U.S. AIR FORCE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

Altus Air Force Base

2022

(See INRMP signature pages for plan approval date)

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ABOUT THIS PLAN

This installation-specific Environmental Management Plan (EMP) is based on the United States Air Force's (USAF) standardized Integrated Natural Resources Management Plan (INRMP) template. This INRMP has been developed in cooperation with applicable stakeholders, which includes Sikes Act cooperating agencies and/or local equivalents, to document how natural resources will be managed. Where applicable, external resources, including Air Force Instructions (AFIs); Department of Defense Instructions (DoDIs); USAF Playbooks; federal, state, and local requirements; Biological Opinions; and permits are referenced.

Certain sections of this INRMP begin with standardized, USAF-wide "common text" language that address USAF and Department of Defense (DoD) policy and federal requirements. This common text language is restricted from editing to ensure that it remains standard throughout all plans. Immediately following the 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 the approved plan owner.

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

DOCUMENT CONTROL

Standardized INRMP Template

In accordance with (IAW) the Air Force Civil Engineer Center (AFCEC) Environmental Directorate (CZ) Business Rule (BR) 08, *EMP Review, Update, and Maintenance*, the standard content in this INRMP template is reviewed periodically, updated as appropriate, and approved by the Natural Resources Subject Matter Expert (SME).

This version of the template is current as of 06/26/2020 and supersedes the 2018 version.

NOTE: Installations are not required to update their INRMPs every time this template is updated. When it is time for installations to update their INRMPs, they should adopt the most recent version of this template available in the Plan Tool.

Installation INRMP

Record of Review – The INRMP is updated no less than annually, or as changes to natural resource management and conservation practices occur, including those driven by changes in applicable regulations. IAW the Sikes Act and AFMAN 32-7003, *Environmental Conservation*, the INRMP is required to be reviewed for operation and effect no less than every five years. An INRMP is considered compliant with the Sikes Act if it has been approved in writing by the appropriate representative from each cooperating agency within the past five years. Approval of a new or revised INRMP is documented by signature on a signature page signed by the Installation Commander (or designee), and a designated representative of the United States Fish and Wildlife Service (USFWS), state fish and wildlife agency, and National Oceanic and Atmospheric Administration (NOAA) Fisheries when applicable (AFMAN 32-7003).

Annual reviews and updates are accomplished by the installation Natural Resources Manager (NRM), and/or a Section Natural Resources Media Manager. The installation shall establish and maintain regular communications with the appropriate federal and state agencies. At a minimum, the installation NRM (with assistance as appropriate from the Section Natural Resources Media Manager) conducts an annual review of the INRMP in coordination with internal stakeholders and local representatives of USFWS, state fish and wildlife agency, and NOAA Fisheries, where applicable, and accomplishes pertinent updates. Installations will document the findings of the annual review in an Annual INRMP Review Summary. By signing the Annual INRMP Review Summary, the collaborating agency representative asserts concurrence with the findings. Any agreed updates are then made to the document, at a minimum updating the work plans.

INRMP APPROVAL/SIGNATURE PAGES

The United States Fish and Wildlife Service (USFWS), Oklahoma Department of Wildlife (ODWC), and the 97th Air Mobility Wing (97 AMW), by signature of their agency representative, hereby enter into a cooperative agreement for the conservation, protection, and management of natural resources present on Altus Air Force Base. This agreement may be modified and amended by mutual agreement of the authorized representatives of the three agencies. This agreement becomes effective upon the date of the last signatory and shall cover 5 years or until terminated by written notice, in whole or in part, by any of the parties signing this agreement.

By their signatures below, or an enclosed letter of concurrence, all parties grant their concurrence with and acceptance of the following document.

Approving Official: Date

_____ _____

Blaine L. Baker, Colonel, USAF
Commander, 97th Air Mobility Wing

_____ _____

Amy Lueders
Southwest Regional Director, U.S. Fish and Wildlife Service

_____ _____

J.D. Strong
Director, Oklahoma Department of Wildlife Conservation

EXECUTIVE SUMMARY

Installation Supplement

The U.S. Department of Defense (DoD) is responsible under the Sikes Act [Title 16 United States Code (U.S.C.), Section (§) 670a-670f, as amended in 1997] for implementing management strategies to conserve and protect biological resources on its lands. The Sikes Act was enacted into law in 1960 to manage DoD lands for the conservation and wise use of natural resources. The Sikes Act was amended in 1997 to mandate the development of an Integrated Natural Resources Management Plan (INRMP) at DoD installations.

Requirements of the Sikes Act that are implemented by this INRMP include Department of Defense Instruction (DODI) 4715.03, *Natural Resources Conservation Program* (18 March 2011), Air Force Policy Directive (AFPD) 32-70, *Environmental Considerations in Air Force Programs and Activities* (30 July 2018), and Air Force Manual (AFMAN) 32-7003, *Environmental Conservation* (20 April 2020).

The Headquarters Air Force's Directorate of Civil Engineers (AF/A4C), the USFWS, and ODWC have designated Altus AFB as a Category I installation that contains significant natural resources requiring conservation and management. AFMAN 32-7003 requires Category 1 installations to establish and maintain an INRMP. Altus AFB meets the following Category 1 criteria:

- Conducts on-the-ground military missions on unimproved lands that necessitate conservation measures to maintain natural resources and minimize impacts of military testing and training activities (e.g., soil erosion control)
- Allows natural resources-based recreation (hunting and fishing) on the installation
- Operates an outgrant from crop production
- Experiences significant bird/wildlife aircraft strike hazards requiring habitat manipulation on or near the managed airfield and extensive wildlife hazing and depredation activities

This INRMP guides the implementation of the natural resources program at Altus AFB for years 2022 through 2026. The INRMP is an integrated plan based on adaptive ecosystem management that balances natural resources management activities with military mission requirements and other land use activities.

The purpose of this plan is to provide a framework for the conservation and restoration of natural resources in a manner that ensures operational capability of the land to support the AF military mission. The plan details the goals, objectives and methods for managing the lands, waters, and wildlife that comprise the ecosystems within Altus AFB. Implementation of the natural resources program helps maintain training lands and ensures that the environment will remain healthy and stable for continuous military use.

The primary natural resources management goals at Altus AFB are to support military mission sustainability through ecological stewardship and regulatory compliance, conserve native biodiversity by restoring and maintaining native habitat, wildlife populations, and ecological processes, and to provide for and promote the sustainable multi-purpose use of natural resources to improve morale and overall wellbeing of the base populace. Goals and objectives for ecosystem management and biodiversity conservation employ an adaptive ecosystem-based management approach that will enhance the resiliency of the ecosystem to adapt to changes in climate.

The plan is updated annually but has not been revised with significant changes since its 5-year review in 2020. Implementation of goals and objectives of the 2022 INRMP will not be a significant change in management direction for natural resources on the installation.

1.0 OVERVIEW AND SCOPE

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

1.1 Purpose and Scope

Installation Supplement

The purpose of this INRMP is to provide a framework for the sustainable management of natural resources on Altus AFB lands. The INRMP strives to improve and maintain the health of the environment within the context of the military mission. Altus AFB manages its natural resources to facilitate testing and training, mission readiness, and range sustainability in a long-term, comprehensive, coordinated, and cost-effective manner as detailed by DODI 4715.03 *Natural Resources Conservation Program.*

Natural resources that are managed on Altus AFB include soil, water, vegetation, and wildlife. Sustainable multiple-use management is implemented for purposes such as natural resource conservation, ecosystem health, outdoor recreation, agricultural production, human safety, asset protection, and military readiness. Natural resources management is integrated with mission activities and installation planning and programming. INRMP review and coordination with applicable stakeholders ensures compatibility with other installation programs and activities. Wise and multiple use of natural resources combines environmental utilization and protection to ensure long-term sustainability.

This INRMP ensures that natural resources conservation measures and mission activities are integrated and consistent with federal stewardship requirements. The plan is prepared in cooperation with the Oklahoma Department of Wildlife Conservation (ODWC) and the United States Fish and Wildlife Service (USFWS) to ensure that natural resources management activities comply with state and federal environmental laws and regulations.

1.2 Management Philosophy

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This INRMP follows a unified management philosophy that integrates natural resources management with the diverse needs, interests, and visions of the Altus AFB community. The plan was developed in an interdisciplinary and cooperative manner, incorporating input from internal stakeholders, other AF installations, and state and federal agencies. A cross-agency, cross-discipline approach is also used for the INRMP annual review process. Natural resources planning and decision making is integrated with other

installation plans to ensure compatibility with the mission.

This plan strives to maintain the long-term ecological integrity of the environment and the ecosystem services it provides in order to ensure sustained use of land, air, and water resources for military training and testing. The plan also aims to improve morale and overall wellbeing of the people who live and work on the installation.

This INRMP follows the AF principles for ecosystem management and incorporates biodiversity conservation, exotic and invasive species control, and climate change considerations in accordance with DODI 4715.03 and AFMAN 32-7003. The plan provides for the restoration or enhancement of native ecosystems and the maintenance of viable populations of native wildlife when practical and consistent with the military mission. Exotic, feral, and invasive species are to be continuously removed from the installation. Assessments of climate change risks are incorporated into each applicable natural resources section throughout this plan. Routine monitoring of vegetation and wildlife will allow for adaptive management in response to changing ecosystem dynamics. The latest scientific information is incorporated into decision-making and adaptive management techniques to enhance the resiliency of the ecosystem.

The five AF principles for ecosystem management are outlined as follows:

- Maintain or restore native ecosystem types across their natural range where practical and consistent with the military mission.
- Maintain or restore ecological processes such as fire and other disturbance regimes where practical and consistent with the military mission.
- Maintain or restore the hydrological processes in streams, floodplains, and wetlands when feasible and practical and consistent with military mission.
- Use regional approaches to implement ecosystem management on an installation by collaboration with other DoD components as well as other federal, state and local agencies, and adjoining property owners.
- Provide for outdoor recreation, agricultural production, harvesting of forest products, and other practical utilization of the land and its resources, provided that such use does not inflict long-term ecosystem damage or negatively impact the AF mission.

1.3 Authority

Installation Supplement

The Sikes Act requires the development and implementation of an INRMP for all DoD installations that contain significant natural resources. This act provides for cooperation by the DoD and the Department of Interior (DoI) with state agencies in planning, developing, and maintaining natural resources on military installations. The INRMP for Altus AFB is implemented in collaboration with the USFWS and ODWC.

DODI 4715.03, *Natural Resources Conservation Program,* establishes policy and assigns responsibilities for compliance with applicable federal laws and regulations for the integrated management of natural resources. AFPD 32-70, *Environmental Considerations in Air Force Programs and Activities* establishes policy to address environmental considerations in all AF programs and activities using a framework for environmental management. AFMAN 32-7003, *Environmental Conservation,* provides direction and instructions for INRMP preparation and implementation.

A summary of key legislation and guidance used to create and implement this INRMP can be found in Appendix A, which includes all applicable federal laws, executive orders, United States Code (U.S.C.),

DoD policy, instructions, and directives, and AF instructions and directives.

The National Environmental Policy Act of 1969 (NEPA) requires federal agencies to evaluate potential environmental impacts of proposed federal actions and consider alternatives prior to action approval. NEPA may require Environmental Assessments (EAs) and Environmental Impact Statements (EISs) for proposed projects. The base NRM collaborates with action proponents and the base NEPA program manager to ensure that activities that may affect natural resources are fully considered in compliance with NEPA. The Council on Environmental Quality (CEQ) oversees federal adherence to NEPA requirements. 40 CFR 1500-1508, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*, codifies the process for implementing NEPA.

The table below summarizes installation-specific policies, including state and local laws and regulations.

Table 1. Installation-Specific Policies (including State and/or Local Laws and Regulations)	
Oklahoma Administrative Code (OAC) Title 800:25-26 and OK Statute Title 29 §29-4-118	Requires a permit for handling and collecting wildlife, nests, and eggs for scientific purposes
Altus AFB Access Policy	Installation access is limited to DoD employees, guests, family members, and retirees
OAC 800:25 and Oklahoma Statute Title 29	All hunting and fishing must be conducted IAW OK Statute Title 29, as adopted by the ODWC. Base policies take precedence when more restrictive than Title 29
Base Fishing Rules	Catch and release for bass and sunfish. Daily limit of 2 over 12 inches for catfish. No more than 2 rods per person. No swimming or wading in pond
OAC Title 35 OK Statute Title 2	Provides provisions with which installation agricultural outgrant operators must comply

1.4 Integration with Other Plans

Installation Supplement

The INRMP is reviewed annually by representatives of various organizations throughout the installation. The Altus AFB Environmental Element, (97 CES/CEIE) coordinates INRMP projects with all affected installation organizations. The 97 CES/CEIE ensures that the INRMP and any plans that may affect natural resources at Altus AFB are mutually supportive and not in conflict. This includes the following plans:

- Installation General Plan (IGP)
- Installation Development Plan (IDP)
- Installation Contingency Plan (ICP)
- Storm Water Pollution Prevention Plan (SWPPP)
- Integrated Cultural Resources Management Plan (ICRMP)
- Integrated Pest Management Plan (IPMP)
- Bird/Wildlife Aircraft Strike Hazard (BASH) Plan
- Altus AFB Prescribed Burn Plan
- Grounds Maintenance Performance Work Statement (PWS)
- Golf Environmental Management (GEM) Plan
- Air Installation Compatible Use Zone (AICUZ) studies
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) cleanup plans

2.0 INSTALLATION PROFILE

Installation Supplement

Table 2. Profile of Altus Air Force Base

Office of Primary Responsibility (OPR)	97 CES/CEIE has overall responsibility for implementing the natural resources management program and is the lead organization for monitoring compliance with applicable federal, state, and local regulations.
Natural Resources Manager/Point of Contact (POC)	Name: Kelly Niland Phone: 580-481-7606 Email: kelly.niland.1@us.af.mil
State and/or local regulatory POCs	JD Strong, Director Oklahoma Department of Wildlife Conservation Oklahoma City, OK 73152 Matthew Fullerton, Fish & Wildlife Biologist U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office Tulsa, OK 74129
Total acreage managed by installation	8,016 acres
Total acreage of wetlands	26.15
Total acreage of forested land	4.64
Does installation have any Biological Opinions?	No
NR Program Applicability	[X] Fish and Wildlife Management [X] Outdoor Recreation and Access to Natural Resources [X] Conservation Law Enforcement [X] Management of Threatened, Endangered, and Host Nation-Protected Species [X] Water Resource Protection [X] Wetland Protection [X] Grounds Maintenance [ ] Forest Management [X] Wildland Fire Management [X] Agricultural Outleasing [X] Integrated Pest Management Program [X] Bird/Wildlife Aircraft Strike Hazard (BASH) [ ] Coastal Zone and Marine Resources Management [ ] Cultural Resources Protection [X] Public Outreach [X] Geographic Information Systems (GIS)

2.1 Installation Overview

2.1.1 Location and Area

Installation Supplement

Altus AFB, home to the 97th Air Mobility Wing (97 AMW), is located within the City of Altus, at the heart

of Jackson County in southwestern Oklahoma (Figure 1). Altus lies about 140 miles southwest of Oklahoma City and 14 miles north of the Oklahoma/Texas border. The city is intersected from the north and south by U.S. Highway 283 and from the east and west by U.S. 62.

Altus AFB consists of approximately 7,057 acres within the northeast portion of Altus, as shown in Figure 2 (USAF, 2018a). The installation owns a geographically separate unit called the Sooner Drop Zone (SDZ) in Harmon County, approximately 23 miles southwest of Altus. The SDZ is a 959-acre site utilized by aircrews to practice aerial pallet drops of simulated cargo loads. Both Altus AFB and the SDZ contain significant natural resources requiring management that will be addressed in this plan (Table 2).

Altus AFB contains 754 facilities including 166 buildings and 530 privatized housing units. The airfield, shown in Figure 3, includes two north-south runways, an assault strip, and aircraft operations and maintenance areas. The primary runway, 17R/35L, is 13,440 feet by 150 feet. The parallel runway, 17L/35R, is 9,000 feet by 150 feet, and the assault strip, 174/354, is 3,500 feet by 95 feet. The base also uses the Clinton-Sherman Industrial Air Park in Burns Flat, OK, located 45 miles to the north, as an alternative runway for aircraft touch and go practice.

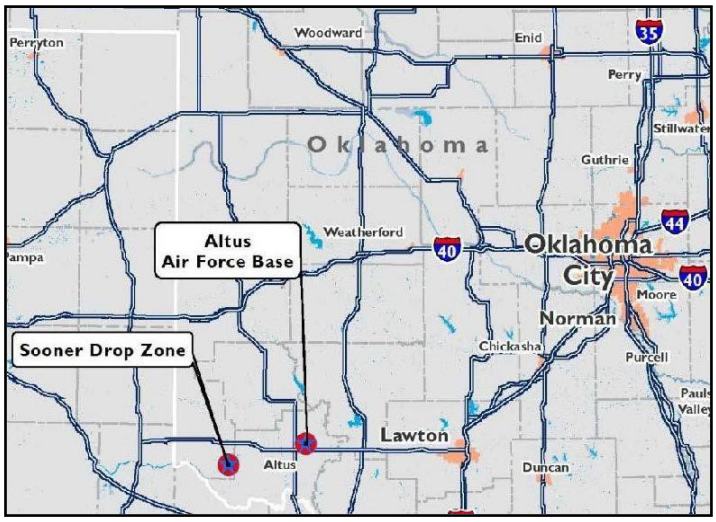

Figure 1. Regional map of Altus AFB

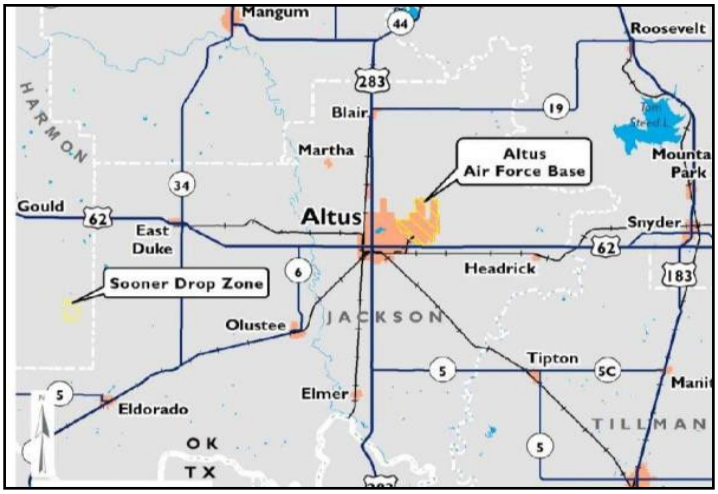

Figure 2. Vicinity map of Altus AFB

Figure 3. Aerial view of Altus AFB

Table 3. Installation/GSU Location and Area Descriptions

Base/GSU Name	Main Use/Mission	Acreage	Addressed in INRMP?	Describe NR Implications
Altus AFB	Training AF airlift and air refueling crews	7,057	INRMP Category I coverage	Management of recreational areas, floodplains, wetlands, pests, wildlife, and airfield landscape
Sooner Drop Zone	AF C-17 airdrop training	959	INRMP Category I coverage	Management of landscape for continued AF training use

2.1.2 Installation History

Installation Supplement

Activated in 1943 as Altus Army Airfield, the installation began as a training base for airmen to learn to operate multi-engine aircraft during World War II (Guinan, 2014). The flat landscape and sunny skies of southwest Oklahoma made an ideal location for flight training. Pilots learned to fly AT-9, AT-17, and UC-78 aircraft. At the end of the war in 1945, Altus Army Air Field was inactivated.

In 1948, the War Assets Administration Office deeded the installation to the City of Altus for $1.00, and it became the Altus Municipal Airport. Five years later, during the Korean War, it was reactivated as Altus Air Force Base (AFB) under control of the AF Tactical Air Command (TAC). The host unit, 63d Troop Carrier Wing, operated C-47 and C-45 aircraft.

In 1954, Strategic Air Command (SAC) assumed control of Altus AFB and activated the 96th Bombardment Wing (96 BW) to fly strategic bomber aircraft to support Cold War operations. The 96 BW flew B-47 all jet-engine bombers, as well as KC-97 strategic cargo and air refueling aircraft.

The 96 BW was replaced by the 11th Bombardment Wing (11 BW) in 1957. The B-47s and KC-97s were replaced by B-52 bombers and KC-135 aerial refueling aircraft. The 11 BW gained the 577th Strategic Missile Squadron (577 SMS) in 1961 and activated twelve Atlas F missile sites in the area. However, the Atlas missile was phased out of military use in 1965, and the 577 SMS was inactivated.

The loss of the 577 SMS prompted a local business executive to travel to Washington, D.C. to ask the president for economic aid for the Altus community. In response, President Lyndon B. Johnson ordered a military unit traveling west to be temporarily diverted to Altus. The 4th Mobile Communications Group (4 MCG) arrived at Altus AFB in 1966 to replace the 11 BW after it phased out the B-52, and the 11 BW was transferred to Bolling AFB, Washington, D.C. The 4 MCG operated tactical air traffic control and landing systems for combat and emergency mission support in the Pacific theater.

In 1968, the Military Airlift Command (MAC) assumed control of Altus AFB and transferred the 443d Military Airlift Wing (443 MAW), from Tinker AFB in Oklahoma City to Altus. The 443 MAW trained aircrews on C-141 cargo aircraft and C-5 transport aircraft. B-52s were phased out of use and the 11 BW was inactivated. KC-135s continued to be flown under tenant units.

In 1984, SAC activated the 340th Air Refueling Wing (340 ARW) to operate the KC-135s as a tenant unit on the base. In 1992, the AF replaced the SAC, TAC, and MAC commands with the Air Mobility Command (AMC), Air Combat Command (ACC), and the Air Education and Training Command (AETC). Altus AFB was now under AMC, and the 443 MAW and 340 ARW were replaced by the new 97th Air Mobility Wing (97 AMW). Command of the 97 AMW was then transferred from AMC to AETC, and the 97 AMW became home to the KC-135 Combat Training School and the C-141 and C-5 Training Schoolhouse, dubbed the

University of Military Airlift Command.
In 1994, Altus AFB was selected as the training school for the new C-17 cargo aircraft. The base acquired a 640-acre tract of land near Eldorado, Oklahoma for airdrop training, called the Sooner Drop Zone. The first C-17 arrived at the base in 1996.

In 2002, the 97 AMW reorganized as a combat wing to conduct strategic airlift, aerial delivery, and aerial refueling training. Altus AFB became an aerial port of embarkation for U.S. Army Fort Sill, Oklahoma. The following year, the base purchased nearly 1,100 acres of easements within the clear zones and accident potential zones of the airfield. In 2005, the Sooner Drop Zone was expanded to allow airmen to practice C-17 dual-row airdrop delivery, which doubles the amount of cargo that can be delivered into combat. C-5 aircraft were transferred out of Altus AFB in 2007.

In 2016, the base reactivated the 56th Air Refueling Squadron (56 ARS) as the formal training unit for the KC-46A *Pegasus* air refueling and cargo aircraft. The base began receiving KC-46 aircraft in 2019.

Despite the primary mission of training airlift and air refueling crews, the 97 AMW has deployed its airmen to support worldwide military efforts including Operations Northern Watch, Desert Storm, Desert Fox, Allied Force, Joint Guard, Enduring Freedom, Noble Eagle, Iraqi Freedom, and New Dawn. The wing also served as the aerial port of debarkation for the 31st Air Defense Artillery Brigade at Fort Sill, Oklahoma, supporting the deployment of two Patriot missile batteries to fortify Turkey during the Syrian civil war.

The 97 AMW transported medical crews and provided fighter aircraft support after the 9/11 terrorist attacks in 2001. The wing flew humanitarian missions following hurricanes Katrina, Rita, and Wilma in 2005 and Gustav and Ike in 2008. The wing also supported Haiti during the aftermath of an earthquake in 2010 and Puerto Rico following Hurricane Maria in 2017. Altus AFB continues to provide support for global contingencies and humanitarian emergencies as needed.

2.1.3 Military Missions

Installation Supplement

Altus AFB is home to the 97th Air Mobility Wing (97 AMW) under the Air Education and Training Command of the Nineteenth Air Force. The installation is the C-17, KC-135, and KC-46 strategic airlift and air refueling training school of the USAF. The Wing provides initial and advanced training programs for flight and aircraft maintenance crews.

As expressed in the mission statement, “We Train Exceptional Mobility Airmen”, the mission of the 97 AMW is to train airmen to be combat-ready to ensure global reach for America. Aircrews are trained, equipped, and ready to deploy for combat in support of the Global War on Terrorism. Approximately 550 mobility positions are maintained to be available for immediate worldwide deployment. Since 2001, the wing has sustained an average of 150 personnel a year deployed at any one time.

The 97 AMW consists of the following major units:

<u>97th Operations Group (97 OG)</u>
The 97 OG executes C-17, KC-135, and KC-46 formal training programs for up to 3,300 students annually. This group sustains airland, airdrop, and air refueling mobility forces providing global reach for combat and contingency operations. It also provides air traffic control and weather forecasting for flight operations. Airmen are trained to operate KC-135s for AF active duty, Air National Guard, Air Force Reserve Command, and international customers. Six units make up the 97 OG:

- 97th Operations Support Squadron
- 97th Training Squadron
- 54th Air Refueling Squadron
- 56th Air Refueling Squadron
- 58th Airlift Squadron
- 730th Air Mobility Training Squadron (Reserve unit)

97th Mission Support Group (97 MSG)

The 97 MSG provides mission support for aircraft operations and base infrastructure to include communications, civil engineering, law enforcement, force/fire protection, contracting, disaster response, environmental, lodging, transportation, recreation, supply, education, mobility, food service, and family and personnel support. Six units make up the 97 MSG:

- 97th Civil Engineer Squadron
- 97th Communications Squadron
- 97th Force Support Squadron
- 97th Logistics Readiness Squadron
- 97th Security Forces Squadron
- 97th Contracting Flight

97th Maintenance Group (97 MXG)

The 97 MXG provides sortie generation, aircraft and equipment maintenance, and transient alert, enabling the 97 AMW to perform its aircrew training mission. Two units and two direct report sections make up the 97 MXG:

- 97th Maintenance Squadron
- 97th Aircraft Maintenance Squadron
- 97th Maintenance Operations Section
- 97th Maintenance Group Quality Assurance Section

97th Medical Group (97 MDG)

The 97 MDG ensures combat readiness and capability by promoting the health, safety, and morale of active duty personnel. The group trains, mobilizes, and provides medical services to support contingency operations worldwide. It operates a healthcare system for over 9,500 beneficiaries, increasing wellness in the local community. Two units make up the 97 MDG:

- 97th Operational Medical Readiness Squadron
- 97th Healthcare Operation Squadron

Table 4. Organizations and Natural Resources Management Responsibilities at Altus AFB

Group	Squadron	Flight/Staff	Responsibilities
Wing Staff		Wing Commander	-Chair, Environment, Safety, and Occupational Health Council (ESOHC) -Approves/signs the INRMP or delegates signature at least every 5 years
		Judge Advocate	-Provides legal advice and regulatory interpretation
		Safety	-Executive Secretary, ESOHC -BASH program implementation/nuisance wildlife control -Ensures INRMP conformance with airfield safety criteria
Mission	Civil	Environmental	-Spill response & stormwater pollution prevention

Support Group	Engineering		-Natural resources program management -Installation restoration program implementation -Hazardous materials/waste management -Recycling/solid waste management
		Engineering	-Stormwater/erosion control design -Construction project design -Community planning
		Operations	-Grounds maintenance/landscaping -Infrastructure construction/repair -Integrated pest management
		Fire Department	-Spill and wildland fire response -Prescribed burn planning/implementation assistance
Operations Group	Operations Support	Airfield Management	-Airfield grounds management -Runway clear zone management
Medical Group	Operational Medical Readiness	Bioenvironmental/ Public Health	-Environmental health risk assessment -Zoonotic disease monitoring

2.1.4 Natural Resources Needed to Support the Military Mission

Installation Supplement

Existing ecosystem components of the installation such as wetlands, floodplains, vegetation, and wildlife are all necessary aspects of a healthy landscape capable of supporting the mission.

Wetlands and floodplains provide free ecosystem services such as erosion and flood control by storing floodwaters from local streams after heavy rainfall, which minimizes loss of property in developed areas. These areas help control stormwater runoff and improve water quality by removing pollutants and excess sediment and nutrients. They contribute to groundwater recharge by promoting infiltration, and contain higher plant diversity that helps maintain biodiversity and ecosystem integrity.

Adequate undeveloped open space is necessary for airfield buffering and contingency training. Vegetation provides water filtration and soil stabilization that prevents erosion. Vegetation also provides privacy and increases the aesthetic value of the landscape.

Natural areas and wildlife provide for enjoyable outdoor recreation experiences that increase the morale of airmen, their families, and guests on the installation. A healthy environment and proactive natural resources management program at Altus AFB will continue to improve the quality of life for airmen and increase the resiliency of the landscape to support the AF mission.

2.1.5 Surrounding Communities

Installation Supplement

Altus AFB is adjacent to the northeast corner of the City of Altus in Jackson County, Oklahoma. According to the most recent U.S. Census Bureau estimate, Altus has a population of approximately 18,709, which makes up 75% of the total population of Jackson County (USCB, 2018). Nearly 18% of Altus residents are below the poverty level, and the median household income for the city is $42,035.

Roughly 2,583 military personnel and their dependents and 1,012 military retirees reside at Altus AFB and the surrounding community. The installation is the largest non-farm employer in Jackson County, employing approximately 5,060 personnel: 1,484 active duty military, 25 Guard/Reserve, 1,740

Cadets/students, and 1,811 civilian personnel (USAF, 2018b). An estimated 1,443 jobs are supported by base operations, and the estimated annual economic impact on the local community is over $361 million.

Agriculture plays a significant role in the local economy. The majority of land in Jackson County is farmland, with 634 farms comprising 510,761 acres of land. According to the 2017 USDA Census of Agriculture, crops account for 85% of all agriculture sales in Jackson County, while livestock, poultry, and animal products account for 15% of agriculture sales (NASS, 2017). Cotton lint and cottonseed account for 85% of the income from crop sales, while grain sales (mainly wheat) account for the rest. Cattle account for 98% of animal/animal product sales, followed by equine, hog, sheep and goat, and poultry sales.

2.1.6 Local and Regional Natural Areas

Installation Supplement

Altus AFB and the Sooner Drop Zone are predominantly surrounded by farmland and undeveloped open space. Developed areas of the city of Altus are in close proximity to the western side of the base. There are no federal wildlife refuges, state wildlife management areas, or nature preserves within five miles of Altus AFB. The closest natural area is Gist Wildlife Management Area (WMA), located about 19 miles southeast of the installation. Gist WMA is an area of bottomland vegetated by sand plum thickets, cottonwoods, and tall grasses. The next closest natural area is a state park named Quartz Mountain Nature Park, located about 24 miles north of the base. Quartz Mountain is one of the westernmost peaks of the Wichita Mountains and overlooks Lake Altus-Lugert.

2.2 Physical Environment

2.2.1 Climate

Installation Supplement

Jackson County experiences a humid subtropical climate bordering a semi-arid climate zone (Köppen, 1936). The region sees hot, dry summers and warm to cool, dry winters. High amounts of direct solar radiation and outgoing radiation create extreme variations between day and night temperatures. Altus AFB experiences around 300 days of clear skies per year, making it very compatible with flying operations.

Spring produces the most rainfall, with intense thunderstorms that produce strong winds and occasional hail. Altus AFB sees an average of 28.9 inches of precipitation per year, and 1.3 days that exceed 2 inches of precipitation (CSU, 2019). On rare occasions, a tornado will touch down in the area. The most recent tornado to cause major damages in Jackson County occurred in 2015.

Summers are extremely hot and dry with occasional heavy rainfall due to remains of hurricanes from the Gulf of Mexico. July and August are the warmest months with average daily temperatures greater than 80°F (Figure 4). Altus sees an annual average of 93.9 days that exceed 90°F, and many days exceed 100°F. The highest recorded temperature of 120°F occurred in 1936.

The autumn season in Altus is brief and warm. The area experiences another peak in precipitation in September and October from thunderstorms. The long growing season for the region averages 224 days.

Winter is generally cool and dry, but temperatures can be extremely variable. Warm Chinook winds from the Pacific Northwest may bring in hot temperatures and dry out vegetation, producing wildfires. At other times, a block may form over the Gulf of Alaska and create cold fronts below 0°F. An average of 78.5

mornings fall to or below freezing each winter. January is the coldest month with an average temperature of 39.3°F. Snowfall occurrence in Altus is rare and minimal.

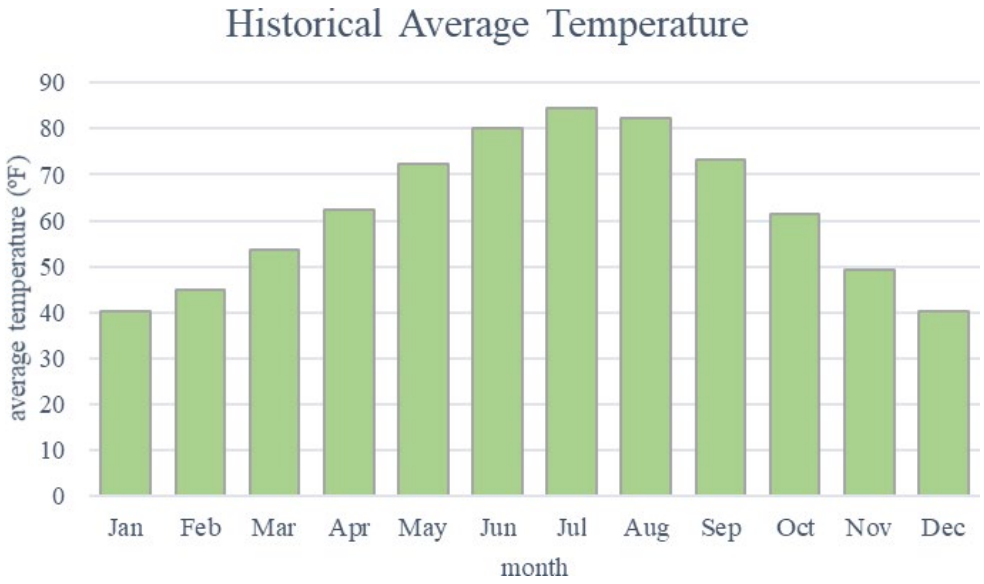

Figure 4. Historical monthly average temperatures at Altus AFB (CSU, 2019)

2.2.2 Landforms

Installation Supplement

Altus AFB lies within the Central Redbed Plains area of the Central Lowlands physiographic region of the United States (Fenneman and Johnson, 1946). This landscape is characterized by mostly level to rolling hills and moderately dissected, rolling plains with numerous stream terraces. Topography at the base is nearly level to gently sloping, and local relief is the result of stream erosion or human activities. Surface elevation ranges from approximately 1,330 feet above mean sea level (MSL) at the south end of the base to 1,390 feet above MSL at the northernmost point (USAF, 2020). Overall, surface topography gently slopes to the south-southeast, from a high elevation near the northwest corner.

2.2.3 Geology and Soils

Installation Supplement

Altus AFB is located within the Wichita Uplift geological province. This area is underlain by the Hennessey Group, a reddish-brown to gray soft shale underlain by sandstone, shale, and siltstone, and interlaced with beds of gypsum and salt (Stanley and Miller, 2004). The stream channel and flood plain of the unnamed tributary to Stinking Creek along the southwestern border of the installation contain alluvium deposits of unconsolidated sand, silt, clay, and gravel (Figure 5).

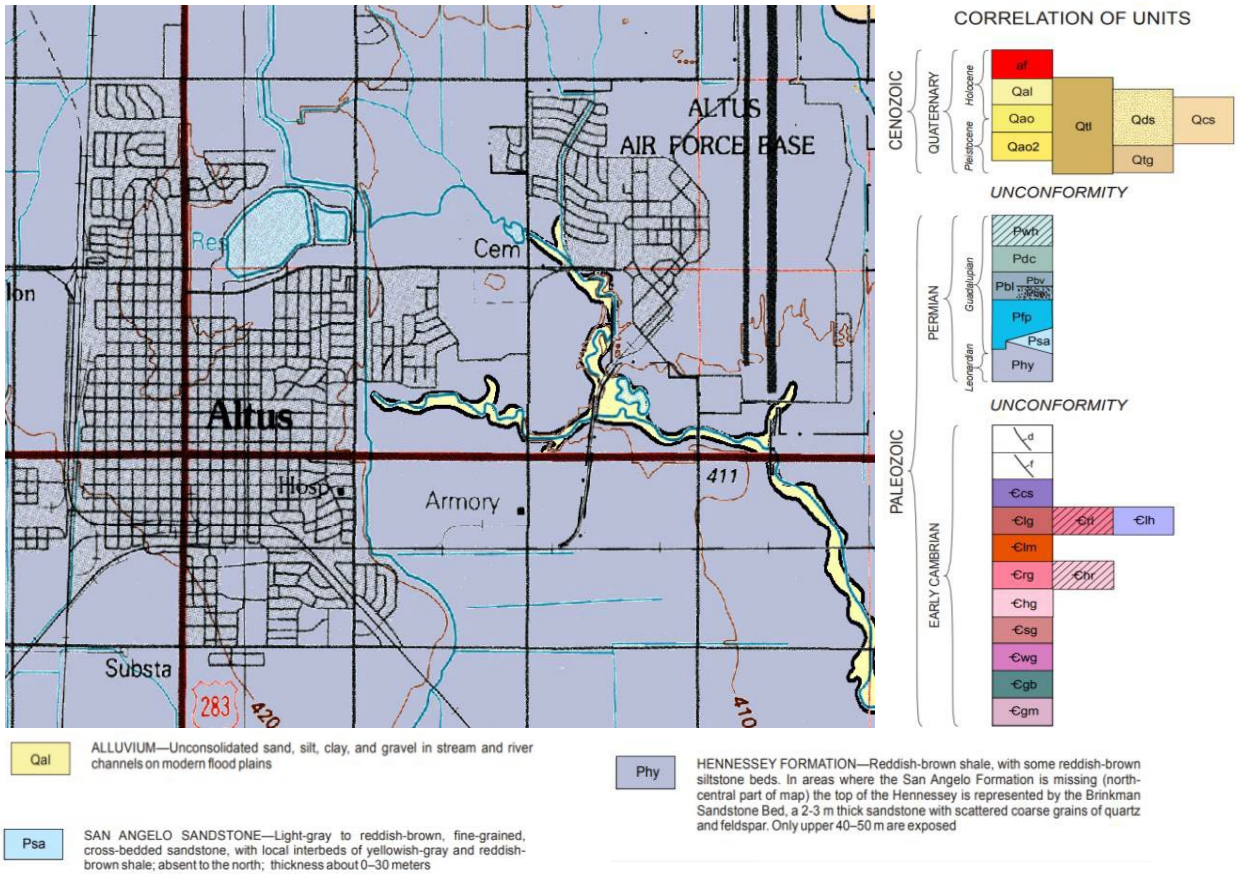

Figure 5. Geologic map of the City of Altus and Altus AFB.

A 1983 USDA soil survey of Jackson County identified four major soil series on Altus AFB as Miles, Tillman, Hollister (intermingled with Tillman), and Altus Series. There are also several small areas of Nobscot, Abilene, Port, Spur, and Mansic soils. The Sooner Drop Zone (SDZ) contains Spur, Vernon, Knoco-Badland, Acme, Beckman, Tilvern, and Westill soil types. Locations of all known soil types on the installation and SDZ are depicted in Figure 6. NRCS (2014) describes each soil type as follows:

Tillman Clay Loam, 1 to 3% Slopes (TaB): This deep soil is well drained, occurring in uplands along natural drains. TaB is hard when dry and firm when moist. This soil has weak granular structure and is moderately susceptible to water erosion. The surface layer is a reddish-brown, granular clay loam that is noncalcareous (lacking lime) with a pH of 7.5. This layer is 5 to 8 inches thick, or less in eroded areas. The subsoil is reddish, more clayey, and 8 to 12 inches thick. The subsoil is calcareous in most places.

Tillman and Hollister Clay Loams, 0 to 1% Slopes (TcA): TcA soils are deep, lean clays that occur in uplands and grade to slowly permeable clays. These soils are composed of about 60% Tillman soil and 40% Hollister soil, in an intermingled pattern. The surface layer is a granular clay loam, 8 to 10 inches thick. This layer is reddish-brown in the Tillman soils and a darker grayish-brown in the Hollister soils. The subsoil is 18 to 27 inches of clay. TcA soils are non-calcareous (pH 7.5 to 8) to a depth of 20-24 inches. TcA soils are hard when dry and firm when moist. They have a moderate to high shrink-swell potential with changes in water content. Lack of moisture that plants can use is the main issue; these soils are moderately susceptible to water erosion. During prolonged dry periods, however, fine particles of clay and silt are detached from the soil mass and blown about. This occurs mainly on poorly managed, cultivated fields.

Miles Fine Sandy Loam, 0 to 1% Slopes (MeA): This soil is deep and well drained but can store large

amounts of moisture that plants can use. MeA contains 10 inches of brown fine sandy loam surface soil. The 44-inch subsoil is moderately permeable to air and water. Both layers are friable, noncalcareous (lacking lime), and neutral to mildly alkaline in reaction. Some areas below the subsoil are calcareous and contain a clayey layer at depths of about 60 inches. Runoff is negligible.

Miles Fine Sandy Loam, 1 to 3% Slopes (MeB): This soil lies along natural drains and on gently sloping hills or ridges. The surface layer contains 6 to 10 inches of brown fine sandy loam. This soil is deep and well drained but can store large amounts of moisture that plants can use. The 44-inch subsoil is moderately permeable to air and water. Both layers are friable, noncalcareous, and neutral to mildly alkaline in reaction. Some areas below the subsoil are calcareous and contain a clayey layer at depths of about 60 inches. Surface runoff is low.

Miles Loamy Fine Sand, 0 to 3% Slopes (MfB): MfB soil has a profile similar to that of MeA, but it contains less plant nutrients so it is not as productive, and it is somewhat sandy throughout. In some places, the 10 to 18-inch surface layer has been lost through wind erosion, exposing the subsoil. Some areas are subirrigated by the water table near the surface. Groundwater saturation creates a somewhat mottled subsoil. Subirrigated areas are in low parts of the landscape or along drainage ways. Runoff is negligible to low.

Altus Fine Sandy Loam, 0 to 1% slopes (AtA): The surface soil of AtA is about 8 inches of dark gray-brown, fine sandy loam that is friable and easy to work. The 34-inch subsoil is sandy clay loam in the upper half and heavy sandy clay loam in the lower part. The subsoil is moderately permeable but readily penetrated by plant roots. The depth to red beds is usually between 4 and 10 feet. In places, the soil is subirrigated during wet seasons; the soil is more clayey throughout and its lower part is mottled. Some areas contain slick spots that diminish during dry periods. During wet years, the water table is generally within 5 feet of the surface. This soil is well drained and runoff is negligible.

Abilene Clay Loam 0-3% slopes (AbA): This very deep, well-drained soil is dark brown throughout. The surface layer, about 8 inches in depth, is granular, friable, and not calcareous. From this layer down to 54+ inches, the soil becomes more clayey and increases in calcium carbonate. Permeability is moderately slow and runoff is negligible to very low.

Wet Spur Clay Loam 0-2% slopes (Sc): This soil is very deep, well drained, and moderately permeable. The soil is found in floodplains of stream tributaries, drainage ways, and irrigated areas. Runoff is negligible to low. Spur soils are flooded for brief durations.

Port Soil (Po): This clay loam is very deep, fertile, moderately permeable, and well drained. Po soil occurs on floodplains and are flooded for very brief durations. It forms on sediments deposited from floodwaters of adjacent streams. This soil has a good water-holding capacity, and is well suited for irrigation. Runoff is negligible to very low.

Nobscot Fine Sand, 0 to 5% slopes (NoC): This light-colored soil forms in deep sands on choppy-surfaced uplands. NoC is very deep, well drained, and moderately rapidly permeable. The texture of the surface soil is fine sand in most areas, with some areas of loamy fine sand. The upper 4 inches of the 15 to 25-inch thick surface layer contains a loose grayish-brown fine sand, underlain by loose fine soil. The subsoil, about 25 to 40 inches in depth, is fine sandy loam that is hard when dry, but friable when moist. This soil is very susceptible to wind erosion and runoff is negligible to low.

Westill Clay Loam 0-3% slopes (WtlA, WtlB): These deep, well-drained upland soils are very slowly permeable. They have a reddish brown color and are alkaline throughout. The first 15 inches of soil are friable, followed by dense, compact soil throughout 80+ inches. Iron-manganese is common in fine accumulations after a few feet of depth. Runoff is high to very high.

Mansic Clay Loam 1-3% slopes (MaB): Mansic soils are very deep, well drained, and moderately permeable. The surface layer is dark brown and the soil becomes lighter with depth. MaB soils are firm,

friable, and moderately alkaline throughout. The first 9 inches may be slightly granular, giving way to very fine soil. Calcium carbonate is irregular near the surface, but becomes more common with depth. This soil is moderately susceptible to water erosion. Runoff is very low to high.

Knoco-Badland Complex (KoBE): This shallow, well-drained, dense clay is very slowly permeable and has a deep reddish color. Calcium carbonate may be found in small amounts, and moderate alkalinity is common. Clay bedrock may be found as shallow as 28 inches. This soil is moderately susceptible to water erosion.

Acme Loam 0-1% slopes (AcmB): This soil is very deep, well drained, and moderately permeable. AcmB soil is a greyish brown color. Upper portions are very fine and friable, while more coarse material may be found in depths of 65+ inches. Calcium carbonate and gypsum are found at about 12 inches of depth, and increase in concentration at greater depths. This soil is moderately susceptible to water erosion.

Vernon Clay loam 3-5% slopes [VerC (63, 64)]: These shallow, reddish-brown soils form over claystone bedrock on uplands. They are well drained and very slowly permeable. The 6-inch surface layer is compact, calcareous, clay loam/clay soil. The subsoil down to 15 inches is mostly red compacted clay. This soil is moderately susceptible to water erosion.

Beckman Silty Clay 0-1% slopes [BekA (10)]: These very deep, compact soils are found on level alluvial flood plains and are dark reddish in color. They are moderately well drained and very slowly permeable. While typically non-saline in the first few inches, salinity increases with depth. Gypsum and salt crystals appear within the first few feet, increasing with depth. Iron becomes prevalent at 2-3 feet of depth. This soil is moderately susceptible to water erosion.

Tilvern Clay Loam 1-3% slopes (TlvB): These deep, well-drained, and very permeable soils have a surface color of dark brown and increasing redness with depth. These soils reach depths of over 80 inches and are firm and blocky throughout. Calcium carbonate begins to be found sporadically at 5 inches deep and increases in concentration in depth. Gypsum, iron, and alkalinity also increase with depth. This soil is moderately susceptible to water erosion.

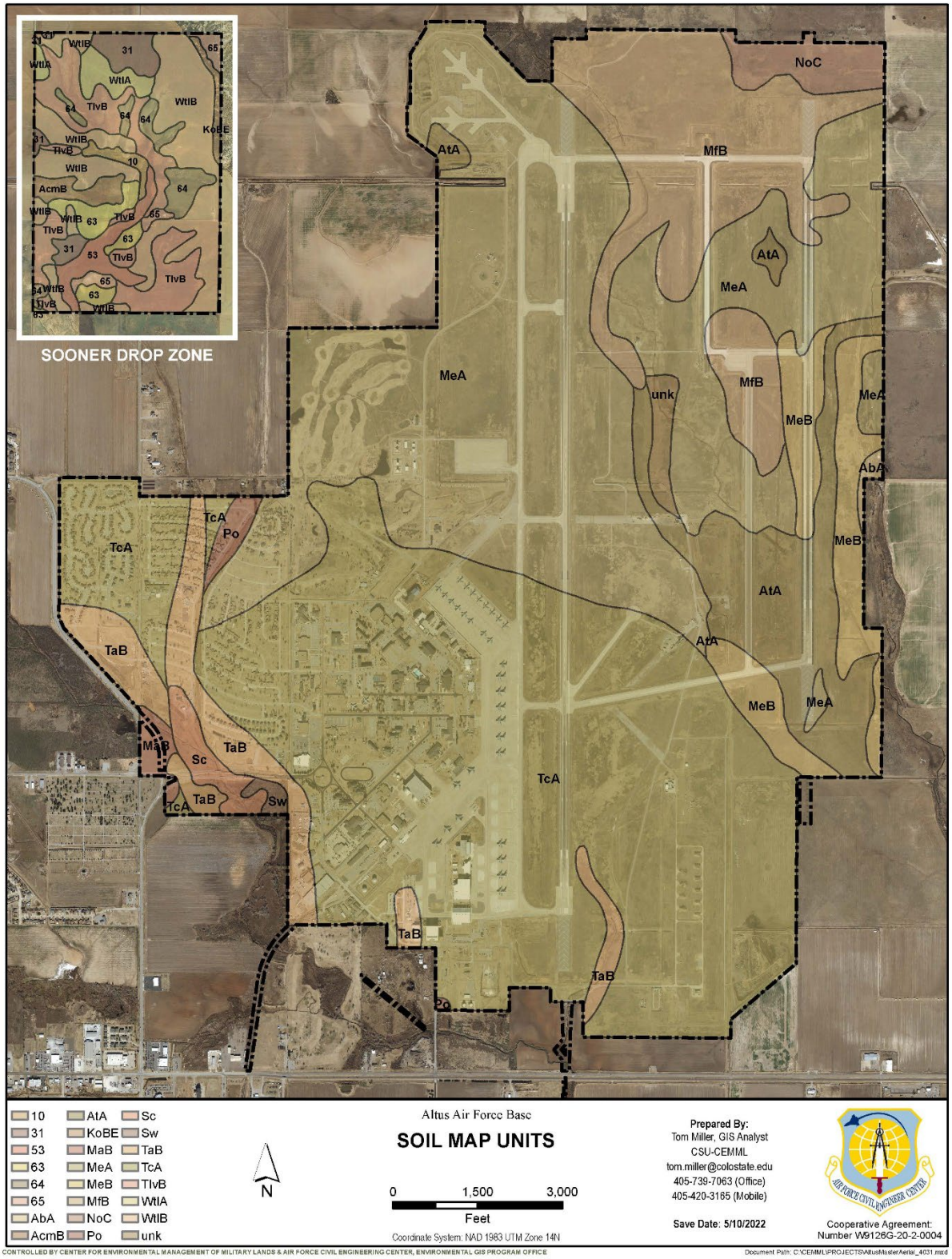

Figure 6. Soil survey map of Altus AFB and Sooner Drop Zone.

2.2.4 Hydrology

Installation Supplement

Groundwater

The Blaine and Seymour aquifers are the major aquifers closest to Altus AFB. Minor aquifers in the area are unconsolidated alluvial deposits associated with the Salt and North Forks of the Red River (USAF, 2004). The primary hydrologic unit underlying Altus AFB is the Hennessey Shale, which only contains a small amount of groundwater. The Hennessey Shale is exposed at the surface (USAF, 2001a). The groundwater is typically shallow and unconfined. Precipitation is the primary source of recharge to the water-bearing zone. Groundwater storage can fluctuate significantly between seasons and periods of heavy rainfall.

The groundwater at Altus AFB moves toward the southeast, generally following surface topography. Shallow groundwater is present at depths of less than 5 feet in some areas (USAF, 2002). The groundwater has a high content of gypsum and suspended solids, and is classified as a Class 3 aquifer that is adequate for livestock, manufacturing, and industrial use (USAF, 1997).

Surface Water

Surface water on Altus AFB drains to watersheds of two small streams on the installation (Figure 7). A stream called Stinking Creek passes through the northern half of the airfield, flowing from the northwest to the southeast. An unnamed tributary to Stinking Creek runs along the southwestern boundary of the installation. These streams flow southeast to the North Fork of the Red River. The North Fork flows south about 13 miles east of the base and the Salt Fork flows south about five miles west of the base. The Red River flows east about 14 miles south of the base on the border between Oklahoma and Texas.

Stinking Creek drains the eastern portion of the base and is a tributary to the North Fork of the Red River approximately 13 miles downstream from Altus AFB. Stinking Creek is a perennial stream with a flow generally less than 20 cubic feet per second, except during rainfall. An unnamed tributary with intermittent flow drains the housing area and western portions of Altus AFB. This stream usually does not flow during the late summer months. South of the housing area, the stream receives stormwater flow from the City of Altus reservoir. The tributary joins Stinking Creek about five miles downstream of Altus AFB.

An agricultural irrigation canal, the Ozark Canal, crosses the northernmost end of the base horizontally. In addition to the Ozark Canal, an unnamed irrigation canal passes under the main runway, flowing southeast for several hundred yards before turning south to exit the base at the southern end. These canals do not receive surface runoff from the base and the base has no access to its waters. The canal is used for agricultural irrigation and may be dry or ponded during the off-season. Altus AFB contains five small impoundments that are all located on the golf course. Some of them are used for golf course irrigation. These are not potable water sources and are not permanent.

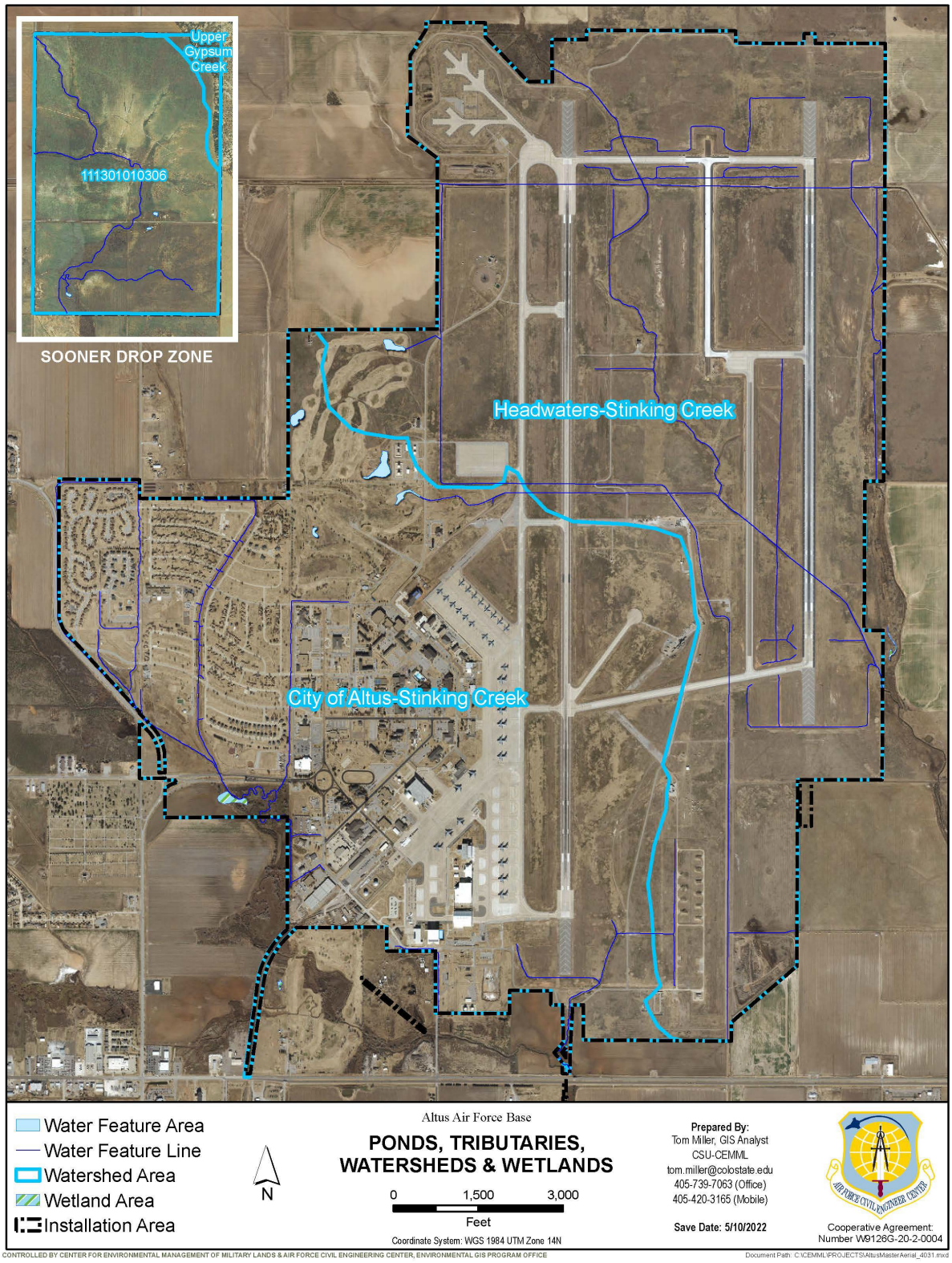

Figure 7. Surface waters of Altus AFB

2.3 Ecosystems and the Biotic Environment

2.3.1 Ecosystem Classification

Installation Supplement

Altus AFB lies within the Dry Domain, Subtropical Steppe Division, Great Plains Steppe and Shrub Province, Redbed Plains Section of the Southern Plains Ecoregion of the United States (Bailey, 2014). This region is characterized by gently sloping to rolling plains. Natural vegetation has been converted to agricultural crops or pasture on about 90% of the land in this area.

Ecosystem coverage within the installation is shown in Figure 8 and listed in Table 5. The natural ecosystems are grassland prairie, floodplain or wetland, and woodland. Floodplain, wetland, and woodland comprise less than 1% of the landscape, while prairie comprises 18.7% of the land. 46.3% of the landscape is open space and 34.4% is developed.

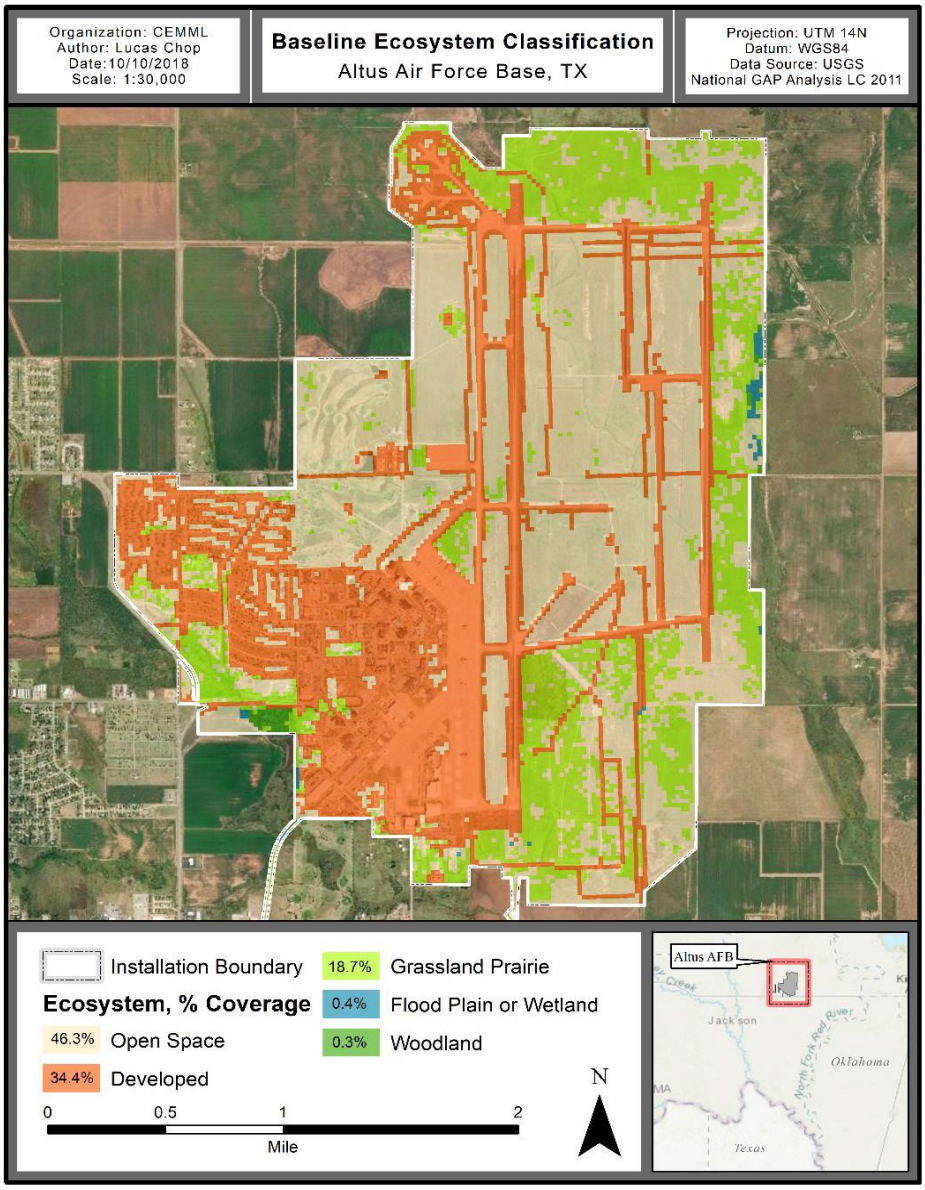

Figure 8. Baseline ecosystem coverage of Altus AFB

Table 5. Ecosystem coverage by area.

Ecosystem Type	Area (acres)	Coverage
Grassland Prairie	762.7	18.7%
Flood Plain or Wetland	14.5	0.4%
Woodland	12.6	0.3%
Open Space	1894.2	46.3%
Developed Land	1404.7	34.4%

2.3.2 Vegetation

Installation Supplement

This section describes the historic and current vegetation associations for the ecological units within and surrounding Altus AFB. It also describes how the application of projected climate scenarios may affect the vegetation associations in the future.

2.3.2.1 Historic Vegetation Cover

Installation Supplement

Altus AFB is located within the Kansan biotic province, originally a region of mixed prairie grassland. Historically dominant grass species were bluestem, buffalo, grama, and needle grasses (USAF, 2002). Other grasses included vine mesquite, switchgrass, tobosa grass, and Arizona cottontop, intermingled by scattered shrubs such as yucca and sagebrush.

Native trees in the area included mesquite and hackberry. Trees mainly occurred in riparian zones along streams and in floodplains.

2.3.2.2 Current Vegetation Cover

Installation Supplement

Grounds on the installation are classified into three categories based on maintenance intensity: unimproved, semi-improved, and improved. Altus AFB contains approximately 283.15 acres of unimproved grounds, 3,487.24 acres of semi-improved grounds (3,231 acres airfield and 256.24 acres non-airfield), and 182.09 acres of improved grounds. The Sooner Drop Zone contains approximately 459.84 acres of unimproved grounds, and 499.3 acres of semi-improved grounds.

Unimproved Grounds

Current vegetative cover in unimproved areas of grassland prairie is similar to historical species composition (USAF, 2009). Table 6 lists the current native vegetative cover at Altus AFB by the soil type in which the plant species are found. Sandy and loamy soils on the alluvial plains and along streams of Altus AFB are dominated by big bluestem and little bluestem. These areas also support silver bluestem, switchgrass, sideoats grama, blue grama, drop seeds, buffalograss, and vine mesquite. Bottomland areas of Tillman clay loam and Hollister soil series are dominated by blue grama and sideoats grama. These areas also support little bluestem, silver bluestem, switchgrass, Indiangrass, sedges, Texas wintergrass, and vine mesquite.

Table 6. Current native vegetative cover on Altus AFB by soil series

Altus fine sandy loam 0 to 1% slopes		Miles fine sandy loam 0 to 1% slopes		Tillman clay loam 0 to 3% slopes		Hollister silty clay loam 0 to 1% slopes	
Common name	**Composition**	**Common name**	**Composition**	**Common name**	**Composition**	**Common name**	**Composition**
Big bluestem	20%	Sand bluestem	20%	Sand bluestem	5%	Sand bluestem	5%
Little bluestem	25%	Little bluestem	25%	Little bluestem	5%	Little bluestem	5%
Indian grass	5%	Silver bluestem	5%	Silver bluestem	5%	Silver bluestem	5%
Sand love grass	5%	Buffalo grass	5%	Buffalo grass	10%	Buffalo grass	10%
Switchgrass	5%	Western wheatgrass	5%	Western wheatgrass	5%	Western wheatgrass	5%
Sideoats grama	10%	Sideoats grama	10%	Sideoats grama	25%	Blue grama	20%
Blue grama	5%	Blue grama	5%	Blue grama	20%	Sideoats grama	25%
Other perennial forbs	7%	Vine-mesquite	5%	Vine-mesquite	5%	Vine-mesquite	5%
Other shrubs	3%	White tridens	5%	White tridens	5%	White tridens	5%
Other perennial grasses	15%	Other perennial grasses	5%	Other perennial grasses	10%	Other perennial grasses	10%
		Other perennial forbs	5%	Other perennial forbs	5%	Other perennial forbs	5%
		Other shrubs	5%				

Semi-improved Grounds

The major native grass species that occur on semi-improved grounds are sideoats grama (*Bouteloua curtipendula)*, blue grama (*Bouteloua gracilis)*, switchgrass (Blackwell variety) (*Panicum virgatum)*, buffalograss (south half of base) (*Buchloe dactyloides)*, and little bluestem (*Andropogon scoparius)*. Native trees on the upland are mesquite and honey locust, while the draws and stream channels contain elm and cottonwood, along with some encroaching saltcedar. Much of the historically mixed prairie land surrounding the installation has been converted to short-grass pasture for livestock grazing (USAF, 1998). Figure 9 depicts vegetation coverage types on Altus AFB, and a complete list of vegetation surveyed and documented at Altus AFB can be found in Table 7.

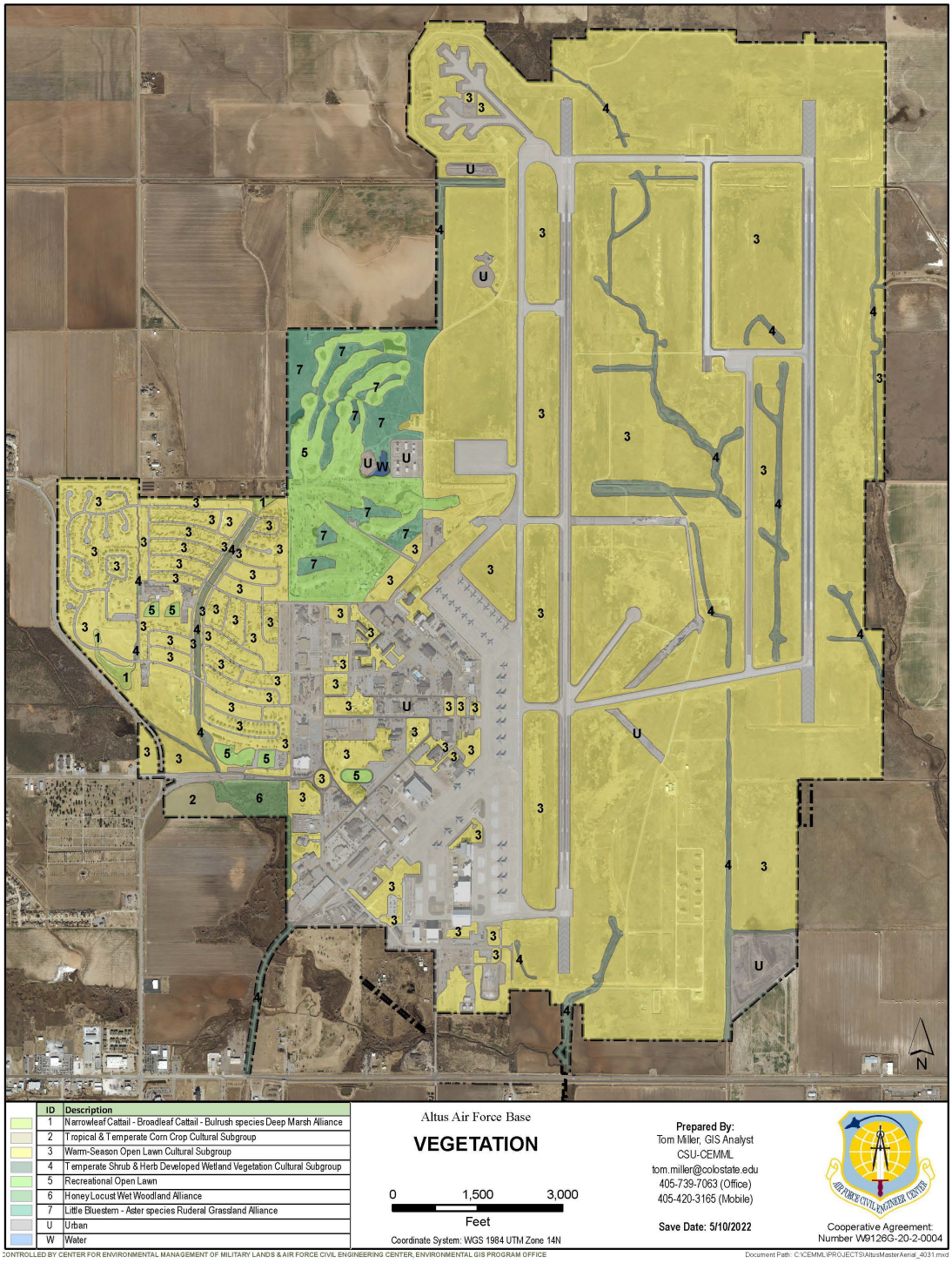

Figure 9. Vegetation coverage types on Altus AFB

Table 7. Vegetative species identified at Altus AFB (Marlow, 2001).

Common Name	Scientific Name	Common Name	Scientific Name	Common Name	Scientific Name
Yarrow	*Achillea millefolium*	Dwarf fleabane	*Conyza ratnosissima*	Carolina cranesbill	*Geranium carolinianum*
Western wheatgrass	*Agropyron smithiz*	Plains coreopsis	*Coreopsis tinctoria*	Honey locust	*Gleditsia triactmthos*
Western wheatgrass	*Agropyron smithiz*	Tropic croton	*Croton glandulosus*	Rayjacksonia annua	*Haplopappus annuus*
Plains onion	*Allium perdulce*	Small cryptantha	*Cryptantha minima*	Wax goldenweed	*Haplopappus ciliata*
Palmer's pigweed	*Amaranthus palmeri*	Buffalo gourd	*Cucurbita foetidissima*	Scratch-daisy	*Haplopappus validus*
Western ragweed	*Ambrosia psilostachya*	Love vine	*Cuscuta gronovii*	Smallhead sneezeweed	*Helenium microcephalum*
Giant ragweed	*Ambrosia trifida*	Winged pigweed	*Cycloloma atriplicifolium*	Common sunflower	*Helianthus annuus*
Plains sandparsley	*Ammoselinum popei*	Bermuda grass	*Cynodon dactylon*	Ashy sunflower	*Helianthus mollis*
King Ranch bluestem	*Andropogon ischaemum*	Bearded flatsedge	*Cyperus aristatus*	Plains sunflower	*Helianthus petiolaris*
Silver bluestem	*Andropogon saccharoides*	Globe sedge	*Cyperus globulosus*	Salt heliotrope	*Heliotropium curassavicum*
Little bluestem	*Andropogon scoparius*	False nutgrass	*Cyperus strigosus*	Golden aster	*Heterotheca latifolia*
Sand bluestem	*Andropogonhallii*	One-flower flatsedge	*Cyperus uniflorus*	Pig nut	*Hoifrnanseggia glaiica*
Sand bluestem	*Andropogonhallii*	Taperleaf flatsedge	*Cypetus acuminatus*	Foxtail barley	*Hordeum jubatum*
Tenpetal anemone	*Anemone berlandieri*	Nine anther dalea	*Dalea enneandra*	Little barley	*Hordeum pusillum*
Lazy daisy	*Aphanostephus skirrhobasis*	Silky prairie clover	*Dalea villosa*	Bush morning glory	*Ipomoea leptophylla*
Thyme-leaf sandwort	*Arenaria serpyllifolia*	Indian apple	*Datura innoxia*	Sumpweed	*Iva annua*
Pricklepoppy	*Argemcme polyanthemos*	Southwestern carrot	*Daucus pusillus*	Grassleaf rush	*Juncus marginatus*
Oldfield threeawn	*Aristida oligantha*	Tansy mustard	*Descurainiapinnata*	Eastern red cedar	*Juniperus virginiana*
Purple threeawn	*Aristida purpurea*	Bundle flower	*Desmanthus illinoensis*	Kochia	*Kochia scoparia*
Spider antelopehorns	*Asclepias asperula*	Hairy crabgrass	*Digitaria sanguinalis*	Prickly lettuce	*Lactuca serriola*
Wreath aster	*Aster ericoides*	Spectacle-pod	*Dimorphocarpapalmeri*	Henbit	*Lamium amplexicaule*
Annual saltmarsh aster	*Symphyotrichum subulatum*	Seashore saltgrass	*Distichlis Spicata*	Valdivia duckweed	*Lemna valdiviana*
Nuttall milkvetch	*Astragalus nuttallianus*	Barnyard grass	*Echinochloa crusgalli*	Peppergrass	*Lepidium densiflorum*
Ground plum	*Astragalus plattensis*	Barnyard grass	*Echinochola muricata*	Bearded sprangletop	*Leptochloa fascicularis*
Groundsel-tree	*Baccharis salicina*	Yerba de tajo	*Eclipta prostrata*	Bush dover	*Lespedeza capitata*
White wild indigo	*Baptisia lactea*	Spikerush/sedge	*Eleocharis* sp.	Dotted gayfeather	*Liatrus punctata*
Sideoats grama	*Bouteloua curtipendula*	Canada wild rye	*Elynms canaderisis*	Oldfield toadflax	*Linaria canadensis*
Downy brome	*Bromus tectorum*	Engelmann's daisy	*Engelmannia pinnatifida*	False pimpernel	*Lindernia dubia*
Rescue grass	*Bromus unioloides*	Mediterranean lovegrass	*Eragrostis barrelieri*	Lindheimet daisy	*Lindheimera texalia*
Chittamwood	*Bumelia lanuginosa*	Stinkgrass	*Eragrostis cilianensis*	Meadow flax	*Linum pratense*
Pink poppy mallow	*Callirhoe altaeoides*	Weeping lovegrass	*Eragrostis curvula*	Narrowleaf puccoon	*Lithospermum incisum*
Purple poppy mallow	*Callirhoe involucrata*	Little lovegrass	*Eragrostis minor*	Osage orange	*Maclura pomifera*
Small-seeded false flax	*Camdina microcarpa*	Red lovegrass	*Eragrostis secundiflora*	Hairy water clover	*Marsilea vestita*
Shepherd's purse	*Capsella bursa-pastoris*	Plains fleabane	*Erigeron modestus*	Alfalfa	*Medicago sativa*
Pecan	*Carya illinoensis*	Daisy fleabane	*Erigeron strigosus*	White sweet clover	*Melilotus alba*
Prairie paintbrush	*Castilleja purpurea*	Prairie cupgrass	*Eriochloa contracta*	Yellow sweet clover	*Melilotus officinalis*
Cigar-tree	*Catalpa speciosa*	Filaree	*Erodtum cicutarium*	Bractless mentzelia	*Mentzelia nuda*
Sugarberry	*Celtis laevigata*	Western wallflower	*Erysimum asperum*	White four o'clock	*Mirabilis albida*
Sandbur	*Cenchrus incertus*	Bushy wallflower	*Erysimum repanclum*	Carpetweed	*Mollugo verticillata*
Mexican tea	*Dysphania ambrosioides*	Whitemargin sandmat	*Euphorbia albomarginata*	Horsemint	*Monarda punctata*
Slimleaf goosefoot	*Chenopodium leptophyllum*	Gever's spurge	*Euphorbia geveri*	Povertyweed	*Monolepis nuttalliana*
Windmill grass	*Chloris vetticillata*	Spreading euphorbia	*Euphorbia humistrata*	White mulberry	*Morus alba*
Showy chloris	*Chloris virgata*	Prostrate spurge	*Euphorbia ptostrata*	Scratchgrass	*Muhlenbergia asperifolia*
Roughhair golden aster	*Chrysopsis canescens*	Warty euphorbia	*Euphorbia spatkulata*	Crow poison	*Nothoscordum bivalve*
Texas thistle	*Cirsium texanum*	Rabbit tobacco	*Evax prolifera*	Showy evening primrose	*Oenothera grandis*
Wavyleaf thistle	*Cirsium undulatum*	Sixweeks fescue	*Festuca octoflora*	Cutleaf evening primrose	*Oenothera laciniata*
Possum grape	*Cissus incisa*	Slender snakecotton	*Froelichia gracilis*	Fourpoint evening primrose	*Oenothera rhombipetala*
Eastern cleomella	*Cleomella angustifolia*	Snake cotton	*Froelichia floridana*	Bigroot prickly pear	*Opuntia macrorhiza*
Erect day-flower	*Commelina erecta*	Indian blanket	*Gaillardia pulchella*	Broomrape	*Orobanche multiflora*
Field bindweed	*Convolvutus arvensis*	Rayless gaillardia	*Gaillardia suavis*	Yellow wood sorrel	*Oxalis corniculata*
Horseweed	*Conyza canadensis*	Velvety gaura	*Gaura parviilora*	Witchgrass	*Panicum capillare*
Texas millet	*Panicum texarium*	Texas dandelion	*Pyrrhopappus multicaulis*	Red false mallow	*Sphaeralcea coccinea*
Switchgrass	*Panicum vitgatum*	Purple groundcherry	*Quincula lobata*	Alkali sacaton	*Sporobolus airoides*
Florida paspalum	*Paspalum floridanum*	Blister buttercup	*Ranunculus scleratus*	Meadow dropseed	*Sporobolus asper*
Thin paspalum	*Paspalum setaceum*	Mexican hat	*Ratibida columnifera*	Common chickweed	*Stellaria media*
Prairie blue curls	*Phacelia strictiflora*	Black locust	*Robinia pseudo-acacia*	Smoothseed wildbean	*Strophostyles leiosperma*
May grass	*Phalaris caroliniana*	Toothcup	*Rotala ramosior*	Sea blite	*Suaeda depressa*
Drummond leaf-flower	*Phyllanthus abnormis*	Sour dock	*Rumex crispus*	Saltcedar	*Tamarix chinensis*
Field ground d1erry	*Physalis viscosa*	Bitter dock	*Rumex obtusifolius*	Common dandelion	*Taraxacum officinale*
Buckhorn plantain	*Plantago lanceolata*	Narrow-leaf dock	*Rumex stenophyllus*	Knotted hedgeparsely	*Torilis nodosa*
Wooly plantain	*Plantago patagoriica*	Black willow	*Salix nigra*	Spiderwort	*Tradescantia bracteata*
Paleseed plantain	*Plantago virginica*	Azure blue sage	*Salvia azurea*	Nettleleaf	*Tragia ramose*
Purple camphorweed	*Pluchea odotata*	Water pimpernel	*Samolus parviflorus*	Goat's beard	*Tragopogon dubius*
Texas bluegrass	*Poa arachnifera*	Sensitive briar	*Schrankia nuttallii*	Goathead	*Tribulus terrestris*
Plains bluegrass	*Poa arida*	Chainnaker's rush	*Scirpus americanus*	White tridens	*Tridens albescens*
Kentucky bluegrass	*Poa pratensis*	Alkali bulrush	*Scirpus maritimus*	Small hop clover	*Trifolittm dubium*
Bushy knotweed	*Polygonuin ramosissimum*	Common threesquare	*Scirpus pungens*	Small venus' looking-glass	*Triodanis biflora*
Smartweed	*Polygonum lapathifolium*	Packera tampicana	*Senecio imparipinnatus*	Purple sandgrass	*Triplasis purpurea*
Pennsylv. smartweed	*Polygonum pensylvanicum*	Green foxtail	*Setaria viridis*	Wheat	*Triticum aestivum*
Lady's thumb	*Polygonum persicaria*	Blue-eyed grass	*Sisyrinchium angustifolium*	Narrow-leaved cattail	*Typha angustifolia*
Rabbitfoot grass	*Polypogon monspeliensis*	Tumbling mustard	*Sisyrnbrium altissimum*	Chinese elm	*Ulmus parviflora*
Juniperleaf	*Polypremum procumbens*	Silverleaf nightshade	*Solanum elaeagnifolium*	Sweet-William	*Verbena bipinnatifida*
Cottonwood	*Populus deltoides*	Black nightshade	*Solanum ptycanthum*	Cowpen daisy	*Verbesina encelioides*
Moss rose	*Portllaca mundula*	Buffalobur	*Solanum rostratum*	Sleepy daisy	*Xanthisma texanum*
Wingpod purslane	*Portulaca umbraticola*	Stiff prairie goldenrod	*Solidago rigida*	Cocklebur	*Xanthium strumartum*
Common devil's claw	*Proboscidea louisitmica*	Spiny-leaved sowthistle	*Sonchus asper*	Arkansas yucca	*Yucca glauca*
Mesquite	*Prosopis glandulosa*	Indiangrass	*Sorghastrum nutans*	Horned pondweed	*Zannicheilia paiustris*
Chickasaw plum	*Prunus angustifolia*	Johnson grass	*Sorghum halepense*		

2.3.2.3 Future Vegetation Cover

Installation Supplement

The dominant ecosystem present at the installation is grassland/prairie. According to CSU (2019), light changes in temperature and precipitation can substantially alter the composition, distribution, and abundance of species in these ecosystems, and the products and services they provide. The extent of these changes will also depend on changes in precipitation and fire. Increased drought frequency could also cause major changes in vegetation cover. Loss of vegetative cover coupled with increases in precipitation intensity and climate-induced reductions in soil aggregate stability will dramatically increase potential erosion rates.

As warmer temperatures increase evaporation and water use by plants, soils are likely to continue to become drier. Average rainfall is likely to increase during winter, spring, and summer. Climate change impacts to grasslands and pasture bioregions include increased seasonal, annual, minimum, and maximum temperature and changing precipitation patterns. Because these ecosystems are relatively dry with a strong seasonal climate, they are sensitive to climatic changes and vulnerable to shifts in climatic regime. Rising temperatures under various climate change scenarios will likely enhance soil decomposition. Together with reductions in rainfall, this may also reduce plant productivity over large areas.

A qualitative analysis of vegetation cover maps in MC2 Dynamic Global Vegetation Model was done to assess potential changes to land cover and uses under the projected climate change scenarios. Historically, vegetation type at Altus AFB has been Subtropical Shrubland C4. Under RCP 8.5, vegetation cover at Altus AFB could be converted to temperate warm mixed woodland (Kim, Kerns, Drapek, Pitts, & Halofsky, 2018). This means a projected loss of grassland/shrubs and prairie ecosystems at the installation in the future.

2.3.2.4 Turf and Landscaped Areas

Installation Supplement

Improved grounds of turf in developed areas of the installation are dominated by common bermudagrass (*Cynodon dactylon*). The majority of shrubs in landscaped areas are dominated by boxwood species of the *Buxaceae* family. Trees planted in developed areas mainly consist of the species listed in Table 8:

Table 8. Tree species located in developed areas of Altus AFB.

Common Name	Scientific Name	Common Name	Scientific Name	Common Name	Scientific Name
Silver maple	Acer saccharinum	Red mulberry	Morus rubra	Buckley's oak/Texas red oak	*Quercus buckleyi*
Sugarberry	Celtis laevigata	Afghan pine	*Pinus brutia var. eldaria*	Escarpment live oak	*Quercus fusiformis*
Oklahoma redbud	*Cercis canadensis var. texensis 'Oklahoma'*	Slash pine	*Pinus elliottii*	Bur oak	*Quercus macrocarpa*
Arizona cypress	*Cupressus arizonica*	Aleppo pine	*Pinus halepensis*	Chinquapin oak	*Quercus muehlenbergi*
Green ash	*Fraxinus pennsylvanica*	Austrian pine	*Pinus nigra*	Pin oak	*Quercus palustris*
Modesto ash	*Fraxinus velutina*	Loblolly pine	*Pinus taeda*	Shumard oak	*Quercus shumardii*
Thornless honeylocust	*Gleditsia triacanthos var. inermis*	Chinese pistache	*Pistacia chinensis*	Bald cypress	*Taxodium distichum*
Eastern red cedar	*Juniperus virginiana*	American sycamore	*Platanus occidentalis*	Lacebark elm	*Ulmus parvifolia*
Crape myrtle	*Lagerstroemia indica*	Eastern cottonwood	*Populus deltoides*	Siberian elm	*Ulmus pumila*
Osage orange	*Maclura pomifera*	Bradford pear	*Pyrus calleryana*		

2.3.3 Fish and Wildlife

Installation Supplement

Altus AFB is home to a diverse variety of wildlife. Many species are only present on the installation briefly during migration. A full list wildlife species documented on the installation can be found in Appendix H. As of June 2022, wildlife species observed include 35 mammals, 118 birds, 17 reptiles, 5 amphibians, and 37 invertebrates. Native fauna of Altus AFB include one federal candidate species and several state-listed species of greatest conservation need, which are identified and discussed in Section 2.3.4. The following paragraphs outline the higher taxonomic classifications present.

Rodents are one of the most abundant mammal groups present. Common species include the deer mouse (*Peromyscus maniculatus*), hispid cotton rat (*Sigmodon hispidus*), fox squirrel (*Sciurus niger*), and thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*). Lagomorphs are also abundant, but are limited to two species, the eastern cottontail (*Sylvilagus floridanus)* and the black-tailed jackrabbit (*Lepus californicus*). Seasonal abundances of bats can be significant, with an acoustic survey by the University of Montana and Tetra Tech, Inc. in 2017 identifying 11 species at Altus AFB. The eastern red bat (*Lasiurus borealis*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and silver-haired bat (*Lasionycteris noctivagans*) dominate activity levels on the installation. Carnivores are also well represented, the most common species being the western coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and gray fox (*Urocyon cinereoargenteus*). Other common species include the nine-banded armadillo (*Dasypus novemcinctus*), white-tailed deer (*Odocoileus virginianus*), and Virginia opossum (*Didelphis virginiana*).

Amphibian presence is mostly restricted to the immediate areas surrounding permanent water bodies or vernal pools. Toads are the exception to this, occupying a larger range of habitats. Amphibian species on base are abundant where found. Species include the barred tiger salamander (*Ambystoma marvortium*), Plains leopard frog (*Lithobates blairi*), Blanchard's cricket frog (*Acris blanchardii*), American bullfrog (*Lithobates catesbeianus*), and Woodhouse's toad (*Anaxyrus woodhousii*).

The most commonly observed reptile species on the installation include the Texas horned lizard (*Phrynosoma cornutum*), bullsnake (*Pituophis catenifer sayi*), Ornate box turtle (*Terrapene ornata*), plain-bellied watersnake (*Nerodia erythrogaster*), red-eared slider (*Trachemys scripta elegans*), and western ratsnake (*Pantherophis obsoletus*).

Birds are the most abundant vertebrates on Altus AFB. The most common species are the mourning dove (*Zenaida macroura*), eastern meadowlark (*Sturnella magna*), western meadowlark (*Sturnella neglecta*), scissor-tailed flycatcher (*Tyrannus forficatus*), red-winged blackbird (*Agelaius phoeniceus*), killdeer (*Charadrius vociferus*), dickcissel (*Spiza americana*), barn swallow (*Hirundo rustica*), common grackle (*Quiscalus quiscula*), rock pigeon (*Columba livia*), and European starling (*Sturnus vulgaris*).

Fish present in streams and ponds on the installation include the green sunfish *(Lepomis cyanellus)*, longear sunfish (*Lepomis megalotis*), red shiner (*Cyprinella lutrensis*), black bullhead (*Ameiurus melas*), yellow bullhead (*Ameiurus natalis*), channel catfish (*Ictalurus punctatus*), and western mosquitofish (*Gambusia affinis*).

Common invertebrate species include the southern plains crayfish (*Procambarys simulans*), western honeybee (*Apis mellifera*), common green June beetle (*Cotinis nitida*), and admirable grasshopper (*Syrbula admirabilis*).

2.3.4 Threatened and Endangered Species and Species of Concern

Installation Supplement

The Endangered Species Act (ESA) of 1973 (16 US Code [USC] §1531 *et seq*.) serves to protect and recover species nearing extinction and the ecosystems upon which they depend. The ESA is administered by the USFWS, which designates federally threatened and endangered terrestrial and freshwater species.

ODWC designates and maintains a list of species that are threatened or endangered in Oklahoma.

According to an endangered species survey conducted by the Oklahoma Biological Survey in 1998, no known federally or state listed threatened or endangered plant or wildlife species are known to occur on Altus AFB or Sooner Drop Zone (SDZ) (Schnell et al. 1998). Furthermore, no habitat listed as critical for any such species has been designated. Federally endangered wildlife species known or believed to occur in southwestern Oklahoma include the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*). The piping plover and red knot, both listed as Threatened, have not been recorded in Jackson County. These species prefer foraging habitats of mudflats and sandy beaches. Red knots pass through the state during migration but rarely stop. Fewer than five individuals are reported in Oklahoma annually (ODWC, 2022). The whooping crane, listed as Endangered, has been recorded in Jackson County. Whooping cranes have the potential to fly over the installation. However, Altus AFB lands do not contain habitats likely to attract any of these species.

Two species that have been observed on Altus AFB may soon become state or federally listed. The USFWS designated the monarch butterfly (*Danaus plexippus*) as a candidate species that warrants listing under the ESA in December of 2020, but it is not yet listed or proposed for listing (USFWS, 2022a). Monarchs can be found on the installation during spring and fall migrations. The tricolored bat (*Perimyotis subflavus*) has been under status review since December of 2017 to determine if federal listing is warranted (USFWS, 2022b). This species was detected on the installation in 2016 during an acoustic bat survey, with an overall mean activity rate of 0.5 bat passes per night (Hauer and Schwab, 2017).

Rare and declining wildlife species in Oklahoma are designated by ODWC as Species of Greatest Conservation Need (ODWC, 2016). Mammalian species of concern that have been documented at Altus AFB include the Brazilian (Mexican) free-tailed bat (*Tadarida brasiliensis*) and western big-eared bat (*Corynorhinus townsendii*). Reptilian species of concern include the spiny softshell turtle (*Apalone spiniferus*), western diamond-backed rattlesnake (*Crotalus atrox*) and the Texas horned lizard (*Phrynosoma cornutum*). One fish species of concern is the red river pupfish (*Cyprinodon rubrofluviatilis*). Avian species of concern include the loggerhead shrike (*Lanius ludovicianus*), burrowing owl (*Athene cunicularia*), little blue heron (*Egretta caerulea*), Bell's vireo (*Vireo bellii*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), northern bobwhite (*Colinus virginianus*), northern pintail (*Anas acuta*), ferruginous hawk (*Buteo regalis*), sandhill crane (*Grus canadensis*), Cassin's sparrow (*Peucaea cassinii*), Harris's sparrow (*Zonotrichia querula*), solitary sandpiper (*Tringa solitaria*) and upland sandpiper (*Bartramia longicauda*).

Several species listed by the USFWS as Birds of Conservation Concern in the U.S. central mixed grass prairie region are known to occur on the installation (USFWS, 2021). Their presence can vary annually, from year-round, seasonal, and migratory to absent. Birds of Conservation Concern confirmed at Altus AFB include the chimney swift (*Cheatura pelagica*), northern harrier (*Circus cyaneus*), and western burrowing owl (*Athene cunicularia ssp. hypugaea*).

2.3.5 Wetlands and Floodplains

Installation Supplement

Wetlands

Wetlands are defined as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (COE, 1987). The National Wetlands Inventory identifies roughly 26.15 acres of wetlands on Altus AFB, as shown in Figure 10 (USFWS, 1983). This does not include creeks, irrigation canals, and drainage swales. A wetlands delineation completed in 1994 identified wetlands at Altus AFB using three designations for aquatic systems (Webb and Aurelius):

System 1 areas are riverine, intermittent streambed systems with seasonal or temporary hydrology. These are natural drainages with a defined bed and bank, and occur in channelized portions of Stinking Creek as well as unnamed tributaries and natural drainages that connect to Stinking Creek. Many of these drainages are routinely mowed and maintained. Small, intermittent oxbow-like, isolated patches of wetland within these beds are considered jurisdictional wetlands, subject to the regulations of Section 404 of the CWA. Plant species commonly observed within these isolated wetlands are threesquare bulrush *(Scirpus pungens)* and Small's spikerush *(Eleocharis smalllii)*.

System 2 areas are palustrine, emergent, persistent systems that may have temporary or seasonal hydrology, or seasonally saturated soils. Altus AFB contains four System 2 areas, which are larger, more easily distinguishable sites that may be subject to Section 404 regulatory review as special aquatic sites.

System 3 areas are riverine, intermittent streambed systems with seasonal, permanent, or temporary hydrology. These areas are constructed drainages and swales that provide drainage for base facilities. Altus AFB contains eight System 3 areas of maintained canals that often connect to natural drainages across the base. Two of these areas have permanent hydrology, four areas have seasonal hydrology, and two areas have temporary hydrology. These systems are usually not regulated under Section 404 of the CWA.

Six excavated areas on Altus AFB are classified as palustrine, unconsolidated bottom aquatic sites that may have semi-permanent hydrology. These areas are percolation ponds for facility treatment systems or ponds used for irrigation for the base golf course. Artificial ponds are not regulated under the CWA.

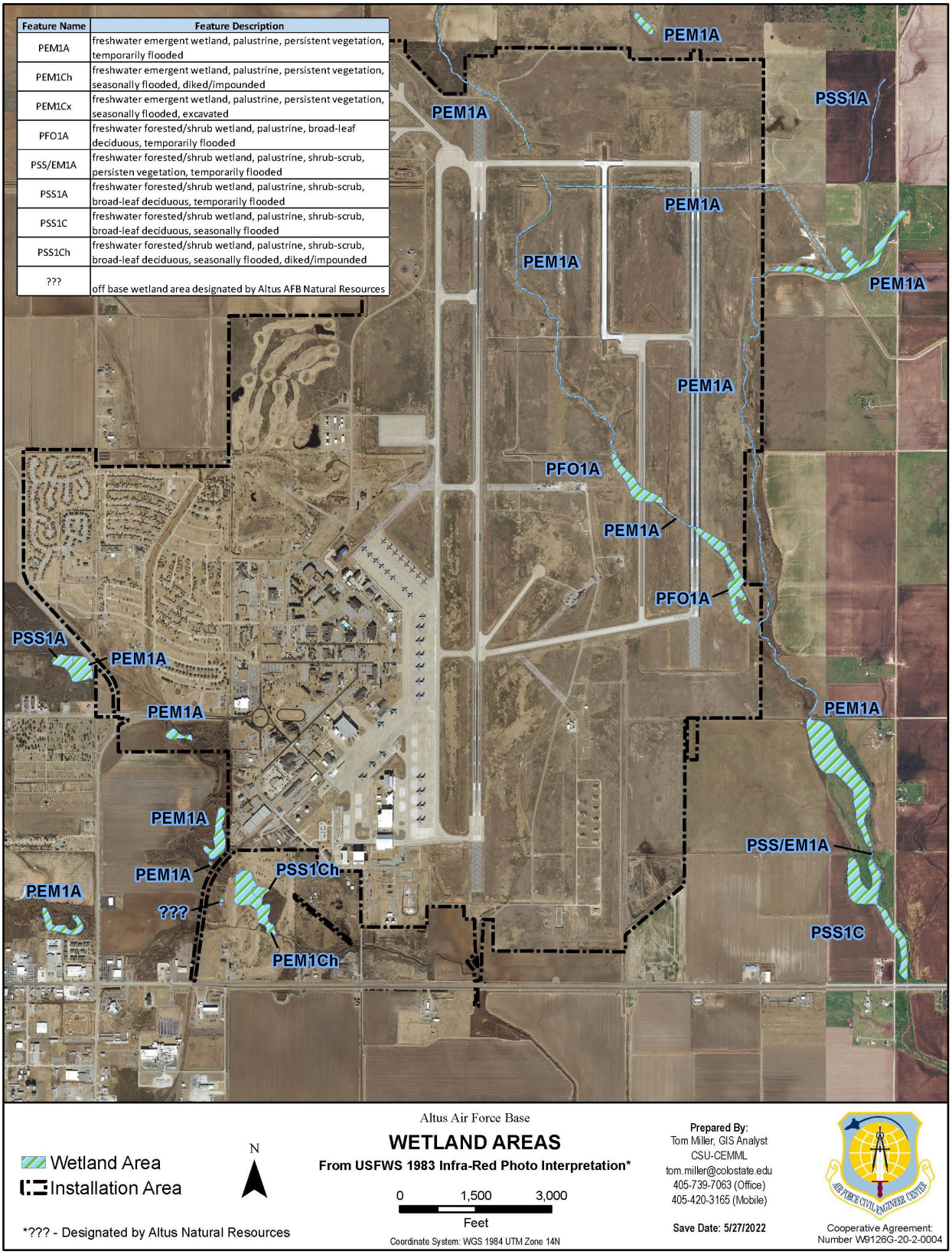

Figure 10. Wetland areas at Altus AFB.

Floodplains

Floodplains are defined by the Federal Emergency Management Agency (FEMA) as "any land area susceptible to being inundated by floodwaters from any source" (FEMA, 2019). Floodplains provide space to accommodate floodwaters from the overflow of streams after heavy rain events. Floodplains on Altus AFB surround Stinking Creek and unnamed tributaries to Stinking Creek. The majority of the floodplains are in unimproved, semi-improved, and airfield grounds.

100-year and 500-year FEMA flood maps for the installation were created in 2012, and are now considered outdated according to FEMA guidelines. Additionally, portions of the FEMA flood maps show no changes or updates since July 2005. A recent floodplain analysis conducted by Colorado State University (CSU) Center for Environmental Management of Military Lands (CEMML) provided updated 100-year and 500-year floodplain mapping information for Altus AFB using high quality spatial data and 2D hydraulic modeling (CSU, 2020). Figure 11 overlays the outdated FEMA floodplain map with the newer CSU floodplain data for the installation.

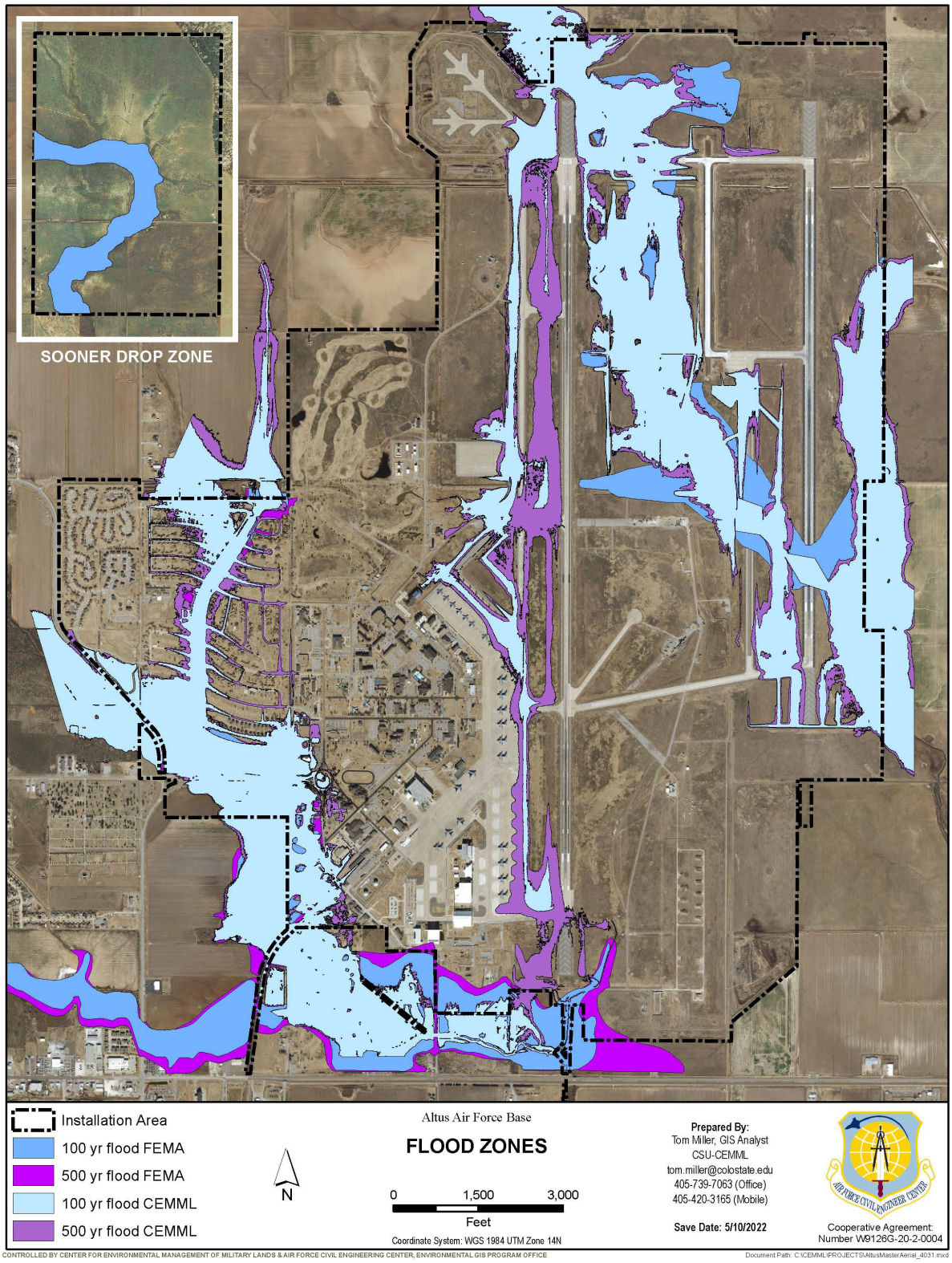

Figure 11. FEMA (2012) vs. CSU (2020) 100-year and 500-year floodplains at Altus AFB.

Effects of Climate Change on Wetlands and Floodplains

Wetland ecosystems will face increases in air and surface water temperatures, alterations in the magnitude and seasonality of precipitation and run-off, and shifts in reproductive phenology and distribution of plants and animals (Parmesan and Yohe, 2003). These ecosystems are naturally resilient, provide linear habitat connectivity, link aquatic and terrestrial ecosystems, and create thermal refugia for wildlife all characteristics that can contribute to ecological adaptation to climate change. Because wetland systems and the projected impacts of climate change are highly variable geographically, there is a pressing need to develop a place-based understanding of climate change threats to riparian ecosystems. Methods used for climate change projections can be found in Appendix G.

Additional floodplain inundation due to climate change is not a major concern, but as development continues on Altus AFB, and if forecasted climate changes eventuate, the quantity and intensity of flooding events may increase; floodplains may not have the capacity to hold increased floodwaters. If the installation expands into flood zones, unmitigated, it would exacerbate flooding impacts on downstream off-base communities such as the City of Altus. Therefore, proper floodplain management is essential.

2.3.6 Other Natural Resource Information

Installation Supplement

This section is not applicable to this installation.

2.4 Mission and Natural Resources

2.4.1 Natural Resource Constraints to Mission and Mission Planning

Installation Supplement

This section identifies all natural resources protection issues that have the potential to pose a constraint to future development and mission expansion at Altus AFB. This includes natural resource constraints to missions and mission planning associated with land uses in the immediate vicinity outside the installation boundary. Natural resource constraints at Altus AFB include floodplains, wetlands, and waterways in which operations and development are permitted with consideration and/or mitigation. These constraints are available as geospatial data layers as shown in Figure 12, and need to be considered and incorporated into the Installation Decvelopment Plan and other component plans in support of future development decisions.

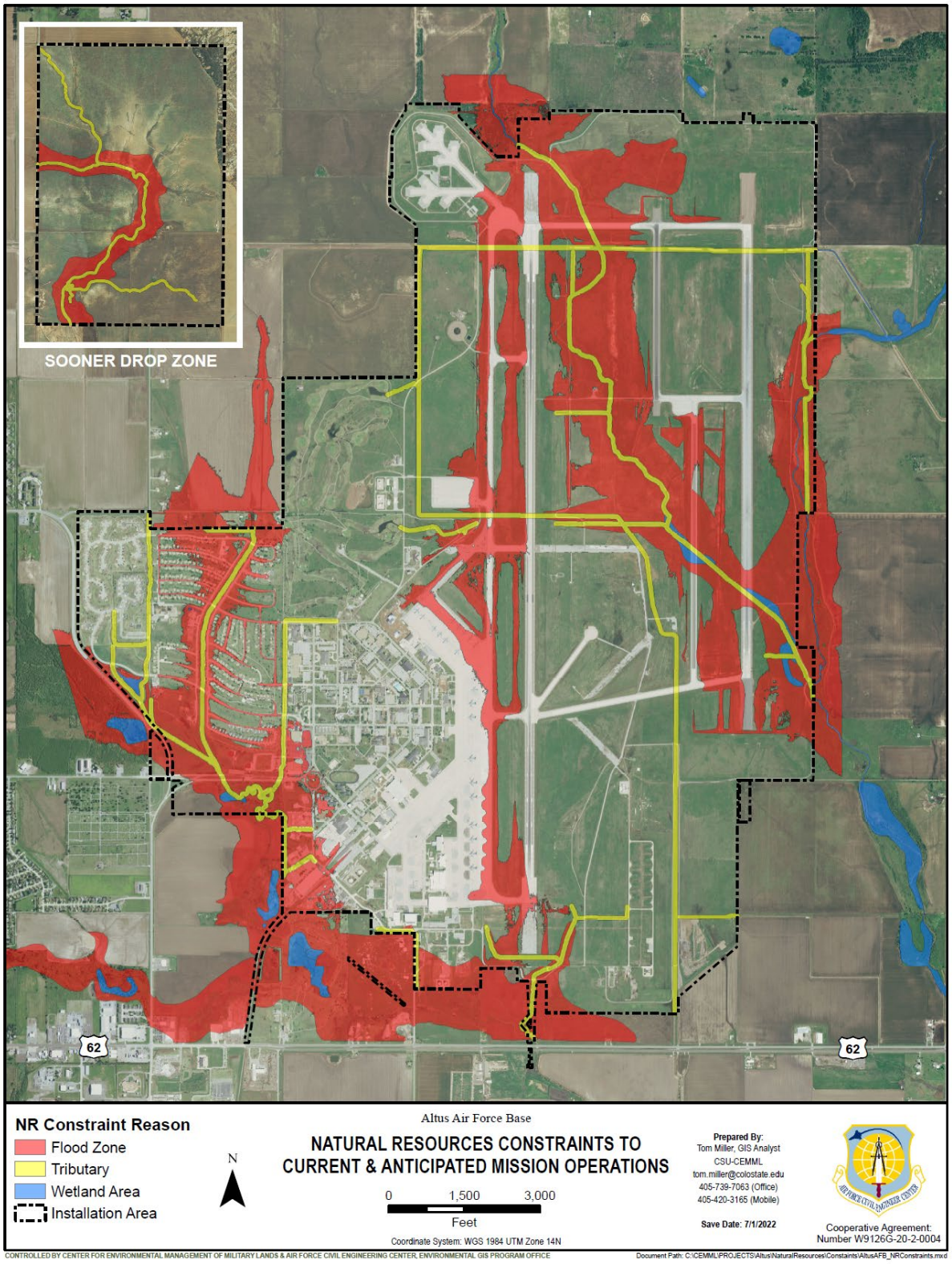

Figure 12. Natural resource constraints to mission operations at Altus AFB.

Legal Impacts of Floodplains, Wetlands, and Waterways

Altus AFB contains floodplains, wetlands, and waterways that may present a constraint to installation development. A map of Altus AFB geospatial wetland data obtained from the USFWS National Wetlands Inventory is presented in Figure 10. A 2020 Colorado State University (CSU) analysis of the FEMA database resulted in the creation of a new floodplain map for Altus AFB using updated geospatial data. Figure 11 maps the CSU floodplain data against the 2012 FEMA data. Proposed actions that have the potential to affect jurisdictional wetlands or waters of the U.S. may require permits and mitigation measures pursuant with the Clean Water Act. Due to the proximity of waterways on the installation and the potential for pollution of stormwater runoff, any construction activity that disturbs at least one acre of land must obtain a stormwater discharge permit from the State. Proposed actions within a floodplain, or that could affect floodplains, must comply with EO 11988, *Floodplain Management*, and identify any effects on flood risk. All proposed federal actions must be assessed via the AF Environmental Impact Analysis Process (EIAP) under the National Environmental Policy Act (NEPA). Mission consequences of failing to recognize the need for an EIAP early in the project planning process include project delays until environmental analysis and documentation are completed, exceedance of budgets, public outcry, and legal injunction and/or civil fines and penalties.

Flooding Impacts

Multiple areas and buildings lie within floodplains, and several have been damaged by flooding in recent years. Flooding is caused by several factors, including intensity and frequency of rainfall, flat terrain, and the soil's low capacity for absorption (USAF, 1997). Off base development and modification along tributaries to the north have caused increased runoff through base property, and some drainage ways outside of the base are narrow and constricted. Excess runoff along with the limited carrying capacities of nearby tributaries cause flood waters to back up onto base property.

Current areas affected include buildings in the southwestern portion of the base, as well as areas of the airfield pictured. Flooding is a problem in the southwest portion of the base including the main gate, the family camping (FamCamp) area, and the outdoor recreation areas (Figure 13). Flooding also occurs in the northeast portion of the base, affecting operations on the parallel runway and assault strip.

According to the CSU analysis of data from the Air Force Geospatial Information Management System (AFGIMS), the following assets on Altus AFB are located within the 100-year floodplain (Figure 13):

- 60 real property buildings
- 8 hazardous materials sites
- 4 hazardous waste sites
- 2 storage tanks
- 16.9% of the airfield

The following assets on Altus AFB are located within the 500-year floodplain (Figure 13):

- 107 real property buildings
- 10 hazardous materials sites
- 6 hazardous waste sites
- 3 storage tanks
- 35.7% of the airfield

CSU projected the 95th percentile maximum flood depth, flood velocity, and shear stress on the local terrain due to flooding for Altus AFB:

- Maximum flood depth is projected to be 1.8 feet for the 100-year storm and 1.9 feet for the 500- year storm.
- Maximum flood velocity is projected to be 1.4 feet/second for the 500-year storm and 1.3 feet/second for the 100-year storm.
- Maximum shear stress on the local terrain due to flooding is projected to be 0.1 lb/ft^2 for the 500- year storm and 0.2 lb/ft^2 for the 100-year storm.

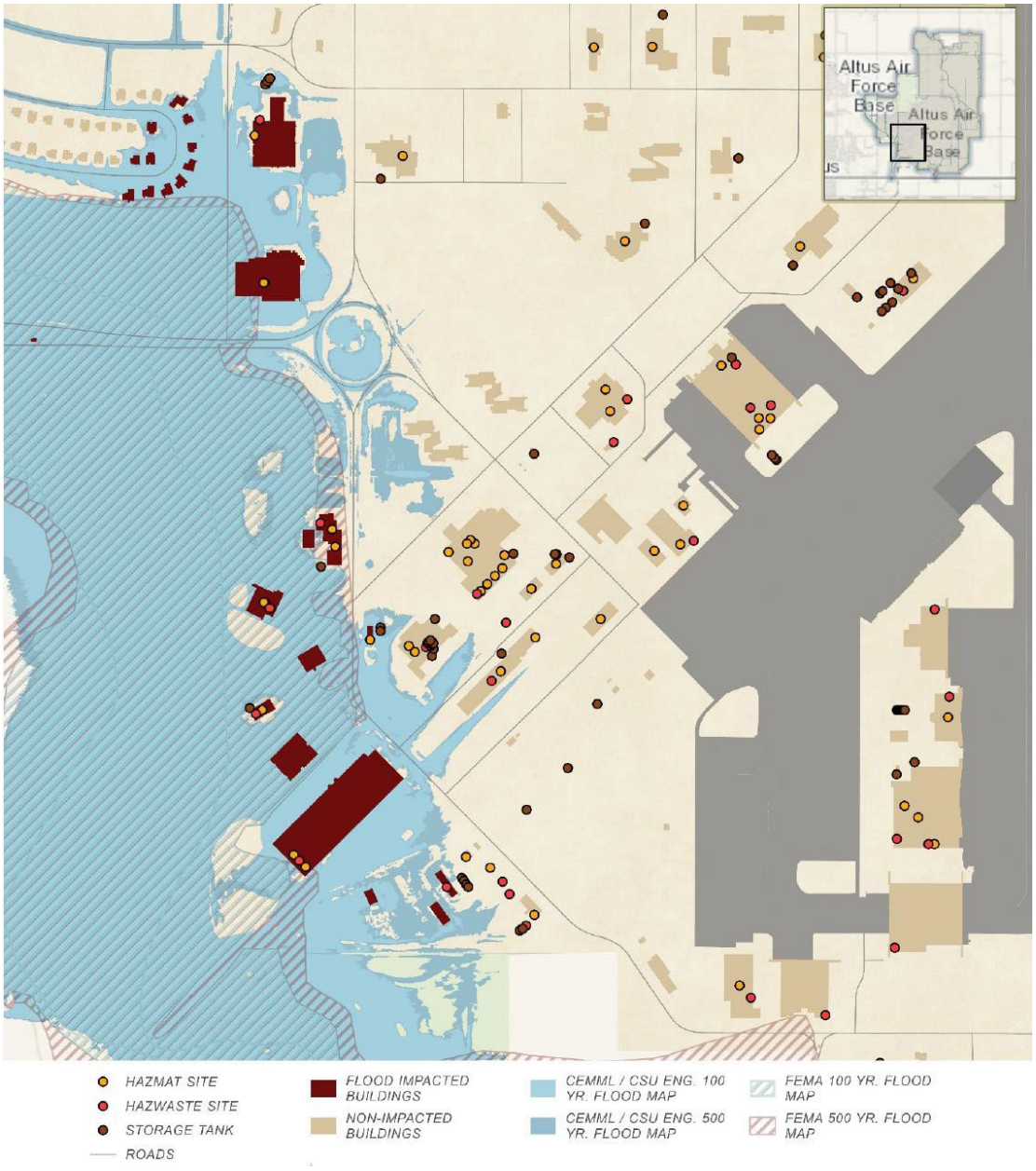

Figure 13. Floodplain area and exposed infrastructure at Altus AFB.

Climate Change Impacts

The undeveloped land and airspace that are needed to fulfill Altus AFB's mission of training aircrews do not require specific habitat or vegetation types that may be an integral part of mission readiness at other installations. Climate change will have negligible to no effect on the amount of air and land space available.

The climate at Altus AFB is expected to get hotter, which could have secondary effects on the mission such as vegetation shifts and species migrations leading to an increased regulatory environment.

Additional floodplain inundation due to climate change is not a major concern, but as development continues on Altus AFB, and if forecasted climate changes eventuate, the quantity and intensity of flooding events may increase; floodplains may not have the capacity to hold increased floodwaters. If the installation expands into flood zones, unmitigated, it would exacerbate flooding impacts on downstream off-base communities such as the City of Altus. Therefore, proper floodplain management is essential. Execution of this INRMP strives to manage the landscape to reduce the effects of future flood events on the mission.

Future impacts to the mission at Altus AFB linked to climate change could include:

- increases in temperature and wind velocity leading to unsafe environmental conditions for the launch of current and planned weapons and equipment, resulting in increased maintenance requirements, requirements for new equipment, or decreased launch capacity (DoD, 2014);
- increased dust generation affecting equipment and visibility (DoD, 2014);
- increased wind velocities damaging vital mission infrastructure (Sydeman et al., 2014);
- increased drought potential (Glick, Stein, & Edelson, 2011);
- potential loss of future training areas that may be needed in light of a changing geopolitical landscape and base realignment.

In addition to these direct effects, climate change has the potential to disrupt the acquisition and transportation of materials required for the maintenance, construction, and storage of the equipment required for these systems (DoD, 2014).

Inundation projections were influenced by four variable inputs: (1) variation in total precipitation between design storms, (2) variation between the daily distribution of precipitation over the three-day period, (3) land cover change over the watershed area used in hydrologic modeling, and (4) land cover change in the area within the installation used in hydraulic modeling.

Projected inundation associated with each climate scenario and the relative change from baseline conditions are summarized in Table 9. The spatial extent of projected flooding is depicted in a series of maps included in Appendix G. Projected changes in stream channel overflow can be used to assess potential vulnerabilities to species, habitat, mission, and built and natural infrastructure.

Total design storm precipitation is projected to decrease in 2030 and increase in 2050 (Table 13. Stream channel overflow is projected to increase by between 5% (RCP 8.5 in 2050) and 17% (RCP 4.5 in 2050) (Table 9). Flooding is projected to decrease by 24% under the RCP 4.5 emission scenario in 2030, despite total design storm precipitation decreasing by 8%. Projected land cover over the modeled watersheds was unique for this scenario having primarily grassland cover, compared to shrubland and forested vegetation, which were dominant in the other scenarios.

Table 9. Area inundated by stream channel overflow.

	Baseline	**RCP 4.5**		**RCP 8.5**	
	2000	2030	2050	2030	2050
Projected inundation (acres)	169	128.8	197.4	186.5	176.8
Change in inundation area from baseline (acres)		-40.2	28.4	17.5	7.7
Percent change from baseline		-24%	17%	10%	5%

2.4.2 Land Use

Installation Supplement

The Major Land Resource Area (MLRA) that Altus lies within is 78C, the Central Rolling Red Plains, Eastern Part (Figure 14). This MLRA is part of Land Resource Region H, the Central Great Plains Winter Wheat and Range Region (NRCS, 2006). Land use consists of 38% private cropland, 56% private grassland, 3% private urban development, 1% federal grassland, 1% private water, and 1% private other.

Farms and ranches that produce grain crops and livestock make up most of this MLRA. Most of the area is used as rangeland. The more gently sloping lands are used for pasture or row crops. Cotton compromises a significant percentage of agricultural land use.

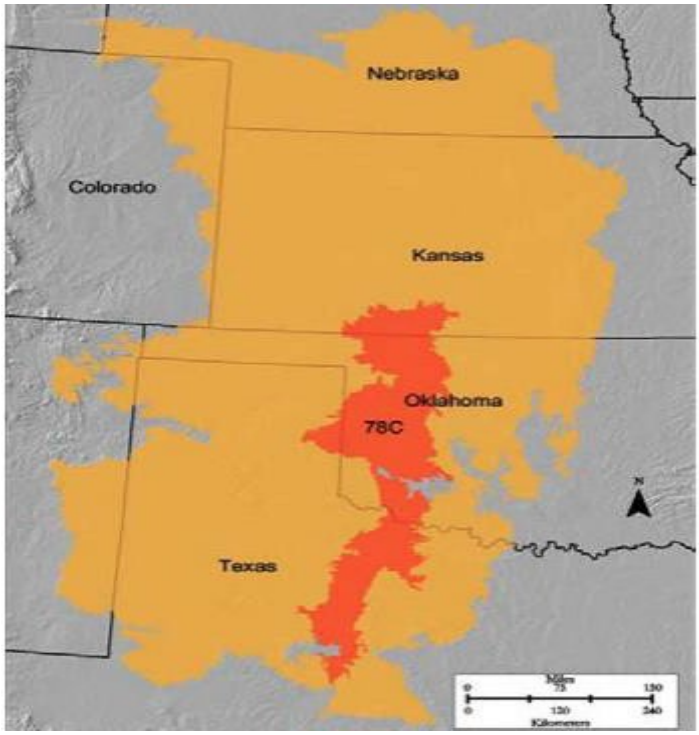

Figure 14: Location of MLRA 78C within Land Resource Region H.

Development at Altus AFB incorporates the grouping of compatible land uses. Industrial facilities are consolidated at the southern edge of the installation, and operations and maintenance areas are located along the flight line. Commercial and service community land uses are centrally located. Privatized military family housing is located in the northwest portion of the base. Open space occurs predominantly along the northeastern border of the base and at the southern edge of the family housing area north of the main gate.

Land use on the installation includes areas for aircraft operations and maintenance, military training, outdoor recreation, and areas of medical, administrative, and industrial facilities, housing, community services, airfield, and open space (Figure 15). Altus AFB is comprised of approximately 5,043 acres within the installation perimeter. About two thirds of total land use acreage consists of airfield. The next largest areas of land use in order of size are open space, housing, outdoor recreation, and industrial areas (USAF, 2014). The Sooner Drop Zone comprises approximately 959.14 total acres, of which 100% is used as airfield.

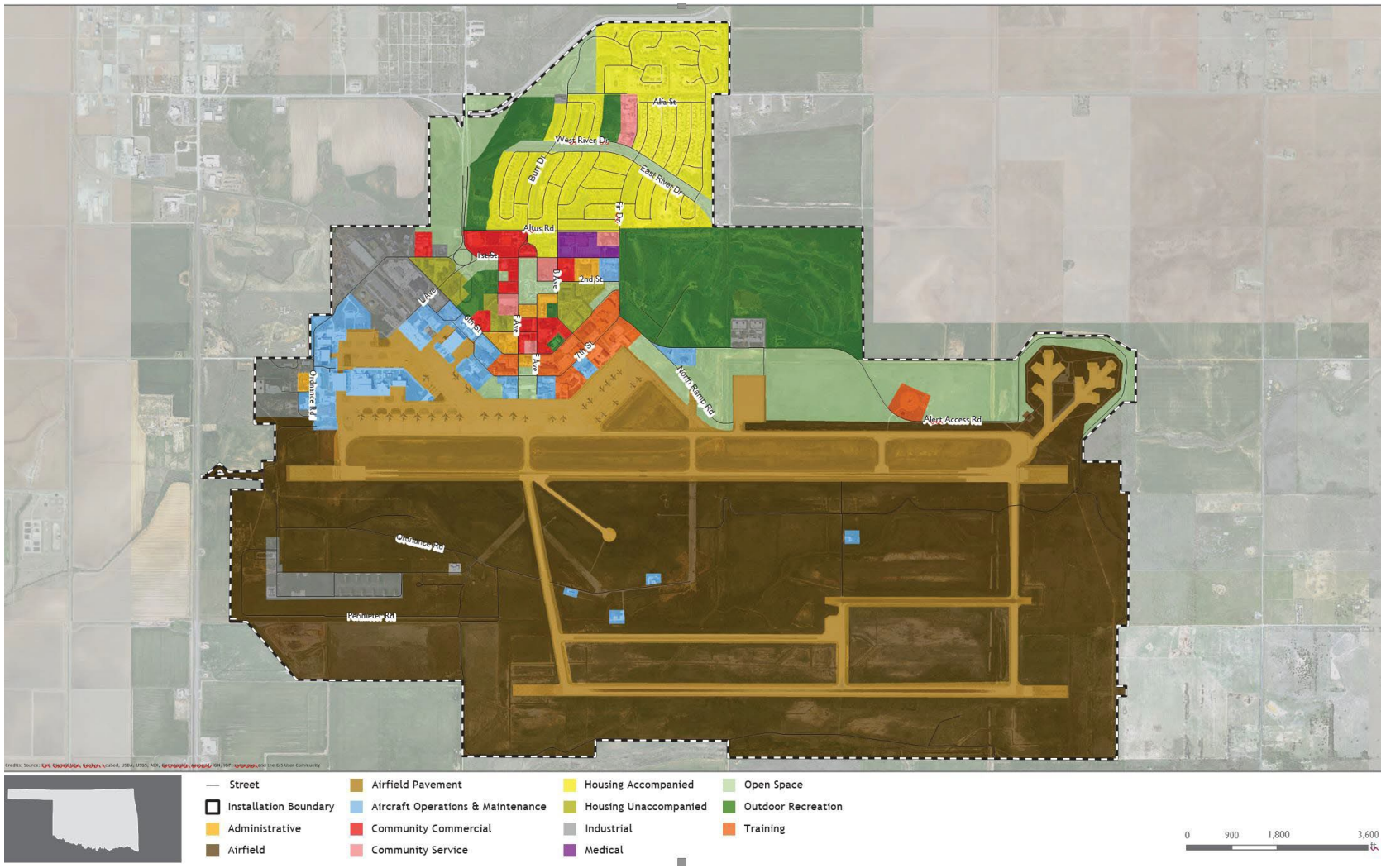

Figure 15. Existing land use at Altus AFB (USAF, 2014).

2.4.3 Current Major Mission Impacts on Natural Resources

Installation Supplement

This section describes current mission operations that affect or may potentially affect natural resources on the installation.

Air Pollution Sources

Various industrial activities at Altus AFB generate air emissions that release pollutants and have the potential to reduce air quality. Air emissions are monitored by the 97 CEIE Air Quality Program Manager and all emission activities and equipment are covered by permits issued by ODEQ. Emission sources on the installation include mobile sources such as aircraft, automobiles, and grounds maintenance equipment, and stationary sources such as power generation, fire training exercises, fueling operations, painting operations, welding operations, and woodworking facilities.

Water Pollution Sources

Altus AFB has six stormwater outfalls that drain industrial areas of the base and four outfalls that drain non-industrial areas. Base operations generate several types of hazardous wastes including oils and fuels, cleaning compounds, paints and solvents, batteries, and mercury and lead foil. Areas where industrial materials are exposed to stormwater include the flight line, maintenance shops, bulk fuel storage, motor pools, and scrap metal and waste recycling facilities. Primary sources of water pollution include petroleum, oil, and lubricant (POL) leaks and spills during aircraft refueling and emergency maintenance activities, aqueous film forming foam (AFFF) discharged during fire prevention and maintenanace activities, and aircraft/runway deicing fluids. These pollutants are primarily exposed to stormwater on aprons and taxiways and have the potential to enter the storm sewer system and contaminate receiving waterways. Hazardous material spills can negatively affect fish and wildlife, water resources, and outdoor recreational areas (USAF, 2017). Spills present a particularly high risk to wetlands, which contain significant biological diversity and provide critical habitat for many types of plants and animals.

Construction activities cause land disturbance to soil and vegetation and constitute the primary avenue of potential erosion and sedimentation damage at Altus AFB. Exposed soils are subject to wind and rain erosion, which can cause sediment buildup in stormwater drainage systems and degrade water quality in local streams.

Solid waste that is improperly contained or littered also contributes to environmental degradation. Waste often accumulates in drainage swales and transports to waterways off base via stormwater runoff. Pollution prevention measures are discussed in Section 7.5.

Vegetation Management

Vegetation management required to support airfield operations has the potential to negatively impact natural resources. The majority of installation land is airfield. Airfield vegetation height is maintained at heights of 7-14 inches, and woody and broadleaf vegetation is kept to a minimum to reduce BASH risks. The portion of Stinking Creek within the airfield does not contain woody riparian habitat, and wetland areas are limited. Lack of vegetation along streams and drainage ditches may increase soil erosion and reduce water quality of receiving waterways. Bank erosion and sediment buildup is evident in all streams on the installation. Airfield vegetation management limits biodiversity and may discourage grassland bird nesting and the presence of specialist species. Prairie restoration of indigenous grass species composition is not feasible in these areas.

Groundwater Contamination

Altus AFB has identified 29 areas on the installation with histories of hazardous waste spills or disposal from past activities. These sites contain contaminants that may pose environmental health risks. The USAF Installation Restoration Program (IRP) identifies, investigates, cleans up, and ultimately closes out such sites in an effort to protect the environment and human health. 15 sites have completed clean up, while 14 sites are still undergoing corrective action activities. Long-term groundwater monitoring must be completed at some sites in order for them to be considered for closure. Monitoring wells are located around the sites where contamination possibly occurred.

2.4.4 Potential Future Mission Impacts on Natural Resources

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According to the 2014 Altus AFB Installation Development Plan (IDP), future land use plans include:

- Expanding airfield pavements and operations and maintenance areas
- Establishing a training campus along parade grounds and removing campus space along the apron to create development opportunities for compatible land uses
- Consolidating unaccompanied housing along parade grounds
- Replacing commercial land use with administrative land use at the head of the parade grounds to improve prominence of wing headquarters
- Expanding outdoor recreation fields and facilities by the traffic circle to establish a central recreation area and improved installation entrance
- Relocating nonflightline functions, such as administrative, away from the flightline and associated industrial uses
- Replacing deteriorating infrastructure
- Reconfigure ingress/egress lanes from Veterans Drive to the main gate
- Construct a visitor center and gatehouse and inspection office at the main gate and reroute access roads to create serpentine paths
- Expand the south gate entry control point

Agricultural areas adjacent to the southwest part of the base are currently being developed into housing. Future development on and surrounding Altus AFB may negatively affect native plant and wildlife communities if not carefully planned and reviewed. Development of open space creates habitat loss and fragmentation, which may decrease biodiversity on the installation. Vegetation removal and increased impervious land cover have the potential to increase soil erosion and flooding impacts. Green infrastructure design and a strong mitigation program will help to lessen the impacts of development on natural resources.

3.0 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. Executive Order (EO) 13990, *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*; DoDI 4715.17, *Environmental Management Systems*; AFI 32-7001, *Environmental Management*; and International Organization for Standardization (ISO) 14001 standard, *Environmental Management Systems – Requirements with guidance for use*, provide guidance on how environmental programs should be established, implemented, and maintained to operate under the EMS framework.

The natural resources program employs EMS-based processes to achieve compliance with all legal

obligations and current policy drivers, effectively manage associated risks, and instill a culture of continual improvement. The INRMP serves as an administrative operational control that defines compliance-related activities and processes.

4.0 GENERAL ROLES AND RESPONSIBILITIES

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

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The installation as a whole is responsible for implementation of the INRMP. However, certain offices have primary responsibility over specific portions of the plan. Table 10 lists the roles and responsibilities of organizations with major roles in INRMP implementation.

Table 10. Roles and responsibilities for implementing the Altus AFB natural resources program.

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
Installation Commander	• Approves and signs the INRMP at least every 5 years or when the plan is significantly revised; or delegates certification to the appropriate designee
AFCEC Natural Resources Media Manager/Subject Matter Expert (SME)/Subject Matter Specialist (SMS)	• Provide base-level support to ensure natural resources program execution in accordance with the Sikes Act and other regulatory requirements
Installation Natural Resources Manager/POC	• Oversees the natural resources program and plans, coordinates, and implements natural resource projects • Maintains the INRMP and ensures regulatory compliance • Provides technical advice on natural resources • Reviews installation plans, project proposals, and work requests to ensure INRMP and regulatory compliance and evaluate potential impacts to natural resources
Installation Security Forces	• Controls access to the installation/natural resources
Installation Unit Environmental Coordinators (UECs)	• Serve as environmental POCs for their unit and disseminate guidance received from Environmental staff • Ensure their units comply with environmental requirements
Installation Wildland Fire Program Manager	• Coordinates with AFCEC/CZOF WSM on all wildland fire matters • Coordinates the annual WFMP review
Pest Manager	• Oversees pest control operations and maintains the IPMP • Serves as the OPR for control of nuisance wildlife species
Range Operating Agency	• Not applicable
Conservation Law Enforcement Officer (CLEO)	• Not applicable – the ODWC Jackson County Game Warden enforces state regulations regarding fish and wildlife and outdoor recreation
NEPA/Environmental Impact Analysis Process (EIAP) Manager	• Analyzes the effects of proposed federal actions that have the potential to significantly affect environmental quality and ensures documentation and disclosure of potential impacts
National Oceanic and Atmospheric Administration (NOAA)/ National Marine Fisheries Service (NMFS)	• Not applicable
US Forest Service	• Provides technical advice on urban forest management • Reviews and signs the installation Tree City USA application annually
US Fish and Wildlife Service (USFWS)	• Reviews and approves the INRMP during annual and 5-year reviews to ensure natural resources management complies with the Sikes Act

Oklahoma Department of Wildlife Conservation (ODWC)	• Reviews and approves the INRMP during annual and 5-year reviews to ensure installation activities will not negatively impact natural resources

5.0 TRAINING

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

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Natural resources management training is provided to ensure that base personnel, contractors, and visitors are aware of their role in the program and the importance of their participation to its success per AFMAN 32-7003, *Environmental Conservation*. Training records are maintained IAW the Recordkeeping and Reporting section of this plan. Below are key natural resources management-related training requirements and programs:

- Altus AFB is a Category I installation which requires NRMs to take the course DoD Natural Resources Compliance, endorsed by the DoD Interservice Environmental Education Review Board and offered for all DoD Components by the Naval School, Civil Engineer Corps Officers School (CECOS).
- Natural resource management personnel at Altus AFB are encouragd to attend appropriate national, regional, state, and local conferences, seminars, and training courses.
- Individuals participating in the capture and handling of sick, injured, or nuisance wildlife receive appropriate training. Pest management and USDA Wildlife Services personnel are trained in wildlife control techniques and are licensed in pesticide application.
- USDA Wildlife Services personnel implement the BASH program. USDA staff have degrees in wildlife biology and receive training in bird species identification, airport wildlife control, and immobilization and euthanasia. Personnel maintain a flight line driver's license and receive firearms and pyrotechnic training annually.

6.0 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

The installation maintains required records IAW AFI 33-322, *Records Management and Information Governance Program*, and disposes of records IAW the Air Force Records Management System (AFRIMS) records disposition schedule (RDS). Numerous types of records must be maintained to support implementation of the natural resources program. Specific records are identified in applicable sections of this plan, in the Natural Resources Playbook, and in referenced documents.

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The NRM maintains natural resources records on eDASH and on the 97th CES share drive network. Some records are also maintained as hard copy documents in the Environmental office.

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.

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Natural resources-related reporting consists of the following:

- Annual INRMP review summary (NRM to USFWS, ODWC, AFCEC, and installation stakeholders)
- Annual Scientific Collectors Permit renewal and collection report (NRM to ODWC)
- Annual report and renewal of the Migratory Bird Treaty Act (MBTA) depredation permit (USDA-Wildlife Services to USFWS and NRM)
- Annual Depredation Report Form 3-202-9 (USDA-Wildlife Services Biologist to USFWS and NRM)
- Semi-annual natural resoures EQ Data Call (NRM to AFCEC/CZ via EESOH-MIS database)
- Semi-annual natural resources program assessment (NRM to 97 CES via MICT database)
- Annual agricultural outgrant inspection report (NRM to 97 CES Real Property)
- Annual Reimbursable Conservation Program budget submission (NRM to AFCEC/CZ)
- Prescribed fire reports (WSM to AFCEC/CZOF)
- Wildfire reports (FES or WSM to AFCEC/CZOF)
- Mechanical and chemical fuels treatment reports (WSM to AFCEC/CZOF)

7.0 NATURAL RESOURCES PROGRAM MANAGEMENT

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

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The following natural resources program management activities are conducted at Altus AFB:

- Fish and wildlife management
- Outdoor recreation
- Conservation law enforcement
- Management of species of concern and their habitats
- Water resource protection
- Wetland protection
- Grounds maintenance
- Urban forest management
- Wildland fire management
- Agricultural outleasing
- Integrated pest management
- Bird/wildlife aircraft strike (BASH) hazard management
- Public outreach
- Climate change resiliency
- Geographic Information System (GIS) management

7.1 Fish and Wildlife Management

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Applicability Statement

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

Program Overview/Current Management Practices

Fish and wildlife management is overseen by the 97th Environmental Element (97 CES/CEIE) and guided by AFMAN 32- 7003, *Environmental Conservation*. The goal of fish and wildlife management is maintain or improve ecosystem integrity and landscape resiliency by conserving biodiversity. Management activities focus on creating and improving natural habitat to maintain viable native wildlife populations. The natural resources manager (NRM) collaborates with ODWC, USFWS, and USDA-Wildlife Services during project planning. Activities are conducted in a manner that is consistent with the military mission and compliant with applicable environmental laws and regulations. The following current activities and aspects of fish and wildlife program management at Altus AFB are discussed in this section:

- Fish and wildlife monitoring
- Enforcement of fish and wildlife laws
- Hunting, fishing, and non-consumptive resource uses
- Wildlife education and interpretation programs
- Control of nuisance, exotic, and invasive wildlife and feral animals
- Fish and wildlife habitat creation and enhancement
- Migratory bird conservation
- How a changing climate could impact existing and future management activities

Fish and Wildlife Monitoring

Fish and wildlife populations at Altus AFB should be monitored to inform natural resources management decisions. Wildlife surveys are routinely conducted as a defining metric to assess population trends. Viable populations of all native species are maintained or reestablished when practical and consistent with the military mission and not in conflict with airfield operations or flight safety.

The Environmental team manages game fish to support recreational fishing. Channel catfish are stocked in the fishing pond each spring for an annual fishing derby. Green, redear, and hybrid sunfish are occasionally stocked by ODWC as available. Game and non-game fish species are surveyed and inventoried at least annually in installation ponds and streams. Benthic macro-invertebrate surveys are conducted quarterly by the Water Quality Program Manager to assess and monitor the health of creeks on base. The USDA BASH biologist conducts monthly bird and mammal point count and nocturnal thermal imaging surveys on the airfield and golf course and shares this data with the NRM. Monthly avian surveys are used to monitor migratory bird populations. The NRM oversees wildlife monitoring projects conducted by the USFWS biologist, which include Texas horned lizard tracking and reptile and amphibian surveys. See Section 7.4 for information on the Texas horned lizard study. Herpetofauna surveys were conducted in 2022 using drift fencing, traps, and an acoustic recorder to create a species inventory for the installation. The NRM and USFWS also began sampling snakes caught on base for the infectious fungal disease ophidiomycosis as part of a study by DoD Partners in Amphibian and Reptile Conservation (PARC).

Enforcement of Fish and Wildlife Laws

The Jackson County Game Warden has base access in order to patrol fishing and hunting areas and enforce compliance with state regulations. Conservation law enforcement is discussed in Section 7.3.

Hunting, Fishing, and Non-consumptive Resource Uses

Hunting and fishing is overseen by the NRM and aims to provide consumptive outdoor recreation opportunities to boost morale for base personnel. Hunting and fishing activities are compliant with state and federal laws and regulations, and consistent with DoD principles for ecosystem management and biodiversity conservation. Participation is limited to DoD cardholders with base access.

ODWC provides voluntary assistance to help manage hunting and fishing programs. Game Wardens and fisheries biologists assist with planning and during dove hunts and fishing derbies. Altus AFB does not charge fees for hunting, fishing, or outdoor recreation access. Any fees collected in the future will be used for conservation and management of fish and wildlife, habitat improvements, and investments in assets that directly benefit hunting, fishing, or trapping opportunities.

Altus AFB does not have hunting or trapping seasons due to a lack of unimproved landscape suitable for this purpose. Altus AFB implements a one-day annual dove hunt in order to boost morale among airmen while targeting species that have a high presence on the airfield. The target species are mourning doves (*Zenaida macroura*), white-winged doves (*Zenaida asiatica*), Eurasian collared doves (*Streptopelia decaocto*), and rock doves/common pigeons (*Columba livia*). Eurasian collared doves and rock pigeons are invasive species that are not legally protected, while the mourning dove and white-winged dove have a state-designated hunting season. Participants of the hunt must abide by all federal and state hunting laws and regulations, to include carrying a current state hunting license and a Harvest Information Program (HIP) permit. The NRM coordinates with Security Forces and Airfield Management during dove hunt planning to ensure security and safety requirements are met. The Occupational Safety office may provide a risk assessment for the event. The event includes a clay target shooting station set up by ODWC personnel. The Jackson County Game Warden provides a safety brief to the hunters.

The Sooner Drop Zone contains suitable dove habitat and space, and has potential to be used for hunting in the future. The NR Program does not currently have the resources to implement a dove hunting season at this location.

In 2020, Altus AFB opened a small 1.88-acre pond for recreational fishing. This pond is routinely surveyed to monitor fish populations and managed to maintain suitable habitat for the survival and reproduction of game fish. The water is also sampled quarterly and analyzed to assess water quality conditions. Stocked species include hybrid sunfish (*Lepomis macrochirus X microlophus* and *X cyanellus*) and channel catfish (*Ictalurus punctatus*). Other species found in the pond include bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), and black bullhead catfish (*Ameiurus melas*). Anglers must have a state fishing license and abide by state fishing regulations and base- specific rules. State regulations can be found on the ODWC website (www.wildlifedepartment.com/law/fishing_guide). Base regulations are more restrictive than state regulations; the method of take is limited to rod and reel only, with a maximum of two rods per person. The daily creel limit is set at two and the size limit is 12 inches for channel catfish. The daily creel limit for sunfish species is 10. Largemouth bass, if stocked, will be limited to catch and release only.

The Environmental team implements a free fishing derby annually in April to celebrate Earth Day. A state fishing license is not required to participate in the annual fishing derby if ODWC sanctions the event as a fishing clinic. Channel catfish are stocked each spring to facilitate this event.

Wildlife Education and Interpretation Programs

The Environmental team participates in immersion events for local community members and Science, Technology, Engineering, and Math (STEM) outreach events for local schools, setting up labs to teach

macro-invertebrate identification for water quality assessments. The NRM and USFWS biologist, also demonstrate wildlife tracking equipment to teach about the base Texas horned lizard study. The NRM holds a state Scientific Collector's permit and maintains a wildlife specimen collection, which is used for wildlife education during outreach events. The NRM utilizes Altus AFB Public Affairs to disseminate wildlife information via the installation website, Facebook page, and base-wide emails, and routinely creates educational posts to share on the CE Environmental Facebook page. In some areas of the base, educational signs have been installed; a Monarch Waystation sign at a pollinator habitat patch describes how the space benefits monarchs and signs along the golf course walking trails warn of Mississippi kite aggression during nesting season. See Section 7.15 for more information on public outreach.

Control of Nuisance, Exotic, and Invasive Wildlife and Feral Animals

Exotic, feral, and invasive species are continuously deterred or removed from the installation in order to minimize their economic, ecological, and human health impacts in accordance with EO 13112, *Invasive Species* and EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*. See Section 7.11 for additional information on the integrated pest management program.

Pest Management and Flight Safety are equally responsible for nuisance wildlife control. Pest Management maintains an Integrated Pest Management Plan (IPMP) that guides nuisance wildlife control on the installation (Appendix F). The IPMP ensures that all pest management materials are handled, stored, used, and disposed of IAW local, state, and federal regulations. The Environmental Hazardous Materials Program Manager monitors pesticide storage and inventories IAW applicable legal requirements. USDA BASH staff control nuisance vertebrate species as guided by the BASH plan. The killing or trapping of legally protected nuisance wildlife is facilitated through an interagency agreement between USDA-Wildlife Services and ODWC. USDA provides an annual summary of depredation to ODWC. The Pest Management shop does not lethally control any state-protected vertebrate species without coordination with USDA. The Bioenvironmental Public Health unit conducts mosquito trapping and virus testing, and submits fogging requests to Pest Management. The NRM and USFWS occasionally trap and relocate nuisance snakes in residential areas on the base. The NRM ensures the INRMP, IPMP, and BASH plans are mutually supportive and annually reviews the application to renew the BASH depredation permit.

The objectives of nuisance wildlife control are to minimize negative effects on the mission caused by human health and safety concerns, BASH issues, infrastructure damage, and ecosystem degradation. Techniques used for wildlife control include exclusion, hazing, trapping, shooting, chemical control, and environmental manipulation. Examples include placing mosquito larvicide in standing water and vehicle fogging is conducted when adult mosquito presence on the installation is high. Pesticides are applied in accordance with DoD policy and state and federal regulations. All carcasses are buried on the installation. Feral cats and dogs are controlled by live trapping and transporting to the local animal shelter.

Common nuisance wildlife on Altus AFB include birds roosting and defecating in buildings, Mississippi kites attacking pedestrians, rodents and insects infesting facilities and equipment, and feral dogs and cats roaming the installation. Various mammal species cause damage to infrastructure through burrowing and denning activity. Larger mammals occasionally present a physical threat to human safety on the installation. Numerous species also carry zoonotic diseases that present a threat to human health. Exotic/invasive species that are continuously removed from the installation include feral cats, Norway rats, house mice, European starlings, house sparrows, Eurasian collared doves, and pigeons. The Pest Management shop prioritizes control of wildlife that pose a higher risk to human health, such as bees, wasps, hornets, fleas, ticks, and mosquitoes. Other targeted pests include ants, spiders, millipedes, centipedes, gnats, crickets, mice, termites, gophers, and skunks.

Fish and Wildlife Habitat Creation and Enhancement

Habitat enhancements are planned and implemented to maintain viable populations of native wildlife. The

NRM plans to increase pollinator habitat, restore prairie and riparian habitat, and remove exotic and invasive plants on the installation in the future. Potential effects of climate variability have been considered in plans to restore native ecosystems.

The NRM collaborated with the Natural Resources Conservation Service (NRCS) to plan pollinator habitat projects. The Environmental team established the first patch of pollinator habitat on the installation in 2021 by planting 273 native forbs and grasses, and one pound of NRCS seed mix at the base community garden. Pollinator habitat creation and enhancement is supported by the Pollinator Partnership Action Plan (PPAP) of the Pollinator Health Task Force that was established by the 2014 Presidential Memorandum, "Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators". According to this memorandum, "The Department of Defense shall, consistent with law and the availability of appropriations, support habitat restoration projects for pollinators, and shall direct military service installations to use, when possible, pollinator-friendly native landscaping and minimize use of pesticides harmful to pollinators through integrated vegetation and pest management practices."

Restoring areas of native prairie on the installation will support pollinators and other native wildlife, in addition to providing natural beauty and landscape diversity. The extent of native mixed-grass prairie in the region has been reduced by over 50% due to agriculture (ODWC, 2016). As prairies were converted to crop fields, remaining fragmented patches of prairie declined in quality. Habitat fragmentation disproportionately affects species that require large tracts of habitat for their home ranges or that have limited dispersal and movement capabilities, such as the Texas horned lizard. According to the Oklahoma Comprehensive Wildlife Conservation Strategy, other state-listed Species of Greatest Conservation Need that inhabit mixed-grass prairies include burrowing owls, Cassin's sparrows, loggerhead shrikes, and northern bobwhites. The NRM identified the open space south of base housing as an area of greatest conservation value for restoring native prairie. This space contains the largest acreage on the installation that is feasible for implementing prescribed burns outside of the BASH wildlife exclusion zone. Prairie wildlife will likely benefit from the development of fire regimes and removal of exotic vegetation. Improving Best Management Practices (BMPs) for erosion control and herbicide application are other ways to improve prairie habitat to benefit wildlife.

Restoring riparian zones on the base will enhance stream habitat to benefit native aquatic wildlife and improve water quality. Riparian areas in the region are often degraded or destroyed due to heavy cattle grazing, conversion to pasture and crop fields, fertilizer and pesticide use, stream channelization, and dam construction. Due to the arid climate of the region, existing riparian zones are of high importance to riparian-specific species and other wildlife utilizing water resources. Species of Greatest Conservation Need in these areas include the plains minnow, American bumblebee, and smooth and spiny softshell turtles. Ecosystem services provided by riparian habitats include erosion prevention, runoff filtration of pollutants and sediment, and flood mitigation.

Plans for future habitat enhancement also include controlling exotic and invasive species. Invasive or exotic vegetation species found on Altus AFB include common reed (*Phragmites australis*), johnsongrass (*sorghum halepense*), Bermudagrass (*Cynodon dactylon*), saltcedar (*Tamarix ramosissima*), field bindweed (*Convolvulus arvensis*), and Russian thistle (*Salsola tragus*). These species may outcompete native species, which may eventually reduce the resiliency of the landscape. The NRM plans to conduct a survey in FY2024 to determine the extent of invasive species on the installation and subsequently plan targeted control applications. See Section 7.11 for more information.

Migratory Bird Conservation

Altus AFB conserves migratory birds and their habitats by preventing or abating pollution or detrimental

alteration of the environment. This is accomplished by providing environmental reviews of proposed installation projects and adhering to the Integrated Solid Waste Management Plan (ISWMP), Storm Water Pollution Prevention Plan (SWPPP), Facility Response Plan (FRP), and Spill Prevention, Control, and Countermeasures (SPCC) Plan for preventing environmental contamination. The relatively small size of the installation and the significant risk migratory birds present to aircraft make habitat projects for migratory bird conservation inadvisable. However, if potential conservation projects are identified for ESA-listed species, 97 CES/CEIE will coordinate planning and implementation with the USDA and 97 AMW/SEF. USDA bird surveys and data collected by the Motus system are used to monitor species presence and provide a detection method for potential species of concern.

The Migratory Bird Treaty Act (MBTA) prohibits the acts (or attempted acts) of pursuing, hunting, taking, capturing, killing, or possessing of any migratory bird included in the Migratory Bird Treaty, including any parts, nests, or eggs, unless authorized by a federal permit (16 USC § 703). The majority of bird species at Altus AFB are protected under the MBTA. The Flight Safety office (97 AMW/SEF) maintains a federal migratory bird depredation permit to resolve significant BASH issues. The installation works under a cooperative agreement with USDA-Wildlife Services to decrease the potential for these hazards. A program for integrated wildlife damage management is implemented according to the SEF BASH plan. The BASH plan focuses on wildlife damage control techniques prioritizing habitat modification and nonlethal control, with lethal control implemented when necessary.

Bald and golden eagles have not been observed on the installation, but if they do appear, any harm, harrassment, or removal of nests will be prohibited IAW the Bald and Golden Eagle Protection Act. According to section 315 of the Bob Stump National Defense Authorization Act, incidental take of migratory birds may occur if done by a military member during a military readiness activity. Such incidental take occurs at Altus AFB when aircraft strikes occur during military flying operations.

Potential Climate Change Impacts on Existing and Future Management Activities

Fish and wildlife management on Altus AFB is not likely to change greatly due to projected climate change (CSU, 2021). Current fish and wildlife management issues are likely to persist in the future, such as presence of invasive/pest species, BASH concerns, and habitat management. Fish and wildlife surveys should continue to be conducted on a regular basis. Native species need to continue to be monitored to document changes. Changing climatic conditions also present opportunities for invasive species to flourish and push out native species. Monitoring of invasive species will continue to be important and management plans should be flexible enough to adapt to changing fish and wildlife concerns (Hellmann et al., 2008).

Increasing temperatures could have a negative impact on amphibians, aquatic macroinvertebrates and fish species if water temperatures in lentic systems increase. As water temperatures increase in lentic systems, dissolved oxygen decreases, resulting in diminished habitat quality, particularly for larval amphibians and aquatic macroinvertebrates. Increasing water temperatures can also increase the chances of algal blooms occurring, further depleting dissolved oxygen content and habitat suitability (Paerl et al., 2011). Efforts to remove invasive aquatic plants and algae from ponds should be continued (Poff, Brinson, & Day, 2002).

Increasing temperatures and precipitation favor vectors for diseases such as mosquitoes and ticks (Süss et al., 2008). Minimization of stagnant water in and around the cantonment area will help to reduce mosquito related infections. Tick populations in urban settings can be minimized by keeping lawns mowed and by preventing overabundances of hosts such as deer and rodents.

7.2 Outdoor Recreation and Public Access to Natural Resources

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Altus AFB strives to support the military mission by providing outdoor recreational opportunities to improve morale and enhance the quality of life for people who live and work on the installation. The Altus AFB Outdoor Recreation center offers a variety of outdoor trips and activities including hikes, bike rides, rock climbs, fishing trips, and paintball and archery tournaments. The organization also provides rental items for activities such as camping, hunting, fishing, gardening, biking, and paintball tournaments. The NRM will collaborate with the Community Planner and Outdoor Recreation when planning for new outdoor recreation opportunities at Altus AFB and will ensure that all outdoor recreation activities are consistent with the INRMP and the AF mission.

Outdoor Recreation Area Classifications

Outdoor recreation areas are classified based on recreation potential and ecosystem sustainability as Class I (developed), Class II (dispersed), or Class III (special interest areas). Class I recreation areas are designed to accommodate intensive activities such as sports, RV camping, picnicking, and utilizing paved trails. Developed recreation areas at Altus AFB include a running track, sports fields/courts (volleyball, baseball, softball, football, soccer), playgrounds, an 18-hole golf course, miniature golf course, archery range, and two outdoor saltwater swimming pools. Class I areas also include a one-acre camping area, and a one-acre picnic area. These areas are managed by the 97th Force Support Squadron (FSS). Altus AFB also contains a paved walking trail that passes through the housing area and golf course. This trail is maintained by Balfour Beatty Communities.

Class II dispersed recreation areas are suitable to support activities such as hunting, fishing, bird watching, primitive camping, boating, hiking, and sightseeing. Altus AFB contains one pond used for fishing that is maintained by 97 CES. The base does not contain areas for mountain biking or off-road vehicle use. Available areas of open space will be considered for the creation of nature paths, fishing ponds, and wildlife viewing areas.

Class III special interest recreation areas contain valuable archaeological, botanical, ecological, geological, historical, zoological, or scenic features that warrant special protection and access control. Altus AFB does not contain any Class III recreation areas.

Outdoor recreation areas at Altus AFB are displayed in Figure 16.

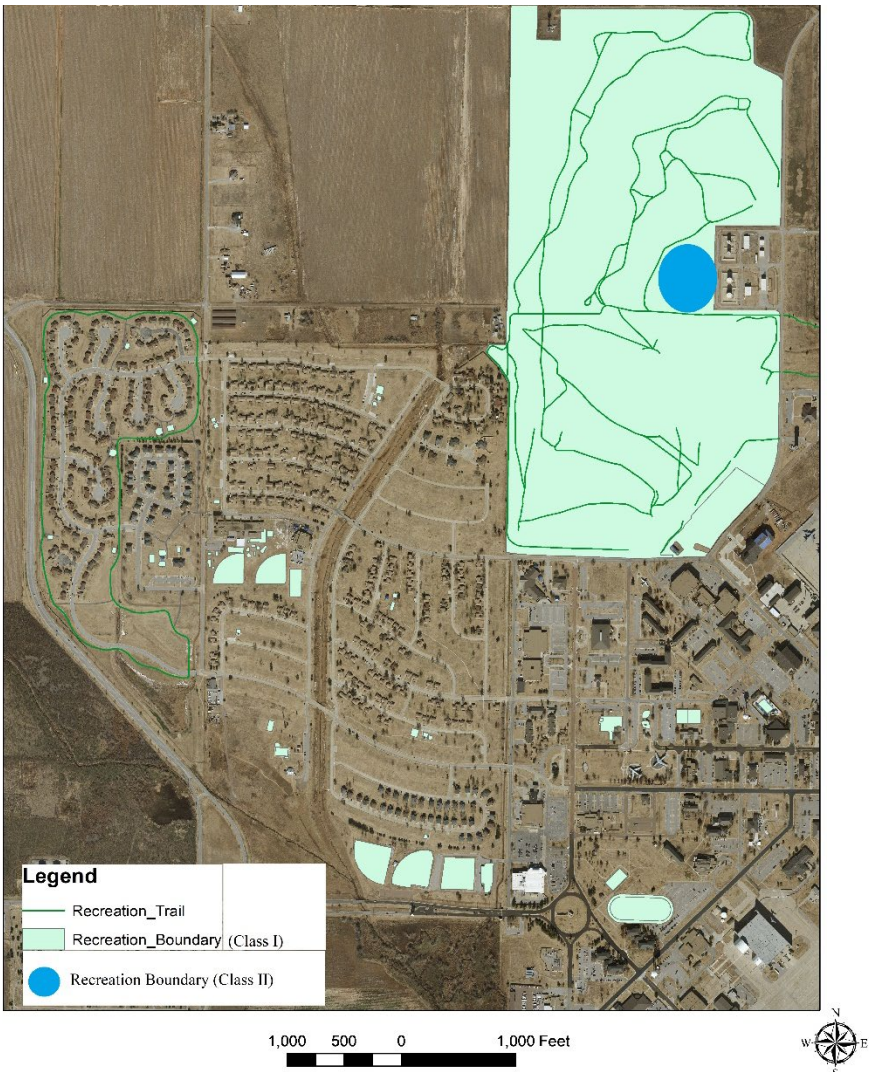

Figure 16. Outdoor recreation areas at Altus AFB.

Access and Participation

The Sikes Act (16 U.S.C. 670 et seq.) requires military installations to allow access for hunting, fishing, trapping and other outdoor recreation activities to the maximum extent practicable. There are three basic access categories for installations as designated in AFMAN 32-7003, *Environmental Conservation*: Open Areas, Restricted Areas, and Off Limits Areas. Open Areas are unrestricted areas on the installation where hunting, fishing, trapping, and outdoor recreation are permitted to all participants, including the public. Restricted Areas are designated by the Wing Commander where hunting, fishing, trapping, and outdoor recreation are permitted to certain categories of participants, or under special conditions as defined by the Commander. Off Limits Areas are designated by the Commander as being off limits to recreational hunting, fishing, trapping, and dispersed outdoor recreation by any person at any time. These are areas where mission security and safety concerns do not allow such use.

Altus AFB does not contain any Open Areas. All outdoor areas on the installation are classified as Restricted Areas, with the exception of the airport operations area (AOA), which is an Off Limits Area restricted to personnel with special security clearance due to mission security concerns regarding military aircraft operations. Restricted Areas on Altus AFB are open to the following categories of participants: active duty military, DoD civilians, active duty military dependents and family members, disabled

veterans, military retirees, DoD civilian retirees, employees of installation prime contractors, and civilians enlisted in the National Guard and Reserve that are not on active duty. Public groups may be allowed controlled access for special events as authorized by the Wing Commander. Outdoor recreation is not available to the public due to installation security requirements; the entire installation is fenced, so people must enter a security gate for access, which is restricted to those with a Common Access Card and escorted individuals. Access designations will not change during Normal, Alpha, or Bravo Force Protection Conditions (FPCON). During FPCON Charlie or Delta, gate closures may affect access to/from the installation; entry may be limited to essential personnel.

The NRM plans to utilize an online Outdoor Recreation Access Management System (RecAccess), beginning in the fall of 2022, to manage outdoor recreation access for hunting and fishing on Altus AFB. RecAcess will be used to issue fishing and/or hunting permits, track recreational user access to the installation, provide interactive mapping and user check in/check out, and announce rules, open and restricted areas, and safety awareness to authorized participants. The system will monitor and control access, ensure public safety, and facilitate the collection of permit fees to be deposited into Air Force collection accounts by interface into the Department of Treasury Pay.gov network. All public users, without having to login, will be able to access the Altus AFB web page, https://altusafb.recaccess.com/, by computer or mobile device, to view specific outdoor recreation information and installation permits added by the NRM.

Camping

The installation contains a one-acre plot of land known as FamCamp, which provides tent campsites as well as full-hookup recreational vehicle (RV) sites with water, electric, and sewer hookups. FamCamp is located just north of the main gate (Figure 17).

Figure 17. Aerial view of Altus AFB FamCamp area.

Climate Change Effects on Outdoor Recreation

Outdoor recreation and public access to natural resources on Altus AFB will not likely be affected by climate change. Low impact activities and use of facilities such as parks, playgrounds, picnic sites,

camping areas, swimming pools, the golf course and sports fields (baseball, softball, football and soccer) should continue without any change.

7.3 Conservation Law Enforcement

Applicability Statement

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

Program Overview/Current Management Practices

The Oklahoma Department of Wildlife Conservation (ODWC) Game Warden of Jackson County has base access to patrol fishing and hunting areas and enforce compliance with state regulations. Altus AFB does not have its own conservation law enforcement program due to its small size and limited fishing and hunting programs. If illegal activities involving natural resources on base occur, Environmental (CEIE) will call to notify the Game Warden, who will be able to arrive promptly. Base-specific hunting and fishing rules that are more restrictive than state regulations may be enforced by Security Forces (97 SFS).

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

Applicability Statement

This section applies to AF installations that have threatened and endangered species on AF property. This section **IS NOT** applicable to Altus AFB.

The Oklahoma Biological Survey conducted an endangered species survey in 1998 with no findings (Schnell et al. 1998). Conservation measures pursuant to the Endangered Species Act (ESA) are not implemented at Altus AFB because no federally or state-listed threatened or endangered species or critical habitats are known to occur on installation property. However, INRMP goals and objectives provide an overall ecosystem management strategy for the protection and recovery of species of concern. All information collected on Altus AFB lands and waters that pertains to a federally listed Threatened, Endangered, or Candidate species will be shared with the USFWS, and any information on state-listed species will be shared with ODWC. Due to the presence or potential presence of federally listed species near Altus AFB, ESA Section 7 consultation with USFWS is required for any proposed or ongoing action that may affect a listed species or critical habitat.

Federally listed wildlife species known or believed to occur in the region include the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*). The piping plover and red knot, both listed as Threatened, have not been recorded in Jackson County. These species prefer foraging habitats of mudflats and sandy beaches. Red knots pass through the state during migration but rarely stop, and fewer than five individuals are reported in Oklahoma annually (ODWC, 2022). The whooping crane (*Grus americana*), listed as Endangered, has been recorded in Jackson County, but installation property does not contain habitat likely to attract this species. Whooping cranes migrate through the Great Plains twice annually between Texas and Canada and have the potential to fly over the installation. The United States Geological Survey (USGS), USFWS, and Canadian Wildlife Service have been monitoring whooping crane movement in the region since 2017 using Global System for Mobile Communications (GSM) transmitters. In 2021, two instances were recorded of a crane flying within five miles of the base, one in the spring and one in the fall. In 2022, Altus AFB installed a Motus Wildlife Tracking System to automatically record signals from radio transmitters attached to wildlife. If whooping crane presence is confirmed at the installation, Altus AFB will consult with USFWS and ODWC to explore ways to reduce the potential for base operations to affect this species.

Two species that have been observed on Altus AFB may soon become state or federally listed. In December of 2020, the USFWS designated the monarch butterfly (*Danaus plexippus*) as a Candidate species that warrants listing under the ESA, but it is not yet listed or proposed for listing (USFWS, 2022a). Monarchs can be found on the installation during spring and fall migrations. The tricolored bat (*Perimyotis subflavus*) has been under status review since December of 2017 to determine if federal listing is warranted (USFWS, 2022b). This species was detected on the installation in 2016 during an acoustic bat survey, with an overall mean activity rate of 0.5 bat passes per night (Hauer and Schwab, 2017). The Altus AFB NRM began conducting stationary acoustic surveys in July of 2022 to monitor the presence of this species. Four stations were set up following the North American Bat Monitoring Program (NABat) protocol. Data collected will be submitted to the USGS for analysis and uploaded to the NABat database. Analysis will determine the presence of any bat species and their estimated activity rates. Survey results will be discussed with USFWS to determine if conservation actions are needed.

Rare and declining wildlife species in Oklahoma are designated by ODWC as Species of Greatest Conservation Need (ODWC, 2016). Mammalian species of concern that have been documented at Altus AFB include the Brazilian (Mexican) free-tailed bat (*Tadarida brasiliensis*) and western big-eared bat (*Corynorhinus townsendii*). Reptilian species of concern include the spiny softshell turtle (*Apalone spiniferus*), western diamond-backed rattlesnake (*Crotalus atrox*) and the Texas horned lizard (*Phrynosoma cornutum*). One fish species of concern is the red river pupfish (*Cyprinodon rubrofluviatilis*). Avian species of concern include the loggerhead shrike (*Lanius ludovicianus*), burrowing owl (*Athene cunicularia*), little blue heron (*Egretta caerulea*), Bell's vireo (*Vireo bellii*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), northern bobwhite (*Colinus virginianus*), northern pintail (*Anas acuta*), ferruginous hawk (*Buteo regalis*), sandhill crane (*Grus canadensis*), Cassin's sparrow (*Peucaea cassinii*), Harris's sparrow (*Zonotrichia querula*), solitary sandpiper (*Tringa solitaria*) and upland sandpiper (*Bartramia longicauda*).

The Texas horned lizard (*Phrynosoma cornutum*) is a species of particular interest at Altus AFB due to population declines throughout Oklahoma (Carpenter et al. 1993, Donaldson et al. 1994). This species is listed by the state of Texas as Threatened but is not listed in Oklahoma. ODWC (2016) identifies the lizard as possibly threatened or vulnerable to extirpation, but insufficient evidence exists to substantiate concern regarding its long-term survival. Uncertainty about the long-term status of this species has led to an increasing number of studies. For nearly 20 years, researchers have been tracking Texas horned lizards at Tinker AFB in Oklahoma City, Oklahoma. The NRM and USFWS collaborated with Tinker AFB to design a study on the populations at Altus AFB; USFWS began surveying in May of 2021. Captured lizards are subcutaneously tagged with passive integrated transponders (PIT tags) and outfitted with radio transmitters or passive transponders for tracking. Individuals will be monitored over time and survey data will be used to estimate abundance, home range, and survival rates. The research goal is to improve understanding of species ecology where populations appear to be successful in fragmented habitat surrounded by agriculture and urban development. This information has the potential to benefit the conservation of this species in areas of decline.

Several species listed by the USFWS as Birds of Conservation Concern in the U.S. central mixed grass prairie region are known to occur on the installation (USFWS, 2021). Their presence can vary annually, from year-round, seasonal, and migratory to absent. Birds of Conservation Concern at Altus AFB include the chimney swift (*Cheatura pelagica*), northern harrier (*Circus cyaneus*), and western burrowing owl (*Athene cunicularia ssp. hypugaea*). These species do not legally require protection on installations, but it is beneficial to monitor their populations to ensure local populations are not in decline, and to conduct research to contribute data towards their conservation. The Altus AFB federal depredation permit limits the take of species on the Birds of Conservation Concern list to 10 individuals per year.

7.5 Water Resource Protection

Applicability Statement

This section applies to AF installations that have water resources. This section **IS** applicable to Altus AFB.

Program Overview/Current Management Practices

Stormwater runoff is collected into a system of open ditches that carry the water to various discharge points from the base. These drainage ways and outfalls covey stormwater to tributaries of Stinking Creek. A detailed map of the stormwater drainage system can be found in the Storm Water Pollution Prevention Plan (SWPPP) maintained by Altus AFB Environmental. Altus AFB implements various measures to protect water resources that may be affected by installation activities. Management practices focus on stormwater pollution prevention, water quality monitoring, and environmental reviews of proposed actions that may affect wetlands and waterways. Environmental impacts of infrastructure projects are assessed to ensure development occurs in an environmentally sensitive manner and that projects reduce risk of flood loss, minimize flood impacts on human safety, health, and welfare, and preserve or restore natural and beneficial values of floodplains. Proposed actions within or that could affect floodplains are assessed for effects on flood risk.

Surface and Groundwater Protection

Altus AFB maintains an industrial stormwater discharge permit issued by the Oklahoma Department of Environmental Quality (ODEQ) and implements a SWPPP to minimize the potential for discharge of pollutants into waterways. Best Management Practices (BMPs) used to prevent stormwater pollution include sediment and erosion controls, oil/water separators, weirs, check dams, grass swales, infiltration galleries, SOPs, good housekeeping practices, and employee training. Routine sampling and inspections of stormwater discharges are conducted to check for pollution and ensure compliance with permitted effluent limits. Industrial facilities, stormwater conveyance systems, and stormwater BMPs are also routinely inspected to ensure proper function for pollution prevention.

Hazardous material use and hazardous waste generation is closely monitored by CEIE for compliance with the Altus AFB Hazardous Materials Management Plan (HMMP) and Hazardous Waste Management Plan (HWMP). Oil storage tanks are routinely inspected by the Tank Custodians for CWA (Clean Water Act) and DoD compliance. Spills and leaks are contained and cleaned up immediately to prevent or minimize groundwater or surface water contamination. Practices and procedures for preventing and responding to releases of petroleum products and hazardous substances are guided by the Altus AFB Spill Prevention, Control, and Countermeasures (SPCC) Plan and Facility Response Plan (FRP). Successful implementation of these plans has the largest direct influence on minimizing the potential exposure of contaminants to stormwater.

Refuse generated on the installation is collected weekly by a contractor and disposed in the City of Altus landfill. Recyclable materials are collected and processed at a recycling center on base. In conjunction with the HWMP, the base Integrated Solid Waste Management Plan (ISWMP) strives to reduce the overall amount of waste generated on the installation. Reduced hazardous material and waste volumes lower the potential for accidental spills and releases.

Construction activities constitute the primary avenue of potential erosion and sedimentation damage at Altus AFB. Exposed soils are subject to wind and rain erosion, which can create sediment buildup in waterways. All construction projects one acre or larger must hold a state-issued OKR10 permit for stormwater discharges from construction activities and maintain a SWPPP. The CEIE Water Quality Program Manager monitors permit compliance by reviewing contractor SWPPPs and conducting monthly site inspections. Prior to initiation of any new construction activity, the NRM coordinates on all Certificates of Compliance for Critical Planning Actions prepared IAW AFI 32-1020, *Planning and*

Programming Built Infrastructure Projects. The NRM and Environmental team review construction project proposals to ensure compliance with the INRMP and applicable environmental laws and regulations. Site level jurisdictional delineations of waters and wetlands of the U.S. must be completed by proponents for proposed development activities that may affect wetlands, streams, and water bodies IAW AFMAN 32-7003, *Environmental Conservation*. The U.S. Army Corps of Engineers must be contacted prior to construction or other activities that may affect open water habitats to determine if a Rivers & Harbors Act Sec 10 permit is necessary. A CWA Section 10 permit is required for construction, excavation, or deposition of materials in, over, or under navigable waters, or for any work that would affect the course, location, condition, or capacity of those waters. Examples of such projects include piers, wharves, breakwaters, bulkheads, jetties, weirs, transmission lines, dredging, disposal of dredged material, excavation, filling, or other modifications to navigable waters of the U.S.

Investigation and remediation of groundwater contamination has been ongoing at Altus AFB for the past 22 years under the AF Environmental Restoration Program (ERP). The primary remediation technology employed is bioremediation. Permeable reactive barriers interrupt contaminated groundwater migration, and vegetable oil is injected into contaminated groundwater. Today, all operations and disposal activities are governed by ODEQ under a Resources Conservation and Recovery Act (RCRA) Corrective Action Permit. Potential damage to natural resources from ERP operations are mitigated by adherence to the SPCC Plan and FRP to contain and clean up any contaminated groundwater overflows.

7.6 Wetland Protection

Applicability Statement

This section applies to AF installations that have existing wetlands on AF property. This section **IS** applicable to Altus AFB.

Program Overview/Current Management Practices

Floodplains and wetlands have high water resource value for natural moderation of floods, water quality maintenance, and ground water recharge. They are also a culturally valuable resource for open space, natural beauty, scientific study, outdoor recreation, and education. In compliance with EO 11990, *Protection of Wetlands*, the AF must seek to preserve the natural values of wetlands while carrying out its mission. To the maximum extent practicable, the AF must avoid actions that would destroy or adversely modify wetlands. Proposals for actions that may affect wetlands are reviewed by the Environmental Element and Army Corps of Engineers for compliance with the Clean Water Act (CWA).

Activities that may impact waters and wetlands of the United States as defined in 40 CFR § 110.1, require full compliance with the Environmental Impact Analysis Process (EIAP), 32 CFR §§ 989 et seq; CWA Sections 401, 404 and 4041(b)(1); and EO 11990 prior to implementation. The term "waters of the United States", as defined by the Navigable Waters Protection Rule in 33 CFR 328.3 and 40 CFR 120, includes territorial seas and traditional navigable waters, perennial and intermittent tributaries that contribute surface water flow to such waters, certain lakes, ponds, and impoundments of jurisdictional waters, and wetlands adjacent to other jurisdictional waters. Site level jurisdictional delineations of waters and wetlands of the U.S. must be completed by proponents for proposed development activities that may affect wetlands, streams, and water bodies IAW AFMAN 32-7003, *Environmental Conservation*.

Section 404 of the CWA mandates regulatory review and permitting for actions that may affect wetlands, to include dredging, filling, and displacing soils or other materials into a wetland. Section 401 of the CWA directs that any proponent of an action that requires a federal license or permit, such as a Section 404 or National Pollution Discharge Elimination System (NPDES) permit, must obtain a water quality certificate from the state agency for water pollution control. This certificate confirms that the action complies with water quality criteria of the state.

7.7 Grounds Maintenance

Applicability Statement

This section applies to AF installations that perform ground maintenance activities that could impact natural resources. This section **IS** applicable to Altus AFB.

Program Overview/Current Management Practices

The Altus AFB grounds maintenance program maintains all lands within the jurisdiction of the base. The primary goal is to maintain attractive, erosion-preventing vegetative cover to provide an aesthetically pleasing environment for people to live and work. The grounds maintenance plan is maintained by the 97 CES Quality Assurance office (97 CES/CEOES). Grounds maintenance on the Windy Trails golf course is guided by the Golf Environmental Management (GEM) plan (Appendix D).

The grounds maintenance contractor maintains approximately 182 acres of unimproved grounds, 20 acres of prestige areas of vegetative and inert beds subject to soil tests, aeration, and fertilization, 3 acres of functional irrigation systems, 256 acres of semi-improved grounds, 223 acres of airfield, and 9 acres of perimeter fencing. Surface drainage ditches account for 7 acres. On the Sooner Drop Zone (SDZ), Grounds Maintenance maintains roughly 108 acres of unimproved grounds, 499 acres of semi-improved grounds, and 2 acres of surface drainage ditches. In total, 7,632 acres are maintained for weed control.

Contractor employees must complete Altus AFB EMS awareness training and must comply with all applicable federal, state and local environmental laws and regulations. Hazardous materials are not brought onto the installation unless authorized for use by the Environmental Element (97 CES/CEIE). The contractor must have spill control kits on hand and must comply with waste minimization and pollution prevention practices and policies.

Grounds maintenance practices include organizing the productive utilization of land and various land and water treatment measures. Some of these measures include the use of chemical herbicides, pesticides and fertilizers. The potential pollution impact from these applications is reduced by using only EPA-approved chemicals under the direction of certified applicators, using proper methods, strictly following label instructions, and avoiding applications in close proximity to surface waters. In 2022, Grounds Maintenance began using an arm mower to control vegetation in drainage ditches instead of herbicides.

Pollution issues associated with pesticides and fertilizers are mitigated by stormwater best management practices (BMPs). Wind and water erosion are prevented by planting turf grasses, ground covers, trees and shrubs, or by mulching. Surface drainage ways are maintained to be free of debris and silt to prevent erosion and allow water flow. Vegetated drainage swales act as a filter for stormwater runoff; the grass within them must be maintained to ensure filtration capabilities and prevent soil erosion and sedimentation downstream. Solid wastes associated with grounds maintenance are collected weekly by a local contractor and disposed of in the City of Altus landfill.

Weed control is limited to noxious or invasive species for improved, semi-improved (non-airfield) and perimeter fence areas. Semi-improved, unimproved, and airfield grounds are mowed to a height between 7 and 14 inches according to FAA guidelines in order to deter avian species that present a high risk for damaging aircraft strikes.

Native plants are given preferential choice for landscaping. Altus AFB lies within the ecological region of the Great Plains Steppe and Shrub Province (Bailey, 2014). Table 11 identifies plants that are native to this region according to the North American Plant Atlas (Kartesz, J.T., 2015) and the USDA Plants Database (USDA, NRCS, 2014). Regionally native plants are better adapted to survive and thrive in the local environment, recognized by native wildlife, and require less maintenance than nonnative plants. Choosing native species promotes a healthy ecosystem and conserves water and soil. Plants that are highly attractive to wildlife should not be planted near the airfield. Work orders for landscaping and tree

removals are reviewed and approved by the Natural Resources Manager.

Table 11. Native Plants Recommended for Conservation Landscaping

Scientific Name	Common Name	Scientific Name	Common Name
Deciduous Trees			
Acacia angustissima	Prairie acacia	*Platanus occidentalis*	American sycamore
Acer negundo	Boxelder	*Populus deltoides*	Eastern cottonwood
Carya illinoinensis	Pecan	*Prunus angustifolia*	Chickasaw plum
Carya texana	Black hickory	*Ptelea trifoliata*	Common hoptree
Celtis laevigata	Sugarberry	*Quercus fusiformis*	Texas live oak
Celtis occidentalis	Common hackberry	*Quercus havardii*	Havard's oak
Celtis reticulata	Netleaf hackberry	*Quercus macrocarpa*	Bur oak
Celtis tenuifolia	Dwarf hackberry	*Quercus marilandica*	Blackjack oak
Cercis canadensis var. texensis	Texas/Oklahoma redbud	*Quercus mohriana*	Mohr's oak
Cornus drummondii	Roughleaf dogwood	*Quercus muehlenbergii*	Chinquapin oak
Cotinus obovatus	American smoketree	*Quercus prinoides*	Dwarf chinquapin oak
Crataegus crus-galli	Cock-spur hawthorn	*Quercus stellata*	Post oak
Crataegus viridis	Green hawthorn	*Salix interior*	Sandbar willow
Diospyros virginiana	Common persimmon	*Salix nigra*	Black willow
Fraxinus pennsylvanica	Green ash	*Sapindus saponaria* var. *drummondii*	Western soapberry
Gleditsia triacanthos var. inermis	Thornless honey locust	*Sideroxylon lanuginosum*	Gum bully
Juglans microcarpa	Little Walnut	*Ulmus americana*	American elm
Juglans nigra	Black walnut	*Ulmus rubra*	Slippery elm
Morus rubra	Red mulberry		
Evergreen Trees			
Juniperus ashei	Ashe's juniper	*Juniperus scopulorum*	Rocky mountain juniper
Juniperus pinchotii	Pinchot's juniper	*Quercus virginiana*	Live oak
Shrubs and Cacti			
Acaciella angustissima	Arizona desert-carpet	*Escobaria missouriensis*	Missouri fox-tail cactus
Ammannia coccinea	Valley redstem	*Escobaria vivipara*	Spinystar
Amorpha canescens	Leadplant	*Forestiera pubescen*	Stretchberry
Amorpha fruticosa	False indigo-bush	*Gutierrezia sarothrae*	Kindlingweed
Argythamnia humilis	Low silverbush	*Haploesthes greggii*	False broomweed
Argythamnia mercurialina	Tall silverbush	*Lycium berlandieri*	Silver desert-thorn
Artemisia filifolia	Sand sagebrush	*Mimosa borealis*	Fragrant mimosa
Artemisia ludoviciana	White sagebrush	*Opuntia humifusa*	Devil's tongue
Artemisia mexicana	Mexican wormwood	*Opuntia macrorhiza*	Twistspine prickly pear
Atriplex canescens	Four-wing saltbush	*Opuntia phaeacantha*	Tulip prickly pear
Baccharis salicina	Great Plains false willow	*Opuntia tortispina*	Grassland prickly pear
Baccharis texana	Prairie false willow	*Paronychia jamesii*	James' nailwort
Ceanothus americanus	New Jersey tea	*Prunus angustifolia*	Chickasaw plum
Ceanothus herbaceous	Prairie redroot/Jersey tea	*Rhus aromatica*	Fragrant sumac
Cephalanthus occidentalis	Common buttonbush	*Rhus copallinum*	Winged sumac
Cylindropuntia davisii	Davis'/Thistle cholla	*Rhus glabra*	Smooth sumac
Cylindropuntia imbricata	Tree cholla	*Rhus microphylla*	Little-leaf sumac
Cylindropuntia leptocaulis	Christmas cactus	*Ribes aureum*	Golden currant
Dalea formosa	Featherplume	*Ribes odoratum*	Clove currant
Echinocactus texensis	Horse-crippler	*Salix interior*	Sandbar willow
Echinocereus reichenbachii	Lace hedgehog cactus	*Ziziphus obtusifolia*	Lotebush
Ephedra antisyphilitica	Mormon-tea	*Yucca glauca*	Soapweed yucca
Vines			
Cissus trifoliata	Sorrelvine	*Parthenocissus quinquefolia*	Virginia creeper
Cocculus carolinus	Carolina coralbead		
Graminoids (Grasses) and Sedges			
Andropogon gerardii	Big bluestem	*Eragrostis secundiflora*	Red lovegrass
Andropogon glomeratus	Bushy bluestem	*Eragrostis spectabilis*	Purple lovegrass
Andropogon hallii	Sand bluestem	*Eragrostis trichodes*	Sand lovegrass
Aristida longespica	Red three-awn	*Hopia obtusa*	Vine mesquite
Aristida oligantha	Prairie three-awn	*Hordeum jubatum*	Foxtail barley

Aristida purpurascens	Arrowfeather three-awn	*Muhlenbergia asperifolia*	Alkali muhly
Aristida purpurea	Purple three-awn	*Panicum obtusum*	Vinemesquite
Bothriochloa barbinodis	Cane bluestem	*Panicum virgatum*	Switchgrass
Bothriochloa laguroides	Silver beardgrass	*Poa arachnifera*	Texas bluegrass
Bouteloua curtipendula	Sideoats grama	*Schizachyrium scoparium*	Little bluestem
Bouteloua dactyloides	Buffalograss	*Sorghastrum nutans*	Indiangrass
Bouteloua gracilis	Blue grama	*Spartina pectinata*	Prairie cordgrass
Bouteloua hirsuta	Hairy grama	*Sporobolus airoides*	Alkali sacaton
Bouteloua rigidiseta	Texas grama	*Sporobolus texanus*	Texas dropseed
Chloris cucullata	Hooded windmill grass	*Tridens muticus*	Slim tridens
Chloris virgata	Feather fingergrass	*Tridens flavus*	Purpletop tridens/Redtop
Elymus canadensis	Canada wildrye	*Tripsacum dactyloides*	Eastern gamagrass
Elymus virginicus	Virginia wildrye		
Annual or Biennial Flowers			
Acmispon americanus	Spanish clover	*Helianthus annuus*	Common sunflower
Aphanostephus skirrhobasis	Arkansas dozedaisy	*Helianthus petiolaris*	Prairie sunflower
Astragalus nuttallianus	Turkey-peas	*Heliotropium convolvulaceum*	Phlox heliotrope
Callirhoe leiocarpa	Tall poppymallow	*Heliotropium curassavicum*	Salt heliotrope
Chamaecrista fasciculata	Partridge pea	*Houstonia humifusa*	Matted bluet
Erigeron strigosus	Prairie fleabane	*Hymenoxys odorata*	Bitter rubberweed
Eustoma exaltatum	Catchfly prairie-gentian	*Nama hispidum*	Sandbells
Gaillardia pulchella	Indian blanket/Firewheel	*Nicotiana obtusifolia*	Desert tobacco
Glandularia bipinnatifida	Dakota mock vervain	*Portulaca umbraticola*	Wingpod purslane
Helenium amarum	Yellow sneezeweed	*Silene antirrhina*	Sleepy silene/catchfly
Perennial Flowers			
Abutilon fruticosum	Texas Indian-mallow	*Monarda punctata*	Spotted beebalm
Achillea millefolium	Common yarrow	*Oenothera albicaulis*	Whitest evening primrose
Achillea millefolium var. *occidentalis*	Western yarrow	*Oenothera macrocarpa*	Missouri evening primrose
Amsonia ciliata	Fringed bluestar	*Oenothera speciosa*	Showy evening primrose
Apocynum cannabinum	Indianhemp	*Penstemon albidus*	White penstemon
Asclepias speciosa	Showy milkweed	*Penstemon buckleyi*	Buckley's beardtongue
Asclepias sullivantii	Prairie milkweed	*Penstemon cobaea*	Cobaea beardtongue
Asclepias tuberosa	Butterfly milkweed	*Penstemon fendleri*	Fendler's penstemon
Astralagus crassicarpus	Ground-plum milkvetch	*Persicaria bicornis*	Pink smartweed
Baptisia australis	Blue wild indigo	*Persicaria pensylvanicum*	Pennsylvania smartweed
Baptisia bracteata	Longbract wild indigo	*Phemeranthus calycinus*	Largeflower fameflower
Berlandiera lyrata	Lyre-leaf greeneyes	*Phemeranthus parviflorus*	Sunbright
Brickellia eupatorioides	False boneset	*Phlox pilosa*	Downy/Prairie phlox
Callirhoe alcaeoides	Light poppy mallow	*Physalis hispida*	Prairie groundcherry
Callirhoe involucrata	Purple poppy mallow	*Physostegia virginiana*	Obedient plant
Calylophus berlandieri	Berlandier's sundrops	*Ratibida columnifera*	Prairie coneflower
Calyophus serrulatus	Yellow sundrops	*Rudbeckia hirta*	Black-eyed susan
Castilleja citrina	Prairie Indian-paintbrush	*Ruellia humillis*	Prairie petunia
Castilleja purpurea	Downy Indian paintbrush	*Salvia azurea*	Azure blue sage
Castilleja sessiliflora	Downy paintedcup	*Salvia reflexa*	Lanceleaf sage
Coreopsis grandiflora	Largeflower tickseed	*Scutellaria drummondii*	Drummond's skullcap
Coreopsis lanceolata	Lanceleaf tickseed	*Scutellaria resinosa*	Resin-dot/Sticky skullcap
Coreopsis tinctoria	Plains coreopsis	*Scutellaria wrightii*	Wright's skullcap
Dalea candida	White prairie clover	*Senna roemeriana*	Twoleaf senna
Dalea purpurea	Purple prairie clover	*Silphium integrifolium*	Wholeleaf rosinweed
Delphinium carolinianum	Prairie larkspur	*Silphium laciniatum*	Compass plant
Desmanthus illinoensis	Illinois bundleflower	*Solidago altiplanities*	High plains goldenrod
Dodecatheon meadia	Prairie shooting-star	*Solidago altissima*	Canada goldenrod
Echinacea angustifolia	Blacksamson echinacea	*Solidago gigantea*	Giant goldenrod
Gaura coccinea	Scarlet gaura	*Solidago missouriensis*	Missouri goldenrod
Geranium carolinianum	Carolina geranium	*Solidago mollis*	Velvety goldenrod
Glandularia bipinnatifida	Dakota mock vervain	*Solidago nemoralis*	Gray goldenrod
Glandularia canadensis	Rose mock vervain	*Solidago petiolaris*	Downy ragged goldenrod

Glandularia pumila	Pink mock vervain	*Solidago speciosa*	Showy goldenrod
Helenium amarum	Sneezeweed	*Sophora nuttalliana*	Silky Sophora
Helenium autumnale	Common sneezeweed	*Sphaeralcea coccinea*	Scarlet globe mallow
Helianthus maximilianii	Maximilian sunflower	*Stenosiphon virgatus*	False gaura
Helianthus mollis	Ashy sunflower	*Symphyotrichum ericoides*	White heath aster
Lespedeza hirta	Hairy lespedeza	*Symphyotrichum falcatum*	White prairie aster
Lespedeza virginica	Slender lespedeza	*Symphyotrichum oblongifolium*	Aromatic aster
Liatris aspera	Tall blazingstar	*Symphyotrichum patens*	Late purple aster
Liatris punctata	Dotted blazingstar	*Tetraneuris scaposa*	Stemmy four-nerve daisy
Limonium limbatum	Trans-Pecos sea lavender	*Tradescantia bracteata*	Longbract spiderwort
Linum berlandieri	Berlandier's flax	*Tradescantia occidentalis*	Prairie spiderwort
Lithospermum carolinense	Carolina pucoon	*Tradescantia ohiensis*	Ohio spiderwort
Lobelia cardinalis	Cardinal flower	*Verbena stricta*	Hoary vervain
Mentzelia nuda	Bractless blazingstar	*Verbena urticifolia*	White vervain
Mirabilis nyctaginea	Wild four-o'clock	*Vernonia fasciculata*	Prairie ironweed
Monarda citriodora	Lemon bee balm	*Zinnia grandiflora*	Plains zinnia
Monarda fistulosa	Wild bergamot		

7.8 Forest Management

Applicability Statement

This section applies to AF installations that maintain forested land on AF property. This section **IS NOT** applicable to Altus AFB. There is no commercial forestry associated with Altus AFB or the Sooner Drop Zone.

Urban Forest Management

Altus AFB's urban forest is the collection of trees that grow within the installation perimeter. Most are located on improved and semi-improved grounds, such as lawns, streets, and landscaped areas. Urban trees provide shade during hot summers, reducing air temperature and ozone buildup. Trees add aesthetic value and landscape diversity, filter the air and stormwater, and improve morale. Altus AFB has attained annual Tree City USA recognition by the Arbor Day Foundation since 2020. The installation meets requirements for this certification each year by spending at least $2 per capita, having a tree board and ordinance, and celebrating Arbor Day.

The goal of the urban forestry program is to increase species diversity and age structure to ensure long-term stability of value and ecosystem services, as well as promote an increasing percentage of native species representation. In addition to this, proper maintenance of current trees should be prioritized. Proper pruning of dead wood, monitoring for plant pathogens, and replacing non-native tree species will be priorities of the program.

The climate and natural history of the region makes establishment of trees difficult. Nutrient-limited soil, low annual precipitation, high wind, high heat, ice storms, and other factors limit the productivity of woody vegetation. While Altus AFB still pursues the establishment and maintenance of urban trees, the natural resources program does not have the resources to facilitate widespread plantings. To meet the goal of the urban forestry program, while also ensuring a higher chance for viability of plantings, native species must be the primary species of consideration for all plantings. According to the 2010 *Guidance for Federal Agencies on Sustainable Practives for Designed Landscapes*, which provides guidance for compliance with EO 13693, *Planning for Federal Sustainability in the Next Decade* (2015), appropriate regionally native species should be selected. Exceptions may be granted for areas within the BASH wildlife exclusion zone to reduce wildlife presence. The following conditions must be met for all new tree plantings:

1. All tree planting/removal requests must be approved by the NRM.

2. Native species must be selected from the Native Plants Recommended for Conservation Landscaping list (Table 11). Other species may be used if approved by the NRM.

3. A plan for irrigation of all plantings for 1 – 2 years must be established before planting.

4. An OKIE811 locate request must be placed for off-base companies to mark utilities prior to any planting. Then a dig permit must be obtained from Civil Engineering (required for any excavation deeper than 4 inches). Submit an AF Form 103 "Base Civil Engineering Work Clearance Request" form to 97 CES/CEOER Requirements and Optimizations office at 97CES.CEO.R_O@us.af.mil or call extension 1220, 6592, or 6606 for information.

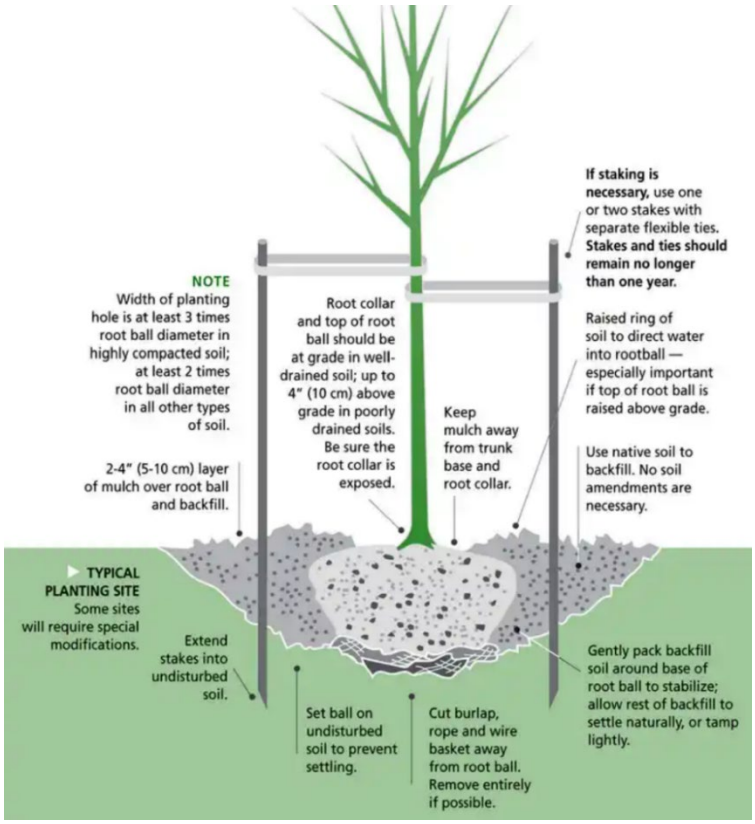

Figure 18. Tree planting diagram (Trees for Missoula, n.d.)

For every live urban tree removed on base, one tree must be planted to offset the loss. Figure 18 shows an ideal planting technique to maintain the health of the tree. Replacement trees must not have a trunk caliper greater than 1.5 inches at the time of planting. Older/larger trees take longer to establish roots, require more water over a longer period, and have a slower growth rate until establishment. Trees with two-inch caliper trunks take at least three years to establish.

To facilitate the goal of the urban forestry program, a complete urban forest inventory will be completed by the USFWS in FY2023. Data collected will include species, GPS location, height, diameter at breast height (DBH), health condition, age class, habitat type, hazard rating, maintenance needs, and ecological status (e.g., native, exotic, invasive). Trees currently identified on the installation inlude: Afghan, Aleppo, and Austrian pines, American sycamore, Arizona cypress, bald cypress, Bradford pear, Buckley's oak, bur oak, Chinese pistache, Chinquapin oak, crape myrtle, eastern cottonwood, eastern red cedar, escarpment live oak, green ash, lacebark elm, loblolly pine, modesto ash, Oklahoma redbud, Osage orange, pin oak, red mulberry, Shumard oak, Siberian elm, silver maple, slash pine, sugarberry, and

thornless honeylocust (see Section 2.3.3.4).

According to Unified Facilities Criteria (UFC) 3-260-01, *Airfield and Heliport Planning and Design,* "All trees within the runway, taxiway, and apron lateral clearance distances and within the graded area of the clear zone need to be removed. Trees that project into the imaginary surfaces must be removed or lowered to a distance below the imaginary surface... Trees are permitted near an airfield provided that they do not cause Bird Aircraft Strike Hazards (BASH), penetrate the imaginary surfaces, the taxiway clearance distance, the apron clearance distance, or instrument procedure obstacle identification surfaces (OIS) as described in TERPS regulations." The USDA BASH biologist assesses trees annually to determine a need for maintenance/removals per BASH and occupational safety requirements. Recommendations are presented for review and approval by the Bird Hazard Working Group, to include Airfield Operations and the NRM. In the winter of 2021, dead trees and limbs that created ideal Mississippi kite nesting and perching habitat were removed from areas where pedestrian attacks were routinely reported.

7.9 Wildland Fire Management

Applicability Statement

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

Wildfires are an essential and historical ecological disturbance regime in southwestern Oklahoma. Native plants have evolved fire tolerance and many native wildlife species benefit from burns. Routine controlled burning reduces the risk of catastrophic wildfires by decreasing fuel loads such as dead vegetation. Prescribed burning is also a time and cost-effective land management tool compared to various mechanical means of vegetative maintenance and habitat manipulation. Prescribed burns control the growth of invasive plants and enable nutrients from dead plant materials to nourish the soil. Controlled burns are often used to restore native prairies.

Executive Order 13855, *Promoting Active Management of America's Forests, Rangelands, and other Federal Lands to Improve Conditions and Reduce Wildfire Risk*, encourages federal agencies to collaborate with state and local governments to manage lands for fire. Altus AFB is required to have a Wildland Fire Management Plan (WFMP) to implement fire management practices because it contains unimproved lands that have the potential for wildlfires, has burnable acreage, and plans to utilize prescribed burns as a land management tool (AFMAN 32-7003). The NRM, Altus AFB Fire and Emergency Services (F&ES), and the Air Force Wildland Fire Branch (AFCEC CZOF) will collaborate on the development of a WFMP for the installation in FY2023.

In FY2022, the NRM, F&ES, and AFCEC CZOF collaborated to develop an Altus AFB Prescribed Burn Plan. The first prescribed burns to be conducted at Altus AFB and the SDZ are scheduled for spring of 2023. Implementation of the WFMP and Prescribed Burn Plan will directly support the AF mission and the INRMP by reducing wildfire potential, protecting and enhancing valuable infrastructure and natural resources, and implementing ecosystem resiliency goals and objectives on Altus AFB lands.

Climate Change Effects on Wildland Fire Management

Despite substantial projected temperature increases in all climate scenarios, fire frequency is likely to remain largely unchanged at Altus AFB. Fire at the installation is very rare. The mission of Altus AFB does not include activities that are highly fire prone, such as live-fire training. Though vegetation and

climate may change in the future, presuming new ignition sources are not added, there is little likelihood for an increase in the number of annual fires.

Those few fires that do occur can be expected to spread more rapidly and produce more intense fire behavior as a result of higher temperatures mostly offsetting the minor increases in precipitation. Precipitation is expected to decrease during the summer months in almost all climate projections, which would lead to increased fire intensity. The increased temperatures throughout the year are likely to lead to reduced relative humidity, particularly during the hottest parts of the day. Additionally, the RCP 8.5 scenarios suggest drier weather from January through April, a time when vegetation tends to still be in its dormant, flammable state.

Estimated vegetation changes vary between projections, but there is a tendency toward a greater dominance of shrub fuels. The grass fuels are unlikely to be extirpated entirely, resulting in a grass and shrub fuel complex in which firefighting is more difficult due to both navigability and, potentially, greater fire intensity. In aggregate, fires will remain infrequent. However, those few that do occur will have a greater potential to grow quickly and become severe.

7.10 Agricultural Outleasing

Applicability Statement

This section applies to AF installations that lease eligible AF land for agricultural purposes. This section **IS** applicable to Altus AFB.

Program Overview/Current Management Practices

Altus AFB leases approximately 14.58 acres of land for crop production, primarily cotton and wheat. This land is located west of the installation and lies south of Falcon Road and east of Veterans Drive. Agricultural outgrant revenue is collected annually and used to support natural resources program initiatives.

The outgrant program is consistent with INRMP and BASH plan goals and objectives and the AF principles of ecosystem management. Altus AFB provides the lessee with land use rules to ensure compatibility with the AF mission and conserve soil, water, and any other sensitive natural resources. The lessee must take all feasible actions to protect the environment and natural resources of the property. Compliance with all applicable laws and regulations pertaining to their activities on the land is mandatory. Disposal of toxic or hazardous materials on the property is prohibited, as well as discharges of waste or effluents that may contaminate surface waters, groundwater, or air.

Appropriate measures must be implemented to prevent or control soil erosion, and soil and water conservation structures must be properly maintained. Erosion control structures such as waterways and/or filter strips may not be cut for hay, disked, or otherwise disturbed. Conservation tillage must be used to the maximum extent possible. Conservation tillage includes any method of crop production that minimizes cultivation and leaves 30% ground cover following harvesting. Fall tillage, when row crops are being grown, must be limited to light chiseling of the ground. Crops must be harvested in a manner that leaves the stubble as tall as practical, and stubble may not be harvested for feed or burned. EPA-registered herbicides, insecticides, and other agricultural chemicals may be used if prior approval is obtained from the Pest Management shop. Outgrantees applying pesticides must maintain state certification requirements and comply with AFMAN 32-1053, *Integrated Pest Management Program*. The outgrantee must report all pesticide usage (in pounds of active ingredient) to Pest Management.

Altus AFB monitors outgranted lands to ensure that land use complies with the land use rules and land stewardship goals, objectives, and implementing guidelines in the INRMP. The NRM developed a

checklist from the land use rules that is used to inspect outgrant operations. Compliance inspections are scheduled IAW AFI 32-9003, *Granting Temporary Use of Air Force Real Property* and AFMAN 32-7003, *Environmental Conservation*. The NRM submits inspection reports to the administering real property office. Cropland outgrants are monitored annually, or when environmental conditions warrant, to ensure that they do not create unacceptable soil losses from erosion or cause point-source or non-point pollution to any natural water body. Other direct and indirect impacts of agriculture outgrant activities on surrounding land and water resources may be monitored as well. Water runoff from cropland outgrants will be monitored as needed to detect levels of pesticides or fertilizer that exceed state regulatory requirements. Agricultural outgrants are also monitored to ensure they do not attract wildlife that pose a risk to airfield operations, and to ensure compliance with the Federal Noxious Weed Act.

7.11 Integrated Pest Management Program

Applicability Statement

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

Program Overview/Current Management Practices

The Altus AFB pest management shop maintains and implements the Integrated Pest Management Plan (IPMP) through a program of inspections and integrated pest management techniques (Appendix F). Integrated pest management (IPM) is defined as "a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health and environmental risks." IPM operations on Altus AFB use targeted sustainable methods to control pests, including the use of the least hazardous pesticides (USAF, 2016).

The program prioritizes control of pests that pose a higher risk to human health, such as bees, wasps, hornets, fleas, ticks, and mosquitoes. Other targeted pests include nuisance pests (ants, spiders, millipedes, centipedes, gnats, crickets, and mice, etc.), structural pests (termites), noxious or invasive animals (feral dogs and cats), undesirable vegetation (grasses and weeds), and vertebrates that present a risk to property or human health.

Common pest issues on the installation include weed control, birds roosting in hangars, and the presence of ants and mice in facilities. Invasive species that may be removed include feral cats, European starlings, house sparrows, Eurasian collared doves, and pigeons. The IPMP ensures that all pest management materials are handled, stored, used and disposed of in accordance with all local, state, and federal regulations, where applicable.

Future habitat enhancement projects also include controlling exotic and invasive species. Invasive or exotic vegetation species found on Altus AFB include common reed (*Phragmites australis*), johnsongrass (*sorghum halepense*), Bermudagrass (*Cynodon dactylon*), saltcedar (*Tamarix ramosissima*), field bindweed (*Convolvulus arvensis*), and Russian thistle (*Salsola tragus*). These species may outcompete native species, which may eventually reduce the resiliency of the landscape. The NRM plans to conduct an invasive species survey in FY2023 to determine the extent of species presence on the installation and plan targeted control applications.

7.12 Bird/Wildlife Aircraft Strike Hazard (BASH)

Applicability Statement

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

Program Overview/Current Management Practices

Wildlife strikes are a serious flight safety concern and can cause significant monetary loss from damages to aircraft. Altus AFB is located in the middle of the Central Flyway and experiences significant BASH risks due to a high presence of migratory birds. The installation has a higher annual strike rate than any other AETC wing. The installation contains favorable habitat for feeding, loafing, breeding and roosting of both resident and migratory bird populations. A large number of mammal and bird species pose a strike risk when they enter the airfield. The impact of bird strikes on the mission is mitigated through the BASH program, which utilizes a full-time USDA Wildlife Services wildlife biologist to deter and remove hazardous wildlife from the airfield environment and surrounding areas. The BASH Plan, which incorporates guidances from DAFI 91-202, *US Air Force Mishap Prevention Program*, and DAFI 91-212, *Bird/Wildlife Aircraft Strike Hazard (BASH) Management Program*, establishes implementation procedures and actions that can be taken to minimize the potential of aircraft bird strikes (Appendix C). The BASH plan focuses on wildlife damage control utilizing habitat modifications and removal of hazardous wildlife from the airfield and surrounding environment in accordance with a federal depredation permit. Such measures include eliminating broad-leaf weeds, maintaining grass heights to between 7 and 14 inches, removing perch sites and brushy or forested areas, reducing or eliminating standing water, planting non-seeding grasses or mowing before seed heads develop, and scheduling aircraft flying hours to avoid peak bird flying times. Emergency wildlife control measures may be warranted if unanticipated wildlife problems endanger base operations or threaten public health.

The NRM collaborates with USDA-Wildlife Services to minimize BASH risks by deterring hazardous birds and other wildlife from the airfield. The NRM reviews the BASH plan and the IPMP annually to make sure they align with INRMP objectives for wildlife management. The Natural Resources Manager coordinates with the USDA BASH biologist to assist with migratory bird habitat management efforts and provides technical expertise on continued development and implementation of the BASH plan to reduce wildlife risks to humans and property. The NRM obtains approval from the USDA biologist for all natural resource projects prior to implementation to ensure there are no conflicts with the BASH program. The NRM assists with raptor banding and relocation efforts and assists the USDA biologist as needed with projects to reduce wildlife attractants on the airfield and nearby areas in the Wildlife Exclusion Zone (Figure 19).

The NRM also reviews the USFWS depredation permit for the installation annually, which is maintained by the Flight Safety office. The flight safety office and the wildlife biologist are responsible for all federal and state permit reporting requirements.

The BASH Plan and its implementation are moderated through the Bird Hazard Working Group (BHWG), composed of representatives of flight safety, civil engineering, airfield management/base operations, air traffic control, operations and other concerned organizations that address BASH concerns and coordinate efforts to reduce risks.

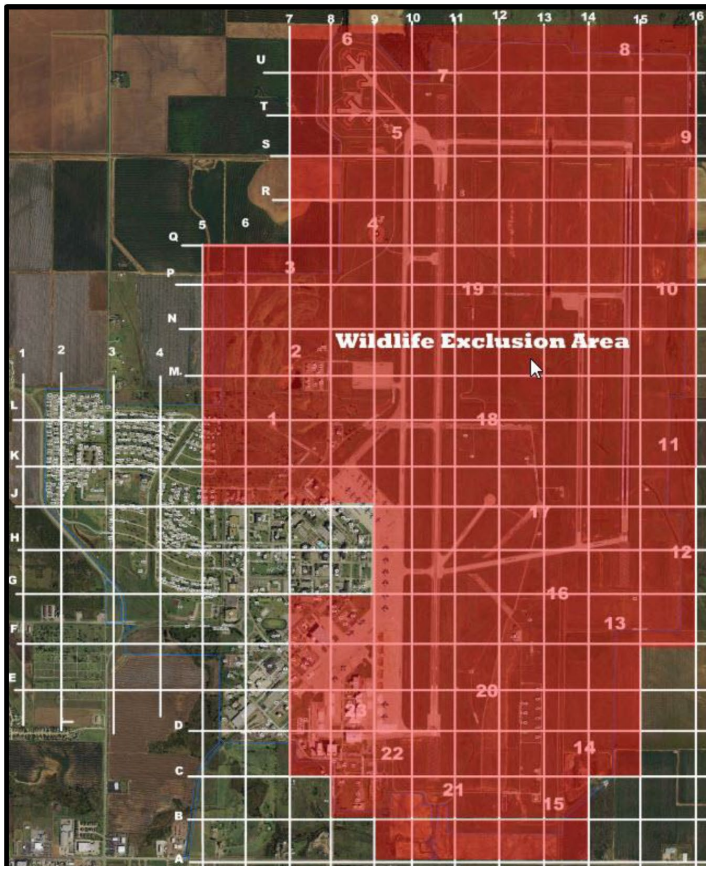

Figure 19. Map of the Altus AFB Wildlife Exclusion Area

7.13 Coastal Zone and Marine Resources Management

Applicability Statement

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

7.14 Cultural Resources Protection

Applicability Statement

This section applies to AF installations that have cultural resources that may be impacted by natural resource management activities. This section **IS NOT** applicable to Altus AFB.

Program Overview/Current Management Practices

According to the Altus AFB 2022 Integrated Cultural Resources Management Plan (ICRMP), the installation does not contain any significant historical or cultural sites and there are no tribal lands within 70 miles of Altus AFB property. Altus AFB maintains an ICRMP due to overflight paths that occur over tribal lands. This plan describes procedures to implement in the event of future archaeological discoveries or tribal relations (Appendix E).

7.15 Public Outreach

Applicability Statement

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

Program Overview/Current Management Practices

CEIE routinely coordinates with base Public Affairs (97 AMW/PA) to publish articles on the Altus AFB website and Facebook page to inform base personnel of natural resource information, projects, and accomplishments. CEIE also posts on its own Environmental Facebook page and periodically disseminates a newsletter to members of the base Cross-Functional Team (CFT), which includes information on current INRMP projects. Educational wildlife signs are located in some areas of the base; a Monarch Waystation sign at a pollinator habitat patch describes how the space benefits monarchs and signs along the golf course walking trails warn of Mississippi kite aggression during nesting season.

The Environmental team participates in outreach events by setting up labs to teach macro-invertebrate identification for water quality assessments and demonstrating wildlife tracking equipment to teach about the base Texas horned lizard study. The NRM also holds a state Scientific Collector's permit and maintains a wildlife specimen collection for educational outreach. This includes native fishes that arein an aquarium in the office. Outreach events include group immersions for local community members and spouse orientations to learn about CEIE's role on the installation, as well as Science, Technology, Engineering, and Math (STEM) events for local schools, which occur on and off base. Groups have sampled benthic macro-invertebrates and catch fish with cast nets, and CEIE has collaborated with EPA's Blue Thumb education program to guide local Girl Scout troops for macro-invertebrate sampling.

7.16 Climate Change Vulnerabilities

Applicability Statement

This section applies to USAF installations that have identified climate change risks, vulnerabilities, and adaptation strategies using authoritative region-specific climate science, climate projections, and existing tools. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Climate projections for Altus AFB, created by Colorado State University (2019), are visible in Table 12 and graphically in Appendix G. The results suggest minimum and maximum temperatures will increase over time under two emission scenarios – a moderate carbon emission scenario (Representative Concentration Pathway [RCP] 4.5) and a high emission scenario (RCP 8.5). The potential impact of these two climate change scenarios on the site's natural resources was analyzed using extracted climate data from 2026 to 2035 to represent the decadal average for 2030, and extracted data from 2046 to 2055 for the decadal average for 2050.

For the decade centered around 2030, both scenarios project an increase in average annual temperature of between 2.7 °F (1.5 °C) for RCP 4.5 and 3.9 °F (2.1 °C) for RCP 8.5 over the historic average. The two emission scenario projections show higher warming by 2050, with RCP 4.5 expressing a warming of 3.6 °F (2.0 °C). RCP 8.5 expresses a slightly greater warming of 5.5 °F (3.1 °C) for this period.

Average annual precipitation (PRECIP) varies between emission scenarios and over time due to larger interconnected ocean-atmosphere dynamics associated with the NCAR CCSM model. For 2030, RCP 4.5 projects an increase in PRECIP of 14% while RCP 8.5 shows a small increase of 2%. For 2050, RCP 4.5 projects a 13% in PRECIP, while RCP 8.5 shows a smaller increase of 10% from the historic average.

Table 12. Historical and projected climate data for Altus AFB

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	28.9	33.0	32.7	29.6	31.7
TMIN (°F)	49.2	51.9	52.5	53.1	54.4
TMAX (°F)	75.1	77.9	79.2	79.1	80.9
TAVE (°F)	62.2	64.9	65.8	66.1	67.7
GDD (°F)	5729	6362	6511	6578	6872
HOTDAYS	93.9	118.9	123.1	127.7	137.1
WETDAYS	1.3	0.3	1.0	0.5	0.8

Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN ºF = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 ºF; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day

Understanding changes in daily intensity and total precipitation for multi-day precipitation events is helpful to evaluate precipitation patterns in addition to assessment of annual averages. Three-day storm events (design storms) were generated from projected precipitation data based on RCP 4.5 and 8.5 emission scenarios for the 2030 and 2050 timeframes (Table 13). Historical precipitation data were used to calculate a baseline storm event for the year 2000 for comparison.

Table 13. Design storm precipitation for Altus AFB.

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.1	1.6	1.7	1.2	1.5
	Day 2	2.2	2.1	2.5	2.2	2.4
	Day 3	1.9	1.1	1.9	0.9	1.4
	Total	5.2	4.8	6.1	4.3	5.3
Percent change from baseline			-8%	17%	-17%	2%

Stream Channel Modeling for Climate Change

Modeling of stream channel overflow (or flood modeling) was conducted for Altus AFB to examine the extent of flooding along Stinking Creek and an unnamed tributary of Stinking Creek associated with climate projections (CSU, 2019). Flood modeling did not consider flooding of independent surface bodies, stormwater systems, or surface ponding. Flood modeling was conducted using local watershed characteristics and the design storms generated from climate projection data (Table 13). The projected design storms do not represent extreme weather events (e.g., hurricanes, extraordinary storm fronts).

Fish and wildlife communities at Altus AFB are not expected to experience significant changes due to climate change. A substantial proportion of Altus AFB is developed and as a result, the majority of its wildlife species are widespread generalists capable of tolerating a wide range of environmental conditions.

Changing climate has the potential to alter vegetation communities. This will likely have a negative impact on specialist wildlife species that have historically depended on specific native plant communities for their survival (Dukes & Mooney, 1999). Changing environmental conditions may also create open niches for non-native invasive species to expand onto Altus AFB. Newly arriving invasive species often have the ability to outcompete native species which are already experiencing reduced fitness due to environmental

conditions shifting away from historic standards (Hellmann, Byers, Bierwagen, & Dukes, 2008). Rising temperatures could also result in the increased potential for foodborne diseases and incidences of infectious disease of animals that are transmittable to humans, particularly those carried by foxes, rodents and arthropods such as rabies and West Nile virus (Süss, Klaus, Gerstengarbe, & Werner, 2008).

Precipitation is projected to increase slightly but will possibly be offset by higher evapotranspiration rates due to increasing temperatures. Increasing temperature could have a negative impact on water quality, particularly in lentic systems. As water temperatures rise in lentic systems, dissolved oxygen content decreases, impairing water quality particularly for larval amphibians and aquatic macroinvertebrates. Increasing water temperature will also increase the chances of algal blooms to occur, further depleting dissolved oxygen content and degrading habitat quality (Paerl, Hall, & Calandrino, 2011).

7.17 Geographic Information Systems (GIS)

Applicability Statement

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

Program Overview/Current Management Practices

GIS is used as a management tool for creating, storing, analyzing, and managing spatial data and associated attributes. GIS allows managers to examine ecosystem components represented as layers in a spatial format. Altus AFB natural resources GIS data are developed and maintained by the AFCEC Installation Support System (ISS) Environmental GIS Support Analyst. The data are stored within ArcGIS and the Air Force Geospatial Information Management System (AFGIMS). ArcGIS software allows CEIE to store and manipulate data for analysis and create digital maps.

Natural resource GIS layers available for Altus AFB include: agricultural outleases, floodplain areas, land cover, ecosystems, natural resources surveys, species locations, natural resources constraints, soil types, vegetation, prescribed burn areas, water bodies, watercourse lines, watersheds, and wetlands. GIS data for the installation is updated annually and data layers are added to the AF GeoBase system as needed.

8.0 MANAGEMENT GOALS AND OBJECTIVES

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

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

conservation budget, as applicable.

Installation Supplement – Management Goals and Objectives

The projects identified in Section 10 seek to give tangible progress towards the successful implementation of the following goals and their associated objectives.

GOAL 1: Support military mission sustainability through ecological stewardship and regulatory compliance.

Objective 1: Provide a natural resources management program to support the 97 AMW mission through a proactive and responsive natural resource analysis and consultation process to ensure compliance with applicable federal, state, and local laws and regulations and USAF policies.

Objective 2: Coordinate with the USDA BASH biologist to provide technical expertise on continued development and implementation of the BASH plan to reduce wildlife risks to aircraft, and assist with migratory bird management efforts.

Objective 3: Enhance the long-term sustainability of natural resources on the installation through implementation of an adaptive wildland fire program that minimizes risks while meeting ecological and land management objectives.

GOAL 2: Conserve native biodiversity by restoring and maintaining native habitat, wildlife populations, and ecological processes.

Objective 1: Restore or maintain ecological processes in native communities damaged or otherwise impacted by human activities or invasive species.

Objective 2: Monitor and develop management strategies for state and federally listed T&E species, species of special concern, and candidate species while ensuring no net loss of military missions.

Objective 3: Inventory, monitor, and develop strategies to manage native plant and wildlife populations.

Objective 4: Monitor and develop strategies to improve water quality, flow regimes, and impaired waterways on the installation.

GOAL 3: Provide for and promote the sustainable multi-purpose use of natural resources to improve morale and overall well-being of the base populace.

Objective 1: Enhance existing outdoor recreation areas and activities on the installation.

Objective 2: Create new opportunities for outdoor recreational activities on the installation.

Objective 3: Improve the aesthetic value of the installation through beautification efforts.

9.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

The entire installation, including tenant organizations, collaborate on the implementation of the INRMP to ensure mission readiness. The natural resources manager (NRM) and 97 CES Environmental Element (97 CES/CEIE) staff oversee implementation of the natural resources program. Natural resource management activities are planned in coordination with all affected installation organizations.

Any actions that would substantially affect natural resources or require changes to this plan will be reviewed

by the installation ESOHC. Such actions will proceed only when compatible with this plan or after the plan has been appropriately changed.

The NRM routinely reviews work requests and activity proposals and reviews installation plans that may affect natural resources to ensure their compatibility with the INRMP. Any construction plans or work requests for activities that may affect natural resources on the installation must be reviewed and approved by the 97 CES/CEIE. Proponents of such actions must coordinate with the 97 CES/CEIE throughout planning and implementation.

9.2 Monitoring INRMP Implementation

Monitoring, coordination with stakeholders and regulators, and recordkeeping are the primary responsibility of the 97 CES/CEIE office. 97 CES/CEIE is responsible for INRMP updates and implementation and natural resources management staffing. Yearly INRMP accomplishments are summarized in an annual review summary.

The Air Force Civil Engineer Center (AFCEC) Installation Support Section tracks INRMP Sikes Act compliance for Altus AFB and assists the 97 CES/CEIE with INRMP implementation.

9.3 Annual INRMP Review and Update Requirements

The INRMP requires annual review, in accordance with DoDI 4715.03, *Natural Resources Conservation Program* and AFMAN 32-7003, *Environmental Conservation*, to ensure the achievement of mission goals, verify the implementation of projects, and establish any necessary new management requirements. The NRM and other 97 CES/CEIE personnel, internal base stakeholders, USFWS, and ODWC annually review the INRMP. Cooperating agencies should mutually agree that the INRMP presents a natural resources management program that is current as to operation and effect for those elements of the INRMP under the jurisdictional authority of each agency.

If the Altus AFB mission or any of its natural resources management issues change significantly after the creation of the original INRMP, a major revision to the INRMP is required. The INRMP is considered compliant with the Sikes Act if it has been approved by signature on the INRMP signature page, or in writing in a signed letter, by the appropriate representative from each cooperating agency. Approval of a revised INRMP must be documented by signature from the installation commander (or designee), the authorized signatory representative of the USFWS, and the authorized signatory representative of the ODWC within the past 5 years.

10.0 ANNUAL WORK PLANS

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

- High: The INRMP signatories assert that if the project is not funded the INRMP is not being implemented and the Air Force is non-compliant with the Sikes Act; or that it is specifically tied to an INRMP goal and objective and is part of a "Benefit of the Species" determination necessary for ESA Sec 4(a)(3)(B)(i) critical habitat exemption.

- Medium: Project supports a specific INRMP goal and objective, and is deemed by INRMP signatories to be important for preventing non-compliance with a specific requirement within a natural resources law or by EO 13112 on Invasive Species. However, the INRMP signatories would not contend that the INRMP is non-compliant if not accomplished within a programmed year due to other priorities.
- Low: Project supports a specific INRMP goal and objective, enhances conservation resources or the integrity of the installation mission, and/or supports long-term compliance with specific requirements within natural resources law; but is not directly tied to specific compliance within the proposed year of execution.

ANNUAL WORK PLANS	OPR	Funding Source	Priority Level
Project 1.1.1 Conduct crop lease compliance inspection (Annual)	97 CES/CEIE	In-house	Med
Project 1.2.1: Support the BASH program/participate in Bird Hazard Working Group (Annual)	97 CES/CEIE	In-house	Low
Project 1.3.1: Develop a Prescribed Burn Plan (FY22)	AFCEC/CZOF	AFCEC	Med
Project 1.3.2: Develop a Wildland Fire Management Plan (FY23)	AFCEC/CZOF	AFCEC	Med
Project 1.3.3: Implement AAFB & SDZ prescribed burns (FY23)	AFCEC/CZOF	AFCEC	Med
Project 2.1.1: Increase/maintain pollinator habitat (FY22-27)	97 CES/CEIE	AFCEC	High
Project 2.1.2: Survey for/map invasive species (FY23)	USFWS	AFCEC	Med
Project 2.1.3: Remove invasive plant species (FY24-27)	97 CES/CEOIC	In-house	Med
Project 2.1.4: Restore native prairie; sow native seeds (FY25)	USFWS	AFCEC	High
Project 2.2.1: Track/monitor Texas horned lizards (FY22-26)	USFWS	AFCEC	High
Project 2.2.2: Monitor birds via Motus telemetry (Annual)	97 AMW/SEF	97 AMW/SEF	Med
Project 2.2.3: Conduct stationary acoustic surveys to determine tricolored bat presence (FY22)	97 CES/CEIE	AFCEC	Med
Project 2.3.1: Sample snakes for ophidiomycosis (FY22)	97 CES/CEIE	DoD PARC	Low
Project 2.3.2: Conduct herptile surveys (FY22, FY27)	USFWS	AFCEC	Low
Project 2.3.3: Conduct small mammal surveys (FY23)	97 CES/CEIE	In-house	Low
Project 2.3.4: Survey flora/update plant spp. inventory (FY26)	USFWS	AFCEC	Med
Project 2.3.5: Complete an urban tree inventory (FY23)	USFWS	AFCEC	Low
Project 2.3.6: Create an urban forest management plan (FY24)	97 CES/CEIE	In-house	Low
Project 2.4.1: Survey benthic macroinvertebrates & analyze water samples to monitor base stream health (Annual)	97 CES/CEIE	In-house	Low
Project 2.4.2: Restore riparian habitat to reduce flooding, soil erosion, & sedimentation, & improve water quality (FY25)	97 CES/CEIE	In-house	Med
Project 2.4.3: Delineate/inventory wetlands (FY23)	97 CES/CEIE	In-house	High
Project 3.1.1: Maintain native tree plantings (Annual)	97 CES/CEIE	In-house	Low
Project 3.1.3: Maintain community garden/collect fees (Annual)	97 CES/CEIE	In-house	Low
Project 3.1.4: Create a pollinator watch/education area (FY24)	97 CES/CEIE	AFCEC	Low
Project 3.1.5: Stock pond & host fishing derby (Annual)	97 CES/CEIE	In-house	Low
Project 3.1.6: Implement a 1-day dove hunt (Annual by request)	97 CES/CEIE	In-house	Low
Project 3.2.1 Design creek-fed fishing pond/assess environmental impacts/implement NEPA requirements (FY23)	USFWS	AFCEC	High
Project 3.2.2: Construct pond to create wetland habitat, alleviate base flooding issues, enhance outdoor rec (FY24)	USFWS	AFCEC	High
Project 3.3.1: Meet Tree City USA requirements (Annual)	97 CES/CEIE	In-house	Low
Project 4.1: Remove golf pond to reduce BASH risk (FY24)	97 CES/CEO	In-house	Low

11.0 REFERENCES

Standard References (Applicable to all AF installations)

- AFMAN 32-7003, *Environmental Conservation*
- Sikes Act
- eDASH Natural Resources Program Page
- Natural Resources Management Playbook - an Internal AF reference

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12.0 ACRONYMS

Standard Acronyms (Applicable to all AF installations)

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

Installation Acronyms

13.0 DEFINITIONS

Standard Definitions (Applicable to all AF installations)

- Natural Resources Playbook – Definitions Section

Installation Definitions

Agricultural outleasing: The use of DoD land under a lease to an agency, organization, or person for growing crops or grazing animals.
Biological diversity: The variety of life forms, the ecological roles they perform, and the genetic variability they contain within any defined time and space.
Commercial forest land: Land under management capable of producing at least 20 cubic feet of merchantable timber per acre per year. It must be accessible and programmed for silviculture prescriptions. The smallest area for this classification is five acres. Roadside, streamside, and shelterbelt strips of timber must have or be capable of producing a crown width of at least 120 cubic feet to be classified as commercial timber.
Consultation: A process initiated by the installation commander in which the commander confers with the State Historic Preservation Office to reduce or avoid adverse effects on historic properties. The Advisory Council on Historic Preservation and certain interested persons may participate as consulting parties.
Cooperative agreement: A written agreement between an Air Force installation and one or more outside agencies (federal, state, or local) that coordinates planning strategies. It is a vehicle for obtaining assistance in developing natural resource plans.
Critical habitat: Any air, land, or water area (excluding existing synthetic structures or settlements that are not necessary to the survival and recovery of a species listed as endangered or threatened) and constituents thereof that the U. S. Fish and Wildlife Service (USFWS) has designated as essential to the survival and recovery of an endangered or threatened species or a distinct segment of its population.
Cropland: Land primarily suitable for producing farm crops, including grain, hay, and truck crops.
Ecosystem management: An approach to natural resources management that focuses on the interrelationships of ecological processes linking soils, plants, animals, minerals, climate, water and topography. Managers view such processes as a living system that affects and responds to human activity

beyond traditional commodity and amenity uses. They also acknowledge the importance of ecosystem services such as water conservation, oxygen recharge and nutrient recycling.

Endangered species: Any plant or animal listed or proposed for listing as threatened or endangered by the federal government or state governments.

Exotic species: Any plant or animal not native to a region, state, or country (This definition excludes certain game species that have become established, such as pheasants).

Featured species:

○ A fish or wildlife species whose habitat requires fish or wildlife management (including coordination, multiple-use planning, direct habitat improvements and cooperative programs) on a unit of land or water.

○ A tree species that the forest management plan cites as having value for wood fiber production. The plan usually specifies one or more featured tree species along with one or more associated species to meet multiple-use management objectives.

Fish: Fresh and saltwater fin-fish, other than aquatic vertebrate organisms and crustaceans and mollusks.

Floodplains: Lowland and flat areas adjoining inland coastal waters, including flood-prone areas on offshore islands, that have a one percent or greater chance of flooding in any given year.

Forest land: Lands on which forest trees of various sizes constitute at least 10 percent of the area. This category includes open land that is capable of supporting trees and is planned for forest regeneration and management.

Forest management: Developing, conserving and protecting forest resources to ensure that they provide sustained yield and multiple uses.

Forest products: Plant materials in wooded areas that have commercial value, such as saw logs, veneer (peeler) logs, poles, pilings, pine needles, cordwood (for pulp, paper, or firewood), fence posts, mine timber, Christmas trees (from unsheared trees cut during intermediate harvests) and similar wood or chemical products.

Game: Any species of fish or wildlife for which state or federal laws and regulations prescribe seasons and bag or creel limits.

Grazing land: Land with vegetative cover that consists of grasses, herbs, and shrubs valuable as forage.

Grazing systems: Specialized methods of grazing management (the manipulation of livestock grazing to accomplish a desired result) that defines systematically recurring periods of grazing and deferment for pastures or management units.

Habitat: An area that provides the environmental elements of air, water, food, cover and space necessary for a given species to survive and reproduce.

Highly erodible soils: Soils that, because of their physical properties or slope, the US Department of Agriculture (USDA), Natural Resources Conservation Service identifies as being highly susceptible to wind or water erosion.

Integrated natural resources management plan (INRMP): A natural resources management plan based on ecosystem management that shows the interrelationships of the individual component plans as well as mission and land-use activities affecting the basic land management plans.

Improved grounds: Grounds on which personnel annually plan and perform intensive maintenance activities. These are developed areas of an installation that have lawns and landscape plants that require intensive maintenance. They usually include the cantonment, parade grounds, drill fields, athletic areas, golf courses, (excluding roughs), cemeteries and housing areas.

Land management unit: The smallest land management division that planners use in developing specific strategies to accomplish natural resources management goals. Land management units may correspond to grazing units on agricultural outleased lands, stands or compartments on commercial forest lands, various types of improved grounds (for example, athletic fields, parks, yards in family housing, or landscaped areas around administrative buildings), or identifiable semi-improved grounds (for example, airfield areas, utility rights-of-way, or roadside areas).

Land-use regulation: A document that prescribes the specific technical or land use and restrictions with which lessees, permitees, or contractors must comply. It derives from the grazing or cropland management plan and forms a part of all outleases, land use permits, and other contracts.

Livestock: Domestic animals kept or raised for food, by-products, work, transportation, or recreation.
Multiple use: The integrated, coordinated and compatible use of various natural resources to derive the best benefit while perpetuating and protecting those resources.
Multiple use and sustained yield management: The care and use of natural resources so as to best serve the present and future needs of the United States and its people without impairing the productivity of the land and water.
Natural resources management professional: A person with a degree in the natural sciences who manages natural resources on a regular basis and receives periodic training to maintain proficiency in that job.
"No funds" service contract: An agreement by which a party performs a land management service for a consideration other than funds. Such a contract exists, for example, when a party hired to establish, control, or remove vegetative cover or growth agrees to take payment for the service in the form of the growth that results.
Noncommercial forest land: Land not capable of yielding forest products of at least 20 cubic feet per acre per year because of adverse site conditions. The classification also includes productive forest land on which mission requirements, accessibility, or incompatible uses preclude forest management activities.
Outdoor interpretation: Observing or explaining the history, development and significance of our natural heritage and natural resources.
Outdoor recreation resources: Land and water areas and associated natural resources that provide, or have the potential to provide, opportunities for outdoor recreation for present and future generations.
Prime farmland: Land that has the best combination of chemical and physical characteristics for producing food, feed, forage, fiber and oil-seed crops and is also available or potentially available for these uses. It has the soil quality, growing season and moisture supply needed to economically produce sustained high yields of crops under modern farming methods. Existing pasture land, rangeland, forest land and other land not in an urban buildup condition is considered eligible for designation as prime farmland, providing it meets the other criteria.
Procurement contract: An agreement by which the government agrees to pay a contractor to establish control, or remove vegetative cover or growth for land management purposes. This contract may not extend beyond the period for which funding for the service is available.
Rangeland: Land on which the native vegetation is predominantly grasses, grass-like plants, herbs, or shrubs suitable for grazing or browsing use. It includes lands revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. It also includes natural grasslands, savannas, shrubland, most deserts, tundra, alpine communities, coastal marshes and wet meadows.
Recreation carrying capacity: The level of recreational use that an area can sustain without damage to the environment.
Reforestation: The renewal or regeneration of a forest by natural or artificial means.
Rotation age: The planned number of years between the regeneration of a forest stand and its final cutting at a specified stage of maturity.
"Sales" service contract: An agreement by which the contractor pays the government for crops, crop residue, or grazing privilege incidental to control or removal of vegetative growth for land management purposes. Sales contracts cover a period of one to five years.
Semi-improved grounds: Grounds where personnel perform periodic maintenance primarily for operational and aesthetic reasons (such as erosion and dust control, bird control, and visual clear zones). These usually include grounds adjacent to runways, taxiway and aprons; runway clear zones; (UFC 3-260-01); rifle and pistol ranges; picnic areas; ammunition storage areas; antenna facilities and golf course roughs.
Stewardship: The management of a resources base with the goal of maintaining or increasing the resources' value indefinitely into the future.
Threatened species: Those federally or state-listed species of plants or animals that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range and that have been designated for special protection and management pursuant to the Endangered Species Act.

Timber management: The application of silviculture knowledge and prescriptions to forest lands within economic and environmental constraints to produce a sustained yield of forest products.
Timber stand improvement (TSI): Silviculture treatment applied to existing stands to improve their quality, composition, condition, or rate of growth (such as pruning, thinning, releasing and prescribed burning).
Unimproved grounds: Grounds not classified as improved or semi-improved and usually not mowed more than once a year. These include weapons ranges; forest lands; cropland and grazing lands; lakes, ponds and wetlands and areas in airfields beyond the safety zones (UFC 3-260-01).
Unique farmland: Land, other than prime farmland, used for producing specific high- value food and fiber crops at the time of designation. It has the special combination of soil quality, location, growing season and moisture supply needed to produce sustained high-quality or high yields of a specific crop under modern farming conditions. Examples are citrus, tree nuts, olives and cranberries.
Urban forests: Planted or remnant native tree species existing within urbanized areas such as parks, tree-lined residential streets, scattered tracts of undisturbed woodlands and cantonment areas.
Urban wildlife: Wildlife that habitually live or periodically survive in an urban environment on improved or semi-improved grounds.
Watchable wildlife areas: Areas identified under the Watchable Wildlife Program as suitable for passive recreational uses such as bird watching, nature study and other nonconsumptive uses of wildlife resources.
Wetlands: Areas inundated or saturated by surface or ground water at a frequency and a duration to support and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions
Wildlife carrying capacity: The maximum density of wildlife that a particular area or habitat can carry on a sustained basis without deterioration of the habitat.

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

Federal Public Laws and Executive Orders	
National Defense Authorization Act of 1989, Public Law (P.L.) 101-189; Volunteer Partnership Cost-Share Program	Amends two Acts and establishes volunteer and partnership programs for natural and cultural resources management on DoD lands.
Defense Appropriations Act of 1991, P.L. 101-511; Legacy Resource Management Program	Establishes the "Legacy Resource Management Program" for natural and cultural resources. Program emphasis is on inventory and stewardship responsibilities of biological, geophysical, cultural, and historic resources on DoD lands, including restoration of degraded or altered habitats.
EO 11593, Protection and Enhancement of the Cultural Environment	All Federal agencies are required to locate, identify, and record all cultural resources. Cultural resources include sites of archaeological, historical, or architectural significance.
EO 11988, Floodplain Management	Provides direction regarding actions of Federal agencies in floodplains, and requires permits from state, territory and Federal review agencies for any construction within a 100-year floodplain and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for acquiring, managing and disposing of Federal lands and facilities.
EO 11989, Off-Road Vehicles on Public Lands	Installations permitting off-road vehicles to designate and mark specific areas/trails to minimize damage and conflicts, publish information including maps, and monitor the effects of their use. Installations may close areas if adverse effects on natural, cultural, or historic resources are observed.
EO 11990, Protection of Wetlands	Requires Federal agencies to avoid undertaking or providing assistance for new construction in wetlands unless there is no practicable alternative, and all practicable measures to minimize harm to wetlands have been implemented and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.
EO 12088, Federal Compliance with Pollution Control Standards	This EO delegates responsibility to the head of each executive agency for ensuring all necessary actions are taken for the prevention, control, and abatement of environmental pollution. This order gives the U.S. Environmental Protection Agency (US EPA) authority to conduct reviews and inspections to monitor Federal facility compliance with pollution control standards.
EO 12898, Environmental Justice	This EO requires certain federal agencies, including the DoD, to the greatest extent practicable permitted by law, to make environmental justice part of their missions by identifying and addressing disproportionately high and adverse health or environmental effects on minority and low-income populations.
EO 13112, Invasive Species	To prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds	The U.S. Fish and Wildlife Service (USFWS) has the responsibility to administer, oversee, and enforce the conservation provisions of the Migratory Bird Treaty Act, which includes responsibility for population management (e.g., monitoring), habitat protection (e.g., acquisition, enhancement, and modification), international coordination, and regulations development and enforcement.
EO 13751, Safeguarding the Nation from the Impacts of Invasive Species	Amends EO 13112 and directs actions to continue coordinated Federal prevention and control efforts related to invasive species. This order incorporates considerations of human and environmental health, climate change, technological

	innovation, and other emerging priorities into Federal efforts to address invasive species; and strengthens coordinated, cost-efficient Federal action.
United States Code	
Animal Damage Control Act (7 U.S.C. § 426-426b, 47 Stat. 1468)	Provides authority to the Secretary of Agriculture for investigation and control of mammalian predators, rodents, and birds. DoD installations may enter into cooperative agreements to conduct animal control projects.
Bald and Golden Eagle Protection Act of 1940, as amended; 16 U.S.C. 668-668c	This law provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds. The 1972 amendments increased penalties for violating provisions of the Act or regulations issued pursuant thereto and strengthened other enforcement measures. Rewards are provided for information leading to arrest and conviction for violation of the Act.
Clean Air Act, (42 U.S.C. § 7401– 7671q, July 14, 1955, as amended)	This Act, as amended, is known as the Clean Air Act of 1970. The amendments made in 1970 established the core of the clean air program. The primary objective is to establish Federal standards for air pollutants. It is designed to improve air quality in areas of the country which do not meet Federal standards and to prevent significant deterioration in areas where air quality exceeds those standards.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (Superfund) (26 U.S.C. § 4611–4682, P.L. 96-510, 94 Stat. 2797), as amended	Authorizes and administers a program to assess damage, respond to releases of hazardous substances, fund cleanup, establish clean-up standards, assign liability, and other efforts to address environmental contaminants. Installation Restoration Program guides cleanups at DoD installations.
Endangered Species Act (ESA) of 1973, as amended; P.L. 93-205, 16 U.S.C. § 1531 et seq.	Protects threatened, endangered, and candidate species of fish, wildlife, and plants and their designated critical habitats. Under this law, no Federal action is allowed to jeopardize the continued existence of an endangered or threatened species. The ESA requires consultation with the USFWS and the NOAA Fisheries (National Marine Fisheries Service) and the preparation of a biological evaluation or a biological assessment may be required when such species are present in an area affected by government activities.
Federal Aid in Wildlife Restoration Act of 1937 (16 U.S.C. § 669–669i; 50 Stat. 917) (Pittman-Robertson Act)	Provides Federal aid to states and territories for management and restoration of wildlife. Fund derives from sports tax on arms and ammunition. Projects include acquisition of wildlife habitat, wildlife research surveys, development of access facilities, and hunter education.
Federal Environmental Pesticide Control Act of 1972 (7 U.S.C. § 136, 86 Stat. 973)	Requires installations to ensure pesticides are used only in accordance with their label registrations and restricted-use pesticides are applied only by certified applicators.
Federal Land Use Policy and Management Act, 43 U.S.C. § 1701–1782	Requires management of public lands to protect the quality of scientific, scenic, historical, ecological, environmental, and archaeological resources and values; as well as to preserve and protect certain lands in their natural condition for fish and wildlife habitat. This Act also requires consideration of commodity production such as timbering.
Federal Noxious Weed Act of 1974, 7 U.S.C. § 2801–2814	The Act provides for the control and management of non-indigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.
Federal Water Pollution Control Act (Clean Water Act [CWA]), 33 U.S.C. §1251–1387	The CWA is a comprehensive statute aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Primary authority for the implementation and enforcement rests with the US EPA.
Fish and Wildlife Conservation Act (16 U.S.C. § 2901–2911; 94 Stat. 1322, PL 96-366)	Installations encouraged to use their authority to conserve and promote conservation of nongame fish and wildlife in their habitats.
Fish and Wildlife Coordination Act (16 U.S.C. § 661 et seq.)	Directs installations to consult with the USFWS, or state or territorial agencies to ascertain means to protect fish and wildlife resources related to actions resulting in the control or structural modification of any natural stream or body of water.

	Includes provisions for mitigation and reporting.
Lacey Act of 1900 (16 U.S.C. § 3371-3378)	Prohibits the importation of wild animals or birds or parts thereof, taken, possessed, or exported in violation of the laws of the country or territory of origin. Provides enforcement and penalties for violation of wildlife related Acts or regulations.
Leases: Non-excess Property of Military Departments, 10 U.S.C. § 2667, as amended	Authorizes DoD to lease to commercial enterprises Federal land not currently needed for public use. Covers agricultural outleasing program.
Migratory Bird Treaty Act 16 U.S.C. § 703–712	Implements various treaties for the protection of migratory birds. Taking, killing, or possessing migratory birds is unlawful without a valid permit.
National Environmental Policy Act of 1969 (NEPA), as amended; P.L. 91-190, 42 U.S.C. § 4321 et seq.	Requires Federal agencies to utilize a systematic approach when assessing environmental impacts of government activities. Establishes the use of environmental impact statements. NEPA proposes an interdisciplinary approach in a decision-making process designed to identify unacceptable or unnecessary impacts on the environment. The Council of Environmental Quality (CEQ) created Regulations for Implementing the National Environmental Policy Act [40 Code of Federal Regulations (CFR) Parts 1500– 1508], which provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of NEPA, as amended.
National Historic Preservation Act, 16 U.S.C. § 470 et seq.	Requires Federal agencies to take account of the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP). Provides for the nomination, identification (through listing on the NRHP), and protection of historical and cultural properties of significance.
National Trails Systems Act (16 U.S.C. § 1241–1249)	Provides for the establishment of recreation and scenic trails.
National Wildlife Refuge Acts	Provides for establishment of National Wildlife Refuges through purchase, land transfer, donation, cooperative agreements, and other means.
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd–668ee)	Provides guidelines and instructions for the administration of Wildlife Refuges and other conservation areas.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001–13; 104 Stat. 3042), as amended	Established requirements for the treatment of Native American human remains and sacred or cultural objects found on Federal lands. Includes requirements on inventory, and notification.
Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.)	Makes it unlawful for the USAF to conduct any work or activity in navigable waters of the United States without a Federal Permit. Installations should coordinate with the U.S. Army Corps of Engineers (USACE) to obtain permits for the discharge of refuse affecting navigable waters under National Pollutant Discharge Elimination System (NPDES) and should coordinate with the USFWS to review effects on fish and wildlife of work and activities to be undertaken as permitted by the USACE.
Sale of certain interests in land, 10 U.S.C. § 2665	Authorizes sale of forest products and reimbursement of the costs of management of forest resources.
Soil and Water Conservation Act (16 U.S.C. § 2001, P.L. 95-193)	Installations shall coordinate with the Secretary of Agriculture to appraise, on a continual basis, soil/water-related resources. Installations will develop and update a program for furthering the conservation, protection, and enhancement of these resources consistent with other Federal and local programs.
Sikes Act (16 U.S.C. § 670a–670l, 74 Stat. 1052), as amended	Provides for the cooperation of DoD, the Departments of the Interior (USFWS), and the State Fish and Game Department in planning, developing, and maintaining fish and wildlife resources on a military installation. Requires development of an Integrated Natural Resources Management Plan and public access to natural resources, and allows collection of nominal hunting and fishing fees. NOTE:

	AFMAN 32-7003 sec 3.9. Staffing. As defined in DoDI 4715.03, use professionally trained natural resources management personnel with a degree in the natural sciences to develop and implement the installation INRMP. (T- 0). 3.9.1. Outsourcing Natural Resources Management. As stipulated in the Sikes Act, 16 U.S.C. § 670 et. seq., the Office of Management and Budget Circular No. A-76, Performance of Commercial Activities, August 4, 1983 (Revised May 29, 2003) does not apply to the development, implementation and enforcement of INRMPs. Activities that require the exercise of discretion in making decisions regarding the management and disposition of government owned natural resources are inherently governmental. When it is not practicable to utilize DoD personnel to perform inherently governmental natural resources management duties, obtain these services from federal agencies having responsibilities for the conservation and management of natural resources.
DoD Policy, Directives, and Instructions	
DoD Instruction 4150.07 DoD Pest Management Program dated 29 May 2008	Implements policy, assigns responsibilities, and prescribes procedures for the DoD Integrated Pest Management Program.
DoD Instruction 4715.1, Environmental Security	Establishes policy for protecting, preserving, and (when required) restoring and enhancing the quality of the environment. This instruction also ensures environmental factors are integrated into DoD decision-making processes that could impact the environment, and are given appropriate consideration along with other relevant factors.
DoD Instruction (DODI) 4715.03, Natural Resources Conservation Program	Implements policy, assigns responsibility, and prescribes procedures under DoDI 4715.1 for the integrated management of natural and cultural resources on property under DoD control.
OSD Policy Memorandum – 17 May 2005 – Implementation of Sikes Act Improvement Amendments: Supplemental Guidance Concerning Leased Lands	Provides supplemental guidance for implementing the requirements of the Sikes Act in a consistent manner throughout DoD. The guidance covers lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission. INRMPs must address the resource management on all lands for which the subject installation has real property accountability, including leased lands. Installation commanders may require tenants to accept responsibility for performing appropriate natural resource management actions as a condition of their occupancy or use, but this does not preclude the requirement to address the natural resource management needs of these lands in the installation INRMP.
OSD Policy Memorandum – 1 November 2004 – Implementation of Sikes Act Improvement Act Amendments: Supplemental Guidance Concerning INRMP Reviews	Emphasizes implementing and improving the overall INRMP coordination process. Provides policy on scope of INRMP review, and public comment on INRMP review.
OSD Policy Memorandum – 10 October 2002 – Implementation of Sikes Act Improvement Act: Updated Guidance	Provides guidance for implementing the requirements of the Sikes Act in a consistent manner throughout DoD and replaces the 21 September 1998 guidance Implementation of the Sikes Act Improvement Amendments. Emphasizes implementing and improving the overall INRMP coordination process and focuses on coordinating with stakeholders, reporting requirements and metrics, budgeting for INRMP projects, using the INRMP as a substitute for critical habitat designation, supporting military training and testing needs, and facilitating the INRMP review process.
USAF Instructions and Directives	
32 CFR Part 989, as amended, and AFI 32-1015, Integrated Installation Planning	Provides guidance and responsibilities in the EIAP for implementing INRMPs. Implementation of an INRMP constitutes a major federal action and therefore is subject to evaluation through an Environmental Assessment or an Environmental Impact Statement.

AFI 32-1015, Integrated Installation Planning	Provides guidance and responsibilities related to the USAF comprehensive planning process on all USAF-controlled lands.
AFMAN 32-7003, Environmental Conservation	Implements AFPD 32-70, Environmental Quality; DODI 4715.03, Natural Resources Conservation Program; and DODI 7310.5, Accounting for Sale of Forest Products. It explains how to manage natural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFPD 32-70, Environmental Considerations in Air Force Programs and Activities	Outlines the USAF mission to achieve and maintain environmental quality on all USAF lands by cleaning up environmental damage resulting from past activities, meeting all environmental standards applicable to present operations, planning its future activities to minimize environmental impacts, managing responsibly the irreplaceable natural and cultural resources it holds in public trust and eliminating pollution from its activities wherever possible. AFPD 32-70 also establishes policies to carry out these objectives.
Policy Memo for Implementation of Sikes Act Improvement Amendments, HQ USAF Environmental Office (USAF/ILEV) on January 29, 1999	Outlines the USAF interpretation and explanation of the Sikes Act and Improvement Act of 1997.

Appendix B. Wildland Fire Management Plan

The development of this plan is scheduled for FY2023.

Appendix C. Bird/Wildlife Aircraft Strike Hazard (BASH) Plan

See the OPR (97 AMW Flight Safety office) for access to this plan.

Appendix D. Golf Environmental Management (GEM) Plan

See the 97 CES Environmental office for access to this plan.

Appendix E. Integrated Cultural Resources Management Plan (ICRMP)

See the OPR (97 CES Engineering office) for access to this plan.

Appendix F. Integrated Pest Management Plan (IPMP)

See the OPR (97 CES Entomology shop) for access to this plan.

Appendix G. Methods for Climate Change Projections

This appendix provides a detailed overview of the data and methods used to assess installation-specific vulnerabilities and potential impacts associated with projected changes under four climate change scenarios. The scenarios represent two global carbon emissions levels called Representative Concentration Pathways (RCPs) for two different target years. The emissions scenarios are medium emissions (RCP 4.5) and high emissions (RCP 8.5). The two timeframes are decades around 2030 (2026-2035) and 2050 (2046-2055). Therefore, the climate change scenarios are RCP 4.5 2030, RCP 8.5 2030, RCP 4.5 2050, and RCP 8.5 2050. Projected climate data were then used to assess potential impacts to Altus AFB's mission and natural resources.

CLIMATE PROJECTIONS

Climate projections are based on recent global climate model simulations developed for the Intergovernmental Panel on Climate Change (IPCC), Coupled Model Intercomparison Project Phase 5 (CMIP5) (Hibbard, Meehl, Cox, & Friedlingstein, 2007; Moss et al., 2008, 2010). Under the CMIP5 protocol, specified radiative forcing of the atmospheric warming were simulated using 32 global climate models to provide scenarios associated with emission levels at 4.5 W/m^2 and 8.5 W/m^2 (van Vuuren et al., 2011), denoted as RCP 4.5 and RCP 8.5, respectively (CMIP5 Data Search | CMIP5 | ESGF-CoG, n.d.).

Climate Methodology

For each AF installation assessed, historical daily temperature and precipitation data over a 30-year period were used to represent average historical conditions and generate climate projections. Future climate conditions under RCP 4.5 and RCP 8.5 emission scenarios were projected to produce a decadal time series of daily climate values for the decades around 2030 (2026-2035) and 2050 (2046-2055).

Within the Contiguous United States (CONUS), DAYMET weather data (Thornton, Thornton, & Mayer, 2012) from 1980 to 2009 was used to represent the historical period. DAYMET provides gridded daily temperature and precipitation data at a 1-km spatial resolution. The historical climate data represent the 30-year historical reference point used by the IPCC to define climate change scenarios.

Climate projections were calculated using US National Center for Atmospheric Research (NCAR) Community Climate System Model (CCSM4) simulations prepared for the IPCC-AR5 (Gent & Danabasoglu, 2011; Hurrell et al., 2013; Moss et al., 2008, 2010). CCSM4 was chosen because it provides consistent and moderate climate representation across various climate regions. CONUS projections used Localized Constructed Analogs (LOCA) CCSM4 data with a 6-km spatial resolution (Pierce, Cayan, & Thrasher, 2014).

For installations Outside of the Contiguous United States (OCONUS), climate data for 1975-2004 from the ½ degree global degree dataset provided by the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) at the Max Planck Institute for Meteorology (Hempel, Frieler, Warszawski, Schewe, & Piontek, 2013) was used for the 30-year historical period. OCONUS climate projections used data from the HadGEM2-ES dataset, also provided by the ISI-MIP project with a spatial resolution of 50-km.

For both CONUS and OCONUS installations, historical climate data were averaged over the 30-year historical period to establish a climatological baseline for each installation. This historical baseline was then used to develop a time series of daily data for the decades around 2030 and 2050. Historical climate data gathered for each installation included average daily temperature (°C), maximum daily temperature (°C), minimum daily temperature (°C), and daily precipitation (mm). Climate data were converted to °F and inches (i.e., English units) for analysis.

For each variable of interest, a daily anomaly was computed for each emission scenario (RCP 4.5 and RCP 8.5) for each day over both 10-year periods (2026-2035 and 2046-2055). Daily data were then averaged over the 10-year period for each variable and scenario to produce annual average temperature (TAVE), average annual maximum temperature (TMAX), average annual minimum temperature (TMIN),

and average annual precipitation (PRECIP) estimated for 2030 and 2050. Daily precipitation data were used to calculate baseline and design storms used in stream channel flood modeling, as applicable.

Generation of Climate Summaries

Two R packages were created and used to generate the climate summary. The DaymetLOCA package produced the site-bounded projected climate data. The ClimatePrimers package generated the climate summary document for each site. Figure E-1 below shows the general workflow.

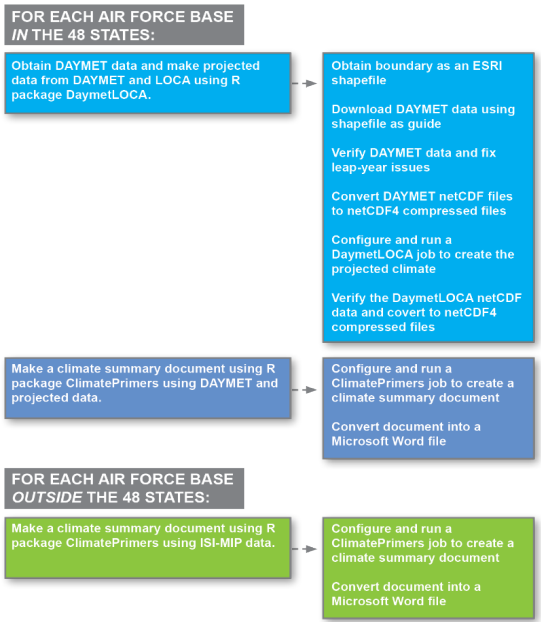

Figure E-1. Climate analysis workflow.

Walter & Lieth Climate Diagrams

The ClimatePrimers package in R also generated Walter & Lieth climate diagrams (Walter & Lieth, 1960), which display average monthly precipitation and temperature patterns throughout a year. The diagrams were developed by averaging temperature and precipitation data by month for each year of the 10-year period for each scenario. Resulting monthly values were then averaged across the 10-year period to generate the Walter & Lieth climate diagrams. An annotated Walter & Leith diagram example is shown in Figure E-2. The diagrams were developed using R functions derived from the "diagwl" function in the climatol R package (Climatol Climate Tools, n.d.). The original function was modified to display values in English units (°F and inches) for CONUS locations.

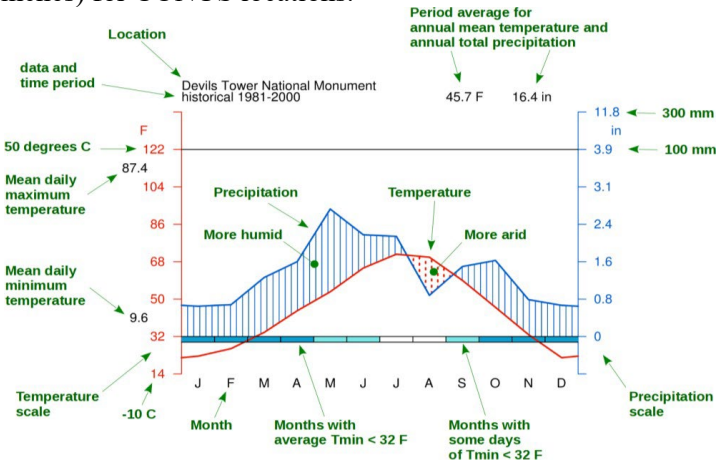

Figure E-2. Example Walter & Leith climate diagram.

HYDROLOGY

Flooding associated with (1) precipitation induced stream channel overflow and (2) coastal sea level rise (SLR) and storm surges (SS) was assessed for USAF installations as applicable.

Stream Channel Modeling

Modeling of stream channel overflow (or flood modeling) was conducted using climate projection data for RCP 4.5 and RCP 8.5 emission scenarios in 2030 and 2050. The scope of flood modeling was limited to stream channel networks and did not consider flooding of independent surface bodies, stormwater systems, or surface ponding.

Design Storm Development

A design storm is a hypothetical storm used to design infrastructure, evaluate flood hazards, and/or inform land use planning and resource management. Daily precipitation data from 1996-2005 were used to estimate baseline design storms for the year 2000. Projected daily precipitation data from 2026-2035 and 2046-2055 were used to estimate design storms for emission scenarios in 2030 and 2050, respectively. Projection methods did not allow for determination of design storm probability. Design storms were based ten years of data and therefore do not represent extreme weather events (e.g., hurricanes, extraordinary storm fronts) and are expected to be smaller than current 100-year storms.

Initially, each 10-year dataset was averaged, however it was determined that averaging daily precipitation data across a 10-year period resulted in decreased variance from day-to-day and, therefore, obscured potentially significant storm events. As a result, algorithms were developed to screen the raw data and identify the biggest three-day storm in each year (defined as the maximum annual precipitation over a three-day period where precipitation occurs each day). Daily totals were then averaged across the 10 selected storms (1 storm per year), omitting values below the 50^{th} percentage. Three-day storm events were used as design storms for flood modeling because rainfall occurring over consecutive days can cause soil saturation, overland flow, and compounding runoff. A design storm hyetograph was produced for each climate scenario representing simulated precipitation intensity over the 72-hour period. The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 was used to develop the synthetic distribution for each design storm. The late-peaking storm distribution was selected for all installations.

Watershed Delineation

The watershed boundary was delineated for each drainage basin that was to be modeled. Most CONUS watersheds were delineated using the United States Geological Survey (USGS) online StreamStats application. If StreamStats watershed data were not available for CONUS locations, then Hydrologic Unit Code (HUC) shapefiles were accessed from the Natural Resources Conservation Service (NRCS) database. The watershed boundary was determined using the Digital Elevation Model (DEM), aerial imagery and/or a topographic map to establish the perimeter of area that would continuously contribute drainage to the installation. For OCONUS locations, watersheds were delineated with the ArcHydro tools package in ArcGIS using available DEM. This tool uses a point shapefile (point of interest) and the DEM of the area to delineate the contributing runoff area upstream of the selected point. Alternatively, the Spatial Analyst toolbox called "Watershed" in ArcGIS could also be used to delineate the watershed using the DEM, point of interest, and flow direction raster.

Flood Modeling

U.S. Army Corps of Engineers' (USACE) Hydrologic Engineering Center (HEC) Hydrologic Modeling System (HMS) software was used to simulate runoff and estimate discharge over the contributing watershed following design storms. HEC–River Analysis System (RAS) 2D software was used for hydraulic modeling to evaluate potential stream channel overflow at the installation. ESRI ArcGIS tools, such as ArcHydro, were used for preprocessing geospatial data used in hydrologic and hydraulic modeling. Figure E-3 shows the workflow for flood modeling.

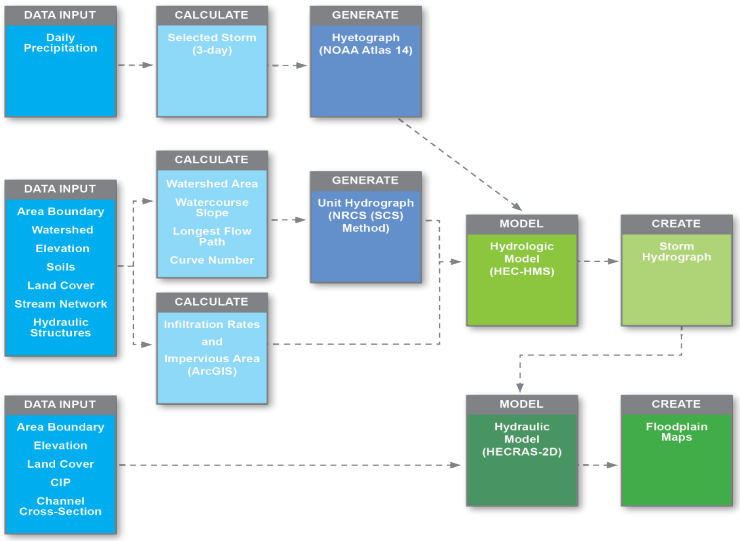

Figure E-3. Flood modeling workflow.

Hydrologic Modeling

A HEC-HMS hydrologic model was created for each watershed to represent how tributaries and sub-basins upstream of the installation are interconnected. Junctions were included where tributaries from sub-basins join a river or where two or more sub-basins drain. River routing was based on available data. Both the kinematic wave and lag routing methods were used to simulate flow. The amount and timing of storm runoff also depends on physical characteristics of the watershed. A unit hydrograph characterizes how the watershed is expected to respond to a unit of rainfall. Unit hydrographs were developed according to the Soil Conservation Service (SCS), now the NRCS, method as described in the NRCS National Engineering Handbook (NRCS, 2009).

The SCS method requires the following parameters:

- Watershed area (above the point where the hydrograph is to be developed)
- Longest flow path using watershed and stream network data
- Average watershed slope using elevation and watershed data
- Curve Number (CN) determined from soils, land cover, and watershed data

Additional inputs into the model included land cover, soil type, depth to water table, and percent imperviousness. Infiltration losses were calculated using the initial and constant method. The NRCS National Engineering Handbook (NRCS, 2009) provides a range of infiltration rates for each type of soil group according to water table depth. Soils data were used to determine infiltration rates for each portion of the land in the sub-basin. The constant infiltration rate was then calculated using a weighted area analysis. Impervious land area was calculated using land cover data. After identifying the imperviousness for each portion of the land in the sub-basin, the total percent imperviousness was calculated using a weighted area analysis. When available, projected land cover data over the delineated watershed was used as a variable input for modeling future climate scenarios. MC2 data were available for most CONUS installations at a spatial resolution of 4-km. Other model parameters including soil type and impervious area were held constant in projection models. Land cover was held constant for OCONUS installations. The HEC-HMS model generated a hydrograph for each design storm estimating discharge in cubic feet per second.

Hydraulic Modeling

A hydraulic model was used to simulate channelized flow and stream channel overflow at the installation. Inputs to the hydraulic model included hydrographs produced from hydrologic modeling, elevation data, land cover data, environmental data, and Common Installation Picture (CIP) data.

A 2D mesh digital representation of the channel and physical terrain adjacent to the channel. Elevation data was imported into the HEC-RAS 2D model to represent terrain and water surface elevations. If the channel bathymetry data was not captured within the elevation data, channel area was mapped and elevation within the channel was dropped to account for channel depth/capacity. Based on the spatial resolution, elevation data were further manipulated to account for hydraulic structures like culverts, bridges, and dams. Stream network data and road network data were imported into the model and assigned as breaklines. Breaklines stabilize the model by refining the cell sizes within the 2D mesh. CIP data were imported into the model to assign buildings and structures as obstructions within the 2D mesh area. Land cover data were imported into the model and Manning's n roughness coefficients were assigned to each land cover classification (Table E-1). Roughness coefficients define the resistance for the terrain in the 2D flow area and have a large impact on the model results. Once the 2D mesh was created, the boundary conditions were established at upstream (inflow) and downstream (outflow) ends of the channel. The inflow boundary condition was used to load the hydrologic information using the flow hydrograph. Since the flood modeling was conducted based on a projected three-day design storm, the inflow boundary conditions were set to unsteady flow data. The outflow boundary condition was used to define the outflow discharge information in the form of water surface elevation (typically set as 'normal' depth). The simulations were computed using full momentum equations for higher accuracy, compared to diffusion wave equations. A computational time interval of 6 seconds was used to generate stable results. Flood maps were created based on resulting inundation to display the spatial extent of projected inundation.

Table E-1. USACE recommended Manning's n roughness coefficients based on NLCD land cover type.

NLCD 'Code' 2011	NLCD 'Type' 2011	USACE 'n' 2016
11	Open Water	0.035
21	Developed, Open Space	0.040
22	Developed, Low Intensity	0.100
23	Developed, Medium Intensity	0.080
24	Developed, High Intensity	0.150
31	Barren Land Rock/Sand/Clay	0.040
41	Deciduous Forest	0.100
42	Evergreen Forest	0.120
43	Mixed Forest	0.080
52	Shrub/Scrub	0.080
71	Grassland/Herbaceous	0.045
81	Pasture/Hay	0.060
82	Cultivated Crops	0.060
90	Woody Wetlands	0.120
95	Emergent Herbaceous Wetlands	0.080

ECOSYSTEMS AND THE BIOTIC ENVIRONMENT

Literature review, available Geographic Information Systems (GIS) data and installation-provided descriptions, analysis and maps were used to assess baseline characteristics of ecosystems at the installation and create a baseline ecosystem feature map comprised of an ecosystem shapefile layer clipped to the installation's boundary. Polygon layers containing land-cover, ecosystem, and wetlands data were drawn from the USAF AFCEC Environmental GIS Project. If the installation-specific data were provided to the USAF AFCEC Environmental GIS Project and/or uploaded into GeoBase, they were used. If installation-specific data was not available, public sources were used as an alternative. Online sources included the USGS GAP- Analysis Project, the Multi-Resolution Land Characteristics (MRLC) Consortium's NLCD, and the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory dataset.

Ecosystem Classification

The ecosystem classification follows the National Hierarchical Framework of Ecological Units or Bailey's Ecoregions (Bailey, 2014), which is a regionalization that links soils, physiography, and ecosystem types

to stratify the landscape into progressively smaller areas. This classification is unlikely to be drastically modified under the climate change scenarios evaluated. Therefore, analysis focused on those ecosystems and vegetation types deemed vulnerable to the RCP 4.5 and RCP 8.5 climate change scenarios.

Vulnerability

Potential impacts of a moderate emission scenario (RCP 4.5) and a high emission scenario (RCP 8.5) on ecosystems under climate data from a decadal time series around 2030 (2026-2035) and 2050 (2046-2055), were evaluated using the framework developed by Comer et.al. (2012) for the Habitat Climate Change Vulnerability Index (HCCVI). This index uses a two-dimension analysis of climate change sensitivity and ecological resilience for each ecosystem type distribution within a given ecoregion, using combined quantitative and qualitative approaches. Quantitative estimates for sensitivity to climate change included climate projections for the decadal averages studied (climate induced stress), land cover condition (historic and projected) and flooding analysis, which were normalized to 0.0–1.0 scores. Analysis of downscaled global climate forecasts for temperature and precipitation variables provided an indication of the relative intensity of climate-induced stress. Climate projection models were used to correlate and map current ecosystem distributions with a suite of key climate variables from a 1980 baseline. Then, the location of that same climate projection as predicted for 2030 and 2050, provided an indication of the directionality, magnitude, and overlap of geographic shift for species from the community and ecosystem. Finally, where available, models of hydrologic regime were used to forecast trends in the alteration or 'departure' from expected conditions for upland vs. riparian/aquatic communities, respectively. Qualitative resilience categorizations used in this vulnerability assessment of the ecosystems at the installation were based on the following criteria:

- Review of the ecological characteristics of each type of ecosystem/land or vegetation cover/ecosystem present at the installation;
- Assessment of the adaptive capacity of each ecosystem/land or vegetation cover/ecosystem based on published scientific research.

The scores for sensitivity and resilience were combined to determine the categorical estimate of climate change vulnerability by the years 2030 and 2050 for each ecosystem type. For the HCCVI, climate-change vulnerability was expressed in three categories: high, moderate, and low. Therefore, the index ratings are quite general, but this is because predictive uncertainty is often high, and the overall intent is a generalized indication of vulnerability. This is analogous to a scoring of "endangered" or "threatened" for a given species, but here focused specifically on climate change vulnerability, and applied to community and ecosystem types. A general framework of the concepts evaluated for each vulnerable ecosystem is shown in Figure E-4. Once vulnerable ecosystems were identified, baseline and inundation maps, ecosystem maps and area tables were generated to reflect the current coverage of vulnerable ecosystems at the installation. Flooding (flood inundation) and/or SLR and SS projections based on the analysis provided by climate and hydrology models were also overlaid with ecosystem data to assess potential impacts. Maps were created from the series of layered maps depicting the flood inundation shapefiles overlaid on the baseline ecosystem layer to show the extent of the projected inundation due to flooding. The maps provide a visual comparison of the projected inundation with the baseline inundation due to flooding. Four maps were created, one for each projected scenario. The baseline ecosystem is also presented to show possible affected ecosystems and the extent of the inundation relative to the different ecosystem classes.

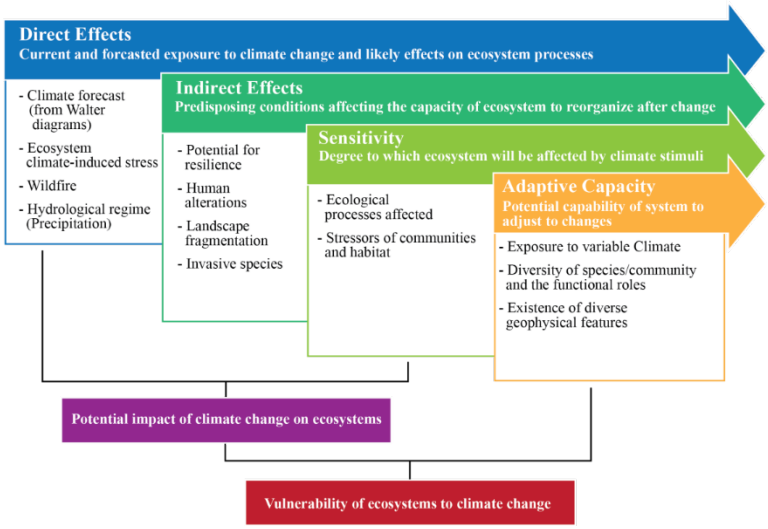

Figure E-4. Framework used to evaluate direct and indirect effects, sensitivity, and adaptive capacity of vulnerable ecosystems.

The SLR and SS inundation layers for each scenario were overlaid on the baseline ecosystem layer to visually depict potential areas of concern for each projected scenario. Each map features the inundation layers for the 4.5 RCP and 8.5 RCP scenarios, and they are organized by the projected model year. The area of inundation for flooding was also compared to the MC2 projected ecosystem scenarios (when available). If the inundation shapefiles covered an area where the MC2 ecosystem type changed from the baseline to one of the projected model years, the area and percent coverage were calculated. Finally, the flood and SLR and SS area tables compare the area of each inundation shapefile to the total area of the installation boundary. The percentage of coverage was calculated to quantify the extent of each inundation layer and to see what percentage of the installation was affected. The change in percentage from one inundation scenario to the next was also included to show whether the area of inundation was increasing or decreasing, compared to the baseline projection.

Fish and Wildlife

Fish and wildlife assessments use climate projections, as well as information related to climate and fish and wildlife species derived from the installation's INRMP. Important variables used in the analysis to determine impacts of climate change on fish and wildlife species include average monthly temperatures, monthly precipitation, and intensity/frequency of storm events, changes in vegetation, projected fire behavior and maps depicting habitat loss through inundation. With this information, qualitative analysis was done to address potential direct and indirect effects of vulnerable fish and wildlife populations. One example of a direct effect would be displacement of a terrestrial species due to habitat inundation. An example of an indirect effect would be increasing temperature causing algal blooms in benthic habitats leading to depletion of dissolved oxygen and displacement of aquatic organisms.

Threatened and Endangered Species and Species of Concern

Vulnerability assessments of threatened and endangered species were conducted using a framework developed by Thomas et al. (2011). The framework defines vulnerability status through the intersection of two dimensions: risk of climate-related decline in existing range and benefits of unaided climate-related expansion. Scores for the first dimension incorporate observed population declines within the species historic/current range and projected effects of climate change in that range. Scores for the second dimension incorporate observed and projected range expansion. Both dimensions are modified by inclusion of risks and benefits that are not directly related to climate change and have a measure of uncertainty. Data from USFWS listing and recovery documents, state threatened and endangered species databases, NatureServe Explorer and other published literature were used in completing the framework.

Population-level data and trends are used. Framework calculations are included on the attached DVD to allow installations to update the analysis using installation-specific sub-population observations.

MISSION IMPACTS ON NATURAL RESOURCES

Natural Resource Constraints to Mission and Mission Planning

The qualitative assessment of climate change impacts to the military mission closely follows the framework of Army Techniques Publication ATP 2-01/MCRP 2-3A, Intelligence Preparation of the Battlefield (IPB) (United States Army, 2014). The basics of this framework are general enough to be used to analyze mission requirements for any military branch and have been done so using Air Force documents related to the branch's specific mission requirements. IPB is a four-step process used by the U.S. Army (and Marine Corps) to provide a "systematic, continuous process of analyzing the threat and environment in a specific geographic area." (United States Army, 2014). Although this framework is designed for continual feedback over a long period, it was used here to assess impacts for multiple emission climate scenarios and time frames. The four-step IPB process as applied to the mission impact analysis was tailored to Air Force mission types (primarily the 12 AF Core Functions), the biological and physical environment of each installation, and the potential primary and secondary effects of climate change on these operational environments and environmental features.

- Describe the Operational Environment. This step collects all available data and information including but not limited to: geographical and climatic area of interest (AOI), mission types conducted within the AOI, habitat and vegetation types within the AOI, mission related infrastructure (including ranges, training areas, buildings, roads, and any other infrastructure relevant to the military mission), and the results of the climate and hydrologic analyses described in section 1.1. Sources include GIS layers, results of all other analyses used for the INRMP climate assessment, INRMPs, as well as Air Force mission related documents such as Installation Complex Encroachment Management Plans (ICEMAP), AF Doctrine Documents (AFDD) and Command Strategic Plans.
- Describe Environmental Effects on Operations. Data and information from Step 1 were synthesized to define any spatiotemporal overlap between climate change effects on environmental exposures (e.g., wind, heat, sea level rise, flooding), military operations required to complete the mission, and environmental conditions required for these critical military operations.
- Evaluate the Threat. A qualitative judgment was made as to the extent and severity of any of the overlaps identified in Step 2. Climate change related threats were deemed as low, moderate, or high risk depending on the predicted or inferred level of impact. This level of impact is contingent on factors such as importance to the mission, possibility of partial or full attainment of the mission with workarounds, and redundancy (such as multiple locations capable of fulfilling mission requirements or alternate routes available for personnel and equipment movement).
- Determine Threat Courses of Action. This step was not conducted in the mission impacts assessment, although it is at least partially fulfilled by considering adaptation strategies within the INRMP climate change assessment.

FISH AND WILDLIFE MANAGEMENT

Fish and wildlife management is based on climate projections and vulnerabilities of fish and wildlife species. The framework for adaptation strategies is shown in Figure A-6 (Comer et al., 2012). Ideally, natural adaptation methods that provide multiple benefits to ecosystems would be implemented. In some cases, there are no feasible adaptation strategies available to combat effects of climate change, such as loss of alpine tundra due to rising temperatures. Adaptation strategies to prevent loss of fish and wildlife species indicated as important or vulnerable in the installations INRMP are provided in a qualitative format.

OUTDOOR RECREATION AND PUBLIC ACCESS TO NATURAL RESOURCES

Impacts of climate change on outdoor recreation and public access to natural areas are based on current recreational demands and opportunities listed in INRMPs and climate projections provided though this project. Qualitative analysis was done using data that included average monthly temperatures, monthly

precipitation, and intensity/frequency of storm events, changes in vegetation, projected fire behavior and maps depicting habitat loss through inundation. In some cases, future climate should have little to no effect on recreational opportunities and no changes in management are deemed necessary. In other cases, recreational access will need to be limited in vulnerable habitat types to limit competition between habitat needs of fish and wildlife. Such cases often involve sandy shorelines at risk of complete deterioration through sea level rise and increasing storm intensity/frequency where requirements for restoration (beach nourishment and stabilization) are in conflict with intensive recreational use. Occasionally recreational use can be of benefit to natural resources management. For example, providing increased hunting is a cost-effective tool in managing invasive species, but will need to be balanced against constraints. Ideally qualitative analysis is conducted to determine land management practices which leave intact recreational opportunities highlighted in INRMP Section 7.2 Outdoor Recreation and Public Access to Natural Areas.

MANAGEMENT OF THREATENED AND ENDANGERED SPECIES, SPECIES OF CONCERN AND HABITATS

Species-specific management actions directed at climate-related vulnerabilities are not recommended. Ecosystem-based, adaptive management approaches that are currently employed in the INRMP are a good foundation for building climate adaptation strategies to protect at-risk species. Climate change consideration should be included in all steps of the adaptive management process (Figure E-5).

Figure E-5. Adaptation process from America's Climate Choices (Bierbaum et al., 2013).

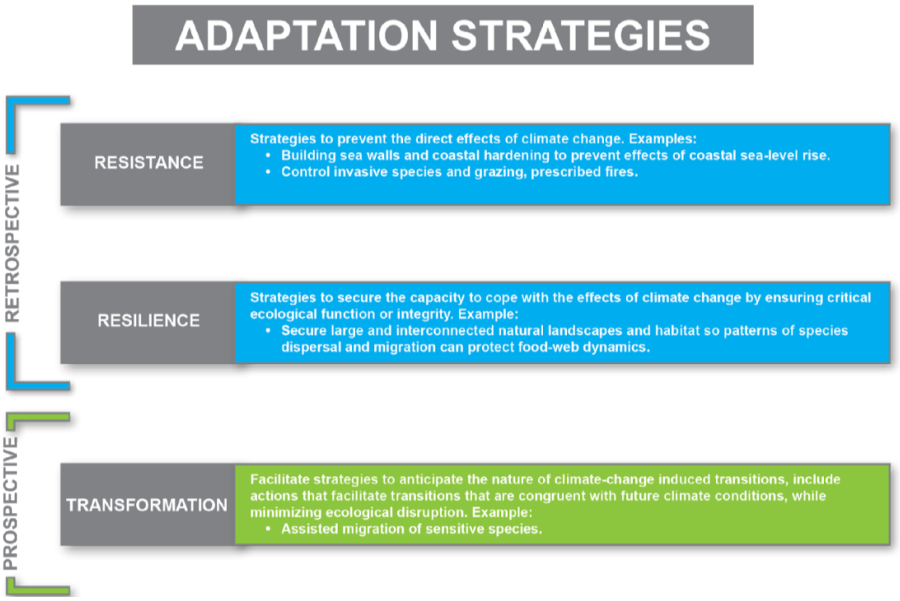

Figure E-6. Adaptation strategy framework.

Adaptation management actions can be forward-looking (proactive/prospective) or reactive (retrospective). Appropriate actions are site-specific and based on the species' needs in the context of the Altus AFB mission. Figure A-6 depicts examples of each type of adaptation strategy (Comer et al., 2012).

WILDLAND FIRE MANAGEMENT

The effect of future climate scenarios on wildland fire hazard was determined by considering each variable contributing to wildfire potential and evaluating its likelihood to worsen, improve, or remain unchanged and the magnitude of any change. Table E-2 shows the primary components of fire hazard, the metrics that comprise each, and the relevant indicators and measures from the projected climate scenarios evaluated. These factors were subjectively analyzed by subject matter experts. Sufficient data to produce a quantitative analysis is not currently available. Many indicators of ignition and wildfire potential were not fully addressed because they are not available at the spatial or temporal resolution necessary for analysis, are beyond the scope of this study, cannot reasonably be estimated into the future, or are not expected to change. These variables are outlined in the table as well, but are assumed to remain equivalent to current day conditions.

Table E-2. Metrics of fire hazard, their indicators and measures, and whether they were considered in the analysis.

Fire Hazard Component	Metrics	Indicators and Measures	Considered in Analysis
Ignition Probability	Ignition Success	Temperature	Yes
		Precipitation Patterns	Yes
		Vegetation Communities	Yes
		Fuel Physical Characteristics	No
		Fuel Chemical Characteristics	No
		Shading	No
		Time of Day	No
		Aspect, Slope, Elevation	No
	Ignition Load	Human Activity (military and civilian)	No
		Lightning	No
Fire Behavior	Fuels	Temperature	Yes
		Fuel Load	Yes
		Vegetation Communities	Yes
		Fuelbed Physical Characteristics	No
		Fuel Chemical Characteristics	No
	Weather	Temperature	Yes
		Precipitation Patterns	Yes
		Wind	No
	Topography	Slope	No
		Aspect	No

DATA SOURCES

***LOCA Projected Date*:** LOCA projected data was downloaded from Lawrence Livermore National Laboratory FTP site. ftp://gdo-dcp.ucllnl.org/pub/dcp/archive/cmip5/loca/LOCA_2016-04-02/CCSM4/16th/ Information on LOCA data can be found at: http://loca.ucsd.edu/

- Coverage Area: CONUS data for CCSM4 for these years:
  - Historical=1950-2005
  - RCP 4.5/8.5=2006-2100
- Climate variables: TMIN, TMAX, PRECIP
- Resolution: Temporal=Daily, Spatial=1/16th degree (~6km)

DAYMET Historical Data: Archived and distributed through the Oak Ridge National Laboratory, the DAYMET data set provides gridded estimates of daily weather parameters for North America. Data was downloaded from: https://daymet.ornl.gov/

- Coverage Area: CONUS plus parts of Canada and Mexico for these years: 1980 to Most Current

Year (2016)

- Climate variables: TMIN, TMAX, PRECIP Resolution: Temporal=Daily, Spatial=1km

Hydrologic Data Information: Geospatial data used in flood modeling were acquired from the USAF AFCEC Environmental GIS Project and various national and international open source GIS data repositories including:

- Elevation Data: USAF GeoBase, United States Department of Agriculture (USDA), USGS, NOAA, ArcOnline and other state/county/city data repositories
- Land Cover Data: USAF AFCEC Environmental GIS Project; National Land Cover Database (NLCD); Dynamic Global Vegetation Model (MC2); and other state/county/city data repositories
- Soils Data: USGS Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) and other state/county/city data repositories
- Watershed Boundaries: USGS HUC boundaries, USGS StreamStats and ArcHydro Tools Stream
- Network: National Hydrography Dataset (NHD), USAF GeoBase
- Common Installation Picture (CIP) Data: USAF GeoBase
- Environmental Data: USAF AFCEC Environmental GIS Project
- Data collected from open source databases generally required processing before it could be used in modeling. Varying spatial resolution, extent, quality of data and attributes as well as varying data formats were reconciled prior to use. ESRI's ArcGIS tools including ArcHydro were used for processing geo- spatial data.
- Hyetographs NOAA Atlas 14 online tool: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html
- StreamStats: https://water.usgs.gov/osw/streamstats/

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CLIMATE ANALYSIS RESULTS

CLIMATE ANALYSIS

The climate associated with Altus AFB is consistent with what is referred to as a humid subtropical climate bordering on a semi-arid climate (Köppen, 1884). It is characterized by extremely hot summers and generally cool, dryer winters. The average annual temperature is 62.2 ºF (16.8 °C) and annual precipitation of 28.9 inches (734mm) per year occurs in higher amounts in summer months.

The climate projections for Altus AFB represent a moderate emission scenario (RCP 4.5) and a high emission scenario (RCP 8.5) based on National Center for Atmospheric Research (NCAR) Community Climate System Model (CCSM) prepared for the IPCC-AR5 (Gent & Danabasoglu, 2011; Hurrell et al., 2013; Moss et al., 2008, 2010). Climate projections do not predict extreme weather events, which are short-term events that are significantly different from the usual weather pattern (hurricanes, flash floods, heat waves). Climate describes trends in temperature and precipitation over a long period of time (usually thirty years) for a given location.

Climate information for historical data are downscaled to approximately 1 km grid resolution, and provide daily climate information from 1900 to 2009. Climate model simulations were downscaled to 6 km grid resolution and data from 2026 to 2035 were extracted to represent the decadal average for 2030 and extracted data from 2046 to 2055 represent the decadal average for 2050.

Climate projections (Table F-1) indicate that minimum and maximum temperatures will increase over time under both emissions scenarios. For the decade centered around 2030, both scenarios project a similar degree of increase in average annual temperature (TAVE) of between 2.7 °F (1.5 °C) and 3.9 °F (2.1 °C) over the historic average. The two emission scenario projections show higher warming by 2050, with RCP 4.5 expressing a warming of 3.6 °F (2.0 °C). RCP 8.5 expresses a slightly greater warming of 5.5 °F (3.1 °C) for this period.

Average annual precipitation (PRECIP) varies between emission scenarios and over time due to larger interconnected ocean-atmosphere dynamics associated with the NCAR CCSM model. For 2030, RCP 4.5 projects a 14% increase in PRECIP while RCP 8.5 shows a small increase of 2%. For 2050, RCP 4.5 projects a 13% increase in PRECIP, while RCP 8.5 shows an increase of 10% from the historic average.

Table F-1. Summary climate data.

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	28.9	33.0	32.7	29.6	31.7
TMIN (°F)	49.2	51.9	52.5	53.1	54.4
TMAX (°F)	75.1	77.9	79.2	79.1	80.9
TAVE (°F)	62.2	64.9	65.8	66.1	67.7
GDD (°F)	5729	6362	6511	6578	6872
HOTDAYS	93.9	118.9	123.1	127.7	137.1
WETDAYS	1.3	0.3	1.0	0.5	0.8

Notes: TAVE °F = annual average temperature; TMAX °F = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD °F = Average annual accumulated growing degree days with a base temperature of 50 °F; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.

Temperature and Precipitation

Monthly climate analysis comparing historical averages with changes in each scenario is provided in Figure F-1 through Figure F-4. The historical time period represents a 30-year historical base period. The projected time periods represent decadal averages centered around 2030 (i.e., 2026-2035) and 2050 (i.e., 2046-2055).

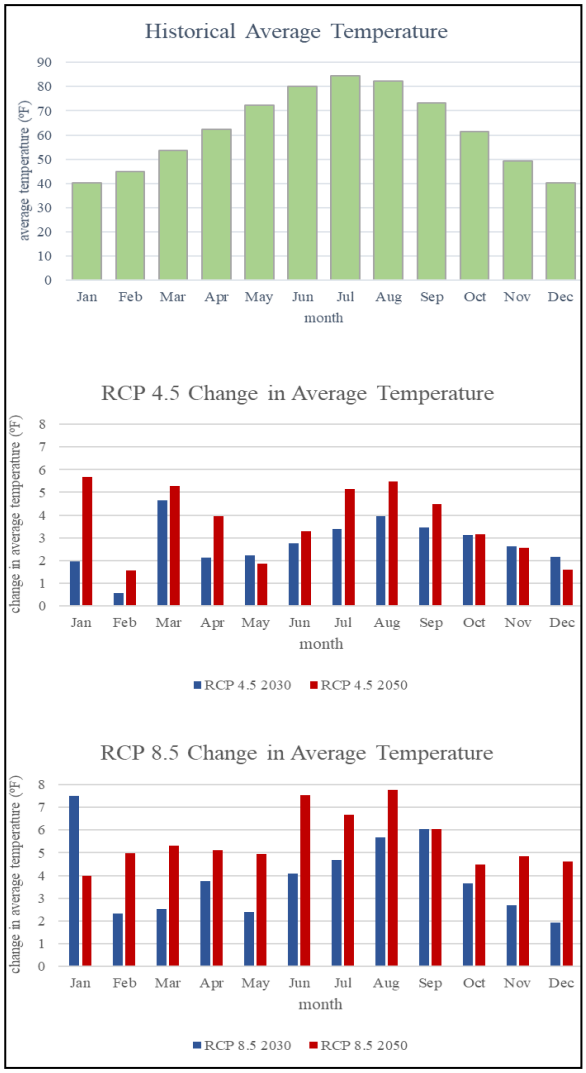

Figure F-1. Monthly average temperature.

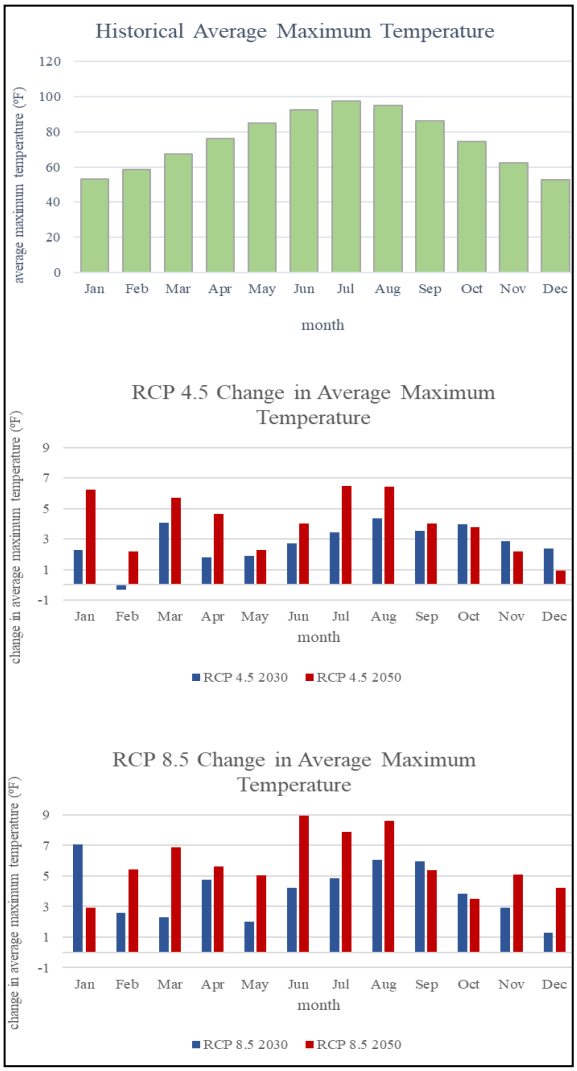

Figure F-2. Monthly average maximum temperatures.

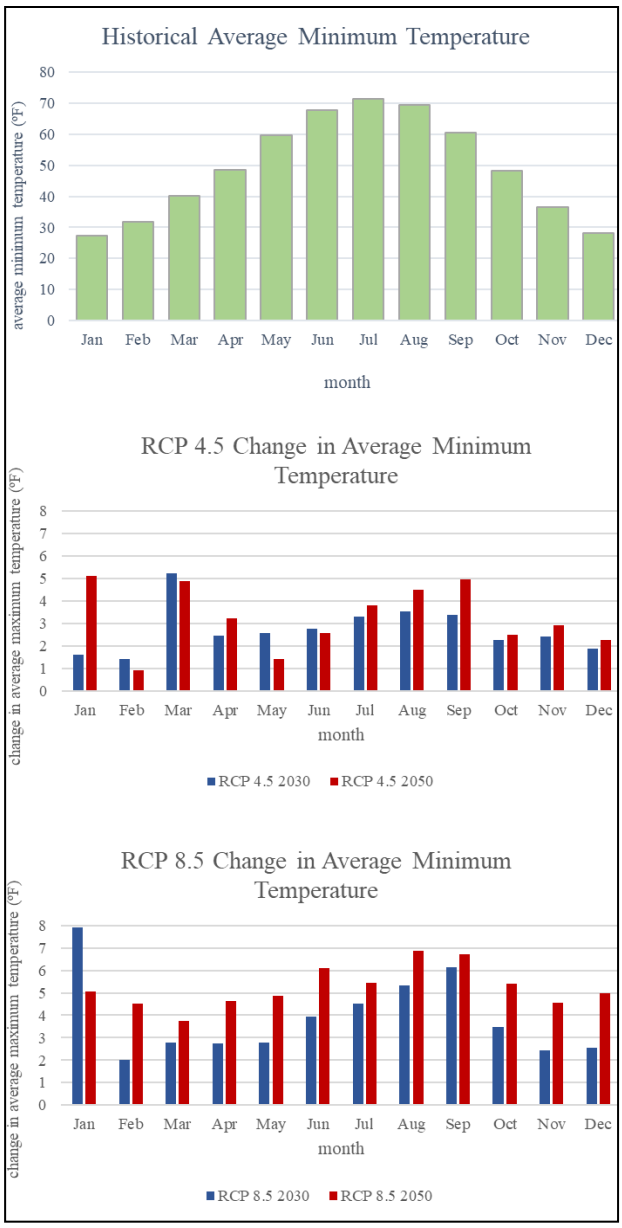

Figure F-3. Monthly average minimum temperatures.

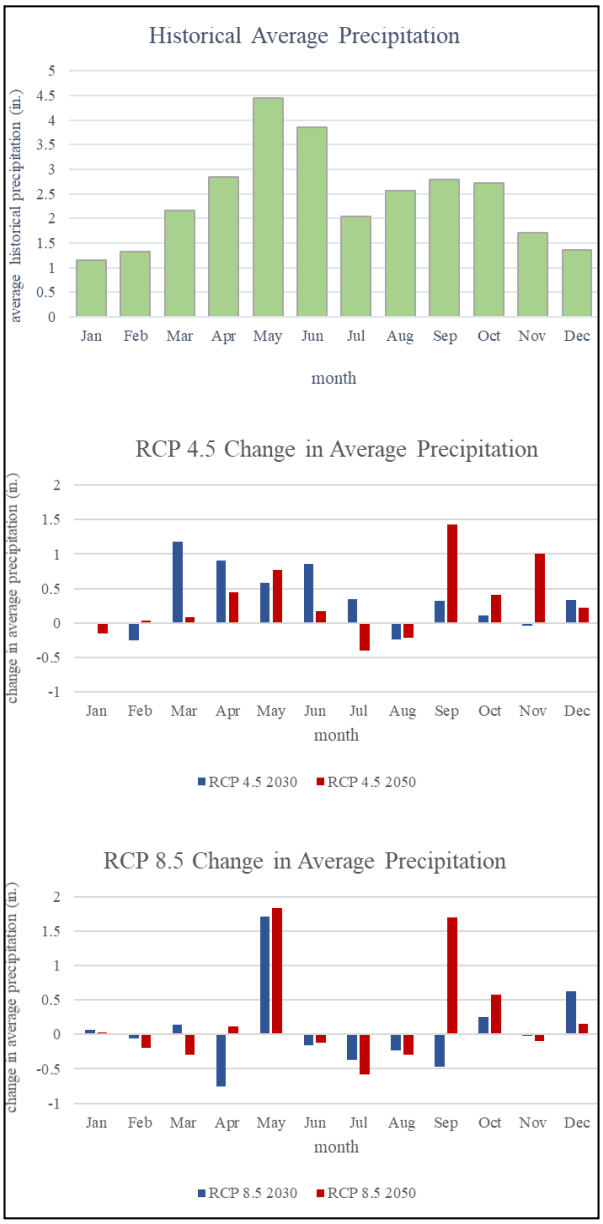

Figure F-4. Monthly average precipitation.

Walter and Lieth climate diagrams (Walter & Lieth, 1960) showing monthly temperatures overlaid with precipitation are shown for historical data and each projected scenario in Figures F-5 through F-8 and Lieth climate diagrams show precipitation and temperature interactions for the year modeled. The red line displays monthly temperature averages (degrees Fahrenheit) measured on the left axis. The blue line shows precipitation (inches) measured on the right axis. The bar along the x-axis defines predicted months with likely (dark blue) or possible (light blue) frost. Values at the top of the panel are mean annual temperature and mean total precipitation. Black numbers beside the axis are the mean maximum and mean minimum temperature of the warmest and coldest months, respectively. The diagrams show seasonal changes in precipitation and temperature that may impact survival of flora and fauna on the installation.

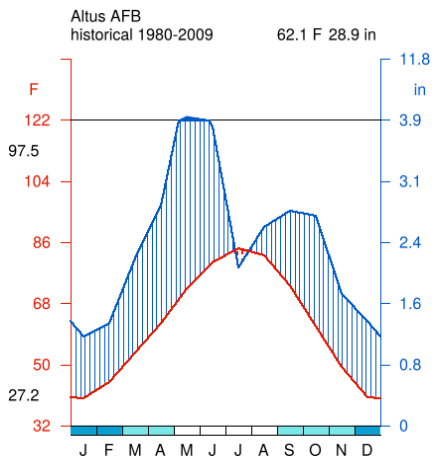

Figure F-5. Walter and Lieth climate diagram over the 30-year historical period.

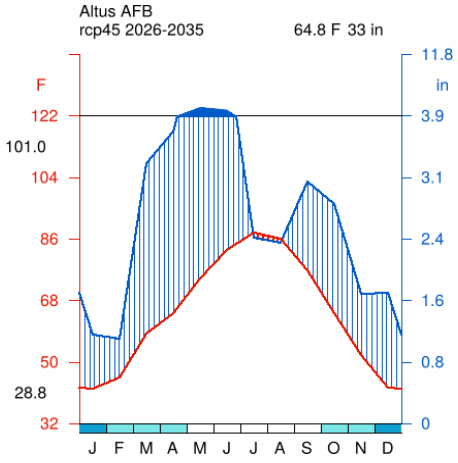

Figure F-6. Walter and Lieth climate diagram for the RCP 4.5 2030 scenario.

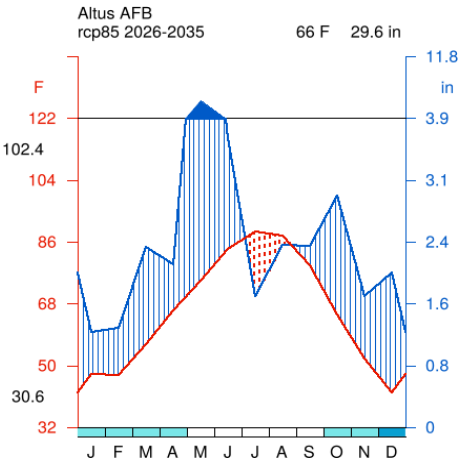

Figure F-7. Walter and Lieth climate diagram for the RCP 8.5 2030 scenario.

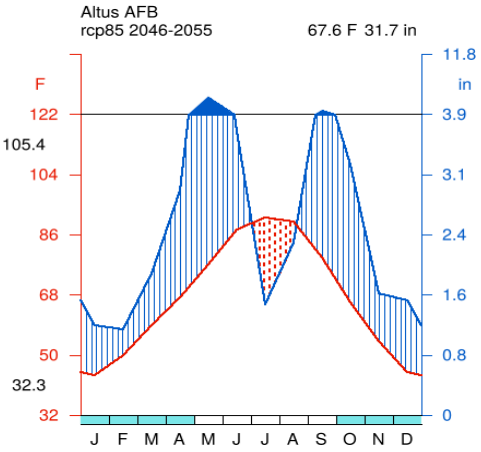

Figure F-8. Walter and Lieth climate diagram for the RCP 8.5 2050 scenario.

CLIMATE DISCUSSION

Temperature and precipitation changes under a single emissions scenario are not linear. In other words, the trends projected in the 2050 timeframe are not simple more extreme versions of the changes projected for 2030. The projections for RCP 4.5 are not simply a less intense pattern than RCP 8.5.

Although PRECIP increases in all scenarios, these increases are associated with decreasing Wetdays. This suggests more frequent, but slightly smaller rain events. Increase in precipitation will be attenuated by accompanying increases in temperature, which results in increase evapotranspiration. As a result of changing precipitation and temperature patterns, a summer arid season could become more severe.

Temperature increases do not happen uniformly throughout the year under either emissions scenario. While the increases are generally greater for the 2050 timeframe, temperature in May, November, and December under the RCP 4.5 2030 is greater than that projected for the RCP 4.5 2050 scenario. This is also the case in the RCP 8.5 scenarios, where January and September in the 2030 timeframe are projected to be warmer than the 2050 timeframe. The greatest temperature increases are expected to occur during the months of June through September, which have historically been hottest. The trend of increasing TAVE and PRECIP will ultimately result in less freeze thaw days, dry days and cold days, more growing degree days and hot days.

The humid subtropical climate that observes extremely hot summers and generally cool, dry winters will transition towards a semi-arid climate with warmer winters and hotter summers. The system-wide impacts of these changes is highly dependent on the ability of the flora and fauna to adapt to changing seasons, temperate extremes and more rapid temperature variation.

ABOUT THE CLIMATE DATA

The climate data sources as well as the North Central Climate Adaptation Science Center should be cited or acknowledged in any publications using these graphics.

ISI-MIP

Historical data used is the historical ½ degree global dataset provided by the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) at the Max Planck Institute for Meteorology (Hempel, Frieler, Warszawski, Schewe, & Piontek, 2013). Climate projections used data from HadGEM2-ES dataset, also provided by the ISI-MIP project. The temporal frequency of data records is daily. The time origin is 1860-1-1 00:00:00 UTC and the time increment is days. Dataset variables are maximum temperature = 'TMAX'; minimum temperature = 'TMIN'; average annual precipitation = 'PRECIP'.

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HYDROLOGY RESULTS

STREAM CHANNEL MODELING

Modeling of stream channel overflow (or flood modeling) was conducted for Altus AFB using climate projection data for RCP 4.5 and RCP 8.5 emission scenarios in 2030 and 2050. The scope of flood modeling was limited to stream channel networks and did not consider flooding of independent surface bodies, stormwater systems, or surface ponding.

Design Storms

A design storm is a hypothetical storm used to design infrastructure, evaluate flood hazards and/or inform land use planning and resource management. Climate projections were used to estimate design storms for the projected climate scenarios (Table G-1). Three-day storm events were used as design storms because rainfall occurring over consecutive days can cause soil saturation, overland flow, and compounding runoff, which may result in flooding. The NOAA Atlas 14 was used to develop a synthetic distribution (hyetograph) for each design storm to use in flood modeling (Figure G-1). Design storms were based on annual events selected from ten years of data and therefore do not represent extreme weather events (e.g., hurricanes, extraordinary storm fronts) and are expected to be smaller than current 100-year storms.

Table G-1. Design storm precipitation.

Design Storm		**Baseline**	**RCP 4.5**		**RCP 8.5**	
		2000	**2030**	**2050**	**2030**	**2050**
Precipitation (inches)	Day 1	1.1	1.6	1.7	1.2	1.5
	Day 2	2.2	2.1	2.5	2.2	2.4
	Day 3	1.9	1.1	1.9	0.9	1.4
	Total	5.2	4.8	6.1	4.3	5.3
Percent change from baseline			-8%	17%	-17%	2%

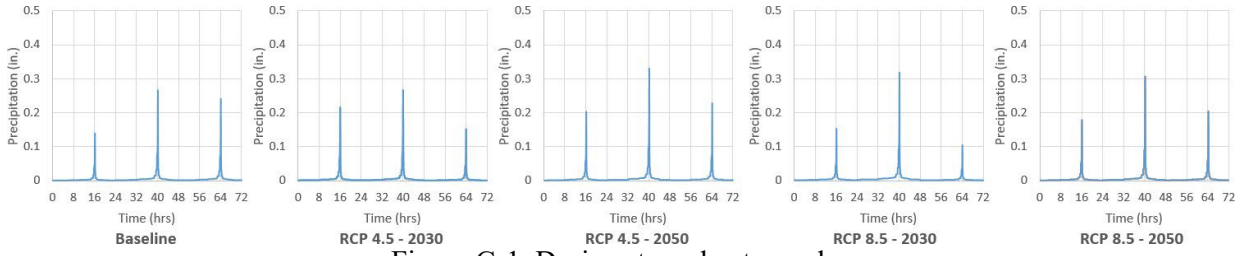

Figure G-1. Design storm hyetographs.

Flood Modeling

Design storms were used to model flooding along Stinking Creek (east) and an unnamed tributary of Stinking Creek (west). The amount and timing of storm runoff depends on physical characteristics of the watershed including soil type, water table depth, land cover, topography, and channel characteristics. These variables were incorporated into a hydrologic model to simulate discharge following the projected storm events for each watershed (Figure G-2 and Figure G-3).

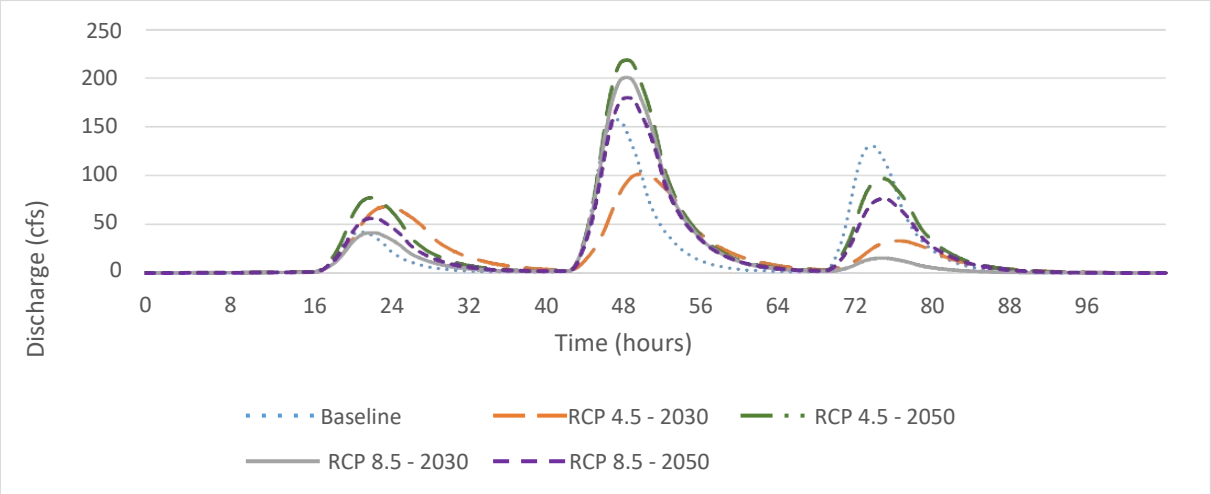

Figure G-2. Hydrographs for Stinking Creek (east).

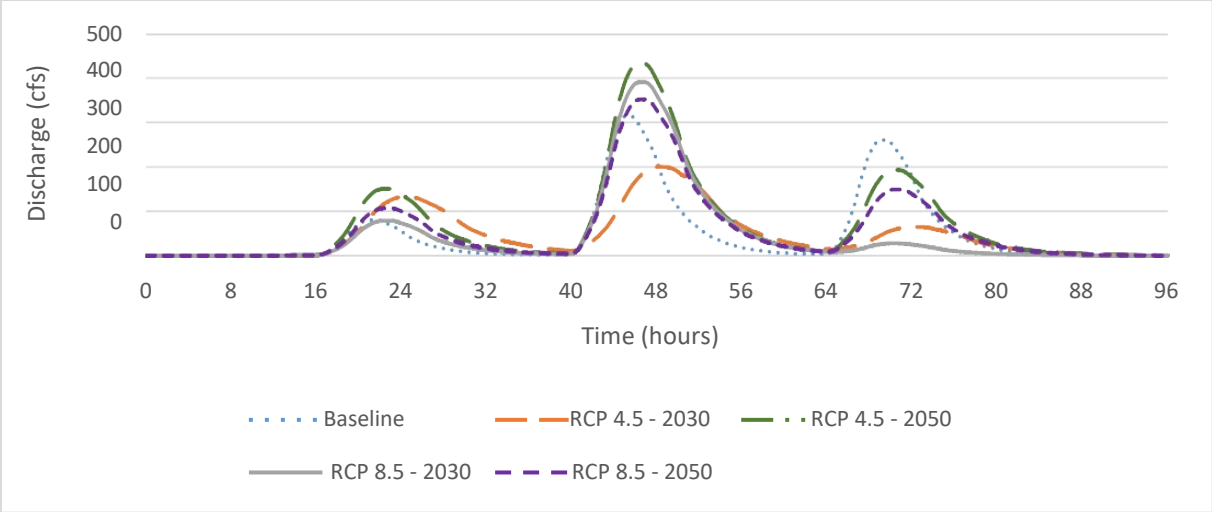

Figure G-3. Hydrographs for unnamed tributary of Stinking Creek (west).

Storm hydrographs (Figure G-2 and Figure G-3), land cover data, environmental data, and elevation data were input into a hydraulic model to estimate inundation from stream channel overflow. Table G-2 summarizes projected inundation by area and percent change from baseline.

Inundation projections were influenced by four variable inputs: (1) variation in total precipitation between design storms, (2) variation between the daily distribution of precipitation over the three-day period, (3) land cover change over the watershed area used in hydrologic modeling, and (4) land cover change in the area within the installation used in hydraulic modeling.

Within the hydrologic model, projected land cover type (variable input) intersected with soils (constant between scenarios) and depth to water table (constant between scenarios) to estimate friction, infiltration rate, and runoff rate, thus contributing to variability in results between scenarios. The variability in the results is then compounded because projected change in land cover within the hydraulic model (installation area modeled) dictates the roughness coefficient (the path the water will take) which also has an effect on inundation.

Total design storm precipitation is projected to decrease in 2030 and increase in 2050 (Table G-1). Stream channel overflow is projected to increase by between 5% (RCP 8.5 in 2050) and 17% (RCP 4.5 in 2050) (Table G-2). Flooding is projected to decrease by 24% under the RCP 4.5 emission scenario in 2030, despite total design storm precipitation decreasing by 8% (Table G-2). Projected land cover over the modeled watersheds was unique for this scenario having primarily grassland cover, compared to

shrubland and forested vegetation, which were dominant in the other scenarios. Figure G-4 through G-8 show the spatial extent of projected inundation for all climate scenarios.

Table G-2. Area inundated by stream channel overflow at Altus AFB.

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (acres)	169	128.8	197.4	186.5	176.8
Change in inundation area from baseline (acres)		-40.2	28.4	17.5	7.7
Percent change from baseline		-24%	17%	10%	5%

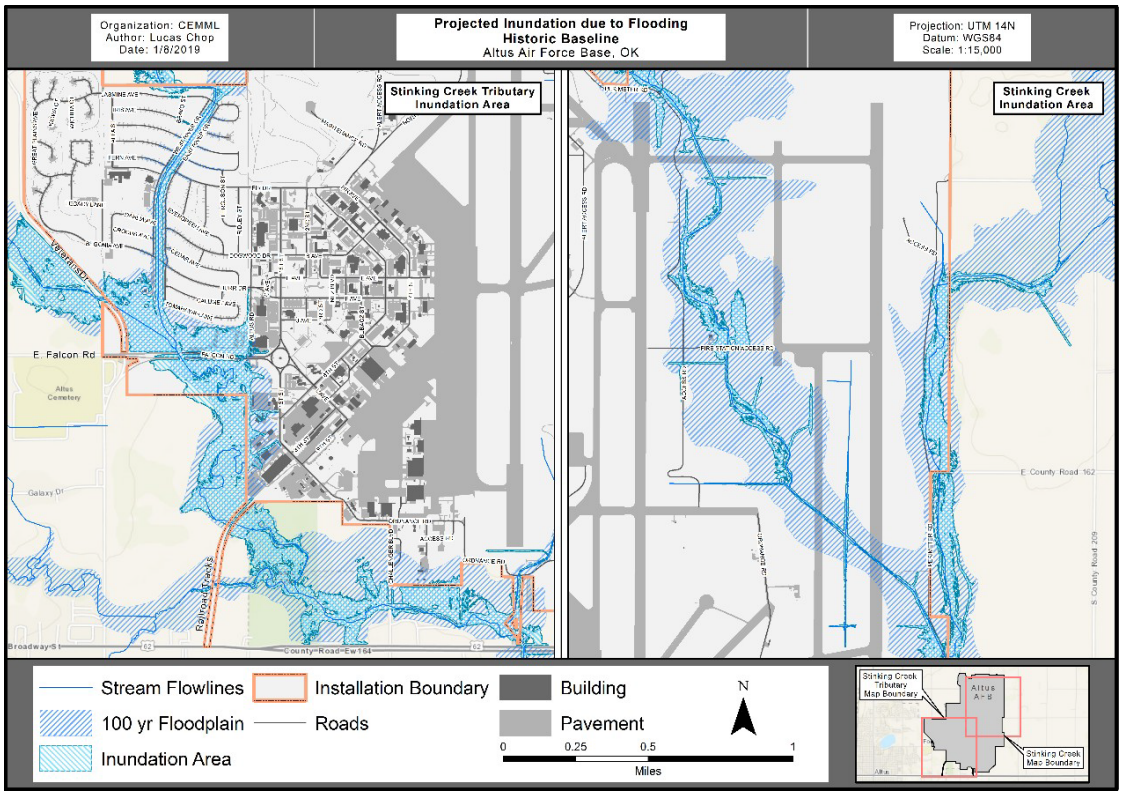

Figure G-4. Stream channel overflow for the baseline design storm.

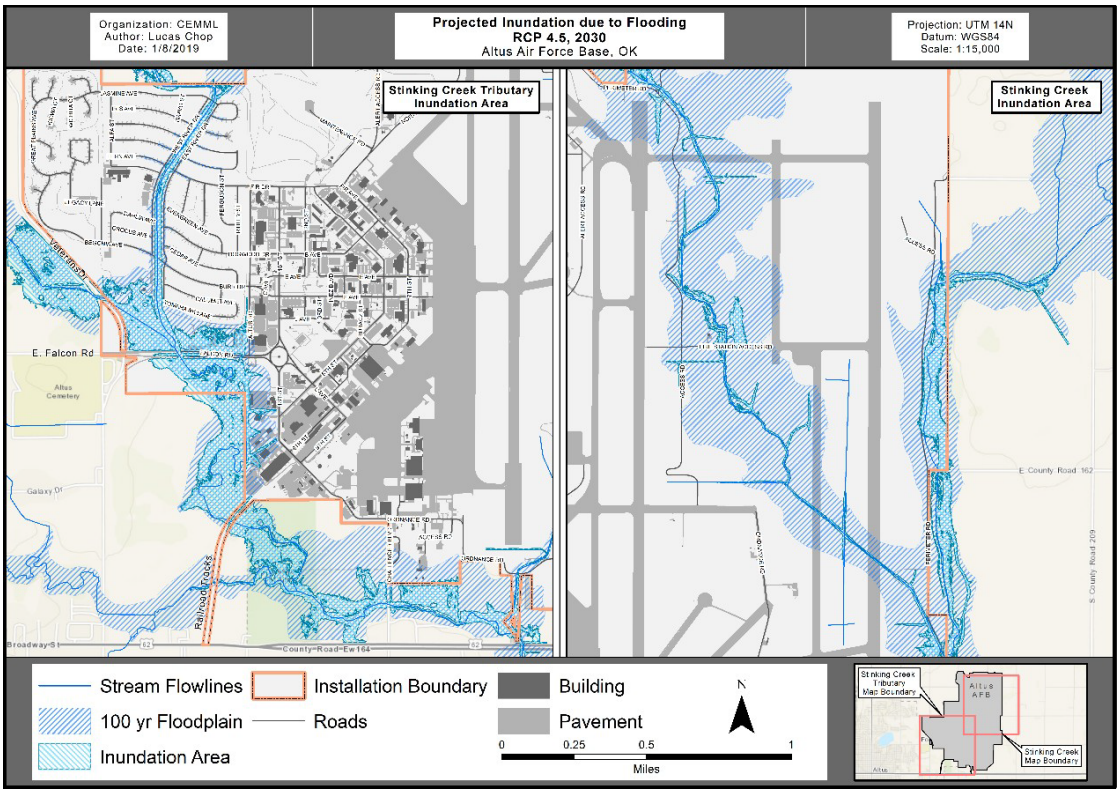

Figure G-5. Stream channel overflow for the RCP 4.5 emission scenario in 2030.

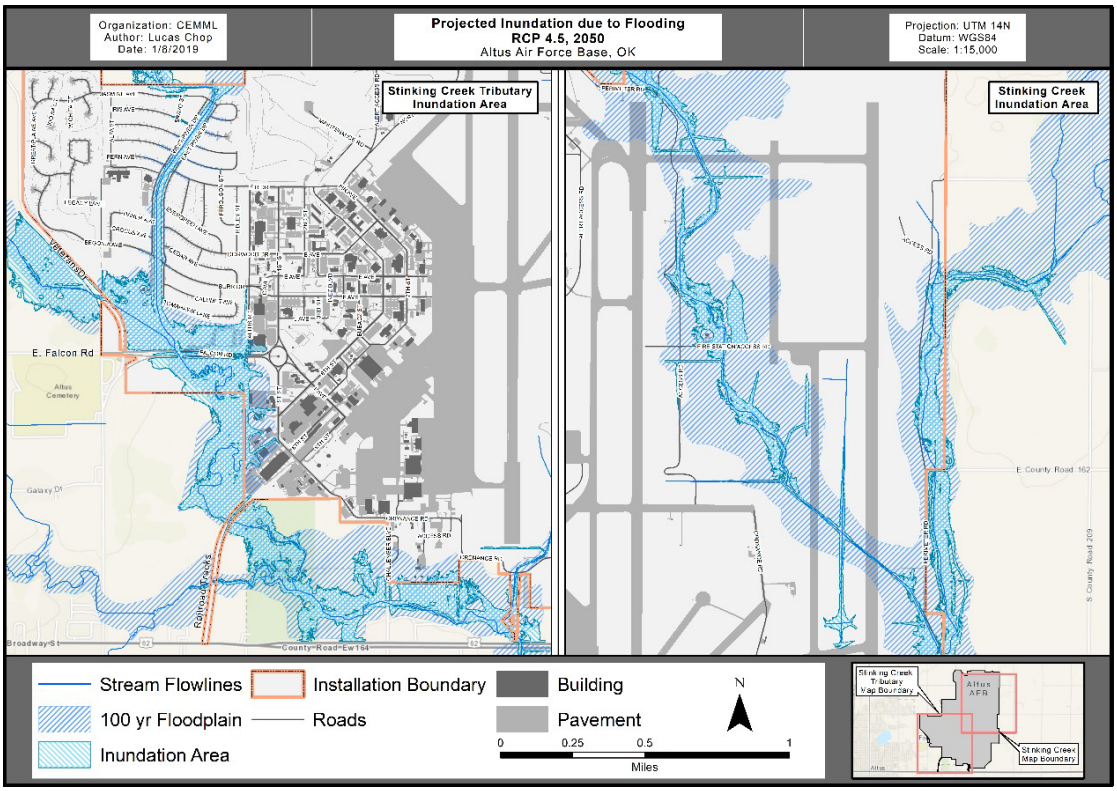

Figure G-6. Stream channel overflow for the RCP 4.5 emission scenario in 2050.

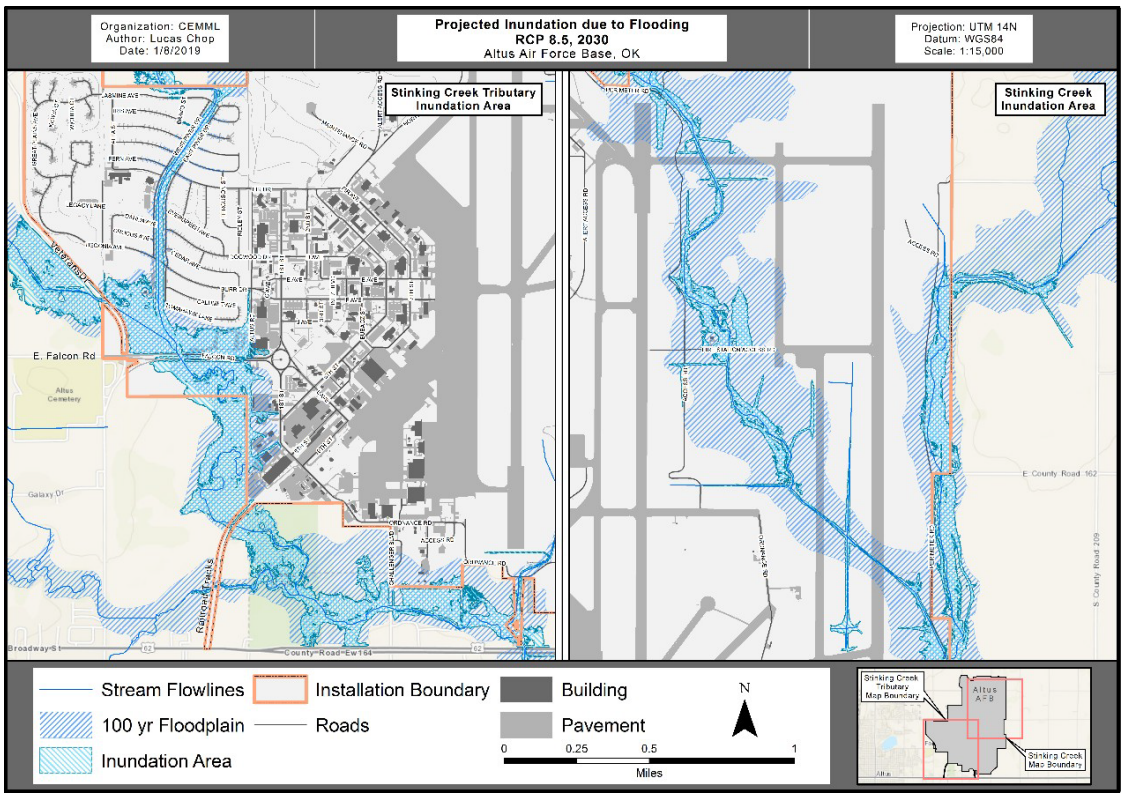

Figure G-7. Stream channel overflow for the RCP 8.5 emission scenario in 2030.

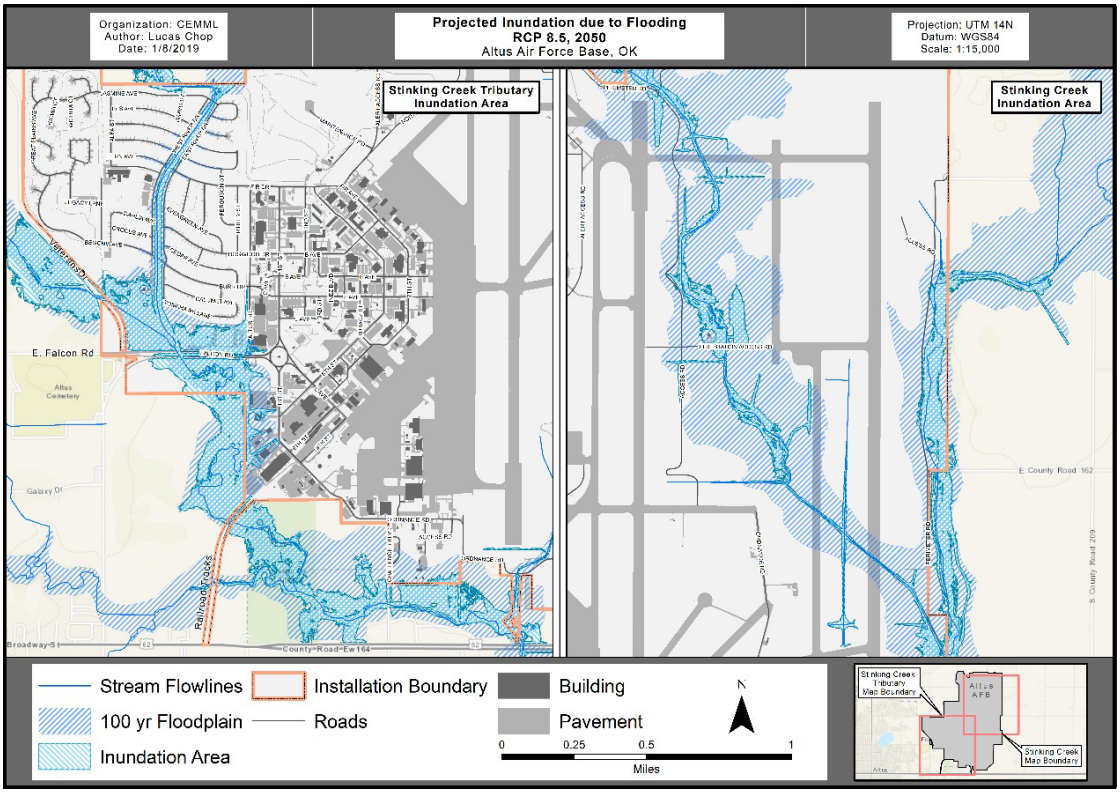

Figure G-8. Stream channel overflow for the RCP 8.5 emission scenario in 2050.

ECOSYSTEM CLASSIFICATION AND VEGETATION

ECOSYSTEM CLASSIFICATION

Three primary natural ecosystems at Altus AFB were identified for analysis: grassland prairie, floodplain or wetland, and woodland. This analysis used data from the USGS National Gap Analysis Project (GAP) Land Cover 2011 classification. Open space and developed areas have limited value as habitat for priority species, but there are significant areas at the installation, so they are included in the map (Figure H-1).

Grassland Prairie

Grasslands and other grass- and graminoid-dominated habitats occupy about 30–40 % of Earth's land surface. They cover more terrestrial area than any other single biome (Blair, Nippert, & Briggs, 2014). The calculated coverage area of this type of ecosystem is around 18.7% of total area in the installation.

Flood Plain or Wetland

These areas occur along watercourses and water bodies. Typical examples include flood plains and streambanks. They are distinctly different from surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by the presence of water (Montgomery, 1996). The calculated coverage area of this type of ecosystem is around 0.4% of total area in the installation.

Woodland

Native trees on the upland are mesquite, with elm and cottonwood in the draws or stream channels. The canopy cover in these areas depends on the maturity of the forest/woodland, with younger areas having somewhat open canopy (around 70%), and older mature forests having denser canopy coverage. These areas are part of a continuum of dry, acidic communities that contain a variety of oak and pine species (Ovaskainen et al., 2013). The coverage area of this ecosystem is around 0.3% of the total installation.

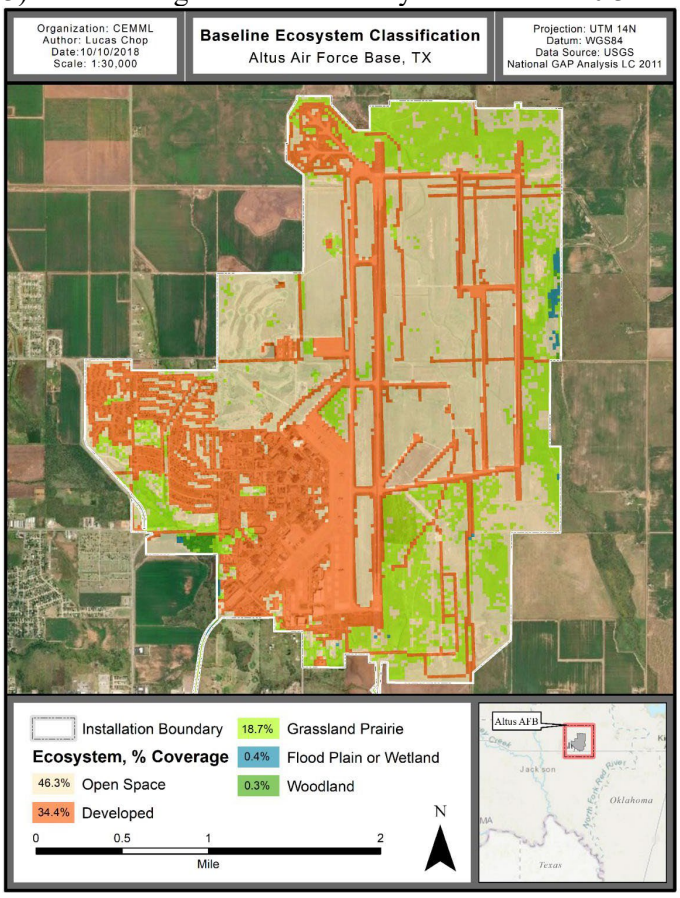

Figure H-1. Ecosystem classification.

VULNERABILITY ASSESSMENT

HCCVI Results Summary

Ecosystem vulnerability to climate change were assessed using the Habitat Climate Change Vulnerability Index (HCCVI) framework developed by Comer et.al. (2012). This index uses a two-dimension analysis of climate change sensitivity and ecological resilience for each ecosystem type distribution within a given ecoregion, using combined quantitative and qualitative approaches. The HCCVI assessment revealed that grassland and prairie ecosystems are classified as highly vulnerable under both studied scenarios. Woodland and floodplain or wetland ecosystems are classified as moderately to highly vulnerable (with low to medium confidence) under both climate scenarios (Tables H-1 and H-2).

Table H-1. Ecosystem vulnerability and level of confidence[1] for the 2030 timeframe.

Ecosystem	Low Vulnerability		Moderately Vulnerability		Highly Vulnerability	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Grassland Prairie					2	2
Flood Plain or Wetland				1	2	
Woodland				1	2	

[1] 3 = high level of confidence, 2 = moderate level of confidence, 1 = low level of confidence.

Table H-2. Ecosystem vulnerability and level of confidence[1] for the 2030 timeframe.

Ecosystem	Low Vulnerability		Moderately Vulnerability		Highly Vulnerability	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Grassland Prairie					3	3
Flood Plain or Wetland				2	2	
Woodland				2	2	

[1] 3 = high level of confidence, 2 = moderate level of confidence, 1 = low level of confidence.

ECOSYSTEM INUNDATION ANALYSIS

Projected inundation from flood modeling is shown with ecosystem coverage in Figure H-2. The 2030 decadal average shows a projected decrease in inundation across all natural ecosystems of up to 34%. Projections for the 2050 decadal average indicate increased inundation for all natural ecosystems under low emission scenarios (RCP 4.5) and a slight 5% decrease in inundation on woodland areas under high emission scenarios (RCP 8.5). Projected inundation varies between the historic baseline, RCP 4.5 2050, RCP 8.5 2030, and RCP 8.5 2050, but the change is not visually distinguishable at the scale of the map.

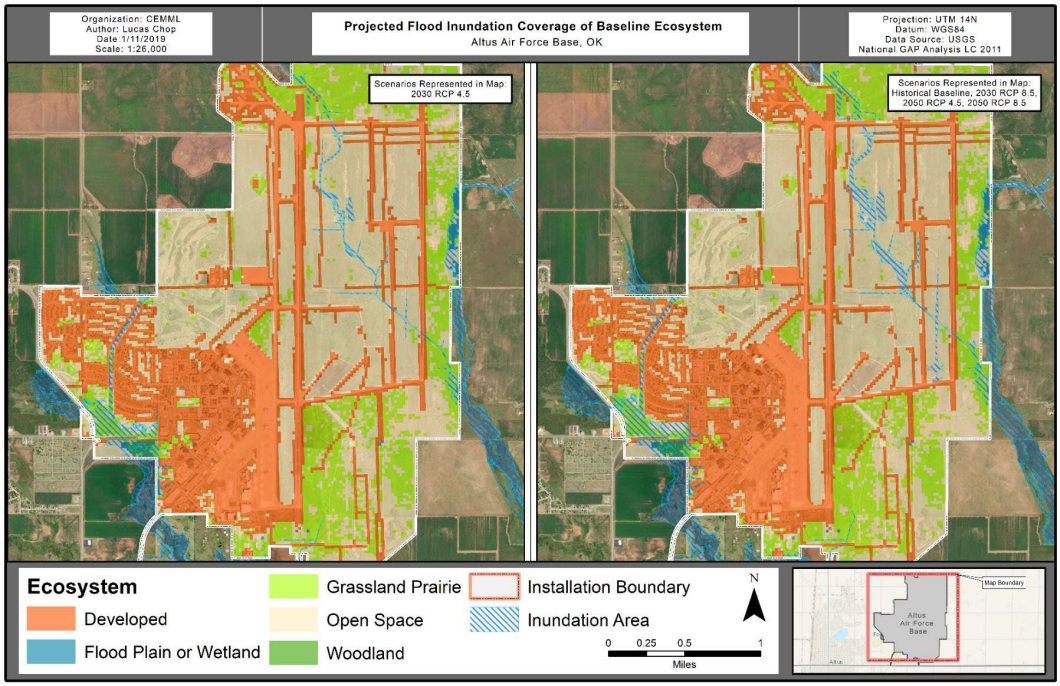

Figure H-2. Projected ecosystem inundation due to flooding.

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Appendix H. Wildlife Species Present at Altus AFB

These lists contain mammal, bird, reptile, and amphibian species confirmed present at Altus AFB, as well as fish species potentially present on the installation.
Species presence data was obtained from the following sources:

- Endangered Species Survey of Altus Air Force Base, Oklahoma (Schnell et al., 1998)
- Wildlife Hazard Management Plan for Altus AFB (Marlow, 2001)
- RCRA Facility Investigation/Investigation Analysis/Corrective Measures Study Report, Appendix I (97 CES/CEVR, 2002)
- Acoustic Survey for Northern Long-Eared Bat (Hauer and Schwab, 2017)
- Amphibian and Reptile Biodiversity on DoD Installations (Petersen, et al., 2017)
- Amphibians and Reptiles of United States Department of Defense Installations (Petersen, et al., 2018)
- Research-grade photo observations documented on iNaturalist (2019 – present)
- Sightings confirmed by the Altus AFB NRM, USDA biologist, or USFWS biologist (2021 – present)
- USFWS reptile and amphibian surveys, including acoustic frog surveys (2022)

* Denotes a state-listed Species of Greatest Conservation Need.

Mammals Confirmed Present at Altus AFB

Common Name	Scientific Name	Common Name	Scientific Name
Bats			
Pallid bat	*Antrozous pallidus*	Western small-footed myotis	*Myotis ciliolabrum*
Townsend's big-eared bat *	*Corynorhinus townsendii*	Cave myotis	*Myotis velifer*
Big brown bat	*Eptesicus fuscus*	Evening bat	*Nycticeius humeralis*
Eastern red bat	*Lasiurus borealis*	Canyon bat	Parastrellus hesperus
Hoary bat	*Lasiurus cinereus*	Tricolored bat *	*Perimyotis subflavus*
Silver-haired bat	*Lasionycteris noctivagans*	Brazilian (Mexican) free-tailed bat *	*Tadarida brasiliensis*
Rodents			
American beaver	*Castor canadensis*	White-footed mouse	*Peromyscus leucopus*
North American porcupine	*Erethizon dorsatum*	Fulvous harvest mouse	*Reithrodonomys fulvescens*
Plains pocket gopher	*Geomys bursarius*	Norway rat	*Rattus norvegicus*
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	Eastern mole	*Scalopus aquaticus*
House mouse	*Mus musculas*	Fox squirrel	*Sciurus niger*
Deer mouse	*Peromyscus maniculatus*	Hispid cotton rat	*Sigmodon hispidus*
Lagomorphs			
Black-tailed jackrabbit	*Lepus californicus*	Eastern cottontail	*Sylvilagus floridanus*
Carnivores			
Western coyote	*Canis latrans*	American badger	*Taxidea taxus*
Bobcat	*Lynx rufus*	Gray fox	*Urocyon cinereoargenteus*
Striped skunk	*Mephitis mephitis*	Red fox	*Vulpes fulva*
Raccoon	*Procyon lotor*		
Other (Marsupial, Ungulate, Xenarthra)			
Nine-banded armadillo	*Dasypus novemcinctus*	Whitetail deer	*Odocoileus virginianus*
Virginia opossum	*Didelphis virginiana*		

Amphibians Confirmed Present at Altus AFB

Common Name	Scientific Name	Common Name	Scientific Name
Blanchard's cricket frog	*Acris blanchardi*	Gray treefrog complex	*Hyla versicolor complex*

Barred tiger salamander	*Ambystoma mavortium*	Plains leopard frog	*Lithobates blairi*
Woodhouse's toad	*Anaxyrus woodhousii*	American bullfrog	*Lithobates catesbeianus*
Western narrow-mouthed toad	*Gastrophryne olivacea*	Spotted chorus frog	*Pseudacris clarkii*

Reptiles Confirmed Present at Altus AFB

Common Name	Scientific Name	Common Name	Scientific Name
Pallid spiny softshell *	*Apalone spinifera*	Western ratsnake	*Pantherophis obsoletus*
Common snapping turtle	*Chelydra serpentina*	Texas horned lizard *	*Phrynosoma cornutum*
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*	Bullsnake	*Pituophis catenifer sayi*
Western diamond-backed rattlesnake	*Crotalus atrox*	Ornate box turtle	*Terrapene ornata*
Ring-necked snake	*Diadophis punctatus*	Checkered garter snake	*Thamnophis marcianus*
Plains hognose snake	*Heterodon nasicus*	Orange-striped ribbonsnake	*Thamnophis proximus proximus*
Yellow mud turtle	*Kinosternon flavescens*	Common slider	*Trachemys scripta*
Plain-bellied watersnake	*Nerodia erythrogaster*	Red-eared slider	*Trachemys scripta elegans*
Diamondback watersnake	*Nerodia rhombifer*	Yellow-bellied slider	*Trachemys scripta scripta*

Birds Confirmed Present at Altus AFB

Common Name	*Scientific Name*	Common Name	*Scientific Name*
Birds of Prey/Raptors			
Cooper's hawk	*Accipiter cooperii*	Swainson's hawk *	*Buteo swainsoni*
Great horned owl	*Bubo virginianus*	Turkey vulture	*Cathartes aura*
Burrowing owl *	*Athene cunicularia*	Northern harrier	*Circus cyaneus*
Red-tailed hawk	*Buteo jamaicensis*	Prairie falcon *	*Falco mexicanus*
Rough-legged hawk	*Buteo lagopus*	American kestrel	*Falco sparverius*
Red-shouldered hawk	*Buteo lineatus*	Mississippi kite	*Ictinia mississippiensis*
Ferruginous hawk	*Buteo regalis*		
Doves			
Rock dove/Pigeon	*Columba livia*	White-winged dove	*Zenaida asiatica*
Eurasian collared dove	*Streptopelia decaocto*	Mourning dove	*Zenaida macroura*
Swifts, Swallows, Nightjars			
Chimney swift	*Cheatura pelagica*	Barn swallow	*Hirundo rustica*
Common nighthawk	*Chordeiles minor*	Common poorwill	*Phalaenoptilus nuttalit*
Cliff swallow	*Hirundo pyrrhonota*		
Corvids, Shrikes, Vireos			
American crow	*Corvus brachyrynchos*	Loggerhead shrike *	*Lanius ludovicianus*
Blue jay	*Cyanocitta cristata*	Bell's vireo *	*Vireo bellii*
Blackbirds			
Red-winged blackbird	*Agelaius phoeniceus*	Common grackle	*Quiscalus quiscula*
Brewer's blackbird	*Euphagus cyanocephalus*	European starling	*Sturhus vulgaris*
Baltimore oriole	*Icterus galbula*	Eastern meadowlark	*Sturnella magna*
Brown-headed cowbird	*Molothrus ater*	Western meadowlark	*Sturnella neglecta*
Great-tailed grackle	*Quiscalus mexicanus*	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Finches, Warblers, Wrens, Chickadees			
Northern cardinal	*Cardinalis cardinalis*	Indigo bunting	*Passerina cyanea*
American goldfinch	*Carduelis tristis*	Yellow warbler	*Setophaga petechia*
House finch	*Haemorhous mexicanus*	Pine siskin	*Spinus pinus*
Tufted titmouse	*Parus bicolor*	Carolina wren	*Thryomanes ludovicianus*
Blue grosbeak	*Passerina caerulea*		
Woodpeckers and Kingfishers			
Belted kingfisher	*Ceryla aicyon*	Red-bellied woodpecker	*Melanerpes carolinus*
Northern flicker	*Colaptes auratus*	Downy woodpecker	*Picoides pubescens*
Ladder-backed woodpecker	*Dryobates scalaris*		

Sparrows			
Grasshopper sparrow	*Ammodramus savannarum*	Cassin's sparrow	*Peucaea cassinii*
Lark sparrow	*Chondestes grammacus*	Eastern towhee	*Pipilo erythrophthalmus*
Horned lark	*Eremophila alpestris*	Vesper sparrow	*Pooecetes gramineus*
Dark-eyed junco	*Junco hyemalis*	Dickcissel	*Spiza americana*
Song sparrow	*Melospiza melodia*	Clay-colored sparrow	*Spizella pallida*
Lincoln's sparrow	*Melospiza lincolnii*	Field sparrow	*Spizella pusilla*
House sparrow	*Passer domesticus*	White-throated sparrow	*Zonotrichia albicollis*
Fox sparrow	*Passerella iliaca*	White-crowned sparrow	*Zonotrichia leucophrys*
Savannah sparrow	*Passerculus sandwichensis*	Harris' sparrow *	*Zonotrichia querula*
Waders/Shorebirds			
Great blue heron	*Areda herodias*	Little blue heron *	*Egretta caerulea*
Upland sandpiper *	*Bartraimia longicauda*	Wilson's snipe	*Gallinago delicata*
Cattle egret	*Bubulcus ibis*	Sandhill crane	*Grus canadensis*
Green heron	*Butorides viriscens*	Black-necked stilt	*Himantopus mexicanus*
Baird's sandpiper	*Calidris bairdii*	Yellow-crowned night heron	*Nyctanassa violacea*
Least sandpiper	*Calidris minutilla*	Sora	*Porzana carolina*
Great egret	*Casimerodius albus*	American avocet	*Recurvirostra americana*
Killdeer	*Charadrius vociferus*	Greater yellowlegs	*Tringa melanoleuca*
Tyrant Flycatchers			
Great crested flycatcher	*Myiarchus crinitus*	Eastern kingbird	*Tyrannus tyrannus*
Eastern phoebe	*Sayornis phoebe*	Western kingbird	*Tyrannus verticalis*
Scissor-tailed flycatcher	*Tyrannus forficatus*		
Thrushes			
Yellow-billed cuckoo	*Coceyzus americarus*	Brown thrasher	*Toxostoma rufum*
Greater roadrunner	*Geococcyx californianus*	American robin	*Turdus migratorius*
Northern mockingbird	*Mimus polyglottus*		
Upland Game Birds			
Northern bobwhite *	*Colinus virginianus*	Wild turkey	*Meleagris gallopavo*
Water Birds (Waterfowl, Grebes)			
Blue-winged teal	*Anas discors*	Snow goose	*Chen caerulescens*
Mallard	*Anas platyrhynchos*	American wigeon	*Mareca americana*
Redhead	*Aythya americana*	Gadwall	*Mareca strepera*
Canvasback	*Aythya valisineria*	Ruddy duck	*Oxyura jamaicensis*
Canada goose	*Brania canadensis*	Pie-billed grebe	*Podilymbus podiceps*
Bufflehead	*Bucephala albeola*	Northern shoveler	*Spatula clypeata*

Fish Species Potentially Present at Altus AFB, Oklahoma (Robertson et al., 2002).

Confirmed species data were obtained via iNaturalist observations.

Family	Scientific Name	Common Name	Confirmed Present
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar	
	Lepisosteus osseus	Longnose Gar	
	Lepisosteus platostomus	Shortnose Gar	
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad	
Cyprinidae	*Cyprinella lutrensis*	Red Shiner	X
	Cyprinella lutrensis × C. venusta	Red Shiner × Blacktail Shiner	
	Cyprinella venusta	Blacktail Shiner	
	Cyprinus carpio	European Carp	X
	Hybognathus placitus	Plains Minnow	
	Macrhybopsis australis	Prairie Chub	
	Notropis atherinoides	Emerald Shiner	
	Notropis bairdi	Red River Shiner	

	Notropis boops	Bigeye Shiner	
	Notropis buchanani	Ghost Shiner	
	Notropis shumardi	Silverband Shiner	
	Notropis stramineus	Sand Shiner	
	Phenacobius mirabilis	Suckermouth Minnow	
	Pimephales promelas	Fathead Minnow	
	Pimephales vigilax	Bullhead Minnow	
	Campostoma anomalum	Central Stoneroller	
Catostomidae	*Carpiodes carpio*	River Carpsucker	
	Ictiobus bubalus	Smallmouth Buffalo	
Ictaluridae	*Ameiurus melas*	Black Bullhead	X
	Ameiurus natalis	Yellow Bullhead	
	Ictalurus punctatus	Channel Catfish	X
	Pylodictis olivaris	Flathead Catfish	
Fundulidae	*Fundulus zebrinus*	Plains Killifish	
	Fundulus olivaceus	Blackspotted Topminnow	
	Fundulus grandis	Gulf Killifish	
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	X
Cyprinodontidae	*Cyprinodon rubrofluviatilis*	Red River Pupfish	X
Centrarchidae	*Lepomis cyanellus*	Green Sunfish	X
	Lepomis humilis	Orangespotted Sunfish	
	Lepomis cyanellus × *L. humilis*	Green Sunfish × Orangespotted Sunfish	
	Lepomis gulosus	Warmouth	
	Lepomis macrochirus	Bluegill	
	Lepomis megalotis	Longear Sunfish	X
	Lepomis microlophus	Redear Sunfish	X
	Micropterus salmoides	Largemouth Bass	
	Pomoxis nigromaculatus	Black Crappie	
	Pomoxis annularis	White Crappie	
Percidae	*Etheostoma radiosum*	Orangebelly Darter	
	Percina caprodes	Logperch	
	Percina sciera	Dusky Darter	
	Etheostoma pulchellum	Plains Orangethroat Darter	
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum	

Invertebrate Species Confirmed Present at Altus AFB

This inventory was created using research-grade iNaturalist observations, CEIE macroinvertebrate surveys, and NRM observations.

Common Name	*Scientific Name*	Common Name	*Scientific Name*
Damselfly	*Aechnidae*	Water beetle	*Hydrophillidae*
Scud	*Amphipoda*	White-lined sphynx	*Hyles lineata*
Western honey bee	*Apis mellifera*	Red-shouldered bug	*Jadera haematoloma*
North American wheel bug	*Arilus cristatus*	Differential grasshopper	*Melanoplus differentialis*
Sachem	*Atalopedes campestris*	Roundworm	*Nematoda*
Mayfly	*Baetidae*	Western spotted orbweaver	*Neoscona oaxacensis*
Mayfly	*Caeniidae*	Backswimmer	*Notonecta*
Elm sphinx	*Ceratomia amyntor*	Water beetle	*Peltodytes*
True fly	*Chironomidae*	Tan jumping spider	*Platycryptus undatus*
Seven-spotted lady beetle	*Coccinella septempunctata*	Cottonwood borer	*Plectrodera scalator*
Damselfly	*Coenagrionidae*	Question mark	*Polygonia interrogationis*
Bathroom moth fly	*Colgmia albipunctata*	Southern plains crayfish	*Procambarys simulans*
Water boatman	*Corixidae*	Black fly	*Simuliidae*
Common green june beetle	*Cotinis nitida*	Mayfly	*Siphlonuridae*
Monarch	*Danaus plexippus*	Admirable grasshopper	*Syrbula admirabilis*
Flea beetle	*Disonycha leptolineata*	Evergreen bagworm moth	*Thyridopteryx ephemeraeformis*

Predaceous diving beetle	*Dytiscidae*	Mayfly	*Tricorythodes*
Variegated fritillary	*Euptoieta claudia*	Flat worm	*Turbellaria*
Snail	*Gastropoda*		