LUKE AIR FORCE BASE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

July 2018

Prepared for:
U.S. Department of the Air Force, Luke Air Force Base

In cooperation with:
U.S. Department of the Interior, Fish and Wildlife Service,
and
Arizona Game and Fish Department

56th FIGHTER WING

October 2018

Prepared by:
Colorado State University
Center for Environmental Management of Military Lands

U. S. AIR FORCE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

Luke Air Force Base, Auxiliary Field 1,

And

Fort Tuthill

Arizona

(See INRMP signature pages for plan approval date)

About This Plan

This installation-specific environmental management plan is based on the U.S. Air Force's (USAF) standardized Integrated Natural Resources Management Plan (INRMP) template. This INRMP has been developed according to the Sikes Act Improvement Act (16 U.S. Code § 670 et seq.) 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. Where applicable, external resources, including Air Force Instructions; USAF Playbooks; and federal, state, local, Final Governing Standards, biological opinions, and permit requirements, are referenced herein.

Certain sections of this INRMP begin with standardized, USAF-wide "common text" language that addresses USAF and Department of Defense policies and federal requirements. This common text language is restricted from editing to ensure that it remains standard throughout all plans. Immediately following the USAF-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 USAF environmental Installation Support Sections and/or installation personnel.

NOTE: The terms 'Natural Resources Manager' (NRM) and Point of Contact (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 U.S. Department of Defense (DoD) Instruction 4715.03, with change 1 (DoD 2017b).

REVIEW AND UPDATE OF THE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN 2018–2023

Luke Air Force Base
Auxiliary Field 1
Fort Tuthill
Coconino and Maricopa Counties, Arizona

APPROVAL

We approve the implementation of the activities in this Review and Update of the Integrated Natural Resources Management Plan for Luke Air Force Base, Auxiliary Field 1, and Fort Tuthill as supporting the military mission while sustaining natural resources for future generations. This plan has been prepared pursuant to the Sikes Act Improvement Act of 1998 (U.S. Code § 670 et seq.).

Todd D. Canterbury
Brigadier General, USAF
Commander, 56th Fighter Wing
Luke Air Force Base, Arizona

_____

Date: _____

Amy Leuders
Director, Southwest Region
U.S. Fish and Wildlife Service

_____

Date: _____

Ty E. Gray
Director
Arizona Game and Fish Department

_____

Date: _____

REVIEW AND UPDATE OF THE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN 2018–2023

Luke Air Force Base
Auxiliary Field 1
Fort Tuthill
Coconino and Maricopa Counties, Arizona

APPROVAL

This Integrated Natural Resources Management Plan was developed by the United States Air Force – Luke Air Force Base in cooperation with the United States Department of Interior, Fish and Wildlife Service and the Arizona Game and Fish Department. The signature below indicates concurrence with and acceptance of the following document. This plan has been prepared pursuant to the Sikes Act Improvement Act of 1998 (U.S. Code § 670a et seq., as amended through 2014).

Todd D. Canterbury
Brigadier General, USAF
Commander, 56th Fighter Wing
Luke Air Force Base, Arizona

Todd D Canterbury

Date: 24 Oct 18

FIVE YEAR REVIEW AND UPDATE OF THE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN 2018–2023

Barry M. Goldwater Range
Maricopa, Pima, and Yuma Counties, Arizona

APPROVAL

This five-year review and update of the Integrated Natural Resources Management Plan was prepared by the United States Air Force and the United States Marine Corps – Barry M. Goldwater Range in cooperation with the United States Department of Interior, Fish and Wildlife Service and the Arizona Game and Fish Department. The signature below indicates concurrence with and acceptance of the following document. This plan has been prepared pursuant to the Sikes Act Improvement Act of 1998 (U.S. Code § 670a et seq., as amended through 2014).

Amy Lueders

Director, Southwest Region

U.S. Fish and Wildlife Service

Date: Oct. 8, 2018

FIVE YEAR REVIEW AND UPDATE OF THE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN 2018–2023

Barry M. Goldwater Range
Maricopa, Pima, and Yuma Counties, Arizona

APPROVAL

This five-year review and update of the Integrated Natural Resources Management Plan was prepared by the United States Air Force and the United States Marine Corps – Barry M. Goldwater Range in cooperation with the United States Department of Interior, Fish and Wildlife Service and the Arizona Game and Fish Department. The signature below indicates concurrence with and acceptance of the following document. This plan has been prepared pursuant to the Sikes Act Improvement Act of 1998 (U.S. Code § 670a et seq., as amended through 2014).

Ty E. Gray
Director
Arizona Game and Fish Department

Date: 8·23·18

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ACRONYMS

ADA	Arizona Department of Agriculture
AF	Air Force
AFAF	Air Force Auxiliary Field
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AZAGFD	Arizona Game and Fish Department
AGL	Above-Ground Level
AHAS	Avian Hazard Advisory System
ABSL	Above Mean Sea Level
APHIS	Animal Planet Health Inspection Services
AUX-1	Auxiliary Airfield 1
AZ	Arizona
BASH	Bird/Wildlife or Bird/Animal Aircraft Strike Hazard
BMGR	Barry M. Goldwater Range
BMP	Best Management Practice
CEIE	Civil Engineer Environmental Element
CES	Civil Engineer Squadron
CRP	Comprehensive Range Plan
DoD	U.S. Department of Defense
DoDI	U.S. Department of Defense Instruction
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EMS	Environmental Management System
EO	Executive Order
ESA	Endangered Species Act
ESM	Environmental Sciences Management
ESRI	Environmental Systems Research Institute Fighter
FW	Wing
FY	Fiscal Year
GEM	Golf Course Environmental Management
GIS	Geographic Information System
ICRMP	Integrated Cultural Resources Management Plan
IDP	Installation Development Plan
INRMP	Integrated Natural Resources Management Plan
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
ISWMP	Integrated Solid Waste Management Plan
MBTA	Migratory Bird Treaty Act
MCAS	Marine Corps Air Station
MOU	Memorandum of Understanding
MWh	Megawatt hours
NEPA	National Environmental Policy Act
NIPRNet	Non-classified Internet Protocol Router Network
NRM	Natural Resource Manager
POC	Point of Contact
RMO	Range Management Office

SGCN	Species of Greatest Conservation Need
SWPP	Storm Water Pollution Prevention Plan
TTW	Tactical Training Wing
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

This Integrated Natural Resources Management Plan (INRMP) provides guidance for the management of natural resources at Luke Air Force Base (AFB), Auxiliary Field 1 (AUX-1), and Fort Tuthill, Arizona. It is a planning tool that instructs managers to take into account an installation's natural resources in all potential undertakings on its facilities. The objective is to ensure the protection and conservation of natural resources at these facilities in compliance with all applicable laws, regulations, and policies relating to natural resources management. This INRMP serves as a Cooperative Agreement between the U.S. Air Force (USAF), U.S. Fish and Wildlife Service (USFWS), and Arizona Game and Fish Department (AGFD) for approval by the participants in order to establish agreement on recommendations.

The requirements for preparation of this INRMP are derived from the Sikes Act, as most recently amended by the Sikes Act Improvement Act (16 U.S. Code 670 et seq.) (hereafter referred to as the Sikes Act) and the implementing Memorandum of Understanding between the U.S. Department of Defense and the U.S. Department of Interior (1978); Fish and Wildlife Coordination Act (16 U.S. Code § 661 et seq.); Air Force Policy Directive 32-70, *Environmental Quality* (USAF 1994); and Air Force Instruction 32-7064, with change 2, *Integrated Natural Resources Management* (USAF 2016a).

The last INRMP for these facilities to receive approval was signed in 2001. Recent iterations have been presented to the AGFD and USFWS for signature, but outdated wildlife and wildlife habitat information resulted in a non-concurrence determination. The most recent vegetation, wildlife, and wildlife habitat surveys are listed below. During all site visits, an effort was made to assess the probability of special-status species (i.e., federal or state listed species) occurring at the three facilities.

- 1994 inventory of vegetation, wildlife, and wildlife habitat at Luke AFB, AUX-1, and Fort Tuthill
- 1994 field reconnaissance of Luke AFB was accomplished 17–18 October
- 1994 field reconnaissance of AUX-1 was conducted 18 October 1994 and 6 December 2013 by the 56 Range Management Office/Environmental Services Management
- Fort Tuthill observations were made May–October 2001

During the past wildlife and habitat surveys, no federal or state protected species were detected. To determine whether this is still the case, Luke AFB has programmed targeted, threatened, and endangered species surveys, for both flora and fauna, on all three parcels. Surveys are scheduled to occur during the next five-year planning period covered by this INRMP, 2018–2023. Surveys will result in a habitat characterization map, survey maps, a habitat assessment characterizing the quality and quantity of habitat available to federal or state protected species and conclusions regarding the presence or absence of protected species. During each annual review, this INRMP will be updated with survey results as they become available.

CHAPTER 1 OVERVIEW AND SCOPE

1.1 Purpose and Scope

Luke Air Force Base (AFB) is located in Glendale, Arizona, just west of Phoenix, and occupies nearly 4,800 acres of land, (Figure 1.1). Luke AFB is home to the 56th Fighter Wing (FW), the largest FW in the U.S. Air Force (USAF) and the only active-duty F-16 training wing. Each year, the base supports training for more than 280 active-duty, Guard and Reserve F-16 pilots and more that 345 maintenance-crew chiefs. On 21 May 2015, Luke AFB training its first class for the F-35 mission. The F-35 is the USAF's latest generation fighter that will replace its aging fleet of F-16 Fighting Falcons and A-10 Thunderbolt IIs. Luke AFB also supports more than 5,500 military and civilian employees on base, and approximately 6,700 family members and 65,000 military retirees who live in the Phoenix area.

Auxiliary Field 1 (AUX-1) is a 1,105-acre inactive airfield located 13 miles northwest of Luke AFB (Figure 1.1). The airfield is used for low-approach, instrument flight training under visual flight rules during daytime training only. Approximately 12,000 operations are performed annually.

Fort Tuthill is located approximately 150 miles north of Luke AFB and 2 miles south of Flagstaff in northern Arizona, adjacent to Fort Tuthill County Park (Figure 1.1). Fort Tuthill is a 14-acre recreational and lodging facility for active-duty personnel from any branch of the U.S. Armed Services.

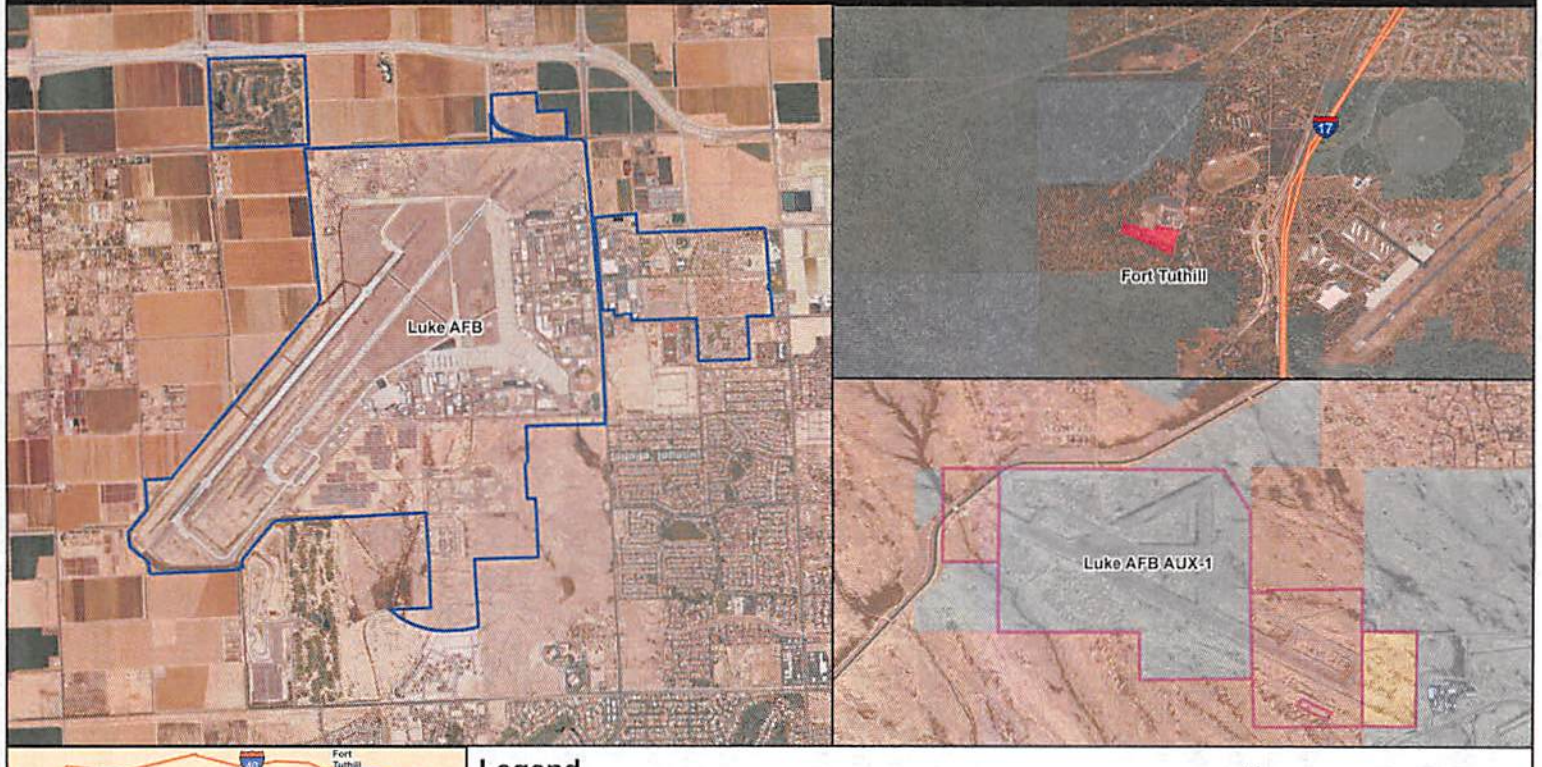
The 56 FW also has purview over the Barry M. Goldwater Range (BMGR) East and the Gila Bend Air Force Auxiliary Field (AFAF). The natural resources and management activities of those lands are described in the BMGR INRMP (see Volume 1) and in the installation overview of Marine Corps Air Station Yuma (see Volume 3), which is the managing agency for the BMGR West portion of the range. A brief discussion of the training activities that occur at BMGR East is provided in Section 2.1 *Installation Overview* of this INRMP.

The resources of Luke AFB, AUX-1, and Fort Tuthill are used for living, working, and recreating. For these activities to take place, multiple-use coordination of facilities and management plans are required. The purpose of the INRMP is to serve as the road map for resource management and as the guiding document for USAF planners, implementers of mission activities, and resource managers.

1.2 Management Philosophy

Resources under the control of Luke AFB will be managed to support the military mission while practicing the principles of multiple-use and sustainability. The conservation of natural resources and the military mission need not and shall not be mutually exclusive. All installation decision-makers and commanders should be kept informed of the conditions of resources, the objectives of resources management, and potential or actual conflicts between mission activities and management plans.

Figure 1.1: General Location and Surrounding Land Ownership
Luke AFB



Legend

- Barry M. Goldwater Range (BMGR)
- Luke AFB Auxiliary Field # 1 (AUX-1)
- Fort Tuthill Recreation Area
- Luke AFB
- USDA Forest Service
- Bureau of Land Management (BLM)
- State of Arizona Trust Land
- Interstates
- Highways
- Major Roads
- City/Town

N

World Geodetic System 1984 (WGS84) Projection
Zone 12 N
GCS_WGS_1984

Base data from ESRI StreetMap
Imagery from USGS

0 1 2 Miles

U.S. Department of Defense Instruction (DoDI) 4715.03, *Natural Resources Conservation Program* (DoD 2017b) outlines policy, assigns responsibilities, and prescribes procedures for the integrated management of natural and cultural resources on property under Department of Defense (DoD) control. This instruction requires installations to incorporate the principles of an ecosystem-based, multiple-species management approach that supports present and future mission requirements while preserving ecological integrity. Ecosystem-based management considers the environment as a complex system functioning as a whole, which takes into account both people and their social and economic needs, and is adaptable to complex and changing requirements. Ecosystem-based management principles are best realized through the engagement and formation of local and regional partnerships that benefit the goals and objectives of this INRMP. DoD ecosystem-based management guidelines are intended to promote/protect natural processes, but do not preclude intervention with active management deemed necessary to address issues, such as invasive species, endangered species recovery, or barriers to wildlife movement inside or outside of the installation.

1.3 Authority

The Sikes Act Improvement Act (16 U.S. Code [U.S.C.] § 670 et seq.) (hereafter referred to as the Sikes Act) stipulates that, to the extent consistent with the military use of Luke AFB, Fort Tuthill, and AUX-1, the INRMP must provide for wildlife and land management, wildlife-oriented recreation, wildlife habitat enhancement or modification, and wetland conservation. Guidance for implementing the Sikes Act on USAF property is provided by DoDI 4715.03 and U.S. Air Force Instruction (AFI) 32-7064 (DoD 2017b, USAF 2016a).

In accordance with the Sikes Act, INRMPs are to be reviewed to operation and effect on a regular basis, but not less than every five years (16 U.S.C. 670a (b)(2)). This requirement reflects the fact that military activities, natural resources protection and conservation needs, and public access opportunities and patterns are likely to change over time and there must be a mechanism for adapting an INRMP to changing conditions if the plan is to provide for effective management.

This INRMP was prepared in compliance with the Sikes Act and as a cooperative effort between the U.S. Fish and Wildlife Service (USFWS) and the Arizona Game and Fish Department (AGFD). It sets forth a single unified management philosophy for the protection, conservation, use, and management of resources at Luke AFB, AUX-1, and Fort Tuthill. In addition, the INRMP was developed in an interdisciplinary manner through coordination with individuals from various disciplines. They include pest control, wildlife biology, community planning and landscape planning, and maintenance. All management strategies will be monitored and adjusted as needed. All installation personnel, both civilian and military, will act responsibly in the public interest as they manage the land and resources that are an integral part of the installation. There shall be a conscious and active concern for the inherent value of resources in installation decisions and actions.

1.4 Integration with Other Plans

The INRMP is a living document that integrates component plans in a manner that fully supports all aspects of resource management in support of the mission. AFI 32-7062, *Comprehensive Planning*

(USAF 2017c) lists the responsibilities and requirements for comprehensive planning and describes procedures for developing, implementing, and integrating an Installation Development Plan (IDP) with activity management plans, including this INRMP. The Luke AFB IDP, developed in April 2014, establishes goals and objectives to more efficiently and effectively facilitate mission accomplishments and accommodate new missions. Goal five of the IDP is to promote environmental stewardship by ensuring continued compliance with this INRMP.

In addition, INRMPs often incorporate subordinate plans that address installation actions, such as the Integrated Pest Management Plan (IPMP) (Luke AFB 2015), Golf Environmental Management (GEM) (U.S. Air Force Center for Engineering and the Environment 2011), Bird/Wildlife Aircraft Strike Hazard (BASH) Plan (56 FW 2013), and the Integrated Cultural Resources Management Plan (ICRMP). These plans are referenced throughout this INRMP (Luke AFB 2017).

CHAPTER 2 INSTALLATION PROFILE

2.1 Installation Overview

Table 2.1: Installation profile.

Office of Primary Responsibility	The U.S. Air Force Civil Engineer Center (AFCEC) Nellis Installation Support Section serves as the office of primary responsibility for this plan. This INRMP will be reviewed annually by the Nellis Installation Support Section Natural Resource Manager (NRM), and updated as needed.
Natural Resources Manager/ Point of Contact (POC)	56th Civil Engineer Squadron/Civil Engineer Environmental Element (CES/ CEIE) Building 302 Luke AFB, AZ 85309
State and/or Local Regulatory POCs	Field Supervisor USFWS, Ecological Services 9828 North 31st Avenue C #3 Phoenix, AZ 85052-2517 602-242-0210 Region VI Regional Supervisor Arizona Game and Fish Department 5000 W. Carefree Highway Phoenix, AZ 85086-5000 602-942-3000
Total Acreage Managed by Installation	Luke AFB—4,842 acres AUX-1—1,105 acres Fort Tuthill—14.5 acres
Biological Opinions	N/A
NR Programs	• Integrated Pest Management • Bird/Wildlife Aircraft Strike Hazard (BASH) Program • Cultural Resources Management Program

Luke AFB (Table 2.1, Figure 2.1) is located in Maricopa County, Arizona, approximately 18 miles northwest of the Phoenix metropolitan area, and 4 miles to the north of Interstate 10 on Litchfield Road. It occupies approximately 4,842 acres and hosts the largest fighter wing in the USAF with 138 F-16s assigned to it. The host command at Luke AFB is the 56 FW, under Air Education and Training Command. An integral part of the Luke AFB F-16 fighter pilot training mission is the BMGR, which consists of approximately 1.7 million acres of relatively undisturbed Sonoran Desert southwest of Luke AFB between Yuma and Tucson, Arizona, south of Interstate 8. Above is a 57,000-cubic-mile airspace where pilots practice air-to-air maneuvers and engage in simulated battlefield targets on the ground. Additionally, there are more than 85,000 cubic nautical miles of special use airspace used

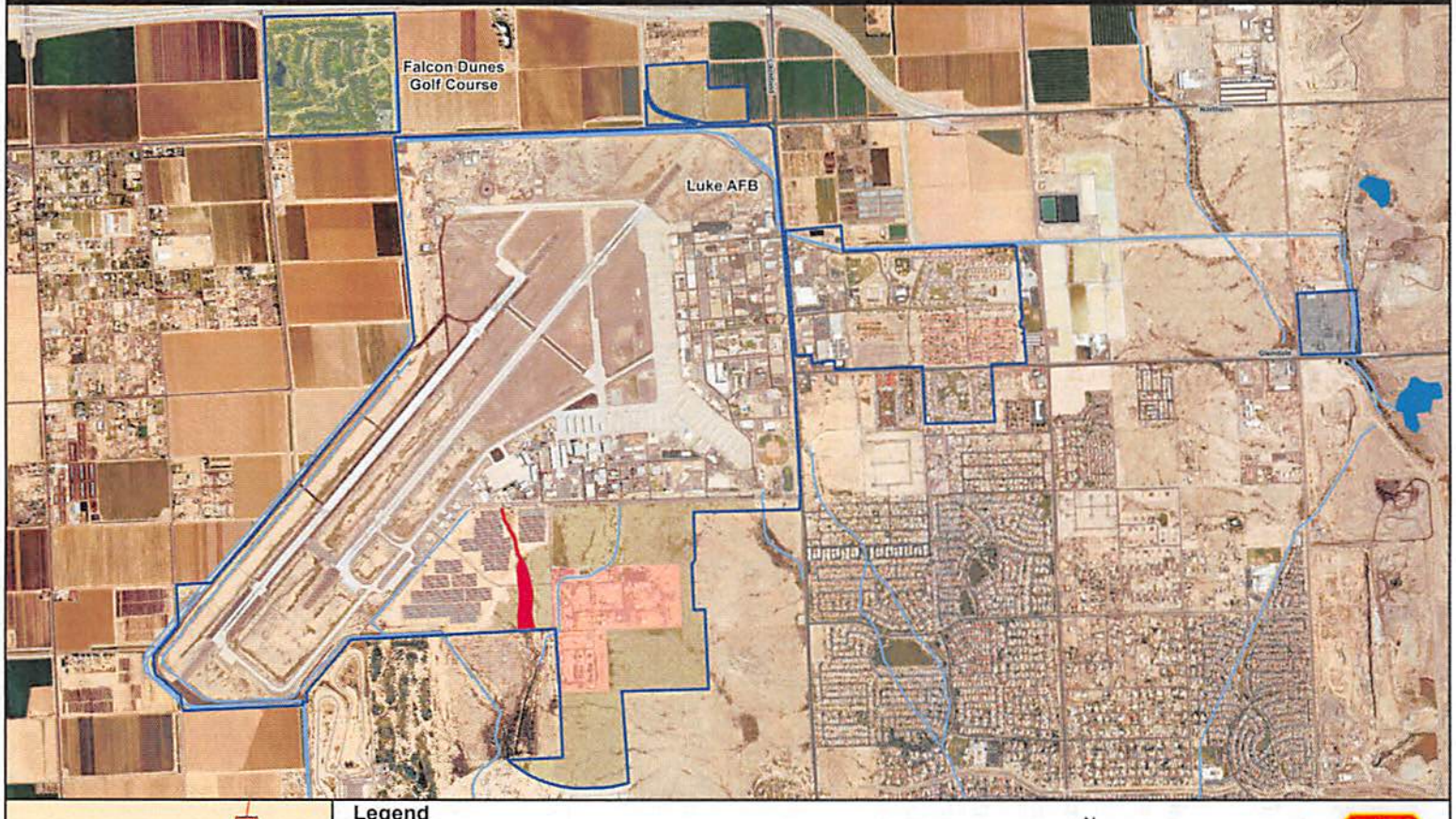
for military operations beyond the airspace above Luke and BMGR, including adjacent Federal and Tohono O'odham lands and other parts of southwestern Arizona, as well as a region northeast of Flagstaff, AZ (see section 1.6 in 56 Range Management Office [56 RMO] 2017). The 56 RMO works closely with the Tohono O'odham Nation to maintain good relations with the tribal government, minimize impacts of overflights on the Tohono O'odham people, and educate range users about any concerns and the constraints imposed on operations in the Military Operation Area over Tohono O'odham lands (see section 1.14.1.1 in [56] RMO [2017] for additional information).

Roughly the size of Connecticut, the immense size of the BMGR complex allows for simultaneous training activities on nine air-to-ground and two air-to-air ranges. The Luke AFB [56] RMO manages the eastern BMGR activities and the Marine Corps Air Station at Yuma (MCAS Yuma) oversees operations on the western portion of BMGR. Luke AFB is transitioning to become the sole pilot training center for the F-35A, the USAF's newest multi-role aircraft.

AUX-1 (Table 2.1, Figure 2.2) occupies approximately 1,105 acres. It is owned by the State of Arizona and leased to Luke AFB. AUX-1 is located approximately 4 miles east of U.S. Highway 60 on Happy Valley Road and about 13 miles northwest of Luke AFB, adjacent to the City of Surprise in central Maricopa County, Arizona. The White Tank Mountains lie approximately 5 miles south of the airfield.

Fort Tuthill (Table 2.1, Figure 2.3) is a 14.5-acre recreational facility. It is located two miles south of Flagstaff in Coconino County, Arizona, and just west of Pulliam Airport off Interstate 17 and State Route 89-A.

Figure 2.1: Luke AFB Installation Area
Luke AFB



Legend

- City/Town
- Luke AFB
- Interstates
- Highways
- Main Road
- Lake/Pond
- Watercourse

Luke AFB Land Cover

- Falcon Dunes Golf Course
- Luke AFB Developed Area
- Munition Storage
- Water
- Rangeland/Open Space
- Waste Water Treatment Plant
- Wildlife Management Area

N

World Geodetic System 1984 (WGS84) Projection
Zone 12 N GCS_WGS_1984

Base data from ESRI StreetMap
NAIP Imagery courtesy of FSA

0 0.75 1.5 Miles

Figure 2.2: Luke AFB Auxillary Field #1 (AUX-1) Installation Area
Luke AFB

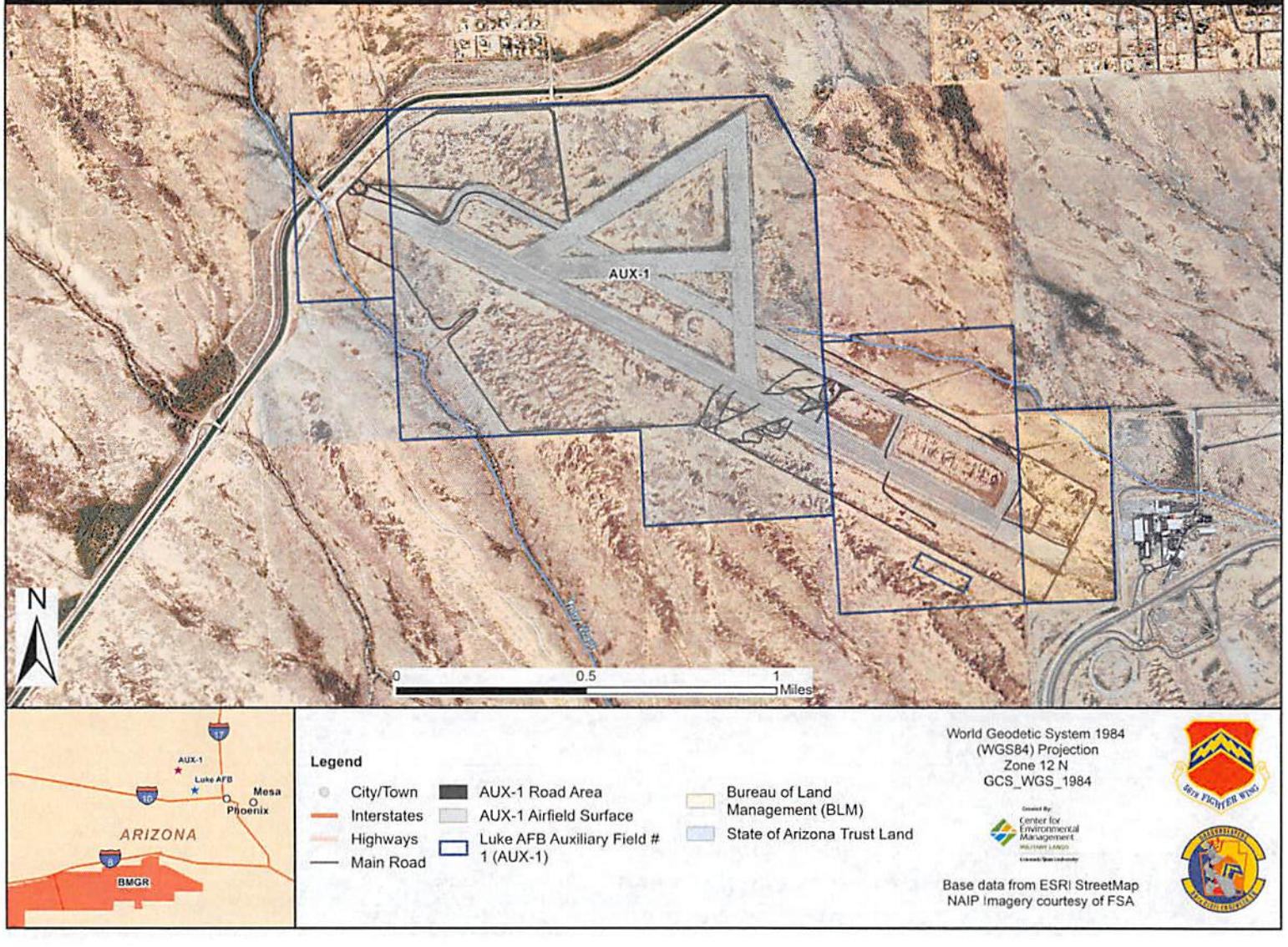


Figure 2.3: Fort Tuthill Recreation Area
Luke AFB

Legend

- City/Town
- Interstates
- Highways
- Main Road
- Fort Tuthill Recreation Area
- Fort Tuthill Camping Area
- Bureau of Land Management (BLM)
- State of Arizona Trust Land
- USDA Forest Service

N

World Geodetic System 1984 (WGS84) Projection
Zone 12 N
GCS_WGS_1984

Base data from ESRI StreetMap

0 250 500 Feet

2.1.1 Installation History

Luke AFB

In 1940, a U.S. Army representative was sent to Arizona to select a site for an Army Air Corps training field for advanced training in conventional fighter aircraft. The city of Phoenix leased 1,440 acres of land to the government, at a rate of $1.00 per year, effective 24 March 1941. On 29 March 1941, the Del. E. Webb Construction Co. began excavation for the first building at what was known at the time as the Litchfield Park AFB. It wasn't until 1941, when Luke Field in Pearl Harbor, Hawaii, was transferred to the Navy, that the commander of Litchfield AFB requested the name be changed to Luke Field. Luke Field was named after the first aviator to be awarded the Congressional Medal of Honor—2d Lt. Frank Luke Jr., born in Phoenix in 1897. During World War I, Luke, who was also known as the "Arizona Balloon Buster," scored 18 aerial victories (14 of which were German observation balloons) in the skies over France before being killed on 29 September 1918 at the age of 21.

The first class of 45 students, Class 41 F, arrived 6 June 1941, to begin advanced flight training in the AT-6, even though few essential buildings had been completed. Pilots flew out of the Sky Harbor Airport until the Luke runways were completed. Pilots received 10 weeks of instruction, with the first class graduating on 15 August 1941. Captain Barry Goldwater served as director of ground training the following year. During World War II, Luke was the largest fighter training base in the Army Air Force. The base graduated more than 17,000 fighter pilots from advanced and operational courses in the AT-6, P-40, P-51, and P-38, earning it the nickname "Home of the Fighter Pilot." By 7 February 1944, pilots at Luke had logged a million hours of flying time. By 1946, however, the number of pilots trained had dropped to 299 and the base was deactivated on 30 November 1946. After combat developed in Korea, Luke Field was reactivated on 1 February 1951 as Luke AFB, part of Air Training Command under a reorganized U.S. Air Force.

Students progressed from the P-51 Mustang to the F-84. Flying training at Luke changed to the F-100 and, on 1 July 1958, the base was transferred from Air Training Command to Tactical Air Command. In 1964, Luke continued its tradition of providing fighter training for allied nations when an F-104 program for German Air Force pilots and a program in the F-5 for pilots from developing nations began. During the 1960s, thousands of American fighter pilots completed their training and left to patrol the skies over Vietnam. In July 1971, the base received the F-4C Phantom II and became the main provider of fighter pilots for Tactical Air Command and fighter forces worldwide. In November 1974, the USAF's newest air fighter, the F-15 Eagle, came to Luke. In February 1983, fighter pilot training began for the F-16 Fighting Falcon. Luke units continued to set the pace for the USAF. The 58th Tactical Training Wing (TTW) had two squadrons—the 312th and 314th Tactical Fighter Training Squadrons—conducting training in the newest C and D models of the Fighting Falcon. The 405th TTW received the first E model of the F-15 Eagle in 1988 and two of its squadrons—the 461st and 550th—began training in this dual-role fighter. In July 1987, the Reserve function at Luke changed when the 302nd Special Operations Squadron deactivated its helicopter function and the 944th Tactical Fighter Group was activated to fly the F-16C/D.

The early 1990s brought significant changes to the base. As a result of defense realignments, the 312th, 426th, and 550th Tactical Fighter Training Squadrons were inactivated, as were the 832nd Air Division and the 405th TTW. The F-15A and B models were transferred out, and the 58th TTW, being the senior wing at Luke, was re-designated the 58th Fighter Wing and once again became the host unit at Luke. In April 1994, after 24 years at Luke, the 58th Fighter Wing was replaced by the 56 FW as part of the Air Force Heritage program. Air Force officials established the program to preserve Air Force legacy and history during a time of military draw-down. The 56 FW is one of the most highly decorated units in USAF history and was selected to remain part of the active fighter force while the 58th Fighter Wing was reassigned as a special operations wing to Kirtland AFB, New Mexico.

AUX-1

The first of Luke's auxiliary airfields, AUX-1, was activated on 1 July 1941. AUX-1 served as the training site for P-40 operations when Luke Field became too congested with aircraft. Today, about 12,000 operations are conducted per year at AUX-1 for instrument-approach training. Under this training, pilots use the instrument landing systems at AUX-1 to simulate approaches under poor weather conditions. One non-active runway at AUX-1 is used for instrument-approach runway alignment for Tactical Air Navigation-approaches, which are non-precision with course guidance but not with glide path guidance; Instrument Landing System approaches, which are precision approaches with both course and glide path guidance; and Precision Approach Radar, which also is a precision instrument approach system. AUX-1 is one of only a few locations in the U.S. for training with Precision Approach Radar, which is commonly used in overseas locations.

Fort Tuthill

Fort Tuthill was a training site for the 158th Infantry Regiment of the Arizona National Guard from 1929 to 1937, in 1939, and in 1948. Established in 1928 as Camp Tuthill (after Brigadier General Alexander M. Tuthill, Commander of the National Guard), it was renamed Fort Tuthill in 1929. Located in pine covered forest, the site allowed for the regiment to meet training objectives that the Arizona desert climate would not allow. In 1955, the Fort became a county park and houses the Fort Tuthill Military Museum.

2.1.2 Military Missions

The primary mission at Luke AFB is to "build the future of airpower..." and is accomplished by the goal to "train the world's greatest F-35 and F-16 fighter pilots."

Figure 2.4: F-35 Lightning II flies alongside an F-16 Fighting Falcon. Photo courtesy of Matthew Short.

2.1.3 Surrounding Communities

The largest communities near Luke AFB are identified in Table 2.2 along with 2010 U.S. Census data and 2011-2015 American Community Survey 5-Year Estimates.

Table 2.2: Surrounding community population 2010–2015.

City	2010 U.S. Census Data[1]	Recent Population Estimates[2]
Avondale, Maricopa County	76,238	82,881
Glendale, Maricopa County	226,721	245,895
Peoria, Maricopa and Yavapai, County	154,065	164,173
Sun City, Maricopa County	37,499	39,363[3]
Surprise, Maricopa County	117,517	127,492[3]
El Mirage, Maricopa County	31,797	35,043
Phoenix, Maricopa County	1,445,632	1,615,017
Flagstaff, Coconino County	65,870	71,459

[1] 2011–2015 American Community Survey (ACS) 5-year estimates, at https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

[2] 2016 U.S. Census Bureau population estimates, by city, at https://www.census.gov/.

[3] 2016 U.S. Census Bureau population estimates not available; 2012–2016 5-year ACS 5-year estimates, at https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

The majority of communities near Luke AFB are in Maricopa County, Arizona. Maricopa County has had the largest annual population increase among any counties in the U.S., with a population now estimated at 4.2 million people. Phoenix was the fastest growing metropolitan area in the U.S. from 2015 to 2016, averaging an increase of 222 people per day.

Arizona recognizes the importance of military aviation to its economy and the safety concerns that arise from incompatible land uses in the vicinity of military airports. To mitigate that risk, the State has adopted legislation to restrict land use in the vicinity of military airports. Pursuant to Arizona Revised Statutes (A.R.S.) § 28-8481 (F) and (P) and Attorney General Opinion No. I08-003, no new residential development shall occur within a High Noise or Accident Potential Zone. This designation helps to ensure that future development is compatible with adverse effects that military aircraft may have on public health and safety.

2.1.4 Local and Regional Natural Areas

Luke AFB

The areas surrounding Luke AFB can be described as densely populated suburbia with few patches of undeveloped land. Within about 5 miles of the installation, there are nearly 12 golf club communities with maintained grassy greens, scattered ponds, and a few disconnected patchworks of

trees and shrubs. The Wildlife World Zoo is located about 0.5 mile to the northwest of Luke AFB and has an abundance of planted and maintained trees, ground cover, and other vegetation to provide habitat for its collection of South American and African animals. There are no current records of federally listed species breeding or occurrences of federally listed plant species within a five-mile radius, although it is possible that listed migratory birds, federally protected bald/golden eagles, or Arizona Species of Greatest Conservation Need could occur within this radius.

The nearest park (about 8 miles away) of significant size that also has natural vegetation is the White Tank Mountain Regional Park, which and is described in more detail in the following (AUX-1) section. The BMGR (see Volume 1) is located approximately 60 miles to the southwest of Luke AFB and is the largest expanse of relatively unfragmented Sonoran Desert in the U.S. With the exception of State Route 85, the land is free of major developments and is ecologically linked to Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, Sonoran Desert National Monument, and lands administered by the Bureau of Land Management.

AUX-1

AUX-1 is located near White Tank Mountain Regional Park, which covers nearly 30,000 acres, making it the largest park in Maricopa County. The park encompasses the rugged White Tank Mountains, which is a freestanding range that separates the Phoenix Basin of the Salt River from the Hassayampa Plain. The park has a rich history, with eleven archaeological sites dating back to A.D. 500–1100, petroglyphs, and possible agricultural terraces or check dams. The park offers approximately 25 miles of trails with vegetation characteristic of the Sonoran Desert.

Fort Tuthill

Fort Tuthill is enveloped within the boundary of a larger county park that is surrounded by Coconino National Forest. The vegetation is primarily disturbed, open ponderosa pine forest or woodland and is typical for the forest in this region.

2.2 Physical Environment

2.2.1 Climate

The Southwest region of the U.S. has become warmer and drier over the past century, and projections expect this trend to continue into the 21st Century (Overpeck et al. 2013). Droughts are expected to become more severe, and precipitation extremes in the winter are expected to become more frequent and intense (Overpeck et al. 2013). Significant changes in the regional climate will have broad impacts on ecosystems and will have consequences for biodiversity (Bagne and Finch 2012).

Luke AFB

The climate at Luke AFB is characterized by warm-to-hot spring, summer, and early fall temperatures. The average July high temperature at nearby Litchfield Park is 106.9 degrees Fahrenheit. Mean temperatures in spring and fall are 86.1 (April) and 89.5 degrees Fahrenheit (October), respectively. Winter temperatures tend to be mild; January is the coolest month of the year, with an average daily high temperature of 66.8 degrees Fahrenheit. Daily minimum

temperatures range from 75.9 (July) to 36.5 degrees Fahrenheit (January). On an annual average, Litchfield Park has 177 days when high temperatures reach or exceed 90 degrees Fahrenheit and 29 days per year when low temperatures drop to or fall below 32 degrees Fahrenheit.

Precipitation at Litchfield Park occurs almost entirely in the form of rain. The occurrence of snow, sleet, and hail are rare events that generate just trace amounts of precipitation. Winter rains occur primarily in December and January, with an annual average of 1.06 and 0.93 inches, respectively. August is normally the wettest month of the year at Litchfield Park, with an annual average of 1.21 inches of rain. Winter rains result from weather fronts that begin in the Pacific Ocean and move east across Arizona. They are generally quite widespread and characterized by gentle rainfall. Summer rains result from moisture moving into Arizona from Mexico, the Gulf of Mexico, and/or the Gulf of California. Summer rains or monsoons tend to be highly localized and result in brief, torrential downpours often accompanied by high winds and lightning. Drought conditions in the vicinity of Luke AFB are common. The weather station at Litchfield Park normally receives about 8 inches of precipitation annually, but extended periods of drought have been recorded.

AUX-1

The climate of AUX-1, like Luke AFB, is characterized by warm-to-hot spring, summer, and early fall temperatures. For example, the average July high temperature at the community of Wittman, located four miles north of AUX-1, is 105.4 degrees Fahrenheit. Mean high temperatures in spring and fall are 81.8 (April) and 87.0 degrees Fahrenheit (October), respectively. Record high temperatures for Wittman approach 120°F. Winter temperatures are moderate; January is the coolest month of the year with daily highs in the low 60s, averaging 63.6 degrees Fahrenheit and lows in the middle 30s, averaging 35.8 degrees Fahrenheit. On average, winter low temperatures can be expected to drop to 32 degrees Fahrenheit or lower on 26 days from November through March (Sellers and Hill 1974).

Precipitation at AUX-1 occurs almost entirely in the form of rain. As is the case in most of west-central Arizona, snow, sleet, and hail events are extremely rare and hardly ever exceed a trace amount. Wittman normally receives about nine inches of rainfall per year, with late spring generally being the driest season of the year. In most years, no rainfall occurs during the month of June, which has a long-term average of 0.06 inches/month. July and August are among the wettest months of the year, averaging 1.04 and 1.33 inches, respectively. Only December (1.06 inches) and January (0.93 inches) are comparable (Sellers and Hill 1974).

Fort Tuthill

The climate of Fort Tuthill is vastly different from that of Luke AFB and AUX-1. Mean annual monthly temperatures range from about 30.5 to 61.2 degrees Fahrenheit. The mean monthly average temperature in July is 65.9 degrees Fahrenheit. January is the coolest month of the year, with an average monthly high temperature of 42.6 degrees Fahrenheit. Daily minimums range from 32.0 in July to –22.0 degrees Fahrenheit in January. On an annual average, Fort Tuthill has 3.1 days where high temperatures reach or exceed 90 degrees Fahrenheit and 208.9 days per year where low temperatures drop to or fall below 32 degrees Fahrenheit. The average frost-free season ranges from 90–120 days. In general, the nighttime freezing temperatures usually begin by mid-September and end in June.

At Fort Tuthill, mean monthly precipitation ranges from 0.0 to 10.05 inches over 50 years of record keeping. Annual mean winter snowfall ranges from 52.9 to 132.6 inches with extremes up to 184.3 inches. Spring is generally the driest season of the year.

2.2.2 Landforms

Luke AFB

The topography of Luke AFB is flat, with elevations ranging from 1,075 to 1,105 feet above mean sea level (AMSL). The base area generally slopes from north to south. Erosion on Luke AFB is controlled only by a man-made canal system found on the northern, southern, and western perimeters of the airfield. There are two hills between Litchfield Road and the munitions storage area near the southeastern boundary of the main portion of Luke AFB. The southernmost hill is known as Sunset Point, the elevation of which is approximately 1,125 feet AMSL. The other hill (unnamed) is about 1,500 feet to the north and has an elevation of approximately 1,100 feet AMSL.

AUX-1

The topography of AUX-1 is flat. The elevation of the northwest portion of the site, adjacent to Trilby Wash, is approximately 1,560 feet AMSL. The site slopes from northwest to southeast. The approximate elevation of the southeast portion of the site is 1,500 feet AMSL.

Fort Tuthill

Fort Tuthill lies in an area where the slope varies from 0 to 10 percent or greater, with elevations ranging from 6,990 to 7,060 feet. The hotel and immediate structures are in an area characterized by slopes of 2–5 percent surrounded by areas of 5–10 percent slope; the balance of the property is characterized by slopes of greater than 10 percent.

2.2.3 Geology and Soils

Luke AFB

Luke AFB is in the Basin and Range physiographic province of the inland Western U.S. and Northwestern Mexico. This province is characterized by north-south trending mountain ranges separated by broad, alluvial valleys (Fenneman 1931). It is situated in the Luke basin, one of many deep, broad basins bound by narrow fault-block mountain ranges. The base is located approximately six miles to the east of the White Tank Mountains (Cook 2013). The White Tank Mountains trend north-south and are remnants of faulted blocks of the earth's crust. To the south are the Sierra Estrella Mountains and to the north are the Hieroglyphic Mountains and numerous inselbergs (Cook 2013). Erosion from these mountains has deposited large volumes of sand and gravel on the valley floors, in many places so deep that it is often difficult to estimate the thickness of these deposits (Chronic 1983). The depth of bedrock in the Luke Basin area ranges from 400 feet near the base of the White Tank Mountains to over 11,200 feet on the eastern edge of the basin (Cook 2013).

Rock types commonly found at Luke AFB include gravel-sized fragments of metamorphic gneiss and igneous granite, both typical of the White Tank Mountains. These rocks are found randomly dispersed in the soil matrix consisting of loam or mixtures of sands, silts, and clays. No sinks or fossil

beds are known to occur at Luke AFB and there are no geological features present to suggest the presence of any fossil beds. The Luke basin contains extensive amounts of evaporate deposits that are a likely remnants of a closed-basin saline lake. The largest of these evaporate deposits is the Luke Salt Body, which is a large salt dome deposit approximately 9 miles long, 6 miles wide, and possibly up to 10,000 feet thick (Cook 2013). Upper-level unconsolidated sediments have been the source of groundwater in the area since the early 1900s.

AUX-1

AUX-1 is also located within the Basin and Range Physiographic Province of the southwestern U.S. (Fenneman 1931). It is situated in a basin approximately five miles east of the White Tank Mountains. The White Tank Mountains trend north-south and are remnants of faulted blocks of the earth's crust. The Vulture Mountains are located to the north and the Hieroglyphic Mountains to the northeast. Erosion from these mountains has resulted in the deposition of large volumes of sand and gravel onto the valley floors.(Chronic 1983).

Gravel- to boulder-sized fragments of metamorphic and igneous rock, including schist, gneiss, and granite, all typical rock types of the adjacent mountain ranges, can be found in the AUX-1 alluvium. Volcanic rock identified as pink, moderately-to-highly-welded tuff can also be found in the alluvium at the site and likely originates from the Vulture Mountains, where volcanic tuff and schist are the dominant rock material (Chronic 1983). Rock material is randomly dispersed in the sand, silt, and clay soil matrix at AUX-1. Various authorities indicate that the area around AUX-1 may not be a significant mineral resource area (McCory and O'Hare 1965, Stipp et al. 1967, Beikman et al. 1986). No fossil beds are known to occur in the area.

Fort Tuthill

According to the Natural Resource Conservation Service soil map for Coconino County, Fort Tuthill lies within the Brolliar-Sponseller Association that is comprised of high basaltic plateaus and mesas south of Flagstaff. The soils are moderately deep and moderately fine-textured. Overall, slopes range from 0 to 30 percent throughout the entire park system.

Brolliar soils have dark-colored, cobbly or stony loam surface layers covered by forest litter with reddish brown clay loam or clay subsoils. Brolliar soils compose approximately 60 percent of the association, with Sponseller soils making up the other 30 percent. The permeability of Brolliar soils is slow, ranging from 0.06 to 0.20 inches per hour with a high water-holding capacity of 0.13 to 0.16 inches at a depth of 30 to 60 inches. Ordinarily found on basalt bedrock, Brolliar soils have a high shrink-swell potential and moderate frost action. Erosion potential for this soil association is severe on slopes greater than 8 percent.

Sponseller soils occur on basalt flows and cinder cones with dominant slopes of 8–25 percent. They have reddish-brown, gravelly or cobbly loam surface layers with reddish-brown gravelly or cobbly clay loam subsoils. Basalt bedrock lies at a depth of 30 to 60 inches. Weathered bedrock of basaltic or cindery materials occur at a depth of 24 to 60 inches. A majority of this soil association lies within the U.S. National Forest. Sponseller soils drain slowly, with a permeability rate ranging from 0.2 to 0.6 inches per hour. As with the Brolliar soils, Sponseller soils have a high water-holding capacity of

0.13 to 0.16 inches in cinders or fractured basalt at a depth of 24 to 60 inches. The shrink-swell potential is moderate to high, as is the potential for frost action. Erosion potential is moderate to severe on slopes greater than 40 percent.

2.2.4 Hydrology

Luke AFB

Principal rivers in the region include the Salt and Gila Rivers. The Salt River flows into the Gila River south of the greater Phoenix area. Near Luke AFB, the Agua Fria River is intermittent and runs infrequently during storm events. There are no perennial or intermittent streams present on base. The area immediately surrounding Luke AFB is highly developed and most natural drainage features have been altered. Surface water at Luke AFB is very limited to nonexistent. During storm events, sheet-flow surface water runoff occurs towards the south of the base. There is a man-made canal around the perimeter of the airfield.

AUX-1

Surface-water runoff at AUX-1 occurs towards the southeast by way of a man-made drainage canal that parallels the abandoned runway, and by five, small, unnamed drainages paralleling the Trilby Wash south of the runway. The Trilby Wash drainage trends northwest to southeast and crosses the western boundary of the AUX-1 site. Surface runoff from AUX-1 flows into the Trilby Wash Detention Basin and into the Agua Fria River. Downstream, the Agua Fria River drains into the Gila River. The Granite Reef Aqueduct of the Central Arizona Project passes along the northwestern boundary of AUX-1, but it does not appear to affect on-site erosional features.

Fort Tuthill

Surface water runoff is generally down slope from south to north and from west to east at Fort Tuthill. In terms of soil limitations for septic tank leach fields, both the Brolliar and the Sponseller soil associations have severe limitations due to its slow permeability rate of less than 0.60 inches per hour. In addition, Brolliar soils tend to have a layer of bedrock 3–4 feet below the surface, further impacting infiltration.

2.3 Ecosystems and the Biotic Environment

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. Ecoregions are critical for structuring and implementing ecosystem management strategies across various agencies and organizations. Ecoregions are identified through the spatial patterns and composition of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. A Roman numeral hierarchical scheme has been adopted for different levels of ecological regions, with Level I being the coarsest and Level IV the most detailed. Luke AFB and AUX-1 lie within the Level III Sonoran Basin and Range Ecoregion, and within the Gila/Salt Intermediate Basins Level IV ecoregions (Griffith et al. 2014). The Gila/Salt Intermediate Basin ecoregion supports

the majority of the state's human population and has permanently altered ecological features and processes (Griffith et al. 2014).

Fort Tuthill lies within the Level III Arizona/New Mexico Mountains and within level IV Montane Conifer Forest ecoregions. The ecoregion is based upon the oldest mountains in the Southwest, containing Precambrian igneous rocks as old as 1.5 billion years. These older volcanic deposits are overlaid by recent sediments and recent Holocene volcanics. This results in a diverse physiographic region with elevations ranging from 6,000 to 9,700 feet in Arizona. The region contains more species of birds and mammals than any other place in the southwestern region of the U.S. (Bell et al. 1999). Ponderosa pine forests in the mountains are subject to fire and flood from poorly managed livestock grazing, fire suppression, and altered hydrological regimes on nearly all levels.

2.3.1 Vegetation

Luke AFB

Luke AFB is situated in the Lower Colorado River Valley Subdivision of the Sonoran Desert (Brown and Lowe 1980). The Lower Colorado River Valley Subdivision is the largest and most arid subdivision of the Sonoran Desert (Turner and Brown 1982). This subdivision is dominated by broad, intermontane plains of alluvial soils, although it is not restricted to this physical setting. Vegetation is generally open and simple, often with many hundreds of square miles dominated by one or two species of low-growing shrubs. The ground surface between shrubs may be fine-textured soil or desert pavements consisting of gravel or rock. Plants are drought-resistant with sclerophyllous adaptations to retard transpiration. Creosote bush (*Larrea tridentata*) is the dominant plant species at most localities, typically forming monotonous, uniform growth on the flat intermontane plains, occasionally broken by paloverde (*Parkinsonia* spp.) and mesquite (*Prosopis* spp.) along the washes.

AUX-1

As with Luke AFB, AUX-1 is situated in the Lower Colorado River Valley Subdivision of the Sonoran Desert (Turner and Brown 1982). Vegetation is composed almost entirely of drought-adapted (e.g., the microphyllous species) or drought-avoiding species (e.g., the macrophyllous species that are active only during periods of abundant moisture). The site has a history of disturbance and human use, which is manifested in the present distribution of vegetation across the site. In the absences of disturbance, AUX-1 would likely be dominated by a creosote bush-bursage (*Ambrosia* spp.) shrubland community, with mesquite and blue paloverde (*P. florida*) shrublands and woodlands occurring along the major drainages. At present, there are a few highly degraded creosote-bursage communities. A majority of AUX-1 is dominated by weedy perennial and annual species. Degraded mesquite and blue paloverde shrublands and woodlands are found along the drainages and a mesquite scrub shrub community grows in the low-lying areas.

Fort Tuthill

At an average elevation of 7,000 feet, Fort Tuthills is located in the cold-temperate climatic zone, which encompasses the Montane Conifer Forest biotic community (Brown and Lowe 1980). Generally, montane forests in the region can be divided into two major communities: a Ponderosa Pine forest and woodland, which is generally found at lower elevations and along south facing slopes;

and a Douglas Fir (*Pseudotsuga menziesii*), White Fir (*Abies concolor*), Limber Pine (*P. flexilis*), and Aspen (*Populus tremuloides*) forest community, which occurs on north facing slopes, in deep canyons, and at higher elevations.

The Fort Tuthill area is dominated by degraded ponderosa pine forests that occur in a "dog-hair thicket" stage characterized by numerous small and closely spaced trees. Gambel oaks (*Quercus gambelii*) are also present in small numbers, as well as a scattering of other tree species. An inventory of vertebrate and plant species likely to occur and actually observed at Fort Tuthill will be included when results from planned species and habitat surveys (see Table 10.1) are available.

2.3.2 Turf and Landscaped Areas

Luke AFB

The largest turf and landscape area at Luke AFB is the Falcon Dunes Golf Course, an 18-hole course occupying approximately 100 acres directly north of the main base. It was constructed as part of a Maricopa County Flood Control District project to contain flooding from Luke AFB and other nearby communities. The golf course is designed to contain runoff from a 100-year storm event. About 30 acres of the course are xeriscaped with regionally appropriate, drought-tolerant (low water use), native vegetation; only the greens, tees, fairways, and parts of the rough are turf.

AUX-1

There are not any landscaped areas at AUX-1.

Fort Tuthill

The only landscaped areas are around the main hotel and outbuildings. Ornamental landscaping is rudimentary around the cabins and vegetation is cleared away from the primitive campsites.

2.3.3 Fish and Wildlife

The last wildlife surveys at Luke AFB, AUX-1, and Fort Tuthill were conducted during the 1980s and 1990s. Luke AFB has programmed funding for the AGFD to conduct wildlife and habitat surveys to update the wildlife inventory. Surveying will begin in FY 2018 and continue for three years.

Luke AFB

Luke AFB is a highly developed area with some wildlife habitat utilized by an array of generalist species and no water resources for fish. Wildlife species present at Luke AFB are characteristic of the Lower Colorado River Valley Subdivision of the Sonoran Desert (Turner and Brown 1982) and urban-adapted species common to this area of Central Arizona. Small, nocturnal, burrowing species of Heteromyid rodents (e.g., pocket mice [*Chaetodipus* spp.] and kangaroo rats [*Dipodomys* spp.]); bats; and diurnal, burrowing species (e.g., round-tailed ground squirrel [*Xerospermophilus tereticaudus*]) are probably the most common and most likely to be encountered in areas that retain some natural habitat characteristics. Bats are unlikely to occur in large numbers over the highly urbanized and landscaped areas of the base. It is common, however, to find small numbers of foraging and/or roosting bats in the area. Other mammals likely to occur within the relatively intact native habitats include black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), kit fox

(*Vulpes macrotis*), and coyote (*Canis latrans*). Some species, particularly the desert cottontail and coyote, are highly adapted to urbanized settings and may utilize landscaped areas such as the golf course. The presence of these prey species may attract a variety of raptors, including (but not limited to) ferruginous hawks (*Buteo regalis*), red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), and western burrowing owls (*Athene cunicularia*), as well as vultures. These birds have been observed infrequently, but may occasionally hunt on these grounds or even become resident species.

Surveys conducted in the 1990s by the U.S. Army Corps of Engineers (USACE 1994) indicated that the most common birds at Luke AFB include the mourning dove (*Zenaida macroura*), horned lark (*Eremophila alpestris*), common starling (*Sturnus vulgaris*), great-tailed grackle (*Quiscalus mexicanus*), and house finch (*Haemorhous mexicanus*). Among this group of birds, the starling, grackle, and finch are mostly associated with human habitation and landscaped habitats. Mourning doves also occur in such habitats but are also very common in native habitats. Horned larks are most common in the open, mowed fields surrounding the base airfield. Reptiles and amphibians likely to occur at Luke AFB include common, widely distributed species, such as side-blotched lizard (*Uta stansburiana*), western whiptail lizard (*Cnemidophorus tigris*), gopher snake (*Pituophis catenifer*), Great Plains toad (*Anaxyrus cognatus*), and Couch's spadefoot toad (*Scaphiopus couchii*). Reptiles and amphibians are most likely to occur in natural areas, although they may occasionally occur in developed areas.

AUX- 1

The wildlife of AUX-1 is also characteristic of the Lower Colorado River Valley Subdivision of the Sonoran Desert (Turner and Brown 1982). Small mammal, bird, reptile, and amphibian species are the most commonly observed wildlife at AUX-1 (Dames & Moore 1994). Surveys from the 1990s describe the presence of desert cottontail, black-tailed jackrabbit, kangaroo rats and pocket mice (Dames & Moore 1994). Additionally, more than one hundred bird species have been observed at AUX-1 over the course of a year, including the spring and fall migration seasons (Dames & Moore 1994). Common bird species at AUX-1 include red-tailed hawk, mourning dove, greater roadrunner (*Geococcyx californianus*), common raven (*Corvus corax*), northern mockingbird (*Mimus polyglottos*), cactus wren (*Campylorhynchus brunneicapillus*), curve-billed thrasher (*Toxostoma curvirostre*), verdin (*Auriparus flaviceps*), and loggerhead shrike (*Lanius ludovicianus*). Reptiles consist of a diverse array of lizards and snakes; however, amphibians are limited in numbers due to the absence of aquatic habitats (Dames & Moore 1994). Common reptiles at AUX-1 include the desert spiny lizard (*Sceloporus magister*), western whiptail lizard, side-blotched lizard, tree lizard (*Urosaurus ornatus*), gopher snake, night snake (*Hypsiglena torquata*), and western diamondback rattlesnake (*Crotalus atrox*). Larger predators also likely inhabit the area. Potential dens observed at AUX-1 could have been constructed by either badgers (*Taxidea taxus*), kit foxes, or grey foxes (*Urocyon cinereoargenteus*), although the habitat is most typical of that occupied by kit foxes. Given the apparently healthy population of round-tailed ground squirrels and other rodents at the site, there may be a sufficient prey base present to support these predators. At least one coyote has been observed in the area.

Evidence of trespass cattle (*Bos taurus*) has been observed at AUX-1. Cattle grazing is not permitted at AUX-1, nevertheless cattle periodically find their way onto the site, representing a recurring problem. Human trespass is frequent, including pedestrians, horseback riders, and vehicles.

Fort Tuthill

The wildlife of Fort Tuthill is a combination typical to the ponderosa pine forest ecosystems of southwestern U.S. and for disturbed areas in the region. Large predators, such as black bears (*Ursus americanus*) and mountain lions (*Puma concolor*), as well as elk (*Cervus canadensis*) and deer (*Odocoileus* spp.), may be found at Fort Tuthill. Other species that have been observed at the site include house sparrows (*Passer domesticus*), house finches, and barn swallows (*Hirundo rustica*).

Feral animals, specifically common house cats (*Felis catus*), are common in the disturbed portions of Fort Tuthill and associated buildings. Feral and free-ranging cats have the potential to be serious pests at Fort Tuthill as they tend to impact native wildlife and migratory bird species. The DoD mandates that all domestic cats be kept indoors in order to keep them safe, and to prevent the killing of federally protected wildlife species on federal lands. Such incidents would violate the DoD's Memorandum of Understanding (MOU) with the USFWS to protect birds covered by the Migratory Bird Treaty Act or 1918 (MBTA).

2.3.4 Threatened and Endangered Species and Species of Concern

The most recent surveys for protected species conducted at Luke AFB, AUX-1, and Fort Tuthill took place in the 1980s and 1990s; no federal or state listed species were detected at that time. Beginning in 2018, Luke AFB has programmed funding to have the AGFD conduct a three-year survey for updating its knowledge of federal and state protected species and potential habitats on the installation. This section will be updated with new survey information once the survey analysis has concluded.

Special Status Species Definition

Special status species are species of plants and animals that, because of their scarcity or documented declining population in a state or nation, have been placed on a special status list. Those lists include any endangered, threatened, proposed, candidate, Species of Greatest Conservation Need (SGCN), or otherwise sensitive species. Both the USFWS and AGFD maintain such lists (Table 2.3).

The USFWS has the authority to list species of plants and animals as endangered or threatened for protection under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) (hereafter referred to as the ESA). The ESA is intended to provide a program of protection for listed species and the ecosystems upon which these species depend. Endangered species are those in danger of extinction throughout all or a significant portion of their ranges and threatened species are those likely to become endangered within the foreseeable future if corrective measures are not taken. Species proposed for listing as endangered or threatened are also protected by the ESA. All federal agencies are required to consult with the USFWS if actions they propose may affect a listed species.

Table 2.3: Federally threatened and endangered species and Arizona Species of Greatest Conservation Need at Luke AFB.

Common Name (*Scientific Name*)	Federal Status[1]	Arizona Status[2]/ SWAP Score[3]	Species of Greatest Conservation Need	Federal Register Reference
Mammals				
American beaver (*Castor canadensis*)	NL	1b	✓	
Antelope jackrabbit (*Lepus alleni*)	NL	1b	✓	
Arizona myotis (*Myotis occultus*)	NL	SC/1b	✓	
Arizona pocket mouse (*Perognathus amplus*)	NL	1b	✓	
Brazilian free-tailed bat (*Tadarida brasiliensis*)	NL	1b	✓	
California leaf-nosed bat (*Macrotus californicus*)	NL	SC/1b	✓	
Cave myotis (*Myotis velifer*)	NL	SC/1b	✓	
Greater western bonneted bat (*Eumops perotis californicus*)	NL	SC/1b	✓	
Harris' antelope squirrel (*Ammospermophilus harrisii*)	NL	1b	✓	
Jaguar (*Panthera onca*)	NL	1a	✓	
Kit fox (*Vulpes macrotis*)	NL	1b	✓	
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	LE	SC/1a	✓	53 FR 38456, 30 September 1988
Little pocket mouse (*Perognathus longimembris*)	NL	1b	✓	
Mexican gray wolf (*Canis lupus baileyi*)		LE,XN		
Ocelot (*Leopardus pardalis*)	LE	1a	✓	
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	S	SC/1b	✓	
Pocketed free-tailed bat (*Nyctinomops femorosaccus*)	NL	1b	✓	
Sonoran pronghorn (*Antilocapra americana sonoriensis*)	LE	SC/1a	✓	32 FR 4001, 11 March 1967
Spotted bat (*Euderma maculatum*)	NL	SC/1b	✓	
Western red bat (*Lasiurus blossevillii*)	S	1b	✓	

Common Name (*Scientific Name*)	Federal Status[1]	Arizona Status[2]/ SWAP Score[3]	Species of Greatest Conservation Need	Federal Register Reference
Western yellow bat (*Lasiurus xanthinus*)	NL	SC/1b	✓	
Yuma myotis (*Myotis yumanensis*)	NL	SC/1b	✓	
Birds				
Abert's towhee (*Melozone aberti*)	S	1b	✓	
Arizona Bell's vireo (*Vireo bellii arizonae*)	NL	1b	✓	
Bald eagle (*Haliaeetus leucocephalus*)	BGEPA	SC/1a		16 U.S.C. 668–668d
California least tern (*Sterna antillarum browni*)	LE			35 FR 8491, 2 June 1970
Ferruginous hawk (*Buteo regalis*)	NL	SC/1b	✓	
Gila woodpecker (*Melanerpes uropygialis*)	NL	1b	✓	
Gilded flicker (*Colaptes chrysoides*)	NL	1b	✓	
Golden eagle (*Aquila chrysaetos*)	BGEPA	1b	✓	
Le Conte's thrasher (*Toxostoma lecontei*)	MBTA	SC/1c		16 U.S.C. 703–712
Lincoln's sparrow (*Melospiza lincolnii*)	NL	1b	✓	
Pacific wren (*Troglodytes pacificus*)	NL	1b	✓	
Savannah sparrow (*Passerculus sandwichensis*)	NL	1b	✓	
Sprague's pipit (*Anthus spragueii*)	NL	SC/1a	✓	
Western burrowing owl (*Athene cunicularia hypugaea*)	MBTA	SC/1c		16 U.S.C. 703–712
Wood duck (*Aix sponsa*)	NL	1b	✓	
Yellow warbler (*Setophaga petechial*)	NL	1b	✓	
Yellow-billed cuckoo (*Coccyzus americanus*)	LT	SC/1a	✓	79 FR 59991, 3 October 2014
Yuma clapper rail (*Rallus longirostris yumanensis*)	LE	SC/1a	✓	32 FR 4001, 11 March 1967
Reptiles				
Desert mud turtle (*Kinosternon sonoriense sonoriense*)	NL	1b	✓	
Gila monster (*Heloderma suspectum*)	NL	1a	✓	
Regal horned lizard (*Phrynosoma solare*)	NL	1b	✓	

Common Name (*Scientific Name*)	Federal Status[1]	Arizona Status[2]/ SWAP Score[3]	Species of Greatest Conservation Need	Federal Register Reference
Saddled leaf-nosed snake (*Phyllorhynchus browni*)	NL	1B	✓	
Sonoran collared lizard (*Crotaphytus nebrius*)	NL	1B	✓	
Sonoran coralsnake (*Micruroides euryxanthus*)	NL	1B	✓	
Sonoran Desert toad (*Incilius alvarius*)	NL	1B	✓	
Sonoran Desert tortoise (*Gopherus agassizii*)	NL	SC/1B	✓	
Sonoran whipsnake (*Coluber bilineatus*)	NL	1B	✓	
Tiger rattlesnake (*Crotalus tigris*)	NL	1B	✓	
Tucson shovel-nosed snake (*Chionactisoccipitalis klauberi*)	NL	SC/1B	✓	
Variable sandsnake (*Chilomeniscus stramineus*)	NL	1B	✓	
Amphibians				
Arizona toad (*Anaxyrus microscaphus*)	NL	SC/1B	✓	
Lowland leopard frog (*Lithobates yavapaiensis*)	S	SC/1A	✓	
Plants				
Acuna cactus (*Echinomastus rectocentrus* var. *acunensis*)	LE	HS		78 FR 60607, 1 October 2013
Arizona agave (*Agave arizonica*)	NL	HS		
Arizona bugbane (*Cimicifuga arizonica*)	NL	HS		
Arizona clematis (*Clematis hirsutissima Pursh* var. *arizonica*)	NL	HS		
Arizona cliffrose (*Purshia (=Cowania) subintegra*)	LE	HS		49 FR 22326, 29 May 1984
Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*)	LE	HS		44 FR 61556, 25 October 1979
Brady pincushion cactus (*Pediocactus bradyi*)	LE	HS		44 FR 61784, 26 October 1979
Canelo Hills ladies-tresses (*Spiranthes delitescens*)	LE	HS		62 FR 665, 6 January 1997
Catalina beardtongue (*Penstemon discolor*)	NL	HS		

Common Name (*Scientific Name*)	Federal Status[1]	Arizona Status[2]/ SWAP Score[3]	Species of Greatest Conservation Need	Federal Register Reference
Chiricahua dock (*Rumex orthoneurus*)	NL	HS		
Cochise pincushion cactus (*Coryphantha robbinsiorum*)	LT	HS		51 FR 952, 9 January 1986
Desert Christmas tree (*Pholisma arenarium*)	NL	HS		
Fickeisen plains cactus (*Pediocactus peeblesianus fickeiseniae*)	LE	HS		78 FR 60607, 1 October 2013
Gentry milk vetch (*Dalea tentaculoides*)	NL	HS		
Gierisch mallow (*Sphaeralcea gierischii*)	LE			78 FR 49149, 13 August 2013
Golden-chested beehive cactus (*Coryphantha recurvate*)	NL	HS		
Goodding's onion (*Allium gooddingii*)	NL	HS		
Holmgren milk-vetch (*Astragalus holmgreniorum*)	LE	HS		66 FR 49560, 28 September 2001
Huachuca groundsel (*Senecio huachucanus*)	NL	HS		
Huachuca water-umbel (*Lilaeopsis schaffneriana* var. *recurve*)	LE	HS		62 FR 665, 6 January 1997
Jones cycladenia (*Cycladenia humilis* var. *jonesii*)	LT			51 FR 16526, 5 May 1986
Kaibab pincushion cactus (*Pediocactus paradinei*)	NL	HS		
Kearney's blue-star (*Amsonia kearneyana*)	LE	HS		54 FR 2131, 19 January 1989
Lemmon's fleabane (*Erigeron lemmonii*)	NL	HS		
Murphey's century plant (*Agave murpheyi*)	NL	HS		
Navajo sedge (*Carex specuicola*)	LT	HS		50 FR 19370, 8 May 1985
Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*)	LE	HS		44 FR 61927, 26 October 1979
Parish alkali grass (*Puccinellia parishii*)	NL	HS		
Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*)	LE	HS		44 FR 61922, 16 June 1976

Common Name (*Scientific Name*)	Federal Status[1]	Arizona Status[2]/ SWAP Score[3]	Species of Greatest Conservation Need	Federal Register Reference
Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*)	LE	HS		58 FR 49875, 23 September 1993
San Francisco Peaks groundsel (*Senecio franciscanus*)	LT	HS		48 FR 52743, 22 November 1983
San Francisco Peaks ragwort (*Packera franciscana*)	LT			48 FR 52743, 22 November 1983
Sandfood (*Pholisma sonorae*)	NL	HS		
Santa Rita mountain yellowshow (*Amoreuxia gonzalezii*)	NL	HS		
Sentry milk-vetch (*Astragalus cremnophylax* var. *cremnophylax*)	LE	HS		55 FR 50184, 5 December 1990
Siler pincushion cactus (*Pediocactus (=Echinocactus=Utahia) sileri*)	LT	HS		44 FR 61786, 26 October 1979
Smallflower century plant (*Agave parviflora*)	NL	HS		
Texas purple spike (*Hexalectris warnockii*)	NL	HS		
Tonto Basin century plant (*Agave delamateri*)	NL	HS		
Trelease's century plant (*Agave schottii Engelm.* var. *treleasei*)	NL	HS		
Welsh's milkweed (*Asclepias welshii*)	LT			52 FR 41435, 28 October 1987
Yellow lady's slipper (*Cypripedium calceolus* var. *pubescens*)	NL	HS		
Zuni fleabane (*Erigeron rhizomatus*)	LT			50 FR 16680, 26 April 1985

[1] **Federal Status:** BGEPA=Bald and Golden Eagle Protection Act, LE=Endangered (U.S. Fish and Wildlife Service), LT=Threatened (U.S. Fish and Wildlife Service), MBTA=Migratory Bird Treaty Act, NL=Not listed, S=Sensitive species (Bureau of Land Management and/or U.S. Forest Service), SC=Species of Concern (U.S. Fish and Wildlife Service).

[2] **Arizona Status:** LE=Listed endangered, HS=Highly Safeguarded, SC=Species of Concern, NA=Not Applicable, NR=Not Rated, XN=Experimental non-essential population.

[3] **Arizona State Wildlife Action plan (SWAP) score (species' vulnerability):** 1A=Scored 1 for vulnerability in at least one of eight vulnerability categories and matches at least one of the following: federally listed as E, T, or Candidate species; specifically covered under a signed conservation agreement or a signed conservation agreement with assurance; recently delisted federally and requires post-delisting monitoring;; closed-season species (i.e., no take permitted), as identified in Arizona Game and Fish; 1B=Scored 1 for vulnerability, but matches none of the criteria listed under 1A; 1C=Unknown status species.

The SGCN list identifies species of concern to the AGFD because their occurrence in Arizona is or may be in jeopardy. Its focus is the degree to which habitats or populations have been impacted and each species' probability of extirpation from Arizona. Known threats and documented population declines are now more important factors than limited distributions. The Arizona Species SGCN list reflects the best information available.

Many native plant species are afforded protection by the Arizona Department of Agriculture (ADA) under the Arizona Native Plant Law, and are categorized as highly safeguarded, salvage restricted, export restricted, salvage assessed, and harvest restricted (ADA 1994). Many plants that fall under the protection of the Arizona Native Plant Law including ironwood (*Olneya tesota*), mesquite, paloverde, ocotillo (*Fouquieria splendens*), and all species of cacti are known to occur at Luke AFB and AUX-1.

2.3.4.1 Migratory Bird and Treaty Act

The MBTA, a federal statute that implements four treaties with the U.S. and Canada, Mexico, Japan, and Russia, is designed to conserve more than 800 species of migratory birds (50 Code of Federal Regulations [CFR] 10.13). The MTBA prohibits the taking, killing, or possessing of migratory birds unless permitted by regulation. In 2003, the National Defense Authorization Act (Public Law 107-314) directed the Secretary of the Interior to exercise his or her authority under the MBTA to prescribe regulations exempting the Armed Forces from incidental take during military readiness activities authorized by the Secretary of Defense. Effective 30 March 2007, the USFWS issued a Final Rule authorizing the take of migratory birds resulting from military readiness activities, provided such activities do not have a significant adverse effect on a given population (USFWS 2007b).

Executive Order (EO) 13186 directs agencies to take certain actions that further strengthen migratory bird conservation under the conventions under the MBTA, the Bald and Golden Eagle Protection Act (BGEPA, 16 U.S.C. § 668, as amended in 1972) (hereafter referred to as the BGEPA) (USFWS 2007a), and other pertinent statutes. It requires establishing MOUs between the USFWS and other federal agencies. Accordingly, DoD and USFWS implemented an MOU in 2010 to promote the conservation of migratory birds (DoD and USFWS 2006). This MOU describes specific actions that should be taken by DoD to advance migratory bird conservation: avoid or minimize the take of migratory birds and ensure that DoD operations—other than military readiness activities—are consistent with the MBTA.

The Environmental Impact Statement (EIS) F-35A Training Basing Mitigation Plan for Luke AFB (USAF Air Education and Training Command 2013) also addresses migratory bird protection. The plan stipulates that, in the military training airspace, (1) existing flight restrictions concerning altitude and offset distances from sensitive species will be adhered to strictly, and (2) the quarter statute mile overflight avoidance of Mexican spotted owl activity centers will be maintained (as stated via informal consultation with the USFWS). The plan also stipulates that an open dialogue will continue between 56 RMO Airspace Managers and Environmental Science staff to (1) ensure compliance with biological opinions and identify/address any emerging issues associated with airspace use, and (2) ensure that protected owl-activity centers are charted and avoidances are described on in-flight guides for military training routes, respectively. Continued

monitoring/recording/tracking of deviations and noise complaints and communicate reported deviations with appropriate offices.

2.3.4.2 Bald and Golden Eagle Protection Act

In addition to the MBTA, the BGEPA prohibits any form of possession or take of bald or golden eagles (including any body part, nest, or egg) unless allowed by permit. The BGEPA defines take as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." On 14 December 2016, the USFWS issued a Final Rule (50 CFR Parts 13 and 22) revising the regulations on permits for incidental take of eagles and eagle nests to improve regulations clarity and improve compliance while maintaining strong protection for eagles Revisions include changes to permit issuance and duration, definitions, compensatory mitigation standards, criteria for nest removal permits, permit application requirements, and fees (50 CFR Parts 13 and 22).

2.3.5 Wetlands and Floodplains

Luke AFB

No wetlands have been identified at Luke AFB (CDM Federal Programs Corporation [CDMFPC] 1995). A drainage ditch located on the northern boundary of the base was found to support hydrophytic vegetation and there was evidence of wetland hydrology, but hydric soils were not present. A site must display evidence of all three wetland indicators to be considered a wetland or, in the case of a problem area (i.e., arid regions), hydric soil indicators are considered a constant factor during the drier times of the growing season (CDMFPC 1995).

AUX-1

There are no wetlands at AUX-1 (CDM Federal Programs Corporation [CDMFPC] 1995).

Fort Tuthill

There are no wetlands at Fort Tuthill.

2.3.6 Other Natural Resources Information

Details of landscaped areas at Luke AFB are provided in section 7.7 of this document and in the Luke AFB Landscape Design and Maintenance Standards Plan (Sherman Group 2003).

2.3.7 Mission Impacts on Natural Resources

Existing natural resources and outdoor recreation at Luke AFB, AUX-1, and Fort Tuthill are described in the following sections. Descriptions of existing conditions for this INRMP are based on information in the Field Survey Report (CDMFPC 1995) prepared in support of this INRMP and field investigations (Cristoffer 1994).

Potential impacts to natural resources due to facilities expansion or mission changes should be considered during planning. Management issues and concerns should focus on habitat for protected species, drainage concerns, and compatible land use.

To facilitate effective ecosystem management for Luke AFB, AUX-1, and Fort Tuthill, impacts on natural resources from activities carried out to meet the military mission must be understood and incorporated into a management framework. Biodiversity goals must be defined and objectives designed to meet those goals and should be integrated into management strategies. Data gaps should be identified and filled to ensure a comprehensive approach.

2.3.8 Land Use

Luke AFB

Luke AFB, comprising 3,054 acres (owned) and 1,788 acres (under easement), is the largest F-16 fighter-training base in the world. The population of Luke AFB averages about 5,500, including military and civilian employees. The majority of Luke AFB is developed with military and military-support buildings. The military buildings are controlled access areas, where only military personnel are permitted. These areas include, numerous hangars, radar and logistics areas, the munitions storage area, the fuels distribution and storage areas, the Armstrong and Avionics Laboratories, and generally all areas immediately adjacent to the tarmac. Military support facilities include dormitories, housing areas, medical facilities, hobby buildings, military retail facilities, warehouses, classrooms, offices, dining halls, leisure areas, and recreational buildings.

The undeveloped or semi-developed lands of Luke AFB include areas adjacent to the runways and surrounding the munitions storage area. These areas are designated as clear zones and will remain undeveloped as long as the fighter-training operations continue.

There is an 18-hole golf course occupying approximately 100 acres directly to the north of the main part of the base. The course has been planted with native grasses to control erosion and suppress dust. It was constructed as part of a project to control flooding at Luke AFB and nearby communities in agreement with Maricopa County Flood Control District. The golf course was designed to contain runoff from storm events of up to 100-year flows.

AUX-1

AUX-1 is currently used for precision-approach landing practice by jet-fighter aircraft. Fighter pilots approach the abandoned runway in landing mode and execute basic landing procedures, but they do not actually touch down on the surface during these maneuvers. The airspace above AUX-1 is labeled "Alert Area A-231—Concentrated Student Jet Transition Training" on the Phoenix Sectional Aeronautical Chart. This restricted zone encompasses the air space between 500 and 6,500 feet above ground level (AGL) (Dames & Moore 1994).

Most of the site is undeveloped land, with the exception of a radar facility and portable generator station. The radar facility and generator are used to support pilot training. The runways represent developed lands, even though they are not maintained and vegetation has grown into the asphalt. Other developments include a limited number of dirt roads; primitive areas cleared for bivouac facilities; parking; and a number of foxholes, trenches, and gun emplacements for personnel of Luke AFB and other military forces during field-deployment training.

Fort Tuthill

Fort Tuthill, is approximately 14.5 acres in size and is used for lodging and outdoor recreation. The lower portion of the recreation area is developed, with little remaining vegetation typical of the natural ponderosa pine forest community. Fort Tuthill is essentially a campground with a variety of cabins, open spaces with *ramadas*, and a hotel.

2.3.9 Current Major Impacts

Most current and future impacts associated with military activities at Luke AFB are associated with the F-35A beddown and were analyzed in the 2012 *Final F-35A Training Basing Environmental Impact Statement* (EIS) (HQ Air Education and Training Command 2012). Construction started in 2013 and will continue through 2023. Construction for the beddown will occur on approximately 22.6 acres of previously disturbed area, primarily along the flightline. No long-term effects on vegetation and wildlife are anticipated. Revegetation of disturbed areas would be conducted with fresh landscaping. Construction activities are monitored as part of the F-35A EIS Mitigation and Monitoring Plan (USAF 2013). To date, no adverse effects to the natural environment have occurred from the F-35 support construction program.

Noise levels in the vicinity of Luke AFB are expected to be qualitatively similar to existing noise. Wildlife species on base live in a military airfield environment and are not expected to be adversely affected by changes in aircraft overflight and noise associated with the F-35A.

In 2010, proposed enhancements at BMGR to support the F-35 beddown were analyzed in the *Final EIS for Proposed BMGR East Range Enhancements* (USAF 2010) and approved for implementation in a Record of Decision. To improve operations, the Record of Decision approved lowering the operational floor of R-2301E restricted airspace over the Cabeza Prieta National Wildlife Refuge to enable fixed-wing aircraft aircrews to perform realistic low-level attacks on targets located in the South Tactical Range and realistic low-level air-to-air intercepts in the air-to-air combat tactics range. Overflights of the refuge are currently restricted to altitudes of 1,500 feet AGL or above, except within approved corridors, under the terms of a 1994 Memorandum of Understanding (MOU) between the DoD and U.S. Department of the Interior. The 2010 EIS assessed proposals to lower the floor to 500 feet AGL to support low-level attack and intercept training that would provide combat conditions that aircrews may encounter in real-world scenarios. This approved action will not be implemented until the MOU is renegotiated.

The impacts of low-level flying in the military operating area were analyzed in the *F-35A Training Basing EIS* (HQ Air Education and Training Command 2012). Based on the very low percentage of time spent in low-level flight by F-35As training within the airspace and on the previous and ongoing exposure of wildlife to training by other aircraft in the airspace, no significant adverse effects on vegetation or wildlife from overflights or noise are anticipated.

Recent environmental impacts at Luke AFB can be attributed to the construction of the 10-megawatt solar array that is located south of Super Sabre Street and west of the Munitions Storage Area. Luke AFB entered into an enhanced-use lease with Arizona Public Service, the base's provider of electricity, to build and operate the solar array on 107 acres of undisturbed land on the south side of

the base. The entire 107 acres have been cleared to make way for the photovoltaic panels, with the exception of the major drainage west of the Munitions Storage Area that bisects the solar array. The drainage was conserved to maintain a microphyll (i.e., primitive plants with leaves that have one single, unbranched leaf vein) woodland, an important habitat type that support 90 percent of the birdlife, while occupying only five percent of the Sonoran Desert landscape (Dimmitt 2000). Environmental benefits of the solar array are expected to include an offset of 1,847 pounds/Megawatt hours (MWh) of CO_2 emissions and 491 gal/MWh of water consumption that would otherwise be generated/consumed by a coal-fired electric-generating facility. Construction of the solar array was completed in June 2016.

Growing evidence suggests that solar arrays may impact wildlife species; in particular, they may attract migratory shore and marsh birds. Although a study to understand the extent of impacts from the array at Luke AFB has not been implemented, any species found near the solar array are documented and reported to 56 RMO staff.

2.3.10 Potential Future Impacts

The projected transition from the use of fourth-generation aircraft (such as the A-10 and F-16) to fifth-generation aircraft (the F-35) will require Luke AFB to update and adapt facilities for proper maintenance, operation, and storage requirements. Ongoing construction needs will continue through 2023. To date, no adverse effects to the natural environment have occurred from the F-35 support construction program.

CHAPTER 3 ENVIRONMENTAL MANAGEMENT SYSTEM

The USAF environmental program adheres to the Environmental Management System (EMS) framework and its "Plan, Do, Check, Act" cycle for ensuring mission success. EO 13693, *Planning for Federal Sustainability in the Next Decade*; DoDI 4715.17, *Environmental Management Systems* (DoD 2017c); AFI 32-7001, *Environmental Management*, with guidance changes (USAF 2017a); and International Standards guidance ISO 14001:2004 (International Organization for Standards 2004), provide guidance on how environmental programs should be established, implemented, and maintained to operate under the EMS framework.

The Natural Resources Programs employ EMS-based processes to achieve compliance with all legal obligations and current policy drivers by 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.

The host command at Luke AFB is the 56 FW. The 56 FW enterprise includes Luke AFB, AUX-1, Fort Tuthill, BMGR East, and the Gila Bend AFAF. Within the boundaries of Luke AFB, there are a number of tenant units. The scope of Luke AFB's EMS includes all the activities, services, and products associated with the operations of the 56 FW and tenants.

The 56 FW Civil Engineer Squadron/Civil Engineer Environmental Element (CES/CEIE) provides Luke AFB, AUX-1, Fort Tuthill, Gila Bend AFAF, and tenants with effective program management and technical oversight of all environmental aspects. The 56 FW RMO Environmental Science Management (ESM) (56 RMO/ESM) manages the natural and cultural resource aspects of BMGR East, while 56 CES/ CEIE manages the other compliance aspects of BMGR East.

The Luke AFB ESM Commitment Statement reads as follows:

> "The 56 FW enterprise is committed to building the future of airpower in an environmentally responsible manner. We will comply with all environmental regulations and AF [USAF] instructions, and strive for continual improvement in our environmental performance. This commitment encompasses the integration of sound environmental practices into our daily decisions and activities while recognizing the regional environmental concerns of air quality and water availability. In support of this commitment, we will:
>
> - "Set environmental goals, measure progress, and communicate results via the Cross Functional Team and Environmental, Safety, and Occupational Health Council.
> - Maintain an effective sustainability program to minimize the generation of wastes and encourage recycling.
> - Conduct regular environmental performance assessments, and develop plans to address noncompliance situations.
>
> "Supporting this EMS commitment is the responsibility of every member of the Luke AFB community in accordance with his or her role and responsibilities in the organization."

CHAPTER 4 GENERAL ROLES AND RESPONSIBILITIES

General roles and responsibilities 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.

Table 4.1: General roles and responsibilities necessary to implement and support the Natural Resources Program.

Office/Organization/Job Tile (not in order of responsibility)	Installation Role/Responsibility Description
Installation Commander	The 56 FW Commander has delegated authority and oversight for all Luke AFB functions, including those occurring on all outlying and satellite areas. **Roles and Responsibilities** • Approve the INRMP by signature and certifies all INRMP revisions. • Ensure that the INRMP is consistent with the use of the installations to ensure the preparedness of the Armed Forces. • Control access to and use of natural resources. • Commit to seek funding and execute all "must fund" projects and activities within identified timeframe. • Provide appropriate staffing to execute INRMP implementation.
AFCEC Natural Resources Media Manager/Subject Matter Expert (SME)/Subject Matter Specialist (SMS)	Advocate for resources and funding to implement approved INRMPs.
Installation Natural Resources Manager/POC	• Support military training by managing the natural resources in accordance with applicable laws, executive orders, and directives. • Coordinate INRMP updates, revisions, and implementation requirements with applicable federal, state, and tribal government agencies, as well as nongovernmental organizations and parties.
Installation Security Forces	N/A
Installation Wildland Fire Program Manager	N/A

Office/Organization/Job Tile (not in order of responsibility)	Installation Role/Responsibility Description
Pest Manager	• Serve as primary POC for all base pesticide use. • Assist natural resources staff with the safe, effective, economical, and environmentally acceptable management of pests.
Range Operating Agency	N/A
Conservation Law Enforcement Officer (CLEO)	N/A
National Environmental Policy Act/Environmental Impact Analysis Process (NEPA/EIAP) Manager	Conduct NEPA/EIAP for all installation projects in coordination with the Natural Resources Managers.
U.S. Forest Service	• Manage the Coconino National Forest surrounding Fort Tuthill. • Serve as the participating agency in the Greater Flagstaff Forest Partnership. • Coordinate with adjacent landowners (Fort Tuthill) to reduce wildfire risk and improve public safety and health through large-scale forest thinning and other fire-suppression activities.
U.S. Fish and Wildlife Service	• Serve as the implementing agency for the ESA, MBTA, and BGEPA. • Conduct Section 7 consultations and issue biological opinions as warranted. • Work with federal and non-federal partners toward recovery of listed species.
Arizona Game and Fish Department	• Provide primary jurisdiction over wildlife management, except where pre-empted by federal law. • Provide assistance for INRMP development and implementation through the 2015 Cooperative Agreement (USACE and AGFD 2015). • Develop and maintain habitat assessment/evaluation, protection, management, and enhancement projects. • Conduct wildlife monitoring. • Manage wildlife predators and recovery of protected species in accordance with the ESA, shared responsibility with the USFWS.

CHAPTER 5 TRAINING

USAF installation Natural Resource Manager/Point of Contact (NRM/POC) personnel 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.

Training requirements and suggested trainings for Luke AFB natural resource support personnel are listed below.

- All natural resources managers are required to complete *DoD Natural Resources Compliance.*
- All personnel tasked with handling or managing protected species should complete *Interagency Consultation for Endangered Species* and/or other courses related to the ESA, MBTA, and BGEPA.
- Natural resource management personnel shall be encouraged to attain professional registration, certification, or licensing for their related fields and may be allowed to attend appropriate national, regional, and state conferences and training courses.
- All individuals who will be enforcing fish, wildlife, and natural resources laws on USAF lands must receive specialized, professional training on the enforcement of fish, wildlife, and natural resources laws in compliance with the Sikes Act. This training may be obtained by successfully completing the Land Management Police Training course at the Federal Law Enforcement Training Center (http://www.fletc.gov/).
- Individuals participating in the capture and handling of sick, injured, or nuisance wildlife should receive appropriate training, including training that is mandatory to attain any required permits.
- Personnel supporting the BASH program should receive flight-line drivers training, training in identification of bird species occurring on airfields, and specialized training in the use of firearms and pyrotechnics as appropriate for their expected level of involvement.
- The DoD-supported publication *Conserving Biodiversity on Military Lands—A Handbook for Natural Resources Managers* provides guidance, case studies and other information regarding the management of natural resources on DoD installations.

CHAPTER 6 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

Military installations maintain required records in accordance with Air Force Manual 33-363, Management of Records (USAF 2008), and dispose of records in accordance with the Air Force Records Management System records disposition schedule (USAF 2018). Numerous types of records must be maintained to support implementation of the Natural Resources Programs. Specific records are identified in applicable sections of this plan, in the Natural Resources Playbook, and in referenced documents.

All natural resources-related documentation is stored and maintained at Building 500, Luke AFB. The 56 CES maintains a Geographic Information Systems (GIS) server for data, which resides in the 56th Comm Network Communication Center and is on the Non-classified Internet Protocol Router Network (NIPRNet).

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.

CHAPTER 7 NATURAL RESOURCES PROGRAM MANAGEMENT

A primary goal of integrated natural resource planning is to maintain ecosystem integrity and dynamics without compromising the military mission. Maintaining healthy ecosystems promotes good stewardship by protecting existing biodiversity, ensures sustainable use of the facility, and minimizes management costs and efforts.

Goals are overall statements of what conditions are desirable within the installation. Objectives are more specific actions designed to meet the stated goals. Objectives are based on current and anticipated conditions. This INRMP must be reviewed over time to ensure that implementation of the objectives is proving effective in working toward achieving stated goals. As resource concerns arise and conditions change, or if goals are not being met, the objectives must be altered to meet those changing needs. The INRMP provides the flexibility to allow for such changes.

7.1 Fish and Wildlife Management

Applicability Statement

This section applies to USAF installations that require fish and wildlife management. This section IS applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Many of the flora and fauna surveys took place in the 1990s and are considered outdated. As a result, Luke AFB has approved funding for conducting surveys over the next five years. Survey results will be incorporated into this INRMP during the annual review process. The following outlines the planned projects to update the species and species habitat information within this INRMP.

FY 2018

- Bird species and migratory bird species survey
- Species, species at risk and candidate/concern species survey
- Habitat and vegetation classification survey

FY 2019

- Habitat and invasive species survey

FY 2020

- Habitat and invasive species survey

Luke AFB

Of primary importance to wildlife species currently occurring at Luke AFB is protecting and conserving portions of the base that support natural, undisturbed vegetation. The 56 CES Environmental Element at Luke AFB must be contacted before any ground-disturbing activities are authorized in these areas. If possible, future development should avoid the major drainage (west of the munitions enclosure) that supports microphyll woodlands and smaller patches of this valuable wildlife habitat type. In terms of wildlife diversity, these areas probably support the most species on

Luke AFB, providing food, cover, and relatively more water for wildlife than the adjacent desert scrub or disturbed areas. In particular, microphyll woodlands should be preserved, as they are likely to support more nesting bird species in comparison to adjacent areas. Microphyll woodlands represent an important resource for resident and Neotropical migratory birds, as well as various small mammals that forage on the seeds produced by the mesquite trees.

In addition to seeds, leaves from the rich ephemeral flora associated with the drainage area provide an important food source for herbivores. Many species of reptiles occur in these drainages, where forage (insects, fruits, green plants, and lizard prey) is more readily available. The protection and conservation of the remaining undisturbed desert scrub vegetation is also desirable. These areas support a host of small mammals, birds, reptiles, and amphibians, and they add an important habitat component for wildlife utilizing the contiguous wash areas. Future development or ground disturbing activities should be restricted to the relatively extensive areas that are already disturbed.

The base housing areas support a variety of large trees, shrubs, and herbaceous flowering plants that provide some foraging and roosting habitat for resident and Neotropical migratory birds. Current conditions should be maintained by replacing or replanting trees and shrubs lost to disease or storms. Native trees should be used to replace ornamental and other non-native trees that are lost (USACE 1994, Clark and Ingraldi 2017).

Ferruginous hawks and western burrowing owls, both protected by the MBTA, are observed at Luke AFB, but they are observed infrequently. The mowed areas around the runways at Luke AFB could provide suitable foraging habitat for ferruginous hawks. This is especially true in early fall and spring when the round-tailed ground squirrel, an important prey species, is active. Ferruginous hawks also have been observed on base in winter and may be attracted by Arizona cotton rats (*Sigmodon arizonae*) that can be found in this disturbed habitat.

Management of an area for special status wildlife species usually involves initiating techniques known to improve habitat and/or food resources for them. However, encouraging the ferruginous hawk population at Luke AFB also increases BASH issues. The goal of management at all USAF bases is to reduce the potential for bird/wildlife air strike hazards by discouraging birds to enter areas of aircraft operation (USACE 1994). As such, a change in maintenance procedures has been recommended to protect aircraft, pilots, and birds of conservation concern (USACE 1994). Any airfield maintenance activity that disturbs a relatively large area of ground (e.g., mowing, construction, etc.) should not be scheduled during hawk migration season (i.e., mid-August, October, November, February, March). Such activity would potentially attract more raptors to feed on rodents displaced by mowing into open areas of the base, which would increase the potential for an aircraft-bird strike and its catastrophic consequences to the pilot, aircraft, and bird (USACE 1994).

The presence of introduced feral animals can have a negative impact on native wildlife. The most prevalent feral animal species is the common house cat, which is found in the disturbed portions of Luke AFB and associated building structures. Feral cats have the potential to be serious pests at Luke AFB and negatively affect native wildlife and migratory bird species. The DoD requires that all cats be kept indoors to keep them safe and to prevent them from killing federally protected wildlife on

federal lands, which would be a violation of DoD's MOU with the USFWS to protect birds covered by the MBTA.

AUX-1

Whereas much of AUX-1 is disturbed, important wildlife habitat does remain along the major drainages of this facility. These drainages support microphyll woodlands, which include small mesquite and blue paloverde trees important to Neotropical migratory birds and a variety of other wildlife species discussed in the previous section. All ongoing and future activities should avoid any ground-disturbing activities in these drainages. Ground-disturbing activities should be confined to previously disturbed areas of relatively low wildlife habitat value. These areas, have been mapped as forb, grass, and creosote bush mixed communities and account for the majority of the surface area at AUX-1. As such, there should be sufficient area to accommodate all ongoing and future training activity.

Deployed troops shall not shoot at, chase, scare, or in any other way harass wildlife at the AUX-1 site, including snakes, lizards, birds, or mammals.

Fort Tuthill

Wildlife at Fort Tuthill should benefit from the proposed tree thinning, exotic plant removal, and wildflower plantings occurring at the area. A Watchable Wildlife program may be initiated at Fort Tuthill to enhance user enjoyment and expand recreational opportunities. Since there is no hunting allowed at Fort Tuthill, emphasis should be placed on non-game species. More specific objectives will be created in collaboration with the AGFD and other interested organizations.

Feral cats have the greatest potential to be serious pests at Fort Tuthill and have a negative impact on native wildlife and migratory bird species. To reduce the killing of birds and other wildlife, Luke AFB has initiated a live trapping and removal program for feral cats. All animals are captured humanely and turned over to the local Humane Society for care.

7.2 Outdoor Recreation and Public Access to Natural Resources

Applicability Statement

This section applies to USAF installations that have available recreational activities. This section IS applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Luke AFB

There are limited outdoor recreational opportunities at Luke AFB. Military personnel and civilians interested in hiking, birdwatching, nature observations, and small game hunting should be directed to the larger natural areas available for these activities outside the installation.

AUX-1

Recreational activities at this site are restricted and generally not allowed because of potential interference with military field-training maneuvers. Moreover, field-training maneuvers could pose a threat to the health and safety of recreational users. If the operational status of AUX-1 were to change and safety of recreational users was not an issue, potential outdoor recreational activities available to the public could include hunting, hiking, off-road bicycling, rock hounding, nature photography, and birdwatching. Any small game hunting at AUX-1 would require a hunting license from AGFD.

Fort Tuthill

Presently, there is no permanent Watchable Wildlife program Fort Tuthill. Because the primary purpose of Fort Tuthill is to provide natural-resource based recreation for USAF personnel, it seems the most likely place to initiate such a program. One possibility is to make visitors more aware of the recreational opportunities on the county, state, and U.S. Forest Service lands adjacent to Fort Tuthill, where certain species such as elk and deer are more likely to be seen. There is an extensive network of hiking and bicycle trails within easy access to Fort Tuthill visitors, as well as other activities (Figure 7.1).

Figure 7.1: Nature trails can be found throughout the campgrounds at Fort Tuthill. Photo courtesy of Senior Airman Darlene Seltmann.

7.3 Conservation Law Enforcement

Applicability Statement

This section applies to USAF installations that require conservation law enforcement. This section **IS NOT** applicable to Luke AFB, AUX-1, and Fort Tuthill. Natural Resources staff are supported by the 56th Security Forces Squadron. With regard to conservation law enforcement needs, the NRM coordinates with the Security Forces and USFWS and AGFD enforcement personnel, as necessary. USAF policy permits access to installations by federal, state, and local conservation personnel for enforcement duties.

7.4 Management of Threatened and Endangered Species, Species of Greatest Conservation Need, and Habitats

Applicability Statement

This section applies to USAF installations that provide suitable habitat and where sensitive species are known to occur. This section **IS NOT** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Conclusions from past surveys indicate that there are no special-status plant or animal species at Luke AFB, AUX-1, or Fort Tuthill that reside and rely on resources at either site. The installation, however, is interested in updating its knowledge on the existence of resident and migratory birds, protected species, and species habitat and has secured funding for these surveys to occur over the next three years (FY 2018–2020). This section will be updated during annual reviews with the results of those surveys and any new management actions to be implemented if protected species or habitat are found.

Species protected by the MBTA or ESA and species listed by AGFD as SGCN are discouraged from occurring on the Luke AFB airfield to minimize the risk of BASH issues and the risk of protected species mortality. Whereas species protected by the MBTA and listed by AGFD as SGCN could occur at AUX-1, AFI 91-202 (USAF 2017d) clarifies that, to reduce BASH issues, airfields and the surrounding airfield environments are not to be managed as wildlife habitat. A U.S. Department of Agriculture (USDA) Animal Planet Health Inspection Services (APHIS) wildlife specialist monitors wildlife populations at and around the airfield and identifies and mitigates threats to aircraft.

Even though Luke AFB and Aux-1 are not managed as wildlife habitat, the 56 FW manages designated airspace over central and southern Arizona. The BMGR and surrounding federal and state lands provide a haven for wildlife dependent on undeveloped desert habitat. A thorough discussion of the species present in these areas and the management actions taken by Luke AFB to protect these species is discussed in detail in the BMGR INRMP (see Volume 1, Section 7.1 *Fish and Wildlife Management* and Section 7.4 *Management of Threatened and Endangered Species*). Actions to protect migratory birds covered by the MBTA and to reduce BASH issues are discussed in Section 7.12 *Bird/Wildlife Aircraft Strike Hazards.* Efforts for protecting bald and golden eagles that could be encountered during training activities are provided below in Section 7.4.1. *Bald and Golden Eagles.*

7.4.1 Bald and Golden Eagles

Since the 1990s when the bald eagle was listed as threatened under the ESA, pilots of military aircraft flown or managed by the 56 FW observe a 1-nautical-mile lateral separation around bald eagle breeding areas during the breeding season (December 1–July 15), in accordance with measures described in a 1994 biological opinion. Since de-listing of the bald eagle on 28 June 2007, this opinion is no longer in effect, but eagles remain protected by the MBTA and the BGEPA. In 2013, the 56 RMO, with technical assistance from USFWS and AGFD, implemented two changes to the avoidance buffers around bald eagle breeding areas. First, the avoidance buffer during the breeding season was changed from 1–nautical-mile of lateral separation to 2,000 feet of lateral and vertical separation. Second, the breeding season is now observed December 1– June 30, in accordance with a 2006 Conservation Assessment.

Less is known about the avoidance measures needed for golden eagles that may be affected by military training activities. This lack of knowledge and updates to the BGEPA have increased the need for golden eagle nest monitoring in the Southwest desert. AGFD designed a three-year study (2013–2015) to evaluate the impact of airborne military training activities on golden eagles. The study has

three primary objectives: to (1) identify and survey the potential distribution of golden eagle breeding areas across military lands, (2) create a landscape-scale model to predict the likelihood of potential golden eagle nesting habitat, and (3) collect golden eagle demographic information and provide management recommendations that will permit BMGR and other southwestern military installations to maintain their training regimes while also complying with the BGEPA (Piorkowski et al. 2015).

The following actions were recommended for implementation.

- Continue monitoring known and suspected golden eagle nests on military installations.
- Coordinate with local, state, and regional authorities on current golden eagle distribution and status to inform current and future military activities for compliance with BGEPA.
- Develop avoidance buffers around known golden eagle nests during the breeding season, specifically those that were occupied within the last five years.
- Avoid disturbance around suspected golden eagle nests during the early breeding season. Nest sites described as suspected are those that provide potentially suitable nest-site structure but where no golden eagles have been observed in the past, or they are currently unoccupied nest sites that were used in the past (i.e., unoccupied does not mean non-use of a suspected golden eagle nest). Normal military training activities can resume in the area once all suspected nests have been deemed unoccupied for a given breeding season.
- Avoid heavy ground and aerial disturbance during the early breeding season within habitat predicted by the habitat model as having a high likelihood of being potential golden eagle nesting habitat. By using precise modeling, reducing heavy disturbance activities in areas of high likelihood may reduce or eliminate incidental take even if surveys to document nesting golden eagles have not been completed in those areas. Future model validation should allow quantification of thresholds associated with high likelihood habitat in the modeled estimates.

There is a current effort underway (via contract between USAF and the Colorado State University's Center for Environmental Management of Military Lands) to compile and standardize all historical locations of eagle nests and associated data for a subset of Air Force installations in the western U.S., including Luke AFB and BMGR. All nest locations recorded on installations after project completion should be shared with the AGFD. Likewise, all eagle nest data recorded by AGFD within the military operating area should be provided to the installations on an annual basis. The project products will include recommendations for compliance with BGEPA, including monitoring eagle populations, behaviors, and productivity; mitigating disturbance; and assessing the risks associated with overhead utility infrastructure.

7.5 Water Resources Protection

Applicability Statement

This section applies to AF installations that hold water resources that require protection to maintain the integrity of the watershed. This section IS applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Surface water at Luke AFB is very limited. There are no perennial or intermittent streams present on the base. Surface water at Luke AFB generally drains along a stormwater drainage network to the south side of Glendale.

The following objectives are set forth to achieve the goal of protecting watershed integrity. Luke AFB is actively pursuing these objectives.

- Continue to restrict aircraft washing to the wash rack.
- Conduct bioremediation of oil/water separators.
- Continue to work with shops to implement best management practices.
- Inspect outfalls during/after rain events that result in discharges.
- Continue to issue Wastewater Treatment Plant Discharge Permits.
- Conduct monthly reviews of Wastewater Treatment Plant operations.
- Conduct monthly reviews of discharge monitoring reports.
- Implement a Water Conservation Program.
- Reduce water usage.
- Convert turf areas to xeriscape.
- Incorporate LEED water conservation strategies at New F-35 facilities.

7.6 Wetlands Protection

Applicability Statement

This section applies to USAF installations that have identified wetlands that require protection. This section **IS NOT** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Even though no wetlands have been identified at Luke AFB, AUX-1 or Fort Tuthill (USACE 1995), in practice any drainage that functions to transport water and has a discernable high-water mark can qualify as a U.S. Water. Developing such drainages would require obtaining a permit from the USACE, pursuant to Section 404 of the Clean Water Act if dredge or fill material is discharged into the drainage (33 U.S. Code § 1344). The Nationwide 26 Permit is applicable if less than an acre of a U.S. Water is affected. When 1–10 acres are affected, it is discretionary as to whether a Nationwide or Individual Permit is required. The determination takes into account whether potential impacts are considered minor or major. An individual permit is required when more than 10 acres are effected. Before any proposed projects that would entail development in washes or small drainages are initiated, the Environmental Flight should be notified so they can consult with the Arizona Area Office of the USACE (Los Angeles District), Regulatory Branch, with regard to permit requirements for the action.

While Fort Tuthill does not include any wetland areas, at times there may be large amounts of runoff during storm events from the steep slopes on that property. Recommendations include monitoring

such events to determine the necessity and feasibility of constructing stormwater retention facilities to prevent or mitigate damage.

7.7 Grounds Maintenance

Applicability Statement

This section applies to USAF installations that perform ground maintenance activities that could impact natural resources. This section IS applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

A majority of Luke AFB is developed with office and residential buildings; air fields; and recreational facilities (i.e., Falcon Dunes Golf Course). These areas account for approximately 91 percent (about 2,650 acres) of the total Luke AFB land area. Landscaping and grounds maintenance across the developed portions of Luke AFB provide environmental, economic, and social benefits. These benefits, as outlined in the Luke AFB Urban Forest Inventory and Urban Forest Management Guidelines (Clark and Ingraldi 2017), are listed below.

- Economic—Landscaping increases property value, reduces cooling costs, increases economic stability, increases community and business district appeal, reduces expenditures on gray infrastructure, and increases the lifespan of pavement.
- Environmental—Landscaping reduces greenhouse gasses, the urban heat island effect, energy consumption (i.e., cooling), and stormwater pollution; improves air and water quality; and provides wildlife habitat.
- Social benefits—Landscaping provides shade for outdoor activities, serves as a sound buffer by reducing noises, and generally increases the quality of life for military personnel and families living and working at Luke AFB.

USAF policies and guidelines regarding grounds maintenance and urban forest management are included under "Land Management" in Chapter 11 of AFI 32-7064 (USAF 2016a). In general, AFI 32-7064 states that installations should design and implement landscaping that emphasizes the use of native plants, minimizes chemical usage and encourages pollution prevention, promotes designs that minimize adverse impacts to natural resources, and implements landscape designs that reduce maintenance and input costs associated with energy, water, chemicals, labor, and equipment needs. To comply with AFI 32-7064, Luke AFB has developed and implemented several management plans to govern ground maintenance and urban forest management activities at the installation. These plans are listed below.

- Luke AFB Landscape Design and Maintenance Standards (Sherman Group 2003)
- Urban Forest Inventory and Urban Forest Management Guidelines for Luke AFB (Clark and Ingraldi 2017)
- Luke AFB IPMP (Luke AFB 2015)
- Stormwater Pollution Prevention Plan (SWPP) for Luke AFB (CH2MHILL 2012)

- Falcon Dunes GEM Plan for Luke AFB (Air Force Center for Engineering & the Environment 2011)

The Luke AFB Landscape Design and Maintenance Standards Plan (Sherman Group 2003) defines the roles, standards, and guidelines for grounds maintenance at the installation. In general, the plan defines the approved plant material list with planting specifications for all turf and ornamental species, mowing and pruning requirements, irrigation duration and frequency requirements—by species—for all seasons, and approved design specifications for all landscaped areas. Grounds maintenance is performed by private landscaping companies through service contract agreements.

General Maintenance Issues Associated with Turf Areas and Ornamental Planting Areas, Such As Disease, Insect, or Invasive Species

The Luke AFB IPMP (Luke AFB 2015) discusses the roles, responsibilities, and protocols for grounds maintenance associated with pest management at Luke AFB, including the Falcon Dunes Golf Course. The stated goal of this plan is attain 100 percent control of turf and ornamental weeds on Luke AFB property through a variety of chemical and mechanical treatment methods. Implementation of the plan falls under the landscape maintenance responsibilities of the National Construction & Maintenance program. Luke AFB utilizes a comprehensive integrated pest management approach to weed and pest control that takes into account the various chemical, physical, and biological suppression techniques available. The program also calls for analyzing the weed or pest habitat and its interrelationship with the ecosystem. Every attempt is made to use the lowest percentage of active-ingredient herbicides possible to attain control and to also prioritize the use of mechanical weed control methods over chemical application wherever practical.

A variety of weeds impact the turf and ornamental areas at Luke AFB. These weeds are controlled through the use of periodic pre-emergent and post-emergent herbicide applications designed to protect high value landscape resources. Isolated weed patches are also controlled by mechanical means such as hoeing and hand pulling. Pest impacting Luke AFB turf and ornamentals areas include gophers and rodents. Weeds impacting the Falcon Dunes Golf Course include annual bluegrass (*Poa annua*), goose grass (*Eleusine indica*), clover (*Trifolium* spp.), and nut grass (*Cyperus* spp.). Pest species impacting the golf course include Green June beetles (*Cotinis nitida*), cutworms, and Rove Beetles (Staphylinidae). Disease issues are not a common at either Luke AFB or the Falcon Dunes Golf Course and are treated on a case by case basis. The Luke AFB IPMP (2015) provides management recommendations for each of these weed/pest species and disease issues. More information regarding the Luke AFB Integrated Pest Management (IPM) program can be found in section 7.11 of this plan.

Non-Point Source Pollution Issues Associated with Landscape Pesticides and Fertilizers

To prevent impacts from non-point source pollution, Luke AFB has developed and implemented a SWPP (CH2MHill 2012) covering the entire Luke AFB installation area. The SWPP provides best management practices (BMPs) for landscaped areas. It is designed to limit water-quality impacts associated with landscaped areas and specifically addresses issues associated with the use of pesticides and fertilizers. Practices recommended under this plan include the BMPs, as follows.

- Properly dispose of landscape waste and sediments.
- Minimize the use of pesticides, herbicides, and fertilizers and follow all label directions.
- Utilize an integrated pest management approach.
- Reduce the need for irrigation by using native, drought-resistant, plants and select plant materials requiring little maintenance and pest control.
- Incorporate landscaping into stormwater detention/retention areas to reduce peak runoff, promote infiltration, and improve water quality.

Programs Handling Solid Waste

The Integrated Solid Waste Management program at Luke AFB is managed by the 56 CES with the primary goal of effectively managing municipal solid waste and construction and demolition waste generated at Luke AFB. This program is guided by the Luke AFB Integrated Solid Waste Management Plan (ISWMP) (Luke AFB 2016) and the Luke AFB Qualified Recycling Program Business Plan (Luke AFB 2016). AFI 32-7042, with change 1 (USAF 2017b), requires installations to implement the program in the most cost-effective manner possible while meeting all applicable USAF, DoD, federal, state, and local laws and requirements. Specific goals of the Integrated Solid Waste Management program, as outlined in the ISWMP (Luke AFB 2016), are listed below.

- Continuously reduce the quantity of non-hazardous solid waste generated and increase the percentage of non-hazardous solid waste diverted from disposal facilities to help meet established solid waste diversion goals.
- Increase the economic benefit of solid waste management.
- Maintain compliance with applicable Air Force, DoD, federal, state, and local solid waste management requirements and laws.
- Increase participation in the installation's qualified recycling program and maximize solid waste diversion through recycling.
- Promote source reduction and reuse practices to reduce waste generation.
- Promote environmentally preferable procurement to close the recycling loop.

The ISWMP (Luke AFB 2016) identifies sources of solid waste on the installation and outlines BMPs for reducing the amount of waste generated. Solid waste collection from commercial, institutional, and industrial areas, along with military family housing areas, are provided by contractors through separate solid waste collection and disposal contracts. Since Luke AFB does not operate an on-site landfill, all waste disposal is provided at a local landfill. The Luke AFB ISWMP is reviewed annually and will be updated by the program manager as required.

Urban Forestry Management Program

As part of the Natural Resource Program at Luke AFB, the Urban Forest Inventory and Urban Forest Management Guidelines (Clark and Ingraldi 2017) was developed and implemented in 2016. All trees and saguaros located within the improved portions of Luke AFB were inventoried as part of this project. Information collected for each tree include location, species, diameter-at-breast-height, height, and general health condition of the specimen. The health of each specimen was determined through visual examination and an assessment of coloration/discoloration evidence of decay and die-back; root characteristics; trunk, branch, and canopy structure; condition of the foliage; and any

evidence of disease or pest issues. Each specimen was given a rating of good, fair, poor, or dead. In total, 5,184 trees representing 68 species were assessed and mapped at Luke AFB and these data were summarized, forming the basis of the Luke AFB Urban Forest Management Plan (Clark and Ingraldi 2017).

The Management Guidelines provided recommendations and short- and long-term action items for urban forest management at Luke AFB. These action items, as identified in Clark and Ingraldi (2016), include both short- and long-term actions.

Short-Term Action Items

- Start developing the base-wide management plan.
- Retain all saguaros when renovations and development occur, whenever possible. Notably, retain large, old-growth saguaros with multiple arms, given that old-growth saguaros often contain the most cavities potentially suitable for smaller birds to nest in and the external structural complexity to support stick nests for larger raptors. The tree inventory data will be used to inform NRMs and other individuals involved with planning and construction whether to allow development around an existing saguaro or, when feasible, to move at-risk saguaros to a new location on base.

Long-Term Action Items

- Increase the fiscal budget for urban and community forestry operations.
- Increase the number of saguaros through plantings.
- Increase the number of trees to increase shade (i.e., reduce energy consumption and the urban heat island effect, provide cooler temperatures for workers and residents), conserve more water (native species are already adapted to local dry conditions), provide more and safer walkable space outdoors for workers and residents, and replace those trees being eliminated by harsh weather and deleterious maintenance operations.
- Increase the diversity of tree species when planting.
- Increase the number of native tree species to support and encourage native wildlife diversity and declining native species (e.g., Gila woodpecker [*Melanerpes uropygialis*], gilded flicker [*Colaptes chrysoides*], lesser long nosed bat [*Leptonycteris yerbabuenae*], western yellow bat [*Lasiurus xanthinus*]).
- Increase the number of different age classes of trees to ensure cohorts are being replaced regularly and mature flowering individuals of a given species are present at all times. Currently, there is an inadequate number of younger trees to replace the aging veterans when they eventually succumb to old age.
- Remove (cut and spray) invasive salt cedar (*Tamarix* spp.).
- Develop a list of current tree management and subsequent maintenance concerns, issues, and needs.
- Inspect trees periodically and perform systematic trimming of trees containing hazardous defects (structural problems, disease, or vandalism).
- Remove hazard trees on public right-of-ways.

- Establish a routine systematic trimming cycle for all trees along the right-of-ways (e.g., clear traffic signals and signs, street lights, pedestrian and vehicular traffic, and buildings).
- Develop working partnerships with local and regional utilities, agencies and organizations, and the local community to improve the effectiveness and efficiency of urban and community forestry operations.
- Identify potential partners for urban and community forestry programming in the community.
- Conduct a community survey to increase awareness and obtain feedback on the appropriate tree species to plant and those to avoid, based on personal experiences within the community.
- Potentially work toward the development of a community Tree Board to provide guidance and recommendations to Luke AFB for care and maintenance of the community forest.
- Increase public education and involvement in the planning, care, and maintenance of the community trees.
- Inform the public of on-going efforts and long-term management strategies for tree recovery after storms or other catastrophic events.
- Work with state highway and transportation agencies on developing standards and criteria for care of trees growing along roadways.
- Develop a comprehensive set of specifications for contracted services.
- Provide training to in-house personnel on all phases of urban and community tree care.
- Continue to update the inventory of all trees, using state of-the-art technology and mapping methods.

A complete list of recommended plants for landscaping in turf and ornamental areas is included in the Luke AFB Landscape Design and Maintenance Standards Plan (Sherman Group 2003). The list includes 37 tree, shrub, and groundcover species. Prohibited species at Luke AFB include all 88 regulated, restricted, or prohibited noxious weeds listed for the State of Arizona, as provided by the ADA, Plant Services Division Administrative codes R3-4-244, *Regulated and Restricted Noxious Weeds*, and R3-4-245, *Prohibited Noxious Weeds* (ADA 2017).

Golf Course Environmental Management (GEM) Plan

The GEM Plan was developed to provide environmental management guidelines at the Falcon Dunes Golf Course (Air Force Center for Engineering & the Environment 2011). This plan complies with the USAF Golf Course Environmental Management GEM program and AFI 32-7064 (USAF 2016a), which requires a GEM Plan as part of the INRMP process. The Falcon Dunes GEM Plan provides guidelines and BMPs for all aspects of environmental management at the golf course, including water use/supply, erosion, stormwater/water quality, BASH concerns, air quality, and floodplain management. Additionally, the plan details short and long-term work plan actions, as listed below.

Short-Term Action Items

- Create, utilize, and collect scouting forms to guide future pest control decisions.
- Continue with planned activities for regular maintenance.
- Prune as many trees as possible during winter

Long-Term Action Items

- Compile and implement a Tree Management Plan for the entire facility.
- Compile and implement a comprehensive Golf Course Water Resource Management Plan to include a Drought Management Plan and Water-Quality Management Zones for the entire facility.
- Utilize a handheld global positioning system unit to assist with mapping the course and improving overall stewardship and management practices.
- Aerate all playing surfaces, per regular maintenance plan.
- Continue employee environmental, safety, and occupational health training and education programs, per course work plan.

7.8 Forest Management

Applicability Statement

This section applies to AF installations that maintain forested land on USAF property. This section **IS NOT** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

No commercial forestry activities occur at Luke AFB, AUX-1, or Fort Tuthill. Urban forest management is covered is Section 7.7, *Grounds Maintenance.*

7.9 Wildland Fire Management

Applicability Statement

This section applies to USAF installations with unimproved lands that present a wildfire hazard and/or that utilize prescribed burns as a land management tool. This section **IS NOT** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Luke AFB

Luke AFB contains approximately 287 acres of unimproved land across three main areas (Figure 2.1). Dissecting these areas are several roads and drainage ditches that would serve as fire breaks in the event of wildfires. Moreover, the low densities of desert vegetation found in these areas (described in section 2.3.1) typically do not provide sufficient fuel to carry a fire over a large area. The installation is located between extensive urban development to the east and south and agricultural lands to west and north. Based on these three factors, the risk of wildfire impacting Luke AFB is very low.

AUX-1

AUX-1 encompasses approximately 900 acres of unimproved land dissected by numerous roads and air strips that could serve as fire breaks in the event of a wildfire (Figure 2.2). The unimproved land is dominated by widely spaced desert shrublands; the bare spaces between the shrubs and small trees can limit a fire's ability to spread. AUX-1 is completely surrounded by similar desert shrubland habitats, with the exception of an irrigation canal to the north and west. Based on these factors, the risk of wildfire impacting AUX-1 is very low.

Fort Tuthill

Only 2.5 acres of the 14.5 total acres at Fort Tuthill contain unimproved lands, with these lands being dominated by ponderosa pine forest (Figure 2.3). Fort Tuthill is used as a recreation and camping area by military personnel and includes a hotel, several cabins, A-frames, yurts, and RV and camping areas. Almost all of Fort Tuthill is surrounded by ponderosa pine forest managed by the Coconino County Parks & Recreation Department, the State of Arizona, and the Coconino National Forest. Coconino County is undertaking a large-scale forest thinning project aimed at improving forest health and public safety and reducing wildfire risk. Eventually, an estimated 220 acres will be treated under this project, including all unimproved lands immediately surrounding Fort Tuthill (Figure 2.3). In addition, Coconino National Forest lands to the south and west also have been thinned aggressively, reducing wildfire risk across the entire area. These projects are part of the larger Greater Flagstaff Forest Partnership, an alliance of private businesses, environmental groups, and governmental organizations aiming to restore natural ecosystem function, manage fuels, and reduce the probability of catastrophic wildfires within ponderosa pine forest surrounding Flagstaff, Arizona (Greater Flagstaff Forest Partnership 2017).

Given the small size of Fort Tuthill, wildfire risk mitigation and management relies almost completely on the actions of surrounding land management agencies. Given this, Luke AFB personnel should keep in contact with these land management agencies and support all efforts to reduce wildfire risk on adjacent lands across the area. Management actions currently being implemented to reduce wildfire risk at Fort Tuthill include maintaining vegetation around camp sites, specifically around designated campfire areas, as well as implementing fire restrictions during times of high fire danger.

7.10 Agricultural Outleasing

Applicability Statement

This section applies to USAF installations that lease eligible USAF land for agricultural purposes. This section **IS NOT** applicable to Luke AFB, AUX-1, or Fort Tuthill.

Program Overview/Current Management Practices

No agricultural outleasing programs are currently being administered at Luke AFB, AUX-1, or Fort Tuthill.

7.11 Integrated Pest Management Program

Applicability Statement

This section applies to USAF installations that perform pest management activities in support of natural resources management (e.g., invasive species, forest pests, etc.). This section IS applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

EO 13751 (EO 2016) requires federal agencies to identify actions that may affect invasive species; use relevant programs to prevent introductions of invasive species; detect, respond, and control such species; monitor invasive species populations; provide for restoration of native species; conduct research on invasive species; and promote public education. An invasive species, as defined in EO 13751, is a "...non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health." To comply with EO 13751, Luke AFB has implemented an IPM program guided by the Luke AFB IPMP (Luke AFB 2015). Luke AFB utilizes a comprehensive IPM approach to weed and pest control, which takes into account the various chemical, physical, and biological suppression techniques available and the weed's or pest's habitat and its interrelationships within the ecosystem. Pest and weed management records are retained within the Integrated Pest Management Information System program and includes management actions covering in-house applications, contractor applications, and golf course applications. Adherence to the Luke IPMP will ensure compliance with all applicable DoD, USAF, federal, and State of Arizona laws and regulations.

The IPMP (Luke AFB 2015) outlines the roles and responsibilities for groups implementing the IPMP at Luke AFB, as listed below.

Civil Engineer Squadron Commander

- Provide oversight and support of all installation pest management programs in accordance with DoD, federal, state, and legally applicable host nation laws.
- Provide facilities, equipment, and pesticides in accordance with DoDI 4150.07 (DoD 2017a).
- Provide the appropriate number of certified pest management personnel according to DoDI 4150.07 and USAF manpower standards to support contingency and installation requirements.
- Provide financial resources for operations and training to meet installation and contingency pest management requirements.
- Select (in writing) an installation pest management coordinator.
- Review and approve installation pest management plans and contracts.
- Provide pest management support for installation facilities, grounds, and airfield BASH mitigation measures, range operations, golf course maintenance (in accordance with AFI 65-106 [USAF 2009]; Appropriated Fund Support of Morale, Welfare, and Recreation; and Non-appropriated Fund Instrumentalities), recreation areas, etc.

Installation Pest Management Coordinator

- Oversee the development of installation pest management plans, collect and report data on all installation pesticide use, review contract specifications, and serve as the primary POC for all installation pesticide compliance.
- Work closely with other civil engineers, services, medical personnel, and the Major Command Pest Management Consultants to produce an effective pest management program.
- With assistance from the installation Natural Resources office, coordinate with federal, state, installation, local pest management, and wildlife personnel as necessary.

The plan also outlines the priorities for pest management work and details the health and safety protocols for implementing the IPMP. Environmental considerations covered under the Luke IPMP include protection of the public, pesticide reduction/measures of merit, pesticide spills and remediation, and endangered or protected species and critical habitats in the sections that follow.

Protection of the Public

Precautions are taken during pesticide application to protect the public, both on and off the golf course. Signs are used to indicate areas of pesticide applications at the golf course and are posted at the 1st and 10th tees. These signs are left displayed until the chemical label re-entry times are satisfied. Whenever pesticides are applied outdoors, care is taken to ensure that any spray drift is kept away from individuals, including the applicator, and non-targeted areas. As a rule, pesticides are not applied outdoors when wind speeds exceed 10 miles per hour. At no time are personnel permitted into a treatment area during pesticide application unless they have met the medical monitoring standards and are wearing proper personal protective equipment. Sensitive Areas, such as medical facilities and child care centers, require extra precautions on where and how pesticides are applied around them.

Pesticide Reduction/Measures of Merit

The pest management shop continues to keep the pesticide usage low at Luke AFB by applying pesticides only as a method of last resort. In general, very little active-ingredient pesticide is used at Luke AFB.

Pesticide Spills and Remediation

The Spill Prevention and Response Plan (CH2MHILL 2012) accounts for pesticide spills at pest management storage and mixing facilities and elsewhere on the base. Each shop has a site-specific spill plan, and the base's fire plan (Luke AFB 2015) for these facilities takes pesticide storage into account.

Endangered or Protected Species and Critical Habitats

The Luke AFB natural resource program uses pesticides or IPM techniques to control undesirable vegetation, urban wildlife, and animal damage. Prevention of harm to threatened and endangered species and environmentally sensitive areas is coordinated through the 56 CES/ CEIE (Natural Resource Management Element). Pesticide label directions regarding environmentally sensitive

areas are strictly enforced. Whenever pesticide application occurs in proximity to threatened and endangered species, the USFWS will be consulted.

A variety of pests affect natural resource management at Luke AFB. As outlined in the Luke AFB IPMP (2015), they include public health pests, animal and insect pests, structural pests, and undesirable vegetation, as described below.

Public Health Pests

Mosquitoes present a concern to USAF personnel given the variety of diseases they can transmit to humans. Both pest management and public health personnel on the installation conduct mosquito breeding site surveys throughout the summer season. Peak mosquito breeding season at Luke AFB typically coincides with the summer monsoon season, when flash floods tend to create areas of standing water, providing an optimal breeding habitat for mosquitoes. The decision to implement mosquito management actions are based on larval surveys, adult trap counts, and customer complaints. While pest management personnel keep pesticides on hand for larval and adult mosquito control, efforts are first concentrated on available cultural, mechanical, and biological control options, as well as customer education, before pesticide application occurs. Management options to control mosquito populations on base are listed below.

- Control and remove areas of standing water.
- Introduce biological predatory fish to areas of standing water.
- Treat areas of standing water with Bactimos Briquettes.
- Spot treat with pesticides along ditch banks and other areas where mosquitoes congregate.
- Conduct fogging in the event that the mosquito problems become severe.

Animal and Insect Pests

Rodents—Rodents that directly impact the natural resources program at Luke AFB include gophers (Geomyidae) and ground squirrels (Sciuridae). These pests can impact turf and ornamental areas and can become BASH concerns because they serve as a food source for a variety of bird and raptor species. Management options for controlling rodent populations include trapping and the use of pesticides. Currently, the most effective control method is trapping using the Gophinator gopher trap. Gophers and ground squirrels are trapped on an as-needed basis.

Coyotes—Coyotes frequent the Luke AFB area. These animals can be a danger to people and they present a substantial BASH hazard if they get on the air field. Coyotes are typically shot by pest management personnel and removed from the installation. Shot guns are utilized for these depredation events and they are held in the armory by security forces. Security forces must be notified prior to implementing a depredation activity. Pest management personnel performing the depredation activity must also be certified to use a shot gun and have their name on the ammunition storage letter to retrieve the weapon. Animals that are on or near the flight line are handled by USDA staff or Airfield Management Base Operations personnel.

Insects—Bees, wasps, and hornets are occasionally removed from Luke AFB grounds. Management options include spot treatment and nest removal when the insects present a danger to USAF

personnel or their families. Because they are valuable pollinators for native plant species, chemical control options are avoided, if possible.

Snakes—Rattlesnakes (*Crotalus* spp.) frequent the base and can be a threat to personnel. Rattlesnakes are also important to the natural resources program, as they reduce rodent issues, which in turn reduces the BASH threat. One way to discourage snakes is to remove harborage areas for rodents in proximity to buildings and other structures. Additionally, exclusion methods can be used to limit snake/people confrontations. When snakes are found in areas near where people are likely to be, snake tongs are used to remove them and place them in a secured, locked transportation box. Rattlesnakes are typically relocated to the west side of the base.

Feral Cats—The presence of feral cats is a concern to the Luke AFB natural resource program, as they can have a substantial negative impact on native wildlife and migratory bird species. Feral cats are common in the disturbed portions of Luke AFB and associated buildings. The DoD urges that all cats be kept indoors to keep them safe and to prevent the killing of federally protected wildlife species on federal lands. A feral cat killing a protected species would violate the DoD's MOU with the USFWS, which requires installations to protect bird species covered under the MBTA.

Structural Pests

Subterranean termites are a severe problem at Luke AFB. Termite inspections are performed every two years as time and funding allow. When an active termite infestation is found, the area is spot treated by contractors. In addition, all new construction sites are pretreated for termites after the new construction statement of work is approved by AFCEC/Chief of Staff Committee. Other structural pests found at Luke AFB include carpenter bees and carpenter ants, which have been treated on a limited basis.

Undesirable Vegetation

Grounds—All mowing and trimming is accomplished by contract. All herbicide use is reported to the pest management shop through the Service Contract's Section on Quality Assurance Evaluations. The grounds contractor is responsible for treating approximately 95 acres of improved grounds at Luke AFB. All contracts require a plan for the application of pre-emergent herbicides for controlling annual weeds. Contact and systemic herbicides are also used for post-emergence spot treatment.

Electrical Substation Area—The pest management office is responsible for spot treatments of weeds at electrical substations, generally using a contact or systemic herbicide.

Facilities—Facility managers are responsible for weeds within 25 feet of their buildings. The Pest Management shop will mix and issue herbicide (glyphosate) in a 1- to 2-gallon tank sprayer for these applications.

Airfield Pavements—The airfield consists of approximately 267 acres of concrete and asphalt pavements. Portions of the asphalt have degraded and weeds are growing through the pavement. A variety of crack and joint sealing products and herbicide sterilants have been used to reduce vegetation growth on airfield pavements.

Golf Course—Pest control, as it relates to golf course turf management, is the responsibility of the lead golf course groundskeeper. All pesticide usage at the golf course is reported and reviewed by the pest management foreman.

Noxious or Invasive Plants and Animals—There are 88 regulated, restricted, or prohibited noxious weeds listed for the State of Arizona by the ADA, Plant Services Division, within their Administrative codes R3-4-244, Regulated and Restricted Noxious Weeds, and R3-4-245, Prohibited Noxious Weeds (ADA 2017).

Fort Tuthill

Noxious weeds affecting Fort Tuthill include Dalmatian toadflax (*Linaria dalmatica*) and common mullein (*Verbascum thapsus*). Possible pest species impacting the ponderosa pine forest include dwarf mistletoe (*Arceuthobium vaginatum*) and bark beetles (*Dendroctonus* spp.). Given the small area of Fort Tuthill and the disturbed nature of the ponderosa pine forest there, impacts from these weed and pest species is expected to be low. Other invasive species could, however, become problematic in the future and should be monitored.

7.12 Bird/Wildlife Aircraft Strike Hazard (BASH)

Applicability Statement

This section applies to USAF installations that maintain a BASH program to prevent and reduce wildlife-related hazards to aircraft operations. This section **IS** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Bird and wildlife populations in the vicinity of the airfield pose a hazard to flying operations. Luke AFB lies within the Pacific flyway, which, at this location, is a minor flyway for waterfowl and a major flyway for raptors and small songbirds. While the area is a minor flyway for waterfowl, there is a small number of waterfowl surrounding Luke AFB due to the presence of irrigation canals. Bird strike concerns at Luke AFB are greatest when aircraft fly at low altitudes during takeoff and landing. An assessment of bird strikes involving Luke AFB assigned aircraft indicates no exceptional hazard from any one particular bird species. Analysis of remains from bird strike incidents have shown that strikes typically involve horned larks, doves (*Zenaida* spp. and *Streptopelia decaocto*), meadowlarks (*Sturnella neglecta*), swallows, pigeons (*Columba livia*), American kestrels *(Falco sparverius*), turkey vultures (*Cathartes aura*), and red-tailed hawks. In general, bird strikes are not limited to a particular time of day and have occurred from early morning to late at night.

BASH reduction plans are developed for DoD military installations where elevated hazards exist and can be controlled and mitigated, as is the case for Luke AFB. In response to this hazard, the 56 FW has developed and implemented a BASH Reduction Plan for Luke AFB and AUX-1 as well as Gila Bend AFAF and BMGR East (56 FW 2013). This plan is designed to accomplish the objectives, as follows.

- Establish a Bird Hazard Working Group.
- Establish procedures to identify and communicate high-hazard situations to aircrews and supervisors to determine whether altering flying operations is required.
- Provide aircraft and airfield operating procedures designed to avoid high-hazard situations.
- Provide for dissemination of information to all assigned aircrews and transient aircrews on specific bird hazards and procedures for avoidance.
- Decrease the attractiveness of the airfield to birds by eliminating, controlling, and reducing environmental factors that support birds and wildlife species.
- Establish an avian and wildlife harassment and depredation procedure for the Luke AFB airfield that will be implemented by qualified personnel and is designed to manage and eliminate potential BASH threats.
- Provide control and management guidelines for specific BASH threat species, including small birds, raptors, waterfowl, and small and large mammals.

In accordance with this plan, the USAF uses the Avian Hazard Advisory System (AHAS), which is a comprehensive method of remote sensing for birds. The AHAS system evaluates weather and radar data and provides real-time alerts to aviators when concentrations of large birds are in the airspace. The AHAS is available online and coverage includes the entire continental U.S. Additionally, as part of the prevention program, AHAS provides pilots and flight schedulers with a near real-time tool when selecting flight routes.

Environmental management guidelines, as identified in the BASH Reduction Plan for Luke AFB, include controlling vegetation (e.g., maintaining vegetation height between 7 and 14 inches, removing dead vegetation and perches), controlling water (e.g., modifying ditches, eliminating standing water), controlling waste (e.g., collecting and disposing of waste rapidly), and controlling birds through chemical and physical alterations (e.g., installing bird proof structures, controlling insects and rodents). Priority BASH management actions under this plan include vigilant threat monitoring and reporting, management of the environment at the Luke AFB airfield, carrion removal around the airfield to reduce the abundance of large avian scavengers (e.g., turkey vultures), and bird/wildlife harassment and depredation, as required. A private contractor from the APHIS Wildlife Services Division currently conducts daily threat monitoring and performs all required airfield environmental management at the Luke AFB airfield. The contractor is also conducting all avian/wildlife relocation services in coordination with state and federal agencies, as well as all BASH harassment and depredation activities. The contractor issues BASH status reports on a monthly basis and provides annual and semi-annual BASH reports that summarize and analyze all monthly data. Bird harassment and depredation at Luke AFB is authorized by the USFWS through a permit issued annually to the 56 FW, which applies to both Luke AFB and Gila Bend Air Force Air Field (USFWS 2017).

7.13 Coastal Zone and Marine Resources Management

Applicability Statement

This section applies to USAF installations that are located along coasts and/or within coastal management zones. This section **IS NOT** applicable to Luke AFB, AUX-1, or Fort Tuthill.

Program Overview/Current Management Practices

Luke AFB, Fort Tuthill, and AUX-1 do not encompass any coastal or marine areas. The installation lies approximately 160 miles north of the Gulf of California, Mexico, the nearest coastal area to the installation.

7.14 Cultural Resources Protection

Applicability Statement

This section applies to USAF installations with archaeological and structural cultural resources. This **IS** applicable to Luke AFB, AUX-1, and Fort Tuthill.

Program Overview/Current Management Practices

Federal statutes, regulations, guidance documents, and EOs constitute the legal basis of USAF compliance responsibilities for managing cultural resources. The USAF will identify, manage, and maintain important cultural resources in a spirit of stewardship for the benefit of current and future Americans (in accordance with AFI 32-7065) (USAF 2016b).

Figure 7.2: Archaeologists excavate land before the development of the solar array at Luke AFB. Photo courtesy of Senior Airmen Sandra Welch.

There are currently no listed or listing-eligible archaeological resources at Luke AFB, AUX-1, or Fort Tuthill. To date, no historical landscape surveys have been conducted at Luke AFB, and there are no known landscapes within the base boundaries that are associated with Native American culture.

A single Cold War-era structure, the Semi-Automatic Ground Environment Direction Center, or "Blockhouse" (Building 1150), has been deemed of national importance. No World War II-era structures are worthy of preservation, and aside from the blockhouse, none of the Cold War properties at Luke AFB qualify for listing on the National Register of Historic Places. As resources turn 50 years of age, they should be re-evaluated under standard criteria for the National Register of Historic Places.

Extensive subsurface archaeological features were discovered during the mitigation of the surface archaeological site in the footprint of the solar array, west of the Munitions Storage Area. There are several other archaeological sites located south of Super Sabre Street that have the potential for the same subsurface features. Therefore, no facilities should be sited south of Super Sabre Street (IDP 2017).

7.15 Public Outreach

The Public Affairs office at Luke AFB has several missions, including internal information, community relations, and media operations. Information is available to the public either through the news section on the Luke AFB website or through the Luke Thunderbolt newspaper. The public affairs office also coordinates with media to provide a civilian media outlet on activities within Luke AFB.

In the past, public participation programs have included posting project information on the Arizona Department of Commerce website (www.azcommerce.com); distributing project information to a mailing list of over 450 community organizations, agencies, and individuals; encouraging local media coverage of Military Compatibility Project achievements and events through distribution of press releases; and distributing documents in hard copy web, email, and data disc formats.

7.16 Geographic Information Systems (GIS)

Applicability Statement

This section applies to all USAF installations that maintain an INRMP, as all geospatial information must be maintained within the USAF GeoBase system. Luke AFB, Fort Tuthill, and AUX-1 **ARE** required to implement this element.

Program Overview/Current Management Practices

Air Force Instruction (AFI) 32-10112 (USAF 2007), *Installation Geospatial Information and Services*, provides the policy and guidance for GIS management on all USAF installations, including Luke AFB, AUX-1, and Fort Tuthill. Geospatial data at Luke AFB, including AUX-1 and Fort Tuthill, are maintained and managed by the 56 CES with the GIS server residing in the 56th Communication Squadron Network Communication Center and on the NIPRNet. All Luke AFB geospatial data are maintained within the USAF GeoBase System and services are provided through the GIS database that is centrally located on the server. The Luke AFB GIS program currently utilizes software from the Environmental Systems Research Institute (ESRI) for GIS data management. The 56 CES adhere to the Spatial Data Standards for Facilities, Infrastructure, and Environment, as required by the DoD, to provide GIS standardization for table structure, metadata, and data storage among all DoD installations.

Staff from the 56 CES utilize the GIS in its daily operations, as the data support the natural resource program at Luke AFB, AUX-1, and Fort Tuthill. Plans for updating Geospatial data periodically and adding GIS data acquisitions over the next five years include, but are not limited to those listed below.

- Further refining and delineating important wildlife habitats and corridors
- Monitoring and managing habitat disturbance and restoration efforts
- Monitoring and tracking invasive species and control effort results
- Analyzing projects for National Environmental Policy Act (NEPA) compliance and storing data for regulatory reporting
- Identifying and monitoring cultural resource sites, if any.

CHAPTER 8 MANAGEMENT GOALS AND OBJECTIVES

The following are the overarching goals for the natural resources program, which reflect the values and desired future natural resource conditions. In this INRMP, the established goals remain valid for a five-year review cycle (2018–2023). Both the policy and resource-specific management goals have base-wide application. The overarching policy goals are non-resource-specific and are in support of and consistent with the military mission and protection and conservation of natural and cultural resources at Luke AFB, AUX-1, and Fort Tuthill. Objectives for specific resource areas, addressed in the respective chapters of this INRMP, are listed below.

- Protect and enhance environmental quality.
- Manage, conserve, develop, and maintain all resources in the best national interest, compatible with military operations and in accordance with the principles of multiple use and sustained yield.
- Design management activities based on an ecosystems management approach to benefit the total environment. Use of one resource should not exclude the use of another, except in the case of endangered or threatened species.
- Provide the greatest net public benefit for the greatest period of time, based upon analysis of prevailing ecological factors, the supply and demand of the various resources, and their uses. In determining the greatest net public benefit, full consideration will be given to both tangible and intangible values, including recreational, aesthetic, social, and commercial.
- Conduct all management activities to minimize the BASH potential. The primary BASH reduction measures will involve reducing bird attractants and implementing harassment and hazing techniques. Depredation will be used as a last option (per USFWS 2017). As much as possible, activities that could potentially affect the breeding success of birds should occur in early spring, before most birds reproduce.
- Utilize and care for resources in a combination best serving the present and future needs of the U.S. and its people.

CHAPTER 9 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

The Sikes Act encourages the DoD to provide adequate staffing with the appropriate expertise for updating, writing, and implementing the INRMP within the scope of DoD component responsibilities, mission, and funding requirements.

The 56 CES provides technically sound combat engineers to build, sustain, and protect Luke AFB through engineering and emergency response services. The 56 CES is organized into 6 flights consisting of 350 personnel and includes the Fire and Emergency Services Flight, Explosive Ordnance Disposal Flight, Readiness and Emergency Management Flight, Installation Management Flight, Operations Flight, and Engineering Flight. The 56 CES supports military training by managing the natural and cultural resources of the base in accordance with applicable laws, executive orders, and directives.

In August 2015, a cooperative agreement was signed between the USACE Omaha District and the AGFD to "collect, analyze, and apply environmental and cultural resource data and implement land rehabilitation and maintenance for optimal management of lands under control of the DoD" (USACE and AGFD 2015). The cooperative agreement provides Luke AFB assistance for executing prescribed tasks to implement the goals and objectives of the INRMP.

9.2 Monitoring INRMP Implementation

The USAF tracks its progress in implementing the updated INRMP during each subsequent five-year period. The AGFD and USFWS also each track their own progress using appropriate metrics. Common elements to be reported include funded/unfunded projects; coordination and feedback from cooperating agencies and military trainers; time frames for project implementation; deliverables for complying with biological opinions; and attainment of project-specific objectives. The effectiveness of management guided by the INRMP also will be gauged annually by tracking the degree to which each project implemented provides progress toward attaining the resource management goals established for the INRMP. The INRMP resource management goals are presented in Chapter 8, *Management Goals and Objectives*, and current implementation projects and the resource management goal(s) addressed by each project are identified in Chapter 10, *Annual Work Plans*.

9.3 Annual INRMP Review and Update Requirements

In accordance with DoDI 4715.03 and AFI 32-7064, INRMPs require annual review to ensure that projects and activities for the upcoming year have been identified and included in the INRMP and that all significant changes to the installation's mission requirements or its natural resources have been identified. The reviews also ensure or verify that all required coordination has occurred; required trained natural resource positions are filled or are in the process of being filled; all "must fund" projects and activities have been budgeted

for; project implementation is on schedule; current information on all conservation metrics is available; any necessary new management requirements are developed; and mission goals are achieved. This process involves installation natural resources personnel and external agencies cooperating to review the INRMP during regularly scheduled annual review meetings.

9.3.1 INRMP Update and Revision Process

This is the 2018 update of the Luke AFB INRMP. It was prepared in support of an ongoing process required by the Sikes Act to monitor and improve INRMP effectiveness and to update or revise the INRMP at least every five years. If an installation's mission or any of its natural resource management issues do not change significantly enough to alter or increase environmental consequences identified in the previous INRMP, then the five-year review generally results in an INRMP update. If, however, there are to be INRMP changes that will result in significant new or altered environmental impacts, then a major INRMP revision is required.

The need for a major revision is normally determined during the annual review with the USFWS and the AGFD. The NRM/POC documents the annual review findings in an Annual INRMP Review Summary and obtains signatures from the coordinating agencies on review findings. During the annual review meetings, the NRM/Installation Support Section updates the external stakeholders/ parties with the year-end execution report and coordinates future work plans and any necessary changes to management methods and other activities affecting natural resources. All parties review the INRMP and begin preliminary collaborative work on updating the INRMP (new policies, procedures, impacts, mitigations, etc.) as applicable.

A major INRMP revision requires approval by all parties involved and, if warranted, preparation of a new or supplemental NEPA analysis. For this current INRMP update, no changes have been identified that warrant the preparation of a NEPA document. The updated or revised INRMP is made available to the public, state and local governments, and Native American tribes on the Luke AFB website.

CHAPTER 10 ANNUAL WORK PLAN

For the 2018–2023 5-year planning period, the USAF has prioritized and funded five surveys to be conducted by AGFD to update species and habitat information (Table 10.1). The flora and fauna information reported in this INRMP was collected during surveys in the 1990s. Monitoring and survey results will be incorporated into this INRMP during the annual reviews as results become available.

Table 10.1: USAF 2018–2023 5-year action plan for Luke AFB, AUX-1, and Fort Tuthill, including year of funding, frequency of action, and partner likely to be involved.

2018 INRMP Resource Management Actions 2018–2023				
Action	**Fiscal Year[1]**	**Funding[2]**	**Frequency[3]**	**Partner[4]**
Bird species and migratory bird species survey	FY 2018	$50,000	One time	AGFD
Species, species at risk, and candidate/concern species survey	FY 2018	$50,000	One time	AGFD
Habitat and vegetation classification survey	FY 2018	$50,000	One time	AGFD
Habitat and invasive species survey	FY 2019	$60,000	One time	AGFD
Habitat and invasive species survey	FY 2020	$60,000	One time	AGFD

[1] Year of funding and completion of action.
[2] Estimate of required funding amount to complete project.
[3] How often action will occur.
[4] Parties responsible for completing the action; AGDF=Arizona Game and Fish Department.

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