is still distributed and used, and a video on the MBTA is available at: https://www.youtube.com/user/EdwardsAFBEM/videos. The current inventory of Edwards-produced brochures, flyers and fact sheets include:

- The Birds of Edwards AFB California (birder's checklist)
- ORVs on Edwards AFB (brochure)
- Wildflower Tour Guide (brochure)
- Off-Roading and Conserving Native Species (flyer)
- The Desert Tortoise at Edwards Air Force Base (brochure)
- Predators (flyer)
- Living with Desert Wildlife (brochure)
- Lakebeds are Alive (flyer)
- Desert Tortoise Alert Card (wallet card)
- Desert Tortoise Awareness Decal
- Do Not Feed Wildlife (poster)
- Wild Animals Can Be Aggressive (poster)
- Living with Birds at Edwards AFB (brochure)
- Common Barn Owl (*Tyto alba*)
- Bobcat (*Lynx rufus*)
- Burrowing Owl (*Athene cunicularia*)
- Red Coachwhip Racer (*Masticophis flagellum piceus*)
- Common Kingsnake (*Lampropeltis getula*)
- Coyote (*Canis latrans*)
- Desert Blonde Tarantula (*Aphonopelma chalcodes*)
- Desert Tortoise (*Gopherus agassizii*)
- Desert Kit Fox (*Vulpes macrotis arsipis*)
- Desert Kangaroo Rat (*Dipodomys deserti*)
- Desert Iguana (*Dipsosaurus dorsalis*)
- Gopher Snake (*Pituophis catenifer*)

- Great Horned Owl (*Bubo virginianus*)
- Greater Roadrunner (*Geococcyx californianus*)
- Mojave "Green" Rattlesnake (*Crotalus scutulatus*)
- Red-Tailed Hawk (*Buteo jamaicensis*)
- Sidewinder (*Crotalus cerastes*)
- White-Tailed Antelope Ground Squirrel (*Ammospermophilus leucurus*)
- Mohave ground squirrel (*Xerospermophilus mohavensis*)

7.16 Geographic Information Systems (GIS)

Applicability Statement

This section applies to all AF installations that maintain an INRMP, since all geospatial information must be maintained within the AF GeoBase system. Edwards AFB is required to implement this element.

Program Overview/Current Management Practices

Air Force Instruction 32-10112, Installation Geospatial Information and Services (Installation GI&S), provides the policy and guidance for GIS management on all Air Force installations including Edwards AFB. The GIS is a management tool that consists of computer hardware, software, geographic and non-geographic, and personnel whose responsibilities are to accurately and efficiently capture, store, maintain, analyze, and display geographically referenced information. The 412th Communications Squadron (412 CS) manages the overall GIS hardware infrastructure, whereas 412 CE manages the environmental functional GIS work; including table design and creation, data storage methodologies, data maintenance, analysis, and the creation of custom end products.

The Edwards AFB GIS is a major proponent of GIS integration in the AFMC and Air Force as a whole. Edwards AFB is leading the way in implementing the GeoBase vision of enabling decision makers with an enterprise capability for installation mapping and the visualization of fused, analyzed, and multi-functional data. Edwards AFB provides Geobase services through a single GIS database, centrally located servers, and a web-based interactive map site. Edwards AFB GIS currently utilizes software from a wide variety of vendors as appropriate; including ESRI, Autodesk, Intergraph, Google, and EXELIS. The Edwards AFB GIS is also on the cutting edge with the implementation of an Oracle spatial database to leverage our existing GIS software while supporting platform independence. In addition, 412 CE adheres to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) required by the DoD. The SDSFIE standard provides GIS standardization for table structure, metadata, and data storage among all DoD installations.

The 412 CE GIS Working Group (GISWG) is a key part of managing the Edwards AFB enterprise GIS. The Edwards AFB GIS uses state of the art equipment, software, and custom configurations to support the mission through efficient and effective management of spatial data and the ability to analyze the data in support of specific program and project requirements. The GISWG oversees strategic initiatives related to exploiting GIS as a tool for planning and execution throughout the base. Environmental Management is a key member of the GISWG and uses GIS extensively in all aspects of its environmental programs.

The Edwards AFB GIS program provides a variety of applications and products for a wide-range of end user needs. Many requirements for custom maps and analyses are currently being met by the Edwards AFB web-based GIS Map Viewer. The GIS Map Viewer provides thousands of maps to hundreds of end-users every month, allowing GIS contractor and government personnel to spend additional time on other

productive activities. The GIS capabilities are divided into the following categories and used in adaptive management of natural resources:

- Data collection
- Data maintenance
- Data analysis
- Data summarization

Based on these capabilities, the Environmental Management staff relies heavily on the use of GIS in its daily operations. The GIS supports Natural Resources, Cultural Resources, Environmental Restoration Program (ERP), Environmental Quality, and the Environmental Impact Analysis Process (EIAP). The types of support provided include, but are not limited to:

7 Providing custom mapping products
8 Locating base infrastructure
9 Locating regional and local government boundaries
10 Delineating wildlife habitats and corridors
11 Locating Air Force flight activity boundaries
12 Monitoring and tracking sensitive species
13 Monitoring and managing habitat disturbance and restoration efforts
14 Modeling habitat suitability
15 Delineating floodplains
16 Characterizing stormwater flow patterns
17 Analyzing projects for NEPA and EIAP compliance
18 Storing data for regulatory reporting
19 Delineating land use controls
20 Providing an interactive GIS Map Viewer

Environmental Management utilizes various data collection methodologies to ensure that a focused and cost-effective long-term monitoring program is achieved. One goal of this monitoring program is to determine how plant communities change spatially over time as a result of ground- disturbance activities. To accomplish this goal, Environmental Management has acquired remote sensing imagery and Light Detection and Ranging (LIDAR) elevation data, and plans to periodically reacquire updated imagery and LIDAR data. Environmental Management acquired multispectral imagery from a satellite platform in 2003 and hyperspectral imagery from an aerial platform in 2008. LIDAR elevation data were collected from an aerial platform in 2006. Environmental Management also has access to high-resolution (3-12") aerial photography acquired periodically by CE. In addition, publically available satellite-based imagery is acquired and utilized when appropriate.

The LIDAR data has been used to develop an accurate and precise digital elevation model (DEM) and generate slope and aspect maps. LIDAR data has also been used to determine spatial distribution of vegetation canopy heights, define surface water flow patterns, and improve the accuracy of 100-year floodplain maps. Imagery and LIDAR-derived data have been used to develop high-quality maps showing the spatial distribution within vegetation communities, to identify areas of past disturbance, and to model potential distributions of sensitive species habitat.

For instance, habitat modeling based on multispectral imagery directly supported the decision by USFWS not to list desert cymopterus.

The GIS data and maps will be used in future surveys and modeling efforts to identify species habitat, evaluate recovery of various habitats from mission-related projects, activities, and operations, as well as support the implementation of environmental projects to benefit the desert ecosystem. This information will also be used to determine habitat stability and will support the regional recovery effort, taking into consideration the goals and objectives of the Desert Tortoise Recovery Plan and this INRMP. Some data gathered from this effort may be shared with federal and state agencies to aid in the regional effort of determining the stability of endangered and sensitive species and potential recovery of desert tortoise throughout its range in the Mojave Desert.

8.0 MANAGEMENT GOALS AND OBJECTIVES

The installation establishes long term, expansive goals and supporting objectives to manage and protect natural resources while supporting the military mission. Goals express a vision for a desired condition for the installation's natural resources and are the primary focal points for INRMP implementation. Objectives indicate a management initiative or strategy for specific long or medium range outcomes and are supported by projects. Projects are specific actions that can be accomplished within a single year. Also, in cases where off-installation land uses may jeopardize AF missions, this section may list specific goals and objectives aimed at eliminating, reducing or mitigating the effects of encroachment on military missions. These natural resources management goals for the future have been formulated by the preparers of the INRMP from an assessment of the natural resources, current condition of those resources, mission requirements, and management issues previously identified. Below are the integrated goals for the entire natural resources program.

The installation goals and objectives are displayed in the 'Installation Supplement' section below in a format that facilitates an integrated approach to natural resource management. By using this approach, measurable objectives can be used to assess the attainment of goals. Individual work tasks support INRMP objectives. The projects are key elements of the annual work plans and are programmed into the conservation budget, as applicable.

Installation Supplement – Management Goals and Objectives

The primary purpose of this INRMP is to implement natural resource management practices that strive to maintain or enhance habitat quality of natural resources and maintainor increase the biodiversity of the desert environment. These goals and objectives represent an integrated strategy to managing the desert ecosystem. A goal reflects a future natural resources condition that will not only sustain the military mission but enhance the native biodiversity for generations. An objective is a measurable aspect for achieving goals. Projects provide the steps necessary to achieve objectives and are used in the planning and programming process to request implementation funding. Each goal is supported by objectives which indicate a management initiative or strategy that will be used to achieve the stated goal.

Goals are broad guiding principles for the program thus they may or may not change over the life of the INRMP. Objectives may be difficult to achieve in a given year; sometimes it takes multiple years. In years when rainfall is below average, which may occur in consecutive years, very little progress can be made with respect to spring surveys, restoration efforts, and even baseline surveys. During these years, listed wildlife and other sensitive species are difficult to find because they occur in low or dispersed populations, or are relatively small, cryptic, rarely active, nocturnal, or distributed over a wider range than in years with normal or above normal rainfall. In other words, wildlife population levels and activity periods in the desert vary widely, depending on the amount and timing of precipitation. Comparisons from one year to the next can be difficult because climatic conditions change year to year. Determining trends may take up to ten or

more years of sampling in order to analyze the results and determine the status of a particular species or its habitat and the overall health of the ecosystem.

Natural Resource Program Management

GOAL 1: Maintain professionally trained government natural resource management staff.

- Objective 1.1: Ensure natural resource management personnel complete the DoD Natural Resource Compliance Course offered by the Naval School, Civil Engineer Corps Officers School (CECOS) as required by AFI32-7064 (2004) and attend other appropriate national, regional, and state conferences and training courses.

GOAL 2: Maintain current INRMP component plans.

- Objective 2.1: Update component plans on a rotating basis.
  - Project 2.1.1: Develop landscape development and management plan.
  - Project 2.1.2: Develop golf course management (GEM) plan.
  - Project 2.1.3: Develop invasive species management plan.

GOAL 3: Integrate management of Edwards AFB natural resources with cooperating agencies.

- Objective 3.1: Prepare INRMP in cooperation with US Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW).
  - Project 3.1.1: Solicit input and draft reviews of INRMP annual updates and revisions with cooperating agencies.
  - Project 3.1.2: Conduct INRMP annual review meetings with cooperating agencies at least once annually.
  - Project 3.1.3: Coordinate all activities listed in INRMP with Edwards AFB Integrated Cultural Resources Management Plan (ICRMP), including providing a copy to local interested tribes.

Fish, Wildlife, and Habitat Management

GOAL 4: **Maintain and enhance quality and quantity of habitat.**

- Objective 4.1: Limit habitat disturbance of unimproved lands.
  - Project 4.1.1: Track and report habitat disturbance annually.
  - Project 4.1.2: Identify and restore disturbed habitat using updated site-specific restoration plans; monitor success for adaptive management (see 2012 Comprehensive Base-Wide Habitat Restoration Plan).
  - Project 4.1.3: Incorporate HQA data into GIS, review and analyze to determine biodiversity trends.
- Objective 4.2: Update Road Closure Plan.
  - Project 4.2.1: Establish baseline map of current locations and types of habitat disturbance.
  - Project 4.2.2: Limit creation of new roads and determine success of road closures to date.
- Objective 4.3: Minimize dust build up on desert vegetation.

GOAL 5: Maintain natural resource based outdoor recreational opportunities.

- Objective 5.1: Enhance fishing at Branch Pond.
  - Project 5.1.1: Remove excess vegetation and soils.
  - Project 5.1.2: Install interpretive signs.
  - Project 5.1.3: Stock fish as needed.
- Objective 5.2: Improve upland game bird hunting.
  - Project 5.2.1: Install wildlife guzzlers.
  - Project 5.2.2: Maintain wildlife guzzlers.
  - Project 5.2.3: Stock upland game birds (e.g., chukar).
- Objective 5.3: Revise EAFBI 32-8 Edwards Hunting and Fishing Regulation.
  - Project 5.3.1: Investigate duck blind drawing process and modify as needed.
  - Project 5.3.2: Promote use of volunteers to support program.

GOAL 6: Protect a sustainable ecosystem through maintenance of biodiversity.

- Objective 6.1: Complete base-wide inventories for pollinators and seed dispersers.
  - Project 6.1.1: Expand terrestrial invertebrate surveys as needed.
  - Project 6.1.2: Conduct base-wide bat survey and compare results to 1996 surveys.
- Objective 6.2: Protect bats as important pollinators and pest managers.
  - Project 6.2.1: Ensure bats are excluded prior to building demolition.
  - Project 6.2.2: Build and erect bat houses to mitigate lost habitat.
  - Project 6.2.3: Consider designating and managing selected abandoned buildings as bat houses.
- Objective 6.3: Manage for migratory birds and their habitats including "Birds of Conservation Concern"

GOAL 7: Improve air quality.

- Objective 7.1: Reduce fugitive dust.
  - Project 7.1.1: Investigate new methods to clear targets on the Precision Impact Range Area (PIRA) and Farm Drop Zone to ensure stabilization of soils.
  - Project 7.1.2: Investigate best management practices for road shoulder maintenance.
  - Project 7.1.3: Stabilize soils on Rogers Dry Lake.

Outdoor Recreation and Public Access to Natural Resources

GOAL 8: Maintain availability of outdoor recreational opportunities for the base populace and surrounding communities.

- Objective 8.1: Develop efficient process to accommodate visits to Piute Ponds.
  - Project 8.1.1: Develop online reservation system for Piute Ponds visitors.
  - Project 8.1.2: Maintain personal connections with Piute Ponds visitors.
  - Project 8.1.3: Install signage at Piute Ponds covering Recreational Use Requirements.
  - Project 8.1.4: Install traffic counter at Piute Ponds to track visitor use.
  - Project 8.1.5: Install live streaming video cameras at Piute Ponds to provide wildlife viewing opportunities to disabled visitors and classrooms, as well as the base populace, public, and out of state visitors.
- Objective 8.2: Determine future of Off Road Vehicle Program (ORV) Areas 1, 2 and 3.

- Project 8.2.1: Determine current use and base level of interest in maintaining the ORVareas.
- Project 8.2.2: Monitor new habitat disturbance on a reoccurring basis.
- Project 8.2.3: Staff a decision document to the 412th TW/CC regarding the continued operation of the ORV Program.
- Project 8.2.4: Develop an EAFB Instruction and document official duties for continued use of ORV areas, or develop and implement closure procedures.

Conservation Law Enforcement

GOAL 9: Maintain an active Conservation Law Enforcement Program for natural resources.

- Objective 9.1: Maintain professionally trained conservation law enforcement officers.
  - Project 9.1.1: Coordinate conservation law enforcement support with cooperating agencies.

Management of Threatened and Endangered Species and Habitats

GOAL 10: Sustain populations of federally listed species in support of ESA Recovery Programs.

- Objective 10.1: Designate two conservation areas in Desert Tortoise core- areas; AFRL arroyos and southern PIRA.
  - Project 10.1.1: Maintain Complex Charlie and Mount Mesa Conservation Area.
  - Project 10.1.2: Create GIS layer depicting conservation areas.
  - Project 10.1.3: Develop conservation area management guidelines.
- Objective 10.2: Conclude Head Start Program.
  - Project 10.2.1: Maintain Interagency Agreement with USGS in coordination with USFWS Recovery Office through the conclusion of the program.
  - Project 10.2.2: Release and track survivability of juvenile tortoises IAW USFWS Recovery Permit.
  - Project 10.2.3: Decommission head start pens and explore options for reuse by other groups.
- Objective 10.3: Maintain desert tortoise protection measures.
  - Project 10.3.1: Survey and repair the desert tortoise exclusion fencing and secure pitfalls periodically.
  - Project 10.3.2: Base will maintain integrity of perimeter fence by repairing fence damage expeditiously to protect habitat.
  - Project 10.3.3: Conduct regular patrols of the base boundary fence by law enforcement personnel.
- Objective 10.4: Conduct base-wide population evaluation to determine desert tortoise population trends.
  - Project 10.4.1: Conduct relative density study and compare to previous studies.
  - Project 10.4.2: Participate in USFWS range-wide population survey.

GOAL 11: Sustain and/or protect populations of at-risk species.

- Objective 11.1: Measure impacts to known populations during project monitoring activities.
- Objective 11.2: Conserve and manage Mohave ground squirrels.
  - Project 11.2.1: Monitor population at five year intervals to determine long-term trends.

- Project 11.2.2: Evaluate threat of round tailed ground squirrels to Mohave ground squirrels.

- Objective 11.3: Conserve and manage Townsend's big-eared bat.
  - Project 11.3.1: Conduct base-wide survey to determine presence and map suitable habitat.
  - Project 11.3.2: Track white-nose syndrome progression across the U.S. and ensure procedures are in place to limit the spread of the fungus on Edwards.
  - Project 11.3.3: Participate in bat working groups (California, Western, and National Military Fish and Wildlife Association).
- Objective 11.4: Conserve and manage wetland-dependent species.
  - Project 11.4.1: Conduct habitat use surveys for important avian species.
  - Project 11.4.2: Update invertebrate study to investigate foraging capacity for birds.
  - Project 11.4.3: Develop and maintain 50-foot wide riparian corridors at Piute Ponds.
  - Project 11.4.4: Develop a citizen science program to monitor wetland-dependent species.
  - Project 11.4.5: Maintain mesquite bosque woodland areas.
- Objective 11.5: Develop and conserve tricolored blackbird breeding and foraging habitat.
  - Project 11.5.1: Create/maintain a successional cattail/bulrush marsh at Piute Ponds and Branch Pond.
  - Project 11.5.2: Conduct tricolored blackbird survey at Piute Ponds.
  - Project 11.5.3: Conduct survey of threats to breeding blackbird colonies in Piute Ponds during their breeding season.
  - Project 11.5.4: Conduct annual surveys to determine long-term population stability.
- Objective 11.6: Conserve and manage sensitive plant and animal species.
  - Project 11.6.1: Conduct surveys for species receiving increased regulatory attention or for which little is known about on base populations, such as Lancaster milkvetch (*Astragalus preussii var. laxiflorus*), *Eriastrum rosamondense* and popcorn flower species including *Plagiobothrys leptocladus, Plagiobothrys canescens* var. *catalinensis* (rare), and *Plagiobothrys bracteatus*.
  - Project 11.6.2: Manage alkali mariposa lily populations by controlling invasive perennial pepperweed (*Lepidium latifolium*) species in Piute Ponds Complex.
  - Project 11.6.3: Conduct threat assessment for each sensitive plant species, including Lancaster milkvetch.
  - Project 11.6.4: Conduct surveys for Mohave Shoulderband Snail
  -
- Objective 11.7: Conserve habitat and determine long-term population stability of burrowing owls.
  - Project 11.7.1: Relocate 4th of July fireworks display from burrowing owl conservation area.
  - Project 11.7.2: Conduct annual surveys of known populations and record distribution, habitat use, nest status, adult pairs, and fledged young.
  - Project 11.7.3: Conduct survey of developed areas to determine distribution.

Water Resource Protection

GOAL 12: Maintain surface water flow within the watersheds to support hydrologic unit.

- Objective 12.1: Ensure no decrease in the natural surface flow reaching the lakebeds.

- Project 12.1.1: Determine surface flow onto lakebeds.
- Project 12.1.2: Evaluate consequences of continued diversion of water from lakebeds.

- Objective 12.2: Maintain adequate amount of supplemental water provided by LA County D14 through Piute Ponds to Rosamond Lake.
- Objective 12.3: Develop agreement with Rosamond Community Service District to obtain supplemental wastewater.
- Objective 12.4: Collaborate with adjacent communities to address and solve water diversion concerns.
  - Project 12.4.1: Become a member of the Integrated Regional Water Management Team (IRWMT).
  - Project 12.4.2: Participate in IRWMT's ongoing planning efforts.
- Objective 12.5: Reduce wind induced soil erosion from Rogers Lakebed surface.
  - Project 12.5.1: Establish baseline soil erosion data and implement monitoring procedures.
  - Project 12.5.2: Investigate sources of supplemental water for Rogers Lakebed.
  - Project 12.5.3: Implement actions to provide increased water to Rogers Lakebed surface and/or shallow subsurface.

GOAL 13: Develop and maintain accurate floodplain information.

- Objective 13.1: Update floodplain delineations.
  - Project 13.1.1: Update Mojave Creek floodplain delineation

<u>Wetland Protection</u>

GOAL 14: Provide sufficient capacity at Piute Ponds for Los Angeles County D14 Waste Water Treatment Plan (WWTP) discharge.

- Objective 14.1: Accommodate requests to allow additional water flow into Piute Ponds.
  - Project 14.1.1: Develop additional ponds capable of accepting water.
  - Project 14.1.2: Finalize Memorandum of Understanding with Edwards AFB and District14

GOAL 15: Enhance Piute Ponds.

- Objective 15.1: Provide a spatial and temporal distribution of different habitat types.
  - Project 15.1.1: Meet breeding, feeding and resting needs for diverse wetland dependent species.
  - Project 15.1.2: Prioritize habitat requirements for focal species.
- Objective 15.2: Maintain current species composition while enhancing habitat for new/rare species.
  - Project 15.2.1: Choose focal species and monitor annual presence using harvest and/or birder data.
  - Project 15.2.2: Develop a citizen science effort to monitor focal species.
- Objective 15.3: Increase vertical habitat structure (trees, platforms, bat houses, etc.).
- Objective 15.4: Manage water within Piute Ponds Water Management Area.
  - Project 15.4.1: Install/maintain water control structures (i.e. board weirs).
  - Project 15.4.2: Maintain water levels to provide habitat mosaic.
  - Project 15.4.3: Maintain and review Los Angeles County D14 WWTP water quality reports.
  - Project 15.4.4: Develop and implement process for funding repair within the Piute

Ponds Complex due to a catastrophic flood event.

GOAL 16: Sustain ecological integrity of the mesquite bosque habitat.

- Objective 16.1: Determine long-term viability of mesquite bosque.
  - Project 16.1.1: Collect and evaluate tree data (age and size class).
  - Project 16.1.2: Evaluate impact of non-native mesquite trees to native mesquite trees.
- Objective 16.2: Establish a conservation area for the mesquite bosque habitat.

GOAL 17: Maintain hydrologic unit integrity.

- Objective 17.1: Use aquatic invertebrate population data as one indicator of ecosystem health.
  - Project 17.1.1: Survey portion of invertebrate population at five year intervals.
  - Project 17.1.2: Conduct dry season sampling and culturing of invertebrate eggs to determine the presence of rare species.
  - Project 17.1.3: Determine the existence, source, and biological significance of differences in water chemistry between pools located in the northwest corner of the base, the PIRA, and the hydrologic unit.
  - Project 17.1.4: Determine changes within the aquatic invertebrate population which would indicate ecosystem deterioration.
  - Project 17.1.5: Install weather stations in various locations throughout the base.
- Objective 17.2: Maintain mission use of the hydrologic unit while discouraging non-mission use that impacts the integrity of the hydrologic unit.

Grounds Maintenance

GOAL 18: Enhance the aesthetic quality of developed areas through landscape design and development.

- Objective 18.1: Improve landscape and land management processes and coordination.
  - Project 18.1.1: Write landscape development and management plan.
  - Project 18.1.2: Use local native plant species in landscape plantings.
- Objective 18.2: Enhance wildlife habitat values of landscaping.
  - Project 18.2.1: Preserve existing trees or replace at a 2:1 ratio.

GOAL 19: Prevent invasion of landscape elements into native habitat (e.g. non-native mesquite).

- Objective 19.1: Eliminate use of invasive plants
  - Project 19.1.1: Eliminate new plantings and remove existing non-native invasive species within developed landscapes.

Wildland Fire Management

GOAL 20: Minimize negative impacts to natural resources from wildland fire.

- Objective 20.1: Maintain coordination with base fire department
  - Project 20.1.1: Map all fires to maintain fire history.
  - Project 20.1.2: Document fire impacts to natural resources; implement Burned Area

Emergency Response Team (BAER) for large fires.
    - Project 20.1.3: Implement and monitor appropriate restoration measures, per the BAER report.
- Objective 20.2: Eliminate causes of anthropogenic fire.
    - Project 20.2.1: Continue to encourage restrictive use of phosphorus flares and spotting charges during fire danger conditions.

GOAL 21: Use fire to restore and improve habitat conditions at Piute Ponds and Branch Pond.

- Objective 21.1: Conduct prescribed burn at Piute Ponds in accordance with Piute Ponds Management Plan.
- Objective 21.2: Develop and implement process that allows natural fire at Piute Ponds Complex to burn while ensuring protection of surrounding desert.
- Objective 21.3: Conduct prescribed burn at Branch Pond as needed.

Installation Pest Management Program

GOAL 22: Ensure Pest Management Manager coordinates with Natural Resource Manager.

- Objective 22.1: Coordinate all rodent, bat, and bird control activities.

GOAL 23: Ensure public safety from predators.

- Objective 23.1: Implement predator control as required.
- Objective 23.2: Implement education and harassment measures prior to lethal control.
- Objective 23.3: Implement lethal control of predators as needed.
- Objective 23.4: Maintain a good working relationship with USDA Wildlife Services.

Invasive Species Management Program

GOAL 24: Reestablish native habitat by eradicating noxious and invasive plant species.

- Objective 24.1: Write and implement an Invasive Species Management Plan.
    - Project 24.1.1: Complete base-wide survey of invasive species, create species distribution maps, and write an Invasive Species Management Plan.
    - Project 24.1.2: Prioritize species for control and create a long-term strategy against which progress is measuerd.
    - Project 24.1.3: Control invasive species (i.e. Chilean mesquite, Sahara mustard, tamarisk) in undeveloped and priority areas, especially those that border pristine, at-risk, or otherwise sensitive habitats.
    - Project 24.1.4: Plant more desirable native trees within the Piute Ponds Complex to replace tamarisk.
    - Project 24.1.5: Leave some tamarisk snags in place for roosting/nesting opportunities but ensure the tree is completely killed.
    - Project 24.1.6: Annually survey Piute and Branch Ponds for the occurrence of tamarisk and eliminate when found.

Bird Wildlife Aircraft Strike Hazard

GOAL 25: Minimize bird strikes.

- Objective 25.1: Maintain Migratory Bird Depredation Permit.
- Objective 25.2: Support BASH Plan
  - Project 25.2.1: Attend semi-annual BASH Working Group meetings.
  - Project 25.2.2: Maintain desert habitat around airfield and eliminate bare ground to the extent feasible.
  - Project 25.2.3: Send bird migration updates to airfield manager.
  - Project 25.2.4: Use falconry to discourage bird activity around the airfield when n eeded.
  - Project 25.2.5: Implement pigeon control program.
  - Project 25.2.6: Eliminate perches on abandoned structures and remove unnecessary debris (e.g. miscellaneous poles, signs, etc.) around the airfield.
  - Project 25.2.7: Conduct a comprehensive wildlife habitat evaluation along runways to determine the best habitat management strategies for minimizing and reducing wildlife airstrike hazards.

Public Outreach

GOAL 26: Foster natural resource awareness and education.

- Objective 26.1: Provide required training to decrease impacts to protected and at-risk species and habitats.
  - Project 26.1.1: Create or acquire and update annual training materials to include rare plants.
  - Project 26.1.2: Conduct Migratory Bird Treaty Act training for base personnel.
  - Project 26.1.3: Conduct desert tortoise, Mohave ground squirrel, and other at-risk species and habitat training.
- Objective 26.2: Advocate harmony between base personnel and the wildland environment.
  - Project 26.2.1: Create or acquire and update annual training materials.
  - Project 26.2.2: Provide training on living with predators and snakes.
  - Project 26.2.3: Discourage feeding of wildlife through interpretive signs, brochures, and other initiatives.
  - Project 26.2.4: Conduct training at newcomer briefings, squadron commander's calls, and other appropriate events.
- Objective 26.3: Encourage education and research pursuits.
  - Project 26.3.1: Track number of educational use activities and research projects.
  - Project 26.3.2: Partner with regional and local universities.
  - Project 26.3.3: Create or acquire and update annual educational materials.
  - Project 24.3.4: Maintain and encourage birding activity at Piute Ponds and encourage data submission via eBird.
  - Project 26.3.5: Develop and maintain specific eBird application for use by citizen scientists participating at Piute Ponds and other birding locations on base.

Geographic Information Systems

GOAL 27: Fully integrate GIS in natural resources management.

- Objective 27.1: Collect and maintain accurate data in GIS database.
  - Project 27.1.1: Maintain GPS capability.
  - Project 27.1.2: Maintain and use GPS data dictionaries.
  - Project 27.1.3: Design and implement GPS data collection and processing standards.
  - Project 27.1.4: Design and implement attribution standards for features stored in GIS.
- Objective 27.2: Increase accessibility of natural resource GIS data to natural resource managers; providing reporting, evaluation, and analysis capabilities.
  - Project 27.2.1: Incorporate natural resources data in a GIS map viewer.
  - Project 27.2.2: Provide training on use of a GIS map viewer.
  - Project 27.2.3: Design and implement automated scripts that provide needed capabilities.
  - Project 27.2.4: Design and build database tables needed to store all natural resources study data.
  - Project 27.2.5: Conduct analyses and models utilizing GIS and remote sensing data.
  - Project 27.2.6: Collect hyperspectral imagery and other remote sensing data.
  - Project 27.2.7: Make all natural resource data available on the desk top for natural resource managers to develop and use for evaluation and analysis.
- Objective 27.3: Increase usability and functionality of GIS data.
  - Project 27.3.1: Create, populate, and maintain metadata for all GIS datasets.
  - Project 27.3.2: Designate feature classes as the government standard (i.e. determining which of numerous vegetation layers will be considered the government standard).
  - Project 27.3.3: Implement a Natural Resource GIS Users Group that meets at regular intervals to focus on GIS methods and work flows used to accomplish data related duties.
  - Project 27.3.4: Complete major table maintenance required by Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) updates.
- Objective 27.4: Increase effectiveness of natural resources GIS capabilities.
  - Project 27.4.1: Attend training and symposiums such as the Environmental Systems Research Institute Inc. annual User's Conference.
  - Project 27.4.2: Design and create automated scripts to assist natural resource data users in repetitive analyses.
  - Project 27.4.3: Design and create automated scripts to provide reports on the status of all natural resources tables.
  - Project 27.4.4: Maintain sufficient manpower.
  - Project 27.4.5: Improve collaboration between natural resource managers and GIS personnel.

9.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

Natural Resources Management Staffing

The staffing requirements for developing, writing, and implementing the INRMP include sufficient government employees at Edwards AFB as required by the Sikes Act. Some of the natural resource staff responsibilities include:

- Drafting of INRMP, any amendments and any associated plans.
- Setting priorities and order of implementation of projects identified in INRMP.
- Oversight of the preparation of all consultation documents (e.g. Section 7) and all negotiations with USFWS and other agencies.
- Oversight of implementation of contracts.
- Assessment of the application and requirements of all environmental laws and regulations, as applied on the base to include mitigation, permits, field study requirements, and level of monitoring.
- Assessment of resources needed to implement projects.
- Completion of DoD Natural Resources Compliance course.

Implementation

The Installation Commander is responsible for management and conservation of natural resources on Edwards AFB. The Environmental Management Office on Edwards AFB is responsible for implementing the natural resource management program as well as conducting the annual INRMP review.

Internal Air Force (AF) organizations that are responsible for support and coordination of the natural resource management program include the Legal Office, Public Affairs, various Civil Engineering (CE) functions, Security Forces, Fire Department, Outdoor Recreation, Safety Office, and test mission organizations.

The primary external stakeholders are the USFWS and CDFW. Other stakeholders include other cooperating government agencies, nongovernmental organizations, and the general public.

9.2 Monitoring INRMP Implementation

The Annual INRMP Review Summary (see Appendix E) will be used by the AF and cooperating partners to monitor INRMP implementation progress. The Review Summary will outline progress, what was accomplished, and should include an analysis of important results and adaptive management strategies that are relevant and feasible. An annual INRMP update will be completed to integrate findings from the annual report.

9.3 Annual INRMP Review and Update Requirements

AFI 32-7064 sets out a process by which annual review and coordination should occur. The Natural Resources Manager shall conduct an annual review of the INRMP in coordination with the USFWS and CDFW. The Natural Resources Manager will meet with USFWS and CDFW personnel throughout the year to coordinate any INRMP related issues. Findings from the annual review meeting will be documented in the Annual INRMP Review Summary. By signature to the Annual INRMP Review Summary, the collaborating agencies assert concurrence with the findings. An on-site annual review may be conducted at the request of cooperating agencies. The Installation Commander or appropriate designee certifies the annual review as valid and current, per AFI 32-7064. The Annual INRMP Review Summary will include:

- A summary of specific INRMP accomplishments since the last review.

- A Work Plan for implementing the INRMP that includes the current year and at least four future fiscal years. The Work Plan must include all projects and activities identified as essential for the successful implementation of INRMP goals and objectives, and an implementation schedule that is realistic and practicable. The Work Plan must also identify Level 0 and Level 1 projects that will be programmed in the budget.
- A statement that sufficient numbers of qualified natural resources management personnel and resources are available to oversee implementation of projects and activities identified in the INRMP Work Plan.
- A summary of the required INRMP updates that will be incorporated into the INRMP to keep the INRMP current in operation and effect for the management of installation natural resources; or alternatively, a statement that significant changes to the installation mission or natural resources goals require a significant INRMP revision.

INRMP Update and Revision Process.

The Sikes Act requires that a formal review be completed no less than every five years, including coordination with the cooperating agencies and applicable stakeholders. AFI 32-7064 and DoDI 4714.03 state that the INRMP should be reviewed annually. Annual reviews are the process by which INRMP updates are maintained, eliminating the need for a five year signatures if annual concurrence is achieved. AFI 32-7064 states that an INRMP update consists of:

> *"Minor edits that provide current information, or adjust implementation timelines that would not result in changes to management goals and objectives that are substantively different than those previously agreed to by the cooperating agencies. Minor update requirements are identified during the annual INRMP review and coordination. An INRMP update documents minor changes agreed to by the partners on how the INRMP will be implemented, and does not represent a change in the scope of the INRMP. Mutual agreement by cooperating agencies that an updated INRMP remains current as to operation and effect with respect to the Sikes Act is documented by signatures to the Annual INRMP Review Summary document."*

For five-year reviews and any future significant revisions that require signature, Environmental Management coordinates with the applicable internal AF organizations, before sending the revised INRMP to the USFWS, CDFW, and the general public for review and comments. For major changes to the INRMP, Environmental Management is responsible for providing a 30-day public review and comment period on the INRMP and EIAP documentation prior to approval by the resource agencies and installation commander's signature. AFI 32-7064 states that an INRMP revision occurs when:

> *"Changes in the installation mission, land use, or the condition of installation natural resources require significant edits to ensure that the INRMP reflects the current condition of the natural resources and appropriate program goals and objectives. The need for an INRMP revision is determined during the annual INRMP review. For new and revised INRMPs, mutual agreement by a cooperating agency is documented by the signature of an authorized representative from each agency on the cover page to the INRMP."*

10.0 ANNUAL WORK PLANS

The INRMP Annual Work Plans are included in this section. These projects are listed by fiscal year, including the current year and four succeeding years. For each project and activity, a specific timeframe for implementation is provided (as applicable), as well as the appropriate funding source, and priority for implementation. The work plans provide all the necessary information for building a budget within the AF framework. Priorities are defined as follows:

- High: The INRMP signatories assert that if the project is not funded the INRMP is not being implemented and the Air Force is non-compliant with the Sikes Act; or that it is specifically tied to an INRMP goal and objective and is part of a "Benefit of the Species" determination necessary for ESA Sec 4(a)(3)(B)(i) critical habitat exemption.
- Medium: Project supports a specific INRMP goal and objective, and is deemed by INRMP signatories to be important for preventing non-compliance with a specific requirement within a natural resources law or by EO 13112 on Invasive Species. However, the INRMP signatories would not contend that the INRMP is not be implemented if not accomplished within programmed year due to other priorities.
- Low: Project supports a specific INRMP goal and objective, enhances conservation resources or the integrity of the installation mission, and/or support long-term compliance with specific requirements within natural resources law; but is not directly tied to specific compliance within the proposed year of execution.

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
FSPM187610	NATIVE ECOSYSTEM ANALYSIS, GIS HYPERSPECTRAL	2019	This project involves collection of new hyperspectral data, analyzing the data, and conducting ground truth surveys of plant communities with the primary purpose of identifying ecosystem change that has occurred subsequent to the previous (FY08) hyperspectral imagery data collection effort. Long-term, periodic hyperspectral Imagery data collection and analysis will provide useful information with respect to trends in ecosystem health; significantly improving our adaptive management capabilities.	10
FSPM147255	MGT, SPECIES, INVERTEBRATES	2015	This project funds a project to improve knowledge of aquatic and terrestrial invertebrate prey for tricolored blackbirds. A colony of tricolored blackbirds utilizes Branch Pond on Edwards AFB, and there is potential habitat at Piute Ponds. An understanding of the potential forage species and abundance around Branch Pond and Piute Ponds would	12

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
			assist in managing for tricolored blackbirds.	
FSPM157257	MGT, SPECIES, BLACKBIRD, VIREO, FLYCATCHER	2015	This study involves surveying for active nest sites, developing management strategies, and incorporating data and conservation measures into the Edwards Air Force Base Integrated Natural Resources Management Plan. These species Include: tricolored black bird (*Agelaius tricolor*), Least Bell's vireo (*Vireo bellii pusillus*), and southwestern willow flycatcher (*Empidonax traillii extimus*).	15
FSPM727415	MGT, SPECIES, RARE PLANTS	2015	This project includes inventory, monitor and manage for *Eriastrum rosamondense* and other sensitive plant species (e.g., sagebrush loeflingia and Lancaster milkvetch). This is a study to identify the population distribution, viability, and ecological relationships.	12
FSPM157250	MGT, HABITAT, MESQUITE TREE	2016	Support evaluation of health of on-base mesquite bosque woodland habitat. Project will assess tree health, evaluate population of Chilean mesquite, and remove any non-native mesquite that is threatening the health and integrity of the rare woodland ecotype that supports at-risk species like alkali mariposa lily.	15
FSPM157255 FSPM157217 FSPM157219	MGT, WETLANDS / FLOODPLAINS	2016-2017; 2019	Sustain the Piute Ponds Complex. Remove overgrown vegetation, buildup of sediment, and recut channels to maintain water flow between individual ponds, marshes, and wetlands. Maintain control over tamarisk in the Piute Ponds Complex. Plant willow, cottonwood, and mesquite. Conduct Mojave Creek floodplain delineation and Rogers Dry Lake surface flow and health study.	14
FSPM157248	MGT, SPECIES, MOHAVE GROUND SQUIRREL	2018	Monitor Mohave ground squirrel (MGS) populations to determine long-term trends, and evaluate threat of round-tailed ground squirrels to	14

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
			MGS. Conduct camera and live-trapping inventories, and document continued presence or absence of the MGS at known locations. Additionally, determine the movement and distribution of the non-listed round-tailed ground squirrel.	
FSPM210017	MGT, HABITAT, AIRFIELD	2017	This project funds a comprehensive wildlife habitat evaluation along runways to determine the best habitat management strategies for minimizing and reducing wildlife airstrike hazards.	17
FSPM722217 FSPM722220	MGT, HABITAT, DESERT TORTOISE FENCING	2017; 2020	This project funds repair of existing tortoise fencing along Mercury Blvd and on the PIRA and AFRL rocket motor/engine test areas to ensure that tortoises do not wander across well-traveled roads or enter hazardous sites. The project also includes minimal repair to barbed-wire boundary fence, which protects tortoise habitat from unauthorized use by the recreating public (i.e. off-road driving). Project may also install tortoise protection signs.	13
FSPM733317	MGT, HABITAT, URBAN LANDSCAPE	2017	Inventory, survey, and manage developed habitats in order to deconflict effects on endangered, rare, sensitive or keystone flora or fauna species. Project will provide technical assistance, expertise, and research to assist Natural Resource Managers with creation of a Landscape Development and Mgmt Plan.	12
FSPM888817	MGT, HABITAT, CREOSOTE SHRUB	2017	Project will investigate best methods to keep PIRA targets clear of vegetation while reducing incidence of fugitive dust. Involves site survey, soil analysis, investigation of vegetation suppression methods, etc.	12

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
FSPM888818	MGT, SPECIES, TERRESTRIAL INVERTS	2018	Survey for new, rare, or unique terrestrial invertebrates described in Pratt 2000 (pg 30) as well as Monarch butterflies.	12
FSPMOS6005B6 FSPMOS6005B7 FSPMOS600519 FSPMOS600520	OUTREACH	2016-2017; 2019-2020	Supports public awareness projects to educate base personnel/public about base cultural resources, natural resources, historical preservation, and conservation activities.	8
FSPMOS7003B6	ENVIRONMENTAL SERVICES, CN, MBTA	2016	Funds contractor services needed to maintain the installation Natural Resources Program. Funds Migratory Bird support for natural resources program. Provides assistance in normal day-to-day management functions and operations of the installation's natural resource program.	12
FSPMOS7203B6 FSPMOS7203B7 FSPMOS7203B8 FSPMOS7203B9 FSPMOS7203C0	MGT, SPECIES, DESERT TORTOISE	2016-2020	This project provides support of ongoing management of desert tortoise, a federal and state listed threatened species IAW Biological Opinions, including field investigations of tortoise incidents/issues, pre-construction surveys, post-construction surveys, monitoring during project activities and AF operations, reports. An annual report is due to USFWS in January of each year. This project also funds efforts by USGS (IAW Interagency Agreement) and USFWS recovery permit to track the remaining 119 Head Start juvenile tortoises that were raised in Head Start pens and released in Oct 2013, April 2014, and Oct 2014. The work includes purchasing transmitters, tracking tortoises in the field, and conducting an annual health assessment on the released juveniles in the field. Data collected includes weight, height, width, length, and evaluating their condition body index and includes an annual report due to USFWS in	20

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
			January of each year. This effort will terminate at the end of fiscal year 2018.	
FSPMOS7204B6 FSPMOS7204B9	MGT, HABITAT, MONITOR HQA	2016; 2019	This project assists with recovery and management of habitat supporting the federal and state listed threatened desert tortoise, other listed and sensitive species, and landscapes. This task includes short-term monitoring of habitat disturbing construction projects. This project also supports spatial and non-spatial data collection, update, maintain reporting, and analysis.	13
FSPM167201 FSPMOS157217 FSPMOS157218 FSPMOS157219 FSPMOS157220	MGT, INVASIVE SPECIES, MULTIPLE	2016-2020	Project will involve conducting baseline field surveys and establish a weed control program. This project will inventory areas for habitat quality, potential weed problems, and weed biomass to begin application of a methodology to improve biodiversity of native vegetation. A comprehensive Invasive Species Management Plan section will be written. Project includes developing a methodology for the removal of Sahara mustard. Trial plots will be developed to test control measures. Also, monitoring and restoration will be completed as needed on previously treated sites. Project also supports spatial and non-spatial data collection, update, maintenance, reporting, and analysis. Project will involve conducting baseline field surveys and establish a weed control program. One goal is to survey roadsides within and adjacent to the base to determine potential future weed problems in native habitats.	15
FSPMOS725116 AFCEPS109517 AFCEPS109518 AFCEPS103519 AFCEPS103520	INTERAGENCY / INTRAAGENCY, GOVERNMENT, SIKES ACT, CLEO	2016-2020	This project establishes a law enforcement program that puts trained specialists in the field to prevent violations of the Endangered Species Act. Annual increases in unauthorized trespass	14

Project Number	Project Title	Fiscal Year	Project Description	Priority Number
			resulting in off-road damage to natural resources, illegal fence cuts on the edges of the base boundary, and extensive ORV use in remote areas within the base boundary are occurring.	
AFCE200117	MGT, SPECIES, ESA PROPOSED, CALIFORNIA	2017	This project conduct surveys for the the Mohave Shoulderband Snail on a butte in the northwestern corner of Edwards AFB. Surveys will determine presence/absence on Edwards AFB.	NA

11.0 REFERENCES

11.1 Standard References *(Applicable to all AF installations)*

- AFI 32-7064, *Integrated Natural Resources Management*
- Sikes Act
- eDASH Natural Resources Program Page
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12.0 ACRONYMS

12.1 Standard Acronyms (Applicable to all AF installations)

- eDASH Acronym Library

- Natural Resources Playbook – Acronym Section
- U.S. EPA Terms & Acronyms

12.2 Installation Acronyms

- 412 TW – 412th Test Wing
- 412 CEG – 412th Test Wing Civil Engineer Group
- 412 CEG/CEVA - 412th Test Wing Civil Engineer Group Environmental Management Division
- AFRL - Air Force Research Laboratory
- eDASH Acronym Library
    - https://cs1.eis.af.mil/sites/edash/Lists/Acronym Library/AllItems.aspx
- HQA – Habitat Quality Analysis
- NASA - National Aeronautics and Space Administration
- Natural Resources Playbook – Acronym Section
    - https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/NRM2/Pages/PlaybookProcesses.aspx?PrintOrder=127
- PIRA - Precision Impact Range Area
- REPI - Readiness and Environmental Protection Initiative
- U.S. EPA Terms & Acronyms
- http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do

13.0 DEFINITIONS

13.1 Standard Definitions *(Applicable to all AF installations)*

- Natural Resources Playbook – Definitions Section

13.2 Installation Definitions

- Natural Resources Playbook – Definitions Section
- https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/NRM2/Pages/PlaybookProcesses.aspx?PrintOrder=128

14.0 APPENDICES

Appendix A. Annotated Summary of Key Legislation Related to Design and Implementation of the INRMP

Federal Public Laws and Executive Orders	
National Defense Authorization Act of 1989, Public Law (P.L.) 101-189; Volunteer Partnership Cost-Share Program	Amends two Acts and establishes volunteer and partnership programs for natural and cultural resources management on DoD lands.
Defense Appropriations Act of 1991, P.L. 101-511; Legacy Resource Management Program	Establishes the "Legacy Resource Management Program" for natural and cultural resources. Program emphasis is on inventory and stewardship responsibilities of biological, geophysical, cultural, and historic resources on DoD lands, including restoration of degraded or altered habitats.
EO 11514, Protection and Enhancement of Environmental Quality	Federal agencies shall initiate measures needed to direct their policies, plans, and programs to meet national environmental goals. They shall monitor, evaluate, and control agency activities to protect and enhance the quality of the environment.
EO 11593, Protection and Enhancement of the Cultural Environment	All Federal agencies are required to locate, identify, and record all cultural resources. Cultural resources include sites of archaeological, historical, or architectural significance.
EO 11987, Exotic Organisms	Agencies shall restrict the introduction of exotic species into the natural ecosystems on lands and waters which they administer.
EO 11988, Floodplain Management	Provides direction regarding actions of Federal agencies in floodplains, and requires permits from state, territory and Federal review agencies for any construction within a 100-year floodplain and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for acquiring, managing and disposing of Federal lands and facilities.
EO 11989, Off-Road vehicles on Public Lands	Installations permitting off-road vehicles to designate and mark specific areas/trails to minimize damage and conflicts, publish information including maps, and monitor the effects of their use. Installations may close areas if adverse effects on natural, cultural, or historic resources are observed.
EO 11990, Protection of Wetlands	Requires Federal agencies to avoid undertaking or providing assistance for new construction in wetlands unless there is no practicable alternative, and all practicable measures to minimize harm to wetlands have been implemented and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Federal Public Laws and Executive Orders	
EO 12088, Federal Compliance With Pollution Control Standards	This EO delegates responsibility to the head of each executive agency for ensuring all necessary actions are taken for the prevention, control, and abatement of environmental pollution. This order gives the U.S. Environmental Protection Agency (US EPA) authority to conduct reviews and inspections to monitor Federal facility compliance with pollution control standards.
EO 12898, Environmental Justice	This EO requires certain federal agencies, including the DoD, to the greatest extent practicable permitted by law, to make environmental justice part of their missions by identifying and addressing disproportionately high and adverse health or environmental effects on minority and low-income populations.
EO 13112, Exotic and Invasive Species	To prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds	The U.S. Fish and Wildlife Service (USFWS) has the responsibility to administer, oversee, and enforce the conservation provisions of the Migratory Bird Treaty Act, which includes responsibility for population management (e.g., monitoring), habitat protection (e.g., acquisition, enhancement, and modification), international coordination, and regulations development and enforcement.
United States Code	
Animal Damage Control Act (7 U.S.C. § 426-426b, 47 Stat. 1468)	Provides authority to the Secretary of Agriculture for investigation and control of mammalian predators, rodents, and birds. DoD installations may enter into cooperative agreements to conduct animal control projects.
Bald and Golden Eagle Protection Act of 1940, as amended; 16 U.S.C. 668-668c	This law provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds. The 1972 amendments increased penalties for violating provisions of the Act or regulations issued pursuant thereto and strengthened other enforcement measures. Rewards are provided for information leading to arrest and conviction for violation of the Act.
Clean Air Act, (42 U.S.C. § 7401– 7671q, July 14, 1955, as amended)	This Act, as amended, is known as the Clean Air Act of 1970. The amendments made in 1970 established the core of the clean air program. The primary objective is to establish Federal standards for air pollutants. It is designed to improve air quality in areas of the country which do not meet Federal standards and to prevent significant deterioration in areas where air quality exceeds those standards.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (Superfund) (26 U.S.C. § 4611–4682, P.L. 96-510, 94 Stat. 2797), as amended	Authorizes and administers a program to assess damage, respond to releases of hazardous substances, fund cleanup, establish clean-up standards, assign liability, and other efforts to address environmental contaminants. Installation Restoration Program guides cleanups at DoD installations.
Endangered Species Act (ESA) of 1973, as amended; P.L. 93-205, 16	Protects threatened, endangered, and candidate species of fish, wildlife, and plants and their designated critical habitats. Under this law, no Federal action is allowed to jeopardize the continued existence of an

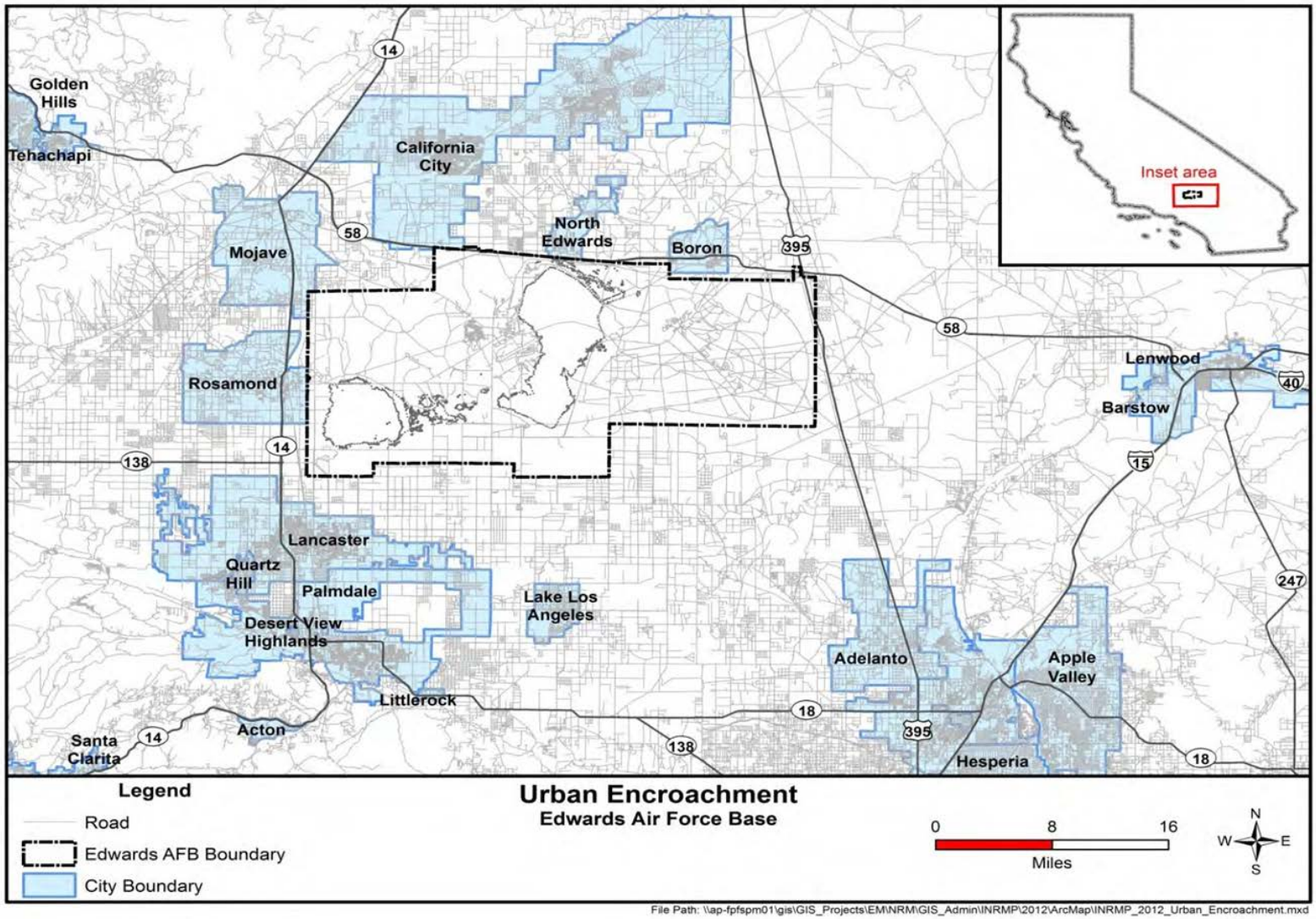
Federal Public Laws and Executive Orders	
U.S.C. § 1531 et seq.	endangered or threatened species. The ESA requires consultation with the USFWS and the NOAA Fisheries (National Marine Fisheries Service) and the preparation of a biological evaluation or a biological assessment may be required when such species are present in an area affected by government activities.
Federal Aid in Wildlife Restoration Act of 1937 (16 U.S.C. § 669–669i; 50 Stat. 917) (Pittman-Robertson Act)	Provides Federal aid to states and territories for management and restoration of wildlife. Fund derives from sports tax on arms and ammunition. Projects include acquisition of wildlife habitat, wildlife research surveys, development of access facilities, and hunter education.
Federal Environmental Pesticide Act of 1972	Requires installations to ensure pesticides are used only in accordance with their label registrations and restricted-use pesticides are applied only by certified applicators.
Federal Land Use Policy and Management Act, 43 U.S.C. § 1701–1782	Requires management of public lands to protect the quality of scientific, scenic, historical, ecological, environmental, and archaeological resources and values; as well as to preserve and protect certain lands in their natural condition for fish and wildlife habitat. This Act also requires consideration of commodity production such as timbering.
Federal Noxious Weed Act of 1974, 7 U.S.C. § 2801–2814	The Act provides for the control and management of non-indigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.
Federal Water Pollution Control Act (Clean Water Act [CWA]), 33 U.S.C. §1251–1387	The CWA is a comprehensive statute aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Primary authority for the implementation and enforcement rests with the US EPA.
Fish and Wildlife Conservation Act (16 U.S.C. § 2901–2911; 94 Stat. 1322, PL 96-366)	Installations encouraged to use their authority to conserve and promote conservation of nongame fish and wildlife in their habitats.
Fish and Wildlife Coordination Act (16 U.S.C. § 661 et seq.)	Directs installations to consult with the USFWS, or state or territorial agencies to ascertain means to protect fish and wildlife resources related to actions resulting in the control or structural modification of any natural stream or body of water. Includes provisions for mitigation and reporting.
Lacey Act of 1900 (16 U.S.C. § 701, 702, 32 Stat. 187, 32 Stat. 285)	Prohibits the importation of wild animals or birds or parts thereof, taken, possessed, or exported in violation of the laws of the country or territory of origin. Provides enforcement and penalties for violation of wildlife related Acts or regulations.
Leases: Non-excess Property of Military Departments, 10 U.S.C. § 2667, as amended	Authorizes DoD to lease to commercial enterprises Federal land not currently needed for public use. Covers agricultural outleasing program.
Migratory Bird Treaty Act 16 U.S.C. § 703–712	The Act implements various treaties for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful without a valid permit.
National Environmental Policy Act of 1969 (NEPA), as amended; P.L. 91-190, 42	Requires Federal agencies to utilize a systematic approach when assessing environmental impacts of government activities. Establishes the use of environmental impact statements. NEPA proposes an

Federal Public Laws and Executive Orders	
U.S.C. § 4321 et seq.	interdisciplinary approach in a decision-making process designed to identify unacceptable or unnecessary impacts on the environment. The Council of Environmental Quality (CEQ) created Regulations for Implementing the National Environmental Policy Act [40 Code of Federal Regulations (CFR) Parts 1500– 1508], which provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of NEPA, as amended.
National Historic Preservation Act, 16 U.S.C. § 470 et seq.	Requires Federal agencies to take account of the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP). Provides for the nomination, identification (through listing on the NRHP), and protection of historical and cultural properties of significance.
National Trails Systems Act (16 U.S.C. § 1241–1249)	Provides for the establishment of recreation and scenic trails.
National Wildlife Refuge Acts	Provides for establishment of National Wildlife Refuges through purchase, land transfer, donation, cooperative agreements, and other means.
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd–668ee)	Provides guidelines and instructions for the administration of Wildlife Refuges and other conservation areas.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001–13; 104 Stat. 3042), as amended	Established requirements for the treatment of Native American human remains and sacred or cultural objects found on Federal lands. Includes requirements on inventory, and notification.
Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.)	Makes it unlawful for the USAF to conduct any work or activity in navigable waters of the United States without a Federal Permit. Installations should coordinate with the U.S. Army Corps of Engineers (USACE) to obtain permits for the discharge of refuse affecting navigable waters under National Pollutant Discharge Elimination System (NPDES) and should coordinate with the USFWS to review effects on fish and wildlife of work and activities to be undertaken as permitted by the USACE.
Sale of certain interests in land, 10 U.S.C. § 2665	Authorizes sale of forest products and reimbursement of the costs of management of forest resources.
Soil and Water Conservation Act (16 U.S.C. § 2001, P.L. 95-193)	Installations shall coordinate with the Secretary of Agriculture to appraise, on a continual basis, soil/water-related resources. Installations will develop and update a program for furthering the conservation, protection, and enhancement of these resources consistent with other Federal and local programs.
Sikes Act (16 U.S.C. § 670a–670l, 74 Stat. 1052), as amended	Provides for the cooperation of DoD, the Departments of the Interior (USFWS), and the State Fish and Game Department in planning, developing, and maintaining fish and wildlife resources on a military installation. Requires development of an Integrated Natural Resources

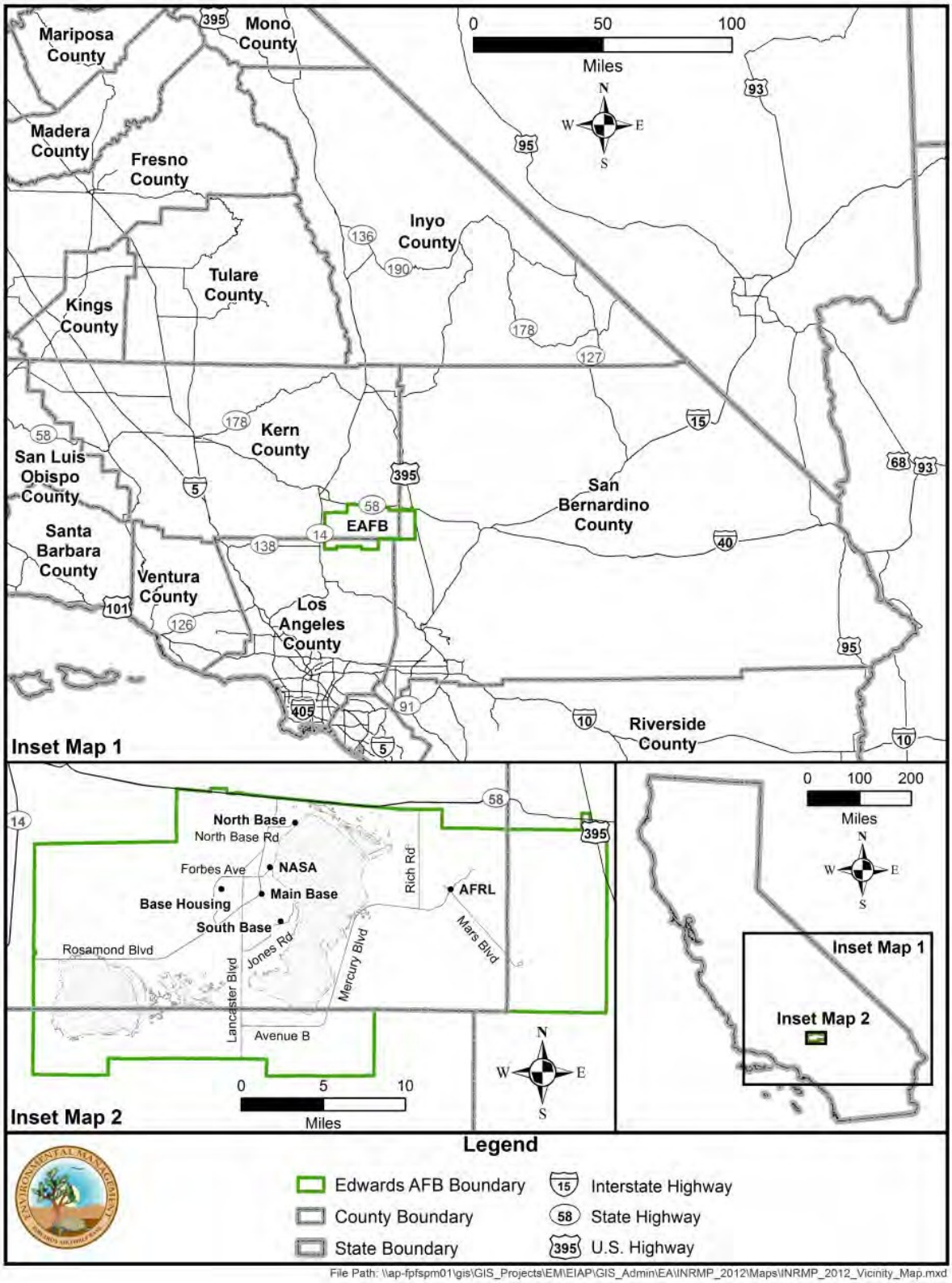
Federal Public Laws and Executive Orders	
	Management Plan and public access to natural resources, and allows collection of nominal hunting and fishing fees. NOTE: AFI 32-7064 sec 3.9. Staffing. As defined in DoDI 4715.03, use professionally trained natural resources management personnel with a degree in the natural sciences to develop and implement the installation INRMP. (T-0). 3.9.1. Outsourcing Natural Resources Management. As stipulated in the Sikes Act, 16 U.S.C. § 670 et. seq., the Office of Management and Budget Circular No. A-76, Performance of Commercial Activities, August 4, 1983 (Revised May 29, 2003) does not apply to the development, implementation and enforcement of INRMPs. Activities that require the exercise of discretion in making decisions regarding the management and disposition of government owned natural resources are inherently governmental. When it is not practicable to utilize DoD personnel to perform inherently governmental natural resources management duties, obtain these services from federal agencies having responsibilities for the conservation and management of natural resources.
DoD Policy, Directives, and Instructions	
DoD Instruction 4150.07 DoD Pest Management Program dated 29 May 2008	Implements policy, assigns responsibilities, and prescribes procedures for the DoD Integrated Pest Management Program.
DoD Instruction 4715.1, Environmental Security	Establishes policy for protecting, preserving, and (when required) restoring and enhancing the quality of the environment. This instruction also ensures environmental factors are integrated into DoD decision-making processes that could impact the environment, and are given appropriate consideration along with other relevant factors.
DoD Instruction (DODI) 4715.03, Natural Resources Conservation Program	Implements policy, assigns responsibility, and prescribes procedures under DoDI 4715.1 for the integrated management of natural and cultural resources on property under DoD control.
OSD Policy Memorandum – 17 May 2005 – Implementation of Sikes Act Improvement Amendments: Supplemental Guidance Concerning Leased Lands	Provides supplemental guidance for implementing the requirements of the Sikes Act in a consistent manner throughout DoD. The guidance covers lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission. INRMPs must address the resource management on all lands for which the subject installation has real property accountability, including leased lands. Installation commanders may require tenants to accept responsibility for performing appropriate natural resource management actions as a condition of their occupancy or use, but this does not preclude the requirement to address the natural resource management needs of these lands in the installation INRMP.
OSD Policy Memorandum – 1 November 2004 – Implementation of Sikes Act Improvement Act Amendments: Supplemental Guidance Concerning INRMP Reviews	Emphasizes implementing and improving the overall INRMP coordination process. Provides policy on scope of INRMP review, and public comment on INRMP review.

Federal Public Laws and Executive Orders	
OSD Policy Memorandum – 10 October 2002 – Implementation of Sikes Act Improvement Act: Updated Guidance	Provides guidance for implementing the requirements of the Sikes Act in a consistent manner throughout DoD and replaces the 21 September 1998 guidance Implementation of the Sikes Act Improvement Amendments. Emphasizes implementing and improving the overall INRMP coordination process and focuses on coordinating with stakeholders, reporting requirements and metrics, budgeting for INRMP projects, using the INRMP as a substitute for critical habitat designation, supporting military training and testing needs, and facilitating the INRMP review process.
USAF Instructions and Directives	
32 CFR Part 989, as amended, and AFI 32-7061, Environmental Impact Analysis Process	Provides guidance and responsibilities in the EIAP for implementing INRMPs. Implementation of an INRMP constitutes a major federal action and therefore is subject to evaluation through an Environmental Assessment or an Environmental Impact Statement.
AFI 32-7062, Air Force Comprehensive Planning	Provides guidance and responsibilities related to the USAF comprehensive planning process on all USAF-controlled lands.
AFI 32-7064, Integrated Natural Resources Management	Implements AFPD 32-70, Environmental Quality; DODI 4715.03, Natural Resources Conservation Program; and DODI 7310.5, Accounting for Sale of Forest Products. It explains how to manage natural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFI 32-7065, Cultural Resources Management	This instruction implements AFPD 32-70 and DoDI 4710.1, Archaeological and Historic Resources Management. It explains how to manage cultural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFPD 32-70, Environmental Quality	Outlines the USAF mission to achieve and maintain environmental quality on all USAF lands by cleaning up environmental damage resulting from past activities, meeting all environmental standards applicable to present operations, planning its future activities to minimize environmental impacts, managing responsibly the irreplaceable natural and cultural resources it holds in public trust and eliminating pollution from its activities wherever possible. AFPD 32-70 also establishes policies to carry out these objectives.
Policy Memo for Implementation of Sikes Act Improvement Amendments, HQ USAF Environmental Office (USAF/ILEV) on January 29, 1999	Outlines the USAF interpretation and explanation of the Sikes Act and Improvement Act of 1997.

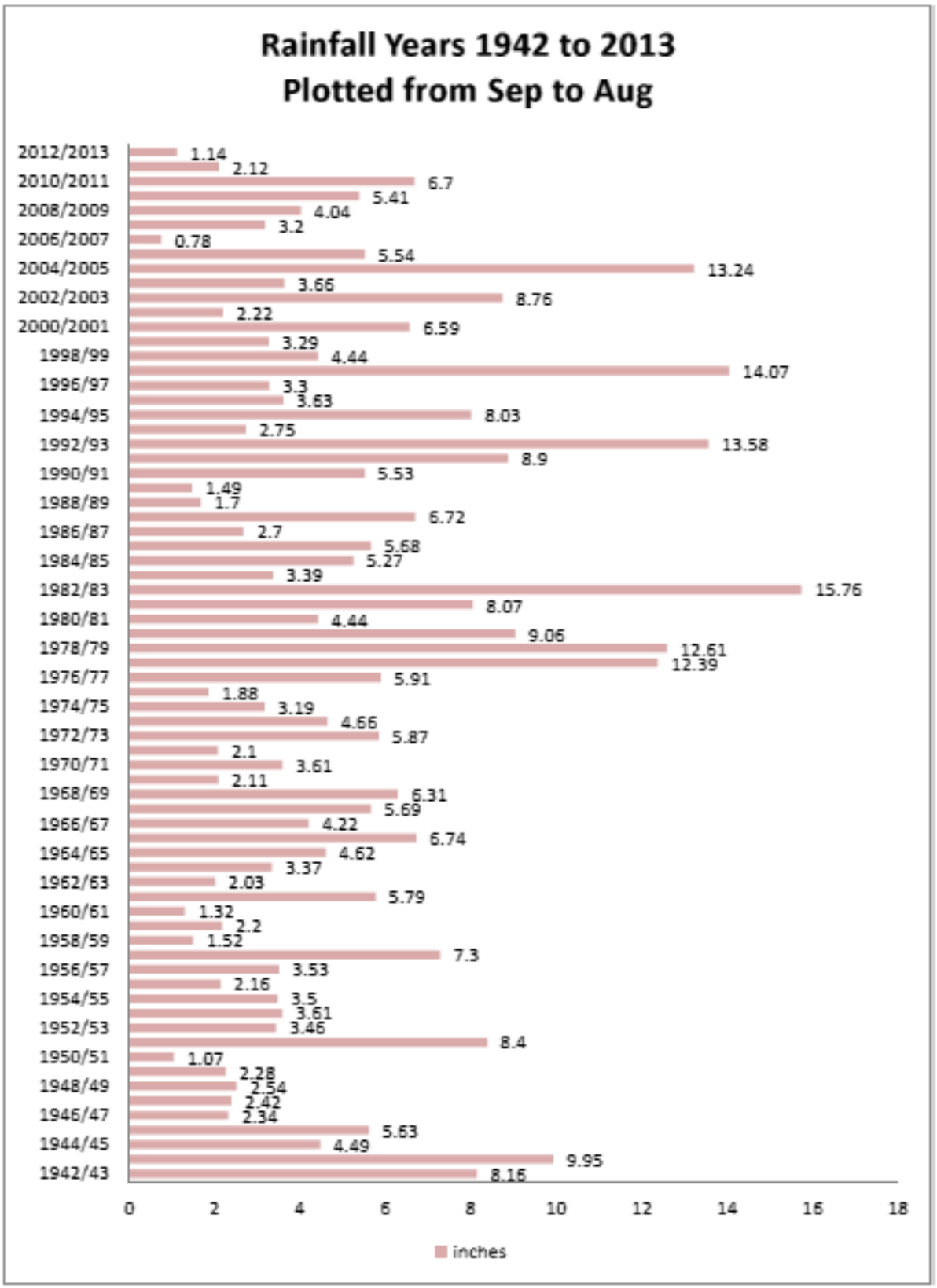
Appendix B. Figures



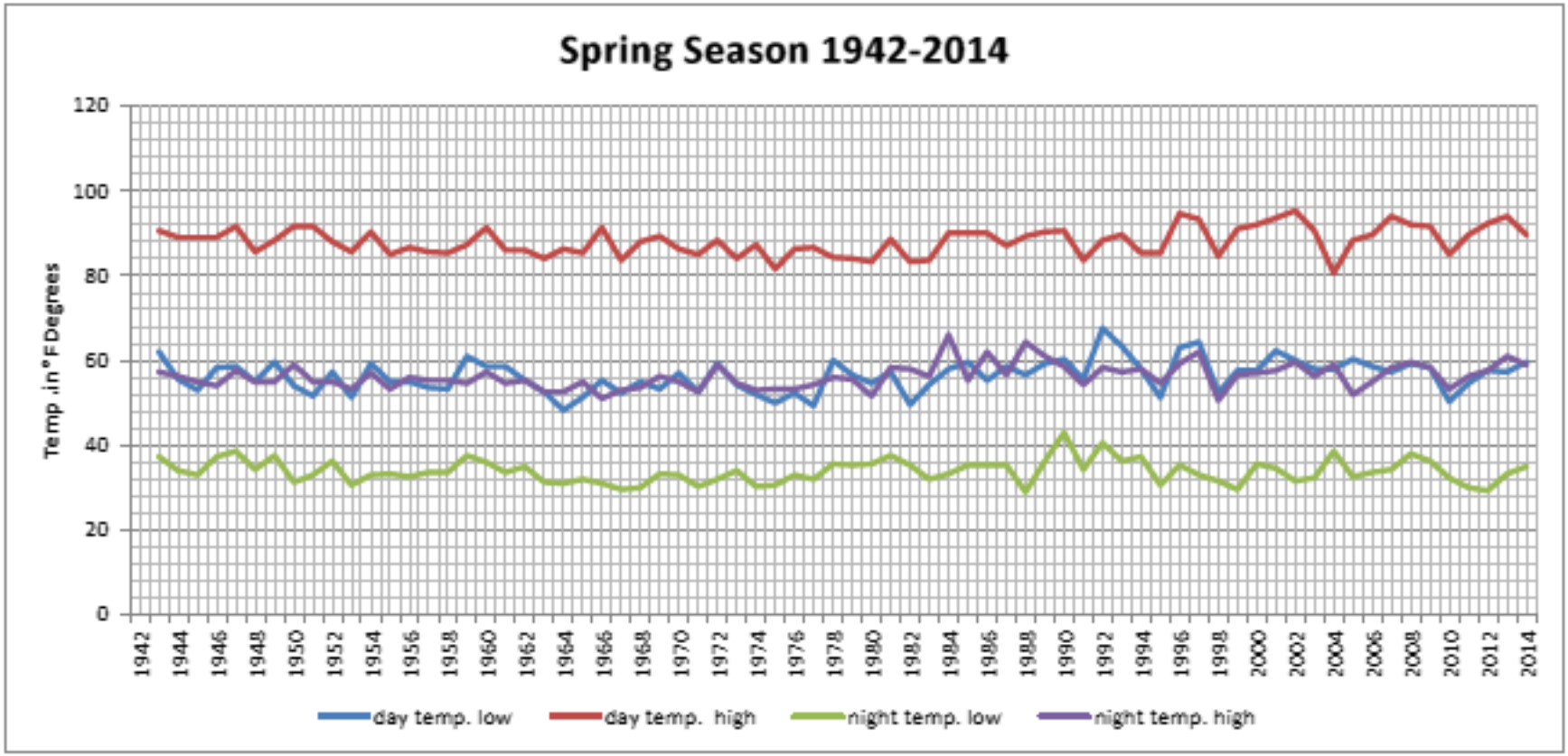
Surrounding Communities



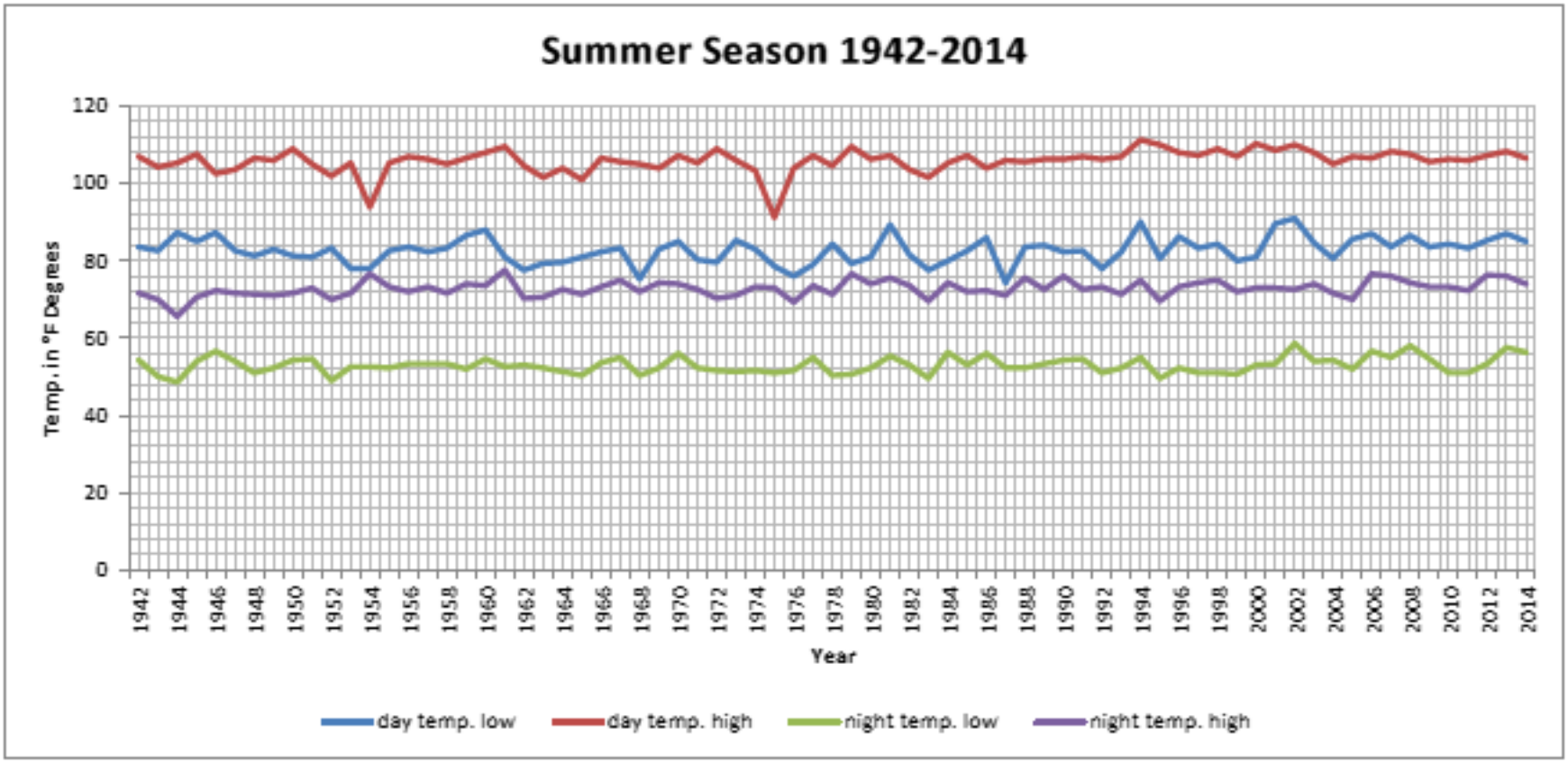
Vicinity Map and Highways



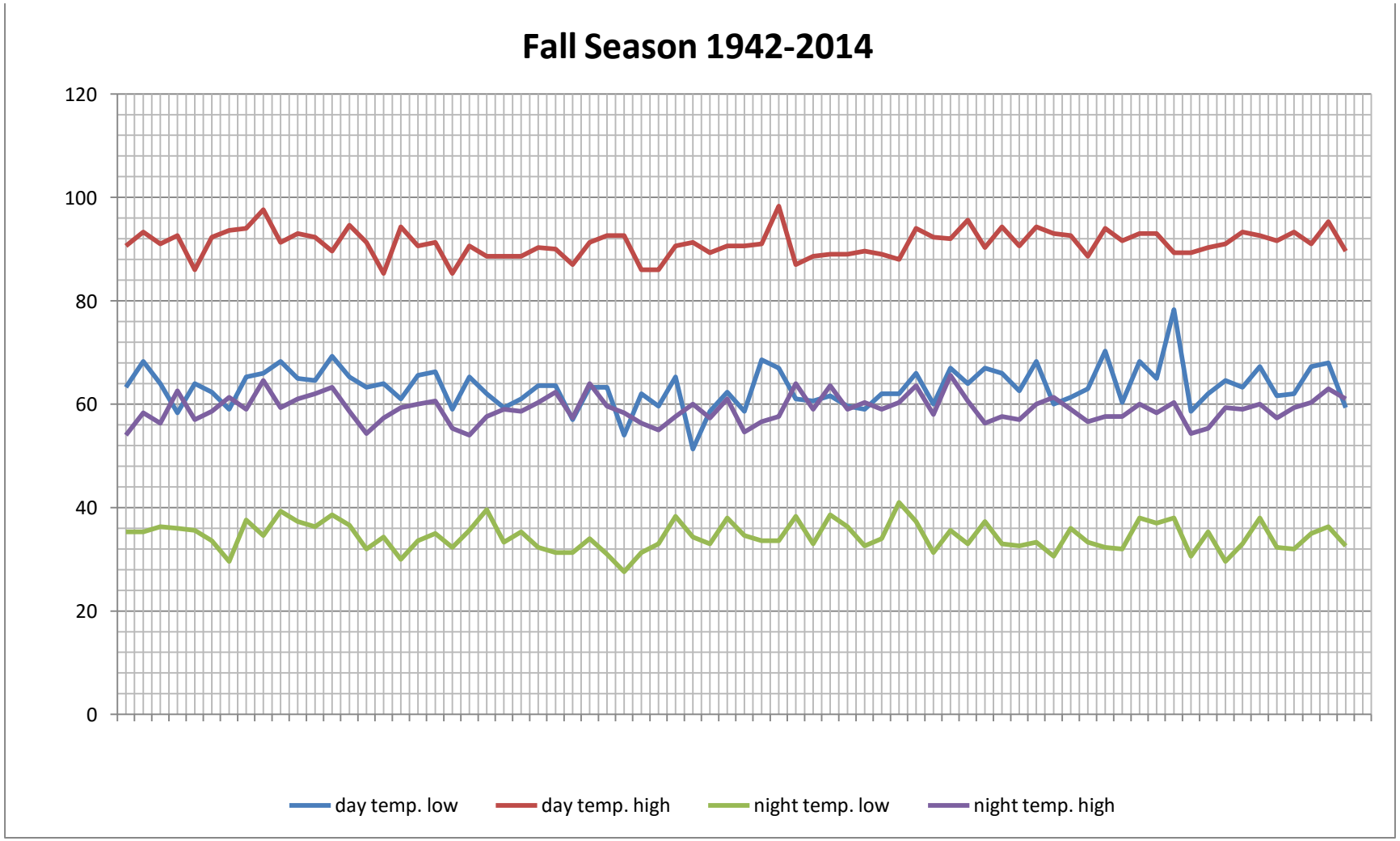
Edwards AFB Rainfall Data



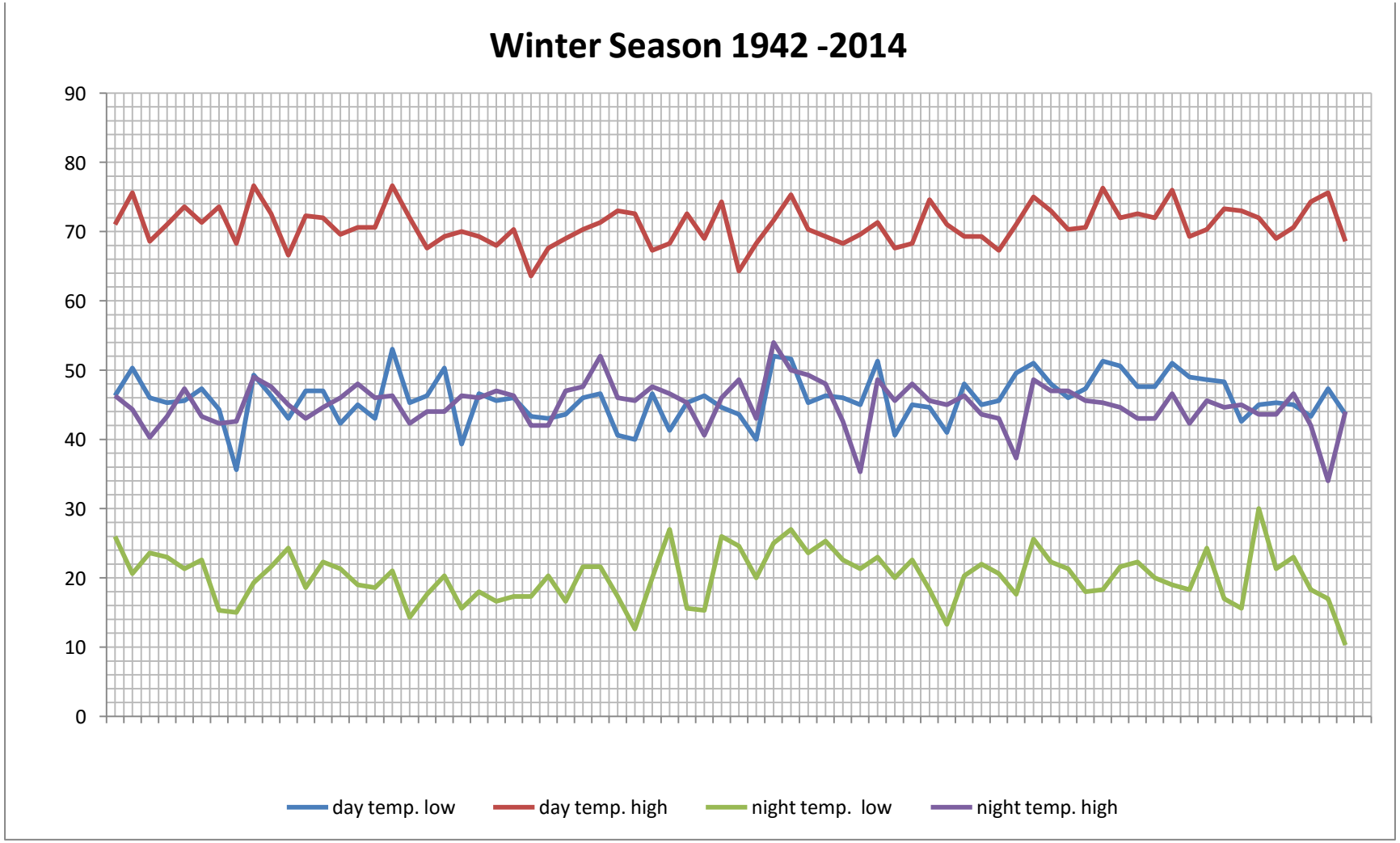
Spring Annual Average Temperatures



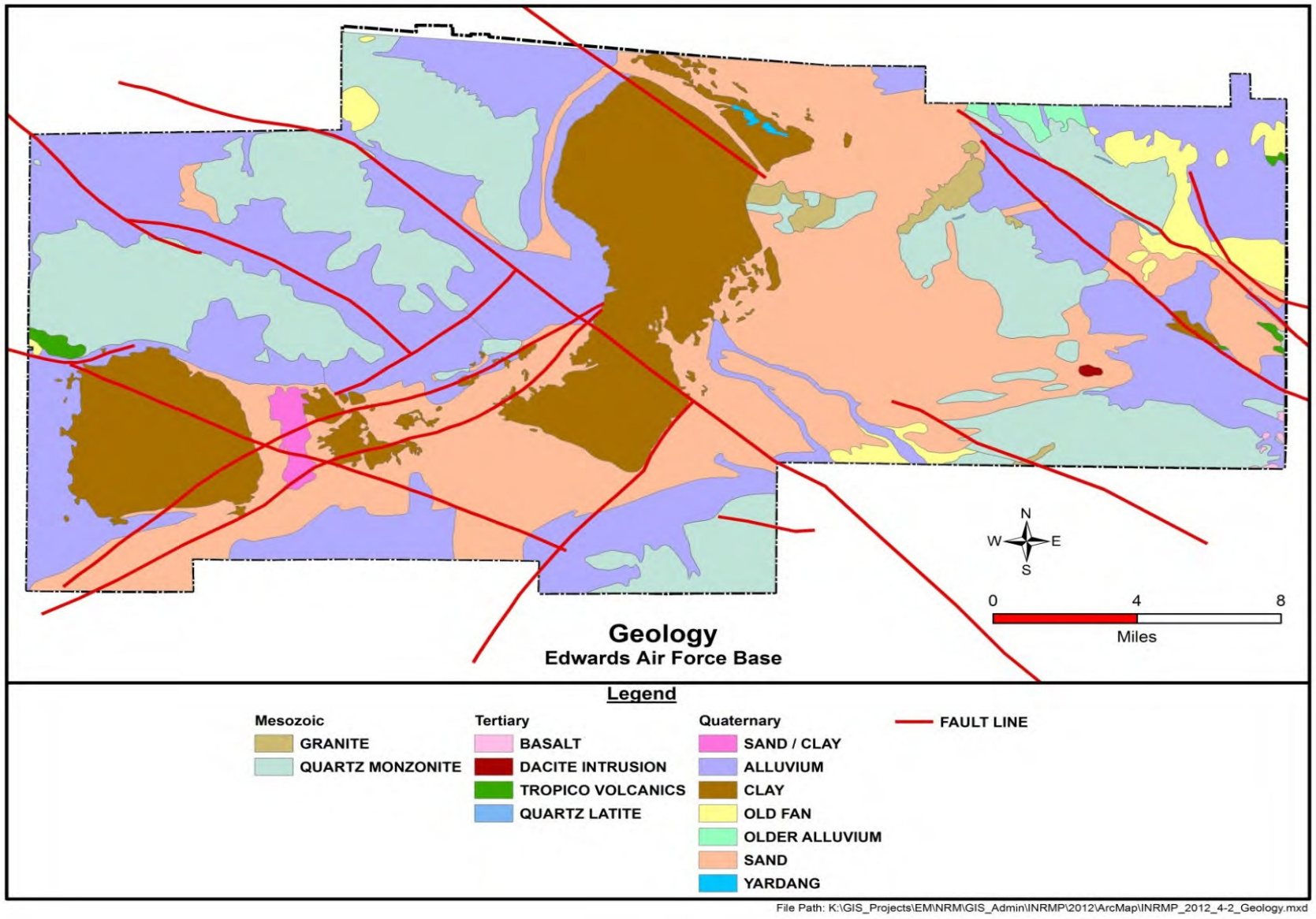
Summer Annual Average Temperatures



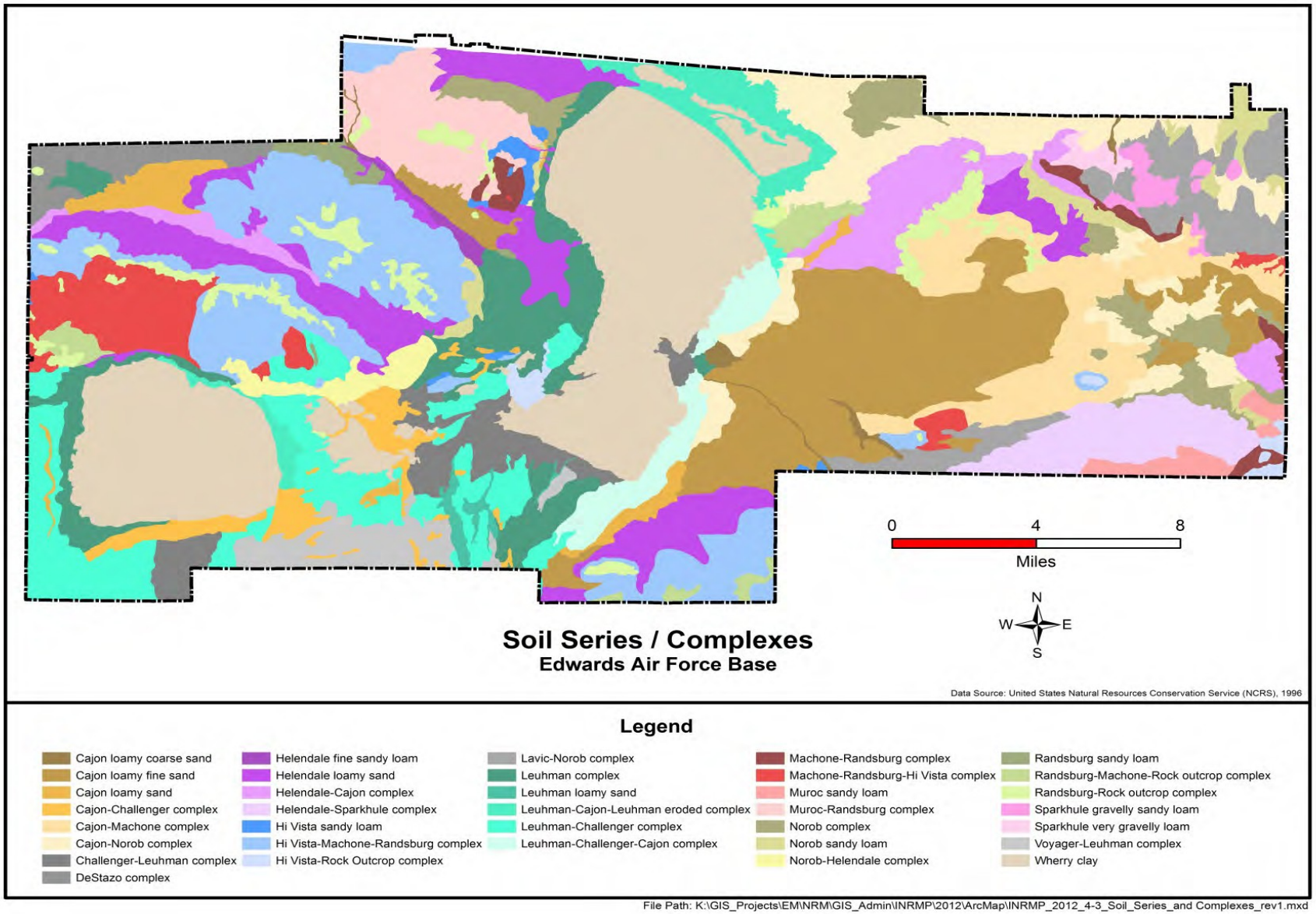
Fall Annual Average Temperatures



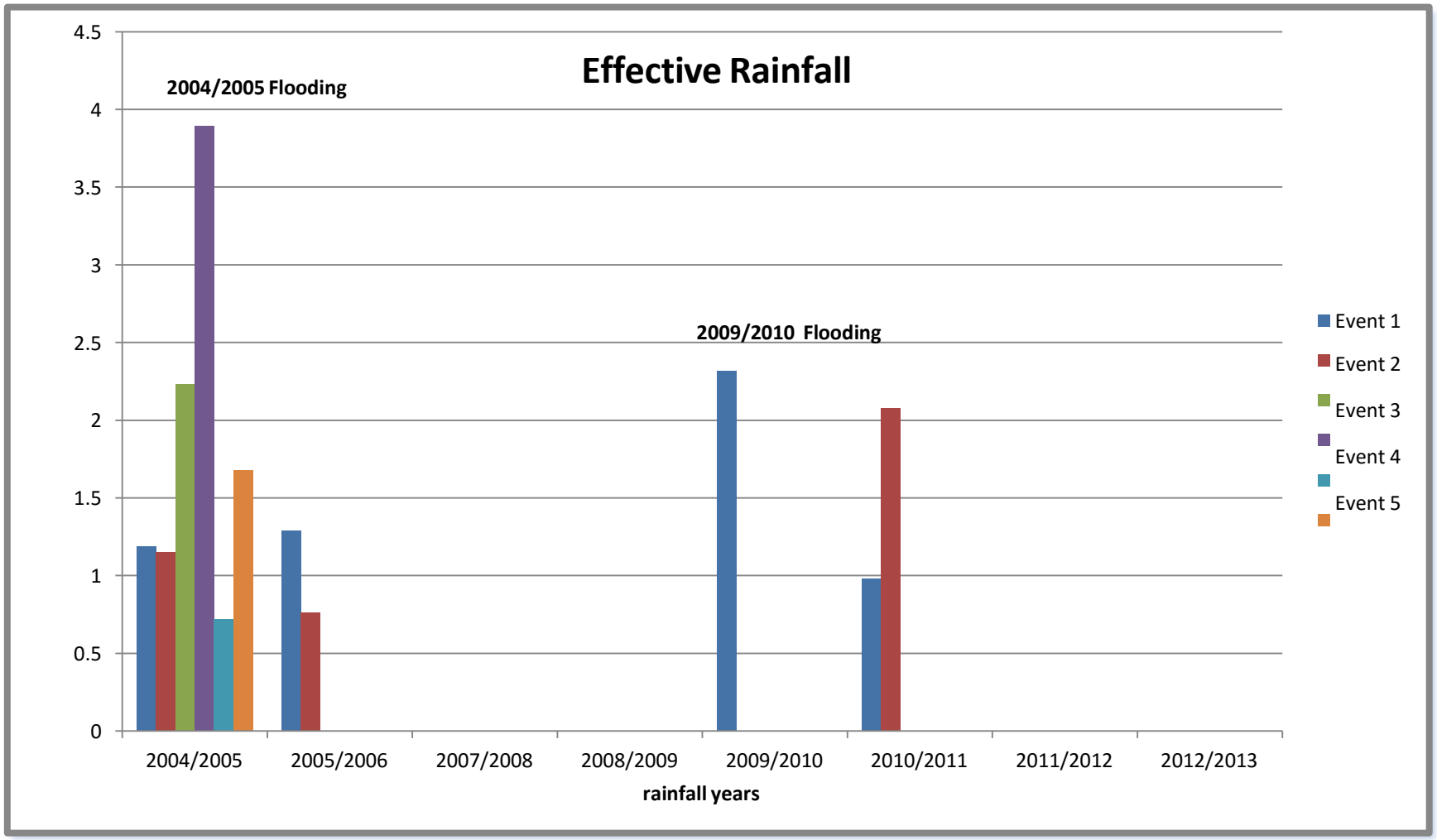
Winter Annual Average Temperatures



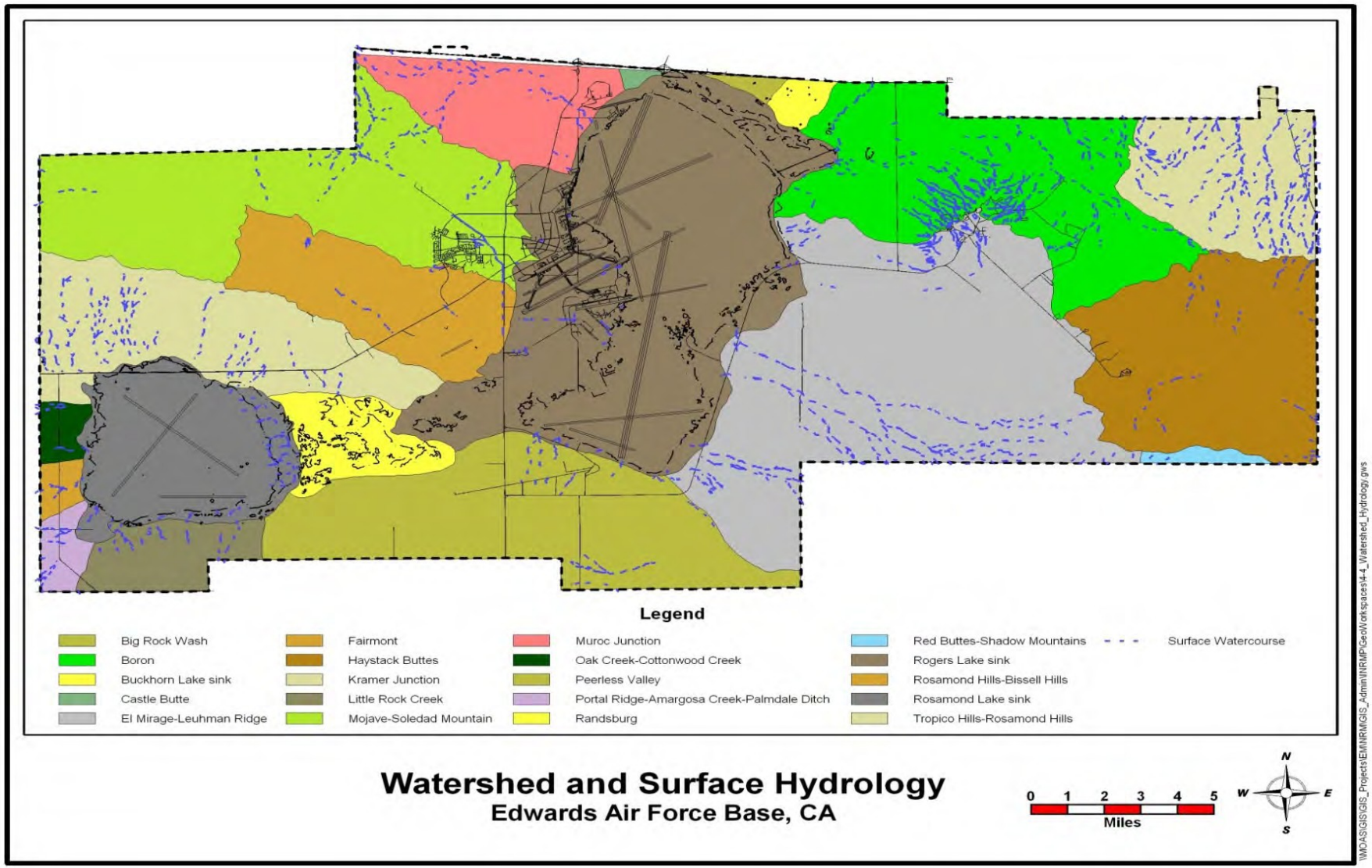
Geological Features on Edwards AFB



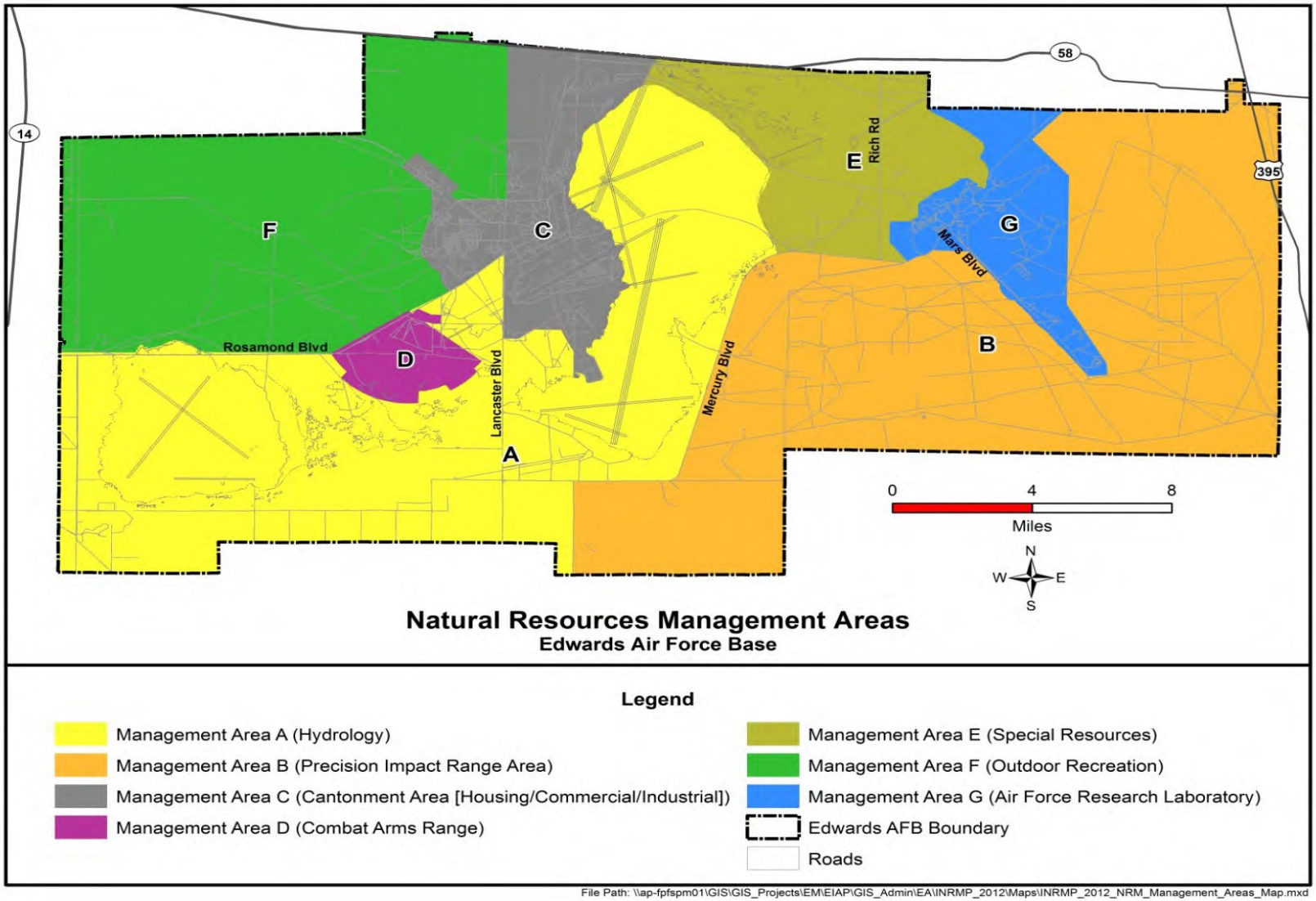
Soil Types at Edwards AFB



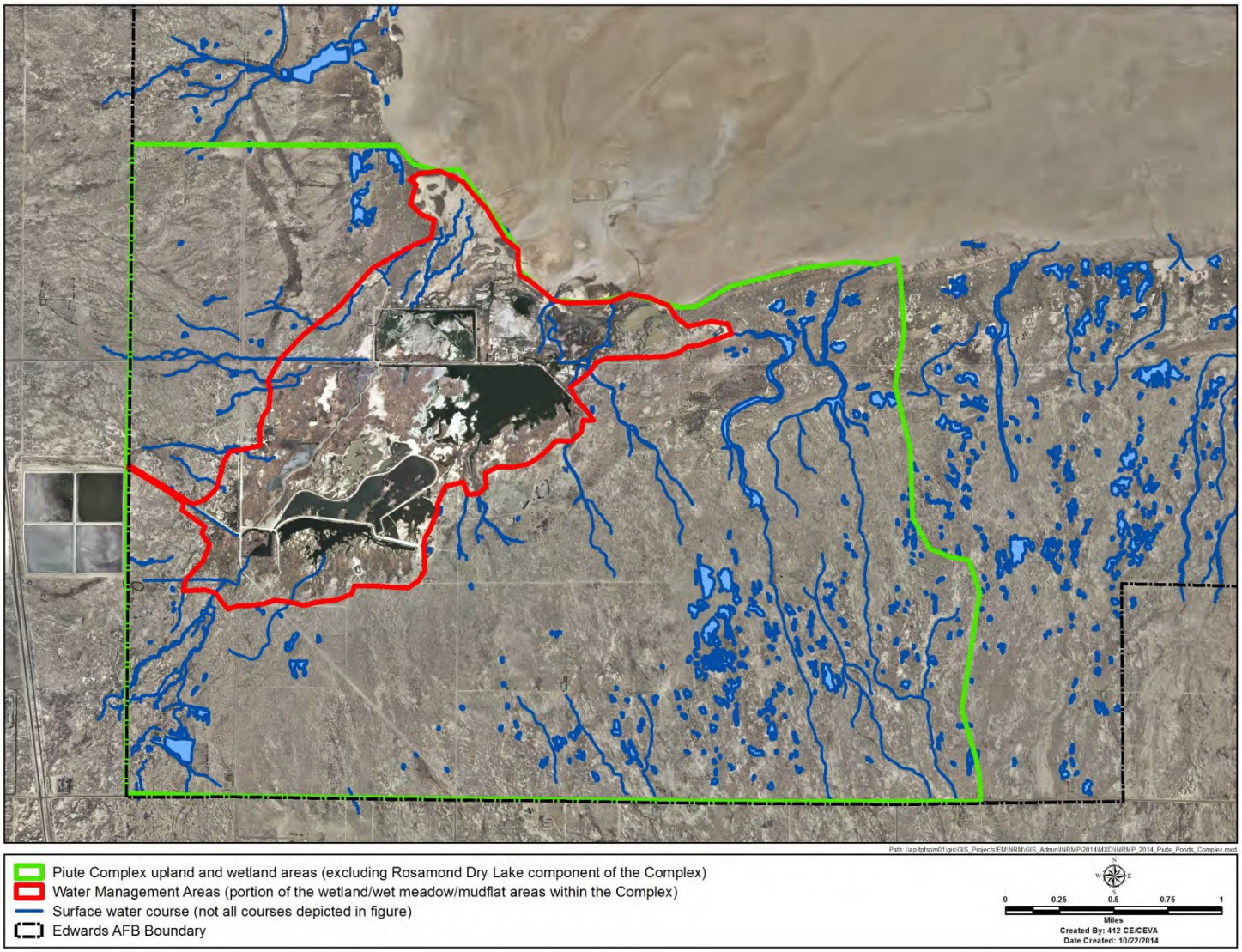
Recent Effective Rainfall Events at Edwards AFB



Watersheds on Edwards AFB



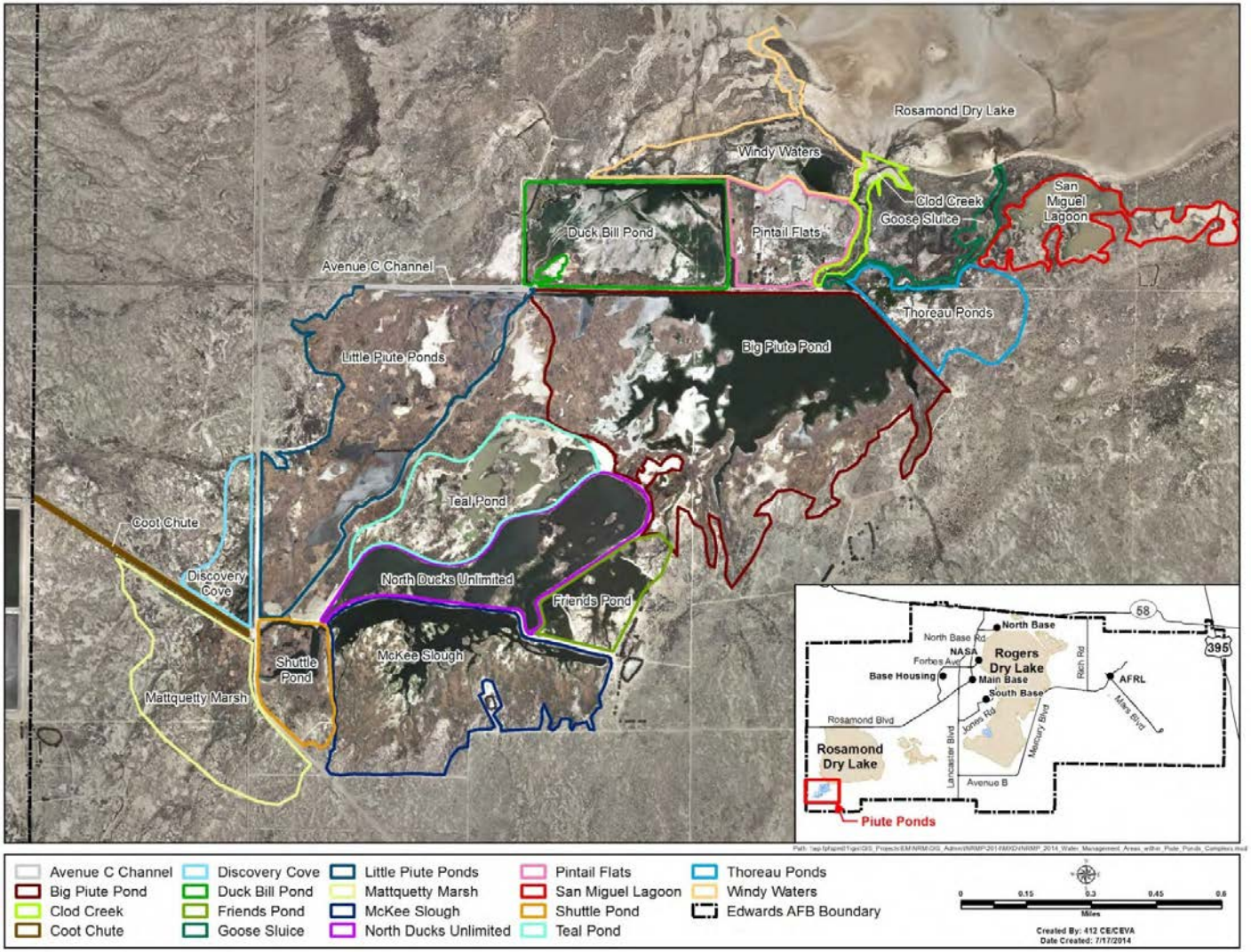
Natural Resource Management Areas



Note: Green boundary indicates the 5,614 acres, the red boundary indicates the 1,410 acres of the water management area

Piute Ponds Complex

INTEGRATEI



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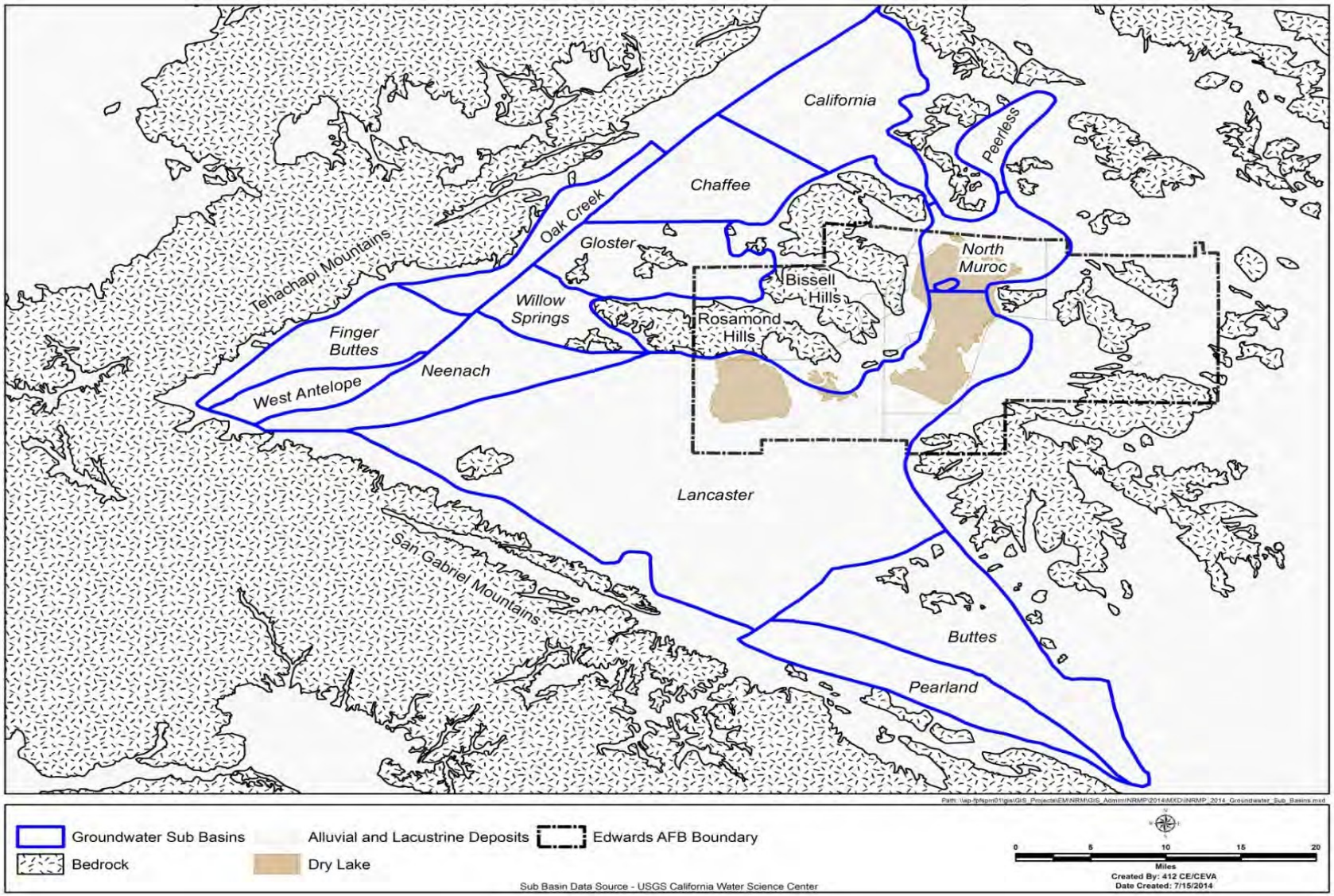
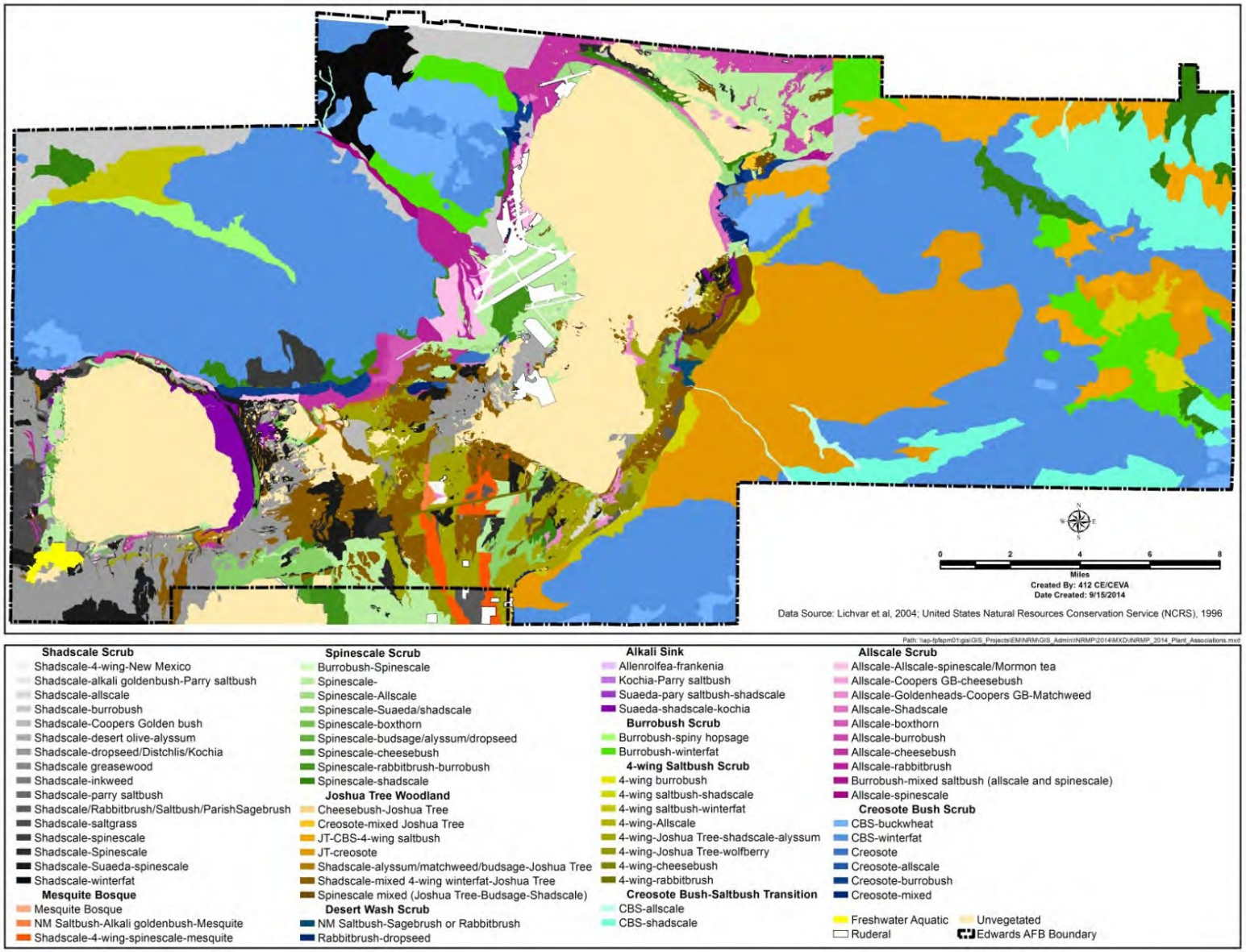
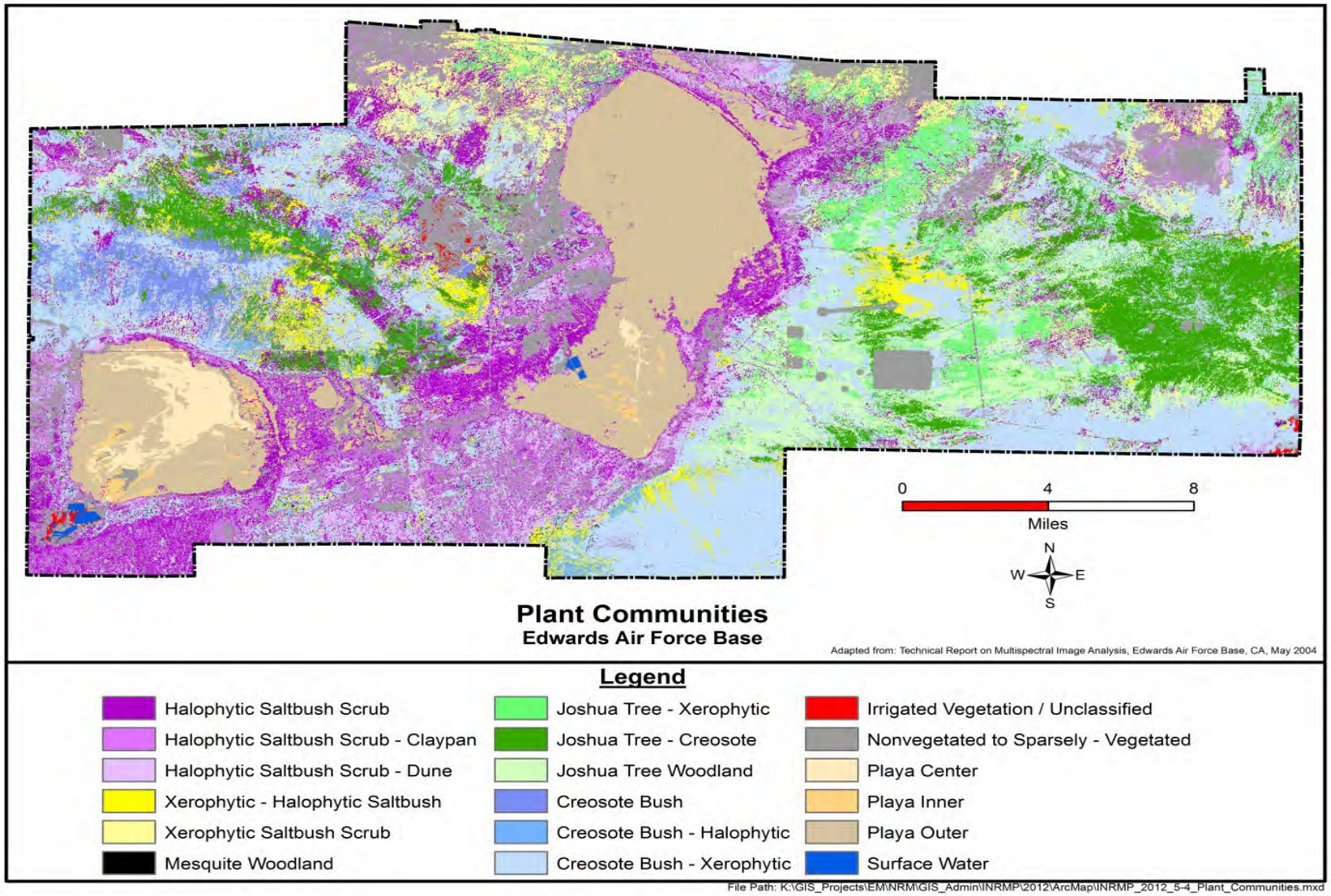
Water Management Areas within Piute Ponds Complex.



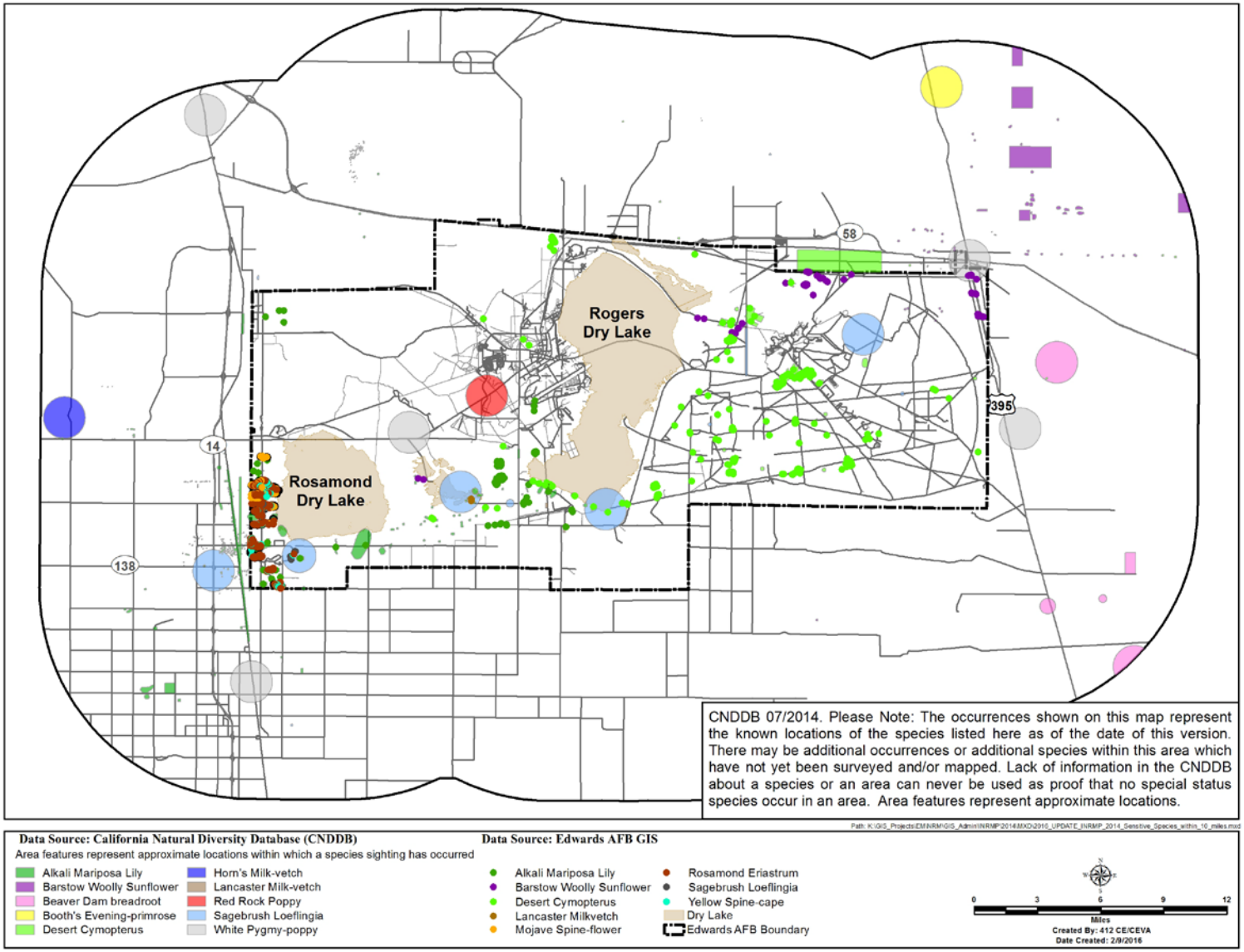
Groundwater Basins



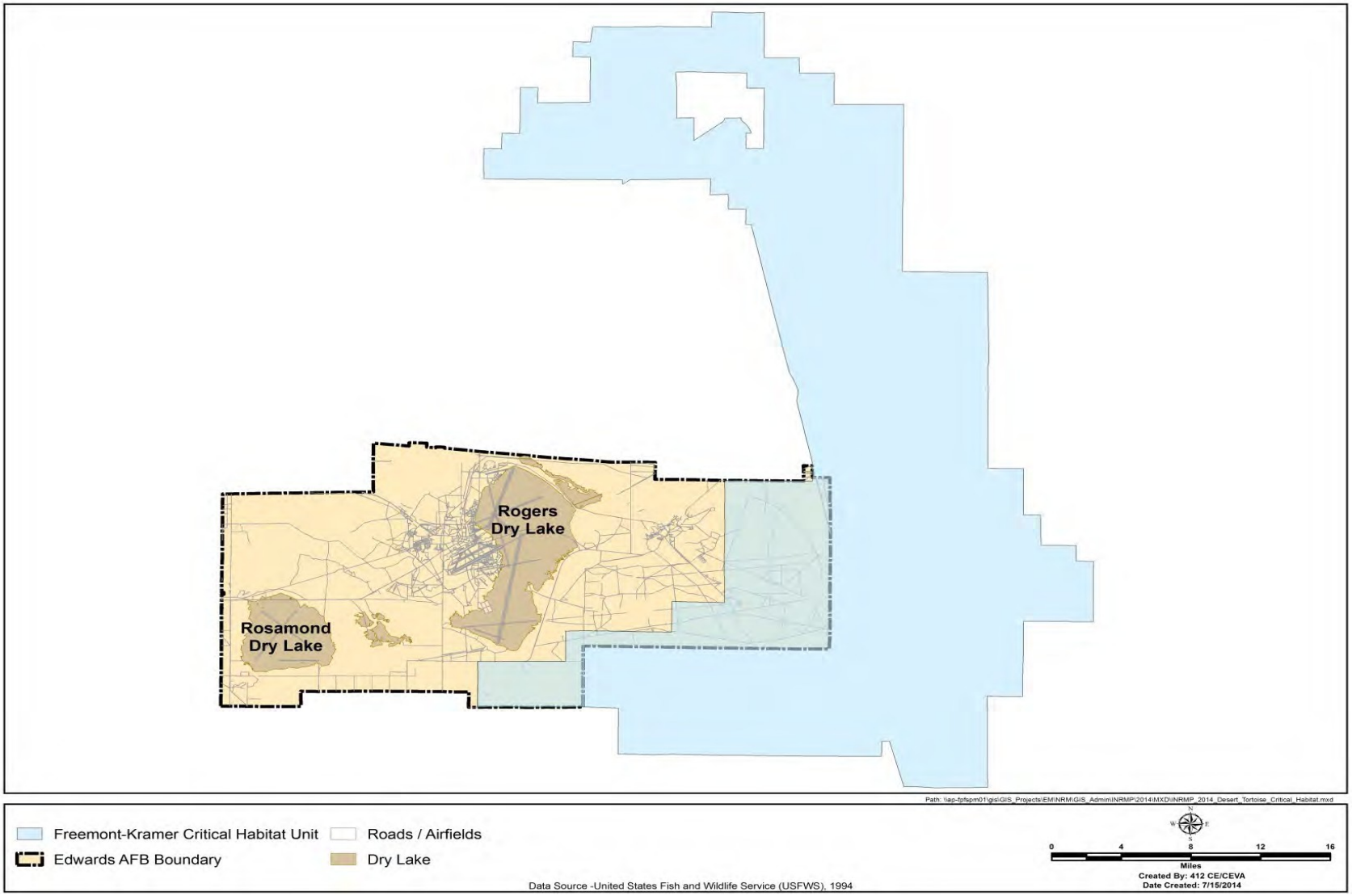
Plant Associations



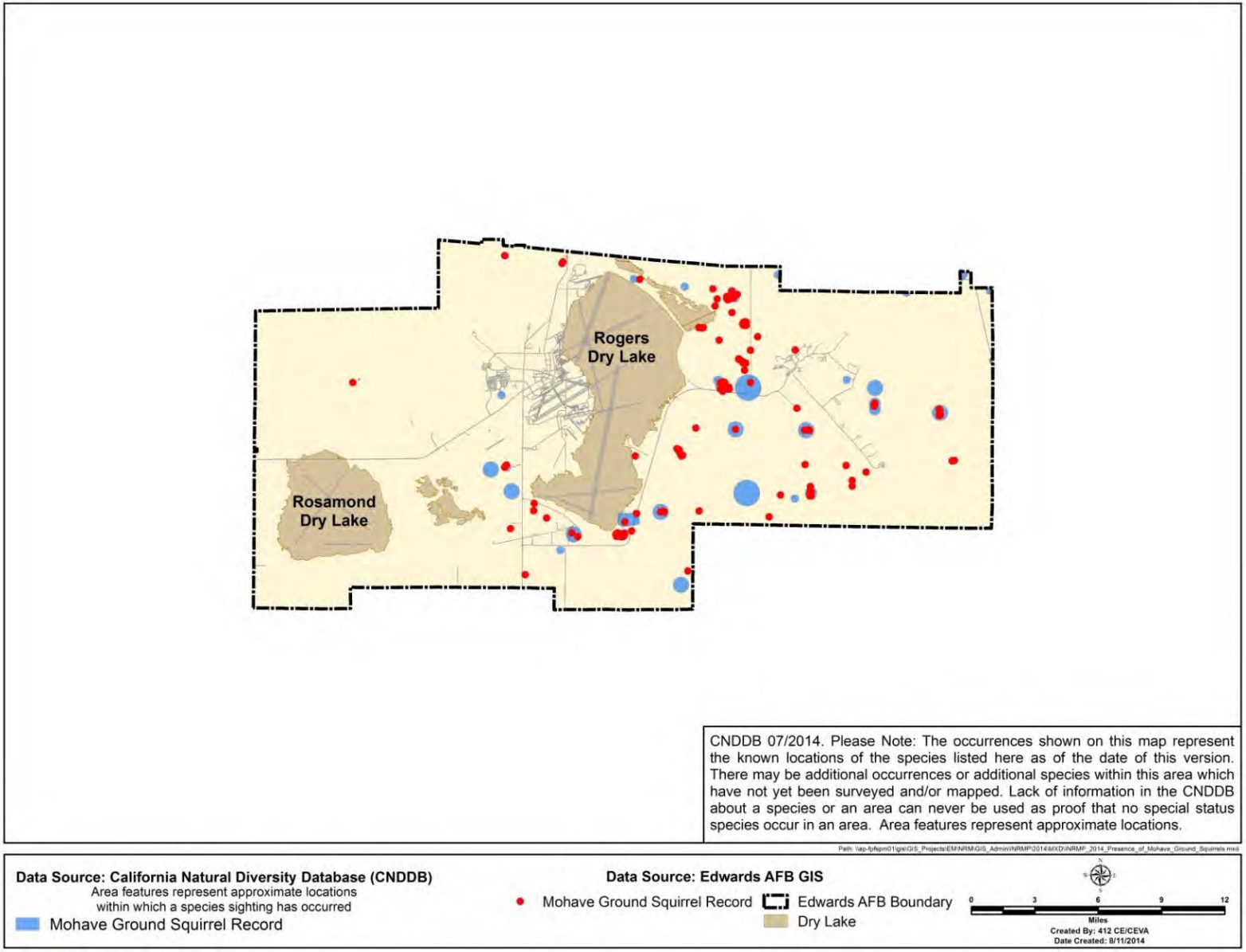
Plant Communities on Edwards AFB



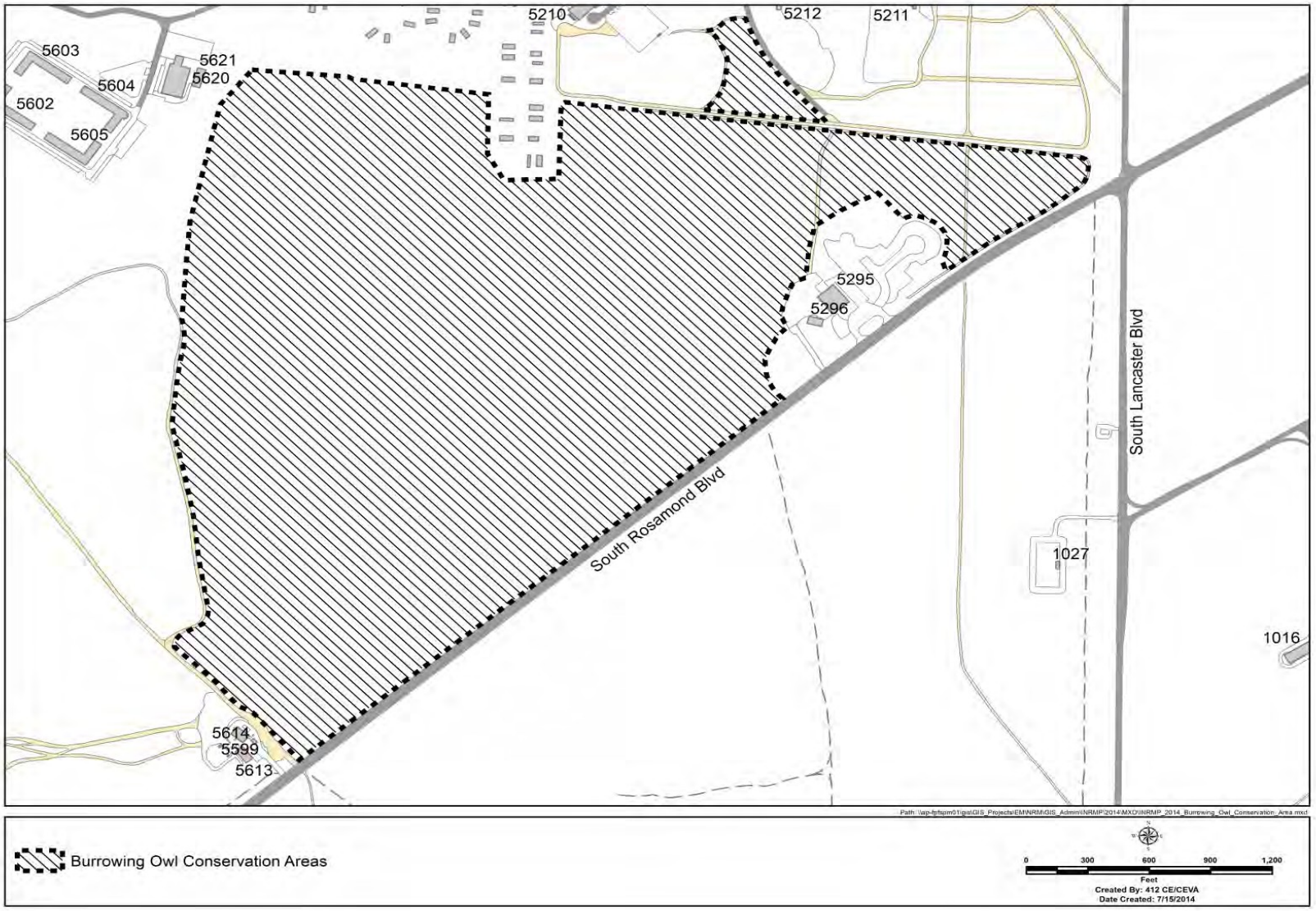
Sensitive Species within 10 Miles of Edwards AFB



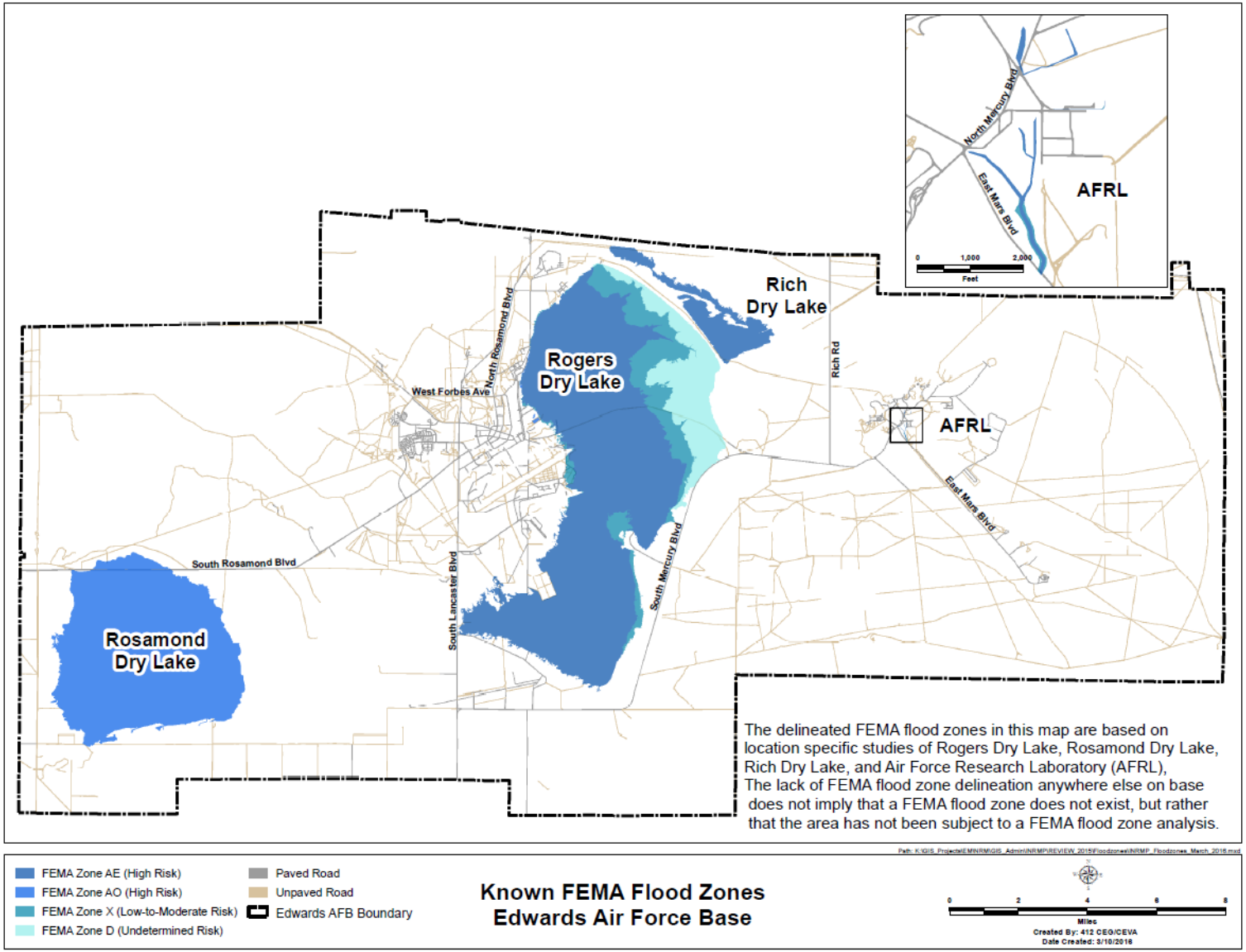
Desert Tortoise Critical Habitat on Edwards AFB



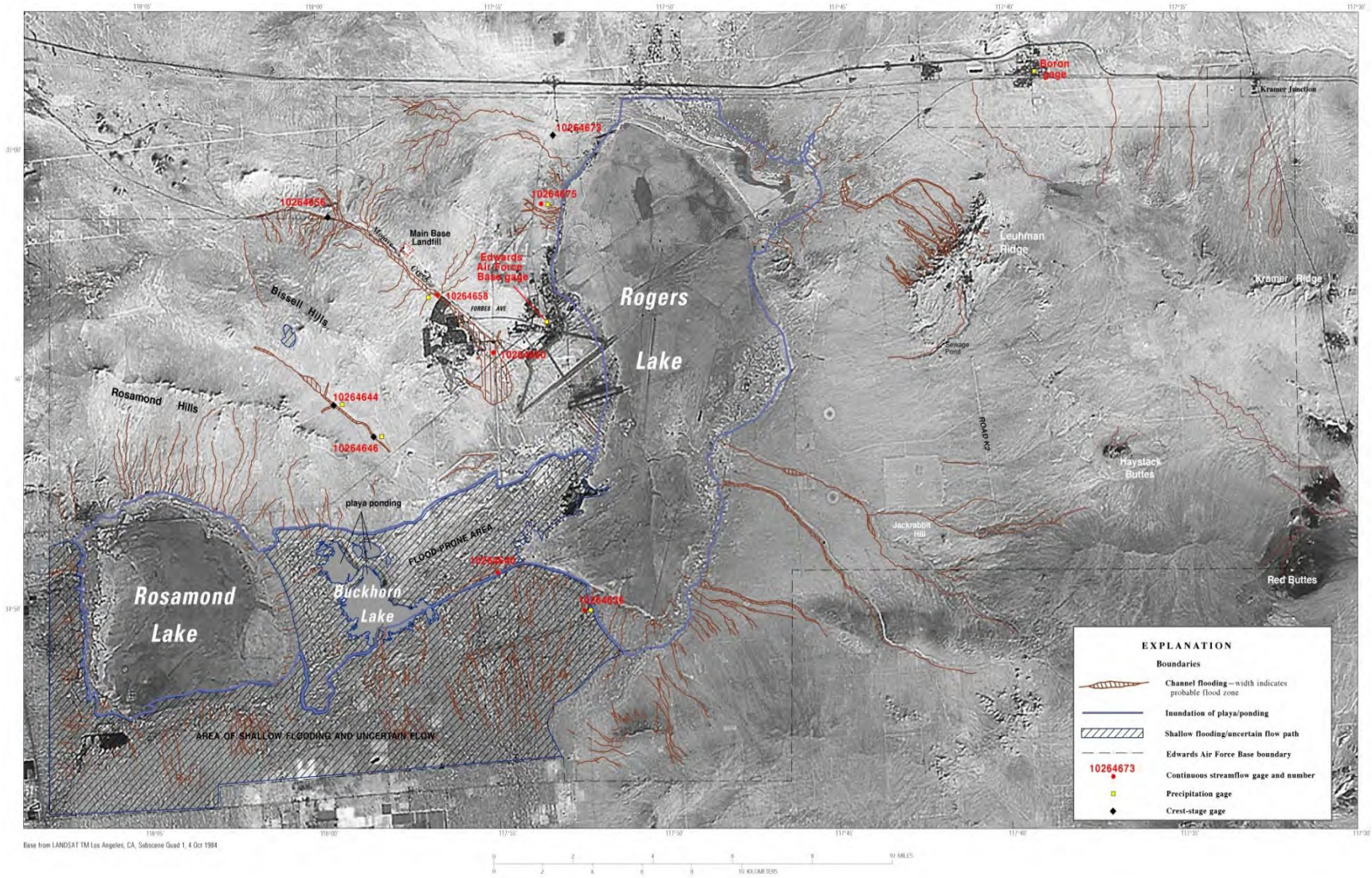
Presence of Mohave Ground Squirrel on Edwards AFB



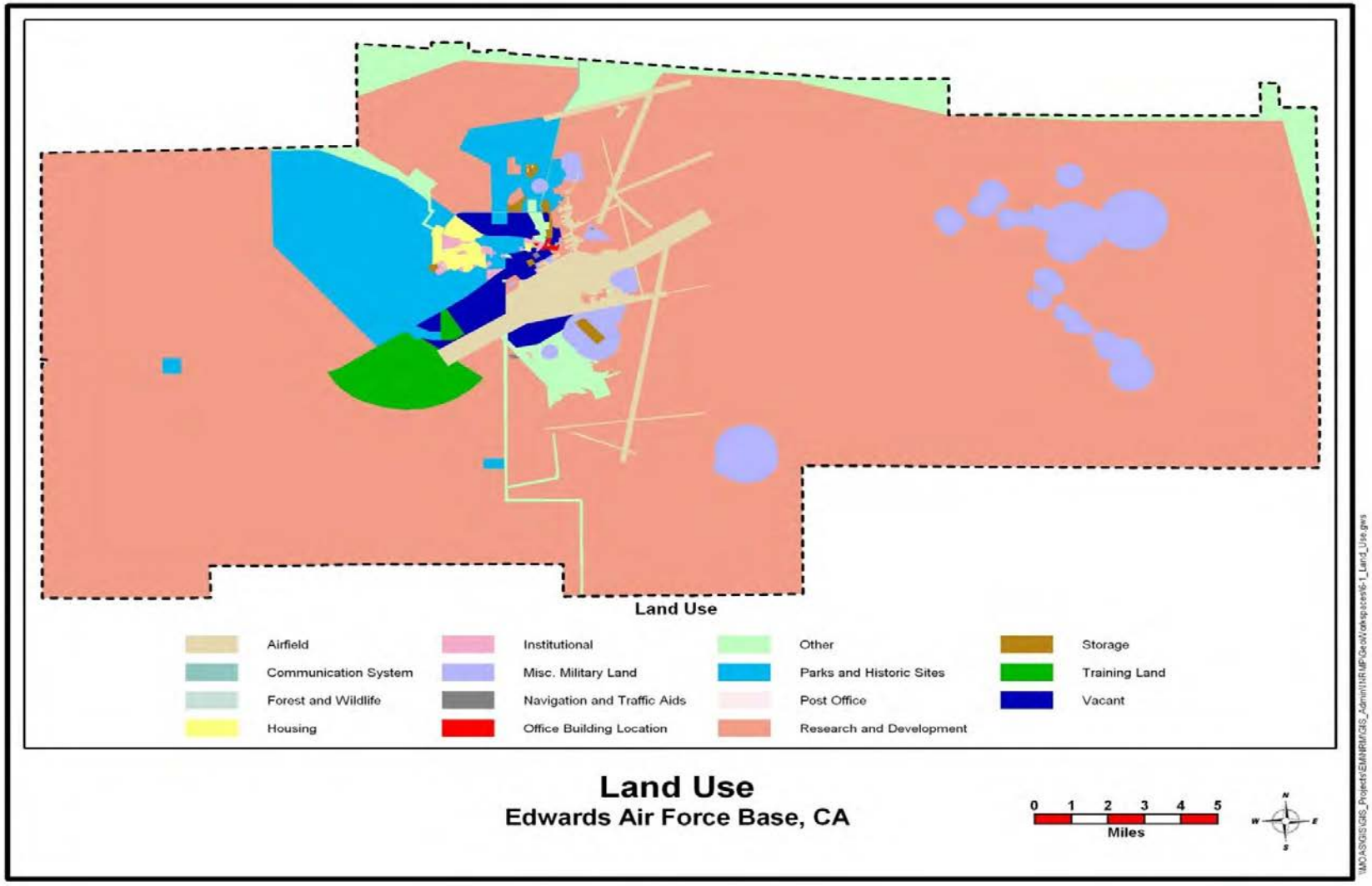
Burrowing Owl Conservation Area



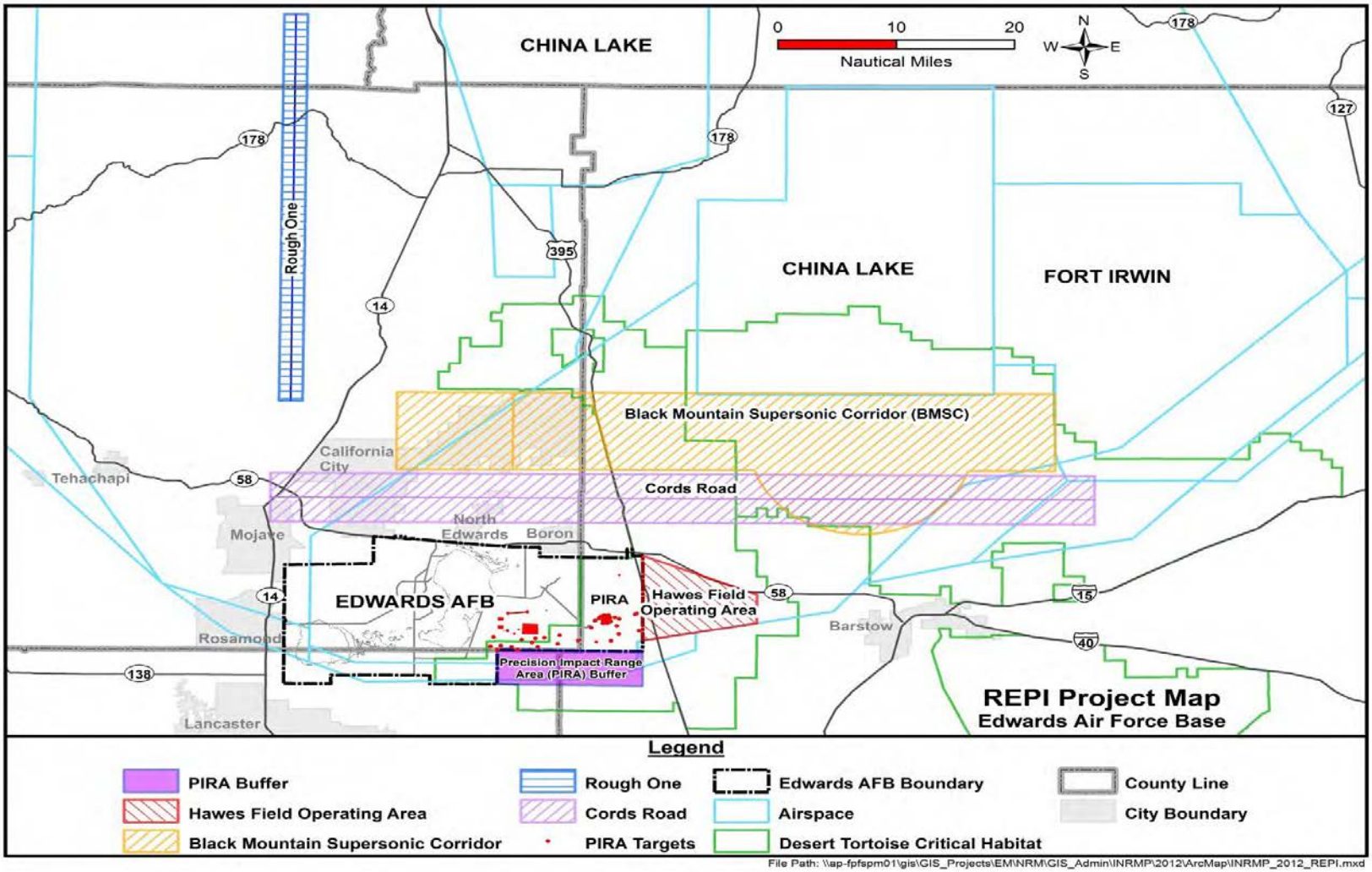
Delineated 100-year Floodplains on Edwards AFB



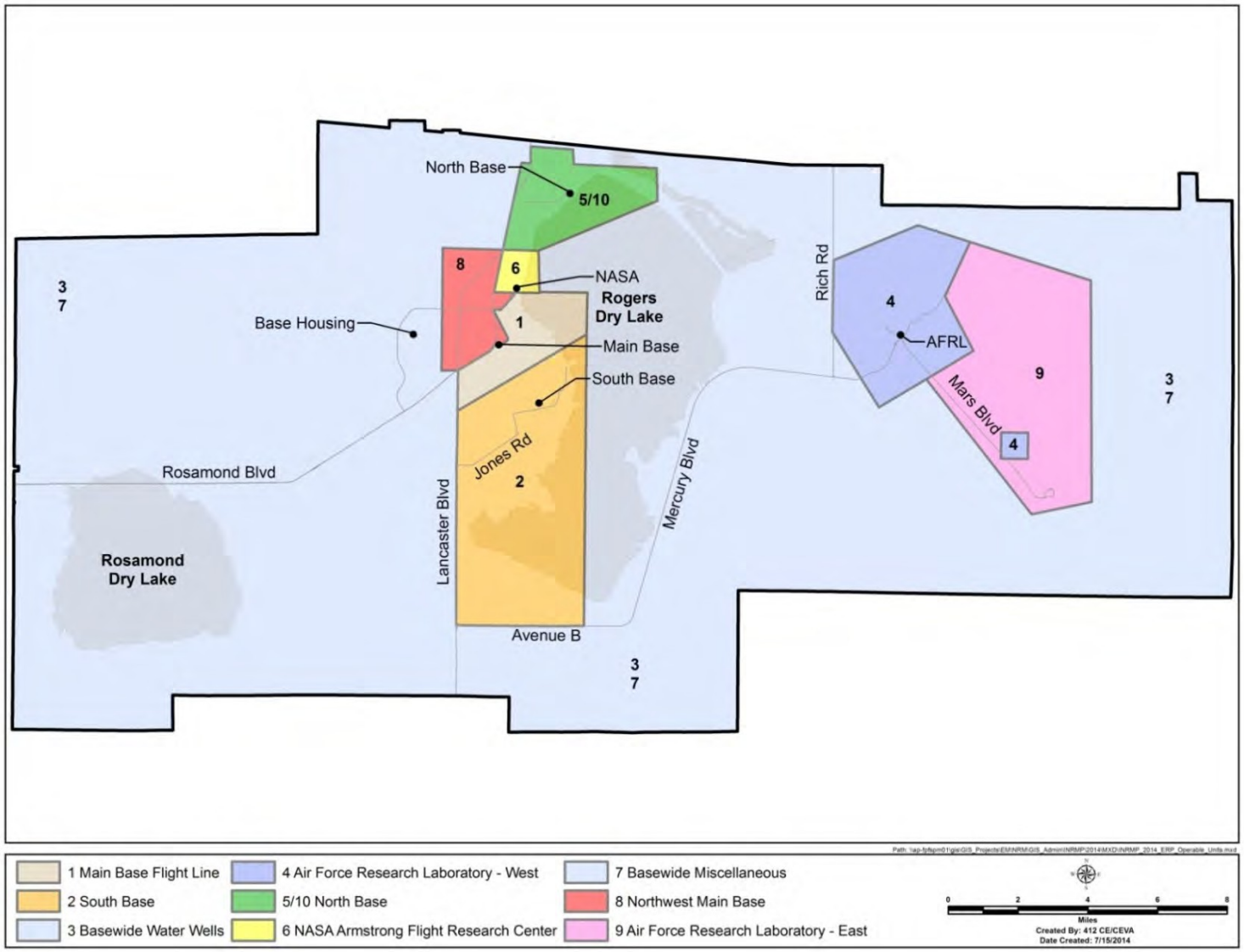
Flood Prone Areas on Edwards AFB



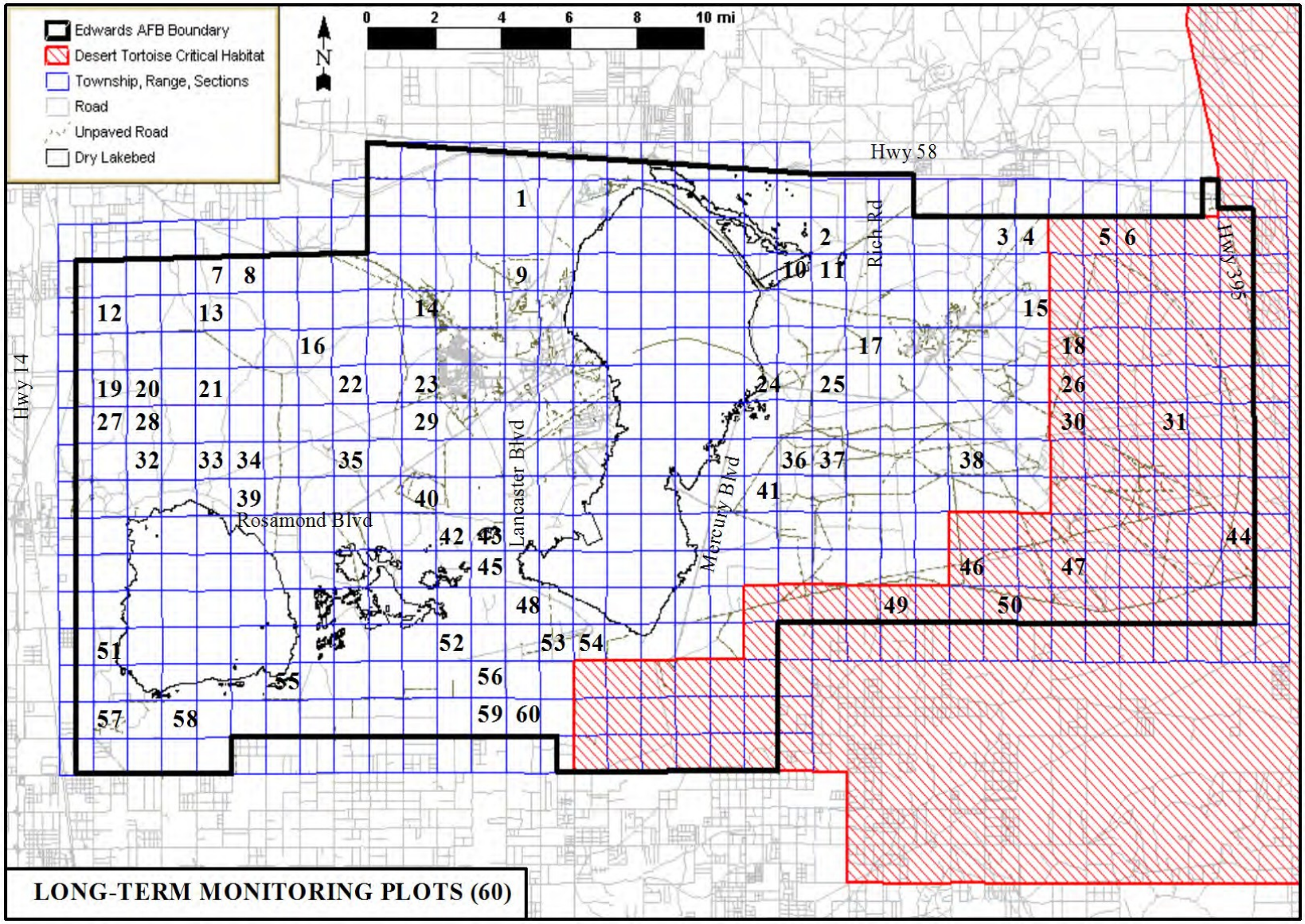
Land Use Designations



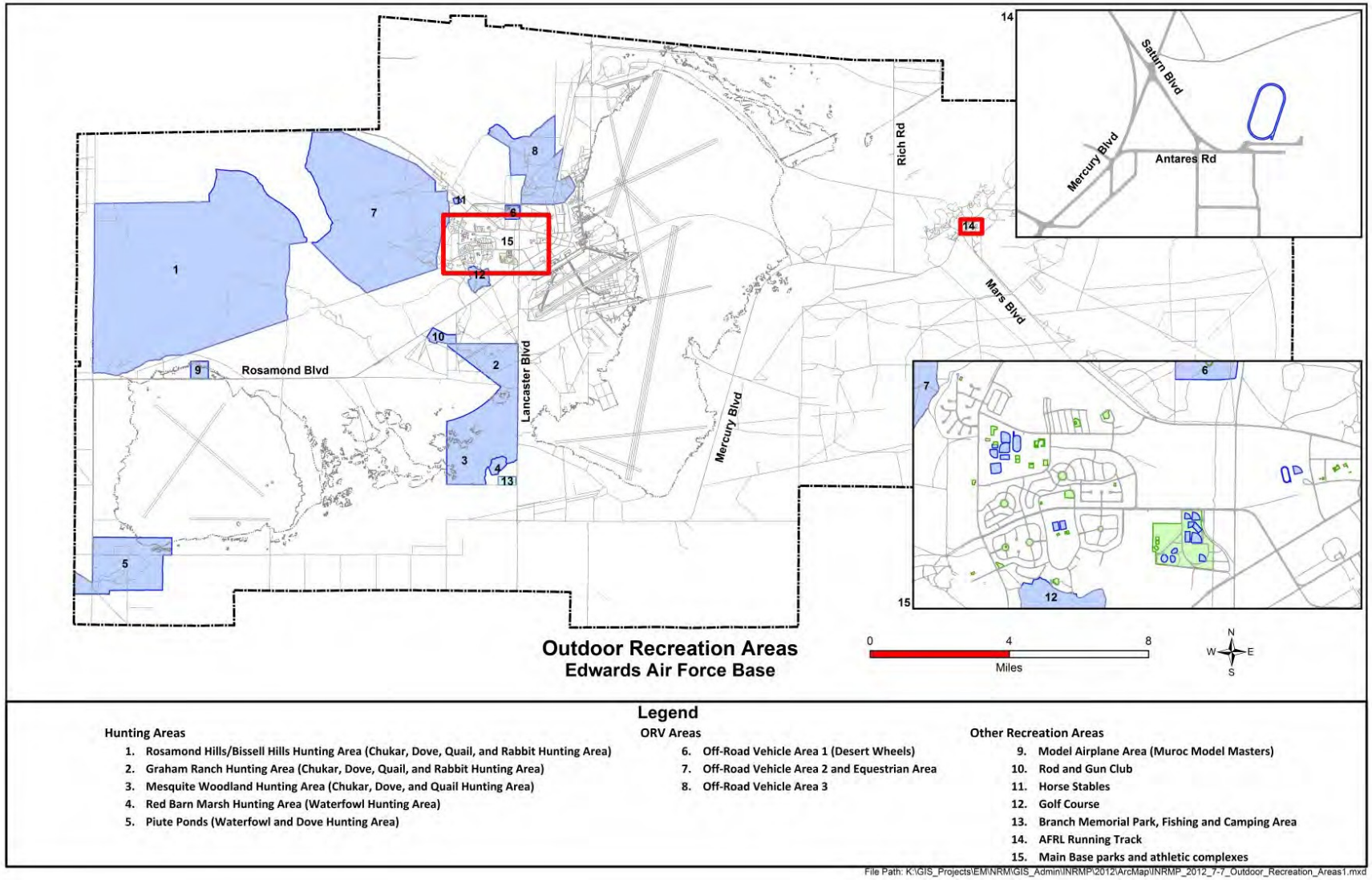
Edwards AFB REPI Project Areas



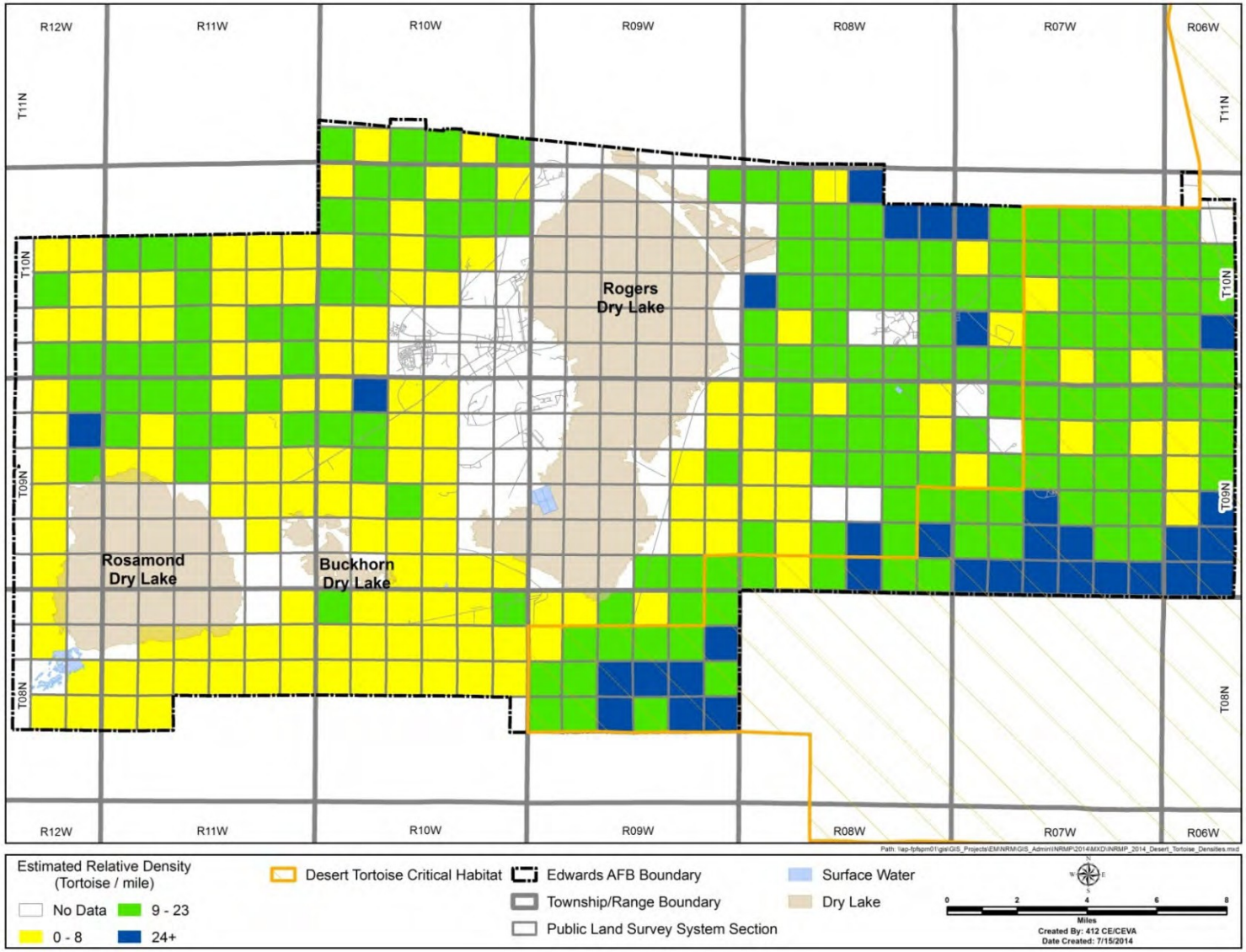
ERP Operable Units



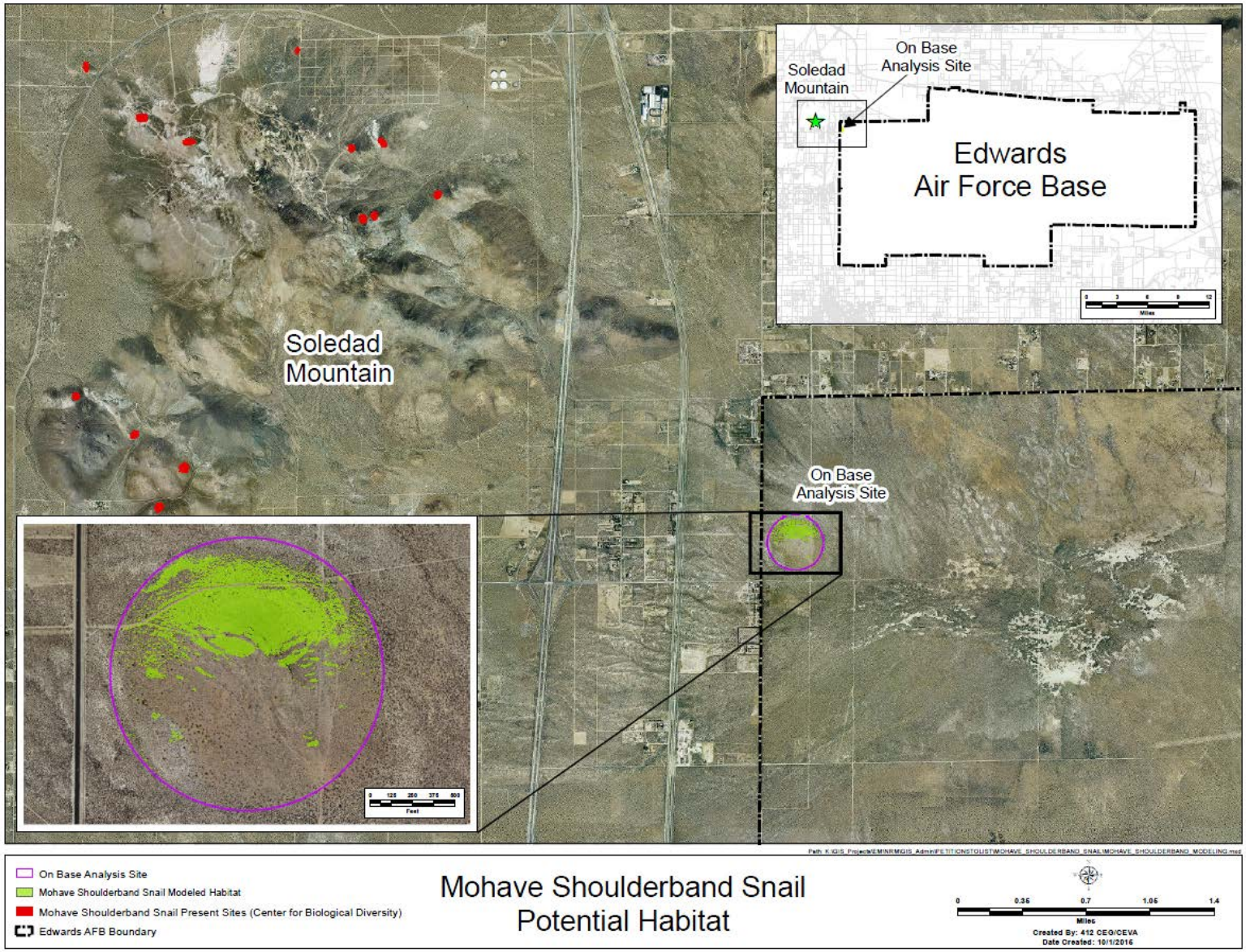
Habitat Quality Assesssment Plots on Edwards AFB



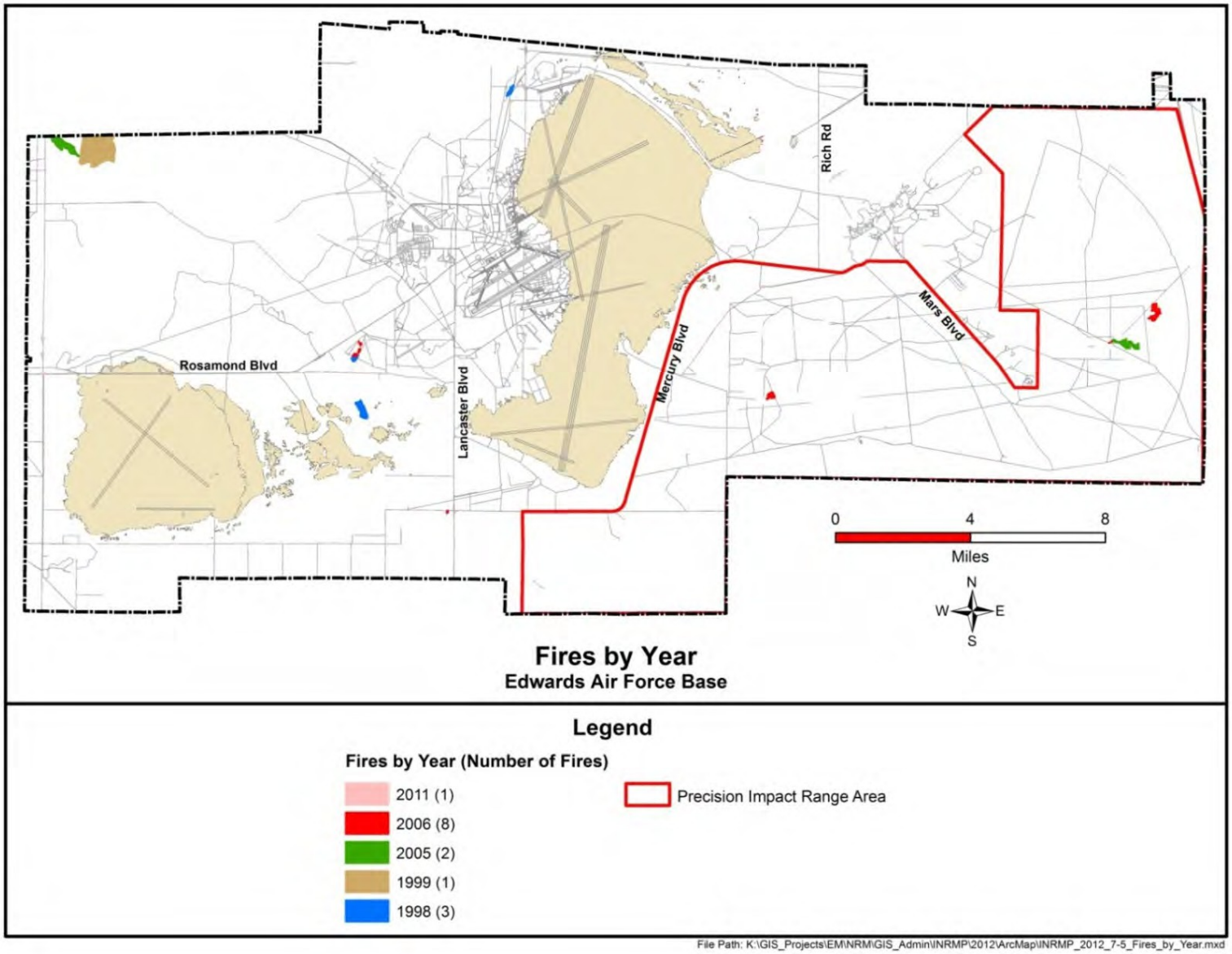
Outdoor Recreation Areas on EAFB



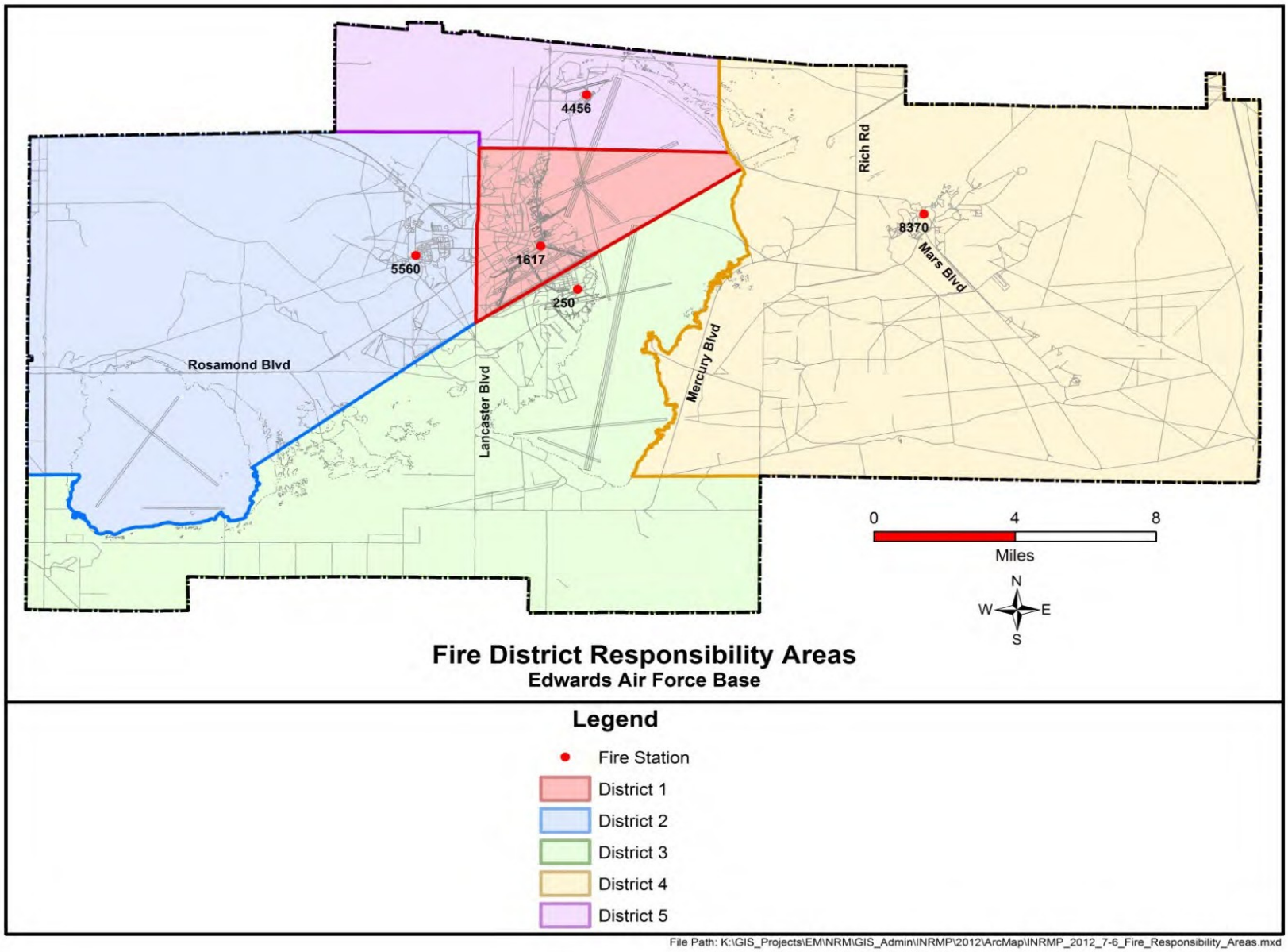
Desert Tortoise Densities



Mohave Shoulderband Snail Potential Habitat



Fires by Year



Fire District Responsibility Areas

Appendix C. Tables

Monthly Range in Temperatures by Month per Year 1942 to 2014

This table shows the range in temperature for each month. The monthly high and low temperature for both day and night time degrees. The top row of numbers represents the lowest day time temperature for that month to the highest day time temperature for that month. The second row represents the same but for the night time temperatures.

Winter Season
Spring Season
Summer Season
Fall Season

- July 1998 & July 2007 have the highest recorded temperatures: 115°F
- Aug, 2007 and July 1979 has the highest recorded nighttime temperature: 81°F
- July 2002 the temperature stayed at 100°F and above. Only one day was 99°F.
- Lowest night time Temperatures recorded (10°F and below): Dec. 1956 9°F, Dec. 1962 8°F, Jan. 1963 4°F , Dec. 1968 7°F, Dec. 1976 10°F, Dec. 1990 4°F and Dec. 1998 5°F.

Years	*Jan Range in degree*	*Feb Range in degree*	*Mar Range in degree*	*Apr Range in degree*	*May Range in degree*	*Jun Range in degree*	*Jul Range in degree*	*Aug Range in degree*	*Sep Range in degree*	*Oct Range in degree*	*Nov Range in degree*	*Dec Range in degree*
1942	(D) 45-69 (N) 23-44	45-70 32-46 Missing data	No temp.	No temp.	No temp	79-103 51-67	90-108 63-75	82-110 49-73	82-97 44-58	53-93 35-54	55-82 27-50	49-74 23-49
1943	53-83 11-47	52-76 25-45	56-80 34-51	65-91 35-54	65-101 43-67	73-100 46-64	86-109 55-76	89-104 49-70	84-102 48-64	60-98 34-60	61-80 24-51	46-68 26-41
1944	48-69 22-42	43-73 26-40	49-79 29-55	55-83 32-54	63-90 41-60	66-104 42-63	89-101 52-64	90-111 52-70	69-107 42-66	72-89 40-51	51-77 27-52	47-64 23-39
1945	46-69 23-41	47-77 27-45	40-80 29-48	57-92 27-59	62-93 43-58	73-105 48-64	94-112 61-75	88-106 53-73	69-104 44-73	60-93 37-61	51-81 27-54	44-67 19-44
1946	48-76 18-44	43-76 19-50	52-80 30-43	59-94 37-59	64-93 45-60	82-99 53-66	91-102 60-74	89-107 57-77	80-101 50-66	60-85 32-57	52-72 25-48	49-69 27-48
1947	44-70 21-39	54-76 29-47	55-82 32-51	54-93 37-58	67-100 47-64	73-100 53-67	92-108 58-72	83-103 51-76	74-104 44-71	65-97 39-62	48-76 18-43	44-68 18-44
1948	45-77 16-40	46-74 15-47	49-73 25-46	54-90 36-55	62-94 42-58	70-106 48-72	85-106 51-70	89-108 54-72	66-107 34-70	59-94 33-62	52-80 22-52	42-70 15-40

1949	28-58 12-36	39-71 16-46	54-73 30-45	63-96 36-57	62-96 47-63	74-105 50-70	92- 107 56-72	83- 106 51-71	81- 106 46-67	53-92 33-61	62-84 34-49	40-76 17-46
1950	40-74 12-55	51-79 21-45	48-82 24-50	59-94 32-62	55-102 38-65	70-108 44-70	86- 108 64-72	88- 111 55-73	74- 109 47-74	69-99 37-60	55-85 20-60	57-77 25-47
1951	48-73 19-46	47-80 24-46	44-82 25-57	53-90 33-55	58-103 41-69	75-104 50-70	91- 105 58-77	77- 106 56-72	81- 104 53-67	71-92 38-61	53-78 27-50	44-65 22-51
1952	42-61 19-44	45-71 28-44	41-80 27-52	61-84 36-50	70-100 46-63	70-97 47-65	87- 105 43-73	93- 104 57-72	71- 102 48-71	79-98 41-61	45-79 23-51	42-68 26-47
1953	47-71 23-46	43-75 18-43	47-80 21-46	51-91 32-55	56-86 39-59	63-105 46-67	95- 106 57-76	72- 105 55-72	80- 103 50-77	61-94 34-59	53-80 25-50	51-71 15-40
1954	47-73 19-44	48-80 31-47	49-74 23-44	62-95 35-61	67-102 41-66	63-111 46-79	91- 107 60-77	80- 104 52-74	86-98 50-76	73-95 32-63	49-76 34-51	46-63 17-43
1955	39-63 25-41	46-73 19-47	57-78 27-52	53-82 34-51	55-95 39-57	72-105 45-69	83- 105 56-75	93- 106 56-76	74- 109 51-72	72-92 37-57	50-83 22-47	42-73 20-50
1956	47-72 24-54	41-70 24-43	52-81 28-50	51-86 33-56	62-93 37-62	81-112 53-75	81- 104 55-76	89- 105 52-65	82- 102 47-63	57-91 30-57	51-81 19-43	47-70 9-47
1957	33-62 15-43	48-80 21-51	51-78 26-53	50-84 34-53	60-95 41-57	77-107 50-75	90- 106 51-73	80- 106 47-72	83- 101 46-70	57-84 40-53	52-71 17-49	48-70 20-44
1958	50-70 17-45	53-76 29-51	46-71 27-48	50-89 34-58	64-96 40-60	74-102 44-68	88- 108 56-71	88- 105 60-76	70- 105 42-71	67-96 32-59	46-82 16-48	56-84 17-43
1959	48-75 15-42	45-72 21-41	57-77 30-49	66-92 42-55	60-93 41-60	85-107 53-72	96- 108 55-75	79- 105 48-75	73- 101 42-71	61-95 38-59	63-76 21-50	43-69 17-44
1960	41-65 13-45	50-72 20-45	58-84 32-51	55-91 35-60	63-99 41-61	85-105 53-72	95- 112 61-75	84- 107 50-74	86- 101 46-71	62-90 35-64	51-83 24-47	48-66 20-42
1961	52-70 14-43	57-75 25-46	55-80 24-51	60-89 35-58	61-89 42-55	70-112 46-78	87- 113 55-79	86- 104 57-76	70-96 46-67	56-90 29-54	51-70 21-45	42-63 22-43
1962	33-72 18-43	41-68 21-48	48-81 26-46	62-89 37-59	56-88 42-61	61-101 48-65	84- 104 57-69	88- 109 54-77	77- 100 47-63	63-92 36-52	56-80 24-47	44-70 8-48

1963	35-63 4-46	57-78 32-53	48-75 23-47	50-83 31-48	60-94 40-63	65-97 49-67	90- 104 56-73	83- 104 52-72	67-99 53-64	69-93 40-62	50-74 26-47	48-67 18-39
1964	43-65 15-40	49-67 17-42	43-79 22-47	50-89 33-52	52-91 38-59	65-104 44-69	88- 105 55-75	86- 103 55-74	76-96 45-64	66-96 40-65	36-74 15-48	45-72 18-59
1965	44-75 18-44	53-75 14-49	47-73 25-49	46-90 34-55	61-93 37-61	66-97 44-64	89- 103 52-76	88- 103 55-74	73-93 42-63	60-93 34-61	50-80 30-52	41-61 20-46
1966	42-60 17-36	45-64 19-39	41-87 22-45	58-92 30-48	67-95 41-60	75-102 48-66	91- 106 56-76	81- 112 57-78	73- 101 45-70	65-88 28-62	53-82 24-49	43-67 16-51
1967	44-68 18-44	52-74 20-43	48-80 26-50	46-71 31-44	63-100 32-65	64-105 41-70	93- 107 62-79	93- 105 62-76	74-95 48-72	68-92 35-60	49-83 32-55	33-61 23-39
1968	45-70 17-44	50-76 26-53	52-83 25-49	56-84 29-49	57-97 36-63	68-103 48-75	83- 112 55-74	75- 100 48-67	70- 100 40-68	65-86 33-54	54-75 21-50	36-61 7-44
1969	43-76 21-54	47-63 28-42	46-84 26-54	54-84 32-52	60-100 42-63	69-99 51-69	86- 106 53-78	94- 107 53-76	78- 103 49-74	58-92 32-66	54-79 21-52	48-72 16-47
1970	47-72 12-57	56-73 26-50	51-81 30-48	54-82 31-54	66-96 38-63	71-106 48-72	88- 108 58-76	96- 108 62-74	77- 101 42-65	60-93 26-61	53-77 25-53	42-69 27-49
1971	37-82 18-41	46-78 16-48	44-82 19-52	53-83 30-51	61-90 42-57	65-101 43-65	86- 107 58-76	90- 108 56-77	62- 106 39-70	47-96 20-56	53-76 24-49	39-59 18-49
1972	41-67 14-42	48-80 14-49	66-86 27-55	52-82 30-55	60-97 39-67	76-110 46-63	77- 113 54-75	86- 104 55-73	74-98 41-67	59-86 27-55	53-74 26-47	31-71 10-46
1973	43-65 11-46	50-67 30-48	48-66 31-45	53-88 34-55	62-98 37-64	72-107 51-71	91- 107 56-70	73- 104 47-72	70-93 43-60	63-86 32-55	46-79 24-50	47-70 19-49
1974	32-67 13-49	52-70 20-43	43-77 24-46	54-84 30-50	59-101 37-63	80-103 49-68	80- 105 53-78	89- 102 53-74	89- 100 50-71	54-94 38-58	53-78 22-44	40-68 18-48
1975	42-71 15-46	48-74 18-48	48-75 27-48	48-74 29-46	54-96 36-66	68-102 47-71	87- 110 53-77	81- 106 53-71	86- 102 51-71	62-92 31-60	46-80 21-49	46-73 14-42
1976	44-70 12-40	48-71 24-45	40-79 25-47	53-86 30-53	64-94 44-60	66-104 47-67	88- 104 57-73	74- 104 51-68	66- 102 49-68	66-87 31-54	44-79 19-50	47-66 10-37
1977	38-66 22-42	49-80 26-47	42-76 25-50	53-86 31-57	53-98 40-56	77-104 50-71	88- 109 56-76	72- 109 59-74	72- 101 47-69	66-90 39-62	49-81 28-52	47-77 30-49

1978	45-63 28-48	49-70 33-51	56-76 36-53	53-80 35-55	71-97 36-60	80-104 52-70	87- 103 52-70	86- 107 47-74	70-98 41-62	58-96 39-58	48-78 24-44	37-60 13-47
1979	35-63 19-45	39-67 22-39	46-76 30-48	58-84 35-56	66-92 41-63	72-106 47-69	83- 112 50-81	83- 111 55-80	89- 105 48-67	65-94 31-48	52-74 22-55	46-75 19-45
1980	52-67 28-57	50-72 26-55	51-71 31-50	56-87 36-50	57-92 40-55	73-100 49-67	86- 108 56-80	84- 111 52-75	79-99 47-70	62- 102 32-58	60-87 22-45	54-76 21-50
1981	50-70 27-49	50-81 27-47	49-75 34-49	57-96 39-62	66-95 40-64	77-105 48-76	94- 106 61-73	97- 111 57-78	77-98 49-74	59-84 35-62	47-79 31-56	55-75 27-54
1982	47-71 23-42	44-74 28-56	43-71 30-58	44-84 34-55	62-95 42-61	72-96 48-69	85- 111 55-75	88- 104 56-77	65- 103 37-70	64-86 35-57	53-77 27-50	45-66 20-50
1983	47-69 21-45	43-70 29-47	51-77 31-56	52-74 30-51	60-100 35-62	68-96 48-63	85- 105 47-69	80- 104 54-77	66- 103 51-73	71-83 44-61	48-81 21-57	49-69 26-52
1984	50-71 22-38	53-72 23-43	53-78 29-58	55-90 30-59	66-102 41-81	74-106 49-70	82- 106 61-79	84- 104 59-74	75- 100 46-70	57-88 35-57	47-79 28-50	35-62 23-47
1985	42-67 23-43	45-77 20-48	48-77 24-51	63-101 39-56	68-92 43-59	74-107 49-71	84-109 57-77	90-106 53-68	68-97 40-67	63-92 32-60	46-80 26-54	44-65 21-43
1986	56-69 24-48	48-81 23-51	48-84 34-55	60-89 32-63	58-97 40-68	83-103 53-69	86-102 54-75	89-107 61-73	62-101 39-68	66-85 35-54	58-81 28-55	50-64 22-47
1987	42-62 16-43	42-70 23-51	49-75 26-50	63-91 36-59	64-95 44-61	73-104 54-68	75-107 51-71	75-107 52-74	76-98 52-65	56-96 45-61	54-70 26-55	38-71 21-43
1988	45-62 25-43	47-71 25-51	55-85 23-56	58-88 29-59	57-95 35-78	69-102 44-72	92-111 62-78	90-104 51-77	68-105 47-70	76-95 43-58	54-82 22-63	43-72 18-50
1989	44-69 20-43	37-84 19-51	53-81 25-55	61-95 39-64	64-95 45-64	73-105 48-69	93-112 59-77	86-102 53-72	65-101 44-68	60-95 30-55	55-81 20-51	53-71 16-43
1990	47-67 17-46	42-74 19-52	51-86 29-52	63-90 41-64	67-96 40-60	71-104 50-74	93-106 58-82	83-109 55-72	80-107 50-70	72-90 36-63	49-79 21-64	34-72 4-37
1991	43-65 19-41	56-78 24-50	46-70 29-49	60-87 35-51	61-94 39-63	75-103 53-69	89-112 57-75	84-106 54-74	81-102 51-73	57-99 26-59	54-86 22-50	48-65 18-48
1992	44-69 22-40	47-74 25-48	57-76 36-50	69-92 40-61	77-97 46-64	70-103 50-69	83-107 53-75	81-109 50-76	86-100 48-65	62-95 41-57	53-76 23-47	44-65 19-43
1993	38-64 19-45	49-66 27-47	58-82 31-55	61-92 37-57	71-95 41-60	72-104 46-68	90-107 54-69	85-110 57-77	74-106 40-68	69-97 38-57	55-80 21-48	50-72 16-37
1994	51-71 18-42	48-72 23-46	55-84 33-51	57-93 35-62	62-97 44-61	80-113 53-73	95-110 57-75	95-111 55-77	77-102 46-69	64-90 33-58	47-80 19-44	50-70 12-44
1995	43-70 28-48	58-77 31-46	47-75 26-50	46-88 28-58	61-93 38-56	60-106 42-68	89-114 52-69	93-110 55-72	75-105 42-70	68-96 29-59	62-82 29-51	52-78 18-52

1996	48-74 23-47	45-78 25-52	53-85 29-52	67-97 35-59	69-102 42-67	72-105 48-70	95-110 56-76	92-109 53-74	76-99 45-67	50-100 25-59	54-80 22-58	51-67 19-52
1997	39-70 22-56	54-77 25-43	60-90 20-53	56-89 35-65	77-101 44-68	74-104 51-71	88-107 48-75	88-111 54-77	72-101 48-70	61-94 30-61	51-83 30-46	45-64 17-42
1998	47-71 20-49	52-63 29-47	49-83 28-49	49-86 31-48	59-85 36-55	68-102 47-70	94-115 51-77	91-110 55-78	70-100 48-67	65-87 29-56	54-79 23-47	43-78 5-41
1999	49-75 17-48	50-83 19-48	53-82 25-48	50-93 26-58	70-98 38-64	63-110 46-71	92-106 52-74	85-105 54-71	83-101 45-66	72-99 33-59	56-82 19-48	55-71 19-40
2000	49-72 15-49	50-73 31-45	48-78 31-50	60-93 39-54	65-105 37-67	72-111 50-72	89-111 56-74	82-109 53-77	70-105 43-66	57-99 33-61	54-71 20-46	53-71 19-40
2001	47-70 22-40	46-80 25-43	58-83 33-51	55-92 33-55	74-106 38-67	86-105 50-71	89-112 55-76	94-109 55-72	92-101 49-68	64-97 41-61	49-81 24-51	50-68 20-46
2002	44-71 17-42	51-78 19-41	53-88 17-54	61-94 36-59	66-104 42-66	86-107 45-69	99-111 59-77	88-112 53-72	71-107 47-70	66-94 35-53	58-78 29-52	48-67 24-46
2003	58-80 25-46	48-78 15-47	56-82 29-54	57-82 33-51	61-108 35-64	78-106 51-70	90-111 55-80	86-107 56-72	81-102 51-70	60-95 42-60	49-77 21-51	47-70 17-47
2004	47-68 17-40	51-73 22-45	46-90 32-57	57-95 40-59	71-99 44-61	71-99 51-66	83-107 57-74	88-109 55-75	73-104 41-68	56-92 35-51	47-72 16-44	49-67 16-42
2005	42-68 28-49	51-66 28-45	54-82 28-47	60-85 30-49	67-98 40-60	73-103 44-62	93-111 58-77	91-107 54-71	70-100 46-60	63-93 38-57	53-78 22-49	53-77 17-43
2006	49-72 18-44	50-78 19-49	48-76 27-45	56-92 31-55	72-101 43-65	80-107 55-78	92-110 61-81	89-103 54-71	77-102 41-70	69-85 30-60	48-86 18-48	46-70 14-41
2007	37-72 7-41	46-75 21-46	52-90 25-55	54-97 32-59	66-95 46-61	68-104 45-70	93-115 61-77	90-106 59-81	68-106 41-75	63-90 37-54	59-84 21-48	45-72 19-48

2008	46-64 21-45	50-77 21-41	54-81 23-52	63-91 36-55	61-104 39-72	75-106 50-73	93-111 63-75	91-106 61-75	86-102 50-66	59-95 32-64	57-81 32-50	39-75 18-45
2009	48-71 21-45	43-72 25-46	50-81 26-49	52-92 30-60	73-102 53-66	71-105 48-73	95-109 63-77	85-103 53-70	75-102 48-71	59-90 27-55	51-83 22-46	45-64 18-40
2010	43-68 20-45	51-72 28-45	49-80 28-49	53-85 29-54	59-90 40-57	80-105 54-70	94-107 58-76	79-107 53-74	77-103 46-64	63-92 33-65	46-85 17-49	41-72 21-50
2011	39-73 25-40	45-75 16-43	52-87 28-53	51-89 30-59	61-93 32-57	72-103 42-71	84-108 55-75	94-107 56-71	86-100 52-72	63-93 29-60	53-80 24-49	46-75 14-43
2012	51-74 16-46	48-78 21-46	49-81 21-50	56-96 25-59	68-100 42-64	71-103 49-69	89-110 55-82	96-109 56-78	88-102 54-71	65-99 34-65	51-85 21-53	43-75 14-50
2013	39-65 9-47	49-73 18-42	48-88 27-57	58-95 35-62	66-99 38-64	82-112 56-73	90-109 60-78	89-104 57-77	71-102 39-74	61-90 31-61	46-77 28-48	43-68 14-43
2014	53-76 23-50	53-85 21-51	57-81 31-52	59-88 32-57	63-100 42-68	83-107 52-70	89-107 61-79	83-106 56-73				

Acres of Habitat on Edwards AFB

Zonal habitats	Acreage*
Joshua tree woodland	47,382
Halophytic saltbush	57,899
Xerophytic saltbush	33,551
Creosote bush	82,718
Lakebeds	46,645
Clay pans	3,264

Azonal habitats	Acreage*
Desert washes	501.1 (miles)
Alkaline meadows	2,111
Wetlands/ponds	1,783 (estimate)
Mesquite bosque	1,394
Ruderal	2,741
Sand dunes	Unknown
Rock Outcrops	3
Caves/Mines	1
Urban	1,133

**Source: GIS, Piute Ponds Plan, and Lichvar and Sprecher 1996.*

Plants Observed on Edwards AFB

Scientific Name	Common Name
Abronia pogonantha	White sand verbena
Abronia villosa var. *villosa*	Sand verbena
Acamptopappus sphaerocephalus var. *hirtellus*	Goldenheads
Achnatherum hymenoides	Indian rice grass
Acnantherum speciosum	Desert needle grass
Acroptilon repens	Russian knapweed
Agoseris retrorsa	Mountain dandelion
Allenrolfea occidentalis	Pickleweed
Allium fimbriatum var. mohavense	Mojave fringed onion
Amaranthus albus	Tumbling pigweed
Amaranthus fimbriatus	Fringed amaranth
Ambrosia acanthicarpa	Western ragweed
Ambrosia dumosa	Burro-bush
Amsinckia menziesii var. *menziesii*	Alkali fiddleneck
Amsinckia tessellata	Rough fiddleneck
Anisocoma acaulis	Scalebud
Artemisia spinescens	Budscale
Artemisia tridentata ssp. *parishii*	Parish's great basin sagebrush
Arundo donax	Giant reed[1]
Asclepias erosa	Desert milkweed
Asclepias fascicularis	Narrow-leaved milkweed
Aster frondosus	Leafy aster
Aster subulatus var. *parviflorus (A. exilis)*	Slim Aster
Astragalus acutirostris	Keel beak
Astragalus didymocarpus var. *didymocarpus*	Dwarf locoweed
Astragalus didymocarpus var. *dispermus*	Dwarf locoweed
Astragalus layneae	Layne's milkwetch
Astragalus lentiginosus var. *variabilis*	Rattlepod
Astragalus lentiginosus var. *albifolius*	Mojave rattleweed
Astragalus preussii var. *laxiflorus*	Lancaster milkvetch
Astragalus purshii var. *tinctus*	Long-flowered Pursh's woolly pod
Atriplex argentea var. *mohavensis*	Large silverscale
Atriplex canescens ssp. *canescens*	Four-wing saltbush
Atriplex confertifolia	Shadscale
Atriplex hymenelytra	Desert holly
Atriplex lentiginosus ssp torreyi	Nevada saltbush

Scientific Name	Common Name
Atriplex parryi	Parry saltbush
Atriplex phyllostegia	Arrowscale
Atriplex polycarpa	Allscale
Atriplex semibaccata	Australian saltbush[2]
Atriplex serenana var. *serenana*	Bractscale
Atriplex spinifera	Spinescale
Avena barbata	Slender wild oats[2]
Baccharis salicifolius	Seep willow
Baileya pleniradiata	Desert marigold
Bassia hyssopifolia	Five-hook bassia[3]
Brassica tournefortii	Sahara mustard[1]
Brickellia desertorum	Desert brickelbush
Bromus diandrus	Ripgut brome[2]
Bromus madritensis ssp. rubens	Red brome[1]
Bromus madritensis ssp. *madritensis*	Loose red brome[1]
Bromus tectorum	Cheat grass[1]
Bromus trinii	Chilean chess
Calochortus kennedyi var. *kennedyi*	Desert mariposa lily
Calochortus striatus	Alkali mariposa lily
Calycoseris parryi	Yellow tackstem
Calyptridium monandrum	Sand cress
Camissonia boothii ssp. *desertorum*	Woody bottlewasher
Camissonia campestris	Desert sun cups
Camissonia claviformis	Brown-eyed primrose
Camissonia palmeri	Palmers primrose
Canbya candida	Pygmy poppy
Capsella bursa-pastoris	Shepards purse
Cardaria pubescens	White top[3]
Castilleja exerta	Purple owls clover
Caulanthus cooperi	Coopers caulanthus
Caulanthus inflatus	Desert candle
Cenchrus longispinus	Sand bur
Centaurea maculosa	White knapweed[1]
Centaurea melitensis	Maltese star-thisle[2]
Centrostegia thurberi	Red triangles
Chaenactis carphoclinia	Pebble pincushion flower

Scientific Name	Common Name
Chaenactis fremontii	Fremont pincushion flower
Chaenactis macrantha	Mojave pincushion flower
Chaenactis stevioides	Broad-flowered pincushion flower
Chaenactis xantiana	Xantu's pincushion flower
Chamaescye serpyllifolia	Thyme-leaved spurge
Chamaesyce albomarginata	Rattlesnake spurge
Chamaesyce micromeria	Sonoran sand mat
Chamomilla occidentalis	Alkali pineapple weed
Chamomilla suaveolens	Pineapple weed
Chenopodium album	Lambsquarter
Chenopodium murale	Nettleaf goosefoot
Chenopodium rubrum	Red goosefoot
Chloris virgata	Finger grass
Chorizanthe brevicornu ssp. *brevicornu*	Brittle spineflower
Mucronea (Chorizanthe) perfoliata	Perfoliate spineflower
Chorizanthe rigida	Rigid spinyherb
Chorizanthe spinosa	Mojave spineflower
Chorizanthe watsonii	Watson spineflower
Chrysothamnus nauseosus ssp. *hololeucus*	White-stem rubber rabbit brush
Chrysothamnus nauseosus ssp. *mohavensis*	Mojave rubber rabbitbrush
Chrysothamnus teretefolius	Round-leaf rabbit brush
Cleome isomeris var. *arborea*	Bladderpod
Cleomella obtusifolia ssp. pubescens	Blunt-leaf stinkweed
Collinsia bartsifolia var. davidsonii	Lowland Chinese houses
Convovulus arvensis	Field bindweed
Conyza bonariensis	South American horseweed
Conyza canadensis	Canadian horseweed
Conyza coulteri	Horseweed
Cordylanthus maritimus ssp. canescens	Alkali birdsbeak
Coreopsis bigelovii	Desert coreopsis
Coreopsis californica	California coreopsis
Coreopsis calliopsidea	Leafy-stem coreopsis
Crassula connata (erecta)	Tillaea
Cressa truxillensis var. *vallicola*	Alkali weed
Croton californicus var. *mohavensis*	California croton
Crypsis schoenoides (new piute ponds)	Sickle grass

Scientific Name	Common Name
Cryptantha circumcissa	Capped forget-me-not
Cryptantha decipiens	Gravel forget-me-not
Cryptantha dumetorum	Wire-stem forget-me-not
Cryptantha micrantha	Small-flowered forget-me-not
Cryptantha nevadensis var. *nevadensis*	Nevada forget-me-not
Cryptantha nevadensis var. *rigida*	Stiff Nevada forget-me-not
Cryptantha pterocarya	Wing-seed forget-me-not
Cryptantha similis	Showy capped forget-me-not
Cucurbita palmata	Coyote melon
Cupressus arizonicus ssp. *arizonicus*	Arizona cypress
Cuscuta californica var. *californica*	California Dodder
Cymopterus deserticola *Cynodon dactylon*	Desert cymopterus Bermuda grass[2]
Datura wrightii var. *quinquecuspidata*	Jimson weed
Delphinium parishii ssp. *parishii*	Desert larkspur
Descurainia pinnata ssp. *glabra* *Descurainia sophia*	Western yellow tansy mustard Flixweed[3]
Dichelostemma capitata var. *pauciflora*	Blue dycks
Dicoria canescens ssp. *hispidula*	Bugseed
Digitaria sanguinalis	Hairy crabgrass
Distichlis spicata	Saltgrass
Dithyrea californica	Spectacle pod
Echinocactus polycephalus var. *polycephalus*	Cottontop cactus
Echinochloa colonum	Jungle rice grass
Eleocharis montevidensis	Mexican spikerush
Elymus elymoides	Squirreltail grass
Emmenanthe penduliflora	Whispering bells
Encelia farinosa var. *farinosa*	Brittlebush
Ephedra aspera	Rough Nevada tea
Ephedra nevadensis	Nevada tea
Epilobium brachycarpa	Annual willow herb
Eremalche exilis	Trailing white mallow
Eremalche rotundifolia	Desert five-spot
Eremocarpus setigerus	Turkey mullein
Eriastrum densifolium ssp. mohavensis	Woolly star-flower
Eriastrum diffusum	Spreading blue mantle

Scientific Name	Common Name
Eriastrum pluriflorum ssp. sherman-hoytae	Many-flowered Eriastrum
Eriastrum sapphirinum ssp. ambiguum	Sapphire flower
Ericameria cooperi var. cooperi	Coopers goldenbush
Ericameria linearifolia	Narrow-leaf goldenbush
Eriogonum angulosum	Angle-stem skeletonweed
Eriogonum baileyi var. baileyi	Bailey's skeletonweed
Eriogonum brachyanthum	Short-flowered skeletonweed
Eriogonum deflexum ssp. *deflexum*	Skeletonweed
Eriogonum fasciculatum ssp. *foliolosum*	Coastal bush buckwheat
Eriogonum fasciculatum ssp. *polifolium*	Desert bush buckwheat
Eriogonum gracillimum	Slender skeletonweed
Eriogonum inflatum	Desert trumpet
Eriogonum maculatum	Spotted buckwheat
Eriogonum mohavense	Mojave buckwheat
Eriogonum nidularium	Birds nest buckwheat
Eriogonum plumatella var. *jaegeri*	Flat-topped perennial buckwheat
Eriogonum plumatella var. *plumatella*	Flat-topped perennial buckwheat
Eriogonum pusillum	Yellow turbans
Eriogonum trichopes var *hooveri*	Little trumpets
Eriogonum viridescens	Green skeletonweed
Eriophyllum mohavense	Barstow woolly sunflower
Eriophyllum pringlei	Bud woolly daisy
Eriophyllum wallacei *Erodium cicutarium*	Common woolly daisy Red-stem filaree[3]
Erodium texanum	Texas filaree
Erysimum asperum ssp. *bealianum*	Dune wallflower
Eschscholzia minutiflora ssp. *minutiflora*	Small-flowered goldpoppy
Eschscholzia minutiflora ssp. *twisselmannii*	Twisselman's poppy
Eucrypta chrysanthemifolia var. *bipinnatifida*	Spotted eucrypta
Eucrypta micrantha	Desert eucrypta
Euthamia occidentalis	Western goldenrod
Festuca octaflora	Six-weeks fescue
Filago depressa	Dwarf filago
Forestieria pubescens	Desert olive
Franklinia salina (grandiflora)	Alkali pink
Gilia aliquanta	Puffy-calyx gilia

Scientific Name	Common Name
Gilia hutchinsifolia	Desert pale gilia
Gilia latiflora var. *davyi*	Broad-flowered gilia
Gilia minor	Dwarf gilia
Gilia ochroleuca	Volcanic pale gilia
Gilia sinuata	Cinder gilia
Gnaphalium palustre	Cudweed aster
Goodmania luteola	Golden goodmania
Grayia spinosa	Spiny hopsage
Grindelia squarrosa var. *serrulata*	Curly gumplant
Guillenia lasiophylla (var. utahense)	Desert crucifer
Gutierrezia microcephala	Small-headed matchweed
Helianthus annuus ssp. lenticularis	Annual sunflower
Heliotropium curassavicum ssp. oculatum	Chinese pusley
Hemizonia pungens	Common spikeweed
Heterotheca grandiflora	Telegraph weed
Hymenolobus procumbens	Slenderweed
Isocoma acradenia ssp. acradenia	Alkali goldenbush
Isomeris arborea	Bladderpod
Iva axillaris	Povery weed
Juncus bufonius var. bufonius	Common toadrush
Juncus mexicanus-balticus	Mexican wiregrass
Kochia californica	Gray molly
Krasheninnikovia lanata	Winterfat
Lactuca serriola	Prickly lettuce
Langloisia matthewsii	Calico flower
Langloisia setosissima	Little sunbonnets
Larrea divaricata var. *tridentata*	Creosote bush
Lasthenia californica gracilis	Goldfields
*Layia glandulosa (*ssp. *glandulosa)*	White tidytips
Lemna sp.	Duckweed
Lepidium flavum var. *flavum*	Yellow peppergrass
Lepidium fremontii var. *fremontii*	Desert alyssum
Lepidium lasiocarpum var. *lasiocarpum*	Hairy-podded peppergrass
Lepidium nitidum	Shiny peppergrass
Lepidium perfoliatu m	Shield-cress
Leptochloa fascicularis	Sprangletop

Scientific Name	Common Name
Lessingia lemmonii var. *ramulosissima*	Autumn vinegar weed
Leymus cinereus	Great Basin ryegrass
Linanthus arenicola	Sand linanthus
Linanthus aureus ssp. *aureus*	Golden gilia
Linanthus bigelovii	Small-flowered desert snow
nanthus dichotomus ssp. *dichotomus*	Desert snow
Linanthus parryae	Sand blossoms
Loeflingia squarrosa ssp. *artemisiarum*	Sagebrush loeflingia
Loeselliastrum matthewsii	Calico flower
Loeselliastrum punctata	Dotted sunbonnets
Loeselliastrum schottii	Little sunbonnets
Lomatium mohavense ssp. *longilobum*	Mojave wild parsley
Lomatium mohavense ssp. *mohavense*	Mojave wild parsley
Lotus humistratus	Foothill, short-podded lotus
Lotus prostratus	Low lotus
Lotus strigosus	Stiff-haired lotus
Lotus wrangelianus	Chilean lotus
Lupinus horizontalis platypetalus	Sunrise lupine
Lupinus odoratus var. *odoratus*	Royal blue lupine
Lupinus shockleyi	Sand lupine
Lycium andersonii	Desert tomato
Lycium cooperi	Peachthorn
Machaeranthera near parviflora	Edwards hoary aster
Malacothrix coulteri var. coulteri	Snake’s head
Malacothrix glabrata	Desert dandelion
Malacothrix sonchoides	Yellow saucers
Malva neglecta	Cheeseweed
Marah fabaceus ssp. agrestis	Sierra manroot
Marrubium vulgare	Horehound[3]
Matricaria matricarioides	Pineappleweed
Matricaria occidentalis	Alkali pineappleweed
Medicago sativa	Alfalfa
Melilotus alba	White sweet clover
Melilotus officinalis	Yellow sweet clover
Mentzelia affinis	Yellow comet
Mentzelia albicaulis	White-stem blazing star

Scientific Name	Common Name
Mentzelia obscura	Obscure blazing star
Mentzelia veatchiana	Copper blazing star
Microseris lindleyi	Silverpuffs
Microseris linearifolia	Silverpuffs
Mimulus fremontii	Fremont monkeyflower
Mimulus pilosus	Downey monkey flower
Mimulus rubellus	Reddish monkeyflower
Mirabilis bigelovii var. *aspera*	Rough wishbone plant
Mirabilis bigelovii var. *retrorsa*	Wishbone plant
Mollugo cerviana	Indian chickweed
Monardella exilis	Desert pennyroyal
Monolepis nuttalliana	Patata
Monoptilon bellioides	Desert stars
Mucronea perfoliata	Red saucers
Muilla coronata	Crowned onion
Nama demissum var. demissum	Purple mats
Nama pusillum	Small-flowered nama
Nemacladus glanduliferus var. *orientalis*	Eastern thread-stem
Nemacladus gracilis	Small-flowered thread-stem
Nicolletia occidentalis	Hole-in-the-sand plant
Nitrophila occidentalis	Alkali pink
Oenothera californica ssp. *avita*	Creeping evening primrose
Oenothera deltoides ssp. *deltoides*	Evening primrose
Oenothera primaveris ssp. *bufonis*	Yellow evening primrose
Opuntia basilaris var. *basilaris*	Beavertail cactus
Opuntia echinocarpa var. *echinocarpa*	Golden or silver cholla
Opuntia ramosissima	Pencil cholla
Orthocarpus purpurascens	Owl’s clover
Oxytheca luteola (Goodmania)	Yellow spinycape
Oxytheca perfoliata	Punctured bract, red saucers
Panicum capillare var. occidentale	Witch grasss
Pectis papposa	Chinch weed
Pectocarya heterocarpa	Chuckwalla combbur
Pectocarya linearis var. ferocula	Coastal combbur
Pectocarya penicillata	Winged combur
Pectocarya platycarpa	Broad-margined combbur

Scientific Name	Common Name
Pectocarya recurvata	Curved combbur
Pectocarya setosa	Erect combur
Peganum harmale	African rue
Petalonyx thurberi ssp. thurberi	Sandpaper plant
Phacelia austromontana	Sticky yellow throats
Phacelia crenulata var. crenulata	Notched-leafed phacelia
Phacelia fremontii	Yellow throats
Phacelia tanacetifolia	Tansy phacelia
Pholisma arenarium	Scaley sand food
Plagiobothrys canescens var. canescens	Valley popcorn flower
Plagiobothrys leptocladus	Alkali popcorn flower
Plantago major	Common plantain
Plantago ovata	Woolly plantain
*Platystemon californicus (*var. *crinitus)*	Cream cups
Poa secunda	Nevada bluegrass
Polygonum arenastrum	Knotweed
Polygonum lapathifolium *Polypogon monspeliensis*	Water smartweed Rabbit's foot grass[3]
Populus fremontii var. *fremontii*	Fremont cottonwood
Portulaca oleracea	Purslane
Prenanthella exigua	Annual lygodesmia
Prosopis glandulosa var. *torreyana*	Honey mesquite
Psathrotes annua	Turtlebacks
Psorothamnus arborescens var. *minutifolius*	Mojave indigo bush
Pucinellia simplex	Annual alkali grass
Rafinesquia neomexicana	Desert chicory
Rumex crispus	Curly dock
Rumex hymenosepalus	Desert rhubarb
Salicornia utahensis	Utah pickleweed
Salix exigua	Sandbar willow
*Salix gooddingii (*var. *gooddingii)*	Black willow
Salix lasiolepis var. *lasiolepis* *Salsola paulensii* *Salsola (australis) tragus*	Arroyo willow Barb wire Russian thistle[3] Tumbleweed, prickly Russian-thistle[3]
Salvia carduacea	Thistle sage
Salvia columbariae var. *columbariae*	Chia sage

Scientific Name	Common Name
Sarcobatus vermiculatus	Greasewood
Schismus arabicus	Arabian grass[3]
Schismus barbatus	Split grass[3]
Scirpus acutus var. *occidentalis*	Tule rush
Senecio vulgaris	Common groundsel
Senna covesii	Cove's cassia
Sesuvium (Mollugo) verrucosum	Carpetweed, Indian chickweed
Sisymbrium altissimum	Tumble mustard
Sisymbrium irio	London rocket
Sisymbrium orientale	Eastern rocket
Solanum eleagnifolium	Silverleaf nettle
Solanum nigrum var. nigrum	Black nightshade
Sonchus asper	Prickly sowthistle
Sonchus oleraceus	Sowthistle
Spergularia atrosperma	Black seeded sand spurrey
Spergularia macrotheca var. leucantha	Large-flowered alkali spurrey
Spergularia marina var. marina	Sand spurrey
Sphaeralcea ambigua ssp. ambigua	Globemallow
Sporobolus airodes	Alkali dropseed
Stanleya pinnata ssp. pinnata	Prince's plume
Stephanomeria exigua ssp. exigua	Annual milk lettuce
Stephanomeria parryi	Rock pink
Stephanomeria pauciflora	Wire lettuce
Stillingia paucidentata	Toothleaf
Streptanthella longirostris	Little twist flower
Stylocline micropoides	Desert nest straw
Stylocline psilocarphoides	Peck nest straw
Suaeda moquinii	Inkweed
Syntrichopappus fremontii	Yellow xerasid
Tamarix aphylla	Athel tree[3]
Tamarix gallica	French tamarisk
Tamarix parviflora	4-petaled tamarisk[1]
Tamarix ramosissima	Salt cedar[1]
Tetradymia axillaris var. *longispina*	Long-spined cottonthorn
Tetradymia glabrata	Littleleaf horsebrush
Tetradymia stenolepis	Feltthorn
Thysanocarpus laciniatus var. *lacinatus*	Lacepod

Scientific Name	Common Name
Tiquilia nuttallii	Annual coldenia
Tiquilia plicata	Plaited coldenia
Tribulus terrestris	Puncture vine
Trifolium gracilentum var. *palmeri*	Pinpoint clover
Triticum aestivum	Cultivated wheat
Tropidocarpum gracile	Keel fruit
Typha angustifolia	Cattail
Uropappus lindleyi	Silverpuffs
Urtica dioica holosericea	Stinging nettle
Veronica sp.	Brooklime
Vulpia bromoides	Native fescue grass
Vulpia microstachys var. *microstachys*	Native fescue grass
Vulpia myuros *Vulpia octoflora var. hirtella*	Rattail fescue Six-weeks fescue[2]
Xanthium spinosum	Spiny clotbur
Xylorhiza tortifolia	Mohave aster
Yucca brevifolia	Joshua tree
Zigadenus brevibracteatus	Desert zygadine

Source: Edwards AFB Geographic Information System

[1]**High**–These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

[2]**Moderate**–These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

[3]**Limited**–These species are invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Fauna Observed on Edwards AFB

Scientific Name	Common Name	Source
CRUSTACEANS		
Brachinecta coloradensis	Colorado fairy shrimp	Edwards AFB GIS
Branchinecta gigas	Giant fairy shrimp	Edwards AFB GIS
Branchinecta mackini	Alkali fairy shrimp	Edwards AFB GIS
Branchinecta lindahli	Versatile fairy shrimp	Edwards AFB GIS
Lepiduras lemmoni	Tadpole shrimp	Edwards AFB GIS
Eocyzicus digueti	Clam shrimp	Edwards AFB GIS
AMPHIBIANS		
Xenophus laevis	African clawed frog	(AMEC Earth and Environmental, 2008)
Rana catesbiana	Bullfrog	(AMEC Earth and Environmental, 2008)
Bufo punctatus	Red-spotted toad	Edwards AFB GIS
Hyla regilla	Pacific Chorus frog	(AMEC Earth and Environmental, 2008)
Bufo boreas halophilus (Anaxyrus boreas halophilus)	Western toad	(AMEC Earth and Environmental, 2008)
REPTILES		
Gopherus agassizii	Desert tortoise	(AMEC Earth and Environmental, 2008)
Chrysemys picta	Painted turtle	(AMEC Earth and Environmental, 2008)
Actinemys marmorata	Western pond turtle	Citizen siting with photos
Lizards		
Coleonyx variegatus	Western banded gecko	(AMEC Earth and Environmental, 2008)
Sauromalus ater	Common chuckwalla	(AMEC Earth and Environmental, 2008)
Xantusia vigilis	Desert night lizard	(AMEC Earth and Environmental, 2008)
Crotaphytus insularis	Mojave collared lizard	(AMEC Earth and Environmental, 2008)
Phrynosoma platyrhinos	Desert horned lizard	(AMEC Earth and Environmental, 2008)
Dipsosaurus dorsalis	Desert iguana	(AMEC Earth and Environmental, 2008)
Sceloporus magister	Desert spiny lizard	(AMEC Earth and Environmental, 2008)
Eucmeces gilbertii	Gilbert skink	Unconfirmed by (AMEC Earth and Environmental, 2008)
Gambelia wislizenii	Long-nosed leopard lizard	(AMEC Earth and Environmental, 2008)
Urosaurus graciosus	Long-tailed brush lizard	Edwards AFB GIS
Crotaphytus bicintores	Mojave black-collared lizard	Edwards AFB GIS
Uta stansburiana	Side-blotched lizard	(AMEC Earth and Environmental, 2008)
Sceloporus occidentalis	Western fence lizard	Edwards AFB GIS
Cnemidophorus tigris	Western whiptail	(AMEC Earth and Environmental, 2008)
Callisaurus draconoides	Zebra-tailed lizard	(AMEC Earth and Environmental, 2008)

Snakes		Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Chilomeniscus cinctus	Banded sand snake	Edwards AFB GIS
Lampropeltis getula	Common kingsnake	(AMEC Earth and Environmental, 2008)
Hypsiglena torquata	Desert night snake	(AMEC Earth and Environmental, 2008)
Arizona elegans	Glossy snake	(AMEC Earth and Environmental, 2008)
Pituophis melanoleucus	Gopher snake	(AMEC Earth and Environmental, 2008)
Sonora semiannulata	Ground snake	Edwards AFB GIS
Rhinocheeilus lecontei	Long-nosed snake	Edwards AFB GIS
Crotalus scutulatus	Mojave rattlesnake	(AMEC Earth and Environmental, 2008)
Masticophis flagellum	Red coachwhip	(AMEC Earth and Environmental, 2008)
Lichanura trivirgata	Rosy boa	Edwards AFB GIS
Crotalus cerastes	Sidewinder	(AMEC Earth and Environmental, 2008)
Phyllorhynchus decurtatus	Spotted leaf-nosed snake	(AMEC Earth and Environmental, 2008)
Trimorphodon biscutatus	Lyre snake	Edwards AFB GIS
Salvadora hexalepis	Western patch-nosed snake	Edwards AFB GIS
Chionactis occipitalis	Western shovel-nosed snake	(AMEC Earth and Environmental, 2008)
Thamnophi hammondii	Two-striped gartersnake	Edwards AFB GIS
BIRDS		
Piplio aberti	Abert’s towhee	Edwards AFB GIS
Melanerpes formicivorous	Acorn woodpecker	Edwards AFB GIS
Selasphorus sasin	Allen’s hummingbird	Edwards AFB GIS
Recurvirostra americana	American avocet	Edwards AFB GIS
Botaurus lentiginosus	American bittern	Edwards AFB GIS
Fulica americana	American coot	Edwards AFB GIS
Corvus brachyrhynchos	American crow	Edwards AFB GIS
Phoenicopterus ruber	American flamingo	Edwards AFB GIS
Pluvialis domenica	American golden plover	Edwards AFB GIS
Spinus tristis	American goldfinch	Edwards AFB GIS
Anas crecca	American Green-winged teal	Edwards AFB GIS
Falco sparverius	American kestrel	Edwards AFB GIS
Falco peregrinus anatum	American peregrine falcon	Edwards AFB GIS
Anthus spinoletta	American pipit	Edwards AFB GIS
Turdus migratorius	American robin	Edwards AFB GIS
Pelecanus erythrorhynchos	American white pelican	Edwards AFB GIS
Anas penelope	American wigeon	Edwards AFB GIS
Calypte anna	Anna's hummingbird	Edwards AFB GIS
Sterna albifrons	Arctic tern	Edwards AFB GIS
Myiarchus cinerascens	Ash-throated flycatcher	Edwards AFB GIS

Dendroica coronata	Audubon's warbler	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Calidris bairdii	Baird's sandpiper	Edwards AFB GIS
Haliaectus leucocephalus	Bald eagle	Edwards AFB GIS
Riparia riparia	Bank swallow	Edwards AFB GIS
Hurundo rustica	Barn swallow	Edwards AFB GIS
Megaceryle alcyon	Belted kingfisher	Edwards AFB GIS
Thryomanes bewickii	Bewick's wren	Edwards AFB GIS
Mniotitla varia	Black and white warbler	Edwards AFB GIS
Sayornis nigricans	Black phoebe	Edwards AFB GIS
Chlidonias niger	Black tern	Edwards AFB GIS
Arenaria melanocephala	Black turnstone	Edwards AFB GIS
Pluvialis squatarola	Black-bellied plover	Edwards AFB GIS
Archilochus alexandri	Black-chinned hummingbird	Edwards AFB GIS
Nycticorax nycticorax	Black-crowned night-heron	Edwards AFB GIS
Pheucticus melanocephalus	Black-headed grosbeak	Edwards AFB GIS
Himantopus mexicanus	Black-necked stilt	Edwards AFB GIS
Polioptila melanura	Black-tailed gnatcatcher	Edwards AFB GIS
Dendroica nigrescens	Black-throated gray warbler	Edwards AFB GIS
Amphispiza bilineata	Black-throated sparrow	Edwards AFB GIS
Guiraca caerulea	Blue grosbeak	Edwards AFB GIS
Polioptila caerulea	Blue-gray gnatcatcher	Edwards AFB GIS
Anas discors	Blue-winged teal	Edwards AFB GIS
Larus philadelphia	Bonepart's gull	Edwards AFB GIS
Branta bernicla	Brant	Edwards AFB GIS
Euphagus cyanocephalus	Brewer's blackbird	Edwards AFB GIS
Spizella breweri	Brewer's sparrow	Edwards AFB GIS
Selasphorus platycercus	Broad-tailed hummingbird	Edwards AFB GIS
Tryngites subruficollis	Buff-breasted sandpiper	Edwards AFB GIS
Pelicanus occidentalis	Brown pelican	Edwards AFB GIS
Molothrus ater	Brown-headed cowbird	Edwards AFB GIS
Bucephala albeola	Bufflehead	Edwards AFB GIS
Icterus galbula bullocki	Bullock’s oriole	Edwards AFB GIS
Athene cunicularia	Burrowing owl	Edwards AFB GIS
Campylorhynchus brunneicapillus	Cactus wren	Edwards AFB GIS
Larus californicus	California gull	Edwards AFB GIS
Eremophilia alpestris	California horned lark	Edwards AFB GIS
Callipepla californica	California quail	Edwards AFB GIS

Sterna albifrons browni	California Least tern	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Toxostoma redividum	California thrasher	Edwards AFB GIS
Pipilo crissalis	California towhee	Edwards AFB GIS
Stellula calliope	Calliope hummingbird	Edwards AFB GIS
Branta canadensis	Canada goose	Edwards AFB GIS
Wilsonia canadensis	Canada warbler	Edwards AFB GIS
Aythya americana	Canvasback	Edwards AFB GIS
Catherpes mexicanus	Canyon wren	Edwards AFB GIS
Hydroprogne caspia	Caspian tern	Edwards AFB GIS
Tyrannus vociferans	Cassin's kingbird	Edwards AFB GIS
Vireo cassini (formerly solitary)	Cassin's vireo	Edwards AFB GIS
Bubulcus ibis	Western cattle egret	Edwards AFB GIS
Bombycilla cedrorum	Cedar waxwing	Edwards AFB GIS
Calcarius ornatus	Chestnut-collared longspur	Edwards AFB GIS
Spizella passerina	Chipping sparrow	Edwards AFB GIS
Alectoris chukar	Chukar	Edwards AFB GIS
Anas cyanoptera	Cinnamon teal	Edwards AFB GIS
Aechmophorus clarkii	Clark's grebe	Edwards AFB GIS
Spizella pallida	Clay colored sparrow	Edwards AFB GIS
Hirundo pyrrhonata	Cliff swallow	Edwards AFB GIS
Tyta alba	Common barn owl	Edwards AFB GIS
Colaptes auratus	Common flicker	Edwards AFB GIS
Bucephala clangula	Common goldeneye	Edwards AFB GIS
Gavia immer	Common loon	Edwards AFB GIS
Merfus merganser	Common merganser	Edwards AFB GIS
Gallinula chloropus	Common moorhen	Edwards AFB GIS
Chordeiles minor	Common nighthawk	Edwards AFB GIS
Phalaenoptilus nuttalli	Common poorwill	Edwards AFB GIS
Corvus corax	Common raven	Edwards AFB GIS
Capella gallinago	Common snipe	Edwards AFB GIS
Sterna hirundo	Common tern	Edwards AFB GIS
Geothylpis trichas	Common yellowthroat	Edwards AFB GIS
Accipitera cooperi	Cooper's hawk	Edwards AFB GIS
Calypte costae	Costa's hummingbird	Edwards AFB GIS
Junco hyemalis	Dark-eyed junco	Edwards AFB GIS
Phalacrocorax auritus	Double-crested cormorant	Edwards AFB GIS
Calidris alpina	Dunlin	Edwards AFB GIS

Empidonax oberholseri	Dusky flycatcher	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Podiceps nigricollis	Eared grebe	Edwards AFB GIS
Sayornis phoebe	Eastern phoebe	Edwards AFB GIS
Philacte canagica	Emperor goose	Edwards AFB GIS
Anas penelope	Eurasian wigeon	Edwards AFB GIS
Sturnus vulgaris	European starling	Edwards AFB GIS
Buteo regalis	Ferruginous hawk	Edwards AFB GIS
Sterna forsteri	Forster's tern	Edwards AFB GIS
Passerella iliaca	Fox sparrow	Edwards AFB GIS
Larus pipixcan	Franklin's gull	Edwards AFB GIS
Dendrocygna bicolor	Fulvous whistling duck	Edwards AFB GIS
Anas strepera	Gadwall	Edwards AFB GIS
Callipepla gambelii	Gambel's quail	Edwards AFB GIS
Larus glaucescens	Glaucous-winged gull	Edwards AFB GIS
Aquila chrysaetos	Golden eagle	Edwards AFB GIS
Regulus satrapa	Golden-crowned kinglet	Edwards AFB GIS
Zonotricha atricapilla	Golden-crowned sparrow	Edwards AFB GIS
Empidonax wrightii	Gray flycatcher	Edwards AFB GIS
Ammodramus savannarum	Grasshopper sparrow	Edwards AFB GIS
Dumetella carolinensis	Gray catbird	Edwards AFB GIS
Vireo vicinior	Gray vireo	Edwards AFB GIS
Ardea herodias	Great blue heron	Edwards AFB GIS
Casmerodius albus	Great egret	Edwards AFB GIS
Bubo virginianus	Great horned owl	Edwards AFB GIS
Geococcyx californicanus	Greater roadrunner	Edwards AFB GIS
Rus canadensis	Greater sandhill crane	Edwards AFB GIS
Aythya affinis	Greater scaup	Edwards AFB GIS
Anser albifrons	Greater white fronted goose	Edwards AFB GIS
Tringa flavipes	Greater yellowlegs	Edwards AFB GIS
Quiscalus mexicanus	Great-tailed grackle	Edwards AFB GIS
Butorides virescens	Green heron	Edwards AFB GIS
Butorides	Green-backed heron	Edwards AFB GIS
Chorura chorura	Green-tailed towhee	Edwards AFB GIS
Anas crecca	Green-wing teal	Edwards AFB GIS
Gelochelidon nilotica vanrossemi	Gull-billed tern	Edwards AFB GIS
Empidonax hammondii	Hammond's flycatcher	Edwards AFB GIS
Parabuteo unicinctus	Harris hawk	Edwards AFB GIS

Zonotricha querula	Harris’ sparrow	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Larus heermanni	Heermann’s gull	Edwards AFB GIS
Catharus guttatus	Hermit thrush	Edwards AFB GIS
Dendroica occidentalis	Hermit warbler	Edwards AFB GIS
Larus argentatus	Herring gull	Edwards AFB GIS
Lophodytes cycykkatys	Hooded merganser	Edwards AFB GIS
Icterus cucullatus	Hooded oriole	Edwards AFB GIS
Podiceps auritus	Horned grebe	Edwards AFB GIS
Carpodactus mexicanus	House finch	Edwards AFB GIS
Passer domesticus	House sparrow	Edwards AFB GIS
Troglogytes aedon	House wren	Edwards AFB GIS
Limosa lapponica	Hudsonian godwit	Edwards AFB GIS
Vireo huttoni	Hutton's vireo	Edwards AFB GIS
Charadrius vociferus	Killdeer	Edwards AFB GIS
Picoides scalaris	Ladder-backed woodpecker	Edwards AFB GIS
Calcarius lapponicus	Lapland longspur	Edwards AFB GIS
Calamospiza melanocorys	Lark sparrow	Edwards AFB GIS
Larus atricilla	Laughing gull	Edwards AFB GIS
Carduelis lawrencei	Lawrence's goldfinch	Edwards AFB GIS
Passerina amoena	Lazuli bunting	Edwards AFB GIS
Toxostoma lecontei	Le Conte's thrasher	Edwards AFB GIS
Vireo bellii pusillus	Least bell's vireo	Edwards AFB GIS
Ixobrychus exilis	Least Bittern	Edwards AFB GIS
Caladris minutilla	Least sandpiper	Edwards AFB GIS
Phoeniconaias minor	Lesser flamingo	Edwards AFB GIS
Pluvialis dominica	Lesser golden plover	Edwards AFB GIS
Carduelis psaltria	Lesser goldfinch	Edwards AFB GIS
Chordeiles acutipennis	Lesser nighthawk	Edwards AFB GIS
Aythya affinis	Lesser scaup	Edwards AFB GIS
Tringa flavipes	Lesser yellowlegs	Edwards AFB GIS
Asyndesmus lewsi	Lewis's woodpecker	Edwards AFB GIS
Melospiza lincolnii	Lincoln sparrow	Edwards AFB GIS
Florida caerulea	Little blue heron	Edwards AFB GIS
Lanius ludovicianus	Loggerhead shrike	Edwards AFB GIS
Numenius americanus	Long billed curlew	Edwards AFB GIS
Limnodromus scolopaceus	Long-billed dowitcher	Edwards AFB GIS
Asio otus	Long-eared owl	Edwards AFB GIS
Oporornis tolmiei	Macgillivray's warbler	Edwards AFB GIS

Anas platyrhynchos	Mallard	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Limosa fedoa	Marbled godwit	Edwards AFB GIS
Cistothorus palustris	Marsh wren	Edwards AFB GIS
Falco columbiarius	Merlin	Edwards AFB GIS
Sialic currucoides	Mountain bluebird	Edwards AFB GIS
Parus gambeli	Mountain chickadee	Edwards AFB GIS
Charadrius montanus	Mountain plover	Edwards AFB GIS
Oreortyx pictus	Mountain quail	Edwards AFB GIS
Zenaida macroura	Mourning dove	Edwards AFB GIS
Dendroica coronata coronata	Myrtle warbler	Edwards AFB GIS
Vermivora ruficapilla	Nashville warbler	Edwards AFB GIS
Colaptes auratus	Northern flicker	Edwards AFB GIS
Circus cyaneus	Northern harrier	Edwards AFB GIS
Mimus polyglottos	Northern mockingbird	Edwards AFB GIS
Icterus galbula	Northern oriole	Edwards AFB GIS
Anas acuta	Northern pintail	Edwards AFB GIS
Stelgid opteryx ruficollis	Northern rough-winged swallow	Edwards AFB GIS
Anas clypeata	Northern shoveler	Edwards AFB GIS
Lanius excubitor	Northern shrike	Edwards AFB GIS
Dendrocopos nuttallii	Nuttall's woodpecker	Edwards AFB GIS
Clangula hyemalis	Oldsquaw	Edwards AFB GIS
Contopus cooperi	Olive-sided flycatcher	Edwards AFB GIS
Vermivora celata	Orange-crowned warbler	Edwards AFB GIS
Icterus spurius	Orchard oriole	Edwards AFB GIS
Pandion haliaetus	Osprey	Edwards AFB GIS
Pluvialis fulva	Pacific golden plover	Edwards AFB GIS
Epidonax difficilis	Pacific-slope flycatcher	Edwards AFB GIS
Myioborus pictus	Painted redstart	Edwards AFB GIS
Calidris melanotos	Pectoral sandpiper	Edwards AFB GIS
Phainopepla nitens	Phainopepla	Edwards AFB GIS
Podilymbus podiceps	Pied-billed grebe	Edwards AFB GIS
Spinus pinus	Pine siskin	Edwards AFB GIS
Falco mexicanus	Prairie falcon	Edwards AFB GIS
Carpodacus purpureus	Purple finch	Edwards AFB GIS
Progne subis	Purple martin	Edwards AFB GIS
Loxia curvirostra	Red crossbill	Edwards AFB GIS

Calidris canutus	Red knot	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Podiceps grisegena	Red necked grebe	Edwards AFB GIS
Phalaropus fulicarius	Red phalarope	Edwards AFB GIS
Mergus serrator	Red-breasted merganser	Edwards AFB GIS
Sitta canadensis	Red-breasted nuthatch	Edwards AFB GIS
Sphyrapicus ruber	Red-breasted sapsucker	Edwards AFB GIS
Aythya americana	Redhead	Edwards AFB GIS
Sphyrapius ruber	Red-napped sapsucker	Edwards AFB GIS
Phalaropus lobatus	Red-necked phalarope	Edwards AFB GIS
Chalidris ruficollis	Red-necked stilt	Edwards AFB GIS
Coplaptes cafer	Red-shafted flicker	Edwards AFB GIS
Buteo lineatus	Red-shouldered hawk	Edwards AFB GIS
Buteo jamaicensis	Red-tailed hawk	Edwards AFB GIS
Gavia stellata	Red-throated loon	Edwards AFB GIS
Agelaius phoeniceus	Red-winged blackbird	Edwards AFB GIS
Larus delawarensis	Ring-billed gull	Edwards AFB GIS
Larus delawarensis	Ring-billed Gull	Edwards AFB GIS
Aythya collaris	Ring-necked duck	Edwards AFB GIS
Phasius colchicus	Ring-necked pheasant	Edwards AFB GIS
Columba livia	Rock dove	Edwards AFB GIS
Salpinctes obsoletus	Rock wren	Edwards AFB GIS
Chen rossii	Ross's goose	Edwards AFB GIS
Buteo lagopus	Rough-legged hawk	Edwards AFB GIS
Regulus calendula	Ruby-crowned kinglet	Edwards AFB GIS
Oxyura jamaicensis	Ruddy duck	Edwards AFB GIS
Arenaria interpres	Ruddy turnstone	Edwards AFB GIS
Philomachus pugnax	Ruff	Edwards AFB GIS
Selasphorus rufus	Rufous hummingbird	Edwards AFB GIS
Calidris ruficollis	Rufous-necked sandpiper	Edwards AFB GIS
Pipilo erythrophthalmus	Rufous-sided towhee	Edwards AFB GIS
Euphagus carolinus	Rusty blackbird	Edwards AFB GIS
Xema sabinii	Sabine's gull	Edwards AFB GIS
Amphispiza belli	Sage sparrow	Edwards AFB GIS
Oreoscoptes montanus	Sage thrasher	Edwards AFB GIS
Calidris alba	Sanderling	Edwards AFB GIS
Passerculus sandwichensis	Savannah sparrow	Edwards AFB GIS
Sayornis saya	Say's phoebe	Edwards AFB GIS
Piranga olivacea	Scarlet tanager	Edwards AFB GIS

Icterus parisorum	Scott’s oriole	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Aphelocama coerulescens	Scrub jay	Edwards AFB GIS
Calidris pusilla	Semipalmated plover	Edwards AFB GIS
Calidris pusillus	Semipalmated sandpiper	Edwards AFB GIS
Accipitera striatus	Sharp-shinned hawk	Edwards AFB GIS
Calidris acuminata	Sharp-tailed sandpiper	Edwards AFB GIS
Limnodromus griseus	Short-billed dowitcher	Edwards AFB GIS
Asio flammea	Short-eared owl	Edwards AFB GIS
Chen caerulescens	Snow goose	Edwards AFB GIS
Egretta thula	Snowy egret	Edwards AFB GIS
Charadrius alexandrinus	Snowy plover	Edwards AFB GIS
Tringa solitaria	Solitary sandpiper	Edwards AFB GIS
Vireo solitarius	Solitary vireo	Edwards AFB GIS
Melospiza melodia	Song sparrow	Edwards AFB GIS
Porzana carolina	Sora	Edwards AFB GIS
Actitis macularia	Spotted sandpiper	Edwards AFB GIS
Pipilo fuscus	Spotted towhee	Edwards AFB GIS
Micropalma himantopus	Stilt-sandpiper	Edwards AFB GIS
Piranga rubra	Summer Tanager	Edwards AFB GIS
Buteo swainsonii	Swainson's hawk	Edwards AFB GIS
Cahtarus ustulatus	Swainson's thrush	Edwards AFB GIS
Melospiza georgiana	Swamp sparrow	Edwards AFB GIS
Vermivora peregrina	Tenessee warbler	Edwards AFB GIS
Larus thayeri	Thayer's gull	Edwards AFB GIS
Myadestes townsendi	Townsend's solitaire	Edwards AFB GIS
Dendroica townsendi	Townsend's warbler	Edwards AFB GIS
Tachycineta bicolor	Tree swallow	Edwards AFB GIS
Agelaius tricolor	Tricolored blackbird	Edwards AFB GIS
Tyrannus melancholicus	Tropical kingbird	Edwards AFB GIS
Olor buccinator	Trumpeter swan	Edwards AFB GIS
Cygnus columbianus	Tundra swan	Edwards AFB GIS
Cathartes aura	Turkey vulture	Edwards AFB GIS
Ixoreus naevius	Varied thrush	Edwards AFB GIS
Chaetura vauxi	Vaux's swift	Edwards AFB GIS
Auriparus flaviceps	Verdin	Edwards AFB GIS
Pyrocephalus rubinus	Vermillion flycatcher	Edwards AFB GIS
Pooecetes gramineus	Vesper sparrow	Edwards AFB GIS
Tachycinetta thalassina	Violet-green swallow	Edwards AFB GIS

Rallus limicola	Virginia rail	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Vermivora virginiae	Virginia's warbler	Edwards AFB GIS
Heteroscelus incanus	Wandering tattler	Edwards AFB GIS
Vireo gilvus	Warbling vireo	Edwards AFB GIS
Anthus sinoletta	Water Pipit	Edwards AFB GIS
Sialia currucoides	Western bluebird	Edwards AFB GIS
Aechmophorus occidentalis	Western grebe	Edwards AFB GIS
Larus occidentalis	Western gull	Edwards AFB GIS
Tyrannus verticalis	Western kingbird	Edwards AFB GIS
Sturnella neglecta	Western meadowlark	Edwards AFB GIS
Calidris mauri	Western sandpiper	Edwards AFB GIS
Piranga ludoviciana	Western tanager	Edwards AFB GIS
Contipus cordidulus	Western wood-pewee	Edwards AFB GIS
Coccyzus americanus	Western yellow-billed cuckoo	Citizen siting with photos
Nuenius phaeopus	Whimbrel	Edwards AFB GIS
Sitta carolinensis	White-breasted nutchatch	Edwards AFB GIS
Zonotrichia leucophrys	White-crowned sparrow	Edwards AFB GIS
Pllegadis chihi	White-faced ibis	Edwards AFB GIS
Calidris fuscicollis	White-rumped sandpiper	Edwards AFB GIS
Elanus leucurus	White-tailed kite	Edwards AFB GIS
Aeronautes saxatalis	White-throated swift	Edwards AFB GIS
Melanitta deglandi	White-winged scoter	Edwards AFB GIS
Catoptrophorus semipalmatus	Willet	Edwards AFB GIS
Empidonax traillii	Willow flycatcher	Edwards AFB GIS
Phalaropus tricolor	Wilson's phalarope	Edwards AFB GIS
Wilsonia pusilla	Wilson's warbler	Edwards AFB GIS
Aix sponsa	Wood duck	Edwards AFB GIS
Dendroica petechia	Yellow warbler	Edwards AFB GIS
Sphyrapicus varius	Yellow-bellied sapsucker	Edwards AFB GIS
Icteria virens	Yellow-breasted chat	Edwards AFB GIS
Xanthocephalus xanthocephalus	Yellow-headed blackbird	Edwards AFB GIS
Dendroica coronata	Yellow-rumped warbler	Edwards AFB GIS
Dendroica dominica	Yellow-throated warbler	Edwards AFB GIS
MAMMALS		
Bats		
Myotis californicus	California myotis	Edwards AFB GIS

Eumops perotis californicus	Greater western mastiff bat	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Lasiurus cinereus	Hoary bat	Edwards AFB GIS
Tadarida brasiliensis	Mexican free-tailed bat	Edwards AFB GIS
\Antrozous pallidus	Pallid bat	Edwards AFB GIS
Corynorhinus townsendii	Townsends's big-eared bat	Edwards AFB GIS
Pipistrellus hesperus	Western pipistrel	Edwards AFB GIS
Carnivores		
Taxidea taxus	Badger	Edwards AFB GIS
Lynx rufus	Bobcat	Edwards AFB GIS
Canis latrans	Coyote	Edwards AFB GIS
Vulpes macrotis arsipis	Desert kit fox	Edwards AFB GIS
Urocyon cinereoargenteus	Grey fox	Edwards AFB GIS
Felis concolor	Mountain lion	Edwards AFB GIS
Bassariscus astutus	Ring-tailed cat	Edwards AFB GIS
Procyon lotor	Racoon	Edwards AFB GIS
Spilogale putorius	Spotted skunk	Edwards AFB GIS
Rodents		
Thomomys bottae	Botta's pocket gopher	Edwards AFB GIS
Peromyscus bolyii	Brush mouse	Edwards AFB GIS
Perognathus eremicus	Cactus mouse	Edwards AFB GIS
Citellus beechyi	California ground squirrel	Edwards AFB GIS
Microtus californicus	California mouse	Edwards AFB GIS
Peromyscus crinitus	Canyon mouse	Edwards AFB GIS
Peromyscus maniculatus	Deer mouse	Edwards AFB GIS
Dipodomys deserti	Desert kangaroo rat	Edwards AFB GIS
Perognathus penicillatus	Desert pocket mouse	Edwards AFB GIS
Neotoma lepida	Desert woodrat	Edwards AFB GIS
Ondatra zibethica	Muskrat	Edwards AFB GIS
Dipodomys microps	Great Basin kangaroo rat	Edwards AFB GIS
Perognathus parvus	Great Basin pocket mouse	Edwards AFB GIS
Perognathus longimembris	Little pocket mouse	Edwards AFB GIS
Perognathus formosus	Long-tailed mouse	Edwards AFB GIS
Chaetodipus formosus	Long-tailed pocket mouse	Edwards AFB GIS
Dipodomys merriami	Merriam's kangaroo rat	Edwards AFB GIS
Xerospermophilus mohavensis	Mohave ground squirrel	Edwards AFB GIS
Dipodomys panamintinus	Panamint kangaroo rat	Edwards AFB GIS
Thomonys umbrinu	Pocket gopher	Edwards AFB GIS

Perognathus inornatus	San Joaquin pocket mouse	Edwards AFB GIS
Scientific Name	**Common Name**	**Source**
Onychomys torridus	Southern grasshopper mouse	Edwards AFB GIS
Reithrodontomys megalotis	Western harvest mouse	Edwards AFB GIS
Ammospermophilus leucurus	Whitetail antelope squirrel	Edwards AFB GIS
Rabbits and Hares		
Lepus californicus	Blacktailed jackrabbit	Edwards AFB GIS
Sylvilagus auduboni	Desert cottontail	Edwards AFB GIS

Checklist of the Birds of Edwards AFB

Species	Dec-Feb Winter	Mar-May Spring	June-Aug Summer	Sep-Nov Fall	Status	Residency
DUCKS, GEESE, & SWANS						
Fulvous Whistling Duck			Oc		SC	VN
Greater White-fronted Goose		R	Oc	R		M
Snow Goose		Oc		Oc		M
Ross' Goose				R		M
Brant		R				V
Canada Goose	Un	Un	Un	Un		M
Tundra Swan	Oc					V
Wood Duck		Oc		Oc		V
Gadwall	Co	Co	Co	Co		RN
Eurasian Wigeon	R	Co	R	Co		M
Mallard	Ab	Ab	Ab	Ab		RN
Blue-winged Teal		Un	R	Un		M
Cinnamon Teal	Co	Co	Co	Co		RN
Northern Shoveler	Co	Co	Un	Co		M
Northern Pintail	Co	Co	Co	Co		M
Am. Green-winged Teal	R	R	R	Un		M
Canvasback	Un	Un	Oc	Un		M
Redhead	Co	Co	Co	Co		M
Ring-necked Duck	Un	Un	Oc	Un		M
Greater Scaup		Oc		Oc		M
Lesser Scaup	Co	Co	R	Un		M
White-winged Scoter				Oc		V
Long-tailed Duck				Oc?		
Bufflehead	Co	Co	Un	Co		M
Common Goldeneye	R			R		M
Hooded Merganser	Oc	Oc		Oc		V
Common Merganser	Oc	R				M
Red-breasted Merganser		Oc				V
Ruddy Duck	Co	Co	Co	Co		RN
QUAIL						
Chukar (I)						
Ring-necked Pheasant (I)		Oc				
California Quail	Co	Co	Co	Co		RN
Gambel's Quail		Oc		Oc		
LOONS						
Red-throated Loon				Oc		V
Common Loon				Oc	SC	VN
GREBES						
Pied-billed Grebe	Co	Co	Co	Co		RN
Horned Grebe	Oc	Oc	Oc	Oc		M

	Dec-Feb	Mar-May	June-Aug	Sep-Nov		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Red-necked Grebe			Oc			V
Eared Grebe	Co	Co	Co	Co		M
Western Grebe	Co	Co	Co	Co		M
Clark's Grebe	Un	Co	Co	Co		M
PELICANS						
American White Pelican	R	Co	Un	Co	SC	MN
CORMORANTS						
Double-crested Cormorant	Co	Co	Co	Co		RN
BITTERNS AND HERONS						
American Bittern	R	Un	Un	Un		R
Least Bittern		Oc		Oc?	SC	VN
Great Blue Heron	Co	Co	Co	Co		RN
Great Egret	Co	Co	Co	Co		R
Snowy Egret	R?	Co	Co	Co		M
Little Blue Heron			Oc			V
Western Cattle Egret		Un	R	R		V
Green Heron		Un	R	Un		Un
Black-crowned Night-Heron	Co	Co	Co	Co		RN
IBISES						
White-faced Ibis	R	Co	R	Co		RN
AMERICAN VULTURES						
Turkey Vulture	Un	Co	Un	Co		M
HAWKS, EAGLES, & KITES						
Osprey	Un	Un	Un	Un		MN
White-tailed Kite	Un	Un	Un	Un	SFP	RN
Bald Eagle	Oc				SE,SFP	V
Northern Harrier	Co	Co	Co	Co	SC	RN
Sharp-shinned Hawk		Oc		Oc	SC	MN
Cooper's Hawk	Un	Oc	Un	Un	SC	UN
Red-shouldered Hawk	Oc	Oc	R	R		R
Swainson's Hawk		Oc		Oc		V
Red-tailed Hawk	Ab	Ab	Ab	Ab		RN
Ferruginous Hawk	Un	Oc		Oc	SC	MW
Rough-legged Hawk	R			R		M

	Dec-Feb May	Mar-	June-Aug	Sep-Nov		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Golden Eagle	Un	Un	Un	Un	SC	R
FALCONS						
American Kestrel	Co	Co	Co	Co		RN
Merlin	?	Oc			SC	V
Peregrine Falcon		R	R	Oc	SE,	M
Prairie Falcon	Un	Un	Un	Un	SC	R
RAILS AND COOTS						
Virginia Rail	Co	Co	Co	Co		R
Sora	Co	Co	Co	Co		R
Common Moorhen	Un	Un	Un	Un		R
American Coot	Co	Co	Co	Co		RN
CRANES						
Sandhill Crane					ST	
PLOVERS						
Black-bellied Plover	Oc	Co	Co	Co		M
Pacific Golden-Plover		R		R		M
American Golden-Plover		R		R		M
Snowy Plover	R?	Un	Un	Un	SC	RN
Semipalmated Plover		Co	Co	Co		M
Killdeer	Ab	Ab	Ab	Ab		RN
Mountain Plover				R	SC	M
STILTS AND AVOCETS						
Black-necked Stilt	Un	Co	Co	Co		RN
American Avocet	Un	Co	Co	Co		RN
SANDPIPERS						
Greater Yellowlegs	Co	Co	Co	Co		M
Lesser Yellowlegs	Oc	Un	Co	Co		M
Solitary Sandpiper		Un	Un	Un		M
Willet		Un	Co	Co		M
Wandering Tattler		Oc		Oc		V
Spotted Sandpiper	R	Co	Co	Co		M
Whimbrel		Co	Un	Un		M
Long-billed Curlew		Un	Un	R	N	M
Hudsonian Godwit		Oc				V
Marbled Godwit		Un	Un	Un		M
Ruddy Turnstone		R	R	R		M
Black Turnstone		Oc				V

Red Knot		Oc	Un	Un		M
	Dec-Feb	**Mar-May**	**June-Aug**	**Sep-Nov**		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Sanderling		Un	R	Un		M
Semipalmated Sandpiper		Oc	R	R		M
Western Sandpiper	Co	Co	Co	Co		M
Red-necked Stint						V
Least Sandpiper	Co	Co	Co	Co		M
White-rumped Sandpiper			Oc			V
Baird's Sandpiper		R	Un	Un		M
Pectoral Sandpiper		Oc	R	Un		M
Sharp-tailed Sandpiper		Oc		Oc		V
Dunlin	Co	Co	Oc	Co		M
Curlew Sandpiper			Oc			V
Stilt Sandpiper			R	R		M
Buff-breasted Sandpiper			Oc	Oc		V
Ruff		Oc	Oc	Oc		V
Short-billed Dowitcher		Un	Un	Un		M
Long-billed Dowitcher	R	Co	Co	Co		M
Wilson’s Snipe	Un	Un	Un	Un		M
PHALAROPES						
Wilson’s Phalarope	Un	Co	Co	Co		M
Red-necked Phalarope		Co	Co	Co		M
Red Phalarope		Oc				V
GULLS AND TERNS						
Long-tailed Jaeger				Oc		V
Laughing Gull			Oc		N	V
Franklin's Gull		R	R	Oc		M
Bonaparte's Gull		Co	Un	Un		M
Heermann's Gull		Oc	Oc			V
Mew Gull				Oc		V
Ring-billed Gull	Co	Co	Co	Co		M
California Gull	Co	Co	Co	Co	N	M
Herring Gull		R		R		M
Thayer’s Gull						
Western Gull	Oc	Oc				V
Sabine’s Gull				Oc		V
Gull-billed Tern			Oc		SC	V
Caspian Tern		Un	Un	Un		M
Common Tern		Oc	R	R		M
Arctic Tern			Oc			V
Forster's Tern	Oc	Co	Co	Un		M

Least Tern		Oc			SE,	V
Black Tern		Un	Un	Un	SC	M
	Dec-Feb	**Mar-May**	**June-Aug**	**Sep-Nov**		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
DOVES						
Rock Pigeon (I)	Un	Un	Un	Un		RN
Band-tailed Pigeon		Oc				V
Spotted Dove		Oc				V
Mourning Dove	Ab	Ab	Ab	Ab		RN
CUCKOOS AND ANIS						
Greater Roadrunner	Un	Un	Un	Un		RN
Western yellow-billed				R	FT	V
OWLS						
Common Barn Owl	Un	Un	Un	Un		RN
Great Horned Owl	Un	Un	Un	Un		RN
Burrowing Owl	Un	Un	Un	Un	SC	RN
Long-eared Owl	?	R	R	R	SC	RN
Short-eared Owl				Oc	SC	Un
NIGHTHWHAWKS						
Lesser Nighthawk		Un	Un			MN
Common Nighthawk	Oc					V
Common Poorwill						
SWIFTS						
Vaux's Swift		Un	Oc	Un	N	M
White-throated Swift	Oc	R	Oc?	?		Un
HUMMINGBIRDS						
Black-chinned			R	Oc		V
Anna's Hummingbird		R	R	Oc		V
Costa's Hummingbird		Oc	Oc			V
Rufous Hummingbird						
KINGFISHERS						
Belted Kingfisher		R	R	R		M
WOODPECKERS						
Lewis's Woodpecker				Oc		V
Acorn Woodpecker		Oc				V
Red-naped Sapsucker				Oc		V
Red-breasted Sapsucker				Oc		V
Ladder-backed	Un	Un	Un	Un		RN

Nuttall's Woodpecker			?			
Northern Flicker	Un	Un	Oc	Un		R
Yellow-bellied Sapsucker				R		V
TYRANT FLYCATCHERS						
	Dec-Feb	**Mar-May**	**June-Aug**	**Sep-Nov**		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Olive-sided Flycatcher		Oc	Oc			V
Western Wood-Pewee		Co	R	R		M
Willow Flycatcher		Un	Un	Un	SE	M
Hammond's Flycatcher		R		Oc		M
Gray Flycatcher		Oc				V
Dusky Flycatcher		Oc				V
Pacific-slope Flycatcher		R	Oc			M
Black Phoebe	Co	Co	Co	Co		RN
Eastern Phoebe		Oc				V
Say's Phoebe	Co	Co	R	Co		M
Vermillion Flycatcher			Oc			VN
Ash-throated Flycatcher		Co	Un	Oc		MN
Tropical Kingbird			Oc			V
Cassin's Kingbird		R	R			M
Western Kingbird		Co	Co	Un		MN
SHRIKES						
Loggerhead Shrike	Co	Co	Co	Co	SC	RN
Northern Shrike	?					V
VIREOS						
Gray Vireo			Oc		SC	V
Cassin's Vireo		Oc				V
Hutton's Vireo		Oc?				V
Warbling Vireo		Un	Oc	Un		M
JAYS AND CROWS						
Western Scrub-Jay	Oc	Oc		Oc		V
American Crow		Oc				V
Common Raven	Ab	Ab	Ab	Ab		RN
LARKS						
Horned Lark	Ab	Ab	Ab	Ab	N	RN
SWALLOWS						
Purple Martin					SC	N
Tree Swallow	Un	Co	Co	Co		M
Violet-green Swallow	R	Un	R	R		M
Northern Rough-winged	Oc	Co	Un	Co		M
Bank Swallow		Un	Un	Un	ST	MN

Cliff Swallow	R	Co	Co	Un		MN
Barn Swallow	R	Ab	Co	Ab		MN
CHICKADEES & TITMICE						
Mountain Chickadee				Oc		V
Verdin	Co	Co	Co	Co		RN
Bushtit		Oc				V
	Dec-Feb	**Mar-May**	**June-Aug**	**Sep-Nov**		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Red-breasted Nuthatch		Oc				V
White-breasted Nuthatch	Oc			Oc		V
WRENS						
Cactus Wren	Co	Co	Co	Co		RN
Rock Wren	Co	Co	Co	Co		RN
Bewick's Wren	R	R	R	R		M
House Wren	Oc	R	Oc	R		M
Marsh Wren		Co	Co	Co	Co	RN
THRUSHES						
Golden-crowned Kinglet				Oc		V
Ruby-crowned Kinglet	Co	Un		Co		M
Blue-gray Gnatcatcher	Oc	R	R	R		M
Western Bluebird	Oc	Oc		Oc		M
Mountain Bluebird	Oc					M
Townsend’s Solitaire						
Swainson's Thrush		R				M
Hermit Thrush	Oc	R		R		M
American Robin	R	Un		Un		M
Varied Thrush				Oc		V
THRASHERS						
Gray Catbird				Oc		V
Northern Mockingbird	Un	Un	Un	Un		RN
Sage Thrasher	Oc	Un				M
California Thrasher	Oc		Oc	Oc		V
Le Conte's Thrasher	Co	Co	Co	Co		RN
STARLINGS						
European Starling (I)	Co	Co	Co	Co		RN
PIPITS						
American Pipit	Co	Co	Un	Co		M
WAXWINGS						
Cedar Waxwing		Oc		Oc		V
SILKY FLYCATCHERS						
Phainopepla		Oc		Oc		V
WARBLERS						

Tennessee Warbler		Oc				V
Orange-crowned Warbler	Oc	Co	Co	Co		M
Nashville Warbler		R		Un		M
Virginia's Warbler			Oc			VN
Northern Parula						V
Yellow Warbler	Oc	Co	Co	Co	SC	MN
Yellow-rumped Warbler	Co	Un	Oc	Co		M
	Dec-Feb	**Mar-May**	**June-Aug**	**Sep-Nov**		
Species	**Winter**	**Spring**	**Summer**	**Fall**	**Status**	**Residency**
Black-throated Gray Warbler		R	Oc	R		M
Townsend's Warbler		R	Oc	R		M
Hermit Warbler		Oc		Oc		V
Black-and-white Warbler		Oc				V
MacGillivray's Warbler		Un	Oc	Un		M
Common Yellowthroat	Co	Co	Co	Co		RN
Wilson's Warbler		Co	Un	Un		M
Canada Warbler			Oc			V
Painted Redstart				Oc		V
Yellow-breasted Chat		Oc		Oc	SC	VN
TANAGERS						
Western Tanager		Un	Un	Un		M
SPARROWS AND ALLIES						
Green-tailed Towhee				Oc		V
Spotted Towhee	R	R		R		V
California Towhee		Oc				V
Chipping Sparrow		R	Oc	R		M
Clay-colored Sparrow						
Brewer's Sparrow	Un	Un	R	Un		M
Vesper Sparrow		R	Oc	Un		M
Black-chinned Sparrow		Oc?				
Lark Sparrow		R	R	R		Un
Black-throated Sparrow	Un	Co	Co	Co		RN
Sage Sparrow	Ab	Ab	Ab	Ab		RN
Savannah Sparrow	Co	Co	R	Co		M
Fox Sparrow		Oc		Oc		V
Song Sparrow	Co	Co	Co	Co		RN
Lincoln's Sparrow	R	Un		Un		M
Swamp Sparrow						
Harris' Sparrow				Oc		V
White-crowned Sparrow	Ab	Ab	Oc	Ab		M
Golden-crowned Sparrow		Oc				M
Dark-eyed Junco	Co	Un		Un		M
McCown's Longspur				Oc		V
Lapland Longspur				Oc		V
Chestnut-collared Longspur				Oc		V

Snow Bunting				Oc		V
Black-headed Grosbeak		R	R	R		M
Blue Grosbeak		Oc				V
Lazuli Bunting		Oc	R			M
BLACKBIRDS & ORIOLES						
Red-winged Blackbird	Co	Co	Co	Co		RN
Tricolored Blackbird	Un	Co	Co	Un	SC	RN
Western Meadowlark	Co	Co	Co	Co		RN
Species	**Dec-Feb Winter**	**Mar-May Spring**	**June-Aug Summer**	**Sep-Nov Fall**	**Status**	**Residency**
Yellow-headed Blackbird	R	Co	Co	Un		
Rusty Blackbird						
Brewer's Blackbird	Co	Co	Co	Co		RN
Great-tailed Grackle	Un	Un	Un	Un		RN
Brown-headed Cowbird	R	R	R	R		R
Orchard Oriole		Oc				V
Hooded Oriole		Oc	Oc			V
Bullock's Oriole		Un	Un	Oc		M
Scott's Oriole		R	R			M
FINCHES						
Purple Finch				Oc		V
House Finch	Ab	Ab	Ab	Ab		RN
Red Crossbill				Oc		V
Pine Siskin				Oc		V
Lesser Goldfinch		Un	R	R		M
Lawrence's Goldfinch		R	R			M
American Goldfinch	Oc	Oc	Oc	Oc		V
Evening Grosbeak			Oc			V
OLD WORLD SPARROWS						
House Sparrow (I)	Co	Co	Co	Co		RN

Codes:

Ab	Abundant - Expected on most trips to the base	**ST**	State Threatened	**Un**	Unknown
Co	Common - Usually observed in suitable habitat	**SFP**	State Fully Protected	**N**	Nesting
Un	Uncommon- Present, but not regularly observed	**SC**	State Species of Special Concern	**W**	Wintering
R	Rare - not usually present on-base, not detected every year	**FE**	Federal Endangered	**M**	Migrant
Oc	Occasional - fewer than 5 records	**FT**	Federal Threatened	**R**	Resident
		SE	State Endangered	**V**	Vagrant

Species of Interest on Edwards AFB

Species Common Name *Scientific Name*	Status	Occurs on Edwards	Habitat/Known Locations	Blooming Period
Alkali mariposa lily *Calochortus striatus*	CNPS 1B.2	O	Clay pans and sand dunes, drainages.	April - June
Desert cymopterus *Cymopterus deserticola*	CNPS 1B.2	O	Sandy soils.	March - May
Barstow woolly sunflower *Eriophyllum mohavense*	CNPS 1B.2	O	Loamy, gravel soils	March - May
Red Rock Poppy *Eschscholtzia minutiflora ssp.*	CNPS 1B.2	O.	Rare annual in Mojave desert scrub. Known from Rand and El Paso Mountains, one record on Edwards.	March - May
Crowned onion *Muilla coronata*	CNPS.2	O	Chenopod scrub, Joshua tree woodland, Mojave desert. Observed 1977 at Edwards AFB (Los Angeles County Sanitation District 2004).	March - May
Slender threadplant *Nemacladus gracilis*	CNPS.3	O	Sandy or gravelly substrate.	March - May
White pygmy poppy *Canbya candida*	CNPS.2	O	Typically found on sandy soils in mixed Mojave scrub, saltbush scrub, juniper woodlands and Joshua Tree Woodlands. Clusters of small white flowers bloom between March and June. There are 16 reported occurrences of this species in Kern County, and 17 occurrences (post 1970) reported for Los Angeles County. This species was observed on Edwards AFB in 1995 (Los Angeles County Sanitation District 2004) and in 2003 (Cione 2008).	March - June
Golden goodmania *Golden luteola*	CNPS.2	O	Alkaline or clay soils within mojave desert scrub, meadows and seeps, playas, and grasslands.	April - August
Sagebrush loeflingia *Loeflingia squarrosa* var. *artemisiarum*	CNPS 2.B.2	O	Desert sand dunes.	April - May
Lancaster milkvetch *Astragalus preussii* var. *laxiflorus*	CNPS 1B.1	O	Areas of high water table in halophytic saltbush scrub, shadscale.	March - May

Rosamond eriastrum *Eriastrum rosamondense*	CNPS 1.B.1	O	David Gowen reported observation at southwest quadrant of West Avenue D and 30th St West (May 2010). Alkaline hummocks, often sandy. Chenopod scrub and vernal pool openings.	April – July
Recurved larkspur *Delphinium*	CNPS 1B.2	E	Alkaline soils, chenopod scrub, cismontane woodlands, and grasslands.	March - June
Popcorn-Flower *Plagiobothrys sp.*	CNPS 1.B.1	E	Parish's popcorn-flower presumed extirpated in area; unknown species of popcorn-flower found on Edwards.	March - November
Mojave spineflower *Chorizanthe spinosa*	CNPS 4	O	Observed in 1995 at EAFB near Rosamond Dry Lake (Los Angeles County Sanitation District, 2004.). Observed in 2003 on Edwards AFB (Cione 2008).	March-June

WILDLIFE					
Species Common Name ***Scientific Name***	**Status**	**Occurs on Edwards**	**Seasonal Occurrence**	**Habitat/Known Locations**	**Breeding Season (Edwards Breeders Only)**
Reptiles and Amphibians					
Desert tortoise *Gopherus agassizii*	FT/ST	O	Resident	Throughout base.	N/A
Western pond turtle *Actinemys marmorata*	SSC	O	Unknown	Piute Ponds	Unknown
Birds					
Bank Swallow *Riparia riparia*	ST	O	Migrant	Piute Ponds, Branch Pond	N/A
Burrowing owl *Athene cunicularia*	SSC/BCC	O	Breeding Season	Burrowing Owl Conservation Area, Piute Ponds, and other locations throughout base.	Burrow Sites & some Wintering Sites
California Least Tern *Sternula antillarum browni*	FE/SE	O	Vagrant	Piute Ponds	N/A
Golden eagle *Aquila chrysaetos*	FP	O	Winter	Power Lines, Piute Ponds	N/A
Greater Sandhill Crane *Grus Canadensis tabida*	FP	O	Vagrant	Piute Ponds	N/A

Least bittern *Ixobrychus exilis*	SSC/BCC	O	Unknown	Piute Ponds	Nesting unknown
Loggerhead shrike *Lanius ludovicianus*	SSC/	O	Resident	Throughout base.	Nesting unknown
Long-eared owl *Asio otus*	SSC	O	Resident	Mesquite woodlands.	Nesting
Northern harrier *Circus cyaneus*	SSC	O	Resident	Branch, Piute, Desert areas.	Nesting
Peregrine falcon *Falco peregrinus anatum*	FP/BCC	O	Vagrant	Piute Ponds	N/A
Prairie Falcon *Falco mexicanus*	BCC	O	Resident	Piute Ponds	Nesting unknown
Redhead *Aythya americana*	SSC	O	Resident	Piute Ponds	Nesting
Swainsons Hawk *Buteo swainsonii*		O	Migrant	Various areas.	N/A
Tricolored blackbird *Agelaius tricolor*	SC /SSC	O	Seasonal resident	Branch Pond, Piute Ponds	Nesting Colony
Western Yellow-billed Cuckoo *Coccyzus americanus*	FT/BCC	O	Vagrant	Piute Ponds	N/A
Willow Flycatcher *Epidonax traillii*	SE	O	Seasonal	Branch Pond, Piute Ponds	Nesting unknown
Mammals					
California mastiff bat *Eumops perotis californicus*	SSC	O	Migrant	Various areas.	N/A
Pallid bat *Antrozus pallidus*	SSC	O	Migrant	Various areas.	N/A
Townsend's big eared bat *Corynorhinus townsendii*	SSC	Unknown	N/A	N/A	N/A
Mohave ground squirrel *Xerospermophilus mohavensis*	ST	O	Resident	Various areas, PIRA.	N/A

American badger *Taxidea taxus*	SSC	O	Resident	Various areas throughout base.	N/A
Desert kit fox *Vulpes macrotis*	FP	O	Resident	Throughout base.	N/A
Crustaceans					
Colorado fairy shrimp *Branchinecta coloradensis*	Locally rare	O	Resident	Northwest corner of base (currently known).	N/A

OCCURS ON EDWARDS: O – Observed, H – Historical occurrence with no recent sightings, E - Expected

STATUS: **California Native Plant Society (CNPS) Status**

List 1B – Plants of very limited distribution; global populations potentially threatened

1. - Seriously endangered in California
2. – Fairly endangered in California
3. – Not very endangered in California

List 2 – Rare, threatened, or endangered in California but more common elsewhere

List 4 – Widespread and common; status does not warrant further consideration at this time

Federal Status

FE – Listed as federally endangered FT – Listed as federally threatened

FPE - Federally proposed as endangered

BCC – Birds of Conservation Concern 2008. USFWS, Division of Migratory Bird Management State Status SE – Listed as state of California endangered

ST – Listed as state of California threatened

SSC – California species of special concern

California Department of Fish and Wildlife (CDFW)

SSC – Species of Special Concern; native species not having state or federal Threatened or Endangered Species status, but thought to warrant monitoring due to declining population numbers.

FP – Fully Protected: Fully Protected species state that these species "may not be taken or possessed at any time and no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected" species although take may be authorized for necessary scientific research

Desert Tortoise Density Comparisons on Edwards AFB

Relative Densities by Habitat Type, East Versus West Base

Habitat type	*Mean Relative Density (per square mile)*		
Habitat type	West	East	Overall
Creosote bush scrub	5.4	12.6	9.5
Joshua tree woodland	5.2	9.1	8.8
Xerophytic saltbush scrub	5.3	10.4	6.9
Hymenoclea-Lycium scrub	4.6	n/a	4.6
Halophytic saltbush scrub	4.2	6.5	4.4
Mesquite Woodland	3.9	n/a	3.9

Relative Densities by Habitat Type Comparing Two Surveys

Habitat type	*Relative Densities 1991-1994 Surveys*	*Relative Densities 2006-2007 Surveys*
Creosote bush scrub	21	10
Xeric saltbush scrub	21	9
Joshua tree woodland	15	7
Halophytic saltbush scrub	7	5
Hymenoclea-Lycium scrub	n/a	4

Relative Densities by Mission Area

Area	*Relative Densities 1991-1994*	*Relative Densities 2006-2007*
PIRA	*21*	*10.1*
AFRL	*15.1*	*12*
Other	*12.1*	*5.6*
Total	*15.9*	*7.8*

Source of data is from: Blandford et al. 2010. *Desert Tortoise (Gopherus agassizii) Relative Density Estimates, Edwards Air Force Base, California. San Bernardino, CA : Tetra Tech, Inc., On file at Edwards Air Force Base. California.*

Appendix D. Cooperating Agencies and Public Review Process and Comments

AGENCY AND PUBLIC INVOLVEMENT

27 February 2012

Sent early notification letters to the United States Fish and Wildlife Service (USFWS), Ventura Field Office in Ventura and the California Department of Fish and Wildlife (CDFW), Regional Office in Fresno, California regarding 5-year update of the Integrated Natural Resources Management Plan (INRMP) for Edwards Air Force Base (AFB). Copies of these letters were also sent to each Regional Office of these agencies. A link was provided for the 2008 INRMP.

16 May 2014

Sent very preliminary draft portions of INRMP to the USFWS, Ventura Field Office in Ventura and the CDFW, Regional Office in Fresno, California requesting agency inputs to management sections of INRMP.

8 July 2014

Received comments on preliminary draft portions of INRMP from the CDFW, Regional Office in Fresno, California.

14 July 2014

Received comments on preliminary draft portions of INRMP from the USFWS, Ventura Field Office in Ventura.

28 August 2014

Held meeting with representatives of the CDFW, to discuss agency inputs to management sections of INRMP.

1 December 2014

Sent emails to Federal and State agencies (USFWS, CDFW) notifying them of 30 day review and comment period.

Published public notice in Antelope Valley Press and placed copy of INRMP in Base Library.

Posted INRMP on Edwards AFB website with a request for any comments or concerns.

2 December 2014

Sent email notification of the INRMP availability, electronic location, and public comment period to the Air Force Test Center Technical Library and the NASA Library.

4 December 2014

Sent a letter and one disc copy of the INRMP to each of the following Native American tribes by certified mail:

Chemehuevi Indian Tribe (Return receipt signed 9 December 2014) Colorado River Indian Tribes (Return receipt signed 8 December 2014) Morongo Band of Mission Indians (Return receipt signed 8 December 2014)

San Manuel Band of Mission Indians (Return receipt signed 6 December 2014)

5 December 2014

Published public notice in base newspaper, Desert Wings.

12 December 2014

Published public notice in Mojave Desert News.

8 January 2015

Called State Clearinghouse (SCH) and received the following SCH numbers: INRMP: SCH #2014124001

INRMP EA: SCH #2014124002

13 January 2015

Received comments on INRMP from USFWS Carlsbad Field Office via email.

21 January 2015

Received SCH letter dated 2 Jan 15 that no state agencies submitted comments by 31 Dec 15. The letter states compliance with SCH review requirements.

16 July 2015

AFCEC/CZOW emailed Air Force responses to CDFW comments.

19 January 2016

The Air Force conducted the annual INRMP review with CDFW and USFWS.

14 March 2017

The Air Force conducted the annual INRMP review with CDFW and USFWS.

ERRATA SHEET AND RESPONSE TO PUBLIC COMMENTS

United States Fish and Wildlife Service (USFWS) Comments and Edwards AFB Response to Comments on the Integrated Natural Resources Management Plan (INRMP)

(USFWS email dated 13 January 2015)

The first six USFWS INRMP comments below are the key substantive comments with a response; other minor comments and responses are addressed as well.

USFWS INRMP Comments–

1) Monarch butterfly studies (USFWS issued a positive 90-day finding in late December on a petition to list the species), if any of your programs help, enhance habitat for, manage for the feeding, roosting, or migration habitat of this species, these should be identified in the appropriate section(s) of the INRMP.

> **Response:** Monarch butterflies are not known to occur on Edwards AFB. Monarch butterflies will be included in 2015 surveys/inventories for invertebrates; inventories for invertebrates are listed in the Section 8.0, Goals and Objectives, Goal 6.

2) We recommend a multi-year population study of MGS (not just presence/absence data collection) be included.

> **Response:** The INRMP does not list presence/absence surveys. Additional studies are discussed in in Section 8.0, Goals and Objectives, Goal 11, and Section 10.0 Annual Work Plans, p. 112, MGS project.

3) Develop and implement a Base-wide raven management plan to contribute to recovery of the desert tortoise and help other wildlife species given the increased raven population numbers and what they prey on.

> **Response:** The Air Force will work with USFWS to develop a specific raven management plan for the base. When completed, this plan will be incorporated into an annual update to the INRMP.

4) Demonstration that you are managing for western snowy plover (WSP). Suggest that you not rely on 3 miles for a difference between listed and not listed when talking about bird occurrences.

> **Response:** The WSP is included as a target species to manage for as part of the Piute Ponds Management Plan, a component plan of the INRMP (see Tab 1.).

5) Participate in the Sonoran Joint Venture (SJV) for migratory birds (includes the Mojave Desert).

> **Response:** The Air Force has worked with Ducks Unlimited through the SJV to fund habitat enhancement projects at Piute Ponds.

6) Install and maintain numerous rain gauges or weather stations throughout the Base especially in areas where there are important natural resources.

> **Response:** The Air Force has included an objective in the INRMP to install more weather data collection stations (see Section 8, Goals 17).

Other changes made or considered based on comments from USFWS include:

Comment: Legal Authority: Under Section 1.3, you might want to add Bald and Golden Eagle Protection Act. Under what authority are you doing the ground water cleanup? If it is CERCLA (mentioned in section 6.3) or RCRA, it is not mentioned in this section

Response: Under Section 1.3 and Appendix A, added the Bald and Golden Eagle Protection Act. Ground water cleanup is conducted under the authority of CERCLA (mentioned in Section 2.4.4 and Appendix A). CERCLA is not listed under Section 2.3 as a natural resources authority.

Comment: Sensitive species/clarification if a species is sensitive or not: The INRMP discusses shrimp species present, but it does not say if they are rare or common (e.g., EAFB is one of several sites where they occur). Also, we found no mention in this section of Townsend's big- eared bat. We suggest adding this information; it would only require a sentence or two for each. No butterflies are listed in Table 5-3 of Appendix B even though a butterfly survey is mentioned on page 24 (Pratt 2000).

Response: Townsend's big-eared bat is not known to occur on Edwards AFB. Surveys are planned to determine presence/absence of this species. Shrimp species on Edwards AFB are not considered rare. Sensitive species (includes rare, threatened and endangered species) are listed in Section 2.3.4 and Appendix C. Tables, Species of Interest on Edwards AFB. The AF will update the species list for butterflies during the annual review process after further invertebrate surveys are completed. Future bat studies are addressed in Section 8.0, Goal 6. Monarch butterflies are discussed above. No changes were made to the INRMP based on these comments.

Comment: Page 20, Soil Characteristic –"Disturbance may be natural from disasters such as fire, which denudes vegetation, or from surface erosion. Once the soil surface is disturbed, the surface is vulnerable to both wind and water erosion." The "...or from surface erosion" does not make sense. Suggest reword to say "or from human activity (e.g., grading, OHV use, etc.)."

Response: Sentence changed to read "or from human activity (e.g., grading, OHV use, etc.)."

Comment: Page 23 - The Muroc golf course pond is much smaller than 3 acres. More like 0.6 acre.

Response: The Muroc golf course pond size was changed from 3 acres to 0.6 acres.

Comment: Page 23 – I would add "nonnative" before fish, and the golf course. I would do this wherever there are nonnative fish or plants that are mentioned in the INRMP.

Response: All fish on Edwards AFB are nonnative to the installation. No change made to INRMP.

Comment: Although the WSPL is not listed on EAFB, I assume the document discusses how EAFB is managing for this species and its habitat.

Response: Although the WSPL is not listed on EAFB, the INRMP includes management for this species and its habitat under the Piute Ponds Component Plan (see Tab 1).

Comment: When listed in 1989 and 1990, the entity was the Mojave population of the desert tortoise. Now it is a species, the Mojave desert tortoise. You might want to update the INRMP.

Response: Comment noted but no changes were made throughout the INRMP. Comment: Page 31- Do you want to update the status of the tri-colored blackbird? Response: Status of the tri-colored blackbird was changed to California Endangered.

Comment: Page 31 – Do bats use the mine shafts? If so, can we put bat gates on them with your approval?

Response: No change made to the INRMP. It is unknown whether bats use mine shafts on Edwards AFB. However, if the USFWS determines it is appropriate and wants to fund a project to place bat gates on mine shafts, the AF will cooperate with this effort.

Comment: Riparian – I would add "nonnative" in front of tamarisk.

Response: Comment noted, did not add "nonnative" in front of tamarisk.

Comment: I would add "nonnative" after stocked and before fish population.

Response: Comment regarding "nonnative"addressed above.

Comment: If it does not interfere with the mission, can you put PV over parking lots?

Response: Placement of PV over parking lots is not included in the INRMP.

Comment: Section 7.1, Can you add that you will participate in the Sonoran Joint Venture partnership for migratory birds (covers Mojave Desert)?

Response: Added Sonoran Joint Venture.

Comment: Section 7.4, Current BOs – This section should reflect the consolidation of active BOs and future needs in to one BO. I would replace the sentence that begins "of the 50, 22 are still actively..." with "In 2014, all active BOs were consolidated into on BO along with all anticipated AF activities and operations that potentially could impact the tortoise and its habitat on base and in the foreseeable future." Then delete the last sentence in the paragraph.

Response: The BO in 2014 did not replace the 22 BOs. No changes made to INRMP.

Comment: Section 7.6, Tricolored blackbirds – I suggest that you update this section to reflect the recently listing action by the Fish and Game Commission.

Response: This was done on page 35, see comment above.

Comment: Water – Do the reports include analysis of the presence of Hg?

Response: No change made to INRMP; however, the LA County Sanitation District 14 reports do include some analysis of Mercury (Hg).

Comment: Section 8.0, Goal 11 – Suggest changing sentence to read "and presence of nonnative perennial pepper weed."

Response: Changed sentence to read "and presence of nonnative perennial pepper weed."

Comment: Page 80 – Mosit should be moist.

Response: Changed Mosit to moist.

Comment: Section 2.3.6 and Section 7.7 – Would the landscape plan specify the use of native plants?

Response: Sentence was added that the landscape plan would specify the use of native plants.

Comment: Section 7.7, Nonpoint Source Pollution – You mention no transport of water to a body of water, should mention that runoff soaks in and adds to the groundwater table which is the Base's drinking

water source. This is another reason why nonpoint source pollution issues are important and should be managed.

Response: Comment noted, but did not change the text in this section of the INRMP.

Comment: Section 7.9, Last sentence in first paragraph suggest changing to "Fires also increase the potential for soil erosion by destroying macrobiotic soil crusts and leaving soils exposed to wind and water erosion thus degrading air and water quality."

Response: The last sentence in first paragraph was changed to read "Fires also increase the potential for soil erosion by destroying macrobiotic soil crusts and leaving soils exposed to wind and water erosion thus degrading air and water quality."

Comment: Section 7.11, Pest Management: Suggest that the document clearly distinguish between Mohave and California ground squirrels. The term ground squirrel is used frequently in this section and not defined. It gives the impression that the INRMP is saying that ground squirrels (no matter what species) can be a target of pest management. I do not think this is the intent but a few words to clarify what "ground squirrel" in the Pest Management section would be helpful.

Response: The term "ground squirrel" was changed to "California ground squirrel" throughout this section.

Comment: Page 89 – "The Installation Pest Management Coordinators maintains all applicable state, federal, and DoD regulations that pertain to pesticides." This sentence does not make sense. I maintain applicable regulations in my office but I cannot obtain or use the pesticides. I think it should say "The Installation Pest Management Coordinators ensure that all required licensing current and follow all applicable state, federal, and DoD regulations pertaining to pesticides."

Response: On Page 89, the sentence "The Installation Pest Management Coordinator maintains all applicable state, federal, and DoD regulations that pertain to pesticides." was changed to read "The Installation Pest Management Coordinators maintains a file of all applicable state, federal, and DoD regulations that pertain to pesticides."

Comment: Section 7.15, Natural Resources Education materials – There should be at least one for the state threatened Mohave ground squirrel.

Response: Added fact sheet for the state threatened Mohave ground squirrel.

Comment: Section 7.16 GIS – Also important to show any changes from climate change. You might consider noting this in the INRMP.

Response: This is included in GIS data sets. No change made to this section.

Comment: Chapter 10, Work Plan MGT, INVASIVE SPECIES Yrs 2015-2019 – Some of the sentences in the first and third paragraphs in this table are similar.

Response: Repetitive sentences were deleted.

The following comments have been addressed above and no further changes have been made to the INRMP.

Under Section 7.4, add Monarch butterfly and Townsend big-eared bat surveys. These bats are colonial roosters so your suggestion to manage for bats in section 7.2 may not work for this species.

Chapter 10, Work Plan – Add Monarch butterfly and consider Townsend bat studies. Modify MGS to use cameras with live trapping and look for population info, not just presence/absence. Weather data - Do you have several rain gauges throughout the Base in undeveloped areas to know where it is and is not raining? You can match these data with vegetation data. Strongly suggest doing this.

Chapter 10, Work Plan - Did not see a base-wide raven management plan for the desert tortoise that covers day-to-day operations/activities as well as surface disturbance activities. We can help EAFB with preparing it. USFWS requests that the AF implement it.

The following comments have been noted. No changes have been made to the INRMP based on these comments.

Section 7.5.7.6, Annual surveys – good! Section 6.3 discusses contaminants – good!

Chapter 8 – I see that you incorporated some of my comments from earlier in 2014 into this chapter. Thanks.

Section 7 – The activity that EAFB does not do that other bases do is mitigate for lost or degraded habitat. The REPI program seems like it lends itself to off-site compensation, a form of mitigation. As the need for using more land at EAFB continues, resulting in the loss of more habitat, mitigation in various forms including off-site compensation, may be needed. I am not sure how to insert this need/approach into the INRMP. The USFWS's goal is to ensure that the military mission is not compromised within the Base boundary or outside it while meeting the public resource doctrine of wildlife that belongs to the people. This is another reason why REPI should be implemented.

Section 7.2– Also avoiding or minimizing delays in implementing the military mission. If EAFB manages for sensitive species, you contribute to pre-listing recovery and help keep species form being listed. If you know where species are on the Base, you know how to avoid them when there is an urgent need to conduct an activity that may adversely affect the species or its habitat. For these and other reasons, it is smart management to know where species and habitats are and their status/trend information. You use this info to adaptively manage to implement the Air Force's mission. Also, natural resources management is great public relations as is involving the schools with natural resources management. Also include improved quality of life (you mention it in section 7.2).

California Department of Fish and Wildlife (CDFW) Comments and Edwards AFB Response to Comments on the Integrated Natural Resources Management Plan (INRMP)

(CDFW email dated 24 July 2015)

NOTE: *Many section and page numbers have changed due to AFCEC formatting requirements. The response contains the correct section and/or page numbers.*

CDFW INRMP comments are summarized below with responses.

1) Natural Resources Management and Protection. The Department supports the EAFB multiple-species conservation approach. The Department supports continued coordination with EAFB to identify key special status species and develop an adaptive management plan for the resources on the EAFB.

> **Response:** EAFB supports continued coordination with CDFW as outlined in Sections 9.1, 9.2, and 9.3.

2) Coordination with State Laws. The SAIA requires domestic military reservations to partner and coordinate activities with the appropriate state wildlife agency. Although the Department has been invited to be involved in the review of the executive draft INRMP, the Department is unclear of the State's role in this plan. The Department recommends the following information be included in the INRMP to clarify the State's role and identify expectations for future coordination and collaboration efforts: a section on coordination as it pertains to the SAIA and State regulations; a detailed analysis on the State's role in managing activities on EAFB; it is identified in executive draft INRMP Section 5, that the base supports the State-listed Mohave ground squirrel, although it is not clear if and/or how the California Endangered Species Act is applied on EAFB; and, a section on how Fish and Game Code sections 1600 *et seq.* are applied to activities on EAFB.

> **Response:** Annual coordination between EAFB and CDFW is outlined in Section 9.1, 9.2, and 9.3. Section 1.3 and 1.4 outlines the authorities under which resources are subject to.

3) Previous Department Comments on 2008 draft EAFB INRMP. In the July 15, 2008 Department comment letter, the Department recommended the following: an evaluation summarizing the effectiveness of the original 2002 INRMP goals and objectives for biological resources; additional information regarding potential environmental contamination issues; information on how EAFB will manage environmental contaminants to avoid or minimize impacts to migratory birds and special status species; and, a goal statement for migratory bird management. The Department is unclear if these recommendations were implemented into the final INRMP. It does not appear that the 2014 executive draft INRMP includes these items. The Department is still recommending that these elements be included into the INRMP, in addition to an evaluation summarizing the effectiveness of the 2008 INRMP goals and objectives for biological resources.

> **Response:** An evaluation of the 2008 INRMP goals and objectives was partially completed (available upon request). The analysis showed that goals 2, 3, 7, 9, 11 and objectives 2.1, 2.2, 3.1, 7.1, 9.1, 11.1 were met. Other goals and objectives were met, but status was not determined. We agree that this is a useful process and plan to engage in annual reviews with our partners with the implementation of the 2015 INRMP update. Environmental contaminants are managed by the Environmental Restoration Program (ERP) and are not under the purview of this document. ERP point of contacts can be provided.

4) Funding. The SAIA requires that Department of Defense facilities specify the natural resource goals and objectives for 5-year cycles. INRMPs are required to specify timeframes for acting on the objectives and provide a budget that reflects the monetary resources dedicated to fulfilling the objectives. Although, in the beginning of Section 7, the annual INRMP review verifies that all must-fund projects and activities have been budgeted for and implementation is on schedule, we do not know if this information is in the executive draft INRMP because the Department only has three sections of the INRMP to review. In the information that was provided to the Department to review, it does not appear that must-fund projects are defined or identified and as such, the Department is not clear what projects would be funded and when the projects would be implemented. If not already included, the Department recommends the following information on funding be incorporated into the INRMP: provide the status of each objective and how it ranks for funding; include a prioritization table that clearly identified the projects that must be funded and projects that, although warranted, would not likely receive funding; identify which projects would be implemented within the first 5-year period, and include a schedule and budget for implementation; and, a summary of projects completed and not completed from the last implemented INRMP.

> **Response:** Management goals, objectives, and associated projects are outlined in Section 8.0 (p. 98). Section 10.0 (p. 110) outlines the annual work plan programmed for funding and prioritized

projects. The priority score is explained in the opening paragraphs on page 110. Generally scores above 12 get funded annually. The INRMP is a public document thus information on budget will not be included. During annual reviews, agency cooperators will be given print-outs showing project level funding and threatened and endangered species expenditures to review and discuss. Adjustments to the work plan will be made annually to accommodate the dynamic nature of natural resource management as dictated by available personnel and resources.

5) Current Vegetative Cover. A list of plants found on EAFB was not provided to the Department. The Department is requesting that this document be provided to us for review. The Department recommends that floristic, alliance- and/or association-based mapping and vegetation impact assessments be conducted on EAFB. The Department utilizes the vegetation classification system found in the Manual of California Vegetation, Second Edition, and we recommend its use to inform any vegetation mapping and assessment (Sawyer et al. 2009).

Response: Extensive mapping has been conducted on Edwards. See Appendix B, Figures (p. 146-148). Also, see Appendix C, Tables (p. 170 and 202) for the list of plants found on EAFB. The Air Force welcomes further discussion of what a "vegetation impact assessment and association-based mapping" might look like. We have not used the MCV vegetation classification system, but we have used a variety of other vegetation classification systems including the NRCS plant associations and remote-sensing (Landsat) based plant communities. We classify vegetation communities where we have habitat quality assessment plots including Joshua Tree Woodland, Creosote Bush Scrub, Halophytic Saltbush Scrub, Xerophytic Saltbush Scrub, and Mesquite Woodland.

6) Joshua Tree Woodland. This section refers to a Jones and Stokes study conducted in 2008; the Department requests a copy of this report to inform our evaluation and any comments or recommendations. This section also states, "The only difference between scrub and woodland is the presence of the trees in sufficient density to visually become woodland, which is defined on EAFB as 10 trees per acre". The Department recommends that the INRMP reference where this definition of woodlands comes from. Additionally, the Department recommends using the association-based classifications found in the Manual of California Vegetation, Second Edition, for the most technically accurate vegetation description.

Response: Text was changed to "Joshua trees generally occur in coarse sands, very fine silts, gravel, or sandy loams on gentle alluvial fans, ridges, or gentle to moderate slopes (Sawyer, Keeler-Wolf, and Evens, 2009). The largest expanse of Joshua tree woodlands on base occur on the PIRA (Jones and Stokes 2008). Joshua tree woodland has an open to intermittent canopy with an open to intermittent shrub layer where Joshua trees are evenly distributed with equal to or over 1% cover (Sawyer, Keeler-Wolf, and Evens, 2009). Edwards AFB, however, defines Joshua tree woodlands as areas containing at least 10 trees per acre. The main understory shrub vegetation on Edwards AFB is saltbush or creosote bush. Annual plant diversity in this community is normally high (Jones and Stokes 2008). Guilds of wildlife species are specifically attracted to Joshua trees. These vary from insects, such as pollinators, to reptiles and many species of birds." We added this citation: Sawyer, J., Keeler-Wolf, T. and J. Evens. 2009. A Manual of California Vegetation. 2nd Edition. California Native Plant Society.

7) Rock outcrops/Abandoned buildings and Cave/Mines. The Department recommends that this section reference any bat species known from the area and highlight the importance of these areas for bats. Of special interest is the State candidate for threatened species, the Townsend's big-eared bat. The seasonal use of certain habitat in the area (e.g., rock outcrops, caves, abandoned buildings, and mines) for breeding

and the rearing of dependent young (creche site use) is critical to the survival of this species. Female bats of this species typically have only one young per year. The Department recommends surveying for this species and documenting occurrences on the base, so that protective measures can be implemented.

> **Response:** Townsend's big-eared bat is discussed in Section 2.3.4; conservation and management in Goal 11, p. 102. See Section 7.1, Bats, for a discussion of the mid-1990's bat surveys. An additional bat survey was completed in 2014 and was not extensively incorporated into the INRMP as the report was not finished until 2015 (report is provided for review). Townsend's big-eared bat was not detected during targeted 2014 surveys and thus it was not included.

8) Fish and Wildlife. The Department requests the Table mentioned to inform our evaluation and any comments or recommendations. Additionally, please provide copies of the referenced studies to the Department: Pratt, 2000; Miller and Payne, 2000; TetraTech, 2009; Unknown, 2006; and AMEC Earth and Environmental, 2008.

> **Response:** The referenced table is in Appendix C, Tables, p. 181, 193, and 203) and updated references can be found in Section 11.1, Standard References.

9) Insects and Arthropods. This section states that several new species and several range expansions were documented on EAFB. The Department recommends the INRMP include maps and more information about where these species occur on EAFB.

> **Response:** Management goals/objectives/projects were created to target these populations (see p. 113) Management of Terrestrial invertebrates. Though terrestrial invertebrates are important, impacts from Air Force activities are believed to be limited. Funds covering invertebrates were received in 2015, but targeted only aquatic invertebrates.

10) Mammals. The Department requests that EAFB provide maps and more details regarding bat roosts, including species use, roost type, and frequency of use, so appropriate management and protection can be identified for these areas. The Department recommends this section be expanded to include a threats analysis and impact assessment for potential and/or actual activity resulting in roost disturbance. The Department also recommends that all known bat species in the area be listed including how the area is used by each species.

> **Response:** The Wilson 2014 Bat Report is available for review. The only threat identified includes building demolition. Less than five buildings are currently used by bats, and only 1 on a regular and reoccurring basis during the day and night (though breeding was not detected). The known vertical mine shafts have not been surveyed due to time and personnel constraints.

11) Burrowing owls. "In the Main Base area, construction projects and pest management activities (e.g., control (removal) of ground squirrels and filling in their burrows) may result in a loss of prey and habitat. Occasionally, fire department personnel have entered the Burrowing Owl Management Area to suppress spot fires from the annual 4th of July fireworks display." The Department recommends that burrowing owl occupied habitat be clearly identified by providing a map·in the INRMP. Specific management measures need to be identified for burrowing owl inhabited areas to prevent impacts to owls. Identification of areas where pest management is not necessary for Mission Critical activities is also recommended. Additionally, the Department recommends the INRMP identify what measures are taken to avoid or mitigate impacts to owls during normal base activities. It is advised to avoid the use of rodenticide on EAFB as several studies have documented secondary poisoning as a major threat to birds of prey and mammals that eat poisoned rodents. It is recommended that areas where rodent pest control

may be necessary to ensure human health or public safety are identified, alternative control methods be taken, where appropriate, to limit the use of rodenticide.

> **Response:** Burrowing owl information is found on pp. 35, 74 with discussion of the conservation area. Appendix B, Figures, p. 151 has a Burrowing Owl Conservation Area map. The area is marked with signs. Goal 11, Objective 11.7 is specific to the burrowing owl. Pest Management is discussed in Section 7.11, p. 87 and references the Pest Management Plan, Tab 5). All work orders are reviewed by Environmental where minimization and avoidance measures for Burrowing Owl would be addressed. Specific avoidance and minimization measures for species of concern are not currently addressed in the INRMP, but are included in base permitting actions when warranted: 332 (Work Order), 813 (NEPA compliance), or Dig Permit.

12) Threatened and Endangered Species and Species of Concern. The Department is requesting that the INRMP include maps for all rare, threatened and endangered species documented on EAFB.

> **Response:** See Appendix B, Figures and Appendix C, Tables. The INRMP is a public document thus any locations presented in the INRMP can be seen by the general public.

13) California Species of Concern, Flora. This section leaves out numerous plant species, observed on EAFB or that only occur on EAFB as identified in the California Natural Diversity Database (CNDDB) (CDFW, 2014). The Department recommends the INRMP include a write-up of all rare plants, including Lancaster milk-vetch, pygmy poppy, Mojave spineflower, crowned onion, Red Rock poppy, sagebrush loeflingia, slender nemacladus, Coves' cassia, golden goodmania, and any other species that are known to occur, or may occur, on EAFB. The Department recommends including an analysis in this section that included the statement that Lancaster milkvetch is only documented in five locations in California, all of which are on EAFB. Of the five locations reported on EAFB, two are likely duplicate reports. On June 18, 2014, Department staff (Kelly Schmoker, Senior Environmental Scientist, [specialist]), collected and verified with Andy Sanders (University of California, Riverside) that one population of approximately 37 individuals is still extant on EAFB. The other two locations, as well as other potentially suitable habitat, needs be comprehensively surveyed as this species is extremely rare and its continued existence is dependent upon EAFB management actions. A sixth occurrence of this species reported from Coachella Valley listed in the CNDDB, is a misidentification (personal communication, Andy Sanders). The Department strongly encourages management for this species which is extremely rare and at severe risk of extirpation in California.

> **Response:** See Appendix B, Figures, p. 146-148 and Appendix C, Tables, p. 170 and 202 and see pages 25-28, 34-35, and 70-73. We added clarification and citations for Lancaster milkvetch (see p. 72).

14) Wetlands and Floodplains, Piute Ponds Complex. As stated, "Due to the importance and complexity of the Piute Ponds Complex area, a specific component plan (Piute Ponds Complex Management Plan) is incorporated into this INRMP by reference (Appendix XX)." Please provide the Department this referenced document for review.

> **Response:** The Piute Ponds Management Plan is Tab 1.

15) Hunting, fishing, trapping program organization and management. The Department recommends that this section be expanded to include an outline of what mosquito and other disease vector control methods are being utilized or implemented at EAFB.

Response: See Tab 5 for the Installation Pest Management Plan. Pest control is under the management of the Pest Management Shop, not the Natural Resource Manager. The Pest Management Shop coordinates activities through the Natural Resource Manager via the Work Order Process. The Natural Resource Manager also reviews and provides comments on the Pest Management Plan when it is updated.

16) Tri-colored Blackbirds. The INRMP identifies the need to manage tri-colored blackbirds and five (5) objectives are identified in Section 8 to develop and conserve tri-colored blackbird breeding habitat on EAFB. In addition to the proposed objectives, the Department recommends that EAFB restrict the thinning and removal of emergent vegetation (e.g., cattails, etc.) in the fishing pond (Branch Memorial Park Pond) where tri-colored blackbirds are known to nest. The small linear strips of remnant vegetation are not preferred nesting habitat for the species. The Department strongly recommends delineating zones where vegetation would be left in sufficient patches to allow successful tri-colored blackbird breeding, nesting, and fledging, as well as only clearing areas outside of this zone during the non-breeding season.

Response: Proper consideration and protection of tri-colored blackbird breeding habitat will occur in zones and patches, not strips. This management activity is covered by existing objectives (Objective 11.5, p. 102) and an annual work plan (see p. 111, project Blackbird). Additionally, all Air Force activity complies with federal law (i.e. Migratory Bird Treaty Act avoidance of nesting season). In order to preserve and maintain Branch Pond, it must also be maintained as a recreational fishing pond with consideration for Federal and State water conservation initiatives. Use of Branch Pond in 2015 by an estimated 1000 nesting tri-colored blackbirds is evidence that multiple-use management has been successful.

17) Aquatic Invertebrates. As stated in INRMP, "Several historical surveys on aquatic invertebrates note concerns and specify recommendations to improve management of this sensitive ecosystem. Certain base activities and procedures are deemed harmful to the fairy shrimp populations and to the playas and pools. Among these are vehicles on the lake beds which crush eggs and break down soil structure, the "biodegradable petroleum product" which is used to mark runways and appears to hamper fairy shrimp populations, and the inflow of gravel and other elements from areas of concentrated base activities along the flight line which perturb water chemistry and change soil structure. Measures could be taken to reduce the impact of these activities (Branchiopod Research Group, 1993)." The Department recommends that the INRMP identify specific measures that EAFB personnel would undertake to prevent impacts to fairy shrimp species. The Department also recommends a comprehensive fairy shrimp survey and mapping effort including maps in the INRMP that identify which fairy shrimp species are found in which dry lakes.

Response: During the environmental impact analysis process (EIAP) review of base projects, the Natural Resource Manager attempts to deal with impacts to sensitive and at-risk species. Because none of the fairy shrimp are on any “species of concern” list, they are not a high priority for protection per AFI 32-7064. Despite this fact, several existing goals, objectives, and projects that address the important areas of aquatic invertebrate management (see Goal 17, p. 104).

Projects focused on invertebrates funded in 2015 included “Understanding availability of aquatic and terrestrial invertebrate prey for tricolored blackbirds at Piute Ponds and Branch Pond areas”, “Aquatic invertebrate survey, 2015, at Edwards AFB, California”, and “Invertebrate and bird habitat protection.”

18) Conservation Law Enforcement. As stated in the INRMP, "the CDFW also has authority to enforce state and federal laws on Edwards AFB." The Department is requesting an expansion on this section

including incorporation of what enforcement coordination would likely occur with the Department and what would trigger Department notification of potential activities.

> **Response:** Edwards AFB is currently working with CDFW Law Enforcement to update and implement a Memorandum of Agreement for FY16. Funds are available annually to support outside law enforcement support for Edwards AFB.

19) Mohave ground squirrel. The INRMP identifies the need to manage Mohave ground squirrel (MGS) and two (2) objectives are identified in Section 8 to conserve and manage MGS. The objectives include (1) Monitor population at five- year intervals to determine long-term trends, and (2) evaluate threat of round tailed ground squirrels to MGS. However, the discussion on MGS in Section 7 is currently incomplete, and the Department cannot provide specific comments to the current management plans for the species. The Department does recognize that MGS population monitoring has been conducted on EAFB since the late 1980s as stated in the executive draft INRMP. The INRMP also states that a new survey protocol with two different sampling techniques was evaluated for MGS on EAFB after the 2009 surveys were completed to determine occupancy and density across all survey sites. The INRMP does not state what sampling techniques are used or if they are to be used in the long-term population monitoring that would occur every five years. As such, the Department cannot advise on whether five-year intervals would be adequate for determining long-term trends with unknown methodologies. As stated in the INRMP, "A goal in the 2008 INRMP for 2011 was to conduct a population viability analysis of our MGS populations based on years of baseline inventories." The Department recommends the INRMP provide the status of the 2008 goal for MGS.

> **Response:** Edwards Air Force Base is a member of the Mohave Ground Squirrel Technical Advisory Group (TAG). Monitoring and sampling techniques are expected to follow TAG recommendations to the extent practicable. A project is scheduled for FY18 to determine current occupancy status of previously known locations and to determine whether round-tailed ground squirrels are present on the installation.

20) As stated in the INRMP, "The desert tortoise management program includes implementation of the Edwards Air Force Base Revegetation Plan (AFFTC, 1994c)". The Department requests a copy of this EAFB Revegetation Plan, and, as part of this document, indicate specifically what measures from the EAFB Revegetation Plan are proposed to be implemented as part of the Desert Tortoise Management program.

> **Response:** The 1994 Revegetation Plans are available. Habitat restoration funded by ERP occurs as required by Biological Opinion. Restoration techniques include irrigation (Just Add Water), planting seedlings, and seeding/imprinting.

21) Critical Habitat. The Department requests that the fire history data be included for review in this section. The impacts of fire, controlled or uncontrolled burns, shape critical habitat and plant and animal species in the area. The Department recommends that a fire monitoring protocol is established in areas with critical habitat.

> **Response:** See Appendix B, Figures, p. 161-162. Additional fire information related to critical habitat is provided in the Wildland Fire Management Plan (Tab 3) and Fire Section, 7.9, p. 85. The primary mission-related cause of fire (flares) is closely monitored and accounted for under existing Biological Opinions.

22) Woodlands Management Issues and Concerns. This section references an "Edwards Air Force Base Revegetation Plan" and a "mesquite bosque management plan". Please provide these plans to the

Department for review. The Department recommends that, when possible, the INRMP reference specific measures within a plan rather than referencing a plan as a whole. This will facilitate quicker and easier review of any reference documents.

> **Response:** The 1994 Revegetation Plan is available. The current version of the INRMP does not reference a "*mesquite bosque management plan*" and states the following: "*Environmental Management encourages conservation of Joshua trees wherever feasible. The Edwards Air Force Base Revegetation Plan (AFFTC, 1994c) recommends replacement or replanting Joshua trees to maintain the diversity of natural habitats on base. Joshua tree restoration efforts will follow the recommendations in the Edwards Air Force Base Revegetation Plan.*"

23) Management of Sensitive Species. Both Sections 5 and 7 omitted Lancaster milkvetch, Mojave spineflower, golden goodmania, pygmy poppy, crowned onion, Red Rock poppy, sagebrush loeflingia, slender nemacladus, Coves' cassia, and golden goodmania. The Department recommends adding these, and any other rare plant species that may occur on EAFB, into the INRMP. The referenced EAFB Revegetation Plan (1994) is over 20 years old. Given the discoveries of new populations of rare plants, newer locations of sensitive resources, and the discovery of new species documented on EAFB, the Department recommends that this plan be updated. The Department is also recommending that the INRMP include mapping that provides locations of all sensitive plant species found on EAFB.

> **Response:** See comment 13 for rare plants and comment 20 for revegetation plan.

24) Desert Cymopterus. As stated in the INRMP, "The conservation strategies for desert cymopterus are reviewed in Section 8.0 Management Goals and Objectives and 10.0 Work Plans." The Department recommends that Section 8 clearly include each sensitive plant species that have planned management actions. Currently it does not appear that this species is actually included in the goals and objectives of Section 8. Please note, the Department was not provided Section 10 and can't provide comments at this time. Section 8 references a desert cymopterus training program, the Department requests a copy of the training program to inform our evaluation of desert cymopterus goals and objectives, and any comments or recommendations. This section also states, "EM has developed a conservation strategy for desert cymopterus, an Edwards AFB plant species of interest, for actions that may occur in areas of known populations." The Department also requests a copy of this conservation strategy.

> **Response:** See comment 13. The current version of the INRMP does not reference a "*desert cymopterus training program.*" However, Section 7, p. 73 states that "*Additional management strategies will be developed based on the results of future inventories and studies*." When a project is occurring in an area near desert cymopterus where damage could potentially occur, the area is flagged when possible and personnel are informed to avoid the area.

25) Barstow Woolly Sunflower. This section is currently incomplete, and the Department cannot provide specific comments to the current management plans for the species. The Department recommends that relevant information for this section be included so the Department can provide feedback.

> **Response:** See comment 13.

26) Alkali Mariposa Lily. As stated in the INRMP, "Creation of an Edwards AFB Lily Conservation Area may benefit the species. Conservation of this species could also be added to Readiness and Environmental Protection Integration (REPI) program goals for future land acquisition consideration. Proposed management activity that will support conservation of this species is reviewed in Section 8.0 Management Goals and Objectives and 10.0 Work Plans." The Department supports the creation of a Lily Conservation Area on EAFB and would be available to provide input on conservation efforts and

strategies, and supports the addition of the species to the REPI Program. However, the Department is unclear if this species is also included Section 8 management goals and objectives. Please note, the Department was not provided Section 10, and cannot provide comments. The Department recommends that this section address changes in local surface hydrology, such as culverts and streets, as a major threat to alkali mariposa lily. Improperly sized and placed culverts, as well as grading that changes the local drainage topography, appear to be impacting one of the healthier alkali mariposa lily populations on base. Specifically, a culvert has concentrated runoff and has resulted into a channel being cut through the alkali flat area, which could, over the long term, degrade the alkali mariposa lily population at this site. As the channel deepens and widens, it could remove alkali mariposa lily plants. The Department recommends that this site is monitored, and if possible, restored back to the original hydrology to preserve the hydrology of this site.

Response: See comment 13 and 27 for the latest rare plant updates and maps. Discussion of an Edwards AFB Lily Conservation Area is not included in the current version of the INRMP. Section G of the Piute Ponds Complex Management Plan (p. 239) states that "*The alkali sink and undisturbed pan and dune habitat will be managed for little to no impact which will protect important upland areas including the alkali mariposa lily populations."* A 2015 study of *E. rosamondense* (in progress) includes information about Alkali Mariposa Lily.

27) *Eriastrum rosamondense* D. Gowen. This section is currently incomplete. No information is provided about direct impacts for potential threats and the Department cannot provide specific comments to the current management plans for the species. The Department recommends that relevant information for this section be included so the Department can provide feedback.

Response: See comment 13.

28) Lancaster Milkvetch. As already discussed in this letter, this species was left out of the rare species assessment in both Section 5 ahd 7, although it is known to occur on EAFB. The Department recommends that these sections add this species and include a threats analysis and impact assessment. The Department also recommends surveying for this species and documenting occurrences on the base, so that appropriate management and protective measures can be implemented.

Response: See comment 13.

29) Pygmy Poppy. In Kern and Los Angeles counties, this species is typically found on sandy soils in mixed Mojave scrub, saltbush scrub, juniper woodlands and Joshua Tree Woodlands. Clusters of small white flowers bloom between March and June. There are 16 reported occurrences of this species in Kern County, and 17 occurrences (post 1970) reported for Los Angeles County. This species was observed in 1995 at Edwards AFB (LWRP, 2004). This species was left out of the rare species assessment in both Section 5 and 7, although it is known to occur on EAFB. The Department recommends that these sections add this species and include a threats analysis and impact assessment. The Department also recommends surveying for this species and documenting occurrences on the base, so that protective measures can be implemented.

Response: See comment 13.

30) Mojave spineflower. This species was left out of the rare species assessment in both Section 5 and 7, although it is known to occur on EAFB. This species was observed in 1995 at EAFB near Rosamond Dry Lake (LWRP 2004). The Department recommends that these sections add this species and include a threats analysis and impact assessment. The Department also recommends surveying for this species and documenting occurrences on the base, so that protective measures can be implemented.

Response: See comment 13.

31) Crowned onion. This species was left out of the rare species assessment in both Section 5 and 7, although it is known to occur on EAFB. This species was observed 1977 at EAFB (LWRP, 2004). The Department recommends that these sections be expanded to add this species and include a threats analysis and impact assessment. The Department also recommends surveying for this species and documenting occurrences on the base, so that protective measures can be implemented.

Response: See comment 13.

32) Other Special Status Plant Species. Red Rock poppy, sagebrush loeflingia, slender nemacladus, Coves' cassia, and golden goodmania were left out of the rare species assessment in both Section 5 and 7. The Department recommends that these sections be expanded to add these species, including threat analyses and impact assessments for each one, as well as any other rare plant species that may occur on EAFB. The Department also recommends surveying for these species and documenting occurrences on the base, so that appropriate management and protective measures can be implemented.

Response: See comment 13.

33) Wetland Protection. Piute Ponds Complex. Avian Use. The Department recommends that this section be expanded to include greater detail, including relevant statistics and figures. This section includes one methodology for determining wetland health, habitat use, and waterfowl population density, which may not accurately evaluate these conditions. This methodology includes collecting harvest data from the hunting season on a regular basis, and relies on hunter success on opening day of duck season, as the primary measure of how the resident waterfowl utilize Piute Ponds Complex. Hunter numbers and averages are often elevated during opening day of duck season. At that time of year, migratory ducks have arrived and mixed with resident waterfowl. Resident waterfowl numbers and site use are more accurately assessed in June and July. The Department recommends that waterfowl and associated habitat evaluations occur at that time.

Response: See Tab 1, Piute Ponds Management Plan and Section 2.3.5 Wetlands. Edwards AFB has a three-year avian species study in progress which is looking at focal species and sensitive species within the Piute Ponds Complex. The hunter data provides useful information at no additional cost to the Air Force. We also have information about species observed at Piute Ponds by birders over the entire year. Sightings by birders are posted on eBird: http://ebird.org/ . Birders also participate in the Audubon Christmas bird count: http://www.audubon.org/conservation/science/christmas-bird-count. There is also a website (not officially affiliated with the Air Force) where information about Piute Ponds is shared: http://www.piuteponds.com/ . Migratory bird surveys are expensive and difficult to obtain funding for based on the Air Force scoring model; however, we will review the potential for this in the future.

34) Vegetation. The Department recommends expanding this section to include a vegetation management plan for bulrush *(Schoenoplectus* spp). Wetlands provide critical habitat for many plant and animal species. In particular, bulrush plants are vital food sources for many native waterfowl, and other species.

Response: See Tab 1, Piute Ponds Management Plan.

35) Water. The Department would like further details and clarification regarding the statement *"The overall health of the Piute ponds complex is considered good although some* more *restoration is needed"*. The section describes in some detail the restoration activity that has and/or is currently occurring. The

Department recommends further articulation as to why more restoration is needed, including the primary restoration objectives.

> **Response:** See Tab 1, Piute Ponds Management Plan. See Section 7.6, p. 77, "Restoration work at Piute Ponds is intended to develop several areas to provide more capacity to take water from Los Angeles County Sanitation District 14, provide the base more opportunities to move or hold water off the lakebed when necessary for operational missions, and enhance ecosystem health and function. This restoration work helps us to meet the goals identified in the Piute Ponds Complex Management Plan."

36) Golf Course Pond. The Department recommends the golf course located at EAFB be included for monitoring and evaluation of its impacts on native wildlife. The golf course provides optimal habitat for many species and the pond is a vital water source due to limited water/ponds on base. If a Golf Course Management Plan exists, the Department requests a copy to inform our evaluation of the INRMP. It would be potentially valuable to determine what, if any, requirements or provisions relating to wildlife or wildlife management would be outlined in a Golf Course Management Plan.

> **Response:** Unfortunately, golf course management plans cannot be funded with Environmental Quality (EQ) funding, so Natural Resource Managers will work with responsible parties to ensure consistency with the INRMP. No GEM currently exists. See Goal 2, p. 99.

37) Grounds Maintenance. This section appears to be incomplete. No information was provided for "4.4.2 Outdoor Recreation and Green Space". The grounds maintenance practices and techniques utilized at EAFB have the potential to directly impact the surrounding habitat, native wildlife and plant species. The Department requests that more information be provided in this section.

> **Response:** See Section 7.7, p. 83. See Goal 2, p. 99 amd Goal 18, p. 104. See Annual Work Plan, p. 113, Project Urban Landscapes has been programmed for funding in FY17.

38) Integrated Pest Management Program, Predator Control and Other Pest. As stated in the INRMP, "*Security Forces Wildlife Control assists pest management personnel by removing other wildlife (e.g., snakes, birds) and stray or feral animals (e.g., dogs and cats) from housing and facilities on Main Base, North Base, and South Base*." Although, it appears that this section does not include information regarding where the nuisance animals are deposited. The Department requests clarification and further details in this section.

> **Response:** See Tab 5, Integrated Pest Management Strategies, which states: "*Written permission to relocate wildlife species must be received prior to trapping activities. For further information, contact the Department of Fish and Game*." All contact with CDFW should occur through the Natural Resource Office. See Section 7.11, p. 89 and 90. "Written permission to relocate wildlife species must be received from the Natural Resource Manager prior to trapping activities."

39) Goals and Objectives Section 8 Comments**.** Currently, Objective O.)(i.) states, "*Conduct surveys for species receiving increased regulatory attention or for which little is known such as Eriastrum rosamondense and popcorn flower species including Plagiobothrys Jeptocladus, Plagiobothrys canescens var. catalinensis (rare), Plagiobothrys bracteatus."* These popcorn flower species were left out of the rare species assessment in both Section 5 and 7. The Department recommends that these sections add the listed popcorn flower species if these species are likely to occur on EAFB and their status warrants special attention, including threat analyses and impact assessments for each one. The Department recommends prioritizing surveys for the rare plant species which are known to occur on EAFB but little is

known, including but not limited to, Lancaster milk-vetch, *Eriastrum rosamondense,* and other rare species Department recommended for inclusion to the INRMP.

Response: See responses to comments 13 and 43.

40) The Department recommends the following Goals and Objectives to be included: Under Natural Resource Program Management, add: Quarterly coordination meetings with resource agencies, to inform agencies of future projects, planning, on-going resource assessment, and general coordination for Rare, Threatened and Endangered species.

Response: See response to comment 47. If annual meetings are not sufficient, more frequent meetings may be considered.

41) Under Fish, Wildlife, and Habitat Management, add: Inventory non-essential roads, retire them from vehicle use, and restore to native habitat. Do not allow off-road vehicle use in Buck Thorn Dry Lake, or other sensitive habitat areas where rare plants occur.

Response: A Road Closure Plan is specifically referenced in Goal 4, Objective 4.2, p. 100. It is not mentioned elsewhere in the document, thus we will review the Road Closure Plan and consider revision of current projects to align with CDFW comments.

42) The Department recommends the following Goals and Objectives to be included: Under Fish, Wildlife, and Habitat Management, add: Survey EAFB for Rare, Threatened and Endangered plant species and develop a management and conservation strategy to protect these populations.

Response: See Goal 10 and Goal 11, pp. 101-103. We will continue to discuss this with CDFW at our next annual meeting.

43) The Department recommends the following Goals and Objectives to be included: Under Fish, Wildlife, and Habitat Management, add: In coordination with the Department, develop a conservation strategy/management plan for Lancaster milkvetch. A conservation strategy/management plan may include a monitoring program, a seed collection plan, and any other management actions or strategies for conservation of the species. The Department recommends that Lancaster milkvetch receives special attention, because the only known occurrences of this species are on EAFB.

Response: See comment 13. See Goal 11, p. 111. We will continue to discuss this with CDFW at our next annual meeting.

44) The Department recommends the following Goals and Objectives to be included: Under Fish, Wildlife, and Habitat Management, add: Update the EAFB Revegetation Plan (1994). Given the discoveries of new populations of rare plants, newer locations of sensitive resources, and the discovery of new species documented on EAFB, the Department recommends that this plan is updated to include such new information. Implementation of an outdated plan may have negative consequences for species that have since been documented on EAFB.

Response: The INRMP is the primary authority on species management concerns and avoidance/minimization measures are part of the EIAP process. When restoration is planned, updated site-specific restoration plans, using the 1994 plan as a starting point, will be created before restoration is implemented. Plans will be well-researched and use the best available information. A Comprehensive Base-Wide Habitat Restoration Plan was developed in 2012. This plan includes information about previous revegetation projects on Edwards AFB.

45) Department staff did not have definitions for many acronyms used throughout the Sections, making review of the Sections difficult. For future review of the INRMP or its Sections, the Department recommends EAFB provide a list of acronyms used with definitions.

Response: Acronym list provided under Section 12.0.

46) The Department name officially changed to California Department of Fish and Wildlife as of January 1, 2013. The Department is now referred to as "CDFW" rather than "CDFG". The Department requests the INRMP update our acronym throughout the document for accuracy.

Response: Done.

47) The Department recommends that EAFB collaborate with us on a routine basis regarding the conservation, protection, and management of fish, wildlife, native plants, and habitats necessary for biologically sustainable populations.

Response: Edwards AFB will be conducting annual meetings for INRMP review. We will continue meeting with the CDFW as often as necessary to discuss the latest information on important flora and fauna pertinent to Edwards AFB.

2016 EAFB INRMP Update – Summary of Changes: Corrections to address inaccuracies and inconsistencies in text of 2015-2019 EAFB INRMP, and to apply the new AFCEC required INRMP format.

- 2.0 Installation Profile, new Table (p. 14)
- 2.3.5 Wetlands an Floodplains, new text and reformatted pictures (pp. 36-44)
- 4.0 General Roles and Responsibilities, new Table (pp. 52-53)
- 7.0 Natural Resources Program Management, new text based on substantial comments from USFWS and CDFW (pp. 54-74)
- 7.6 Wetland Protection, new text and reformatted pictures (pp. 76-83)
- 8.0 Management Goals and Objectives, new text and renumbered (pp. 99-108)
- 9.1 Natural Resource Managemet Staffing and Implementation, new text (pp. 108-110)
- 10.0 Annual Work Plans, new text (pp. 110-115)
- 11.0 References, updated and formatted (pp. 115-123)
- 12.2 Installation Acronyms, new text (p. 124)
- Appendix B. Figures, new format with all figures in one place and in order of how they are mentioned in text. Several new figures (p. 148, 152, 160)
- Appendix C. Tables, new format with all tables in one place and in order of how they are mentioned in text. New entries in several tables (pp. 163-206)
- Appendix D. Cooperating Agencies and Public Review Process and Comments, new text with separate section for CDFW and new format (pp. 207-226)

- Appendix E. Annual Review Summary

2017 EAFB INRMP Update – Summary of Changes: Corrections to address updates, inaccuracies and inconsistencies in text of 2016 EAFB INRMP Update. Pages refer to 2017 EAFB INRMP Update.

- 2.0 Installation Profile, updated Table (p. 14)
- 2.1.1 Location and Area, updated text (p. 15)
- 2.2.3 Geology and Soils, new text (pp. 19-21)
- 2.3.2.2 Current Vegetative Cover, clarified text (p. 28)
- 2.3.4 Threatened and Endangered Species and Species of Concern, new and updated text (pp. 32-37)
- 2.3.5 Wetland and Floodplains, new text (pp. 39-45)
- 2.4.1 Natural Resource Constraints to Mission and Mission Planning, updated text (p. 46)
- 2.4.3 Current Major Impacts, updated text (pp. 48-50)
- 2.4.5 Natural Resources Needed to Support the Military Mission, updated text (p. 52)
- 4.0 General Roses and Responsibilities, clarified text in Table (p. 54)
- 5.0 Training, updated text (p. 55)
- 7.0 Natural Resources Program Management, updated text (pp. 55-56)
- 7.1 Fish and Wildlife Management, updated text (p. 57)
- 7.2 Outdoor Recreation and Public Access to Natural Resources, updated text)pp. 60-64)
- 7.3 Conservation Law Enforcement, updated text (pp. 64-65)
- 7.4 Management of Threatened and Endangered Species, Species of Concern and Habitats, updated text (pp. 65-74)
- 7.6 Wetland Protection, updated text (pp. 79-84)
- 7.9 Wildland Fire Management, updated text (pp. 86-87)
- 7.12 Bird/Wildlife Aircraft Strike Hazard, updated text (pp. 93-94)
- 7.15 Public Outreach, updated text (p. 95)
- 8.0 Management Goals and Objectives, new text and renumbered (pp. 99-104)
- 10.0 Annual Work Plans, new text in Table (pp. 112-116)
- 11.0 References, updated and formatted (pp. 116-126)

- Appendix C. Tables, new entries in several tables (pp. 196-232)
- Appendix E. Annual Review Summary (pp. 240-245)

Appendix E. Annual Review Summary

2015 Annual Report
Edwards Air Force Base
Integrated Natural Resources Management Plan (INRMP)
1 January 2015 through 31 December 2015

1 April 2016

Prepared By: Stephen Watts
412 CEG/CEVA
120 N. Rosamond Blvd, Bldg 3735, Edwards AFB, CA 93524

Topic 1: Sufficient Natural Resource Staff — Implementation Status: Green

Sufficient numbers of qualified natural resources (NR) management personnel and resources are available to oversee implementation of activities identified in the INRMP Work Plan (INRMP Section 10.0, Page 110).

In 2015, 412 CEG/CEVA personnel providing full time support for natural resources management included Ms. Wanda Deal, Mr. Mark Hagan, and Dr. Laura Hudson. Mr. Hagan retired during 2015 and was replaced by Dr. Hudson. Personnel providing part time support for natural resources management included Ms. Misty Hailstone, Mr. Wes King, Dr. Danny Reinke, and Dr. Stephen Watts. Additional natural resources support was provided by Ms. Lauren Wilson from the Travis Installation Support Team (IST). In 2015, a basic level of funding was available to complete or start all actions identified in the INRMP work plan, except for two projects. FSPM057715, Native Ecosystem Analysis, GIS Hyperspectral, was replaced by a FY14 funded project and was in progress during FY15. FSPMOS7208B5, Environmental Services, CN, Interagency Law Enforcement, was not funded because a Memorandum of Agreement with the California Department of Fish and Wildlife was not complete.

Topic 2: Significant INRMP Changes — Implementation Status: Green

Significant changes to the installation's mission requirements or its natural resources have not been identified; therefore, the current INRMP and 2016 Summary of Changes (INRMP Appendix D, Page 207) are current as to operation and effect in accordance with the Sikes Act.

The Summary of Changes tracks all minor updates made to the INRMP in 2015. No changes in the installation mission have occurred that adversely impact natural resource requirements to a degree that requires a revision to the current plan.

Topic 3: Programming and Budgeting — Implementation Status: Green

Projects identified in the INRMP have been budgeted and implementation is on schedule as summarized in the INRMP Work Plan (INRMP Section 10.0, Page 110).

The INRMP Work Plan lists the current year and four future fiscal years. The INRMP Work Plan also indicates whether the project has been programmed and is thus on schedule. The programmed project is followed by a funding score (4-24, a higher number indicates increased

likelihood of funding authorization), which indicates the funding priority of the project against all other environmental requirements. The funding cut off line for 2013 and 2014 were scores of 12 and 14, respectively. All Natural Resource projects were funded in 2015. Budget cuts and sequestration actions may affect this funding line in the future, thus actual funding is always unknown. The current priority as assessed by Edwards is management of desert tortoise.

Topic 4: Partner Coordination **Implementation Status: Green**

Coordination with the USFWS and CDFW occurred.

Agency personnel, Edwards AFB (412 CEG/CEVA), and Travis IST natural resource personnel met on 19 January 2016 to review implementation of the INRMP. Meeting Minutes (Enclosure 1) are available that capture agency priorities and concerns, which were incorporated into the INRMP and documented in the 2015 Summary of Changes (INRMP Appendix D, Page 207).

Topic 5: Plan Implementation Progress **Implementation Status: Green**

Progress towards meeting the agreed upon goals and objectives for natural resources management were completed in 2015.

Geographic Information System (GIS): A remote sensing project to collect hyperspectral imagery and light detection and ranging (LIDAR) data was conducted during 2015. The imagery and data were collected using an aerial platform during March – April 2015. Image processing and final delivery of imagery, data, and documentation were expected to be completed in early 2016. The hyperspectral imagery includes visible, near infrared, and shortwave infrared wavelengths with a 1m pixel size. LIDAR spot spacing was ~0.67m. Remote sensing data will support GIS-based modeling and analysis for threatened and endangered species, sensitive species, invasive species, ecosystem health, trend, and project planning.

Desert Tortoise: Daily ongoing management of desert tortoise was provided in 2015. Pre-surveys, field investigations, monitoring, and post-surveys were conducted to comply with terms and conditions of 23 biological opinions. Base project planning documents were reviewed to ensure that minimization measures were implemented as required to protect desert tortoise populations. Annual reports on the biological opinions were submitted to USFWS. Desert tortoise training was provided to government and contractor personnel as required. Monitoring of headstart desert tortoises continued in 2015. Support continued for the Edwards AFB desert tortoise adoption program.

Migratory Bird Treaty Act and Bird Air Strike Hazard (BASH): Bird surveys, monitoring, and investigations of displaced or injured birds were conducted as required during 2015. Annual reports and depredation permit applications were submitted to USFWS. Personnel participated in the Edwards AFB BASH working group. Airfield BASH habitat surveys are planned in 2016 and 2017.

Rare Plants: A project to identify the population distribution of rare plants, viability, and important ecological relationships was conducted in the southwestern portion of Edwards AFB in 2015. Species identified included Rosamond eriastrum (*Eriastrum rosamondense*), Alkali Mariposa Lily (*Calochortus striatus*), Sagebrush Loeflingia (*Loeflingia squarrosa*),Yellow Spinecape (*Goodmania luteola*) and Mojave Spineflower (*Chorizanthe spinosa*). Population distribution data were added to the Edwards AFB GIS.

Invasive Species: A project to identify the population distribution of invasive species and to identify best management practices for their control was conducted in 2015. The species focus was on Tamarisk (*Tamarix* spp.) and Sahara mustard (*Brassica Tournefortii)*. Many Tamarisk trees occur on base; often associated with old homesteads, and are prevalent in the Piute Ponds Complex. No Sahara mustard was identified on Edwards AFB during this survey.

Habitat Quality Analysis (HQA): A project to conduct monitoring of 12 HQA study plots assessing the health of the habitat and its ability to support endangered, threatened, rare, sensitive or keystone flora and fauna was conducted in 2015. Data were collected on species condition, species richness, relative abundance, vegetation structure, percent cover, and proportion of native and exotic plants. Established HQA transect methodology for estimating habitat quality was utilized. Data were entered into the Edwards AFB GIS.

Bird Surveys: A project to improve knowledge of aquatic and terrestrial invertebrate prey for tricolored blackbirds was conducted in 2015. A colony of tricolored blackbirds utilizes Branch Pond on Edwards AFB, and there is potential habitat at Piute Ponds. An understanding of the potential forage species and abundance around Branch Pond and Piute Ponds would assist in managing for tricolored blackbirds. A sensitive avian species project was also conducted to provide data on target avian species in riparian/wetland type habitats in 9 primary areas on Edwards AFB. Presence or absence, breeding status, abundance, times target species are present, and areas/habitat types used by target species were determined. Rare target species include tricolored blackbird, least Bell's vireo, and willow flycatcher.

Summary: Overall Rating **Implementation Status: Green**

Rating for Edwards AFB INRMP implementation and compliance is green.

The overall rating for the implementation of the Edwards AFB INRMP is green as all five topics were met with reasonable success in 2015.

Edwards Integrated Natural Resources Management Plan Annual Signature

The INRMP for Edwards Air Force Base, California fulfills the requirements of the Sikes Act (16 U.S.C. 670a *et seq.*, as amended), Department of Defense 4715.03 *Natural Resources Conservation Program*, and Air Force Instruction 32-7064 *Integrated Natural Resources Management*. By signature to this *Annual INRMP Report*, or an enclosed letter of concurrence, all parties assert concurrence with the findings of this report and the content of the updated INRMP, tracked by the *Summary of Changes* (INRMP Appendix D).

CARL E. SCHAEFER, Brig Gen, USAF
Commander, 412th Test Wing

25 APR 16
Date

Field Supervisor
U.S. Fish and Wildlife Service

Date

Regional Manager
California Department of Fish and Wildlife

Date

Enclosures:

Enclosure 1: Annual Review Meeting Minutes with Agencies, 19 January 2016

Enclosure 2: Edwards AFB Integrated Natural Resource Management Plan (INRMP), Red Line Version with Track Changes

Enclosure 3: Edwards AFB Integrated Natural Resource Management Plan (INRMP), Clean Version

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE CALIFORNIA

MEMORANDUM FOR DISTRIBUTION

FROM: 412 CEG/CEVA

SUBJECT: Meeting Minutes of the Edwards Air Force Base Integrated Natural Resources Management Plan (INRMP) Annual Review, 19 January 2016

1. Place: Building 3735, Conference Room 1

2. Time: 1000

3. Chairperson: Dr. Stephen Watts

4. Personnel Present:

Name	Organization
Ms. Wanda Deal	412 CEG/CEVA
Ms. Misty Hailstone	412 CEG/CEVA
Ms. Judy Hohman	USFWS
Dr. Laura Hudson	412 CEG/CEVA
Mr. Evan King	CDFW
Mr. Wesley King	412 CEG/CEVA
Mr. Thomas Rademacher	412 CEG/CEVA
Dr. Danny Reinke	412 CEG/CEVA
Dr. Stephen Watts	412 CEG/CEVA
Ms. Lauren Wilson	AFCEC/CZOW

5. Business:

A) Introductions

1) Personnel present at the meeting introduced themselves.

B) INRMP update overview

1) Dr. Watts presented an overview of the INRMP annual review process.

a) Information covered included a brief overview of Edwards Air Force Base (EAFB) and its mission, why EAFB has an INRMP, a description of the cooperative approach to INRMP preparation, an explanation of the annual review process, and an outline of the Annual INRMP Review Summary.

C) Responses to Comments

1) Dr. Watts went over the U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) comments and the EAFB responses to comments.

D) CDFW input

1) Mr. King indicated that he was satisfied with the responses to comments.

E) USFWS input

1) Ms. Hohman indicated that she was satisfied with the responses to comments.

F) Wrap-up

1) Dr. Watts summarized the information discussed and indicated that EAFB would implement the INRMP updates and generate the Annual INRMP Review Summary.

6. The meeting was adjourned at approximately 1400.

2016 Annual Report
Edwards Air Force Base (EAFB)
Integrated Natural Resources Management Plan (INRMP)
1 January 2016 through 31 December 2016

2 March 2017

Prepared By: Stephen Watts
412 CEG/CEVA
120 North Rosamond Boulevard, Building 3735
Edwards Air Force Base, CA 93524

Topic 1: Sufficient Natural Resource Staff — Implementation Status: Green

Sufficient numbers of qualified natural resources (NR) management personnel and resources were available to oversee implementation of activities identified in the INRMP Work Plan (2016 EAFB INRMP Update, Section 10.0, Page 110).

In 2016, 412 CEG/CEVA personnel providing full time support for natural resources management included Ms. Wanda Deal, Ms. Misty Hailstone, Dr. Laura Hudson, and Mr. Larry Zimmerman. Dr. Hudson retired during 2016 and was replaced by Mr. Zimmerman. Ms. Deal retired in 2016 and was replaced by Ms. Hailstone. Personnel providing part time support for natural resources management included Mr. Wes King, Mr. James Papin, Dr. Danny Reinke, and Dr. Stephen Watts. Additional natural resources support was provided by Ms. Lauren Wilson from the Travis Installation Support Team (IST) and Mr. Daniel Garcia from the Edwards IST. In 2016, a basic level of funding was available to complete or start all actions identified in the INRMP work plan.

Topic 2: Significant INRMP Changes — Implementation Status: Green

Significant changes to the installation's mission requirements or its natural resources have not been identified; only corrections to address updates, inaccuracies and inconsistencies in the text of the 2016 EAFB INRMP Update were made; therefore, the 2017 EAFB INRMP Update and 2017 Summary of Changes (2017 EAFB INRMP Update, Appendix D, Page 230) are current as to operation and effect in accordance with the Sikes Act.

The Summary of Changes tracks all minor updates made to the 2016 EAFB INRMP Update in 2016. No changes in the installation mission have occurred that adversely impact natural resource requirements to a degree that requires a revision to the current plan.

Topic 3: Programming and Budgeting — Implementation Status: Green

Projects identified in the INRMP were budgeted and implementation is on schedule as summarized in the INRMP Work Plan (2016 EAFB INRMP Update, Section 10.0, Page 110).

The INRMP Work Plan lists fiscal years 2015-2020. The INRMP Work Plan also indicates whether the project has been programmed and is thus on schedule. The programmed project is

followed by a funding score (4-24, a higher number indicates increased likelihood of funding authorization), which indicates the funding priority of the project against all other environmental requirements. The funding cut off line for 2013 and 2014 were scores of 12 and 14, respectively. All Natural Resource projects were funded in 2015 and 2016. Budget cuts and sequestration actions may affect this funding line in the future, thus actual funding is always unknown. The current priority as assessed by Edwards is management of desert tortoise.

Topic 4: Partner Coordination **Implementation Status: Green**

Coordination with the USFWS and CDFW occurred.

Agency personnel, Edwards AFB (412 CEG/CEVA), and Edwards Installation Support Team (IST) natural resource personnel met via teleconference on 14 March 2017 to review implementation of the INRMP. Meeting Minutes that capture agency priorities and concerns were incorporated into the 2017 EAFB INRMP Update and documented in the 2017 Summary of Changes (2017 EAFB INRMP Update, Appendix D, Page 240).

Topic 5: Plan Implementation Progress **Implementation Status: Green**

Progress towards meeting the agreed upon goals and objectives for natural resources management were completed in 2016.

Desert Tortoise: Daily ongoing management of desert tortoise was provided in 2016. Pre-surveys, field investigations, monitoring, and post-surveys were conducted to comply with terms and conditions of the basewide biological opinion. Base project planning documents were reviewed to ensure that minimization measures were implemented as required to protect desert tortoise populations and their habitat. An annual report on the basewide biological opinion were submitted to USFWS. Desert tortoise training and educational outreach was provided to government personnel, contractor personnel, and the public as required. Monitoring of headstart desert tortoises continued in 2016. Support continued for the Edwards AFB desert tortoise adoption program.

Migratory Bird Treaty Act and Bird Aircraft Strike Hazard (BASH): Bird surveys, monitoring, and investigations of displaced or injured birds were conducted as required during 2016. Annual reports and depredation permit applications were submitted to USFWS. Personnel participated in the Edwards AFB BASH working group. Airfield BASH habitat surveys were conducted in 2016 and planned for 2017. A project to remove large tamarisk (*Tamarix* spp.) trees near the flightline was also conducted in 2016 to eliminate a potential BASH issue. The trees were cut and chipped, and the stumps were treated with herbicide to preven regrowth.

Invasive Species: A project to identify invasive plant species utilizing helicopter flight reconnaissance over portions of the northeast, northwest, and Piute Ponds areas of the base was conducted in 2016. The data confirm that overall levels of invasive plant species are low on Edwards AFB. Populations of Sahara mustard (*Brassica tournefortii*) were identified along highway 395. Relatively low density plumes of Russian thistle (*Salsola* spp.) were identified spreading from off base in the northwest corner of the base and Piute Ponds area. Due to the presence of water and off base vectors, the Piute Ponds area has localized populations of tamarisk, perennial pepperweed (*Lepidium latifolium*), arundo (*Arundo donax*), five-hook bassia (*Bassia hyssopifolia*), bull thistle (*Cirsium vulgare*), and Russian knapweed (*Acroptilon repens*). Plans are in development to treat all of these species; some treatments were initiated in

2016. Native willow trees were planted at Piute Ponds to facilitate a type change from tamarisk to willow; this is expected to take many years to complete.

Bird Surveys: A project to improve knowledge of aquatic and terrestrial invertebrate prey for tricolored blackbirds was completed in 2016. Although tricolored blackbirds have regularly nested at Branch Pond, nesting was unsuccessful there in 2016. There is also potential tricolored blackbird habitat at Piute Ponds. An understanding of the type and abundance of species foraged by tricolored blackbirds around Branch Pond and Piute Ponds will assist in managing habitat for tricolored blackbirds. A sensitive avian species project was continued in 2016 to provide data on target avian species in riparian/wetland type habitats in 9 primary areas on Edwards AFB. Presence or absence, breeding status, abundance, times target species are present, and areas/habitat types used by target species were determined. Rare target avian species include tricolored blackbird, least Bell's vireo, and willow flycatcher.

Management of Hunting and Fishing Program: A project to revise *EAFBI 32-8, Management of Hunting, Fishing and Volunteer Program, 2003,* was completed in 2016 with publication of *EAFBI 32-7064, Management of Hunting and Fishing Program*. Responsibilities, Sikes Act permit fee schedule, hunting provisions and rules were updated.

Conservation Law Enforcement: A project to conduct conservation law enforcement was implemented during 2016. A memorandum of understanding with California Department of Fish and Wildlife was completed during 2016 and funding was provided to allow Game Wardens to conduct regular patrols, especially at Piute Ponds during waterfowld hunting days. Other areas, including upland game hunting, fishing, and off road vehicle areas will be patrolled.

Summary: Overall Rating **Implementation Status: Green**

Rating for Edwards AFB INRMP implementation and compliance is green.

The overall rating for the implementation of the Edwards AFB INRMP is green as all five topics were met with reasonable success in 2016.

Edwards Integrated Natural Resources Management Plan Annual Signature

The INRMP for Edwards Air Force Base, California fulfills the requirements of the Sikes Act (16 U.S.C. 670a *et seq*., as amended), Department of Defense 4715.03 *Natural Resources Conservation Program*, and Air Force Instruction 32-7064 *Integrated Natural Resources Management*. By signature to this *Annual INRMP Report*, or an enclosed letter of concurrence, all parties assert concurrence with the findings of this report and the content of the updated INRMP, tracked by the *Summary of Changes* (2017 EAFB INRMP Update, Appendix D).

31 May 2017

FOR CARL E. SCHAEFER, Brig Gen, USAF — Date

Commander, 412th Test Wing

PAUL A MEYER, Colonel, USAF
IMA to the 412TW/CV

_____ _____

Field Supervisor — Date

U.S. Fish and Wildlife Service

_____ _____

Regional Manager — Date

California Department of Fish and Wildlife

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

14 March 2017

MEMORANDUM FOR DISTRIBUTION

FROM: 412 CEG/CEVA
Environmental Management
120 North Rosamond Boulevard
Building 3735, Suite A
Edwards Air Force Base CA 93524-8600

SUBJECT: Meeting Minutes of the 2016 Edwards Air Force Base (EAFB) Integrated Natural Resources Management Plan (INRMP) Annual Review, 14 March 2017

1. Place: Building 3735, Conference Room 1, Teleconference

2. Time: 0900 hours

3. Chairperson: Mr. Larry Zimmerman

4. Personnel Present:

Name	Organization
Mr. Thomas Rademacher	412 CEG/CEVA
Dr. Stephen Watts	412 CEG/CEVA
Dr. Danny Reinke	412 CEG/CEVA
Mr. Larry Zimmerman	412 CEG/CEVA
Ms. Misty Hailstone	412 CEG/CEVA
Mr. Wesley King	412 CEG/CEVA
Mr. James Papin	412 CEG/CEVA
Mr. Daniel Garcia	AFCEC/CZOW
Dr. Nancy Ferguson	USFWS/R8
Mr. Ray Bransfield	USFWS/PSFWO
Ms. Victoria Monroe	CDFW

5. Business:

a. Introductions were made by all in attendance.

b. The 2016 EAFB INRMP Annual Review's purpose, requirement and process was discussed. The 2015-2019 EAFB INRMP signed by the mandatory tripartite signatory parties (United States Air Force, United States Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW)) was noted as Sikes Act compliant effective 21 July 2015. The 2015-2019 EAFB INRMP expiration date is 20 February 2020. The 2015 INRMP

Annual Review meeting minutes were documented by memorandum and along with the 2015 EAFB INRMP Annual Report inserted into Appendix E of the 2016 EAFB INRMP Update.

c. 2016 accomplishments described in the 2016 EAFB INRMP Annual Report for 1 January 2016 through 31 December 2016 were discussed. Dr. Watts clarified that 412 TW/SEF is the lead for Bird/Wildlife Aircraft Strike Hazard (BASH) and that 412 TW/XPP is the lead for the Readiness and Environmental Protection Integration (REPI) program. The USFWS expressed interest in conserving desert tortoise habitat off-base via REPI and in facilitating coordination with EAFB and other military installations on landscape scale concerns. The status and future action of a USFWS proposed Mohave tui chub research project was determined to be the responsibility of the USFWS. Dr. Watts discussed consideration of designating EAFB as a Wildlife Management Area to aid in hunting and fishing regulation enforcement.

d. Proposed 2017 corrections to address updates, inaccuracies and inconsistencies in the text of the current 2016 EAFB INRMP Update were provided and agreed to by all party representatives. These corrections will be written into the 2017 EAFB INRMP Update.

e. Natural resource management projects proposed or underway for 2017 were presented. These projects include: basewide desert tortoise relative density survey, invertebrate study, invasive plant survey, bat survey, tri-colored blackbird study, Mohave shoulderband snail survey, terrestrial species stressor study, iSportsman implementation updating of EAFB Instruction 32-7064 *Management of Hunting and Fishing Program*, update of INRMP species lists, Mojave Creek floodplain survey, and Piute Ponds willow planting.

f. The teleconference was adjourned at approximately 1100 hours.

6. All partner representatives agreed the proposed corrections to the 2016 EAFB INRMP Update for incorporation into the 2017 EAFB INRMP Update would not affect the currency of the INRMP as to "operation and effect," and thus does not affect the compliance status of the INRMP in accordance with the Sikes Act, and therefore does not require partner agency signature renewals that an INRMP revision or five year signature expiration would.

7. For further assistance or information on this matter, contact Mr. Larry Zimmerman at (661) 277-1418, larry.zimmerman.3@us.af.mil.

LARRY P. ZIMMERMAN, NH-III
Natural Resource Manager

DISTRIBUTION:
USFWS/R8
USFWS/PSFWO
CDFW

15.0 ASSOCIATED PLANS

Tab 1 – Piute Ponds Complex Management Plan

Click here to open the Piute Ponds Complex Management Plan

Tab 2 – Grazing and Cropland Management Plan

Click here to open the Grazing and Cropland Management Plan

Tab 3 – Wildland Fire Management Plan

Click here to open the Wildland Fire Management Plan

Tab 4 – Bird/Wildlife Aircraft Strike Hazard (BASH) Plan

Please contact Edwards AFB if you wish to request a copy of the Bird/Wildlife Aircraft Strike Hazard Plan.

Tab 5 – Integrated Pest Management Plan (IPMP)

Click here to open the Integrated Pest Management Plan