Integrated Natural Resources Management Plan

Camp Bowie
Brownwood, Texas
Brown County

2020

View from hilltop on Camp Bowie

Prepared by:

CFMO Environmental Branch
2200 West 35th Street
Austin, Texas 78703

National Guard Bureau Signature Page

This updated Integrated Natural Resources Management Plan (INRMP) meets the requirements for INRMPs listed in the Sikes Act (16 USC 670a et seq.), Army Regulation 200-1, and Department of Defense Instruction 4715.03. It has set appropriate and adequate guidelines for conserving and protecting the natural resources of Camp Bowie.

_____ _____

Anthony Hammett
Col, EN
Chief, ARNG G9

Date

Texas ARNG Signature Page

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_____ _____
Date

Adjutant General
Texas Military Department

_____ _____
Date

Director of Facilities
Texas Military Department

_____ _____
Date

Base Operations Manager,
Training Centers Garrison Command
Texas Military Department

_____ _____
Date

Base Operations Supervisor, Camp Bowie
Texas Military Department

_____ _____
Date

Environmental Program Manager
Texas Military Department

_____ _____
Date

Natural Resources Manager
Texas Military Department

Wildlife Agencies Signature Page

The U.S. Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) are both cooperating agencies in the development of INRMPs in Texas. An INRMP is not considered finalized until both agencies mutually agree to their respective components and it is signed by Army National Guard Directorate. The signatures below indicate the mutual agreement of each agency to the revised INRMP for Camp Bowie.

_____ _____

Date

Regional Director, Southwest Region
U.S. Fish and Wildlife Service

_____ _____

Date

Executive Director
Texas Parks and Wildlife Department

Annual Review and Coordination Page

This page provides for signatures and documentation of annual review and coordination for

Camp Bowie INRMP.

For Annual Review conducted on _____, 20____.

_____ _____

Training Center Garrison Commander
Texas Military Forces

Date

_____ _____

Construction and Facilities Maintenance Officer
Texas Military Forces

Date

_____ _____

Environmental Program Manager
Texas Military Forces

Date

_____ _____

Natural Resources Program Manager
Texas Military Forces

Date

_____ _____

Sikes Act Coordinator
U.S. Fish and Wildlife Service

Date

_____ _____

Sikes Act Coordinator
Texas Parks and Wildlife Department

Date

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Executive Summary

Camp Bowie is an 8,932-acre training center for the Texas Military Department (TMD) located in west central Texas approximately 2.5 hours northwest of Austin. Camp Bowie is owned by the TMD (5,018 acres) and by the U.S. Army Corps of Engineers (USACE; 3,914 acres). Camp Bowie is used primarily for military training activities by the Texas Air and Army National Guard, ranging from billeting and small arms ranges to drop zones and heavy maneuver training. The majority of training activities are related to infantry training by the Texas Army National Guard.

The purpose of this revised Integrated Natural Resources Management Plan (INRMP) is to support military training by guiding natural resources and land management at Camp Bowie. The need for this INRMP is derived from the Sikes Act (16 USC 670a et seq.) and Army Regulation (AR) 200-1. This INRMP supports military training by identifying ways to support the sustainability of the training site and to provide information that facilitates those activities.

The INRMP goals are to support the TMD's mission of assisting with the compliance of relevant laws and regulations, support and enhance sustainability of TMD lands, and increase environmental awareness and training of soldiers, staff, and public. The objectives to meet these overall program goals include reviewing the INRMP annually, specifically the goals, objectives, targets, and projects with trainers, facility managers, and other agency personnel, USFWS, TXPWD, and ARNG G9; revising the INRMP as needed or every five years (whichever is sooner); reducing the number of critical natural resource issues; and improving integration of natural resources data and guidelines with TMD planning. The mechanism for accomplishing these goals and objectives is identifying specific management areas and establishing specific goals and objectives for each of those areas and then implementing this plan.

The overall program goals for the INRMP are to support the TMD mission, assist the TMD in complying with relevant laws and regulations, support and enhance sustainability of TMD lands, and increase environmental awareness and training of soldiers, staff, and public. The objectives to meet these overall program goals include reviewing the INRMP annually, specifically the goals, objectives, targets, and projects with trainers, facility managers, and other agency personnel; revising the INRMP as needed or every 5 years (whichever is sooner); reducing the number of critical natural resource issues; and improving integration of natural resources data and guidelines with TMD planning. The mechanism for accomplishing these goals and objectives is identifying specific management areas and establishing specific goals and objectives for each of those areas and then implementing this plan.

The INRMP identifies the military mission and its effects on natural resources and vice versa.It identifies resources and programs requiring natural resources management. The plan sets goals, objectives, and targets for that management and provides guidelines for natural resources and land management to maintain biodiversity and sustainability of Camp Bowie with no net loss to the training mission. Furthermore, it describes the physical and biological conditions present at Camp Bowie and provides an avenue for public involvement and coordination and cooperation with other agencies.

Chapter 1. Program Overview

1.1 Overall Natural Resources Program

1.1.1 Desired Future Condition

The desired future condition for the Camp Bowie Natural Resources Program is an effective, robust program based on scientific principles and sound data that assists with land management planning and implementation and supports Master Planning for the installation for the long-term benefit and use of military training by integrating with the Integrated Training Area Management (ITAM) Program and other Facilities Maintenance functions.

1.1.2 Program Goals and Objectives

The overall program goals for natural resources management on TMD property are:

Goal 1: Support TMD mission
See all sections.

Goal 2: Assist TMD in complying with relevant laws and regulations
Obj 1: Review the INRMP annually, specifically goals, objectives, targets, and projects with trainers, facility managers, and other agency personnel.
Obj 2: Review the INRMP at least every 5 years for operation and effects and revise as needed

Goal 3: Support and enhance sustainability of TMD lands
Obj 3: Reduce number of critical natural resource issues.
Target: See all sections.
Obj 4: Improve integration of natural resources data and guidelines with TMD planning.
Target: Use Record of Envrionmental Consideration (REC) process to minimize impacts and improve integration.

Goal 4: Increase environmental awareness and training of soldiers, staff, and public
See Section 3.2.

Additional goals and objectives that are specific to different areas of natural resources management but that support these overall goals and objectives are listed in Appendix F.

1.2 Design of INRMP

1.2.1 Definitions of Key Terms

- Goal – broad summary of long-term intention
- Objective – specific item to be achieved that supports one or more Goals
- Target – measurable outcome with deadline to achieve Objective
- Project – specific activity derived from Targets; often a "project" is a "contract"; a "target" is sometimes a "project" as well

1.2.2 Plan Organization

This INRMP consists of 4 chapters and several appendices:

Chapter 1 provides an overview of the INRMP, including the overall goals and objectives, responsibilities, and compliance requirements.

Chapter 2 provides an overview of the current conditions and current use of the training site as well as a summary of projected changes.

Chapter 3 reviews each area of natural resource management and provides an overview of that program as

well as identifying the goals, objectives, and targets associated with it.

Chapter 4 provides an overview of the implementation of the INRMP, including staffing, strategies, funding.

Appendices provide the supporting documentation in detail for readers interested in how the information presented in Chapters 1-4 was developed. Acronyms, Glossary, and Regulations are presented in Appendices A, B, and C, respectively. Standard Operating Procedures (SOPs) and Best Management Practices (BMPs) related to policy and programs are presented in Appendix D. The Environmental Assessment (EA) required to comply with National Environmental Policy Act (NEPA) requirements and the current REC are presented in Appendix E. The summary goals, objectives, and targets table and a summary of Fiscal Year (FY)18-22 targets dates are found in Appendix F. A natural resources summary is presented in Appendix G. Complete species lists are presented in Appendix H. A complete summary of all reports generated from natural resources projects are presented in Appendix I. The complete written correspondence between TMD and other agencies during review of this INRMP are presented in Appendix J. A sample Prescribed Fire Plan is in Appendix K. Species summaries for priority invasive species management are in Appendix L. Species summaries for priority rare species management are in Appendix M.

1.2.3 Updating the INRMP

The INRMP is reviewed annually (see Chapter 4), and adjustments to the targets and project list are made accordingly. The INRMP is based on adaptive management, which requires regular and continual review of projects to verify they are meeting the targets summarized in Appendix F. Adjustments are made on a regular basis to continue moving toward those targets and objectives. Major revisions are made when substantial changes in natural resource management are needed, whether that is due to changes in mission, land condition, regulations, or another reason. This process follows the Environmental Management System (eMS) process – "Plan, Do, Check, and Act." "Plan" consists of the development of this INRMP and the activities of the Land Management Working Group (LMWG). "Do" consists of accomplishing the targets and projects laid out in the INRMP. "Check" consists of analyzing the data from monitoring programs and from annual reviews with trainers, facility managers, the U.S. Fish and Wildlife Service (USFWS), and the Texas Parks and Wildlife Department (TPWD). "Act" consists of updating the targets and projects and revising SOPs and BMPs as necessary.

This update of the INRMP is considered an update from the previous INRMP and required a complete review and NEPA process review. The revisions include the addition of goals and objectives, military transformation, new environmental review processes, organizational restructuring, changes in Army funding policy, and substantial increases in baseline information. This INRMP will undergo Annual Review by required parties (see Annual Review and Coordination Page) as well as a 5-year formal review to determine the need for revision.

The 5-year review consists of a formal review for operation and effect with the TMD, the USFWS, the TPWD, and the Army National Guard Installations and Environment Office (ARNG G9), with a resulting determination to continue with the existing INRMP, update the existing INRMP, or revise the existing INRMP.

The targets will be updated annually to reflect completed projects and new information, based on Annual Review by the trainers, the USFWS, and the TPWD (see Section 4.3). Every 5 years during the Annual Review, the INRMP will be reviewed for operational effect, and a determination will be made whether a major update is required per the Sikes Act, Sikes Act Improvement Act (SAIA), and associated Department of Defense (DoD) Policy.

1.3 Regulations and Policies

There are numerous regulations and policies that impact the development and implementation of the INRMP. Listed below are the key ones that shape this INRMP. Appendix C contains a complete list of environmental regulations and their purpose and applicability to the INRMP.

1.3.1 Sikes Act and Sikes Act Improvement Act

The Sikes Act and Sikes Act Improvement Act (SAIA) require development and implementation of an INRMP for appropriate DoD installations in cooperation with the USFWS and the state wildlife agency, TPWD. The Sikes Act requires that several elements be included in the plan, including goals and objectives, so the final result is no net loss of land to military training. The Sikes Act also requires an opportunity for public comment and annual reviews and reports of the implementation.

1.3.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the impact to the environment of any action. NEPA also requires public notification and public comment on the action under certain circumstances. This INRMP is accompanied by an EA and associated REC that can be found in Appendix E.

1.3.3 Endangered Species Act (ESA)

INRMP development and implementation are coordinated with the USFWS to satisfy Sikes Act requirements. Additionally, management of listed endangered and threatened species is discussed in Chapter 3, Section 3.11.

1.3.4 Army Regulation (AR) 200-1

AR 200-1 covers natural resources management. Army regulations guide environmental programs at Army installations including Army National Guard installations. Regulations cover water resources, land resources, endangered species, cultural resources, pollution prevention, and various other environmental programs.

1.4 Responsibilities

1.4.1 Installation Organizations

1.4.1.1 The Adjutant General (TAG)

TAG is the head of the TMD, which consists of the federal entities of the TXARNG and Texas Air National Guard (TXANG), as well as the state entities of the Texas State Guard (TXSG) and the Office of the Executive Director (OED). TAG has the ultimate responsibility for operating and maintaining TMD facilities, including Camp Bowie, and implementing the INRMP. In this capacity, TAG's responsibilities per AR 200-1 include the following:

- Ensure Base Support activities support military training in a manner conducive to environmental stewardship
- Ensure environmental requirements are identified and incorporated into the Master Plan and Range Complex Master Plan (RCMP)
- Ensure the Strategic Planning Office incorporates sustainability principles into management plans
- Implement and maintain a mission-focused eMS
- Ensure regular meetings of the Environmental Quality Control Committee (EQCC)
- Designate personnel responsible for major program requirements
- Ensure sufficient numbers of professionally trained Natural Resource personnel

- Hold tenants accountable

1.4.1.2 Deputy Adjutant General for the Army (DAG-A)

The DAG-A serves as chairman of both the EQCC and the Real Property Planning Board (RPPB). The EQCC provides overall guidance and policy direction to the Environmental Program. The RPPB provides overall guidance and project prioritization for land use and real property planning. As a result of chairing both committees, the DAG-A has substantial oversight and responsibilities for ensuring that environmental considerations are incorporated at all levels of policy and project planning. While both boards are chaired by the DAG-A, there is Air National Guard representation on these boards. The DAG-A is also the direct supervisor of the Construction and Facilities Maintenance Office (CFMO) (see Section 1.4.1.6).

1.4.1.3 Operations and Training (G3/5)

G3/5 has primary responsibility for scheduling military training and ensuring the safety of all personnel while training is being conducted. G3/5 determines the training load at Camp Boiwe based upon the force structure determined by the TAG, including developing a baseline of current and projected training requirements and facilities as well as planning for land use based on mission requirements while minimizing negative environmental effects. G3/5 is also responsible for allocating funds for and coordinating the ITAM Program through the Training Center Garrison Commander.

1.4.1.4 Training Center Garrison Command (TCGC)

TCGC and associated personnel are in charge of operations and maintenance of all training sites. TCGC personnel are key implementers of this INRMP. TCGC has direct oversight of the Range and Training Land Program (RTLP), the ITAM Program, and the ITAM Coordinator. The ITAM Program is responsible for some components of ecological restoration, erosion control, monitoring, and awareness. For more on the role of the ITAM Coordinator and Program, refer to Sections 1.5.1 and 4.2. TCGC also has direct oversight of the Training Site Manager for Camp Bowie.

1.4.1.5 Base Operations Supervisor (Training Center Manager)

The Base Operations Supervisor of Camp Bowie schedules training and other activities on site as well as supervises the day-to-day maintenance and repairs of facilities and training lands. The supervisor is also responsible for identifying and reporting impediments to training, ensuring that SOPs and BMPs are followed, protecting sensitive resources, and distributing Environmental Awareness materials to units and other users.

1.4.1.6 Director of Facilities and Construction and Facilities Maintenance (CFMO)

The CFMO provides a full range of facility planning, facility management, financial, and engineering disciplines for all TMD facilities. The CFMO is responsible for Master Planning, construction projects, and facility repair and maintenance funds. In conjunction with these roles, the CFMO is responsible for ensuring that all construction, repair, and maintenance projects comply with Environmental regulations and consult with Environmental prior to any construction projects. Repair and maintenance funds and projects are essential to the full implementation of this INRMP. The CFMO is also the Executive Secretary of the RPPB as well as a member of the RPPB (see Section 1.5.2).

1.4.1.7 Environmental Management Branch (Env Branch)

The Environmental Branch is organized within the CFMO and is responsible for supporting and ensuring compliance and conservation requirements, for all TXARNG facilities and training lands, comply with municipal, state and federal laws. The Env Branch has direct oversight of Natural Resources, Cultural Resources, Hazardous Material Compliance, RCRA, GIS, Training, Pest Management, JLUS, ACUB, eMS, and Stormwater/Clean Air/ Clean Water Programs. The organization also provides technical assistance to Facilities Maintenance and planning personnel by developing projects; securing permits;

conducting field studies; providing Environmental Awareness materials; GIS mapping and monitoring natural and cultural areas; preparing and revising various plans; and providing oversight of the NEPA process. The Env Branch facilitates cooperation on environmental issues between military operations and other government agencies at the local, state, and federal levels.

Public Affairs Officer (PAO)

The PAO serves as the liaison with the public in public meetings, prepares press releases, and generally interacts with various neighbor and community groups.

1.4.1.8 Texas Military Department (TMD)

The TMD is the state of Texas landowner of Camp Bowie on behalf of the Adjutant General of Texas. The CFMO provides facility management, primarily repair and maintenance of buildings and real property actions, for TMD property. The TMD properties are maintained with a combination of state and federal funds (see Section 1.4.1.4).

1.4.2 Army National Guard Directorate

The Army National Guard Directorate (ARNG-D), a federal component of the National Guard Bureau (NGB), is the federal agency responsible for providing Army funds for facility and land management to the 54 state ARNGs. Installations and Environment (I&E) is the responsible office within ARNG-D for ensuring requirements of the Sikes Act are implemented. ARNG G9 reviews the INRMP and other plans, reviews and approves NEPA documents, reviews and approves environmental funding requests, and provides technical expertise and reporting tools. ARNG G9 coordinates and reviews proposed construction projects, reviews installation and engineering funding requests, and provides design and construction support through the CFMO. ARNG-D Training (TRS) coordinates the ITAM Program with other training support requirements, reviews and approves the ITAM work plan, and provides technical expertise.

1.4.3 U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department (TPWD)

The U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD) are cooperators in the development of and must mutually agree to the INRMP. In this capacity, the USFWS has the responsibility to review and comment on drafts of the INRMP. In their role during Section 7 consultations for the ESA, the USFWS has the responsibility to ensure no taking of threatened or endangered species or to issue biological opinions and permits, if applicable. In their roles as cooperators per the Sikes Act, USFWS and TPWD have the responsibility to provide input to the goals, objectives, and targets for the INRMP and either provide a signature or a letter of mutual agreement on the final INRMP. TPWD Game Wardens also assist with natural resources law enforcement when necessary. In addition, the USFWS and TPWD participate in an annual review of the INRMP and implementation progress and a formal 5-year review process to determine if the INRMP needs update.

1.4.4 Native American Tribes and Texas Historic Commission (THC)

Federally recognized tribes with historic interests in Camp Bowie are provided an opportunity to comment on the INRMP per DoD American Indian and Alaska Native Policy (27 October 1999). Their comments can provide useful information and identify projects not recognized by other stakeholders. The THC is also given an opportunity to comment on the INRMP via the Section 106 process of the National Historic Preservation Act. The THC is the State Historic Preservation Office (SHPO) for Texas. In addition to reviewing plans, TMD collaborates with interested tribes on various activities to achieve the goals identified in this INRMP. For example, TMD can include tribal participation in deer harvesting and brush management to achieve specific targets.

1.5 Integration with Other Programs

1.5.1 Sustainable Range Program

The Sustainable Range Program (SRP) is the Army's overall approach for improving the way in which it designs, manages, and uses its ranges to ensure long-term sustainability. Its core programs, the Range and Training Land Program RTLP and the Integrated Training Area Management ITAM Program, define the SRP. The RTLP integrates mission support, environmental stewardship, and economic feasibility and defines procedures for determining range projects and training land requirements to support live-fire and maneuver training. The ITAM is responsible for maintaining training land to help the Army meet its training requirements. The RTLP and ITAM Program are core programs managed by the TCGC. In addition, the RCMP is compiled by the TCGC as part of the SRP. The Range Complex Master Plan, RCMP, provides an overview of available assets, identifies users, and establishes training capabilities. The RCMP also provides short- and long-term project plans related to training assets.

The TCGC ITAM Program is completely integrated with the Natural Resources Program, and personnel from both organizations work together as the "Land Management Team." The ITAM Coordinator is involved in every step of the development of the INRMP and is a key player in project implementation. The ITAM Program consists of Land Rehabilitation and Maintenance (LRAM), Range and Training Land Assessment (RTLA), and Sustainable Range Awareness (SRA). LRAM is incorporated in the INRMP in the sections on erosion and sediment control (Section 3.4), fire management (Section 3.5), invasive species management (Section 3.6), and vegetation management (Section 3.8). RTLA is incorporated in the section on monitoring (Section 3.3). SRA is incorporated in the section on awareness (Section 3.2).

1.5.2 Real Property Planning Board and Master Planning

The RPPB is the primary means by which land use planning occurs in the TMD. It is chaired by the DAG-A, and it is organized by the CFMO. This board reviews projects from various proponents, prioritizes projects, and approves land use actions. The RPPB takes recommendations from 4 working groups, with 2 groups being critical to land management. The Range Utilization Board is a key group related to the development and oversight of implementation of the RCMP (see Section 1.5.1).

1.5.3 Other Environmental Programs

Natural Resources personnel coordinate daily with personnel from other Environmental Programs, including Cultural Resources, Clean Air, Clean Water, Hazardous Waste, and NEPA. The development of the INRMP involves input from both Natural and Cultural Resources Programs. Any natural resources actions that may affect cultural resources are coordinated through the Cultural Resources Manager and follow the ICRMP

1.5.4 Neighbors/Regional Plans by Others

Interaction with neighbors and regional land use planning efforts is done by a variety of personnel, including staff in Environmental, TCGC, CFMO, PAO, and the Command Group. Natural Resources personnel assist when appropriate and participate in regional natural resources efforts. Natural Resources personnel also will continue to provide input to the regional or statewide plans of other organizations, such as the TPWD and the Nature Conservancy.

1.5.5 Other Agencies, Non-Governmental Organizations (NGOs), and the Public

When appropriate, Natural Resources personnel are involved with other organizations, such as Texas A&M Forest Service (TFS) and TPWD, in efforts to monitor and control invasive species, manage forests, and conduct ecological restoration. During the public comment period, drafts of this INRMP are sent to non-governmental organizations (NGOs), university staff, agricultural extension services, and other known interested parties. Additionally, the drafts are made available for comment from the public in neighboring libraries, at the training site, and at the headquarters at Camp Mabry in Austin, Texas.

Chapter 2. Current Conditions and Use

2.1 Site Description

2.1.1 Location, Map, Acreage, and Boundary

Camp Bowie is an 8,753-acre (3,452-ha) TXARNG training site located in Brown County, near the City of Brownwood. A Map of Camp Bowie is provided in Figure 2-1.

2.1.2 Facilities, Ranges, and Infrastructure

Camp Bowie is composed of both state and federal land. The northern 4,895 acres (1,981 ha) are state owned by the Texas Military Department (TMD) for primary use by the TMD. The southern 3,858 acres (1,602 ha) are federally owned by the USACE and licensed to the TXARNG for use as a training center (Figure 2-1). Approximately 34 acres (14 ha) consist of improved grounds associated with buildings, 190 acres (77 ha) consist of range infrastructure (firing points, towers, and targets), and the remaining 8,529 acres (3,452 ha) consist of primarily unimproved grounds. See Table 2-1 for a complete list of support and training facilities available through the seven training areas (TAs) at Camp Bowie (Figure 2-2). Bivouac sites occur in various locations throughout Camp Bowie.

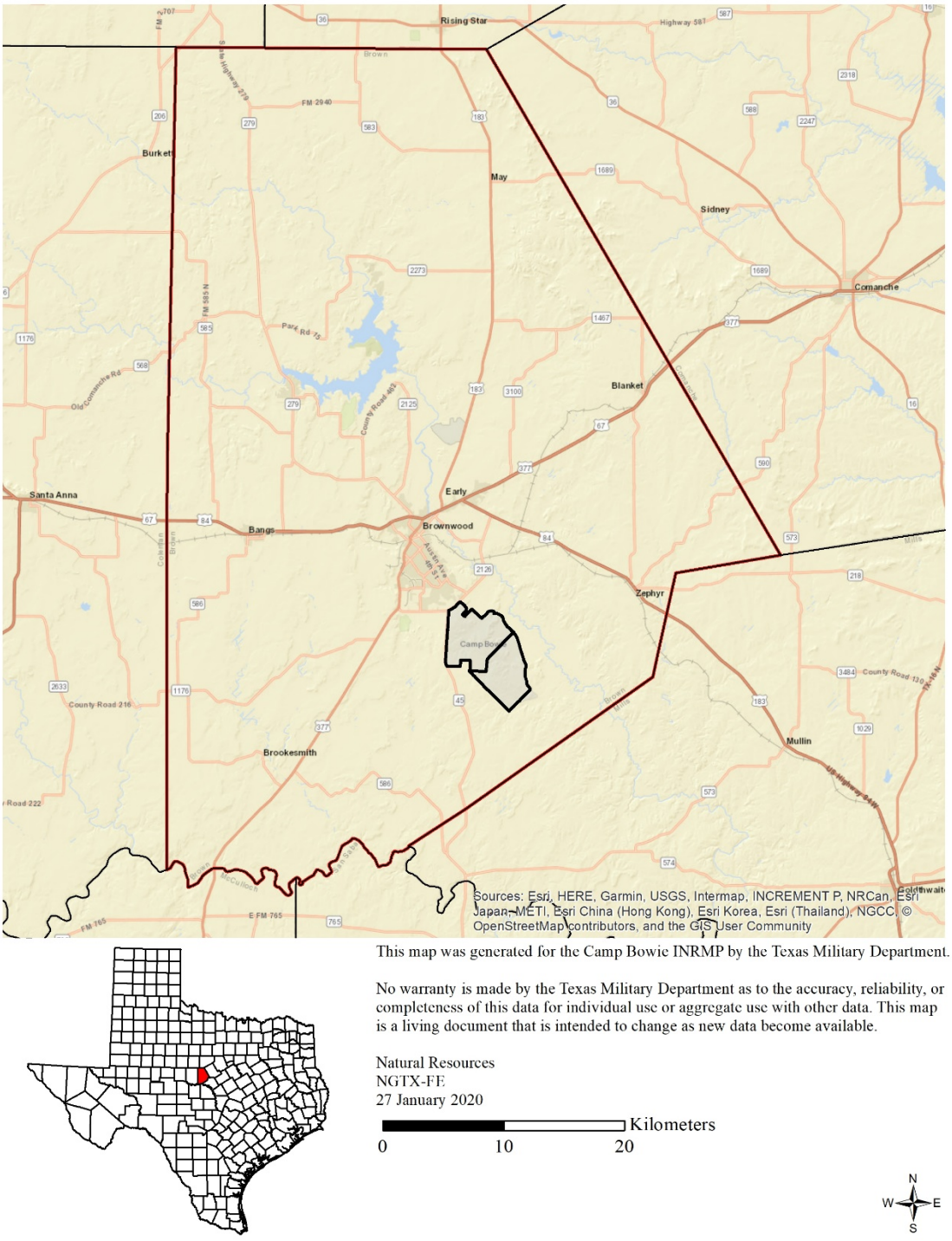
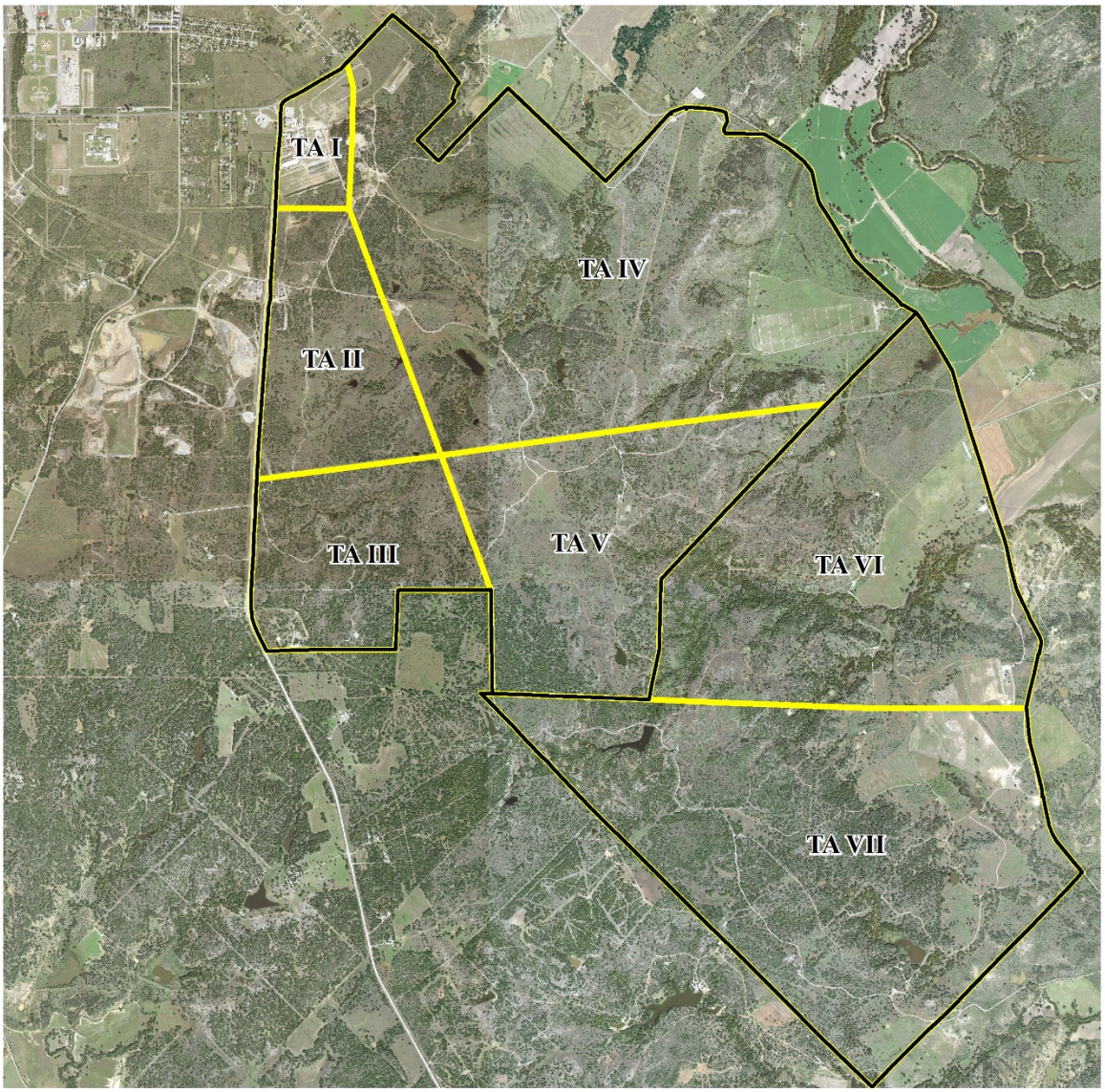


Figure 2-1. Map of Location of Camp Bowie

Support Facilities	TA	Live Fire Training Facilities	TA	Non-Live Fire Training Facilities	TA
Headquarters Building	I	Multi-Use Range	IV	Tank Weapons Gunnery Simulation	I
Billets for 774 People	I	Combat Pistol Qualification Course	VI	HMMWV Egress Assistance Trainer (HEAT)	I
Dining Facility	I	Grenade Launcher M203 Range	VI	Engagement Skills Trainer 2000	I
Office Building (2)	I	Modified Record Fire Range	VI	Firearms Training System	I
Armory (classrooms, office)	I	10/25M Zero Rifle Range	VI	JANUS Battle Suite (Battalion)	I
State Maintenance Shop	I	Automated Multipurpose Machine Gun Range	VII	Nuclear/Biological/ Chemical Chamber	I
Classroom & Warehouse Building	I			Hand Grenade Qualification Course	I
Unit Training Equipment Site Facility	I			Military Operations in Urban Terrain Site	III/VI
Wash Rack	I			Equipment Drop Zone (2)	IV/V
Weather Station (portable)	I			Personnel and Equipment Drop Zone	VII
Laundry Facility	I			Land Navigation Course	VII
Musgrave Facility (planned)	VII			Bivouac Site (5)	IV/V/VII

Table 2-1. Summary of Support and Training Facilities Present at Camp Bowie



This map was generated for the Camp Bowie INRMP by the Texas Military Department.

No warranty is made by the Texas Military Department as to the accuracy, reliability, or completeness of this data for individual use or aggregate use with other data. This map is a living document that is intended to change as new data become available.

Natural Resources
NGTX-FE
27 January 2020

Meters
0 2,500 5,000

Boundary
Training Areas

N
W E
S

Figure 2-2. Map of Camp Bowie Training Areas

2.2 Mission and Natural Resources

2.2.1 Mission Aspects and Impacts to Natural Resources

In general, physical impacts to natural resources can be minimized by limiting total use, redistributing use, modifying types of use, altering behavior of use, and/or manipulating the natural resources for increased durability. Modifying types of use and altering behavior of use are addressed throughout Chapter 3, particularly with regards to development of SOPs and BMPs and identifying new ways to accomplish tasks, particularly in facility managemen.t The manipulation of natural resources to increase durability and resilience is addressed throughout Chapter 3, particularly in Sections 3.4 and 3.8.

Some key actions that can minimize impacts generally include avoiding repeated and unnecessary activity on wet soils, avoiding soil disturbance early in the non-growing season, which results in higher risk of erosion, using equipment appropriate for the task, minimizing damage to woody plants, and siting activities appropriate to the soil (e.g. digging activities on deep, productive, low erodibility soils).

Another key action is redistribution of use, which does not change the total amount of use or the types of land uses but reduces overutilization of some areas and underutilization of others. Section 3.1 identifies targets required to determine areas of over- and underutilization and to determine actions needed to rectify any imbalances in use.

2.2.1.1 Facilities Maintenance

The first aspect of the mission that affects natural resources is the indirect avenue of Facilities Maintenance to support military training. Facilities Maintenance includes land management, such as grounds maintenance, road maintenance, pest management, brush management, fire management, and other related items as discussed in Chapter 3. The majority of negative impacts of these activities occur in the form of soil compaction, erosion and sediment loss, and changes to vegetation structure and related wildlife. Facilities Managment as identified in this INRMP also has many positive impacts as discussed in Chapter 3. These include building maintenance and other related activities that usually have minimal impacts on natural resources once the buildings are constructed.

The REC process captures potential impacts from Facilities Maintenance activities (see Section 1.5.3).

2.2.1.2 Military Training

The second aspect is military training itself, which can result in intensive land use. Overuse of training areas can result in loss of vegetative cover, rutting, soil compaction, and erosion, especially in these regions. Military training often requires clearing and maintaining areas for landing zones, drop zones, bivouacs, and ranges. Wildfire risks are possible from live fire exercises, which can lead to habitat loss and soil disturbance during wildland fire operations (firebreak construction, heavy vehicle traffic). The majority of impacts from these activities occur in the form of soil compaction, erosion and sediment loss, and in changes in vegetation structure and related wildlife.

Military activities during periods of high soil moisture significantly increase the likelihood of damage, particularly from soil compaction. In the past, many trails were constructed with little regard to location, long-term stability, soil type, or erosion control. Once a trail was created, other vehicles often followed. This scenario eventually leads to a random network of trails, often in unsuitable locations, that lead to expanding and expensive erosion problems easily observed in aerial imagery. Section 3.3 in Appendix F identifies targets required to determine unsuitable areas for roads and trails and the actions needed to minimize future..

2.2.2 Natural Resources Management Aspects and Impacts to Mission

The three aspects of natural resources management that impact the military mission are vegetation

management (Section 3.8, including fire management Section 3.5), erosion and sediment control (Section 3.4), and invasive animal management (Section 3.6). Vegetation management opens the understory and reduces canopy cover that facilitates most forms of training and can reduce vegetation loss due to soil compaction and erosion. Erosion and sediment control prevents area closures, and it stabilizes and restores already disturbed areas, which eventually reopens them to training. Invasive animal management reduces safety risks to soldiers by reducing their exposure to wild pigs and fire ants. Overall, this INRMP will provide for sustainable land management that will ultimately prevent limitations to training use of the facility, in addition to the specific projects that directly impact training use.

2.3 Regional Land Use

Land use surrounding Camp Bowie has historically been primarily agricultural, including farming and livestock grazing. While agricultural activities, particularly grazing, still occur in the area around Camp Bowie, it has been declining since the 1930s, although some cultivation activities still occur on neighboring properties. Nonagricultural surrounding properties include the Camp Bowie Industrial Park (including product and service companies) to the northwest and the City of Brownwood landfill and recycling facility 1/2 mile to the southwest. There are residences associated with agricultural activities surrounding Camp Bowie and an increasing number of residences in rural subdivisions to the north and northwest.

2.4 Site History

Camp Bowie, named in honor of Texas patriot James Bowie, was established in 1940 as an infantry and artillery-training center for the 36th Infantry Division of the Texas National Guard. It was the first major World War II defense construction project in Texas. By October 1942, Camp Bowie had expanded from its original 2,000 acres (809 ha) to a total of 123,000 acres (49,776 ha). In 1943, an Italian and German POW camp was established. The mission of the installation was initially for infantry training but shifted to armor and artillery training within the first year. Camp Bowie was declared surplus by a War Department Order effective August 31, 1946, and much of the facility's lands were sold or transferred. The remaining 5,410 acres (2,189 ha) were retained and placed under the federal control of the TXARNG in 1947. The property was later deeded to the state and 516 acres (209 ha) were sold. The additional 3,858 acres (1,561 ha) were purchased federally in 1994 for an extension of a range safety and additional tank maneuver areas. Most of the improvements constructed during the original development have been demolished. See ICRMP for a more complete site history, existing cultural resources, and historic aerial images.

2.5 Physical Setting

Camp Bowie sits in in a transitional area between rolling hills and the Osage Plains. The property lies on Triassic, Permian, and Pennsylvanian Permian and Triasic aged rocks that are overlain by Cretaceous Limestones that dip gently to the east and form the higher elevations on the site.

The soils in the upland areas consist of sandy loams with limestone and sandstone underneath or as clay loams with limestone underneath. The soils in the low-lying areas consist of clay-rich shales. These areas also contain the remnants of former streambeds and riverbeds. There are 3 major soils on Camp Bowie: Bolar-Brackett, Frio-Sunev-Winters and Leeray-Sagerton-Nukrum, with Bolar-Brackett soils present at higher elevations and accounting for 70% of the land area. Camp Bowie soils are mostly potentially highly erodible with some not highly erodible soils in floodplains and some locations with highly erodible soils, with K Factors ranging between 0.10 and 0.37. The terrain ranges from flat uplands to steep ridges to low-lying flood-prone areas with elevations from 1,270 to 1,595 feet above sea level.

There are 4 major watersheds present on Camp Bowie that all drain into Pecan Bayou and, ultimately, the

Colorado River. There are approximately 2 acres (1 ha) of wetlands across 3 sites and approximately 49 acres (20 ha) of open water across 87 ponds. All the open water sites are man-made, and most dry out in the summer. There are approximately 48.4 miles (78 km) of streams and tributaries on Camp Bowie with approximately 11 miles (18 km) of perennial streams with the remainder as intermittent streams. The climate is subtropical and sub-humid with hot, humid summers and dry winters. The average winter high temperature is 55 °F, and the average winter low temperature is 33 °F. The average summer high temperature is 96 °F, and the average summer low temperature is 69 °F. The average rainfall is 27 inches per year. The average first freeze is November 13, and the average last freeze is March 23 (30 Year Average Climate Data from NOAA Climatic Summaries). See Appendix G for an Environmental Overview with complete details of the physical and biological setting and maps of all features.

2.6 Biological Setting

Camp Bowie is located in the Limestone Plains at the transition with the Western Cross Timbers in west central Texas. Plant communities present include Plateau Live Oak-Midgrass woodlands, Post Oak-Blackjack Oak woodlands, Texas Oak woodlands, American Elm-Cedar Elm woodlands, Pecan-Sugarberry woodlands, Ashe Juniper-Oak woodlands, Ashe Juniper woodlands, Mesquite woodlands and forests, and Sideoats Grama-Little Bluestem grasslands. There is a high diversity of plants (over 400 species), vertebrates (246 species), and invertebrates (at least 687 species across 109 families) at Camp Bowie. There are at least 4 rare plant and 46 rare animal species at Camp Bowie, along with 16 non-native plant and 4 non-native animal species. There is 1federally listed endangered species, the black-capped vireo, and one state listed threatened species, the Texas horned lizard (see Appendix M for more information on priority rare species). There is no critical habitat designated at Camp Bowie. Baseline surveys have been completed for plants, reptiles, amphibians, birds, mammals, aquatic invertebrates, and insects (see Appendix H for species lists). See Appendix F for an Environmental Overview with complete details of the biological setting and associated maps.

Chapter 3. Natural Resources Management

3.1 Management Framework

LEGAL AUTHORITIES: Sikes Act, DoD Instruction 4715.03, AR 200-1
PROPONENTS: ITAM, Natural Resources, Environmental, GIS

3.1.1 State-and-Transition Model

A state-and-transition model identifies the possible types of plant communities for a given region and soils by describing vegetation patterns and hypothetical causes of change. The models also describe persistent transitions in vegetation and suggest the mechanisms underlying those dynamics. The formulation of a state-and-transition model involves identifying the vegetation states, determining which of the states are linked, and describing the transitions. The current state of the landscape depends on what "inputs" have occurred and what the starting point of the landscape was. Movement between some states occurs without any inputs other than time, while other transitions require substantial input. The boxes in the diagram (see Figure3-1) indicate greater or lesser amounts of energy or inputs needed to move the landscape from one state to another. It takes more inputs to move between the larger boxes than the smaller boxes. The standalone boxes take even more energy.

The following state-and-transition model is adapted from the Natural Resources Conservation Services (NRCS) models for the ecological sites present at Camp Bowie (Figure 3-1). The heavy continuous grazing resulting from leases on the state portion of Camp Bowie for several decades has played a major role in the vegetation states present. The grazing was terminated in March 2007 but will continue to influence vegetation communities for some time. Not all potential ecological sites are depicted here, and this model will be updated as more information becomes available. The information presented illustrates that changes in communities occur as a result of disturbance, management, and natural factors.

3.1.2 Management Philosophy

The desired future condition of Camp Bowie is to provide the most land for training in the most sustainable way possible within the constraints of the habitats and ecosystem present, with a mosaic of habitat types linked by hydrologic flow, nutrient cycles, fire, animal movement, and transitional zones. To achieve this condition, ecosystem management and two related land management tools—adaptive management and watershed analysis—must be used.

Ecosystem management is "driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function" (Christensen et al. 1996). For example, the goals, objectives, and targets defined in this management plan will be accomplished by following the guidelines in the plan, all management actions will be monitored, and management will be adapted according to monitoring results—thus, an endless feedback loop. Ecosystem management is based on a holistic, systems-oriented approach and not on single species management or maximizing the prevalence of a small group of organisms. Rare species management should complement the conservation of a healthy ecosystem.

The goal of ecosystem management on military training lands is to ensure that military lands support present and future training requirements while, as much as possible, preserving, improving, and enhancing an ecosystem's characteristics and communities of which it is comprised. Over the long term, that approach will maintain and improve the sustainability and biological function of ecosystems, while supporting sustainable economies, human use, and the environment required for realistic military training operations (DoD Instruction 4715.03).

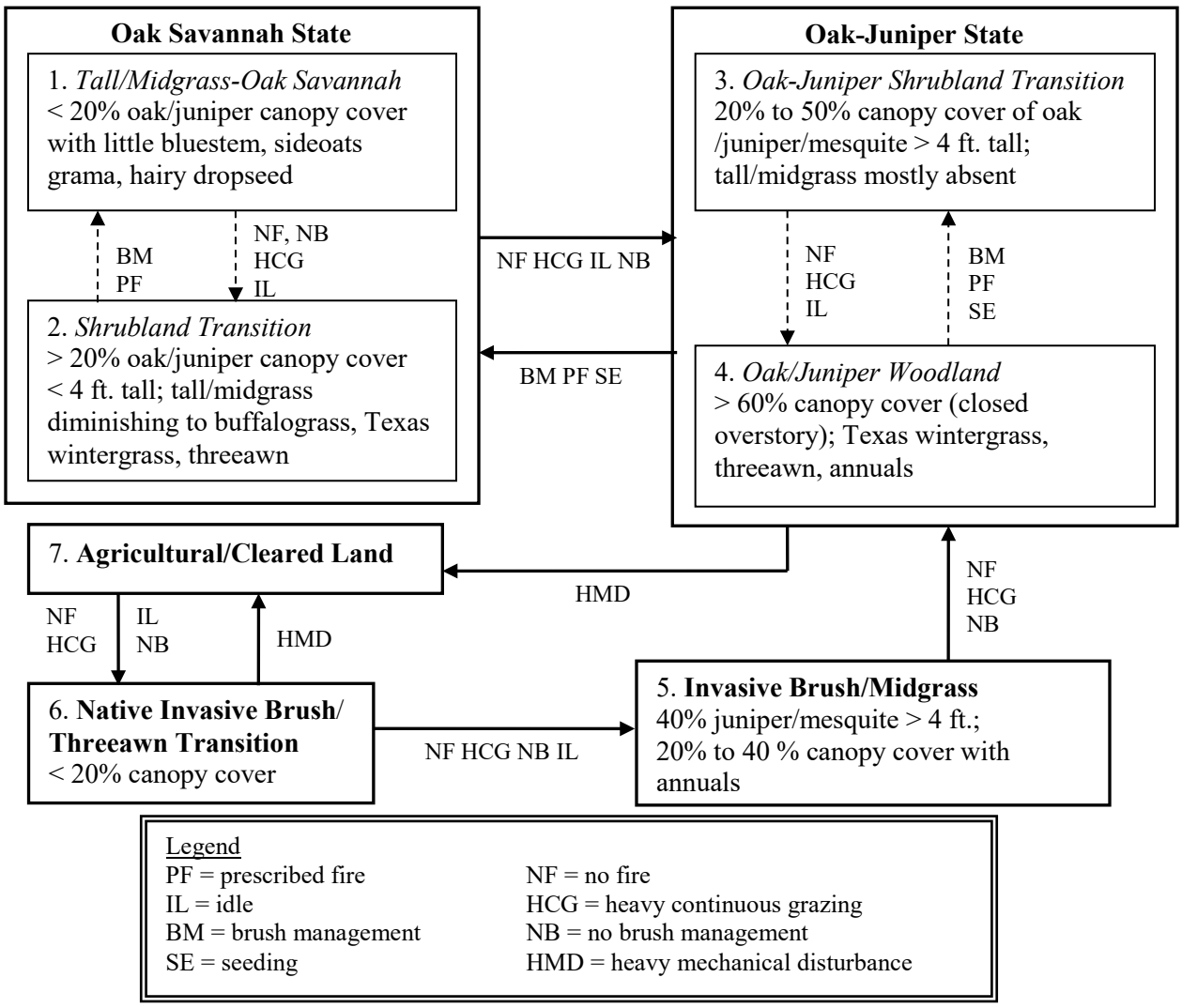


Figure 3-1. State and Transition Model for the Most Common Ecological Site at Camp Bowie
Pink Caliche 40-54 adapted from NRCS models and Range Site Description. Ashe juniper tends to invade in areas that have shallow soils while mesquite is the dominant invader in areas that have deeper soils.

Adaptive management is the process of linking ecological management within a learning framework. Monitoring is the cornerstone of adaptive management, the only way to evaluate, learn, and adapt. The characteristics of adaptive management include (Unnasch and Maddox 2005):

- Recognizing the low probability of predicting the future state of populations or systems and the complexity of natural systems
- Recognizing that extrapolation is difficult
- Using experience to learn incrementally
- Treating all conservation activities as experiments
- Minimizing risk to species, communities, and ecosystems
- Acknowledging that local actions may have effects elsewhere, at different scales and/or at different time lags
- Understanding that it is cyclic and incremental in nature

Watershed analysis is one of the principal analyses that will be used to meet the ecosystem management objectives of this INRMP. Watershed analysis will be the mechanism to support ecosystem management based on sub-watersheds identified on site as well as the larger watershed that contains Camp Bowie. Watershed analysis will focus on collecting and compiling information within the watershed that is essential for making sound management decisions. It will serve as the basis for developing project-specific proposals and determining monitoring and restoration needs for a watershed.

3.1.2.1 Reference Cited

Christensen NL, Bartuska AM, Brown JH, Carpenter S, D'Antonio C, Francis R, Franklin,JF., MacMahon JA, Noss RF, Parsons DJ, Peterson CH, Turner MG, Woodmansee RG. 1996. The report of the ecological society of America committee on the scientific basis for ecosystem management. Ecol. Appl. 6:665-691.

Unnasch R, Maddox D. 2005. Monitoring and assessment in support of military Training. Boise (ID):Sound Science LLC.

3.2 Awareness

3.2.1 Program Summary

LEGAL AUTHORITIES: Sikes Act, DoD Instruction 4715.03, AR 200-1
PROPONENTS: ITAM, Natural Resources, Environmental

The Environmental Branch has responsibilities for educating soldiers and training site staff and headquarters staff about land management activities and issues. The Environmental Program produces and distributes environmental awareness materials and conducts environmental training for various personnel throughout the TMD using a variety of mechanisms.

The Sikes Act requires public access to the training center when appropriate and without affecting the military mission. Due to consistent heavy training activity at Camp Bowie, public access for recreational or educational purposes is not practical.

3.3 Monitoring

3.3.1 Program Summary

LEGAL AUTHORITIES: DoD Instruction 4715.03, AR 200-1
PROPONENTS: Environmental

The Monitoring Program is designed to assess the impacts of the management actions taken on the landscape within the framework of the status and trends of the ecological communities. The results are used to assess and direct management activities and, therefore, are the primary data required for adaptive management.

In 2004, a project was begun to identify insect indicator species for use in assessing changes in habitat due to training activities. Insects are generally good candidates due to high population numbers, high species diversity, short generation times, and mobility. In particular, ground beetles (Coleoptera: *Carabidae*) and ants (Hymenoptera: Formicidae) have been shown to be useful indicators in habitat assessment in other locations. Camp Swift has a high diversity of both groups based on surveys completed in 2010, and further data collection will be done through planning level surveys.

Every component of land management requires some level of monitoring. Some components only require minimal and qualitative monitoring, while other components require regular and quantitative monitoring. The initial task in the Monitoring Program is to identify which components need to be monitored and how they need to be monitored. These elements along with the others identified in Section 3.3.1 will contribute to the Monitoring Plan that will bring all the monitoring needs and protocols into one place.

3.4 Erosion and Sediment Control

3.4.1 Program Summary

LEGAL AUTHORITIES: Clean Water Act, DoD Instruction 4715.03, AR 200-1
PROPONENTS: Facilities Maintenance, Engineering, Natural Resources, ITAM

Erosion is the detachment of particles of soil, sediments, and rocks, which occurs by hydrological (i.e., water-related) processes of sheet erosion, rilling and gully erosion, mass wasting, and the action of wind. Where land use causes soil disturbance, erosion may increase greatly above natural rates. Plant and litter cover protect the soil from raindrop impact and splash, tend to slow down the movement of surface runoff, and allow excess surface water to infiltrate. Soil erosion can both cause vegetation loss as well as be the result of vegetation loss. Vegetation loss results in greater storm water runoff, which results in less water entering the ground reducing plant productivity even further. Soil erosion also reduces basic nutrients needed for plant growth and survival, and it decreases the diversity and abundance of soil organisms.

Soil compaction is a key cause of soil erosion due to changes in soil strength, penetration potentials, water infiltration, aeration, erosion potentials, nutrient dynamics, and gaseous losses, most of which affect seedling establishment. Compaction can be defined as the application of forces to a soil mass, which results in increased soil density and strength. The susceptibility of a soil to compaction is primarily a function of soil moisture, texture, and organic matter content. Compaction contributes to erosion by reducing vegetative cover and reducing infiltration rates and, therefore, increasing overland flow and erosion. Soil compaction is caused by Facilities Maintenance, former grazing and hunting leases, and training activities. If soil compaction is combined with activities on slopes greater than 12° and/or longer slopes, erosion problems increase exponentially.

Sediments in streams degrade water supplies and provide an important medium for a wide range of chemical pollutants that are readily absorbed on sediment surfaces. Soil erosion is an important ecological, social, and economic problem as well as an essential factor in assessing ecosystem health and function. Estimates of erosion are essential to land and water management, including sediment transport and storage in lowlands, reservoirs, estuaries, and irrigation and hydropower systems. Erosion is a fundamental and complex natural process that is strongly modified, usually increased, by human activities such as land clearing, grazing, agriculture, forestry, construction, surface mining, and urbanization. Erosion, once started, can become difficult and expensive to reverse with substantial loss of topsoil.

Managing existing erosion and preventing new erosion is a cooperative, coordinated effort among ITAM, Natural Resources, Clean Water, and Facilities Maintenance Programs. Each program has a portion of the funding and responsibility for addressing erosion. The basic foundation of the Sediment and Erosion Control Program is the prediction, prevention, quantification, and control of erosion.

Camp Bowie is located in a semi-arid environment with soils that are moderately erosive and often shallow. All management at Camp Bowie must consider the soil properties. The Bolar-Brackett soils, which cover approximately 70% of Camp Bowie, are generally problematic, because they are gravelly to loamy soils over sandstone or shale. These soil conditions are relatively fragile, since sands erode relatively easily once vegetation cover is removed. Restoration of these soils, once erosion begins, is relatively difficult since precipitation events can erode soils faster than vegetation can colonize the sites.

The very thin, stony, moderately permeable soils with low runoff potential are capable of supporting heavy loads but are slow to recover when the characteristically thin vegetation has been destroyed by traffic or grazing (Nance and Werman 1993).

These conditions are readily observable based on correlating the existing erosion features to the past land uses. It is speculated that the historic grazing (i.e. cows, goats, and sheep at high densities) may have accelerated the natural erosion process along the ridges of this soil association. This type of erosion accounts for nearly 45% of the erosion observed on Camp Bowie (Reineke 2005). The grazing also generally reduced watershed health on the state portion by reducing litter cover, encouraging early successional species, increasing invasive species, and increasing soil compaction (Reineke 2005). These conditions all reduce resilience to disturbance and prevent the use of fire to manage juniper and mesquite. See Appendix G for thorough discussion of soil types and potential for erosion of soils at Camp Bowie as well as maps of soil types and existing erosion areas.

A watershed assessment was completed in 2005 that documented all the erosion sites and their current condition (see Table 3-1 for a summary) as well as general watershed health. Prior to this assessment, several major erosion problems had been identified by ITAM and Natural Resources and addressed at various times. A complete prioritized list of erosion sites has not been compiled, but it is a key target for completion in FY22.

Watershed	Accelerating		Static/Unknown		Stabilizing		Total	
	No.	Area Acres (Ha)	No.	Area Acres (Has)	No.	Area Acres (Ha)	No.	Area Acres (Ha)
1	0	0.00 (0)	1	2.73 (1)	0	0.00 (0)	1	2.73 (1)
2	0	0.00 (0)	0	0.00 (0)	1	0.16 (0.1)	1	0.16 (0.1)
3	0	0.00 (0)	2	9.37 (4)	1	0.20 (0.1)	3	9.57 (4)
4	0	0.00 (0)	5	9.50 (4)	1	0.49 (0.1)	6	10.00 (4)
5	2	0.33 (0.1)	3	4.65 (2)	2	10.55 (4)	7	15.53 (6)
6	0	0.00 (0)	13	75.46 (31)	0	0.00 (0)	13	75.46 (31)
7	1	0.42 (0.2)	3	1.31 (1)	1	0.63 (0.3)	5	2.36 (1)
8	1	0.68 (0.3)	6	24.51 (10)	0	0.00 (0)	7	25.18 (10)
9	1	0.18 (0.1)	4	16.40 (7)	2	3.41 (1)	7	19.99 (8)
10	2	3.43 (1)	4	2.95 (1)	4	3.82 (2)	10	10.20 (4)
11	0	0.00 (0)	2	1.45 (1)	2	4.68 (2)	4	6.12 (2)
12	0	0.00 (0)	5	7.16 (3)	1	0.27 (0.1)	6	7.43 (3)
13	0	0.00 (0)	4	15.98 (6)	1	2.85 (1)	5	18.83 (8)
14	0	0.00 (0)	0	0.00 (0)	1	2.93 (1)	1	2.93 (1)
Total	7	5.02 (2)	52	171.47 (69)	17	30.00 (12)	76	206.49 (84)

Table 3-1. Summary of Known Erosion Sites and Their Current Condition by Watershed

3.5 Fire Management

3.5.1 Program Summary

LEGAL AUTHORITIES: DoD Instruction 4715.03, AR 200-1
PROPONENTS: Facilities Maintenance, Natural Resources

Fire management encompasses both wildfire and prescribed fire programs. There are several benefits of proactive wildland fire management. Primarily, proper fire management can maintain and open training areas by minimizing the dense understory and shrub growth that can reduce the utility of training areas. Fire management serves to reduce hazardous fuel loads and wildfires. The training areas and areas adjacent to them can rapidly accumulate abundant, dense, flammable vegetation that would present significant control problems during wildfires.

Fire plays a significant role in maintaining biodiversity and habitat of rare species, and it is critical for maintaining ecosystem health and wildlife habitat. Most native plant communities, including those at Camp Swift, are adapted to fire. Prescribed fires can increase the edge effect and amount of browse material, improving conditions for deer and other wildlife. For example, quail and turkey favor forage plants and semi-open and open conditions that can be created and maintained by burning. Finally, fire can be used to reduce certain non-native species that have not evolved in an environment of regular exposure to fire and are consequently not adapted to fire. Due to the fact that fire is used in many program areas such as invasive species, vegetation, and wildlife, the goals, objectives, and targets associated with fire management are consolidated in the Fire Management Program (see Appendix F, Section 3.5). It is important for a Prescribed Fire Program to be able to vary the seasonality and spatial extent of fires that are applied to the landscape. Small, patchy fires applied at varying times of the year, including summer, will be most beneficial to maintain diversity and sustainability of the landscape and the wildlife. Most prescribed burns occur in the winter, but it is important for a Prescribed Fire Program to be able to vary the seasonality whenever possible. All prescribed fires will go through a review of environmental concerns to mitigate the effects on matters such as migratory birds and sensitive plants, as well as avoid cultural resources and specific training times for Soldiers.

Most vegetation types on Camp Bowie require fire to maintain composition and structure and prevent substantial encroachment from Ashe juniper (*Juniperus ashei*) and honey mesquite (*Prosopis glandulosa*) seedlings. In general, fuel models present at Camp Bowie include grass (GR), shrub (SH), and timber (T). The fuel models listed in Table 3-2 are only for reference and may not be entirely accurate. The set of fuel models listed are meant for use with Rothermel's surface fire spread model. See Figure 3-2 for Fuel Models and Burn Units at Camp Bowie.

Fuel Model Descriptions	Fuel Model	Acres	Ha
Short, Sparse Dry Climate Grass (Dynamic)	GR1	216	87
Low Load, Dry Climate Grass (Dynamic)	GR2	372	151
Moderate Load, Dry Climate Grass (Dynamic)	GR4	432	17
High Load, Dry Climate Grass (Dynamic)	GR7	27	11
Moderate Load, Dry Climate Grass-Shrub (Dynamic)	GS2	4653	1883
Moderate Load, Humid Climate Grass-Shrub (Dynamic)	GS3	404	164
Non-burnable Water	NB8	42	17
Non-burnable Bare Ground	NB9	4	2
High Load, Dry Climate Shrub	SH5	8	3
Very High Load, Dry Climate Shrub	SH7	11	5
Moderate Load, Conifer Litter	TL3	19	8
Moderate Load, Broadleaf Litter	TL6	78	32
Moderate Load, Humid Climate Timber-Shrub	TU2	473	191
Moderate Load, Humid Climate Timber-Grass-Shrub (Dynamic)	TU3	2192	887

Table 3-2. Fuel Models Present at Camp Bowie

Annually, it is expected that at least 1,200 acres will be burned with a target of 1,500 to 2,500 acres depending on weather and trained personnel across 23 burn units (see Figure 3-2). Typically, prescribed fires are initiated with conventional drip torches. Roads, natural barriers (e.g. streams) and firebreaks are used as primary fire lines and to define burn units. Burn unit boundaries are flexible depending on environmental conditions, smoke management issues, and resource objectives. Construction of new firebreaks or reclamation of unmaintained fire breaks must be coordinated with Natural Resources to ensure that placement and methods used for clearing and subsequent maintenance will not cause erosion and are consistent with the Integrated Wildland Fire Management Plan (IWFMP). Brush piles are generally discouraged due to potential for prolonged smoke production, spotting, escape, and soil sterilization (see Appendix D, SOP on Protocol for Brush Piles). The size of brush piles must be kept as small as possible. No brush piles will be created within 300 ft. of any property boundary. A prescription must be on file in order to burn a brush pile, and a brush pile burn will be treated as all other prescribed fires as outlined in the IWFMP.

Details regarding staffing, training, and other wildland and prescribed fire logistics are addressed in detail in the IWFMP, which is maintained by the Natural Resource Office. The IWFMP identifies all the procedures, protocols, training, burn units, and other relevant details associated with wildland fire. Prescribed fire operations are conducted by the Tx Forestry Service through a Memorandum of Understanding (MOU). This MOU also allows for National Wildfire Coordinating Group training for training center personnel at least once per year. A prescribed fire regime to achieve natural resources objectives was initiated at Camp Bowie in 2005 although small, prescribed fires have occurred over the years for training purposes. It is important for a prescribed fire program to be able to vary the seasonality and spatial extent of fires that are applied to the landscape. Small, patchy fires applied at varying times of the year, including summer, will be most beneficial to maintain diversity and sustainability of the landscape and the wildlife.

Prescribed fire prescriptions must be on file prior to ignition and signed off by qualified personnel. Prescribed fires must follow the Texas Commission on Environmental Quality (TCEQ) regulations (RG-

049, 2008). An important factor considered when conducting a prescribed fire is smoke production. Proper smoke management will likely be the most important aspect for the future of prescribed fires in Texas. Buildings that contain smoke sensitive receptors must be identified prior to each prescribed fire in the prescription (see Appendix K), which minimizes the chance of causing a nuisance or other damage. According to the TCEQ Outdoor Burning Rule, Title 30 Texas Administrative Code, Sections 111.201 through 111.221 (2017), buildings that contain sensitive smoke receptors must not be downwind of or must be at least 300 ft. from the fire. An exception to this rule can be obtained with written permission from the landowner. The boundaries of Camp Bowie are adjacent to private homes, farms, and ranches. The Bowie Memorial Airstrip is approximately 5 miles (8 km) north, the Brownwood Hospital is 4 miles (6 km) northeast, the City of Early is approximately 4 miles (6 km) northeast, and the City of Brownwood is approximately 4 miles (6 km) north/northwest of the training center. A map of sensitive receptors, as well as other smoke management techniques, can be found in the IWFMP. This sample prescription does not necessarily reflect requirements for TFS prescribed fire operations.

Other areas to avoid and/or protect during prescribed fire operations also vary with the burn unit in question. These issues must be listed in the prescription itself (see Appendix K for a sample) and can include, but are not limited to, sensitive habitat, cultural resources, erosion sites, invasive species, structures, telephone lines, and fences. Coordination with Cultural Resources and other TMD entities will occur through the NEPA process.

Wildfire frequency varies with weather conditions and training exercises but approximately 1-2 fires per year occur that, on average, do not exceed 5 acres (2 ha). The training center staff responds to on-site wildfires as first responders. The procedures for wildfire response are outlined in the IWFMP. Currently, no wildfire response or assistance off site with training center equipment or personnel is permitted.

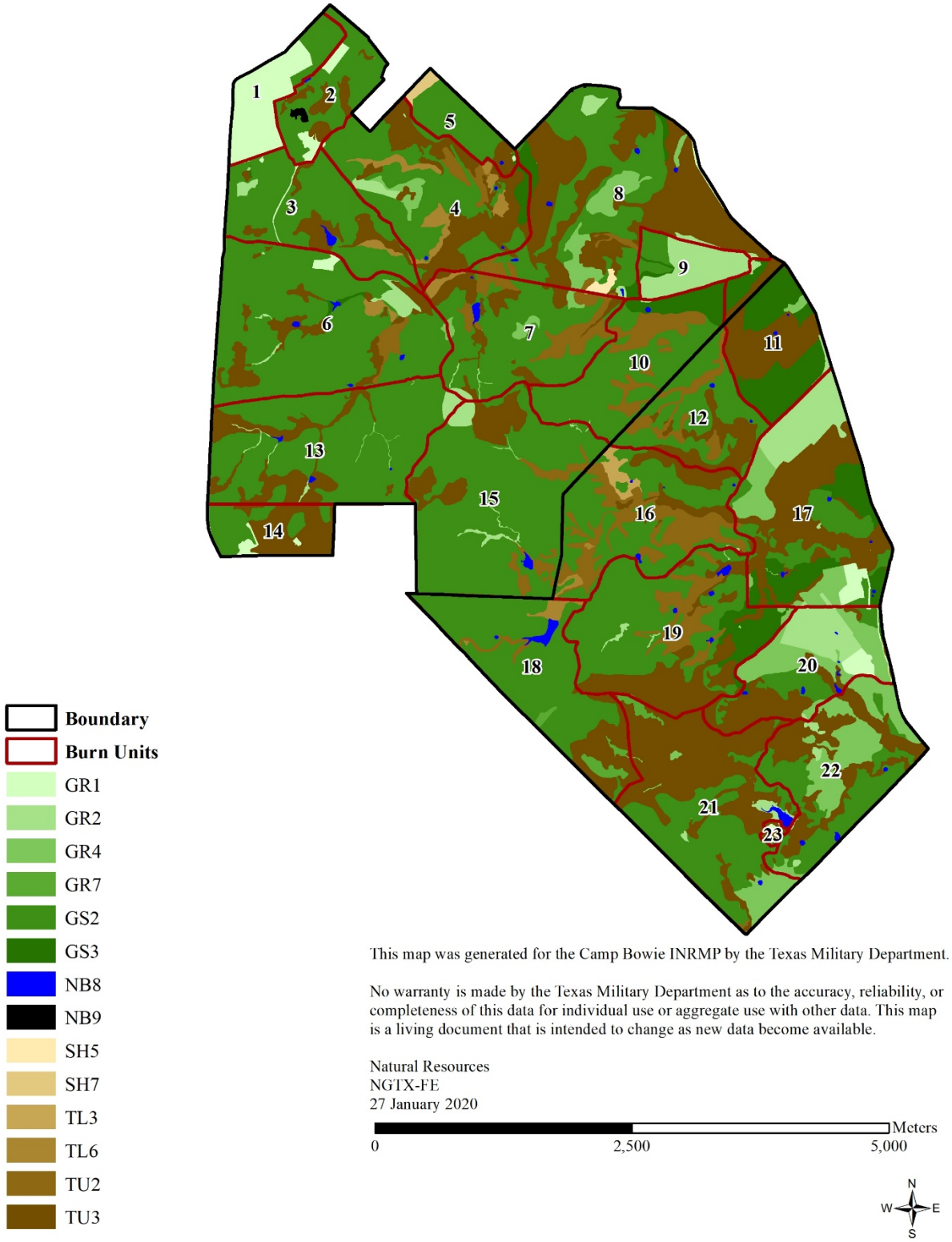


Figure 3-2. Burn Units and Fuel Models at Camp Bowie

3.6 Invasive Species Control and Pest Management

3.6.1 Program Summary

LEGAL AUTHORITIES: EO 13112, Federal Insecticide, Fungicide, and Rodenticide Act, Federal Noxious Weed Act, AR 200-1, Texas Agricultural Code - Chapter 19, DoD Instruction 4715.03
PROPONENTS: Facilities Maintenance, Natural Resources, ITAM

An invasive species is a non-native species to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. Invasive species can cause serious ecological and economic damage and require control measures and monitoring to manage their populations. Invasive species management plays a significant role in maintaining biodiversity and habitat of rare species and is critical for maintaining ecosystem health. One of the most serious problems threatening biological communities in Texas is loss of heterogeneity through invasive plant establishment, spread, and eventual dominance. This loss of heterogeneity can occur on many different spatial scales, from statewide to individual training centers. Without proper management and control of invasive species, areas that are now relatively healthy may degrade in quality and, ultimately, jeopardize the sustainability of the military training lands.

Based on planning level surveys and various other plant-related surveys, 16 invasive plant species have been documented at Camp Bowie. Maltese star thistle (*Centaurea melitensis*) and Japanese privet (*Ligustrum japonicum*) have been identified as priorities for control, primarily due to their potential impacts to the ecosystem. The spread and establishment of Maltese star thistle may be associated with the movement of cattle across the landscape and their associated disturbances. However, discontinuing the grazing lease has significantly decreased the spread and further establishment of this species. The Japanese privet was noted in one stream reach, likely near a homestead site.

Invasive grasses such as Johnsongrass (*Sorghum halepense*), bermudagrass (*Cynodon dactylon*), and yellow bluestem (*Bothriochloa ischaemum*) will be minimized as other management techniques such as growing season prescribed fire and BMPs are put into place; additionally, they will be monitored and thresholds for action will be established regarding rate of spread and relative influence on the training landscape. Other invasive plants will be addressed when appropriate and as time permits. See Table G-8 Invasive Plants of Camp Bowie for a complete list of non-native, invasive plants.

Oak wilt has been documented at Camp Bowie, and although the identified areas have been addressed in coordination with TFS, the risk of further spread is high. Oak wilt is an infectious disease caused by the fungus *Ceratocystis fagacearum*, which invades and disables the water-conducting system in susceptible oaks. To minimize the spread of oak wilt, there is an SOP for Tree Management that minimizes risk due to tree trimming and tree removal (see Appendix D). Steps are being taken to educate the training center staff and units training at Camp Bowie to recognize the effects of oak wilt and to understand its implications for the health of the landscape.

In addition to invasive plants, there are invasive animals present at Camp Bowie, notably red imported fire ants and wild pigs. See Table G-10 Invasive Animals of Camp Bowie for a complete list. For the past 10 years, there have been ongoing efforts to reduce the area affected by red imported fire ants. These efforts have reduced the level of red imported fire ants on the ranges, but continued treatments are necessary. See Appendix D for the SOP for Red Imported Fire Ant Treatment. Wild pigs have been documented at Camp Bowie and control measures have been implemented to reduce their numbers. They compete for food with native wildlife, kill ground nesting birds and destroy their habitat, damage riparian areas while creating erosion and increased sedimentation, prey on small animals such as young wildlife and domestic animals, carry various diseases and parasites, and have been found to damage ranges.

In addition to planning for invasive species control at an ecosystem level, the goals and objectives for

land management aspects of the Integrated Pest Management Program are presented in Appendix F. This program is presented in its entirety in the Integrated Pest Management Plan (IPMP), but portions related to land management are presented here to facilitate integration between the programs. Integrated pest management is the judicious use of both non-chemical and chemical control to suppress or prevent pests from exceeding an acceptable population or damage threshold. Emphasis is placed on minimizing environmental disruption and being in full compliance with environmental regulations. Integrated pest management strategies depend on monitoring to establish the need for control and to establish the effectiveness of management efforts. Any use of chemicals for pest or invasive species management must be conducted by certified personnel and reported to the Integrated Pest Management Coordinator as specified in the IPMP.

3.7 Wetlands, Ponds, and Riparian Areas

3.7.1 Program Summary

LEGAL AUTHORITIES: Clean Water Act, Sikes Act, DoD Instruction 4715.03, AR 200-1, Executive Order (EO) 11988, EO 11990
PROPONENTS: Facilities Maintenance, Engineering, Natural Resources, ITAM

Wetlands, ponds, and streams were originally identified in 1999 and updated with more GIS documentation and condition assessment in 2005. Official wetland delineations according to USACE standards have not been completed and are only done when a specific project requires delineation. The only perennial waters on Camp Bowie are 3 large stock tanks/ponds with a total of 10 acres (4 ha) and parts of Devil's River, Lewis Creek, and MacKinally Creek are perennial. All other water resources are intermittent in nature, with total of 51 acres (21 ha) of surface water, with 84 ponds comprising approximately 49 acres (20 ha), and 3 wetlands comprising 2 acres (1 ha), and 49 miles (79 km) of streams. See Appendix G for more details on available water resources and maps of their locations.

Wetlands, ponds, and streams themselves, as well as associated vegetation, are all important habitat elements for both native plants and animals. They are also the areas most frequently affected by invasive plants and animals because of the availability of water (see Appendix F for more on targets for invasive and native species).

Aquatic plants, as opposed to riparian plants, have a major role in maintaining the integrity of lakes, ponds, streams, and rivers for fish, wildlife, other organisms, and human enjoyment. Specific roles of aquatic plants include:

- Habitat and food for fish, invertebrates, amphibians, and waterfowl
- Food for other wildlife and mammals
- Spawning medium for many fish, invertebrates, and amphibians
- Production of oxygen
- Protection of stream river banks, lake and reservoir beds, and shorelines
- Stabilization of temperature, light, and functioning of a diverse aquatic ecosystem
- Recycling nutrients and reduce sediment transport
- Correlate with aquatic invertebrates and ultimately fish productivity

Riparian areas and vegetative buffers around wetlands and ponds are important features of a training center because they intercept overland drainage, reduce bank erosion, help trap sediments and nutrients, filter water, replenish groundwater reserves, and moderate flooding. They are also important habitat areas

because the vegetation they support is often unique and diverse, and they provide critical habitat or corridors for wildlife.

Invasive, non-native plants can disrupt the balance of vegetation and aquatic organisms in and near lakes, streams, or rivers. In some circumstances, even native vegetation can grow to nuisance levels, and these plants require control and/or management practices. It is usually obvious when a dense bed of a single species becomes a nuisance. Under these conditions fish and wildlife habitat and activities are altered.

Problems with invasive aquatic plants occur primarily because their growth habits enable them to rapidly reach very large and dense population levels. Excessive growth of many of these invasive aquatic species often is responsible for:

- Deterioration of fish and wildlife habitat
- Potential loss of habitat for threatened and endangered fish, wildlife, and other aquatic species
- Deterioration of wetlands and water quality
- Reduction of the area for recreational activities such as fishing and boating
- Reduction of the property value adjacent to the deteriorated aquatic habitat
- Impeding commercial navigation
- Blocking pumps, sluices, and industrial, agricultural, and domestic water supply intakes
- Flooding, increased silting, and reduced reservoir capacity

In general, activities within wetlands and streams and associated buffers and riparian areas are limited due to the saturated nature of the soils as well as the topography. Other than recent cattle grazing and trampling on the state portion, most activities occur well outside a 100-ft. buffer around any water resources, exceptions being travel on established stream crossings, roads, and trails. See Appendix F, Section 3.7, for more information on targets to reduce erosion and sedimentation.

Management of floodplains and waters of the U.S., including wetlands, are subject to the provisions of Executive Order (EO) 11988, EO 11990, and Section 404 of the Clean Water Act. Any changes or impacts to these water resources must comply with Section 401 and 404 of the Clean Water Act. Any construction activities are required to either have a Stormwater Pollution Prevention Plan and/or follow BMPs per Section 401 of the Clean Water Act as defined by the USACE and the TCEQ. Any activities that may affect water resources must be approved through the REC processes.

3.8 Vegetation Management

3.8.1 Program Summary

LEGAL AUTHORITIES: Sikes Act, DoD Instruction 4715.03, AR 200-1
PROPONENTS: Facilities Maintenance , Natural Resources, ITAM

Vegetation management covers many aspects of land management, including prescribed fire, invasive plants, woody brush encroachment, maintaining intact old growth forests, and maintaining ground cover. Vegetation management includes any forest management requirements. Brush management plays a significant role in maintaining biodiversity and habitat of rare species, and it is critical for maintaining ecosystem health. The Integrated Brush Management Program at Camp Bowie is defined by management objectives and the inventory of the training center and is prioritized based on training needs and economic and environmental analyses of the potential solutions. Any brush management or revegetation activities at Camp Bowie must be reviewed and approved through the REC process.

There is usually a negative response by perennial vegetation to most types and degrees of vehicle use, with the degree of negative impact on plants varying with conditions and intensity of use (Blackburn et al. 1992; Lathrop 1983; Thurow 1991; Thurow et al. 1986). The immediate effect tends to be a reduction of warm-season grasses followed by the invasion of annual cool-season grasses and annual warm-season forbs. Although these annuals provide some cover when spring precipitation patterns are near and above normal, they do not become established in the disturbed areas when precipitation is below normal levels. Thus, in droughty areas, there will be a further reduction in vegetative cover and an increased potential for erosion. For lands sensitive to erosion, management should not depend on annual plant cover to maintain soil erosion rates at an acceptable level. Below-normal precipitation or an extended drought would mean the loss of this annual cover, and soils would be subject to excessive erosion. In addition, annuals that invade these areas usually have a single stem growth form that is less obstructive to overland water flow and erosion than bunchgrass clumps and other perennial vegetation.

Brush management is an integral aspect of land management in Texas. Brush, mainly mesquite and juniper, has increased in density and distribution in areas that were once open grasslands due to past land use, management practices, and lack of fire over the last 100 years. Although mesquite and juniper both belong as a component of the native landscape, fire suppression and past land use have allowed them to outcompete the native grasses, and they have established as the dominant species in some areas. The management of these brush species must be approached with a multidisciplinary understanding of the landscape along with a focus on land management goals and objectives. An ideal native landscape and military training ground has a mosaic of habitat types. This mosaic can be created and maintained with an integration of many brush management tools. An Integrated Brush Management Program uses fire, mechanical practices, and wildlife management to address brush management issues.

The methods selected for brush management for a specific project should consider the following (Hanselka et al. 1999):

- Degree of control of brush expected
- Target brush species characteristics and weaknesses
- Expected life of the treatment applied and need for maintenance treatments
- Possible secondary effects of the treatment (soil loss, erosion, invasive plants, etc.)
- Requirements of the chosen application (equipment, certifications, etc.)
- Timing of the treatment (seasonality and access)
- Effect on wildlife habitat (and rare species)
- Cost versus benefit analysis
- Safety of military users and those implementing the brush management

Prescribed fire will be the primary maintenance method after high densities of large individuals are reduced. Mechanical methods are used to accomplish pre-fire thinning or in areas where prescribed fires are not feasible. Mechanical methods of removal for juniper and mesquite typically involve the use of a tree shear or a track hoe, respectively. This equipment greatly reduces the amount of soil disturbance and loss of topsoil that can result from improper brush management techniques and greatly reduces the amount of mesquite that resprout. Herbicide applications are used only when other methods are not viable for a given project or species. Aerial application of herbicides at Camp Bowie is not permitted without a current Aerial Application Statement of Need (ASSON) that has been signed and approved by the ARNG Pest Management Consultant (PMC).

Past vegetation management projects at Camp Bowie generally focused on reducing woody encroachment, opening land for training, and restoring disturbed areas with native seed (Figure 3-3). In the past, methods such as bulldozing vegetation and root plowing were used to clear and maintain areas for training. These methods were found to inflict too much disturbance on the landscape. Recently, Ashe

juniper (*Juniperus ashei*) and honey mesquite (*Prosopis glandulosa*) encroachment have been managed using low disturbance methodologies. The Integrated Brush Management Program at Camp Bowie is defined by management objectives and the inventory of the training site, and it is prioritized based on training needs and economic and environmental analyses of the potential solutions.

3.8.1.1 References Cited

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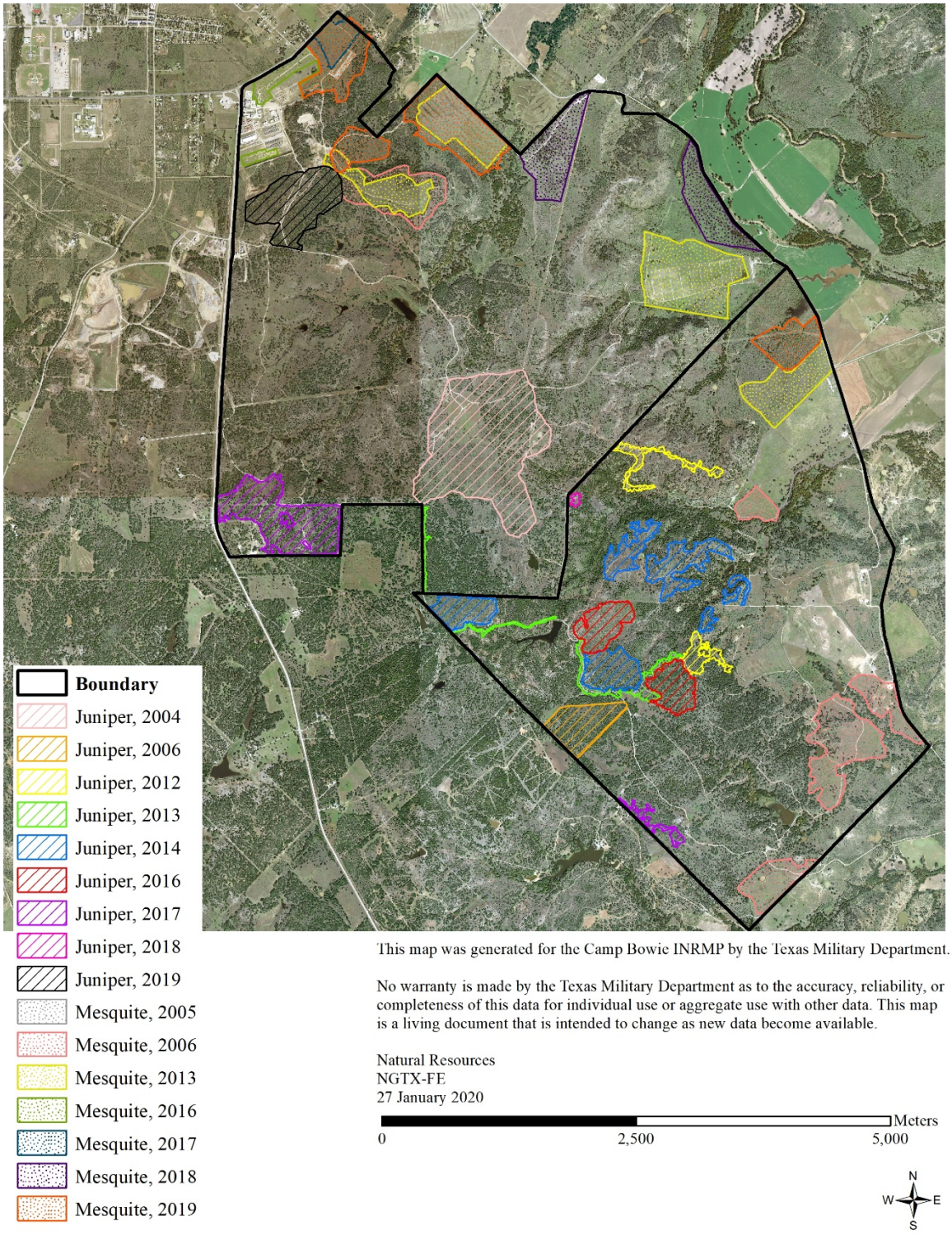

Figure 3-3. Brush Management History at Camp Bowie

3.9 Landscaping and Grounds Maintenance

3.9.1 Program Summary

LEGAL AUTHORITIES: EO 13423, DoD Instruction 4715.03, AR 200-1, AR 420-10
PROPONENTS: Facilities Maintenance and Repair, Natural Resources

Xeriscaping and wise placement of trees can conserve energy, reduce heat island effects, reduce maintenance time and costs, and increase biodiversity. Landscaping and grounds maintenance are activities that primarily occur in the cantonment area, although grounds maintenance also occurs on ranges. Landscaping is generally present in some form on improved grounds (i.e. cantonment area), while ground maintenance occurs on improved, semi-improved, and unimproved grounds. These activities are, therefore, primarily a function of facility maintenance. Both activities can generate substantial impacts on nearby areas through erosion, invasive species, and pesticide use. Natural Resources and ITAM personnel work closely with Facilities Maintenance personnel to troubleshoot and determine new products and methods for minimizing these impacts. Table 3-3 identifies invasive plants that are prohibited from all landscape plantings.

Habitat	Common Name	Scientific Name
Terrestrial	Tree-of-Heaven	*Ailanthus altissima*
	Giant reed	*Arundo donax*
	Thorny olive	*Elaeagnus pungens*
	Euonymus	*Euonymus alata/fortunei*
	Wax-leaf ligustrum	*Ligustrum japonicum/lucidum*
	Privet	*Ligustrum sinense/vulgare*
	Japanese Honeysuckle	*Lonicera japonica*
	Chinaberry	*Melia azedarach*
	Heavenly bamboo	*Nandina domestica*
	Red-tipped photinia	*Photinia serratifolia*
	Bamboo	*Phyllostachys/Bambusa* spp.
	Pyracantha	*Pyracantha koidzumii*
	Salt cedar	*Tamarix ramosissima*
	Asian jasmine	*Trachelospermum asiaticum*
	Chinese tallow	*Triadica sebifera*
Aquatic	Alligatorweed	*Alternanthera philoxeroides*
	Water hyacinth	*Eichhornia crassipes*
	Hydrilla	*Hydrilla verticillata*
	Water spinach	*Ipomoea aquatica*
	Eurasian watermilfoil	*Myriophyllum spicatum*
	Water lettuce	*Pistia stratiotes*
	Giant salvinia	*Salvinia molesta*

Table 3-3. Prohibited Aquatic and Terrestrial Invasive Plants.
These plants cannot be used in landscape plantings.

3.10 Fish and Wildlife Management

3.10.1 Program Summary

LEGAL AUTHORITIES: Sikes Act, DoD Instruction 4715.03, AR 200-1
PROPONENTS: Natural Resources

Fish and wildlife management has historically been a secondary function of natural resources management at Camp Bowie. There are stable populations of deer, although the population on both the federal and state portions of the site is quite high as is typical for the region based on a well-developed browse line, poorly developed shrub layer, and a lack of palatable forbs and grasses across most of the site. Based on food consumption, 7 deer will eat about as much as 1 medium-sized cow. The combination of heavy continuous grazing by cattle and the overpopulation of deer has clearly reduced plant diversity and ground cover at Camp Bowie.

In 2018-19, TPWD assessed both the state and federal portions of Camp Bowie and recommended deer harvest rates and estimated acres/deer. Ideally, the stocking rate in the Texas Hill Country is 15-20 acres (6-8 ha)/deer. For the state side, TPWD recommended harvesting 20 antlerless deer/year and 15 bucks/year at the current stocking rate of 10 acres (4 ha)/deer. For the federal side, TPWD recommended harvesting 20 antlerless deer/year and 10 bucks/year at the current stocking rate of 7 acres (3 ha)/deer.

In addition, all deer harvesting/hunting is managed and coordinated by the Natural Resources office to achieve a stocking rate of at least 15-20 acres (6-8 ha)/deer. The exact nature of the deer harvesting program is currently being developed and will vary from year to year depending on the number of deer requiring harvest and the training schedules during the legal deer hunting season. Currently, all hunting is permitted and regulated by the Natural Resource staff and adheres to the policies set forth by the TPWD Managed Land Deer Permitting (MLDP) system. Camp Bowie is enrolled and adheres to the Conservation Option within the TPWD's MLDP system.

The results of the deer harvesting program and changes to the program will be reviewed and approved by the LMWG yearly. Any other harvesting, fishing, or fish stocking activities on the federal side must be coordinated with and reported to Natural Resources. Any new land and wildlife management activities not covered in this INRMP must be reviewed and approved by the LMWG regardless of whether it is on the state or federal portion.

Wildlife monitoring occurs in-house by training site personnel with oversight from the Natural Resources office. This monitoring has included deer surveys and documentation of sightings of unusual wildlife, such as mountain lions. Surveys will be conducted for fish in FY20, mammals FY18, herptiles FY17, birds yearly, and insects FY17 as a DoD policy. Some of these surveys were either incomplete or missing data due to limited access to the state side during hunting seasons.

There are only 3 ponds (also known as stock tanks) with a total of 10 acres (4 ha) that are perennial in nature at Camp Bowie, and even those experience wide fluctuations in water level. The fluctuations make establishment of good fish nursery habitat difficult. Without good nursery habitat, it is difficult to achieve a stable population structure with large fish of interest to fishermen. One stock tank has been restored to the natural stream contour while 4 stock tanks have been planted with fringe species to begin improving the wetland diversity and generating stock for planting elsewhere on site. Most of the stock tanks are not very large, which is not conducive to large fish. However, several stock tanks at Camp Bowie are routinely used for fishing. A catch and release program must be enforced at Camp Bowie until further analysis is done on fish fillets to assess any human health risk because in 1996 nickel exceeded whole body screening levels in Landfill Lake and Barrel Pond while copper exceeded whole body screening levels in Landfill Lake and Big Fishing Lake.

All wildlife currently has free movement across traditional barbed wire fences with neighboring properties. This prevents inbreeding depression and allows for movement of wildlife across the landscape over seasons and life cycles. Occasional specimens and DNA samples may be collected for research purposes. Every effort will be made to coordinate with state and federal agencies to accommodate needs regarding wildlife management as they arise.

3.11 Endangered, Threatened, and Rare Species Management

3.11.1 Program Summary

LEGAL AUTHORITIES: ESA, EO 13186, Migratory Bird Treaty Act, DoD Instruction 4715.03, AR 200-1, TPWD Code, Chapters 68 and 88
PROPONENTS: Natural Resources

Based on past surveys, there are currently no federally listed threatened or endangered species at Camp Bowie but one recently de-listed species, the Black-capped Vireo. Black-capped Vireos are still listed as a state endangered species and have been documented breeding in 2016 and 2018. Several patches of suitable habitat exist on Camp Bowie.

Camp Bowie has approximately 63 scattered hectares of suitable Black-capped Vireo (*Vireo atricapillus*) habitat, primarily on the federal portion. Management suggestions for this habitat involve connecting the patches of suitable habitat together to form a larger, more contiguous area using selective thinning practices and/or prescribed fire. Several prescribed fires and brush management projects have decreased Ashe juniper and increased growth of shin oak in and around habitat. Even though the fire and brush management have reduced the immediate suitability for Black-capped Vireos, the treatments will likely increase the future suitability of these areas, as the preferred habitat is dense, multi-stemmed Shin Oak (see Appendix M: Priority Rare Species Summaries for more information).

The USFWS was petitioned to list the Sprague's Pipit on 10/9/2008, published a finding of "warranted but precluded" on 9/14/2010 and not warranted on 4/5/2016. The Sprague's Pipit is no longer a candidate for listing under the ESA as a result of this finding. A survey in 2017 detected 38 pipits at Camp Bowie. This survey was conducted to confirm winter use, determine distribution, and approximate abundance. Habitat and vegetation management practices (Sections 3.5 and 3.8) and military use (range maintenance) objectives support the native and disturbed grassland wintering habitat requirements of the species.

Other migratory birds of concern observed in addition to the Sprague's Pipit according to USFWS Birds of Conservation Concern 2008 and the DoD Partners in Flight Mission Sensitive Species ranking 2017 are Northern Bobwhite, Scissor-tailed Flycatcher, Loggerhead Shrike, Bell's Vireo, and Grasshopper Sparrow. A coordinated avian monitoring program was established in 2011 and continues to provide long-term data on bird populations. Proper land management to maintain and restore habitat will benefit all migratory birds. Management will be coordinated to support state and federal efforts. Federally listed Piping Plover, Least Tern, Red Knot, and Whooping Crane have been observed in the county or surrounding counties and could potentially make a stop at the installation during migration. In 2015, an assessment of stopover habitat for the whooping crane was completed and identified 3 ponds that were potential habitat. Starting in 2017 and continuing in 2019, enhancement of the ponds has and will be conducted to improve the environment of each. These improvements as well as other conservation efforts of the wetlands and ponds at Camp Bowie should benefit the other 3 contiguous species should they visit stopover.

The only other state listed animal species present at Camp Bowie is the Texas Horned Lizard (*Phyrnosoma cornutum*), which is considered "threatened." The Texas Horned Lizard has been documented twice during surveys. They have been found primarily in the uplands and along the ridge. The current status of Texas Horned Lizards across their range is still unclear, but substantial declines have

occurred over the last 30 years for a variety of reasons (see Appendix M for more information).

Several state threatened species of mussels found in Brown County are candidate species for federal listing. The Smooth Pimpleback, Texas Pimpleback, and Texas Fatmucket were surveyed for in 2004 and in 2012, but none were found. Natural Resources staff will conduct future surveys for the presence of the species. If they are ever documented, management to protect and conserve the species will be implemented. In the meantime, current management of streams and waterbodies will support freshwater mussel habitat.

The Hill Country Wild Mercury (*Argythamnia aphoroides*) is a rare endemic plant, currently reported to occur in 14 counties of the Edwards Plateau and the southwest part of north central Texas (see Appendix M for more information). With more than 6 but fewer than 20 populations known for the species, it has a G2S2 ranking (G=global, S=state, 2=imperiled) and is listed as a species of concern by the USFWS. The species appears to be at risk due to habitat loss, and in several parts of its range, this appears to be a result of urban sprawl. In 1999, a small population was discovered at Camp Bowie, and this location represents the most northern site known for the species. Past surveys in 2005 and 2012 confirm that healthy populations are still present. The lack of basic biological and ecological information for this species severely limits management efforts. Scientific investigations and more extensive inventory, mapping, and habitat modeling efforts are currently being undertaken so that science-based decisions can be made to effectively protect and manage this rare plant species.

Rare species are defined as being either globally (G) or regionally (S) rare with a ranking of G2 or S2 (2=imperiled) or lower. G3/5 (3=vulnerable/5=secure) or S3 indicates a species vulnerable to further declines. Occasionally, a species with S4 (4=apparently secure) rank may be monitored closely because of known rapid declines either globally or regionally. Additionally, some endemic species of limited distribution may also be monitored.

Management of most rare species consist of regular updates to the planning level surveys to document any new occurrences, monitoring of existing known populations, and managing invasive species. The control of fire ants and monitoring for the presence of wild pigs is critical for managing for rare species. Both invasive animals can have far reaching effects on an ecosystem and cause declines in a wide variety of species, particularly ground nesting birds. For the invasive species control program, refer to Section 3.6.

For a complete list of rare plants and animals, refer to Appendix G, Section G.2, Tables G-7 and G-9.

3.1 Climate Change

3.1.1 Program Summary

LEGAL AUTHORITIES: DoD Instruction 4715.03, DoD Manual 4715.03, ESA, EO 13186, AR 200-1, Texas Parks and Wildlife Code, Chapters 68 and 88
PROPONENTS: Natural Resources, Training Center Garrison Command

Mean global temperatures have been increasing over the past century and will likely continue to rise. It is predicted that the climate in Texas will continue to become hotter (3-10 °F average) and dryer over the next 50-100 years. It is also predicted that while lakes and streams will hold less water, the declining number of annual precipitation events will become more extreme, accentuating erosion and flooding issues. The changing climate will likely result in changes in plant and animal communities, and it may impact rare and endangered species on the installation. The TMD will implement adaptive management strategies on Camp Bowie to meet its combat readiness mission of providing realistic training environments while simultaneously assuring the long-term sustainability of the natural environment and species of concern.

Climate change and its impacts on natural resources are expected to occur gradually over the next 50-100 years. There are uncertainties associated with all aspects of the predicted changes (i.e. societal actions to reduce change, timing, magnitude, etc.). Adaptively managing Camp Bowie's natural resources in the face of climate change and associated uncertainties will require thorough periodic reviews of monitoring data (plants, animals, their communities, etc.), evaluations of species and community vulnerability, and adjustment of long-term management plans. Camp Bowie will initiate periodic vulnerability assessments of its natural resources in cooperation with the USFWS, TPWD, and other military installations. Periodic planning level surveys of plant and animal species and their communities will be conducted for use with vulnerability assessments and long-term management planning as needed.

Long-term management actions will require gradual incremental efforts and redirections, implemented as plant and animal communities change. For example, invasive plants will be removed to reduce competition with native species for declining resources. Drought tolerant native species will be planted back where invasive species have been removed to ensure appropriate species are present to fill new niches. Native riparian species will be established along streams to reduce erosion in the face of the predicted increase in extreme runoff events. Appropriate native species may also be established in the uplands to increase absorption and retention of precipitation, reducing the occurrence of flooding.

As competition for declining stored water resources in reservoirs and aquifers increases, resource management agencies will likely restrict nonessential water uses (landscaping) in favor of essential uses (drinking water). Educating Camp Bowie staff will be critical to helping them adjust to reductions in water availability. Educating Facilities Maintenance staff on xeriscaping concepts will aid them in planning landscape design and proper plant selection in dealing with reduced water availability. Educating staff about rainwater capture from roofs and other sources for use in meeting remaining landscape watering and other needs will be necessary as well.

Chapter 4. Plan Implementation

4.1 Coordination

Implementation of the INRMP is the final step in the planning process. Successful INRMP implementation involves public review and support, staffing, funding, revisions plans, cooperation and coordination within the TMD and other outside agencies. Coordination within the TMD includes discussion with, input to, and guidance from the Command Group, State Judge Advocate, Installation Management Division, Environmental, Plans Operations and Training, TCGC, ITAM, Master Planning, Public Affairs, and Army and Air National Guard decision makers. Outside agency coordination on land management includes USFWS, TPWD, and TFS.

4.2 Staffing

4.2.1 Environmental and Natural Resources

Environmental personnel, other than Natural Resources, who support implementation include the NEPA manager, hazardous waste manager, environmental engineer, cultural resources manager, and GIS technician. Natural Resources personnel consist of a natural resources manager, plant ecologist, wildlife biologist, pest coordinator, and a field biologist. They are responsible for conducting surveys and monitoring and providing expertise in brush management, ecological restoration, wildlife management, pest management, fire management, wetlands management, and rare species management.

4.2.2 ITAM

The ITAM Program currently has an ITAM Coordinator and a RTLA/LRAM Coordinator with the option to hire seasonal crews and other additional personnel. The ITAM Coordinator has oversight of projects related to soldier training, including environmental awareness materials, monitoring, ecological restoration, erosion repair and control, and vegetation management. The RTLA/LRAM Coordinator has oversight of projects related to monitoring, ecological restoration, erosion repair and control, and vegetation management

4.2.3 Training Center Staff

Some projects, particularly ITAM and maintenance projects, are managed by TCGC staff and completed through the state maintenance shop. These projects include road and range maintenance, small scale vegetation and erosion management, observation of buffer zones, identification of land management needs, and use of BMPs. The Base Operations Supervisor is responsible for managing incoming facility users, while avoiding conflicting land uses. Therefore, the Base Operations Supervisor is a key implementer of the policies described in this INRMP.

4.2.4 State Universities

The majority of survey and rare species projects are completed through agreements with state universities. The professors and graduate students at state universities are often the best experts for their fields within the state and can provide highly skilled crews for a variety of projects. Faculty, staff, and students at state universities are often involved in various contracted projects. University faculty are also encouraged to develop cost-share research projects using TMD training sites when such projects do not interfere with military training. TMD sites are often excellent places to conduct research due to controlled access and healthy ecosystems, particularly the regular presence of fires.

4.2.5 Contractors

Contractors are employed for larger projects whose scope is beyond in-house capabilities of the TMD. Contracts are let through a variety of mechanisms using either state or federal contracting procedures.

4.3 Annual Coordination

The primary means of annual review of INRMP implementation with trainers and facility managers will be through an annual coordination meeting involving all stakeholders. Regular updates are given at the Real Property Planning Board (RPPB) and/or through the Environmental Quality Control Committee (EQCC) and Quarterly Training Center Garrison Command TCGC briefings. At these reviews, the projects implemented in the last year and priorities for future projects will be reviewed and updated based on input from attendees using the table presented in Appendix F. In some cases, the USFWS and TPWD may be present at these meetings or separate reviews will be conducted with those agencies, depending on scheduling and availability of personnel. Every 5 years, a complete review for operational effect will be conducted with the same group to determine if major revision is required per the Sikes Act, SAIA, and associated DoD Policy (see Section 1.2.3).

4.4 Strategies for Implementation

There are 3 primary requirements for successful implementation: personnel, processes, and funding. Personnel are discussed above in Section 4.2. Processes include the RPPB, EQCC, NEPA, and Master Planning. These processes are all critical for incorporating natural resources needs and impacts in the planning for the TMD. They are also critical for prioritizing natural resources and land management projects and ensuring SOPs and BMPs are followed. These processes ensure that any land management supports the TMD mission and supports the sustainability of the TMD training lands. Any new land management activities not covered by this INRMP must be approved through the annual review meetings and may require additional NEPA analysis.

Funding comes from 3 primary sources: Environmental, ITAM, and Installation Management (see Table 4-1). Environmental funding generally covers listed species management, ecosystem management, planning level surveys, monitoring, and GIS requirements for natural and cultural resources, INRMP revisions, and salaries for Natural and Cultural Resources personnel. ITAM funding generally covers vegetation management to make land more suitable for training, ecological restoration needed as a result of training, erosion control and stream crossings needed for training, trail construction and maintenance, cultural site protection from training, monitoring of training impacts, and Environmental Awareness materials for soldiers. Installations funding generally covers facility maintenance, road construction and maintenance, landscaping, erosion recovery, BMPs, as well as some prescribed fire, wetland protection, and invasive species control projects.

Funding Source	Responsibilities
Environmental Conservation (VENQ)	Primary responsibility and funding for all land management related surveys, threatened and endangered species management, and INRMP, ICRMP, and IPMP development.
Environmental Compliance (VENC)	Primary responsibility for clean air and clean water, pollution prevention, hazardous waste, and hazardous materials.
SRP – ITAM	Primary responsibility and funding for recovering training damage, monitoring impacts of training, providing environmental awareness to soldiers training at sites, and preparing areas for training. In particular, responsible for removal of vegetation that inhibits training activities, creating and maintaining maneuver trails and hardened water crossings for tactical vehicles, and clearing other natural or man-made material to open land to maneuver and training. Does not pay for roads or naturally caused erosion within the training area.
SRP – RTLP	Primary responsibility and funding for maintaining and upgrading ranges
SRM – Sustainment and Modernization	Primary responsibility and funding for improvements and maintenance of structures, such as bridges, buildings, etc.
Department of Public Works (DPW) – Facilities Maintenance	Primary responsibility and funding for Facilities Maintenance and repairs, which include erosion repairs, invasive species control, pest control, brush management, and prescribed fires.
MWR – Moral, Welfare, and Recreation	MWR funds are the only TMD source of fishing docks, hike/bike trails, and other outdoor recreation facilities.

Table 4-1. Summary of Potential Funding Sources for Land Management from Army National Guard Funding Pathways
This does not include special funds that require grant writing or special application procedures from other elements within DoD.

Appendix A. Acronyms

AR	Army Regulation
ARNG-D	Army National Guard Directorate
ARNG G9	Army National Guard Installations and Environment Office
ASSON	Aerial Application Statement of Need
BMP	Best Management Practice
CFMO	Construction and Facilities Maintenance Office
CFR	Code of Federal Regulations
CRM	Cultural Resources Management
DA	Department of the Army
DAG-A	Deputy Adjutant General-Army
DoD	Department of Defense
DPW	Department of Public Works
EA	Environmental Assessment
eMS	Environmental Management System
EO	Executive Order
EQCC	Environmental Quality Control Committee
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FNSI	Finding of No Significant Impact
FY	Fiscal Year
G3/5	Operations and Training
GIS	Geographical Information System
HEAT	HMMWV Egress Assistance Trainer
HEL	Highly Erodible Lands
HUC	Hydrolic Unit Classification
IC	Incident Command
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
IPMC	Integrated Pest Management Coordinator
IPMP	Integrated Pest Management Plan
ITAM	Integrated Training Area Management
IWFMP	Integrated Wildland Fire Management Plan
LMWG	Land Management Working Group
LRAM	Land Rehabilitation and Maintenance
MLDP	Managed Land Deer Permitting
MOU	Memorandum of Understanding
MWR	Morale, Welfare, and Recreation
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NGB	National Guard Bureau
NGB-I&E	Environmental Programs Installations and Environment
NGO	Non-governmental Organization
NGTX-FE	Environmental Management Branch
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OED	Office of the Executive Director

PAO	Public Affairs Officer
PLS	Planning Level Survey
PMC	Pest Management Coordinator
POC	Point of Contact
POW	Prisoner of War
RCMP	Range Complex Master Plan
REC	Record of Environmental Consideration
RIFA	Red Imported Fire Ant
ROTC	Reserve Officer Training Corps
RPPB	Real Property Planning Board
RTLA	Range and Training Land Assessment
RTLP	Range and Training Land Program
Rx	Prescription
SAIA	Sikes Act Improvement Act
SHPO	State Historic Preservation Office
SO	Safety Officer
SOP	Standard Operating Procedure
SRA	Sustainable Range Awareness
SRP	Sustainable Range Program
TA	Training Area
TAG	Adjutant General
TCEQ	Texas Commission for Environmental Quality
TCGC	Training Center Garrison Command
TFS	Texas A&M Forest Service
THC	Texas Historical Commission
TMD	Texas Military Department
TPWD	Texas Parks and Wildlife Department
TRI	Training Requirements Integration
TRS	Training
TXANG	Texas Air National Guard
TXARNG	Texas Army National Guard
TXSG	Texas State Guard
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

Appendix B. Glossary

Adaptive management – A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.

Billet – A shelter for troops or the act of sheltering troops.

Biological opinion – The document that states the opinion of the USFWS as to whether or not the federal agency action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Bivouac – A temporary military encampment that is usually formed in an unsheltered area.

Conservation – The wise use and scientific management of natural resources according to principles that provide optimum public benefit, continued productivity for present and future generations, and support of the military mission.

Critical habitat – Specific areas within the geographical area occupied by the species at the time it is listed in accordance with the ESA, on which are found those physical or biological features (1) essential to the conservation of the species and (2) which may require special management considerations or protection. It includes specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the ESA, upon a determination by the Secretary of the Interior or Commerce that such areas are essential for the conservation of the species.

The areas formally designated as critical habitat by the USFWS are listed in 50 CFR 17 and 226.

Cultural Resources management – Similar to Natural Resources management but for cultural resources, which include Native American archeological sites and traditional cultural properties, historic archeological sites, and buildings potentially eligible for the National Register of Historic Places.

Cumulative effects – Effects of future state or private activities, not including federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation.

Destruction – The direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and the recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.

Ecosystem – An interconnected and symbiotic grouping of animals, plants, fungi, and microorganisms.

Ecosystem management – A strategy or plan to manage ecosystems to provide for all associated organisms, as opposed to a strategy or plan for managing individual species.

Endangered species – A species that is in danger of extinction throughout all or a significant part of its range; a species on a federal or state endangered species list.

Endemic – A species restricted to and native to a particular geographic area.

Environmental Assessment – A document required by NEPA if there is the potential for environmental impact as a result of federally funded activities.

Environmental quality – The development and maintenance of harmonious interaction between man and that part of the world in which living organisms can sustain their kind.

Fauna – The total animal population that inhabits an area.

Fire management –Managing fire on a given landscape, both in carrying out prescribed fires and in deciding which wildfires to fight and which to contain but let burn.

Flora – The total vegetation assemblage that inhabits an area.

Forest management – The science, the art, and the practice of managing the natural resources that occur on or in association with forest lands. The achievement of management goals will result in optimal benefits to humankind and indigenous forest ecosystem inhabitants.

Goal – Broad summary of long-term intention.

Grounds – The term is used to classify installation acreage according to the level of grounds maintenance required and includes all land and water acreage for which an installation commander has responsibility (including satellite areas). See improved grounds and unimproved grounds.

Habitat – An area where a plant or animal species lives, grows, and reproduces, and the environment that satisfies any of its life requirements.

Habitat heterogeneity – Variation in habitat types present in a location; typically, more heterogeneity means higher species richness partially due to more microclimates.

Heavy maneuver training – Training that utilizes heavy equipment, usually tracked vehicles such as tanks and Bradleys, during exercises.

Hydrology – Scientific study of the properties, distribution, and effects of water on the Earth's surface, in the soil and underlying rocks, and in the atmosphere.

Improved grounds – This category includes acreage on which intensive grounds maintenance activity must be planned and performed annually as fixed requirements. Activities include mowing, irrigation, fertilization, cultivation, aeration, seeding, sodding, spraying, pruning, and trimming; weed, dust, and erosion control; drainage, planting for landscape effect, wind and sound abatement, and other intensive practices. See grounds and unimproved grounds.

Informal consultation – An optional process that includes all discussions, correspondence, etc. between the USFWS and a federal agency prior to formal consultation, if required.

Integrated Training Area Management (ITAM) Program – An Army program for the management of military training and testing lands and other land uses.

Invasive species – Non-native species of plants or animals that out-compete native species in a specific habitat.

Land management – The planning and execution of programs to improve, utilize, and maintain all land and water areas for the greatest long-term net public benefit while supporting the military mission.

Included are subordinate land uses that are mutually compatible and consistent with maintaining environmental qualities.

Light maneuver training – Military training exercises that involve maneuvering across the landscape, but without the use of heavy equipment or tracked vehicles.

Listed species – Any species of fish, wildlife, or plant that has been determined to be endangered or threatened under Section 4 of the ESA. Listed species are found in 50 CFR 17.11-17.12.

Natural resources – The viable and/or renewable products of nature and their environments of soil, air, and water. Included are the plants and animals occurring on grasslands, rangelands, croplands, forests, lakes, and streams.

Non-native species – A plant or animal species found outside its natural range.

Noxious weed – Plant species identified by federal or state agencies as requiring control or eradication.

Objective – Specific item to be achieved that supports one or more Goals.

Off-road vehicle – A vehicle designed for travel on natural terrain. The term excludes a registered motorboat confined to use on open water and a military, emergency, or law enforcement vehicle during use by an employee or agent of the government or one of its contractors in the course of employment or agency representation.

Outdoor recreation – Recreational program, activity, or opportunity that is dependent on the natural environment. Examples are hunting, fishing, trapping, picnicking, bird-watching, off-road vehicle use, hiking and interpretive trails use, wild and scenic river use, and underdeveloped camping areas.

Developed or constructed activities such as golf courses, lodging facilities, boat launching ramps, and marinas are not included.

Prescribed fire – Planned, controlled fire (also called prescribed burn); or wildfires managed under prescribed conditions.

Project – Specific activity derived from Targets; often a "project" is a "contract"; a "target" is sometimes a "project" as well.

Range – A designated land or water area that is set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration.

Rare species – A species that is not widely distributed or has a small population size, although not necessarily on an endangered or threatened list.

Recovery – The improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA.

Riparian areas – Areas located alongside a watercourse, typically a river or stream.

Sedimentation – The process that deposits soils, debris, and other materials either on the ground surfaces or in bodies of water or watercourses.

State-listed species – Any species, plant or animal, that is listed by the appropriate state as threatened or endangered within the state, but it may not be listed by the U.S. Department of the Interior.

Target – Measurable outcome with deadline to achieve Objective.

Threatened species – A species of flora or fauna likely to become endangered within the foreseeable future; a species on a federal or state threatened species list.

Unimproved grounds – All other acreage (including water areas, areas under buildings, and surfaced areas), not classified as improved or semi-improved. Practices and intervals of attention are generally unpredictable such as might evolve from flood, fire, insects, or disease epidemics.

Vegetation community – A collection of plants that combined make up a distinct community.

Watershed – A region or area over which water flows into a particular lake, reservoir, stream, or river.

Wetlands – Land (marshes or swamps) saturated with water constantly or recurrently; conducive to high biodiversity.

Wildfire – Unplanned or uncontrolled fire caused naturally, accidentally, or intentionally.

Wildland fire – All fires, including wildfires and prescribed fires, that occur in areas without buildings or other urban infrastructure.

Wildlife management – The practical application of scientific and technical principles to wildlife populations and habitats so as to maintain such populations essentially for ecological, recreational, and/or scientific purposes.

Woody encroachment – Growth and spread of woody plants (i.e. plants that have woody stems once mature) into an area that was previously grassland.

Appendix C. Laws, Regulations, Executive Orders, and Policies

C.1 Introduction

The management of TMD lands is guided by public laws, EOs, rules, and regulations, directives of the DoD, and Army policies. Policy sets the framework and provides direction for management decisions. It is the goal of the Environmental Branch to protect, preserve, and enhance the environmental diversity and integrity of training land while providing a realistic training environment and ensuring that the training requirements and force readiness goals are met.

C.2 Federal Laws

32 CFR 190 – Natural Resources Management Program (22 February 1989): prescribes policies and procedures for an integrated program for multiple-use management of natural resources on property under DoD control.

32 CFR 651 – Environmental Analysis of Army Actions (29 March 2002): revises policy and procedures for implementing the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations in the Code of Federal Regulations (CFR). These guidelines replace policy and procedures found in current Army Regulation 200-2, Environmental Effects of Army Actions.

(7 USC 2801) Federal Noxious Weed Act: gives the Secretary of Agriculture "the authority to designate plants as noxious weeds by regulation, and the movement of all such weeds in interstate or foreign commerce was prohibited except under permit." The Secretary was also given authority to "inspect, seize and destroy products, and to quarantine areas, if necessary to prevent the spread of such weeds."

(16 USC 670) Sikes Act of 1960 (Public Law 86-797): requires military installations to provide public access for those uses that are appropriate and consistent with the military mission. It also requires the DoD to implement and maintain INRMPs and a program of planning for and maintenance of wildlife, fish, game, and non-game conservation.

National Environmental Policy Act (NEPA) of 1969: provides the broad national framework for protecting the environment. It assures that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment.

(10 USC 2671) Military Reservations and Facilities – Hunting, Fishing, and Trapping: requires that all hunting, fishing, and trapping at an installation or a facility be in accordance with the fish and game laws of the state or territory in which it is located.

(16 USC 460) Endangered Species Act (ESA) of 1973: protects threatened and endangered plant and animal species and their critical habitat. It requires all federal agencies to consult with the USFWS on any activities that may negatively impact those species or their habitat. It also requires federal agencies to contribute to recovery of listed species.

(16 USC 703-711) Migratory Bird Treaty Act of 1918: prevents taking, killing, and possessing neotropical birds, their nests, and eggs.

Clean Water Act (as amended through 2002): regulates the discharges of pollutants to waters of the United States and sets effluent standards on an industry basis and sets water quality standards for all contaminants in surface waters.

Clean Air Act (as amended through 1990): regulates air emissions from area, stationary, and mobile sources. This law allowed for the establishment of National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972: provides federal control of pesticide distribution, sale, and use. Requires that users receive certification as applicators of pesticides. All pesticides used in the United States must be registered (licensed) by the Environmental Protection Agency.

C.3 Executive Orders

EO 11988, Floodplain Studies (24 May 1972): requires agencies to evaluate the potential effects of proposed undertakings on floodplain areas and to ensure that action take into account flood hazards and floodplain management needs. This EO provides agencies with guidance in questions of development in floodplain contexts and suggests avoidance of such development whenever possible.

EO 11989 and 11644, Use of Off-Road Vehicles on Public Lands: Mandates that USDI, USDA, DOD, and Tennessee Valley Authority shall control and direct off-road vehicle use to protect the resources, maximize safety and minimize conflict. EO 11989 exempts emergency and military vehicles from regulation and authorizes land managers to close any areas to off-roads vehicles if considerable adverse impact will be or has been caused by off-road vehicles.

EO 11990, Protection of Wetlands: minimizes the destruction, loss, or degradation of wetlands to enhance the natural and beneficial values of wetlands.

EO 12962, Recreational Fisheries: mandates that federal agencies shall improve the quantity, function and sustainable production of aquatic resources for recreational fishing.

EO 13112, Invasive Species: prevents the introduction of invasive species, monitors and controls existing populations of invasive species, and restores native species.

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds: directs federal agencies to promote the conservation of migratory bird populations in conjunction with USFWS.

EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management: mandates that "Federal agencies conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner."

C.4 Army Regulations

AR 200-1 Environmental Protection and Enhancement and Pamphlet 200-1: provide an overview of environmental programs and requirements. The pamphlet describes Army procedures for preserving, protecting, and restoring environmental quality in accordance with Army Regulation 200-1.

C.5 Army National Guard Regulations

Army National Guard, Guidance, Army National Guard Directorate, Environmental Programs Division Guidance for the Creation, Implementation, Review, and Revision and Update of Integrated Natural Resource Management Plans (09 April 2012): provide an overview of how TXARNG will review and seek approval for INRMPs as well as how the TMD will request funding from ARNG G9, and specific

requirements for what must be included in the INRMP.

C.6 Department of Defense Policies

DoD Instruction 4715.03 (18 March 2011) – Environmental Conservation Program: implements policy, assigns responsibilities, and prescribes procedures for the integrated management of natural and cultural resources on property under DoD control.

DoD Manual 4715.03 (25 November 2013) – INRMP Implementation Manual: provides procedures to prepare, review, update, and implement INRMPs in compliance with section 670-670o of Title 16, USC, also known as the Sikes Act.

DoD Manual 5525.17 (17 October 2013) – Conservation Law Enforcement: establishes Conservation Law Enforcement organizations, authorities, etc.

C.7 State Laws and Regulations

Texas Department of Agriculture (as filed with the Office of the Secretary of State on 17 Dec 2004), Chapter 19, Quarantines and Noxious Plants: outlines how TXDA adopts lists of noxious plants. New §19.300 is adopted to establish a noxious plant list in accordance with the passage of Senate Bill 854, 78th Texas Legislature, 2003, which amended the Texas Agriculture Code (the Code), by adding new §71.151. Section 71.151 requires the department by rule to publish a list of noxious plant species that have serious potential to cause economic or ecological harm to the state.

Parks and Wildlife Code (amended through 1 Sept 1997), Chapter 66, Fish: outlines guidelines for fishing as well as polices relating to the treating of fish.

Parks and Wildlife Code (as amended through 26 Aug 1991) Chapter 88, Endangered Plants: defines what classifies a plant as endangered and outlines the policies concerning the treatment of said plants.

Appendix D. Standard Operating Procedures

D.1 Red Imported Fire Ant Treatment Protocol

Standard Operating Procedure (SOP)
Red Imported Fire Ant Treatment Protocol

Date: 8 May 2015
Number:

Texas Military Department
2200 West 35th Street
Austin, TX 78703

OPR: Construction & Facilities Maintenance Officer (CFMO)
Environmental Branch

Official: _____
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To establish a protocol for the routine treatment of red imported fire ants (RIFAs) at facilities with minimal impact on native ants and minimal use of pesticides.

Applicability. This SOP is applicable to all personnel involved maintaining facilities, particularly around buildings and on ranges. Only Texas State certified pesticide applicators or personnel trained in the self-help program by the Integrated Pest Management Coordinator (IPMC) may apply pesticides, and only using pesticides authorized at their certification level.

Management Control Process.

Proponent and Exception Authority. The proponent for this SOP is the Director of Construction and Facilities Maintenance Office (CFMO). The deputy director and Environmental Branch Chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through the CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

Suggested Improvements. Users are invited to send comments and suggested improvements concerning this SOP directly to the CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

Distribution. A

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Chapter 1. Responsibilities

Facility managers will ensure this protocol is distributed and utilized by maintenance personnel when necessary. Maintenance personnel will follow the guidelines described here to treat RIFAs to minimize impact to the environment, while reducing the impact of RIFAs on people, equipment, and property.

Chapter 2. Protocol

1. This protocol is designed to protect people, equipment, and property while minimizing impacts to native animals and the environment.

2. Only Texas State certified pesticide applicators or personnel trained in the self-help program by the IPMC may apply pesticides, and only using pesticides authorized at their certification level.

3. Only direct mound application methods at the application rate described on the product label are authorized. Broadcast methods will not be used even if they are described on product labeling.

4. Inspect the volume of pesticide in the product container (i.e., 1/2 package, 1/4 package, etc.) prior to beginning application and record the observation on the self-help reporting form or other appropriate form.

5. Implement individual mound treatment methods at the label rate. Pesticides will be applied around mounds but not directly on the disturbed soil.

6. Inspect the volume of pesticide remaining in the product container after application is complete. Use the volume estimates to estimate the proportion of the product in the container that was used (i.e., 1/2 package, 1/4 package, etc.) and record on the reporting form. Record the total package volume (i.e., 2 lb. etc.) on the form. Provide the reporting form to the IPMC (NGTX-FE, 512-782-6218).

7. Monitor the site periodically to determine if the treatment worked and when reapplication is needed.

Chapter 3. Restrictions

1. Applications should be made in early spring and mid-fall. Fall applications only may be sufficient at some locations.

2. Applications should be made when the temperature is between 70-80 °F. Bait will become rancid quickly on hot days, and ants will be less active on cold days.

3. Do not apply baits if rain is likely within the next 48 hours or within 24 hours after a heavy rain.

4. Report pounds of active ingredient applied to IPMC (NGTX-FE, 512-782-6218) as with other pesticides and herbicides.

5. Only Texas State certified pesticide applicators or personnel trained in the self-help program by the IPMC may apply pesticides on federal or state-owned land.

Chapter 4. Recommended Chemicals

Only chemicals on the IPMP or self-help lists for the given applicator's certification level or with prior approval from the IPMC may be used. Contractors and staff must contact the IPMC at 512-782-6218 to confirm authorizations of chemicals that are not on the lists prior to application.

Chapter 5. Points of Contact

1. A copy of this SOP is kept in Appendix D of the INRMP and the Environmental Compliance Toolkit. It is also available on the Environmental website and Lone Star Portal.

2. Questions should be directed to NGTX-FE, IPMC at 512-782-6218.

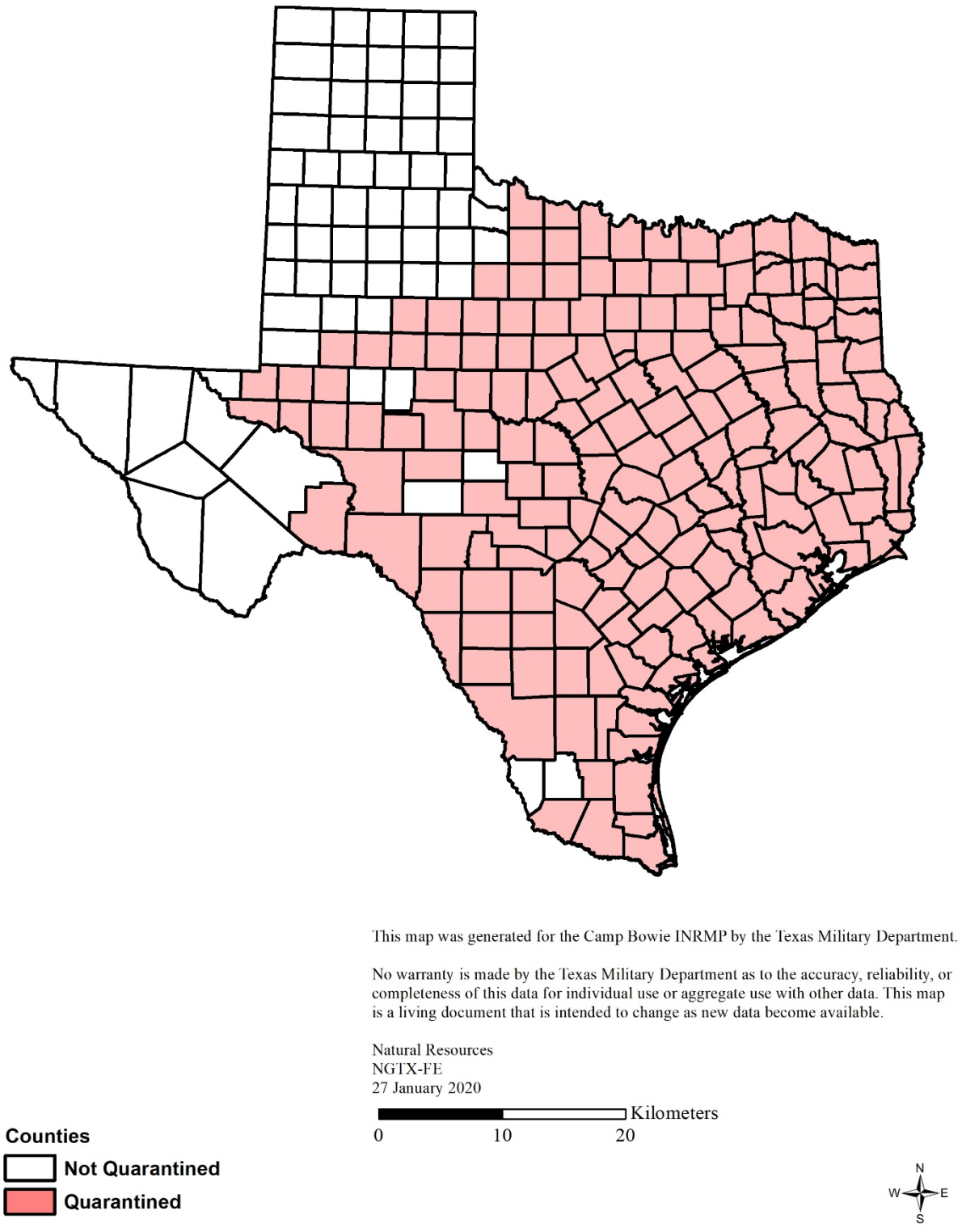

Figure D-1. Red Imported Fire Ant Quarantine Areas of Texas

D.2 Protocol for Tree Management

Standard Operating Procedure (SOP)

Tree Management

Number:

Texas Military Department
2200 W. 35th St
Austin, TX 78703

OPR: Construction & Facilities Management Officer (CFMO)
Environmental Branch

Official: John L. Davis
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To ensure that any activities associated with tree management on state or federal Texas National Guard properties are performed in a manner that ensures long-term tree health. This SOP establishes a protocol for trimming, pruning, cutting and care of trees. The protocol should result in a reduced incidence of oak wilt and the spread of other diseases in trees and a heightened awareness of general management techniques.

Applicability. This SOP applies to all TMD persons responsible for direct or indirect maintenance, care, and health of all species of trees within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving trees. The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director, and environmental branch chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

Suggested Improvements. Users are invited to send comments and suggested improvements concerning this SOP directly to Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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Figure 1 -
Oak Wilt Occurrence in Texas Counties.

Chapter 1. Tree maintenance request procedures.

1. No tree(s) will be disturbed, cut, trimmed, or removed without prior approval from CFMO Environmental Branch.

2. To prevent the spread of oak wilt and other disease, all equipment used for tree management will be sterilized with a solution of either Lysol TM spray or a 70% rubbing alcohol solution. Arrangements should be made ahead of time regarding disposition of any parts of trees that are removed.

3. Avoid pruning oaks from February 1 through June 1, due to increased susceptibility to the spread of oak wilt.

4. All wounds on oaks shall be painted with a commercial pruning paint immediately after the wound has been made. This includes cutting and trimming of limbs as well as accidents produced by weed eaters, bulldozers, mowers, wind damage or other trauma.

5. Oak trees that are damaged by weather or have fallen limbs should be painted as quickly as possible.

6. Digging or trenching under the canopy of a tree requires prior approval and a Record for Environmental Consideration (REC) process. The Environmental Branch of CFMO, must review and approve these RECs prior to the implementation of any action. The form may be found here; https://portal.tx.ng.mil/arg/arg010/SitePages/env_rec.aspx..

7. In the event that a sick or distressed tree or group of trees is observed, notify CFMO Environmental immediately. Signs of stress or illness include sloughing of bark, browning, and shedding leaves during the growing season.

Chapter 2. Points of contact.

1. Questions, Natural Resources Manager, Dr. Linda Brown, at 512-782-5818.

2. Camp Mabry requires authorization from either Dr. Linda Brown 512-782-5818 or Mr. Pete Byers 512-782-5709.

3. Digging or trenching 512- 782-5818.

4. Sickness or distresses 512-782-5818 or 512-782-6227.

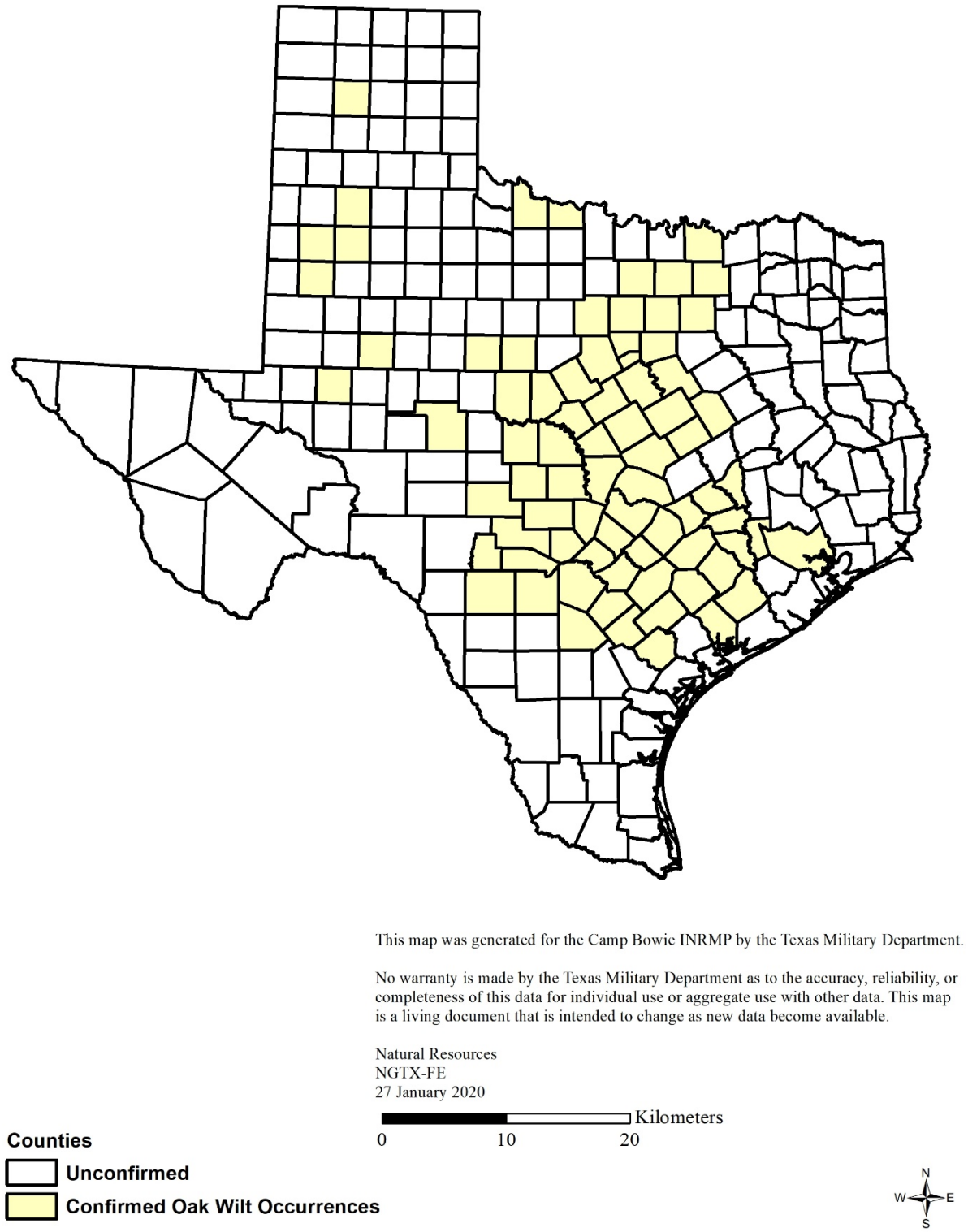

Figure D-2. Oak Wilt Occurrences in Texas Counties.

D.3 Landscaping Design Guidelines

Standard Operating Procedure (SOP)

Landscaping Design

Number:

Texas Military Department
2200 W. 35th St
Austin, TX 78703

OPR: Construction & Facilities Management Officer (CFMO)
Environmental Branch

Official: John L. Davis
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To establish protocol for landscape design in cantonment areas and near structures.

Applicability. This SOP applies to all TMD persons responsible for direct or indirect maintenance, care, and up keep of the grounds within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving landscape modificaiton or design. The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director, and environmental branch chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

Suggested Improvements. Users are invited to send comments and suggested improvements concerning this SOP directly to Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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Chapter 1. Responsibilities

1. Engineers and architects under the Construction and Facility Management Office (CFMO) are responsible for ensuring that these guidelines are incorporated into new designs and, where applicable, modifications of existing structures.

2. Natural Resource staff are responsible for reviewing any landscape plans.

3. Cultural Resource staff are responsible for reviewing any landscape plans for consistency near buildings of historical significance. Facilities and Engineering staff are responsible for reviewing security concerns.

Chapter 2. Guidelines

1. Landscaping projects shall emphasize native plants, water conservation and low maintenance according to Texas Parks and Wildlife and the Texas Extension Service guidelines.

2. Soil moisture and amount of sun, as well as use of area are key design considerations. Trees should have pervious cover from trunk to dripline and any grade changes will require review and tree protection. In areas with high deer density, considerations should be given to preventing mortality from deer.

3. In some locations, a soil analysis is critical for successful landscape design. Most locations would benefit from the addition of organic matter to landscaping beds.

4. Turf areas should be minimized to the extent practical. Turf areas typically require more maintenance and greater water. Native grass turf areas are a feasible alternative with low maintenance and no watering needs (after establishment).

5. Use plants native to ecoregion that do well in the soil and climate of the area. This reduces maintenance, fertilizer needs, pest problems, watering and mortality as well as providing habitat for other organisms. Invasive plants, or plants prone to escaping cultivation, should never be used. Adapted, non-invasive plants may be approved on a case-by-case basis.

6. Mulch should be applied with landscape installation and during the 1 year maintenance period. Until the plants are well established and there is minimal bare ground, mulch should be top-dressed once or twice a year. Mulch near buildings should be discussed with project engineer or architect to minimize potential termite damage.

7. Have temporary driplines installed during plant establishment. After establishment,

native plants should only require additional water during times of drought. In that case, only water occasionally but thoroughly to promote good root growth, preferably with a drip line. Trees and shrubs should receive supplemental watering inside the dripline of the tree during first two years as needed, typically once a month during dry periods.

8. One year of maintenance should be included in any landscaping contract. This guarantees that the landscaping company will weed, irrigate, mulch and replace any plants that die during the critical first year of plant establishment. After the initial year, minimize mowing to turf areas to promote good ground cover and root growth. Higher turf height (3" or higher) can also reduce storm water runoff and pollution from impervious areas. Fertilizer (non-chemical) and water should only be applied as needed.

9. Typically vegetation within 10 meters of an 'inhabited' building (not storage structures) must have clear line of sight in the 6' immediately above the soil. Security criteria are addressed in the Unified Facility Criteria (UFC) 4-010-01 and Security Construction Measures can be obtained from Facility and Engineering staff.

10. Project specific plant lists can be developed in conjunction with Natural Resource staff.

Chapter 3. Points of contact.

1. Natural Resources Manager, Dr. Linda Brown, at 512- 782-5818.

D.4 Activities Near or In Water Ways

Standard Operating Procedure (SOP)

Activities Near or In Water Ways

Number:

Texas Military Department
2200 W. 35th St
Austin, TX 78703

OPR: Construction & Facilities Management Officer (CFMO)
Environmental Branch

Official: John L. Davis
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To establish protocols for maintenance and use of areas in or near waterways to include perennial or intermittent (dry) streams, stock tanks, ponds and lakes.

Applicability. This SOP applies to all TMD persons responsible for direct or indirect maintenance, care, and up keep of the grounds within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving waterways. The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director, and environmental branch chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

Suggested Improvements. Users are invited to send comments and suggested improvements concerning this SOP directly to Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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Chapter 1. Responsibilities

1. Facility managers are responsible for ensuring that users and maintenance personnel follow this SOP.

2. Facilities & Engineering are responsible for ensuring any designs or contracts adhere to this SOP.

Chapter 2. Guidelines

1. Water resources are critical to the long-term sustainability of the facility and the associated vegetation provides critical filtration and erosion management.

2. Vegetation management. Vegetation shall never be removed (mowed or otherwise) up to the edge of a water body or waterway. At least a 25 foot buffer shall be undisturbed. Disturbance of vegetation for an additional 75 feet should be limited.

3. Access points. Access points will be designed to minimize erosion and will only be as large as necessary for the type of access.

4. Adjacent roads and trails. Roads adjacent to or crossing waterways or water bodies require extra care during maintenance. Vegetation buffers shall be maintained between roads and water resources. Mowed buffers are not effective. Stream crossings should be either armored low water crossings or a span crossing. See SOP for Unimproved Roads for more details on stream crossings and maintaining roadsides. See SOP for Trails, Fence lines and Firebreaks for more details on maintaining those features.

5. Fishing. No live bait except grubs and worms will be used unless it is caught within the water body that is being fished. All fishing will be “catch and release” unless otherwise posted and approved by Natural Resources.

6. Decontamination of Equipment. ALL equipment (including boats, nets, and boots) will be free from any debris before entering any water body or waterway. ALL equipment will be thoroughly rinsed and dried before entering any water body or waterway. This minimizes the spread of aquatic plants and animals, particularly invasive ones such as *Hydrilla*, Zebra, Mussels, and *Corbicula* clams.

Chapter 3. Points of contact.

1. Questions, Natural Resources Manager, Dr. Linda Brown, at 512-782-5818.

2. Digging or trenching 512-782-5818.

D.5 Brush Piles

Standard Operating Procedure (SOP)

Brush Piles

Number:

Texas Military Department
2200 W. 35th St
Austin, TX 78703

OPR: Construction & Facilities Management Officer (CFMO)
Environmental Branch

Official: John L. Davis
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To ensure that any activities associated with burning of brush on state or federal Texas National Guard properties are performed in a manner that ensures smoke reduction and reduction of unintended burn areas. This SOP establishes a protocol for activities regarding brush management. The protocol should result in a reduction in smoke produced and a reduction in the potential for unintended burn or fire spread.

Applicability. This SOP applies to all TMD persons responsible for direct or indirect maintenance, care, and removal brush piles of any size within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving requests for any proposed action involving the burning of brush piles, (A brush pile is defined as any 'woody' vegetation removed and stocked or piled in any size.) The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director, and environmental branch chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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Chapter 1. Responsibilities

1. Facilities & Engineering are responsible for ensuring contracted design or maintenance work complies with this SOP.

2. Maintenance personnel at training sites are responsible for ensuring activities comply with this SOP.

3. The Wildland Fire Program Coordinator is responsible for evaluating requests for proposed action involving the creation or burning of brush piles.

Chapter 2. Guidelines

1. Prior approval for creating or adding to brush piles is required through the Record for Environmental Consideration (REC) process. The Environmental Branch of CFMO, must review and approve these RECs prior to the implementation of any action. The form may be found here; https://portal.tx.ng.mil/arg/arg010/SitePages/env_rec.aspx. Brush piles that require a prescribed burn for disposal or that may increase wildland fire risk must be coordinated with the Wildland Fire Coordinator.

2. Brush piles should only be used as a last resort to prevent unnecessary smoke production near sensitive receptors and soil sterilization. Other means of brush disposal must be considered first, such as chipping, leaving brush in place, hauling the brush off site, or considering a different location to clear.

3. Brush piles cannot be created within 300 feet of an exterior boundary.

4. Brush piles can only be created using a fork attachment (or similar). Bulldozer blades shall not be used due to the loss of topsoil. In addition, the resulting soil in the brush pile does not allow for combustion of the materials and creates more smoke than necessary.

5. Brush pile burning is a prescribed fire and therefore a prescription must be on file in NGTX-FE and reviewed and approved by qualified personnel. The brush pile must be burned by qualified personnel and monitored by personnel until smoke is no longer produced for 24 hours.

Chapter 3. Points of contact.

1. Natural Resources Manager, Dr. Linda Brown, at 512-782-5818.

2. Wildland Fire Coordinator, Mr. Wayne Strebe, at 512-782-6227.

D.6 Roadside and Dam Mowing

Standard Operating Procedure (SOP)

Roadside and Dam Mowing

Number:

Texas Military Department
2200 W. 35th St
Austin, TX 78703

OPR: Construction & Facilities Management Officer (CFMO)
Environmental Branch

Official: John L. Davis
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To ensure that any activities associated with mowing of roadsides and earthen dams on state or federal Texas National Guard properties are performed in a manner that ensures long-term health of native vegetation. This SOP establishes a protocol for trimming, pruning, cutting and care of native species. The protocol should result in an increase to critical habitat and a heightened awareness of general management techniques.

Applicability. This SOP applies to all TMD persons responsible for direct or indirect maintenance, care, and health of all species of vegetation within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving removal, planting, digging, and extension of mow buffers on or near waterways. The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director, and environmental branch chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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CFMO SOP

Chapter 1. Responsibilities

1. Facility managers are responsible for ensuring that users and maintenance personnel follow this SOP.

2. Facilities & Engineering are responsible for ensuring any designs or contracts adhere to this SOP.

Chapter 2. Guidelines

1. Vegetation, especially native flowers and grasses, are critical to native pollinators. By reducing the width of roadside mowing, reducing the number of times mowed, and by timing mowing to certain times of the year, critical habitat can be protected for these species.

2. Vegetation management. Vegetation shall never be removed (mowed or otherwise) up to the edge of a water body or waterway. At least a 25 foot buffer shall be undisturbed. Disturbance of vegetation for an additional 75 feet should be limited.

3. Roadsides. Mowing along roadsides should be limited to one mower width along each side of the road. Roads adjacent to or crossing waterways or water bodies require extra care during maintenance. Vegetation buffers shall be maintained between roads and water resources. Mowed buffers are not effective.

4. Dams. Dams should be mowed no more than twice a year in late fall (November) and or early spring (February) the vegetation located on dams is prime habitat for Milkweed and other pollinator species.

5. Decontamination of Equipment. ALL equipment should be regularly cleaned to prevent the spread of invasive nonnative plants. Strongly washing all machinery, blades and undercarriages is mandatory.

Chapter 3. Points of contact.

1. Natural Resources Manager, Dr. Linda Brown, at 512-782-5818.

D.7 Migratory Birds

Standard Operating Procedure (SOP)
Migratory Birds

Date:
Number:

Texas Military Department
2200 West 35th Street
Austin, TX 78703

OPR: Construction & Facilities Maintenance Officer (CFMO)
Environmental Branch

Official: _____
John L. (Les) Davis
COL, IN, TXARNG
Director, CFMO

Summary. To ensure that any activities associated with migratory bird management on state or federal Texas National Guard properties are performed in a manner that ensures long-term health of migratory bird habitat. This SOP establishes a protocol for activities during the nesting season and nest disturbance The protocol should result in an increase in migratory bird habitat and a heightened awareness of general management techniques.

Applicability. This SOP to all TMD persons responsible for direct or indirect maintenance, care, and health of all migratory bird species within TMD property.

Management Control Process. CFMO Environmental Branch is responsible for evaluating requests pertaining to any proposed action involving migratory birds and their habitat. The evaluation shall include compliance issues related to local, state, and federal laws.

Proponent and Exception Authority. The proponent for this SOP is the Director of CFMO. The deputy director and Environmental Branch Chief have authority to approve exceptions to this SOP consistent with controlling guidance and regulation.

Supplementation. Supplementation of this SOP or establishment of command and local forms on (subject of SOP) is prohibited without prior approval from the Director (CFMO), through the CFMO Operations Office, ATTN: CFMO, P.O. Box 5218, Austin, TX 78763-5218.

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Chapter 1. Responsibilities

1. Facility managers are responsible for ensuring that users and maintenance personnel follow this SOP.

2. Facilities and Engineering are responsible for ensuring any designs or contracts adhere to this SOP.

3. The Wildland Fire Program Coordinator is responsible for evaluating requests for proposed action involving the burning of vegetation.

Chapter 2. Guidelines

1. Migratory birds use a variety of habitats to raise young and rest during long journeys on their migratory routes. With proper management, habitat can be protected for these species.

2. No bird nest(s) will be disturbed or removed without prior approval from CFMO Environmental Branch. If a nest is found during work, establish a 50 meter no work zone and then contact CFMO Environmental Branch.

3. Vegetation management. All vegetation removal requires prior approval and a Record for Environmental Consideration (REC) process. The Environmental Branch of CFMO must review and approve these RECs prior to the implementation of any action. The form may be found here: https://portal.tx.ng.mil/arg010/SitePages/env_rec.aspx.

4. Limit habitat disturbance during the breeding season, between March and April.

5. Vegetation burning is a prescribed fire and, therefore, a prescription must be on file in NGTX-FE and reviewed and approved by qualified personnel. Vegetation must be burned by qualified personnel and monitored by personnel until smoke is no longer produced for 24 hours.

Chapter 3. Points of Contact

1. Natural Resources Manager, Dr. Linda Brown, at 512-782-5818.

2. Wildland Fire Coordinator, Mr. Wayne Strebe, at 512-782-6227.

D.8 Integrated Pest Management Plan

Refer to the 2018 Integrated Pest Management Plan for information on Pest Management and Self Help of Pest Manaegement.

https://portal.tx.ng.mil/Pages/Default.aspx

Appendix E. Environmental Assessment

FINDING OF NO SIGNIFICANT IMPACT (FNSI)
IMPLEMENTATION OF AN
INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN (INRMP),
CAMP BOWIE, BROWN COUNTY, TEXAS

Refer to the 2006 Environmental Assessment for information.

\\ng.ds.army.mil\ngtx\G-Drive\CFMO\ENVIRONMENTAL\Natural_Resources

Enviro Tracking #:	ARNG ENVIRONMENTAL CHECKLIST	State ARNG
	Enter information in the yellow shaded areas.	Texas

PART A - PROJECT INFORMATION

1. PROJECT NAME:

Camp Bowie 2020 INRMP

2. PROJECT NUMBER: (MILCON if applicable)	3. DATE PREPARED:
N/A	8/4/2020

4. DESCRIPTION AND LOCATION OF THE PROJECT/PROPOSED ACTION:

a. Location (Include a detailed map, if applicable):

Camp Bowie. State and Federal lands 8,753ac

b. Description:

Project consists of updating the 2020 INRMP for Camp Bowie. The INRMP was updated to bring it up to date with current and future projects, agreements with USFWS and the state wildlife agency and other partners in implementing natural resources conservation. An EA was completed for the original INRMP in 2006 TXARNG took a "hard look" at the existing EA, per 32 CFR 651.5.g.2, to ascertain the adequacy of

c. The proposed action will involve (check all that apply):

- ☐ Training activities/areas
- ☐ Maintenance/repair/rehabilitation
- ☐ Innovative readiness training project
- ☐ Other (Explain):
- ☐ Construction
- ☐ Real estate action
- ■ Natural resource management
- ■ Environmental plans/surveys

d. Project size (acres): 8,753 (if applicable) Acres of new surface disturbance (proposed): 0 (if applicable)

5. START DATE of PROPOSED ACTION (dd-mmm-yy): 10/1/2020 Note: This must be a future date.

6. PROGRAMMED FISCAL YEAR (if applicable):

7. END DATE (if applicable):

PART B - DECISION ANALYSIS GUIDE

To use a categorical exclusion, the project must satisfy the following three screening criteria: no segmentation, no exceptional circumstances and a qualifying categorical exclusion that covers the project. The following decision tree will guide the application and documentation of these three screening criteria. The criteria were extracted from 32 CFR Section 651.29 and represent the most common screening conditions experienced in the ARNG. NOTE: Each question in Part B must have an applicable block checked for concurrence with REC.

1. Is this action segmented (the scope of the action must include the consideration of connected, cumulative, and similar actions)? ☐ YES (go to #30) ■ NO (go to #2)

2. Is there reasonable likelihood of significant environmental effects (direct, indirect,and cumulative)? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question. ☐ YES (go to #30) ■ NO (go to #3)

3. Is there a reasonable likelihood of significant effects on public health, safety or the environment? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question. ☐ YES (go to #30) ■ NO (go to #4)

4. Is there an imposition of uncertain or unique environmental risks? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question. ☐ YES (go to #30) ■ NO (go to #5)

5. Is the project of greater scope or size than is normal for the category of action? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question. ☐ YES (go to #30) ■ NO (go to #6)

6. Does the project introduce or employ unproven technology? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question. ☐ YES (go to #30) ■ NO (go to #7)

PART B - DECISION ANALYSIS (continued)

7. Will there be reportable releases of hazardous or toxic substances as specified in 40 CFR Part 302? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question.

☐ YES (go to #30) ■ NO (go to #8)

8. If proposed action is in a non-attainment or maintenance area, will air emissions exceed de minimus levels or otherwise require a formal Clean Air Act (CAA) conformity determination? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question.

☐ YES (go to #30) ■ NO (go to #9) ☐ NA (go to #9)

9. Will the project have effects on the quality of the environment that are likely to be highly controversial? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question.

☐ YES (go to #30) ■ NO (go to #10)

10. Will the project establish a precedent (or make decisions in principle) for future or subsequent actions that are reasonably likely to have future significant effects? If action meets screening criteria but is assessed in an existing EA or EIS, check NO and proceed to the next question.

☐ YES (go to #30) ■ NO (go to #11)

11. Has federal funding been secured for the Innovative Readiness Training (IRT) project?

■ N/A (go to #13) ☐ YES (go to #13) ☐ NO (go to #12)

12. NOTE: IRT projects not currently funded can secure approved NEPA documentation. However, once funding is secured State ARNG is required to coordinate with ARNG-ILE-T to complete natural and cultural surveys via proponent funding.

☐ CONFIRMED (go to #27)

13. Do you have a species list from the U.S. Fish and Wildlife Service that is less than 90 days old?

■ YES (go to #14) Date of List: 6/1/2020 ☐ NO (update species list return to #13)

14. In reviewing the species list, what determination was made by the State ARNG?

☐ No species present (go to #16)
■ No affect (go to #16)
☐ May affect but not likely to adversely affect (go to # Date of USFWS concurrence:
☐ May affect likely to adversely affect (go to #15)

15. Does an existing Biological Opinion cover the action?

☐ YES (go to #16) Date of BO: ☐ NO (go to #30)

16. Have the Endangered Species Act, Section 7 requirements completed?

■ YES (go to #17) Date of Documentation: 6/1/2020 ☐ NO (complete documentation, return to #16)

17. Does the project involve an undertaking to a building or structure that is 50 years of age or older?

☐ YES (go to #18) ■ NO (go to #20)

18. Has the building or structure been surveyed for the National Register of Historic Places?

☐ YES (go to #19) ☐ NO (complete inventory, return to #18)

19. Is the building or structure eligible for or listed on the National Register of Historic Places?

☐ YES (go to #20) ☐ NO (go to #20)

20. Does the action involve ground disturbing activities?

☐ YES (go to #21) ■ NO (go to #22)

21. Has an archaeological inventory or research been completed to determine if there are any archeological resources present?

☐ YES (go to #22) ☐ NO (complete inventory or conduct research, return to #21)

22. In reviewing the undertaking, under the National Historic Preservation Act (NHPA) (for both above and below ground resources), what determination was made by the State ARNG?

■ No 106 undertaking; no additional consultation required under NHPA (go to question #27)
☐ No properties affected (go to #24) Date of SHPO Concurrence:
☐ No adverse effect (go to #24) Date of SHPO Concurrence:
☐ Adverse effect (go to #23)

23. Has the State ARNG addressed the adverse effect?

☐ YES (place date of MOA or existing PA and explanation of mitigation in box below, go to #24) ☐ NO (go to #30)

23a.

PART B - DECISION ANALYSIS (continued)

24. Per DoDI 4710.02 did the state ARNG determine that tribal consultation was necessary for this project?

■ YES (go to #25)

☐ NO (Provide reason in this block 24a, go to #27)

24a. Tribes are provided copies of INRMP for review and comment at annual consultation and in conjunction with any Traditional cultural Property Surveys and no comments on INRMP from them have been received.

25. Did the Tribes express an interest or respond with concerns about the project?

☐ YES (go to #26) ■ NO (go to #27) Date of Documentation: Annual Meeting Minutes

26. Has the State ARNG addressed the Tribal concerns?

☐ YES (place date of MOU or explanation of how State ARNG addressed tribal concerns in box below, go to #27)

☐ NO (address concerns, return to #26)

Complete only if additional documentation is required in question #26

26a.

27. Does the project involve an unresolved effect on areas having special designation or recognition such as those listed below? For any yes responses go to #30 otherwise go to #28. If any No response is a result of negotiated and/or previously resolved effects please describe resolution in box 27a below.

TYPE	Unresolved Effects?	TYPE	Unresolved Effects?
a. Prime/Unique Farmland	no	e. Wild/Scenic River	no
b. Wilderness Area/National Park	no	f. Coastal Zones	no
c. Sole-Source Aquifer	no	g. 100-year Floodplains	no
d. Wetlands	no	h. National Wildlife Refuges	no

27a.

28. Is this project addressed in a separate EA or EIS review?

■ YES (complete table below; go to Part C, Determination) ☐ NO (go to #29)

Document Title:	Environmental Assessment of the Integrated Natural Resources Management Plan For Camp Bowie
Lead Agency:	Texas Military Forces Adjutant General's Department of Texas
Date of Decision Document:	April 2006

29. Does the project meet at least one of the categorical exclusions listed in 32 CFR 651 App B?

☐ YES (complete table below; go to Part C, Determination) ☐ NO (go to #30)

List primary CAT EX code	
Descibe why CAT EX applies	

30. At this time your project has not met all the qualifications for using a categorical exclusion under 32 CFR 651. Unless the scope of the project is changed, it will require an Environmental Assessment or possibly an Environmental Impact Statement. If you feel this is in error, please call your NEPA Regional Manager to discuss. If needed, go to Part C Determination.

Additional Information (if needed):

PART C - DETERMINATION

On the basis of this initial evaluation, the following is appropriate:

- ☐ IAW 32 CFR 651 Appendix B, the proposed action qualifies for a Categorical Exclusion (CX) that does not require a Record of Environmental Consideration.
- ☐ A Record of Environmental Consideration (REC).
- ■ An Environmental Assessment (EA).
- ☐ A Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS).

Signature of Proponent (Requester)	Environmental Program Manager
Linda Brown	Richard Martinez
Printed Name of Proponent (Requester)	Printed Name of Env. Program Manager
8/4/2020	8/4/2020
Date Signed	Date Signed

Other concurrence (as needed):

Signature	Signature
Printed Name	Printed Name
Date Signed	Date Signed
Signature	Signature
Printed Name	Printed Name
Date Signed	Date Signed
Signature	Signature
Printed Name	Printed Name
Date Signed	Date Signed

Enviro Tracking #:	ARNG Record of Environmental Consideration	State ARNG
	Enter information in the yellow shaded areas.	

1. PROJECT NAME:

Camp Bowie 2020 INRMP

2. PROJECT NUMBER: (MILCON if applicable)	3. DATE PREPARED:
N/A	8/4/2020

4. START DATE of PROPOSED ACTION (dd-mmm-yy): 10/1/2020 Note: This must be a future date

5. PROGRAMMED FISCAL YEAR:

6. END DATE (if applicable):

7. DESCRIPTION AND LOCATION OF THE PROPOSED ACTION:

a. Location (Include a detailed map, if applicable):

Camp Bowie all Lands State and Federal

b. Description:

Project consists of updating the 2020 INRMP for Camp Bowie. The INRMP was updated to bring it up to date with current and future projects, agreements with USFWS and the state wildlife agency and other partners in implementing natural resources conservation. An EA was completed for the original INRMP in

8. CHOOSE **ONE** OF THE FOLLOWING:

- [x] An existing environmental assessment* adequately covers the scope of this project. Attach FNSI if EA was completed by another federal agency (non-ARNG).
  - EA Date (dd-mmm-yy): 04/01/2006 Lead Agency: Texas Military Forces Adjutant Gene
- [ ] An existing environmental impact statement* adequately covers the scope of this project.
  - EIS Date (dd-mmm-yy): Lead Agency:
- [ ] After reviewing the screening criteria and completing the ARNG environmental checklist, this project qualifies for a
  - Categorical Exclusion Code:
  - See 32 CFR 651 App. B
  - Categorical Exclusion Code:
  - **See 32 CFR 651 App. B**
  - Categorical Exclusion Code:
  - **See 32 CFR 651 App. B**
- [ ] This project is exempt from NEPA requirements under the provisions of:
  - Cite superseding law:

*Copies of the referenced EA or EIS can be found in the ARNG Environmental Office within each state.

9. REMARKS:

Signature of Proponent (Requester)	Environmental Program Manager
Linda Brown	Richard Martinez
Printed Name of Proponent (Requester)	Printed Name of Env. Program Manager
08/04/2020	8/4/2020
Date Signed	Date Signed

Proponent Information:

10. Proponent: TXARNG

11. Address: 2200 W 35th ST Austin TX 78603

12. POC: Linda Brown

13. Comm. Voice: 512-782-5818

14. Proponent POC e-mail: linda.a.brown110.nfg@mail.mil

Appendix F. Goals, Objectives, and Targets

The following is a summary table of all the goals, objectives, and targets listed in the INRMP. This table will be reviewed annually to track progress toward targets for each annual review. Targets may be achieved through one or more projects. Projects can be completed using in-house resources, through cooperative agreements with other agencies and partners, or by contract action.

Section	Goal	Objective	Review Date	Target	Execution Date
Management Framework					
	Maintain and improve usability of land for training		1/11/2025		
		Conduct annual review of land management with operators (training site staff and planners)	1/11/2025		
				Determine extent to which natural resources projects affect Ongoing military activities quarterly	8/2020 (annually thereafter)
				Determine any land management issue that needs to be addressed to improve training	8/2020 (annually thereafter)
		Recover areas previously damaged by training and reopen Responsible - ITAM	1/11/2025		
				Identify and prioritize areas previously damaged	12/2020 (annually thereafter)
				Begin recovery of areas	12/2020 (annually thereafter)
	Identify potential problems during		1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
	planning phases and avoid or mitigate in design				
				Create a GIS-based model to identify sensitive areas with buffers for planning	12/2020 (annually thereafter)
				Maintain comprehensive GIS data in required formats with metadata	2020 (annually thereafter)
				Provide general data for use by TMD and cooperating agencies	12/2020 (annually thereafter)
				Maintain and update natural resources data regularly	12/2020 (annually thereafter)
	Maintain ecosystem functions and all components with no net loss of training area		1/11/2025		
		Identify information gaps regarding management techniques and ecosystem function	1/11/2025		
				Develop a list of needs for primary research to support management decisions	12/2020 (annually thereafter)
				Adapt management regime based on research results	Result Dependent
				Create state and transition models for riparian sites and other additional sites	12/2020 (annually thereafter)

Section	Goal	Objective	Review Date	Target	Execution Date
		Institute adaptive management structure	1/11/2025		
				Conduct annual review of land management with USFWS, TPWD, trainers, and Facilities Maintenance	12/2020 (annually thereafter)
				Modify goals, objectives, and targets as needed	12/2020 (annually thereafter)
				Develop database with goals, objectives, and targets to use for tracking queries	12/2020 (annually thereafter)
				Attend Symposiums and conferences to stay current on management processes and new science	2020 annually thereafter
Awareness					
	Inform and involve training site staff with natural resources management		1/11/2025		
		Inform staff about projects and results of projects	1/11/2025		
				Provide maps of Ongoing projects as needed	Quarterly @ TCGC brief
				Determine who needs to know what and when	Quarterly @ TCGC brief
				Develop examples and photos of successful, innovative solutions	12/2020 (annually thereafter)

Section	Goal	Objective	Review Date	Target	Execution Date
		Provide awareness materials for staff to distribute to users	1/11/2025		
				Develop brochures about training site resources and management	As needed
	Educate soldiers about natural resources		1/11/2025		
				Develop computer presentations that can be used for briefings (long and short versions)	Quarterly @ TCGC brief
				Educate soldiers on natural resources safety issues (poison ivy, insects, feral hogs, snakes)	Quarterly in EarthGuard
	Inform and assist headquarters staff about natural resources and land management		1/11/2025		
		Develop SOPs and BMPs that support goals and objectives	1/11/2025		
				Identify all SOPs and BMPs needed and evaluate annually	12/2020 (annually thereafter)
		Participate in planning processes	1/11/2025		
				Attend RPPB meetings and working groups	Quarterly
				Participate in master planning, REC review processes	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
		Share analysis and results of monitoring data with staff	1/11/2025		
				Present results at annual review	12/2020 (annually thereafter)
	Increase public outreach activities		1/11/2025		
		develop outreach presentations for neighbors/community	1/11/2025		
				Develop 1 outreach program per year on topics such as oak wilt, prescribed fire, restoration, plant ID, invasive species, youth hunting and others	12/2020 (annually thereafter)
				Initiate “open house” day annually starting	12/2020 (annually thereafter)
		Increase public participation in land management projects	1/11/2025		
				Initiate Public Lands Day projects	12/2020 (annually thereafter)
				Present results of surveys and projects at conferences and in newsletters	ongoing
Monitoring					
	Establish a coordinated monitoring program with ITAM and Natural Resources		1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
		Cooperation between ITAM and Natural Resources	1/11/2025		
				Natural Resources team supports ITAM with data sharing for fire program, water quality monitoring, GIS and vegetation management	As results are available
		Monitor military training impacts (ITAM)	1/11/2025		
				Incorporate an RTLA component within the overall Monitoring Plan	12/2020 (annually thereafter)
				Determine the thresholds and make recommendations on the frequency and intensity of training area usage	Ongoing
				Identify areas directly impacted by military training	Ongoing
				Develop a monitoring plan for military training	12/2020 (annually thereafter)
				Analyze results yearly and present at annual review	12/2020 (annually thereafter)
		Database management and analysis strategy	1/11/2025		
				Identify any computer software or hand-held data loggers needed	As needed
				Maintain photo-point database and update per manual	2020(annually thereafter)

Section	Goal	Objective	Review Date	Target	Execution Date
				Maintain seeding and planting database	As needed
				Develop additional databases	As needed
		Incorporate weather trends into management analysis			
				Coordinate with Texas Forest Service to access weather data from the nearest appropriate station	2020 (annually thereafter)
Erosion and Sediment Control					
	Reduce new erosion		1/11/2025		
		Incorporate erosion considerations into infrastructure and training planning	1/11/2025		
				Utilize soil erodibility information in facilities planning	Ongoing
				Consider erosion potential during REC project review process	Ongoing
		Avoid erosion-prone areas	1/11/2025		
				Identify erosion site and create a layer in GIS	ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Establish buffers around erosion features and identify in GIS	ongoing
				Develop and share maps with ITAM	ongoing
		Evaluate proposed road and fire lane maintenance to prevent new erosion	1/11/2025		
				Develop BMPs and SOPs for maintenance of fire lanes, creek crossings, roadside ditches, grading roads, water bars, and seed mix and application	2020 (annually thereafter)
		Maintain/increase vegetation cover and soil stability	1/11/2025		
				Prioritize watersheds and sensitive areas, including wetlands and streams, based on watershed assessment	ongoing
				Musgrave pond and stream restoration projects	2021
				Monitor erosion areas before and after each prescribed fire or wildfire	ongoing
		Manage feral hogs and their impact on water resources	1/11/2025		
				Conduct Feral Hog Control Projects	ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
Fire Management					
	Reduce risk associated with wildland fires		1/11/2025		
		Establish or improve communication with neighbors and general public about wildland fire	1/11/2025		
				Develop Fire Management Plans	2021
				Use all forms of media for public awareness and notifications, including social media, concerning wildland fire operations (see Section 3.2)	Ongoing
				Participate in area wide wildland fire programs held by local, state, or national agencies	Ongoing
				Establish or update MOUs and MOAs with outside agencies	As needed
		Improve wildfire incident reporting	1/11/2025		
				Maintain a wildfire history map	2020 (annually thereafter)
				Develop and maintain a database for recording wildfire incidents	2020 (annually thereafter)

Section	Goal	Objective	Review Date	Target	Execution Date
		Reduce hazardous fuel accumulation to reduce the probability of extreme wildfire damage to habitat	1/11/2025		
				Assess all on-property structures using Firewise for urban-wildland interface	Ongoing
				Conduct prescribed fire on a natural fire return interval to reduce woody encroachment	Ongoing
				Identify and maintain all existing roads and firebreaks	Ongoing
				Identify and create additional firebreaks as needed	Ongoing
	Maintain and improve the usability of the training centers for military training		1/11/2025		
		Conduct prescribed fires on a natural fire return interval to manage brush encroachment, open understory, and stimulate native grasses	1/11/2025		
				Identify training areas with highest use to prioritize burn units	2020 (annually thereafter)
				Keep staff current with fire certifications through fire management CEU's	ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Coordinate with ITAM on projects to improve training areas	Ongoing
	Maintain high quality areas while promoting native biodiversity		1/11/2025		
		Conduct prescribed fires on natural fire return interval to maintain intact native vegetation	1/11/2025		
				Improve and update GIS priority model to identify areas in need of prescribed fire	2020 (annually thereafter)
				Vary spatial extent and seasonality of prescribed fires to create a heterogeneous environment	Ongoing
				Identify the responses and necessity of prescribed fire for rare, endangered, and invasive species	Ongoing
Invasive Species Control and Pest Management					
	Prevent introduction of new invasive species or establishment of new populations		1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
		Develop an early detection system for potential invasive species	1/11/2025		
				Monitor populations of non-native species that are not invasive through vegetation planning level surveys	2020 (annually thereafter)
				Provide training for certified personnel concerning invasive plant identification and provide a reporting format for discoveries	Ongoing
				Update invasive plant distribution maps for priority species annually	ongoing
				Examine any dead/dying ash trees for emerald ash borer (*Agrilis planipennis*)	Ongoing
		Participate in statewide initiatives and data sharing to identify potential risks	1/11/2025		
				Remain current on statewide invasive species issues and patterns of spread near Camp Maxey	2020 (annually thereafter)
				Participate in Texas State Invasive Species Council as appropriate	Ongoing
				Share invasive species spatial data with other state and federal agencies	2020 and Ongoing thereafter

Section	Goal	Objective	Review Date	Target	Execution Date
		Prevent spread of oak wilt centers	1/11/2025		
				Educate training site personnel to identify oak wilt with oak wilt brochure	2020 (annually thereafter)
				Continue to educate about the SOP for Tree Maintenance	2020 (annually thereafter)
				Introduce and encourage native trees that are not susceptible to oak wilt	2020 (annually thereafter)
				Incorporate invasive species into NEPA analysis	2020 (annually thereafter)
	Reduce or maintain existing populations of invasive species		1/11/2025		
		Certify personnel to treat small invasions in-house to prevent larger treatments	1/11/2025		
				Have at least two state certified pesticide applicators through CEU's to maintain current licenses	2020 (annually thereafter)
				Encourage natural predators by maintaining intact diverse native ecosystems	2020 (annually thereafter)
		Manage feral hogs and reduce numbers when feasible	1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
				Target: Communicate with adjacent landowners and extension agents	2020 (annually thereafter)
				Target: Continue feral hog eradication program	2020 (annually thereafter)
		Monitor and manage high-risk invasive species for potential spread	1/11/2025		
				Identify priority areas for treatment, map and re-evaluate annually	Ongoing
				Treat species on sites interior from roads as needed	2020 (annually thereafter)
				Treat species along roadsides and dirt piles	2020 (annually thereafter)
				Identify best management practices to discourage future establishment of non-natives	Ongoing
				Maintain GIS database for invasive species	Ongoing
				Monitor the effects of fire on invasive species	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Treat Invasive Malta Star thistle	2020 and yearly thereafter as needed
	Implement the Integrated Pest Management Plan		1/11/2025		
		Use an integrated pest management approach to maximize safety and minimize pesticide use and potential hazards and consider alternatives to pesticide use	1/11/2025		
				Assist training center personnel with guidance for pest treatments	2020 (annually thereafter)
				Perform PMQAE duties and maintain training requirements	2020 (annually thereafter)
				Annual review of Integrated Pest Management Plan	2020 (annually thereafter)
				Update Integrated Pest Management Plan every 5 years	2021 (annually thereafter)
		Implement self-help pesticide program	1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
				Perform self-help trainings to educate training center staff and suggest appropriate equipment for safety, application, containment, and storage	As needed
				Ensure the Self-Help Pest Program SOP is up to date	2020 (annually thereafter)
				Update SPUL as needed and annually	2020 (annually thereafter)
		Report pesticide application	1/11/2025		
				Collect and compile self-help and contract labor pesticide application records	Quarterly
				Compile pounds per active ingredients and report to NGB annually	2020 (annually thereafter)
				Submit ISR reporting as requested	As needed
Wetlands, Ponds, and Riparian Areas					

Section	Goal	Objective	Review Date	Target	Execution Date
	Maintain with no net loss and improve high quality wetlands, ponds, and riparian areas		1/11/2025		
		Include wetland, riparian, and floodplain considerations in REC project review processes	1/11/2025		
				Restrict vehicular traffic in stream beds	Ongoing
				Prevent construction in wetlands, floodplains, and buffers	Ongoing
				Minimize bivouac and camping activities within 25 ft of a water resource	Ongoing
		Protect and restore critical wetland areas	1/11/2025		
				Wetland Planting Projects	2021
				Musgrave pond and creek restoration project	2021
				Identify sensitive areas and establish buffers if appropriate	Ongoing
				Identify and wetlands, ponds, and riparian areas in need of restoration	Ongoing
				Assess feasibility and results of aquatic macrophyte vegetation	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Reduce mowing in picnic areas at Lamar Lake to prepare for an event only	Ongoing
				Restore and maintain grassland buffers adjacent to Water Bodies	Ongoing
				Address beaver damage	Ongoing
				Develop BMPs and SOPs to prevent increased sediment loads into water resources	Ongoing
				Reduce erosion contributing to wetlands, ponds, and riparian areas	Ongoing
				Reduce existing invasive species, particularly feral hogs and Eurasian milfoil, and prevent introduction of new invasive species	Ongoing
				Maintain forested riparian areas	Ongoing
				Keep staff trained in wetland needs though CEU's and conferences related to wetlands	ongoing
Vegetation Management					Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
	Manage encroaching woody vegetation using integrated brush management supported by GIS		1/11/2025		
		Develop prioritized brush management areas based on state and transition models	1/11/2025		
				Keep staff trained in vegetation management needs though CEU's and conferences	Ongoing
				Utilize GIS layers with priority, target species, maintenance period, and recommended method	Ongoing
				Develop a GIS model to prioritize brush management areas	Ongoing
		Reduce the number of eastern red cedar <4 ft tall using prescribed fire	1/11/2025		
				Use prescribed fire in burn units on a natural fire return interval	Ongoing
				Utilize Herbicide management as appropriate	Ongoing
		Reduce acreage of eastern red cedar >4 ft tall	1/11/2025		
				Identify areas with high populations of eastern red cedar > 4 feet tall	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Implement eastern red cedar management projects using a variety of management techniques	Ongoing
		Monitor success of brush management projects	1/11/2025		
				Implement vegetation and photo point monitoring	Ongoing
	Goal 2: Maintain intact native vegetation		1/11/2025		
		Maintain forested areas (particularly riparian areas)	1/11/2025		
				Minimize removal of vegetation within riparian and wetland buffers	Ongoing
				Remove invasive understory plants that prevent native forest regeneration using a variety of management techniques	Ongoing
		Maintain open grasslands and woodland edges by using prescribed fires	1/11/2025		
				Use prescribed fire in burn units on a natural fire return interval	Ongoing
				Use a variety of management techniques to reduce woody vegetation where fire is ineffective	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
		Identify relatively undisturbed, intact areas	1/11/2025		
				Use historic aerial imagery to identify areas with little disturbance	Ongoing
		Identify areas with native remnants and other areas sensitive to brush management methods	1/11/2025		
				Maintain GIS layers of areas consisting of native remnants and areas sensitive to disturbance	Ongoing
				Incorporate rare plant survey management	Ongoing
		Determine management needs or protective measures necessary for the *Quercus stellate* wetland forests	1/11/2025		
				Monitor for tree mortality related to drought stress	Ongoing
				Incorporate rare plant survey management	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
		Establish seed harvesting and replanting of rare or "missing" species	1/11/2025		
				Maintain areas that are appropriate for broad scale seed harvesting	Ongoing
				Use ecological site descriptions and species lists to analyze composition of native seed mixes	Ongoing
				Maintain seeding and planting database	Ongoing
		Carefully analyze proposed disturbances in deep sand areas to preserve high occurrence of endemic species	1/11/2025		
				Maintain GIS layer of deep-sand areas	Ongoing
		Monitor and prevent further spread of invasive plants and animals (see Section 3.6)	1/11/2025		
				Maintain GIS layer of invasive plant and animal occurrences	Ongoing
	manage shortleaf pine (*Pinus echinata*) forest, woodland, and isolated stands		1/11/2025		
		Establish baseline information on current short-leaf pine stands	1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
			1/11/2025	Analyze historic data including aerial photographs, GIS, and cultural resources information	Ongoing
		Identify pine stands for active management	1/11/2025		
				Define desired future condition for each stand and determine management needs	Ongoing
				Conduct prescribed fires in pine stands on a natural fire return interval	Ongoing
Landscaping and Grounds Maintenance					
	Follow xeriscape principles in landscape design and installation		1/11/2025		
		Replace invasive plants with native plants	1/11/2025		
				Identify federal noxious weeds in all landscaping areas	Ongoing
				Remove invasive weeds from landscaped areas	Ongoing
		Implement SOP on Landscaping Design Guidelines	1/11/2025		
				Increased coordination with NR and Engineering project planning	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Prohibit the use of invasive and non-native plants in landscaping	Ongoing
	Establish maintenance protocols for ranges and cantonment areas to minimize erosion, invasive plants, and pesticide use		1/11/2025		
		Use native short grass turf when practical/appropriate to reduce mowing	1/11/2025		
				Replace non-native turf with native turf in suitable areas starting	Ongoing
				Incorporate native short grasses into construction project design	Ongoing
		Determine maintenance guidelines and requirements for facilities while minimizing environmental impact	1/11/2025		
				Determine mowing guidelines for specific ranges to minimize erosion and maximize usability	Ongoing
				Determine if mowing regime or equipment, as a vector of seeds, can be adjusted to limit spread of invasive grasses	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
Fish and Wildlife Management					
	Maintain healthy, viable populations of native species		1/11/2025		
		Update planning level surveys at least every five years (mammals, herptiles, birds, fish, insects)	1/11/2025		
				Begin updates starting with mammals and herptile	Ongoing
				Implement bat surveys and look for white nosed syndrome	Ongoing
		Maintain healthy white-tailed deer population	1/11/2025		
				Conduct annual surveys to determine harvest and document population structure	Ongoing
		Maintain healthy upland game bird populations	1/11/2025		
				Conduct baseline surveys to document population structure of upland birds	Ongoing
				Implement habitat management strategies to increase foraging and nesting habitat for upland bird populations such as turkey bobwhite quail, migratory duck, and dove species	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Consider implementation of sustainable hunting practices to manage upland game bird populations	Ongoing
		Improve recreational fishing program	1/11/2025		
				Manage for suitable nursery habitat to provide “structure” for larger game fish	Ongoing
				Develop youth fishing derby	2020 and annually thereafter
		Maintain a diverse landscape that provides diverse habitat and food sources for wildlife	1/11/2025		
				Keep staff trained in wildlife science though CEU’s and conferences related to wildlife	ongoing
				Consider wildlife habitat (structure, size, shape, and richness) when planning brush management operations	Ongoing
				Include wildlife habitat analysis in prescribed fire planning	Ongoing
				Conduct prescribed fires at various seasons and with varying patch sizes to stimulate forbs and browse regrowth	Annually in the fall Ongoing
				Conduct yearly Migratory bird surveys	Annually

Section	Goal	Objective	Review Date	Target	Execution Date
		Minimize negative impacts from native wildlife	1/11/2025		
				Assist other agencies with regional wildlife management initiatives	Ongoing
				Support Facilities and Engineering with removal and prevention of unwanted wildlife near structures	Ongoing
				Diversify vegetation structure using prescribed fires	Ongoing
				Eliminate or reduce non-native species	Ongoing
		Develop aquatics program	1/11/2025		
				Implement water quality monitoring program	Ongoing
				Create an aquatics SOP including the fishing program	2020
		Enhance migratory waterfowl habitat	1/11/2025		
				Implement habitat improvements as necessary Including plantings, vegetation management, invasive species control	Ongoing
		Evaluate migratory waterfowl populations	1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
				Conduct baseline waterfowl populations and species richness survey	Ongoing
				Possible implementation of waterfowl harvest program	Ongoing
		Improve habitat for whooping crane use	1/11/2025		
				Improve stopover habitat through vegetation management	Ongoing
		Improve habitat for aquatic species of concern	1/11/2025		
				Monitor aquatic species	Ongoing
				Implement habitat improvement projects	Ongoing
Endangered, Threatened, and Rare Species Management					
	Maintain populations of rare species		1/11/2025		
		Maintain populations of ESA Listed Avian Species, State listed species and Army Species of Concern	1/11/2025		
				Continue to document migratory birds through surveys	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Keep staff trained in ESA Management though CEU's and conferences	Ongoing
				Identify specific migratory birds of concern that merit additional surveys or monitoring	Ongoing
				Determine management actions required to maintain or increase populations	Ongoing
				Continue prescribed fire operations to maintain forest edge and grassland habitats	Ongoing
		Maintain populations of bat species of concern	1/11/2025		
				Continue to document bat species through planning level surveys	Ongoing
				Identify potential habitat enhancements based on species present	Ongoing
				Determine management actions required to maintain populations	Ongoing
		Maintain and Improve habitat for Monarch Butterflies			
				Implement habitat projects including brush management, native vegetation re-establishment and habitat diversity projects	Ongoing
				Habitat restoration projects	2021

Section	Goal	Objective	Review Date	Target	Execution Date
				Identify critical areas and methods of protection with minimal impact to training	Ongoing
		Maintain populations of rare plants	1/11/2025		Ongoing
				Determine management actions required to maintain populations	Ongoing
				Maintain database and geodatabase of locations of rare plants	Ongoing
				Communicate to training site staff about locations and the minimization of disturbance on a project specific basis	Quarterly at TCGC Updates
		Determine which unusual plant communities require protection	1/11/2025		
				Maintain GIS layer of plant communities	Ongoing
				Identify protection and monitoring requirements for each area	Ongoing
		Use REC processes to minimize impacts to populations as available and outlined on CFMO page located on Lonestar portal	1/11/2025		
				Use REC process to identify areas of potential impacts of projects	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
		Protect known populations of Rare, ESA, State listed and Army Species of Concern Mammals, Herptile, and Invertebrates	1/11/2025		
				Identify protection and monitoring requirements for each area	Ongoing
				Conduct Surveys as needed	Ongoing
				Implement management projects for each	Ongoing
				Implement Horned Lizard management projects	ongoing
		Consider rare, threatened and endangered species when planning prescribed fires and brush management projects	1/11/2025		
				Input GIS layers into prescribed fire prioritization model for prescribed fire planning	Annually
				Create buffer zones in GIS for project planning	Ongoing
	Identify any new occurrences of rare, endangered, or threatened species		1/11/2025		
		Document any sightings of rare species	1/11/2025		

Section	Goal	Objective	Review Date	Target	Execution Date
				Target potential habitat and seasons to document rare species during planning level surveys	2020 Ongoing thereafter
				Provide means for training site staff to communicate sightings to natural resources	Ongoing
				Conduct Surveys as needed	Ongoing
Climate Change					
	Predict likely effects of climate change on existing natural resources		1/11/2025		
		Begin collaborating on vulnerability assessments with other military installations in the region, USFWS, and TPWD by 2025	1/11/2025		
				Keep staff trained in advances in climate adaptation though conferences related to subject	ongoing
				Monitor influences of climate change on natural resources	Ongoing
				Conduct periodic PLS for plants, wildlife, and their communities on post as need is determined	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Monitor rare or endangered plant and animal populations for impacts of climate change through planning level surveys	Ongoing
		Implement management actions to mitigate changes in natural resources	1/11/2025		
				Conduct periodic reviews (5 year) to determine appropriate management approaches and actions in response to detected and predicted changes to plant and animal communities	2020
				Begin to establish drought resistant plants along streams to reduce erosion from storm events	Ongoing
				Begin to use more drought tolerant species to revegetate invasive species removal project sites	Ongoing
				Promote rainwater capture for watering landscaping plants on post through educating grounds maintenance staff	Ongoing
				Coordinate with grounds maintenance staff on xeriscaping concepts, appropriate plant species, and methods annually	Ongoing

Section	Goal	Objective	Review Date	Target	Execution Date
				Install erosion prevention, anti-sedimentation, and water diversion structures in streams as need is determined	Ongoing

Appendix G. Environmental Overview

G.1 Physical Setting

G.1.1 Topography

Camp Bowie is an 8,753-acre training center located on the edge of the Texas Hill Country in south central Brown County. The terrain ranges from flat to gently rolling on the west side, to a ridge in the middle, and flat low-lying areas on the east side with elevations from 1,270 ft. (387 m) to 1,595 ft. (486 m) above mean sea level. The western uplands are typically located around 1,509 ft. (460 m) in elevation, while the eastern floodplains are typically located around 1,345 ft. (410 m). See Figure G-1 Elevation Contours of Camp Bowie.

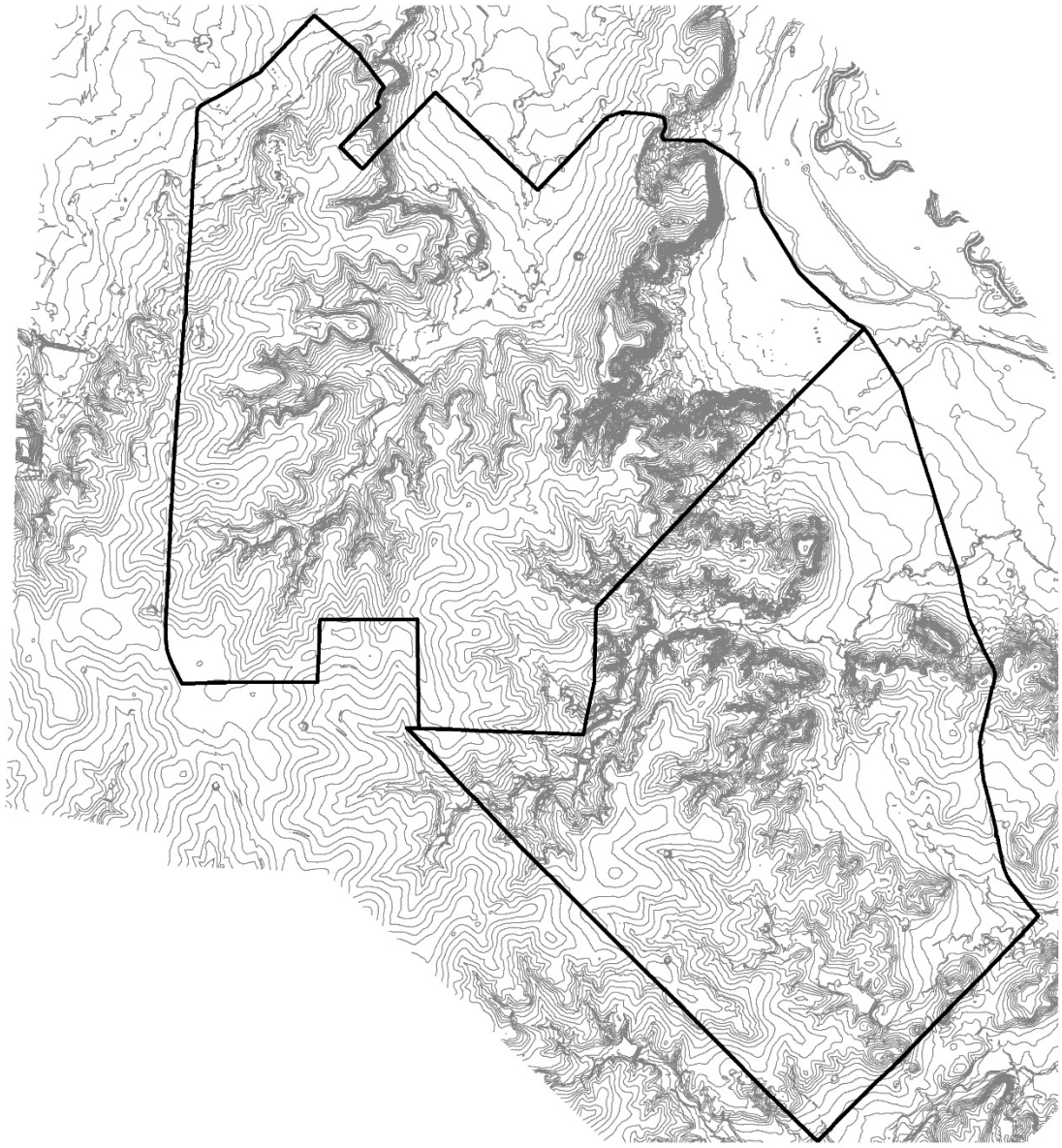
G.1.2 Geology

Camp Bowie lies on a transition between rolling hills built on Cretaceous rock from the east and the lower-lying Osage Plains built on Triassic, Permian, and Pennsylvanian rocks (Nance and Wermund 1993). The ridge and uplands on Camp Bowie consist of sedimentary rock from the Cretaceous Travis Peak formation. The soils in those areas consist of sandy loams with limestone and sandstone underneath or as clay loams with limestone underneath. The low-lying areas consist of sedimentary rock from the Pennsylvanian Strawn group that also underlie the ridge. The soils in those areas consist of clay-rich shales. These areas also contain the remnants of former streambeds and riverbeds.

G.1.3 Soils

There are 3 major soils on Camp Bowie: Bolar-Brackett, Frio-Sunev-Winters, and Leeray-Sagerton-Nukrum. The majority of these soils on Camp Bowie consist of 6 soil associations or series: Doudle-Real, Real, Owens-Harpersville, Pedernales, Frio, and Nukrum (Clower 1980; Nance and Wermund 1993). Bolar-Brackett soils are present at higher elevations along the southwestern edge of Camp Bowie and account for 70% of the land area. Soils in this association consist of expansive gravel or loam and are approximately 3 ft. deep over sandstone or shale. Frio-Sunev-Winters soils are present in the lowland, flood-prone areas along the eastern edge of Camp Bowie. These soils consist of loams and clays and are up to 8 ft. deep over loam and clay alluvium. Leeray-Sagerton-Nukrum soils are found along the FM 2126 highway and Lewis Creek. These soils consist of loam and clay and are less than 8 ft. deep over clay or loam sediment. All soils are calcareous and tend to promote corrosion of uncoated metals.

The soil erodibility factor (K Factor) represents a relative index of the susceptibility of bare soil to erosion. A K Factor less than 0.2 indicates less erodible, better drained soils. A K Factor greater than 0.3 indicates more erodible, less well-drained soils. Hydrologic soil group represents a relative index of the rainfall infiltration rates. Group A has the lowest runoff/highest infiltration potential, while Group D has the highest runoff/lowest infiltration potential. Therefore, Group A soils are less erodible than Group D soils. The Highly Erodible Lands (HEL) Classification is a relative classification of the overall wind and water erodibility of a soil type. Ecological site descriptions, determined by the NRCS, indicate the type of ecological community that is expected on those soils in that region (see Section G.2.1 for more details). See Table G-1 Summary of the Soil Types at Camp Bowie, Figure G-2 Soils of Camp Bowie, and Figure G-3 Erosive Soils at Camp Bowie.



This map was generated for the Camp Bowie INRMP by the Texas Military Department.

No warranty is made by the Texas Military Department as to the accuracy, reliability, or completeness of this data for individual use or aggregate use with other data. This map is a living document that is intended to change as new data become available.

Natural Resources
NGTX-FE
27 January 2020

Meters
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Boundary
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Figure G-1. Elevation Contours of Camp Bowie

Soil Type	Acres (Ha)	K Factor (Hydrologic Group)	HEL Classification	Ecological Site Description
Doudle-Real association	3786 (1,532)	0.28 (B)	Potentially highly erodible	Pink Caliche PE 40-54
Owens-Harpersville complex, > 8% slope	940 (380)	0.32 (D)	Highly erodible	Rocky Hill PE 36-50
Real association, hilly	888 (359)	0.10 (D)	Highly erodible	Steep Adobe PE 40-54
Pedernales fine sandy loam	486 (197)	0.28 (C)	Not highly erodible	Tight Sandy Loam PE 36-52
Frio silty clay loam, frequently flooded	1,433 (354)	0.32 (B)	Not highly erodible	Loamy Bottomland PE 40-54
Nukrum silty clay	320 (130)	0.32 (D)	Not highly erodible	Clay Loam PE 36-50
Callahan-Throck complex	297 (120)	0.17 (D)	Potentially highly erodible	Claypan Prairie PE 36-50
Leeray clay	290 (117)	0.32 (D)	Not highly erodible	Clay Flat PE 36-50
Sagerton clay loam	266 (108)	0.32 (C)	Not highly erodible	Clay Loam PE 36-50
Deleon silty clay	230 (93)	0.32 (C)	Not highly erodible	Clayey Bottomland PE 36-50
Bosque loam, occasionally flooded	223 (90)	0.28 (B)	Not highly erodible	Loamy Bottomland PE 36-52
Sunev clay loam	156 (63)	0.28 (B)	Not highly erodible	Clay Loam PE 40-54
Callahan loam	154 (62)	0.32 (D)	Potentially highly erodible	Claypan Prairie PE 36-50
Bonti fine sandy loam	114 (46)	0.37 (C)	Highly erodible	Sandy Loam PE 36-50
Bonti-Owens complex, > 8% slope	105 (43)	0.28 (C)	Highly erodible	Sandstone Hill PE 36-50
Bonti-Callahan complex	68 (28)	0.28 (C)	Potentially highly erodible	Sandy Loam PE 36-50
Mereta clay loam	40 (16)	0.32 (C)	Highly erodible	Shallow PE 36-50
Rochelle fine sandy loam	34 (14)	0.37 (C)	Potentially highly erodible	Sandy Loam PE 36-50
Abilene clay loam	2 (1)	0.37 (C)	Not highly erodible	Clay Loam PE 36-50

Table G-1. Summary of Soil Types and Estimated Area at Camp Bowie

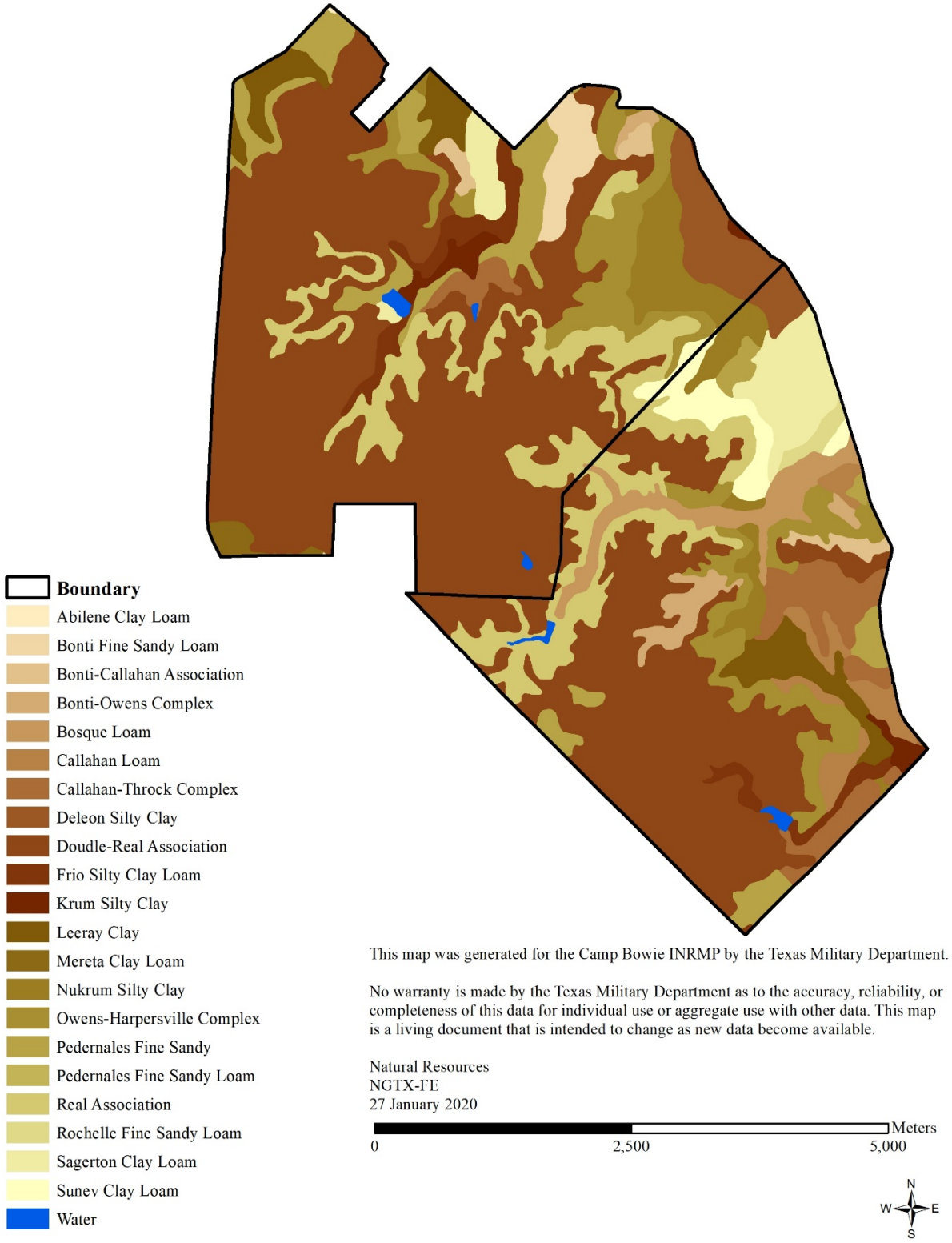

Figure G-2. Soils of Camp Bowie

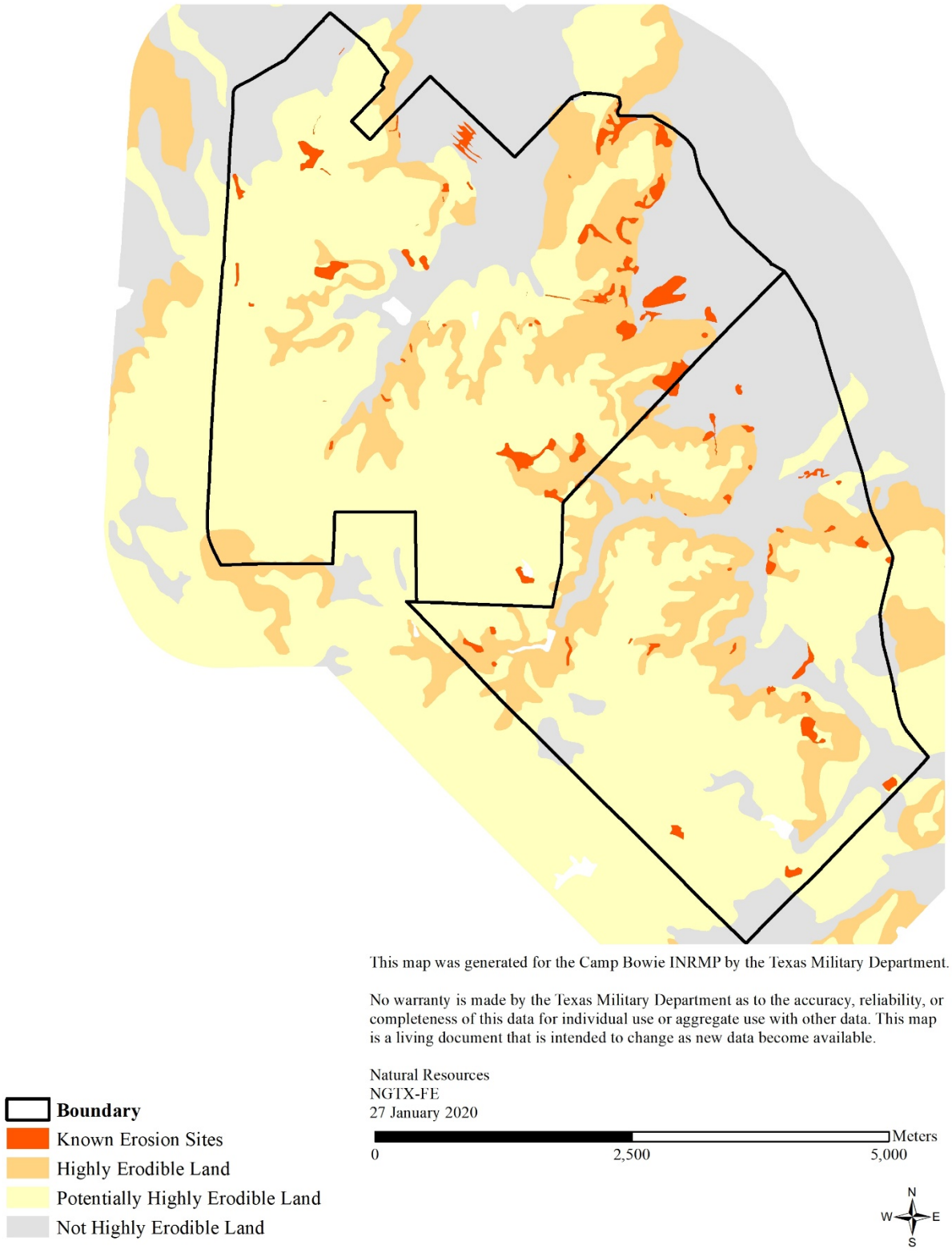

Figure G-3. Erosion Soils of Camp Bowie

The Doudle-Real association soils are found primarily on the southwestern portion of Camp Bowie (TAs II, III, V, VII). These soils cover approximately 43% of the land area. Doudle-Real soils are composed of 56% Doudle soils and 34% Real soils and are typically found on uplands (Clower 1980). These soils are typically composed of a cobbly and very gravelly surface layer of loam or clay loam over a layer of loam or limestone. Erosion potential for these soils is slight to moderate, while infiltration is moderate to rapid with low to very low water capacity. Therefore, these soils have a low susceptibility to vehicle damage. However, it is difficult to reestablish vegetation in these soils, and they are readily susceptible to contamination.

The Owens-Harpersville complex soils are found primarily in drainages with steep slopes along the ridge running through the central portion of Camp Bowie, accounting for close to 11% of land area. Owens-Harpersville complex soils are deep, stony soils and are typically found on hilly uplands. These soils are typically composed of a stony, clay loam surface layer over a clay subsoil. Erosion potential is high when wet, while infiltration is slow with moderate water capacity. Therefore, these soils have a high susceptibility to vehicle damage, especially when wet and with sparse vegetation.

The Real association soils are found primarily on slopes and in drainages just east of the Doudle-Real uplands and above the Owens-Harpersville soils, accounting for 10% of the land area at Camp Bowie. These soils are typically composed of a very gravelly loam surface layer over cemented limestone. Erosion potential is high, while infiltration is moderate with very low water capacity. Therefore, these soils have high susceptibility to vehicle damage.

Pedernales fine sandy loam is found primarily on the north and eastern portions of Camp Bowie near the state highways accounting for close to 6% of the land area. Pedernales soils are developed from limestone-capped benches from the Strawn group and are typically found on low slopes between the uplands and lowlands. These soils are typically composed of a sandy loam surface layer over clay. Erosion potential for these soils is high, while infiltration is low with high water capacity. Therefore, these soils have a high susceptibility to vehicle damage.

Frio silty clay loam is frequently flooded and found primarily in the Lewis Creek and MacKinally Creek drainages on the eastern half of Camp Bowie, accounting for approximately 4% of the land area. These soils are typically composed of a deep, silty clay loam or loam surface layer over a sandy loam layer. Erosion potential for these soils is moderate, while infiltration is slow with high water capacity. Therefore, these soils have a moderate susceptibility to vehicle damage. However, most of these soils are located in floodplains or stream beds, and these areas are generally off-limits to vehicular traffic and many types of military training due to the presence of wetlands and high moisture content rather than soil type.

Nukrum silty clay is found primarily next to drainages on the southeastern and eastern boundary of Camp Bowie, accounting for less than 4% of the land area. Nukrum silty clay forms on high terraces of modern streams and forms cracks when dry. These soils are typically composed of a deep, silty clay surface layer over a clay loam layer. Erosion potential for these soils is moderate, while infiltration is high with high water capacity. Therefore, these soils have a moderate susceptibility to vehicle damage. However, most of these soils are located in or near floodplains, and these areas are generally off-limits to vehicular traffic and many types of military training due to the presence of wetlands and high moisture content rather than soil type.

Characteristics of upland soils at Camp Bowie show that higher elevations are more maneuverable with moderate permeability and erodibility. Activities and training conducted on slopes or ridgetops should avoid disturbing vegetation so that hillside erosion, which accelerates rapidly, can be prevented. Due to the permeability of upland soils, spills should be carefully avoided to prevent water table contamination.

Lower elevation soils are less permeable, less prone to erosion, and more maneuverable. However, activities conducted in lowland areas should avoid rutting the soils. Rutted areas collect moisture and then create cracks as they dry, providing avenues for contamination of the nearby water table.

Water and wind erosion are the main natural causes of soil loss at Camp Bowie. When these natural forces are coupled with training or other activities that disturb ground cover, additional soil loss can occur. Current erosion at Camp Bowie is mainly associated with the ridge or with stream banks, particularly in areas near roads. Stable soils can be resilient to a certain level of disturbance with proper use and monitoring. Therefore, stable soil types should be focused on when planning for high-impact training activities. To further reduce environmental degradation, training activity locations should be closely monitored and rotated to ensure the integrity of the vegetative cover.

G.1.4 Water Resources

Camp Bowie is contained within the Pecan Bayou catchment basin (HUC 12090107, USGS) of the Colorado River. For management purposes, 4 major watersheds, which contain 14 subwatersheds, have been identified. This subwatershed scale is used as the spatial framework for management decisions, analysis of cumulative disturbance, and effects of specific activities. The subwatersheds are used for planning data collection for surveys as well as for monitoring and identifying sensitive areas and potential impacts. See Figure G-4 Water Resources of Camp Bowie.

Watershed	Acres (Ha)	Average K Factor	Average Hydrologic Group	Average % Vegetation Cover	No. of Erosion Sites
1	429 (174)	0.29	B	76.3	1
2	32 (13)	0.28	C	87.5	1
3	307 (124)	0.29	B	65	3
4	521 (211)	0.3	C	75.7	6
5	760 (308)	0.22	B	65	7
6	870 (352)	0.28	D	62.8	13
7	1,046 (423)	0.26	B	75.5	5
8	1,225 (496)	0.24	C	70.6	7
9	555 (225)	0.26	C	70.7	7
10	541 (219)	0.29	C	49	10
11	327 (132)	0.21	C	61.7	4
12	729 (295)	0.28	C	58.8	6
13	1,191 (482)	0.28	C	79	5
14	207 (84)	0.27	C	90	1

Table G-2. Summary of Watersheds at Camp Bowie

Camp Bowie has approximately 51 acres (21 ha) of water bodies, including streams, ponds, and wetlands (Clayton and Reinecke 2003; Fisher et al. 1996; Gravatt et al. 1999; Reinecke et al. 2005). See Table G-3 for a summary of wetlands and other surface water and Figure G-4 for a map of wetlands and other water resources. Official wetland delineations and jurisdictional determinations according to USACE standards have not been completed and are only done when a specific project requires delineation. Ponds comprise approximately 49 acres (20 ha) and wetlands comprise approximately 2 acres (0.81 ha). All 87 ponds are man-made and serve a variety of purposes, including sources of water for wildfire suppression. There are

several small, temporary ponds that are good habitat for aquatic insects, and several medium-sized ponds that are good habitat for amphibians. The ponds typically do not contain vegetation due to variable water levels. All 3 wetlands are depressions along level areas with minimal drainage. These wetlands typically contain spikerushes (*Eleocharis* spp.), sedges (*Carex* sp.), flatsedges (*Cyperus* spp.), seacoast sumpweed (*Iva annua*), and dropseed (*Sporobolus compositus*). Each of these wetlands is present within the alluvial plain of Pecan Bayou ecological floodplain. The current and past land use has indicated that not only have these wetlands been recently impacted through mowing and grazing, but they may have been historically impacted through cultivation. The past land use is the most probable cause of the limited vegetation structure observed within these wetlands. Jurisdictional determinations were not made on these wetlands.

Class	Class Description	No. of Sites	Area Acres (Ha)
PEM1A	Palustrine system, Emergent class, Persistent subclass, with a Temporarily Flooded water regime	3	2 (0.8)
PUB3Ax	Palustrine system, Unconsolidated Bottom class, Mud subclass, with a Temporarily Flooded water regime and excavated special modifier	6	15 (6)
PUB3Ch	Palustrine system, Unconsolidated Bottom class, Mud subclass, with a Seasonally Flooded water regime and diked/impounded special modifier	14	18 (7)
PUB3Cx	Palustrine system, Unconsolidated Bottom class, Mud subclass, with a Seasonally Flooded water regime and excavated special modifier	24	3.8 (2)
PUB3Hh	Palustrine system, Unconsolidated Bottom class, Mud subclass, with a Permanently Flooded water regime and diked/impounded special modifier	3	10.2 (4)
PUB3J	Palustrine system, Unconsolidated Bottom class, Mud subclass, with an Intermittently Flooded water regime	1	.01 (.1)
PUB3Jh	Palustrine system, Unconsolidated Bottom class, Mud subclass, with an Intermittently Flooded water regime and diked/impounded special modifier	13	7.2 (3)
PUB3Jx	Palustrine system, Unconsolidated Bottom class, Mud subclass, with an Intermittently Flooded water regime and excavated special modifier	26	8 (3)
	Total	90	51 (21)

Table G-3. Wetlands and Other Waters on Camp Bowie
Class based on USWS Classification (Cowardin et al. 1979) as modified for National Wetland Inventory Mapping Convention.

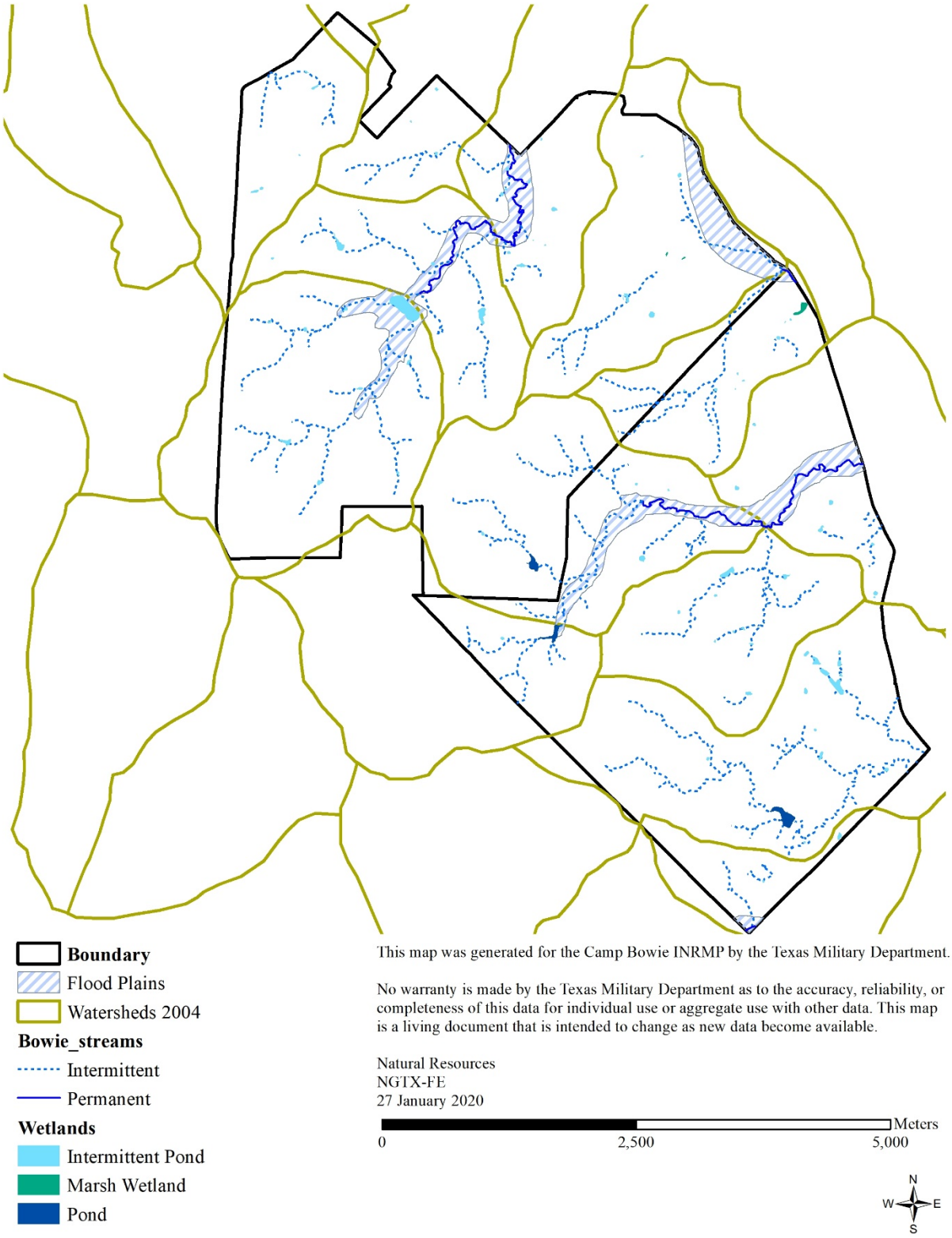

Figure G-4. Water Resources of Camp Bowie

There are approximately 48 miles (78 km) of intermittent and perennial tributaries either providing drainage through Camp Bowie or originating with headwaters on Camp Bowie (see Table G-4 for a summary of streams). Lewis Creek is the largest creek on site, with perennial water and high biodiversity. Devil's River and MacKinally Creek both have perennial sections although less so than Lewis Creek. All 3 creeks have a large portion of their headwaters on Camp Bowie and drain into Pecan Bayou just to the east of Camp Bowie. Willis Creek has only a small portion on Camp Bowie and drains to the north and then east into Pecan Bayou. There is also an unnamed tributary of Pecan Bayou on the east side that has regular water and floods heavily. There are several intermittent tributaries. Riparian corridors vary widely in condition, due to long-term grazing on the state portion of Camp Bowie. See Figure G-4 Water Resources of Camp Bowie.

Stream Order	Class	Class Description	No. of Segments	Length Km (Mi)
1	R4SB3	Riverine system, Intermittent subsystem, Streambed class, with a Cobble-Gravel subclass	63	27 (42)
2	R4SB3	Riverine system, Intermittent subsystem, Streambed class, with a Cobble-Gravel subclass	16	11 (18)
3	R3UB1	Riverine system, Upper Perennial subsystem, Unconsolidated Bottom class with Cobble-Gravel subclass	5	11 (18)
		Total	84	48.4 (78)

Table G-4. Streams and Linear Drainage Features on Camp Bowie
Class based on USWS Classification (Cowardin et al. 1979) as modified for National Wetland Inventory Mapping Convention.

Flood hazard areas on Camp Bowie are limited to areas adjacent to streams that flow into Pecan Bayou including South Willis Creek, Lewis Creek, Devil's River, and unnamed tributaries of MacKinally Creek. These floodplains extend along the banks and become wider as the streams reach Pecan Bayou (Fisher et al. 1996). Flooding in areas adjacent to creeks is typically minor, although low-lying areas along the eastern boundary are occasionally severely flooded. A survey has been done to determine the condition of all stock tanks and stream reaches (Clayton and Reinecke 2003). The results of this survey indicate that riparian zones vary widely in condition and efforts are underway to begin restoring areas to improve water and sediment flow during flooding. This work will be combined with efforts to restore natural hydrology in waterways. Wetlands, ponds, and streams are generally off-limits to vehicular traffic except on established road or trail crossings. There are well-developed riparian zones in the floodplains, and they pose no risk to any structures. See Figure G-4 Water Resources of Camp Bowie.

The primary aquifers in the area are found in the sands of the Travis Peak formation, although water can be found in the Trinity and Strawn groups and in alluvium (Fisher et al. 1996; Nance and Wermund 1993). The primary means of groundwater recharge is through the fractures in the limestone on the top of the ridge. Groundwater flow is generally to the east, but on a small-scale, it will flow toward creeks and streams. Depth to groundwater at Camp Bowie is 7-10 ft. for the Strawn Group, 72-77 ft. for the Travis Peak, and less than 30 ft. for the alluvial deposits. There are several intermittent springs and seeps at Camp Bowie. All abandoned wells have been closed under the rules of the TCEQ.

G.1.5 Climate

Brown County has a subtropical, subhumid climate with hot, humid summers and dry winters characterized by highly variable temperatures and precipitation. The climate is typically influenced by a continental regime, but a modified maritime regime can influence the weather during summer and winter. The highest temperatures are typically associated with fair skies, westerly winds, and low humidity. Summer hot spells can be broken by cool fronts that reduce humidity temporarily. Rain occurs occasionally due to thunderstorm activity either from the cool fronts or, more often, from tropical storm activity in the Gulf of Mexico. Periods of rainy weather usually only last a few days and are followed by several days of clear skies. Thunderstorms occur throughout the year but are most frequent in spring. Hail typically occurs 2 or 3 days a year. Tornados occur occasionally, primarily in the summer. Snowfall is rare. Humidity is typically between 40% and 70%. The average length of the warm season is about 242 days, with average first freeze on November 13 and average last freeze on March 23.

January is the coolest month, with an average high temperature of 55 °F and average low temperature of 31 °F. July is the warmest month, with an average high temperature of 96 °F and average low temperature of 72 °F, although August has similar temperatures. Average winter high temperature is 55°F; average winter low temperature is 33 °F. Average summer high temperature is 96 °F; average summer low temperature is 69 °F. Prevailing winds are typically southerly with average wind speeds ranging from 10-13 mph, with the highest speeds in March and April and the lowest speeds in August and September. The wettest months are June and September with a mean annual precipitation of 27.42 in., which varies from 13-37 in./year (Nance and Wermund 1993; 30 Year Average Climate Data from NOAA http://www.srh.noaa.gov/sjt/html/climate/climo.html).

G.2 Biological Setting

G.2.1 Vegetation Communities

Camp Bowie is located in the Limestone Plains (also called Rolling Plains) ecoregion at the transition with the Western Cross Timbers (see Figure G-5 Ecoregions of Camp Bowie). Much of Brown County has been identified as suitable for rangeland and pastureland, while areas with more organic matter are appropriate for cultivation (Clower 1980). The southern part of Camp Bowie has not been grazed since acquisition in the mid-1990s. The northern part of Camp Bowie has had intermittent grazing and cultivation since its transfer to use by the TMD. The typical potential native vegetation has been described as open prairies with occasional live oak trees (Clower 1980). The savannahs and forests on the state side are in poor condition partially as a result of large areas of oak decline that may partially be ascribed to oak wilt. Additionally, there is a substantial amount of woody plant encroachment in the understory, specifically Ashe juniper. The juniper is currently of a size appropriate for prescribed fire control, but within 1-2 years, the juniper will be too large so more expensive and disruptive techniques such as mechanical removal will have to be employed.

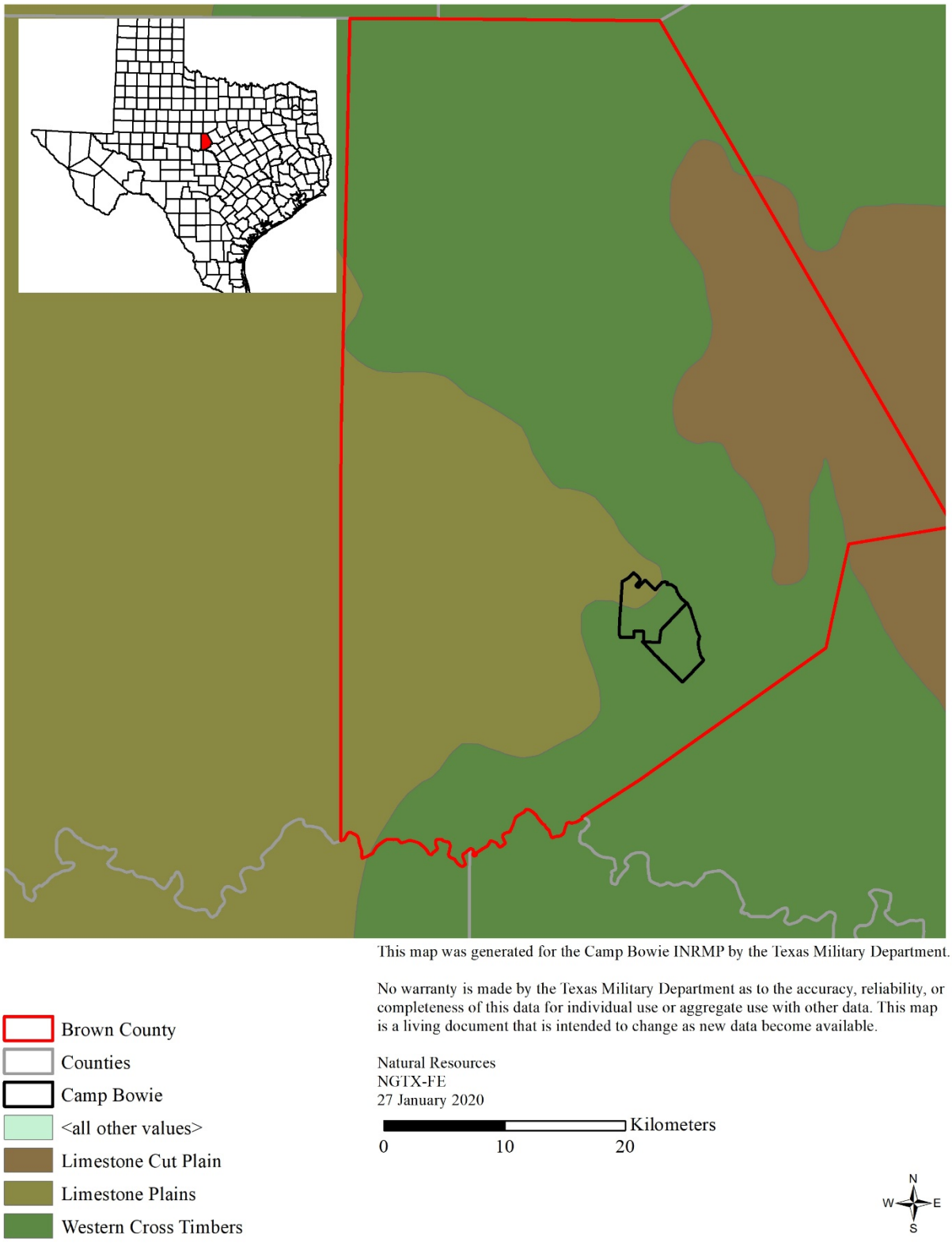

Figure G-5. Ecoregions of Camp Bowie

Dominant grasses include little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), Canada wildrye (*Elymus canadensis*), hairy grama (*Bouteloua hirsuta*), tall dropseed (*Sporobolus compositus* var. *compositus*) and Texas wintergrass (*Nasella leuchotricha*). The woody vegetation consists mainly of plateau oaks (*Quercus fusiformis*), post oaks (*Quercus stellata*), blackjack oaks (*Quercus marilandica*), honey mesquite (*Prosopis glandulosa*), cedar elm (*Ulmus crassifolia*), and pecan (*Carya illinoinensis*). Riparian woodlands occur in areas near streams and tributaries and, in general, are dominated by cedar elm (*Ulmus crassifolia*), American elm (*Ulmus americana*), sugar hackberry (*Celtis laevigata*), and pecan (*Carya illinoinensis*). Woody plant diversity increases where upland savannah and woodlands merge with riparian woodlands. Many species of woody plants, such as mesquite, Ashe juniper, various oak species, and other shrubs, are encroaching into grasslands and woodland areas due to fire suppression and past land use. Accidental fires from range activity and occasional prescribed fire have occurred over the years. A more formal prescribed fire program has begun, which is expected to facilitate vegetation recovery, encourage more diverse vegetative communities, and reduce wildfire risk. In addition, several mechanical thinnings of mesquite and juniper have been undertaken to facilitate training, reduce fuel load, and improve wildlife habitat.

These plant associations comprise the plant communities present at Camp Bowie that have been classified as Plateau Live Oak-Midgrass Woodland, Post Oak-Blackjack Oak Woodlands, Texas Oak Woodlands, American Elm-Cedar Elm Woodlands, Pecan-Sugarberry Woodlands, Ashe Juniper-Oak Woodlands, Ashe Juniper Woodlands, Mesquite Woodlands and Forests, and Sideoats Grama-Little Bluestem Grasslands (Fischer and Senseman 2003; Wolfe et al. 1996). See Table G-5 Vegetation Communities of Camp Bowie and Figure G-6 Vegetation Communities of Camp Bowie. Camp Bowie also has the potential to have Sideoats Grama (*Bouteloua curtipendula*) Prairies and Vine Mesquite (*Panicum obtusum*) Prairies.

Alliance Name	**Common Names**	**NVC Code**	**Acres (Ha)**
Quercus fusiformis-Schizachyrium scoparium Woodland	Live Oak-Midgrass Savannah	II.A.2.N.a.1	2,775 (1,123)
Juniperus ashei Woodland	Ashe Juniper Woodland with Oaks	II.A.4.N.a.3	1,249 (506)
Ulmus Americana-Ulmus crassifolia Woodland	American Elm-Cedar Elm Woodland	I.B.2.N.d.8	13 (5)
Quercus stellata-Quercus marilandica Woodland	Post Oak-Blackjack Oak Savannah	II.B.2.N.a.25	300 (121)
Quercus buckleyi Woodland	Texas Oak Woodland	II.B.2.N.a.30	46 (19)
Celtis laevigata-Carya illinoinensis Forest	Hackberry-Pecan Forest	II.C.2.N.a.1	23 (9)
Prosopis glandulosa Forest	Mesquite Forest		314 (127)
Prosopis glandulosa Woodland	Mesquite Woodland	II.B.2.N.a.11	348 (141)
Bouteloua curtipendula-Schizachyrium scoparium-Herbaceaous	Sideoats Grama-Little Bluestem Grassland	V.A.5.N.c.20	3,389 (1,372)

Table G-5. Vegetation Communities of Camp Bowie

These plant community classifications are based on the standard descriptions for vegetation communities used by the U.S. National Vegetation Classification system derived from The Nature Conservancy's National Community Classification System (Grossman et al. 1998). For more information, go to the NatureServe web page at http://www.natureserve.org/explorer/.

The Little Bluestem-Sideoats Grama Grasslands comprise 38% of the installation (3,389 acres; 1,371 ha) and are found throughout Camp Bowie. Little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), yellow bluestem (*Bothriochloa ischaemum*) and Indiangrass (*Sorgastrum nutans*) are the dominant species in the community. Additional areas with deep silty clays could support Sideoats Grama Midgrass Prairies, but mesquite woodlands presently dominate these areas. Elimination of grazing and increased prescribed fire during various seasons could improve these grasslands over time. Woody plants, particularly Ashe juniper and mesquite, have increased on these sites over the past 100 to 150 years. Where the site was once cultivated, honey mesquite (*Prosopis glandulosa*) tends to dominate the grassland. However, it seems as though little bluestem grasslands are beginning to expand and more native tallgrass species, particularly Indiangrass, are increasing in frequency in response to the reintroduction of fire and an integrated brush management approach. This vegetation shift should result in an oak-little bluestem savannah in transition zones. Grasslands are commonly used for training activities requiring open areas.

The Plateau Live Oak Savannah comprises 31% of the installation (2,775 acres; 1,123 ha) and is found primarily in the central part of Camp Bowie on stony clay soils on rolling uplands. Plateau live oak trees (*Quercus fusiformis*), Ashe juniper (*Juniperus ashei*), elbowbush (*Forestiera pubescens*), eastern poison ivy (*Toxicodendron radicans* ssp. *eximium*), greenbriar (*Smilax bona-nox*), and hackberry (*Celtis reticulata*) characterize this community. Ground cover consists mostly of short grasses and forbs with some midgrasses. The open nature of this area is conducive to many types of training. The occurrence of Ashe juniper has begun to diminish and will continue to as long as fire is part of the ecosystem. Based on a generalized state and transition model (see Section 3.1), this community will expand in extent and increase in density with a decrease in overall species diversity. Prescribed fire and brush management can shift the edges of these communities to a patchier distribution of savannah and woodland, resulting in an overall increase in species diversity, habitat types, and a more diverse setting for training.

The Ashe Juniper-Oak Savannah comprises 13% of the installation (1,208 acres; 485 ha), along with Ashe Juniper Woodlands that comprise 0.5% (42 acres; 17 ha). Ashe Juniper Shrubland is found primarily in the southwest portion of Camp Bowie. Ashe juniper (*Juniperus ashei*), white shin oak (*Quercus sinuata* var. *breviloba*), post oak (*Quercus stellata*), Nuttall oak (*Quercus texana*), and honey mesquite (*Prosopis glandulosa*) characterize this community. This community is the result of a lack of disturbance, particularly from fire. The occurrence of Ashe juniper has begun to diminish and will continue to as long as fire is part of the ecosystem. Prescribed fire will shift the composition of this community to contain more white shin oak than Ashe juniper over time. A small portion of this community that is not dominated by Ashe juniper is potential habitat for black-capped vireos, a federally endangered bird species, but the total area is not deemed large enough to support a substantial breeding population.

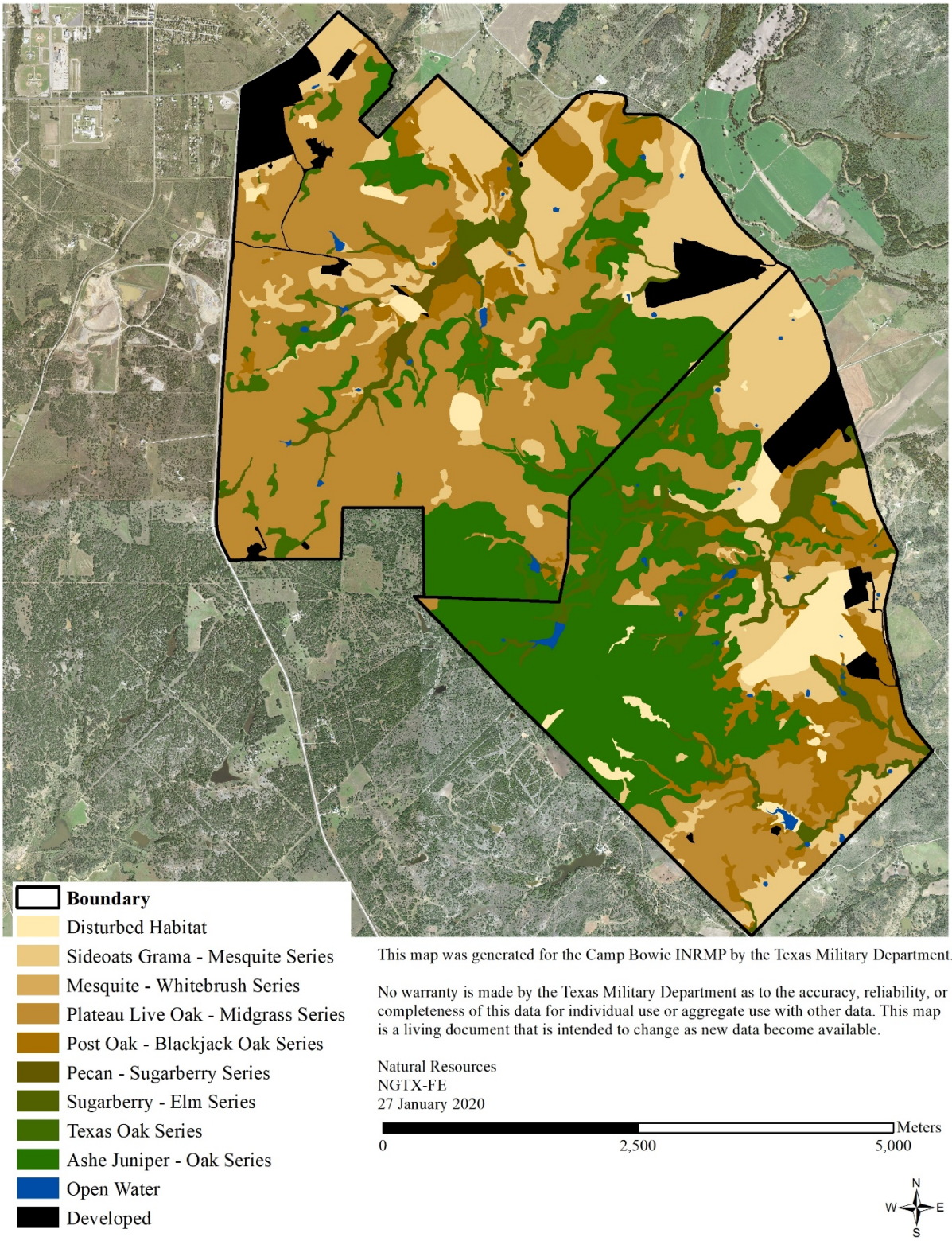

Figure G-6. Vegetation Communities of Camp Bowie

The Mesquite Woodlands and Forests comprise 7% of the installation (662 acres; 268 ha) and are found primarily in the eastern portion of TA IV. Honey mesquite (*Prosopis glandulosa*) of varying ages and Texas wintergrass (*Nassella leucotricha*) characterize this community. The mesquite communities indicate a prior cultivated land use and indicate that the land is recovering. Prescribed fire and selective clearing, combined with natural succession, should shift this community over the long-term. Based on a generalized state and transition model (see Section 3.1), these communities may transition over time to other communities but not without significant input and/or time. An integrated approach that includes prescribed fire and brush management can shift the edges of these communities to a patchier distribution of savannah and woodland, resulting in an overall increase in species diversity, habitat types, and a more diverse setting for training.

The Post Oak-Blackjack Oak Savannah comprises about 3% of the installation (300 acres; 121 ha) and is found primarily in the northeastern portion of TA V, near the Pecan Bayou floodplain. Other vegetation communities (Texas Oak Woodlands, Elm Woodlands, and Sugar Hackberry-Pecan Forests) are also associated with floodplains or riparian areas throughout the installation. Cedar elm (*Ulmus crassifolia*), American elm (*Ulmus americana*), sugar hackberry (*Celtis laevigata*), and pecan (*Carya illinoinensis*) characterize these communities. These vegetation communities form the bulk of the riparian zones on Camp Bowie, and although the vegetation is potentially useful for cover and concealment, it is rarely used for training due to dense, thorny vines such as greenbriar (*Smilax bona-nox*) and the proximity to creeks, wetlands, and water bodies. This community has the potential to expand along some of the waterways if protected from mechanical disturbance and as long as prescribed fire is a part of the system.

These descriptions and the map of the vegetation communities seem to represent a stable state. However, the landscape is dynamic and has the potential to transition from 1 vegetative state to another within certain ecological constraints. In other words, multiple stable plant communities can potentially occupy any one location or ecological site. Some vegetative communities can transition into a different state while other vegetative communities reach a state that cannot be changed or reversed without extreme inputs/energy. This “irreversible” state occurs when certain ecological thresholds are passed, and one stable state replaces another. Conversely, vegetation dynamics can also be continuous and reversible. The evaluation of vegetation at Camp Bowie must take into consideration continuous and reversible, as well as discontinuous and nonreversible, vegetation dynamics. State-and-transitions models represent both types of vegetation dynamics because they represent change due to several variables and inputs and help visualize where thresholds occur. State-and-transition models use the visualization and identification of ecological thresholds “for recognition of the various stable plant communities that can potentially occupy an ecological site” (Briske et al. 2003).

The Texas NRCS offices are in the process of developing ecological site descriptions across Texas including those found in the Camp Bowie area. The sites are tied directly to soil type (see Table G-1). Typical vegetation for the various ecological sites on Camp Bowie is presented below in Table G-6 and sites are mapped in Figure G-7 NRCS Ecological Sites of Camp Bowie. A different state and transition model will eventually be developed for each of the ecological site descriptions. Currently, 6 of the 14 ecological sites present at Camp Bowie have been completed by the NRCS. An example of a state-and-transition model for Camp Bowie can be found in Section 3.1.

Ecological Site Name	Ecological Site Description	Acres (Ha)
Clay Flat PE 36-50	Deep, nearly level, clay soils that crack when dry. Climax vegetation is blue grama, buffalograss, Arizona cottontop, alkali sacaton, vine-mesquite, white tridens, tall dropseed, heath aster, western ragweed, Condalia, Ephedra, and indian rushpea.	290 (117)
Clay Loam PE 36-50	Deep, nearly level clay loams. Potential vegetation is dominated by sideoats grama and vine-mesquite, with lesser stands of buffalograss, Arizona cottontop, meadow dropseed, western wheatgrass, Texas wintergrass, bluegrama, asters, ratany, sensitive briar, greenthread, Engelmann daisy, western ragweed, and Ephedra.	588 (238)
Clay Loam PE 40-54	Nearly level to rolling uplands of clayey soils. Climax plants are predominately little bluestem with Indiangrass, big bluestem, switchgrass, vine-mesquite, sideoats grama, elm, live oak, hackberry, and many forbs such as Maximilian sunflower, Engelmann daisy, bush sunflower, halfshrub sundrop, and ratany.	156 (63)
Clayey Bottomland PE 36-50	Flat floodplains of deep, clayey, alluvial soils, frequently flooded, with restricted plant growth. Climax vegetation includes buffalograss, meadow dropseed, perennial sedge, white tridens, heath aster, vine-mesquite, western ragweed, hackberry, Ephedra, bumelia, and Condalia. Alkali sacaton occurs in salty areas.	230 (93)
Claypan Prairie PE 36-50	Nearly level to gently sloping uplands with very slowly permeable soils. Potential vegetation includes vine-mesquite, meadow dropseed, white tridens, Arizona cottontop, buffalograss, Texas wintergrass, sideoats grama, blue grama, heath aster, Engelmann daisy, ragweed, greenthread, and sensitive briar.	451 (182)
Loamy Bottomland PE 36-52	Floodplains of alluvial soils. Vegetation includes Indiangrass; little, sand, or big bluestem; switchgrass; wildryes; Texas wintergrass; vine-mesquite; false switchgrass; meadow dropseed; western wheatgrass; sideoats grama; ragweeds; Engelmann daisy; heath aster; Maximilian sunflower; Guaras; elm; hackberry; bumelia; soapberry; grapes; cottonwood; and ash.	223 (90)
Loamy Bottomland PE 40-54	Deep, fertile, clay loam and loam, bottomland soils. Climax vegetation includes eastern gamagrass, switchgrass, little bluestem, Virginia wildrye, blood ragweed, hairy ruellia, hairy tubetongue, ast, Maximilian sunflower, and white crownbeard with pecan, elm, cypress, oak, and ash.	354 (143)
Pink Caliche PE 40-54	Shallow, hilly uplands with calcareous clay loam surfaces. Climax vegetation is savannah of little bluestem, Indiangrass, tall grama, tall dropseed, sideoats grama, oaks, blackfoot daisy, orange zexmenia, Dalea, bundleflower, and sundrop. Juniper invades the site.	3,786 (1,532)
Rocky Hill PE 36-50	Steep hillsides of fertile, stony calcareous clays, and shaly soils. Vegetation includes little and big bluestems, Indiangrass, sideoats grama, vine-mesquite, Texas cupgrass, Texas wintergrass, tall dropseed, buffalograss, heath aster, bush sunflower, gayfeather, Daleas, bumelia, hackberry, elm, elbowbush, and sumac.	940 (380)

Ecological Site Name	Ecological Site Description	Acres (Ha)
Sandstone Hill PE 36-50	Shallow, stony sandy loam. Climax vegetation is savannah and includes little bluestem, sand lovegrass, purpletop, sideoats grama, Scribner panicum, post oak, live oak, elm, hackberry, bumelia, greenbrier, sensitive briar, sagewort, Lespedeza, and other forbs.	105 (43)
Sandy Loam PE 36-50	Upland sandy loam soils. Climax vegetation is little bluestem, Indiangrass, purpletop, sideoats grama, sand lovegrass, Texas wintergrass, hooded windmillgrass, fringeleaf Paspalum, sand dropseed, Engelmann daisy, prairie clover, bundleflowers, Neptunia, western indigo, sumacs, post oak, and blackjack oak.	216 (87)
Shallow PE 36-50	Rolling, shallow clay and clay loams producing sideoats grama, Texas wintergrass, vine-mesquite, silver bluestem, Texas cupgrass, buffalograss; with small amounts of Indiangrass, big and little bluestems; and greenthread, prairie clover, Engelmann daisy, ragweeds, bush sunflower, hackberry, Ephedra, catclaw, and yucca.	40 (16)
Steep Adobe PE 40-54	Steep, shallow, calcareous clay loam. Climax vegetation is savannah of little bluestem, Indiangrass, tall grama, sideoats grama; seep, canyon, and *Lindheimer muhlys*; Texas oak; live oak; sumac; catclaw; madrone; juniper; blackfoot; gayfeather; sundrop; zexmenia; and Dalea.	888 (359)
Tight Sandy Loam PE 36-52	A savannah of level to gently rolling sandy loams. Vegetation includes sideoats grama, vine-mesquite, buffalograss, Texas wintergrass, sand dropseed, silver and little bluestem, hairy grama, ragweed, sagewort, dayflower, sensitive briar, Engelmann daisy, gayfeather, heath aster, post oak, elbowbush, greenbrier, and bumelia.	486 (197)

Table G-6. Ecological Site Summary for Camp Bowie

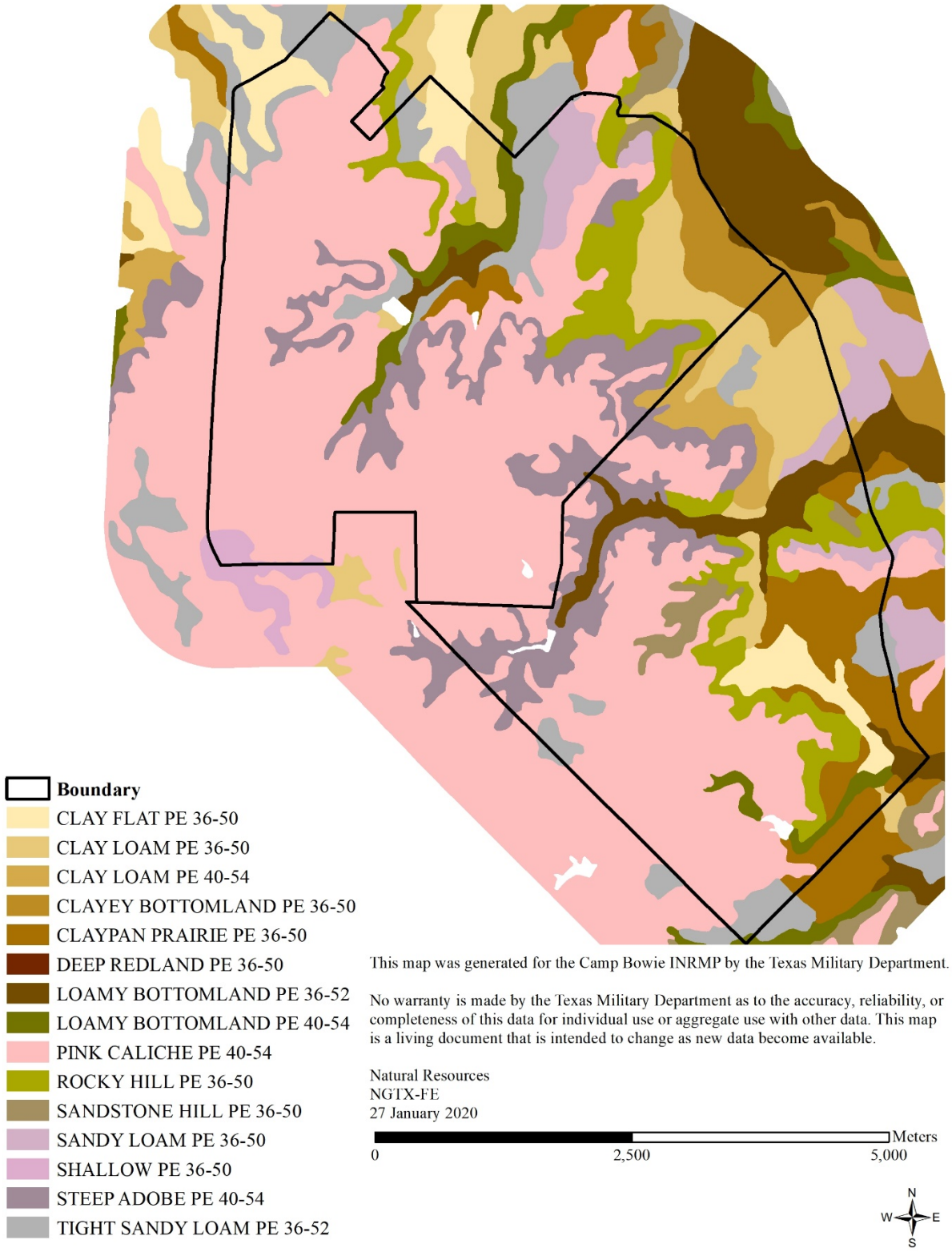

Figure G-7. NRCS Ecological Sites of Camp Bowie

G.2.2 Flora

Camp Bowie supports a substantial diversity of plants due to the variety and transitional nature of the habitat. Various biological inventories, rare plant surveys, and chance encounters over the last 10 years have resulted in the documentation of approximately 430 plant species representing 81 families (Clayton and Reinecke 2003; Farquhar et al. 1996; Farquhar et al. 1998; Gravatt et al. 1999; Reinecke et al. 2005; Wolfe et al. 1996). An alphanumeric code is used to indicate the global or state conservation status as identified by NatureServe, Texas Natural Diversity Database, and USFWS (G1/S1 = critically imperiled; G2/S2 = imperiled; G3/S3 = vulnerable; G4/S4 = apparently secure; G5/S5 = secure. G = global, S = state, T = threatened, W = watched). There are 77 species in the grass family (Poaceae), 64 species in the sunflower family (Asteraceae), and 27 species in the legume family (Fabaceae). There are 5 plant species considered rare at Camp Bowie with 1 ranked S2, and 3 ranked S3, with 1 ranked G2 and none ranked G1 (see Table G-7). A rare plant survey was conducted in 2013 that focused on potential endangered, threatened, rare, endemic, and plants of conservation concern for Camp Bowie. Neither of the two federally listed endangered species, Tobusch fishhook cactus (*Sclerocactus brevihamatus* ssp. *tobuschii*) nor Texas poppy-mallow (*Callirhoe scabriuscula*) was encountered during the field surveys. However, several populations of Hill Country wild mercury (*Argythamnia aphoroides*) and Hall's prairie clover (*Dalea hallii*) were located. An exhaustive survey for Hill Country wild mercury (*Argythamnia aphoroides*) is currently in progress and will be complete in 2018. Additionally, the crested coral-root orchid (*Hexalectris spicata*), was documented at Camp Bowie. The presence of *H. spicata* may indicate appropriate habitat for its two congeners (*H. nitida* and *H. warnockii*), which are rare species that occupy similar habitats (Bergman and Cohen 2007). See Appendix H for a current complete plant list. Voucher specimens will be collected as appropriate.

Scientific Name	Common Name	State Rank	Global Rank
Argythamnia aphoroides	Hill Country wild mercury	S2	G2
Dalea hallii	Hall's prairieclover	S3	G3
Mimosa aculeaticarpa var. *biuncifera*	Catclaw mimosa	SNR	G4
Thelocactus setispinus	Miniature barrel cactus	S3	G4
Yucca pallida	Pale yucca	S3	G3G4

Table G-7. Plant Species of Concern at Camp Bowie
Status indicates state or global conservation status as identified by NatureServe (G1/S1= critically imperiled, G2/S2= imperiled, G3/S3=vulnerable, G4/S4= apparently secure, G5/S5= secure. G=global, S=state).

A survey specifically for invasive plants has not been undertaken, but 3 other surveys have identified various invasive plants over the last 10 years (Clayton and Reinecke 2003; Farquhar et al. 1996; Reinecke et al. 2005). This survey, other surveys, and projects have identified 18 non-native invasive plants at Camp Bowie, with 3 species listed as state noxious weeds. The majority of these species occur in small numbers or small areas associated with disturbance. The Maltese star thistle (*Centaurea melitensis*) is considered the highest priority for control and management. Refer to Section 3.6 for more discussion of the Invasive Species Control Program. See Table G-8 Invasive Plants of Camp Bowie.

Scientific Name	Common	Priority
Bothriochloa ischaemum	Yellow bluestem	Medium
Bromus catharticus	Rescuegrass	
Bromus arvensis	Field brome	
Centaurea melitensis	Maltese star thistle	High
Cirsium vulgare	Bull thistle	High
Cynodon dactylon	Bermudagrass	TX Weed
Echinochloa crus-galli	Barnyardgrass	
Ligustrum japonicum	Japanese privet	High
Lolium perenne	Italian ryegrass	
Marrubium vulgare	Horehound	Low
Medicago minima	Little burclover	
Melilotus indicus	Annual yellow sweetclover	
Parthenium hysterophorus	Whitetop weed	
Polypogon monspeliensis	Rabbitfoot beardgrass	
Sorghum halepense	Johnsongrass	TX Weed, Medium
Torilis arvensis	Canada hedgeparsley	
Tribulus terrestris	Goathead	TX Weed
Verbascum thapsus	Flannel mullein	Medium

Table G-8. Invasive Plants of Camp Bowie
Priority for control is based on extent of potential impact and feasibility of control. "TX Prohibited" indicates the species is on the prohibited list for Texas. "TX Weed" indicates the species as been identified by Texas Department of Agriculture as an official weed for Texas.

G.2.3 Fauna

Due to the location of Camp Bowie, there is an interesting diversity of vertebrate animals. The first biological surveys were conducted by TPWD in 1994 and focused on plants and birds (Farquhar et al. 1996). Surveys for animals and an update to the bird survey have recently been completed by researchers from Angelo State University, University of North Texas, and University of Texas at Tyler. Preliminary aquatic surveys were conducted at Camp Bowie in 1995 and included fish and macroinvertebrates (Linam et al. 1996). Voucher specimens have been collected at various times over the last 30 years for all taxa documented. See Appendix H for current complete species lists for vertebrates and invertebrates. Details about the invasive species program are in Section 3.6 and the rare species program are in Section 3.11. Table G-9 summarizes all rare animals and Table G-10 summarizes all non-native animals.

The first baseline survey for mammals was completed in October 2003 (Dowler et al. 2004). A variety of survey methods were used to assess all mammals, from large carnivores to bats to small rodents. Currently, there is an ongoing survey to identify bat species that occur on or use Camp Bowie for foraging. The surveys to date have identified 32 species in 15 families, with 9 species of carnivores, 14 species of rodents, 3 species of bats, and 6 species of other mammals. Wild pigs have been reported in the county but do not currently occur on Camp Bowie. Although they have not been documented, there are most likely house mice and possibly the roof rat or Norway rat. Only 1 mammal of concern, the mountain lion, has been recorded.

The first baseline survey for reptiles and amphibians (also referred to as "herptiles") was completed in October 2003 (Dowler et al. 2004). Incidental observations of amphibians also occurred during an initial

survey for Texas horned lizards during 2002 as well as the initial biological inventory conducted in 1995 (Dowler et al. 2004; Farquhar et al. 1996; Lutterschmidt and Cook 2003). All surveys to date have identified 34 species in 14 families, with 9 species of frogs and toads, 0 species of salamanders, 4 species of turtles, 9 species of lizards, and 12 species of snakes. There have been no non-native herptiles recorded. Only 1 reptile of concern has been identified, the Texas horned lizard (*Phrynosoma cornutum*). Two juveniles were captured during baseline surveys. There is an ongoing project to confirm the sighting and document the number, location, and specific habitat preferences of Texas horned lizards at Camp Bowie.

There have been several studies over the last 10 years on birds. The first baseline survey for birds was conducted in 1994-1995 (Farquhar et al. 1996) with an update completed in May 2005 (Pogue 2005). There have also been annual summer breeding bird surveys since 1995 as part of the national Mapping Avian Productivity and Survivorship (MAPS) program (DeSante et al. 2004; 2005; Nott et al. 2003; Pyle et al. 2005). The surveys to date have identified 170 species in 37 families, including 15 duck species, 12 raptor species, 2 hummingbird species, and 99 songbird species. There were approximately 58 permanent residents, 43 winter residents, and 28 spring and summer residents. One federally endangered bird, the black-capped vireo (*Vireo atricapillus*), occurs occasionally as a transient on Camp Bowie and has potential habitat there (see Section 3.11 for more information). Forty-three other birds of concern, as identified by USFWS, Partners in Flight, and NatureServe, occur on Camp Bowie including painted buntings (*Passerina ciris*) and ladder-backed woodpeckers (*Picoides scalaris*) (see Section 3.11). Three non-native birds (European starling, house sparrow, and rock pigeon) have been recorded.

A fish survey was conducted in 1995 at Musgrave Pond and 3 other stock tanks as well as Lewis Creek and Devil's River (Linam et al. 1996). An update to the fish survey was conducted in 2007 (Hendrickson and Cohen 2007). Catfish, sunfish, and minnows were documented with 15 fish species from 4 families—all of which are primarily lentic species. No fish species of concern have been documented at Camp Bowie. Water quality appeared to be high, but water quantity was limited. The majority of streams and stock tanks at Camp Bowie are intermittent. Those that are perennial are man-made and were likely stocked at one time with largemouth bass and channel catfish. There have been 2 non-native fish species documented—the common carp (*Cyprinus carpio*) and the golden shiner (*Notemigonus crysoleucas*).

Preliminary aquatic macroinvertebrate surveys were conducted in 1995 (Linam et al. 1996) with comprehensive terrestrial and aquatic invertebrate surveys completed in 2005 (Kennedy et al. 2005). In addition, insect collections have been completed in conjunction with assessing the impacts of red imported fire ants (*Solenopsis invicta*) (Cook JL 2002, 2004a, 2004b; Cook JL and Cook TJ 2005; Cook TJ 2002, 2003, 2004). These initial efforts at classifying invertebrates have documented at least 710 species present at Camp Bowie. Identifications for many groups will take years to accumulate as there are a limited number of experts available. A wide variety of methods was used for these surveys in all seasons and in all habitats to develop this species list.

The results from these invertebrate surveys represent 720 species in 109 families in 13 orders of insects and 5 families in 4 orders of non-insect invertebrates (e.g. spiders, mollusks, and crustaceans). Within insects, there are 13 species of *Ephemeroptera*, 29 species of *Trichoptera*, 3 species of *Plecoptera*, 37 species of *Odonata*, 34 species of *Lepidoptera*, 66 species of *Orthoptera*, 58 species of *Hemiptera*, 78 species of Diptera, 106 species of Hymenoptera, and 237 species of Coleoptera. In Coleoptera, there are 27 species of ground beetles (Carabidae), 9 species of long-horned beetles (Cerambycidae), 32 species of leaf beetles (Chrysomelidae), 33 species of diving beetles (Dytiscidae), and 21 species of scarab beetles (Scarabaeidae), among other families. Within the Hymenoptera, there are 38 species of ants (Formicidae), 23 species of velvet ants (Mutillidae), along with other families of bees and wasps. No rare invertebrates have been documented; however, this is likely due to lack of information, not lack of rare invertebrates. There is only one documented non-native invertebrate—the red imported fire ant (*Solenopsis invicta*).

Insects play a critical role in shaping landscapes via seed dispersal, herbivory, pollination, and parasitism. Without an understanding of the insects, any understanding of the ecosystem will be extremely limited. They are often primary players in shaping the habitat and in plant population dynamics. Insects can serve as useful indicators for assessing the impacts of land use and land management.

Scientific Name	**Common**	**State Rank**	**Global Rank**
Vireo atricapillus	Black-capped vireo	S2	G2G3, PIF
Phrynosoma cornutum	Texas horned lizard	S4, threatened	G4G5
Accipiter cooperii	Cooper's hawk	S3S4, PIF	G5
Aimophila cassinii	Cassin's sparrow	S4	G5, BCC, PIF
Aimophila ruficeps	Rufous-crowned sparrow	S4	G5, BCC, PIF
Aix sponsa	Wood duck	S3	G5, GBCC
Ammodramus leconteii	LeConte's sparrow	S3	G4, BCC, PIF
Anas acuta	Northern pintail	S3	G5, GBCC
Anas americana	American widgeon	S3	G5, GBCC
Anthus spragueii	Sprague's pipit	S4	G4, BCC, PIF
Archilochus alexandri	Black-chinned hummingbird	S5	G5, PIF
Aythya affinis	Lesser scaup	S3	G5, GBCC
Aythya americana	Redhead	S3, PIF	G5, GBCC
Aythya collaris	Ring-necked duck	S4	G5, GBCC
Aythya valisineria	Canvasback	S4, PIF	G5, GBCC
Buteo swainsoni	Swainson's hawk	S4, PIF	G5, BCC
Calamospiza melanocorys	Lark bunting	S4	G5, PIF
Carduelis psaltria	Lesser goldfinch	S5, PIF	G5
Charadrius vociferus	Killdeer	S5, PIF	G5
Chondestes grammacus	Lark sparrow	S4, PIF	G5, PIF
Circus cyaneus	Northern harrier	S2, PIF	G5, BCC, PIF
Coccyzus americanus	Yellow-billed cuckoo	S4, PIF	G5
Coccyzus erythropthalmus	Black-billed cuckoo	S3	G5, BCC
Colinus virginianus	Northern bobwhite	S4	G5, GBCC
Columbina inca	Inca dove	S5, PIF	G5
Dendroica cerulea	Cerulean warbler	S3	G4, BCC
Guiraca caerulea	Blue grosbeak	S4, PIF	G5
Icterus spurius	Orchard oriole	S4	G5, BCC, PIF
Lanius ludovicianus	Loggerhead shrike	S4	G4, BCC, PIF
Melanerpes aurifrons	Golden-fronted woodpecker	S5, PIF	G5, PIF
Passerina ciris	Painted bunting	S4	G5, BCC, PIF
Phalaenoptilus nuttallii	Common poorwill	S4	G5, PIF
Picoides scalaris	Ladder-backed woodpecker	S5, PIF	G5, BCC, PIF
Pipilo fuscus	Canyon towhee	S5	G5, PIF
Pipilo maculatus	Spotted towhee	S4, PIF	G5
Piranga rubra	Summer tanager	S5, PIF	G5
Pooecetes gramineus	Vesper sparrow	S5, PIF	G5
Pyrocephalus rubinus	Vermilion flycatcher	S4, PIF	G5
Scolopax minor	American woodcock	S2S3	G5, GBCC, PIF
Spiza americana	Dickcissel	S4, PIF	G5, BCC, PIF
Spizella pusilla	Field sparrow	S5	G5, BCC, PIF
Thryomanes bewickii	Bewick's wren	S5, PIF	G5
Tyrannus forficatus	Scissor-tailed flycatcher	S3	G5, BCC, PIF

Scientific Name	Common	State Rank	Global Rank
Vireo bellii	Bell's vireo	S3	G5, BCC, PIF
Wilsonia canadensis	Canada warbler	S4	G5, BCC
Zenaida macroura	Mourning dove	S5	G5, GBCC

Table G-9. Animal Species of Concern at Camp Bowie
Status indicates state or global conservation status as identified by NatureServe (G1/S1= critically imperiled, G2/S2= imperiled, G3/S3=vulnerable, G4/S4= apparently secure, G5/S5= secure. G=global, S=state). "BCC" indicates Birds of Conservation Concern, and "GBCC" indicates Game Birds of Conservation Concern as identified by USFWS. "PIF" indicates species identified as at risk by Partners in Flight, either globally or regionally.

Scientific Name	Common Name	Priority	Origin
Passer domesticus	House sparrow	Low	Europe
Sturnus vulgaris	European starling	Low	Europe
Columba livia	Rock pigeon	Low	Europe
Cyprinus carpio	Common carp	Medium	Asia
Notemigonus crysoleucas	Golden shiner	Low	SE US
Solenopsis invicta	Red imported fire ant	High	S. America

Table G-10. Non-Native Animals of Camp Bowie
Priority indicates management concern. Origin indicates continent of origin.

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For a complete summary of all Natural Resources reports related to Camp Bowie, please see Appendix I.

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Appendix H. Species Lists

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
Coniferophyta: Conifers					
			Cupressaceae	*Juniperus ashei*	Ashe juniper
				Juniperus sp.	Juniper
Gnetophyta-Ephedrales: Jointfirs					
			Ephedraceae	*Ephedra antisyphilitica*	Clapweed
				Ephedra trifurca	Longleaf jointfir
Magnoliophyta: Flowering Plants – Monocots					
			Agavaceae	*Yucca constricta*	Buckley's yucca
				Yucca pallida	Twistleaf yucca
				Yucca rupicola	Texas yucca
				Yucca sp.	Yucca
			Alismataceae	*Echinodorus berteroi*	Upright burhead
			Commelinaceae	*Commelina erecta*	Whitemouth dayflower
				Tradescantia occidentalis	Prairie spiderwort
			Cyperaceae	*Carex austrina*	Southern sedge
				Carex crus-corvi	Ravenfoot sedge
				Carex microdonta	Littletooth sedge
				Carex muehlenbergii	Muhlenberg's sedge
				Carex planostachys	Cedar sedge
				Carex sp.	Sedge
				Carex tetrastachya	Britton's sedge
				Cyperus acuminatus	Tapertip flatsedge
				Cyperus echinatus	Globe flatsedge
				Cyperus esculentus	Yellow nutsedge
				Cyperus lupulinus ssp. *lupulinus*	Great Plains flatsedge
				Cyperus odoratus	Fragrant flatsedge
				Cyperus retroflexus	Oneflower flatsedge
				Cyperus sp.	Flatsedge
				Cyperus squarrosus	Bearded flatsedge
				Eleocharis montevidensis	Sand spikerush
				Eleocharis palustris	Common spikerush
				Eleocharis sp.	Spikerush
				Fimbristylis puberula	Hairy fimbry
				Fimbristylis vahlii	Vahl's fimbry

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Fuirena simplex	Western umbrella-sedge
				Rhynchospora nivea	Showy whitetop
			Iridaceae	*Sisyrinchium chilense*	Swordleaf blue-eyed grass
				Sisyrinchium sp.	Blue-eyed grass
			Juncaceae	*Juncus acuminatus*	Tapertip rush
				Juncus filipendulus	Ringseed rush
				Juncus interior	Inland rush
				Juncus sp.	Rush
				Juncus texanus	Texas rush
			Liliaceae	*Allium drummondii*	Drummond onion
				Cooperia sp.	Rainlily
				Dasylirion wheeleri	Common sotol
				Nolina texana	Texas sacahuista
			Najadaceae	*Najas guadalupensis*	Southern waternymph
			Orchidaceae	*Hexalectris spicata*	Spiked crested coralroot
			Poaceae	*Andropogon glomeratus*	Bushy bluestem
				Aristida oligantha	Prairie threeawn
				Aristida purpurea	Purple threeawn
				Aristida purpurea var. *longiseta*	Fendler threeawn
				Aristida purpurea var. *purpurea*	Purple threeawn
				Aristida purpurea var. *wrightii*	Wright's threeawn
				Aristida sp.	Threeawn
				Bothriochloa ischaemum	Yellow bluestem
				Bothriochloa laguroides ssp. *torreyana*	Silver beardgrass
				Bouteloua curtipendula	Sideoats grama
				Bouteloua dactyloides	Buffalograss
				Bouteloua gracilis	Blue grama
				Bouteloua hirsuta	Hairy grama
				Bouteloua hirsuta var. *pectinata*	Tall grama
				Bouteloua rigidiseta	Texas grama
				Bouteloua trifida	Red grama
				Bromus arvensis	Field brome
				Bromus catharticus	Rescuegrass
				Cenchrus spinifex	Coastal sandbur

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Chasmanthium latifolium	Indian woodoats
				Chloris cucullata	Hooded windmillgrass
				Chloris verticillata	Tumble windmillgrass
				Cynodon dactylon	Bermudagrass
				Dichanthelium acuminatum	Tapered rosette grass
				Dichanthelium acuminatum var. *fasciculatum*	Western panicgrass
				Dichanthelium oligosanthes	Heller's rosette grass
				Dichanthelium oligosanthes var. *scribnerianum*	Scribner's rosette grass
				Dichanthelium sp.	Rosette grass
				Digitaria cognata	Fall witchgrass
				Echinochloa crus-galli	Barnyardgrass
				Elymus canadensis	Canada wildrye
				Eragrostis curtipedicellata	Gummy lovegrass
				Eragrostis intermedia	Plains lovegrass
				Eragrostis secundiflora	Red lovegrass
				Eragrostis sessilispica	Tumble lovegrass
				Eriochloa sericea	Texas cupgrass
				Erioneuron pilosum	Hairy woollygrass
				Hilaria belangeri	Curly-mesquite
				Hordeum pusillum	Little barley
				Leptochloa dubia	Green sprangletop
				Leptochloa panicea	Mucronate sprangletop
				Limnodea arkansana	Ozarkgrass
				Lolium perenne	Perennial ryegrass
				Muhlenbergia capillaris	Hairawn muhly
				Muhlenbergia lindheimeri	Lindheimer's muhly
				Muhlenbergia reverchonii	Seep muhly
				Nassella leucotricha	Texas wintergrass
				Panicum coloratum	Kleingrass
				Panicum hallii	Hall's panicgrass
				Panicum obtusum	Vine mesquite
				Panicum virgatum	Switchgrass
				Paspalum distichum	Knotgrass

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Paspalum fluitans	Horsetail paspalum
				Paspalum pubiflorum	Hairyseed paspalum
				Paspalum setaceum	Thin paspalum
				Paspalum sp.	Crowngrass
				Phalaris caroliniana	Carolina canarygrass
				Polypogon monspeliensis	Annual rabbitfoot beardgrass
				Schedonnardus paniculatus	Tumblegrass
				Schizachyrium scoparium	Little bluestem
				Setaria leucopila	Streambed bristlegrass
				Setaria parviflora	Marsh bristlegrass
				Setaria reverchonii	Reverchon's bristlegrass
				Sorghastrum nutans	Indiangrass
				Sorghum halepense	Johnsongrass
				Sphenopholis obtusata	Prairie wedgescale
				Sporobolus compositus	Composite dropseed
				Sporobolus compositus var. *compositus*	Composite dropseed
				Sporobolus cryptandrus	Sand dropseed
				Sporobolus sp.	Dropseed
				Sporobolus vaginiflorus	Poverty dropseed
				Tridens albescens	White tridens
				Tridens flavus	Purpletop tridens
				Tridens muticus var. *elongatus*	Slim tridens
				Tridens muticus var. *muticus*	Slim tridens
				Tridens texanus	Texas fluffgrass
				Triplasis purpurea	Purple sandgrass
				Vulpia octoflora	Sixweeks fescue
			Potamogetonaceae	*Potamogeton diversifolius*	Waterthread pondweed
				Potamogeton nodosus	Longleaf pondweed
				Potamogeton sp.	Pondweed
			Smilacaceae	*Smilax bona-nox*	Saw greenbrier
			Typhaceae	*Typha domingensis*	Southern cattail
				Typha latifolia	Common cattail
				Typha sp.	Cattail

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
Magnoliophyta: Flowering Plants – Dicots					
			Acanthaceae	*Justicia pilosella*	Gregg's tube tongue
				Ruellia nudiflora	Violet wild petunia
			Amaranthaceae	*Froelichia gracilis*	Slender snakecotton
				Gossypianthus lanuginosus	Woolly cottonflower
			Anacardiaceae	*Rhus aromatica*	Fragrant sumac
				Rhus lanceolata	Prairie sumac
				Rhus microphylla	Littleleaf sumac
				Rhus trilobata	Skunkbush sumac
				Toxicodendron radicans ssp. *eximium*	Eastern poison ivy
			Apiaceae	*Ammoselinum popei*	Plains sandparsley
				Chaerophyllum tainturieri	Hairyfruit chervil
				Daucus pusillus	American wild carrot
				Eryngium leavenworthii	Leavenworth's eryngo
				Eurytaenia texana	Texas spreadwing
				Spermolepis echinata	Bristly scaleseed
				Spermolepis inermis	Red River scaleseed
				Spermolepis sp.	Scaleseed
				Torilis arvensis	Spreading hedgeparsley
			Apocynaceae	*Amsonia ciliata*	Fringed bluestar
			Aquifoliaceae	*Ilex decidua*	Possumhaw
				Ilex sp.	Holly
			Aristolochiaceae	*Aristolochia coryi*	Cory's dutchman's pipe
			Asclepiadaceae	*Asclepias asperula*	Spider milkweed
				Asclepias engelmanniana	Engelmann's milkweed
				Asclepias sp.	Milkweed
				Asclepias viridiflora	Green comet milkweed
				Funastrum crispum	Wavyleaf twinevine
				Matelea biflora	Star milkvine
				Matelea reticulata	Netted milkvine
				Matelea sp.	Milkvine
			Asteraceae	*Amblyolepis setigera*	Huisache daisy
				Ambrosia confertiflora	Weakleaf burr ragweed
				Ambrosia psilostachya	Cuman ragweed
				Amphiachyris dracunculoides	Prairie broomweed
				Aphanostephus skirrhobasis	Arkansas dozedaisy

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Aphanostephus sp.	Dozedaisy
				Artemisia ludoviciana	White sagebrush
				Baccharis neglecta	Rooseveltweed
				Baccharis salicina	Willow baccharis
				Baccharis texana	Prairie false willow
				Centaurea melitensis	Maltese star-thistle
				Chaetopappa asteroides	Arkansas leastdaisy
				Chrysactinia mexicana	Damianita
				Cirsium texanum	Texas thistle
				Cirsium undulatum	Wavyleaf thistle
				Cirsium vulgare	Bull thistle
				Conyza canadensis	Canadian horseweed
				Coreopsis basalis	Goldenmane tickseed
				Coreopsis wrightii	Rock tickseed
				Eclipta prostrata	False daisy
				Engelmannia peristenia	Engelmann's daisy
				Erigeron modestus	Plains fleabane
				Erigeron strigosus	Prairie fleabane
				Evax prolifera	Bighead pygymycudweed
				Evax verna	Spring pygmycudweed
				Gaillardia pulchella	Firewheel
				Gaillardia suavis	Perfumebals
				Gamochaeta sp.	Everlasting
				Grindelia sp.	Gumweed
				Grindelia squarrosa	Curlycup gumweed
				Gutierrezia sp.	Snakeweed
				Gutierrezia texana	Texas snakeweed
				Helenium amarum var. *badium*	Yellowdicks
				Helenium elegans var. *elegans*	Pretty sneezeweed
				Helianthus annuus	Annual sunflower
				Heterotheca canescens	Hoary false goldenaster
				Heterotheca villosa	Hairy false goldaster
				Hymenopappus filifolius	Fineleaf hymenopappus
				Hymenopappus scabiosaeus var. *corymbosus*	Carolina woollywhite
				Iva annua	Annual marsh elder

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Liatris punctata	Dotted blazing star
				Lygodesmia texana	Texas skeletonplant
				Marshallia caespitosa	Puffballs
				Melampodium leucanthum	Plains blackfoot
				Palafoxia callosa	Small palafox
				Parthenium hysterophorus	Santa Maria feverfew
				Pinaropappus roseus	White rocklettuce
				Pluchea odorata var. *odorata*	Sweetscent
				Pyrrhopappus sp.	Desert-chicory
				Ratibida columnifera	Upright prairie coneflower
				Rudbeckia hirta	Blackeyed susan
				Simsia calva	Awnless bushsunflower
				Solidago sp.	Goldenrod
				Sonchus sp.	Sowthistle
				Symphyotrichum ericoides var. *ericoides*	White heath aster
				Symphyotrichum sp.	Aster
				Symphyotrichum subulatum	Eastern annual saltmarsh aster
				Tetraneuris scaposa	Stemmy four-nerve daisy
				Tetraneuris scaposa var. *scaposa*	Stemmy four-nerve daisy
				Thelesperma filifolium	Stiff greenthread
				Thelesperma simplicifolium	Slender greenthread
				Thymophylla pentachaeta	Fiveneedle pricklyleaf
				Verbesina encelioides	Golden crownbeard
				Vernonia lindheimeri	Woolly ironweed
				Xanthisma texanum	Texas sleepydaisy
				Xanthium strumarium	Rough cocklebur
			Berberidaceae	*Mahonia trifoliolata*	Algerita
			Boraginaceae	*Heliotropium tenellum*	Pasture heliotrope
				Lithospermum incisum	Narrowleaf stoneseed
				Lithospermum sp.	Stoneseed
			Brassicaceae	*Lepidium austrinum*	Southern pepperwort
				Lepidium virginicum	Virginia pepperweed
				Lesquerella densiflora	Denseflower bladderpod

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Rorippa palustris	Bog yellowcress
				Rorippa teres	Southern marsh yellowcress
			Cactaceae	*Cylindropuntia leptocaulis*	Christmas cactus
				Echinocactus texensis	Horse crippler
				Echinocereus reichenbachii	Lace hedgehog cactus
				Echinocereus reichenbachii ssp. *reichenbachii*	Lace hedgehog cactus
				Echinocereus sp.	Hedgehog cactus
				Escobaria vivipara var. *radiosa*	Spinystar
				Mammillaria heyderi	Little nipple cactus
				Opuntia engelmannii var. *lindheimeri*	Texas pricklypear
				Opuntia macrorhiza	Twistspine pricklypear
				Opuntia sp.	Pricklypear
				Thelocactus setispinus	Miniature barrel cactus
			Campanulaceae	*Triodanis coloradoensis*	Colorado Venus' looking-glass
				Triodanis sp.	Venus' looking-glass
			Capparaceae	*Polanisia dodecandra* var. *trachysperma*	Sandyseed clammyweed
			Caprifoliaceae	*Lonicera albiflora*	Western white honeysuckle
				Viburnum rufidulum	Rusty blackhaw
			Caryophyllaceae	*Arenaria benthamii*	Hilly sandwort
				Arenaria sp.	Sandwort
				Silene antirrhina	Sleepy silene
			Cistaceae	*Lechea san-sabeana*	San Saba pinweed
				Lechea tenuifolia	Narrowleaf pinweed
			Convolvulaceae	*Convolvulus equitans*	Texas bindweed
				Dichondra sp.	Ponysfoot
				Evolvulus nuttallianus	Shaggy dwarf morning-glory
				Evolvulus sericeus	Silver dward morning-glory
			Cornaceae	*Cornus drummondii*	Roughleaf dogwood
			Cucurbitaceae	*Cucurbita foetidissima*	Missouri gourd
			Cuscutaceae	*Cuscuta* sp.	Dodder
			Ebenaceae	*Diospyros texana*	Texas persimmon
			Euphorbiaceae	*Acalypha ostryifolia*	Pineland threeseed mercury

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Argythamnia aphoroides	Hill Country silverbush
				Argythamnia humilis	Low wildmercury
				Argythamnia simulans	Plateau silverbush
				Chamaesyce albomarginata	Whitemargin sandmat
				Chamaesyce fendleri	Fendler's sandmat
				Chamaesyce prostrata	Prostrate sandmat
				Croton lindheimerianus	Threeseed croton
				Croton monanthogynus	Prairie tea
				Croton texensis	Texas croton
				Euphorbia bicolor	Snow on the prairie
				Euphorbia dentata	Toothed spurge
				Euphorbia marginata	Snow on the mountain
				Euphorbia spathulata	Warty spurge
				Phyllanthus polygonoides	Smartweed leaf-flower
				Stillingia texana	Texas toothleaf
				Tragia brevispica	Shortspike noseburn
				Tragia ramosa	Branched noseburn
				Tragia sp.	Noseburn
			Fabaceae	*Acacia greggii*	Catclaw acacia
				Acacia roemeriana	Roundflower catclaw
				Astragalus sp.	Milkvetch
				Cercis canadensis var. *texensis*	Texas redbud
				Dalea aurea	Golden prairie clover
				Dalea hallii	Hall's prairie clover
				Dalea lasiathera	Purple dalea
				Dalea nana	Dwarf prairie clover
				Dalea tenuis	Pinkglobe prairie clover
				Desmanthus velutinus	Velvet bundleflower
				Eysenhardtia texana	Texas kidneywood
				Lupinus texensis	Texas lupine
				Medicago minima	Little bur-clover
				Melilotus indicus	Annual yellow sweetclover
				Mimosa aculeaticarpa var. *biuncifera*	Catclaw mimosa
				Mimosa borealis	Fragrant mimosa
				Mimosa roemeriana	Roemer's mimosa

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Pediomelum latestipulatum	Texas Plains Indian breadroot
				Pediomelum latestipulatum var. *latestipulatum*	Texas Plains Indian breadroot
				Prosopis glandulosa	Honey mesquite
				Senna pumilio	Dwarf senna
				Senna roemeriana	Twoleaf senna
				Styphnolobium affine	Eve's necklacepod
				Vicia ludoviciana	Louisiana vetch
				Quercus buckleyi	Buckley oak
				Quercus fusiformis	Texas live oak
				Quercus marilandica	Blackjack oak
				Quercus sinuata	Bastard oak
				Quercus sinuata var. *breviloba*	Bastard oak
				Quercus stellata	Post oak
				Quercus texana	Texas red oak
				Quercus vaseyana	Sandpaper oak
				Quercus virginiana	Live oak
			Fumariaceae	*Corydalis aurea*	Scrambled eggs
			Gentianaceae	*Centaurium beyrichii*	Quinineweed
				Centaurium sp.	Centaury
				Eustoma exaltatum ssp. *russellianum*	Showy prairie gentian
				Sabatia campestris	Texas star
			Geraniaceae	*Erodium cicutarium*	Redstem stork's bill
				Erodium texanum	Texas stork's bill
			Haloragaceae	*Myriophyllum* sp.	Watermilfoil
			Hydrophyllaceae	*Nama hispidum*	Bristly nama
				Phacelia congesta	Caterpillars
			Juglandaceae	*Carya illinoinensis*	Pecan
				Carya sp.	Hickory
			Krameriaceae	*Krameria lanceolata*	Trailing krameria
			Lamiaceae	*Hedeoma drummondii*	Drummond false pennyroyal
				Marrubium vulgare	Horehound
				Monarda citriodora	Lemon beebalm
				Salvia azurea	Azure blue sage
				Salvia texana	Texas sage
				Scutellaria drummondii	Drummond's skullcap
				Teucrium laciniatum	Lacy germander

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
			Linaceae	*Linum hudsonioides*	Texas flax
				Linum rupestre	Rock flax
				Linum sp.	Flax
			Lythraceae	*Ammannia coccinea*	Valley redstem
				Lythrum californicum	California loosestrife
			Malvaceae	*Abutilon fruticosum*	Texas Indian mallow
				Abutilon incanum	Pelotazo
				Callirhoe involucrata	Purple poppymallow
				Rhynchosida physocalyx	Buffpetal
				Sida abutifolia	Spreading fanpetals
			Menispermaceae	*Cocculus carolinus*	Carolina coralbead
			Moraceae	*Morus microphylla*	Texas mulberry
			Nyctaginaceae	*Mirabilis linearis*	Narrowleaf four-o'clock
				Mirabilis sp.	Four o'clock
			Oleaceae	*Forestiera pubescens*	Stretchberry
				Ligustrum japonicum	Japanese privet
				Menodora heterophylla	Low menodora
			Onagraceae	*Calylophus berlandieri*	Berlandier's sundrops
				Calylophus hartwegii ssp. *pubescens*	Hartweg's sundrops
				Gaura sp.	Beeblossom
				Gaura suffulta	Kisses
				Ludwigia peploides	Floating primrose-willow
				Oenothera laciniata	Cutleaf evening primrose
				Oenothera linifolia	Threadleaf evening primrose
				Oenothera speciosa	Pinkladies
			Oxalidaceae	*Oxalis drummondii*	Drummond's woodsorrel
				Oxalis stricta	Common yellow oxalis
			Papaveraceae	*Argemone albiflora*	Bluestem pricklypoppy
			Pedaliaceae	*Proboscidea louisianica*	Ram's horn
			Phytolaccaceae	*Phytolacca americana*	American pokeweed
				Rivina humilis	Rougeplant
			Plantaginaceae	*Plantago helleri*	Heller's plantain
				Plantago patagonica	Woolly plantain
				Plantago rhodosperma	Redseed plantain

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
				Plantago sp.	Plantain
				Plantago wrightiana	Wright's plantain
			Polygalaceae	*Polygala alba*	White milkwort
				Polygala lindheimeri	Shrubby milkwort
				Polygala sp.	Polygala
			Polygonaceae	*Eriogonum longifolium*	Longleaf buckwheat
				Rumex sp.	Dock
			Primulaceae	*Samolus valerandi* ssp. *parviflorus*	Seaside brookweed
			Ranunculaceae	*Anemone berlandieri*	Tenpetal thimbleweed
				Delphinium sp.	Larkspur
			Rhamnaceae	*Condalia viridis*	Green snakewood
				Ziziphus obtusifolia	Lotebush
			Rosaceae	*Crataegus* sp.	Hawthorn
				Prunus serotina	Black cherry
				Prunus sp.	Plum
			Rubiaceae	*Cephalanthus occidentalis*	Common buttonbush
				Galium aparine	Stickywilly
				Galium texense	Texas bedstraw
				Galium virgatum	Southwestern bedstraw
				Stenaria nigricans var. *nigricans*	Diamondflowers
			Rutaceae	*Thamnosma texana*	Rue of the mountains
				Zanthoxylum hirsutum	Texas Hercules' club
			Salicaceae	*Populus deltoides*	Eastern cottonwood
				Salix nigra	Black willow
			Sapindaceae	*Sapindus saponaria* var. *drummondii*	Western soapberry
				Ungnadia speciosa	Mexican buckeye
			Sapotaceae	*Sideroxylon lanuginosum*	Gum bully
				Sideroxylon lanuginosum ssp. *rigidum*	Gum bully
			Scrophulariaceae	*Leucospora multifida*	Narrowleaf paleseed
				Linaria sp.	Toadflax
				Mecardonia procumbens	Baby jump-up
				Penstemon sp.	Beardtongue
				Verbascum thapsus	Common mullein
				Veronica peregrina	Neckweed

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
			Solanaceae	*Chamaesaracha coniodes*	Gray five eyes
				Physalis sp.	Groundcherry
				Physalis viscosa	Starhair groundcherry
				Quincula lobata	Chinese lantern
				Solanum dimidiatum	Western horsenettle
				Solanum elaeagnifolium	Silverleaf nightshade
				Solanum ptycanthum	West Indian nightshade
				Solanum rostratum	Buffalobur nightshade
			Ulmaceae	*Celtis laevigata*	Sugarberry
				Celtis laevigata var reticulata	Netleaf hackberry
				Ulmus americana	American elm
				Ulmus crassifolia	Cedar elm
			Urticaceae	*Parietaria pensylvanica*	Pennsylvania pellitory
			Valerianaceae	*Valerianella amarella*	Hairyseed cornsalad
			Verbenaceae	*Aloysia gratissima*	Whitebrush
				Glandularia bipinnatifida	Dakota mock vervain
				Glandularia bipinnatifida var. *bipinnatifida*	Dakota mock vervain
				Glandularia pumila	Pink mock vervain
				Lantana urticoides	West Indian shrubverbena
				Phyla nodiflora	Turkey tangle fogfruit
				Phyla sp.	Fogfruit
				Verbena canescens	Gray vervain
				Verbena halei	Texas vervain
				Vitex agnus-castus	Lilac chastetree
			Viscaceae	*Phoradendron* sp.	Mistletoe
				Phoradendron tomentosum	Bigleaf mistletoe
			Vitaceae	*Cissus trifoliata*	Sorrelvine
				Parthenocissus heptaphylla	Sevenleaf creeper
				Parthenocissus quinquefolia	Virginia creeper
				Vitis cinerea var. *helleri*	Heller's grape
				Vitis sp.	Grape
			Zygophyllaceae	*Tribulus terrestris*	Puncturevine
Pteridophyta: Ferns and Allies					

H.1 Plants

Phylum	Class	Order	Family	Scientific Name	Common Name
			Pteridaceae	*Argyrochosma dealbata*	Powdery false cloak fern
				Astrolepis integerrima	Hybrid cloakfern
				Cheilanthes alabamensis	Alabama lipfern
				Cheilanthes lindheimeri	Fairyswords
				Pellaea atropurpurea	Purple cliffbrake

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
Arthropoda					
	Arachnida: Spiders and Scorpions				
		Araneae: Spiders			
			Araneidae	*Argiope* sp.	Orb-weaving spider
		Scorpiones: Scorpions			
			Buthidae	*Centruroides vittatus*	Striped bark scorpion
	Insecta: Insects				
		Coleoptera: Beetles			
			Anobiidae	*Xyletinus pubescens*	
			Anthribidae	*Trigonorhinus rotundatus*	
				Trigonorhinus sp.	
			Attelabidae	*Eugnamptus* sp.	
				Haplorhynchites eximius	
				Homoeolabus analis	
			Bostrichidae	*Lichenophanes bicornis*	
				Xylobiops sp.	
			Brentidae	*Apion* sp.	
			Buprestidae	*Acmaeodera* sp.	
				Agrilus sp.	
				Brachys ovatus	
				Chrysobothris sp.	
				Lampetis drummondi	
				Taphrocerus sp.	
			Cantharidae	*Chauliognathus scutellaris*	
				Malthinus occipitalis	
				Podabrus sp.	
				Silis sp.	
			Carabidae	*Agonum extensicolle*	
				Agonum sp.	
				Amara littoralis	
				Amara sp.	
				Amphasia sp.	
				Apenes sinuatus	
				Ardistomis sp.	
				Bembidion sp.	
				Brachinus sp.	
				Calosoma affine	
				Calosoma macrum	
				Calosoma marginale	
				Calosoma sayi	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Calosoma scrutator	
				Calosoma wilcoxi	
				Calybe sallei	
				Carabus sylvosus	
				Cicindela obsoleta volturina	Large grassland tiger beetle
				Cicindela punctulata	Punctured tiger beetle
				Cicindela sp.	Tiger beetle
				Colliuris pensylvanicus	
				Cyclotrachelus sp.	
				Cymindis sp.	
				Discoderus sp.	
				Harpalus sp.	
				Helluomorphoides sp.	
				Lebia scalpta	
				Notiobia sp.	
				Pasimachus punctulatus	
				Pasimachus sp.	
				Platynus ovipennis	
				Pogonodaptus mexicana	
				Scarites sp.	
				Selenophorus laesus	
				Selenophorus scolopaceus	
				Selenophorus sp.	
				Stenolophus lineola	
			Cerambycidae	*Aneflomorpha* sp.	
				Anelaphus sp.	
				Enaphalodes atomarius	
				Enaphalodes hispicornis	
				Mecas marginella	
				Mecas sp.	
				Plinthocoelium suaveolens	
				Strangalia sexnotata	
				Typocerus octonotatus	
				Typocerus sinuatus	
			Chrysomelidae	*Altica foliacea*	
				Altica litigata	
				Altica sp.	
				Altica texana	
				Anisostena cyanea	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Anomoea laticlavia	
				Anomoea rufifrons mutabilis	
				Asphaera lustrans	
				Brachypnoea lecontei	
				Chaetocnema sp.	
				Chrysolina auripennis	
				Cryptocephalus amatus	
				Cryptocephalus notatus	
				Diabrotica undecimpunctata	Corn rootworm
				Dibolia borealis	
				Distigmoptera apicalis	
				Exema mormona	
				Exema sp.	
				Kuschelina petaurista	
				Longitarsus sp.	
				Margaridisa sp.	
				Metrioidea convexa	
				Ophraella communa	
				Pachybrachis haematodes	
				Pachybrachis hector	
				Pachybrachis nigricornis	
				Pachybrachis sp.	
				Paria sp.	
				Phaedon viridis	
				Phyllobrotica sororia	
				Phyllotreta sp.	
				Psylliodes convexior	
				Smaragdina militaris	
				Spintherophyta globosa	
				Systena hudsonias	
				Xanthonia sp.	
				Zygogramma disrupta	
			Cleridae	*Cymatodera* sp.	
				Enoclerus sp.	
				Isohydnocera sp.	
				Lecontella sp.	
				Pelonides quadripunctatum	
				Phyllobaenus sp.	
			Coccinellidae	*Adalia bipunctata*	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Axion sp.	
				Coccinella septempunctata	Sevenspotted ladybeetle
				Cycloneda sp.	
				Exochomus sp.	
				Harmonia axyridis	
				Hippodamia convergens	Convergent lady beetle
				Olla v-nigrum	
				Psyllobora sp.	
				Scymnus sp.	
			Curculionidae	*Baris* sp.	
				Colecerus sp.	
				Conotrachelus sp.	
				Curculio sp.	
				Dichoxenus sp.	
				Hypera sp.	
				Listroderes apicalis	
				Listroderes costirostris	
				Pandeleteius sp.	
				Polydrusus sp.	
				Scyphophorus sp.	
				Sitona sp.	
			Dermestidae	*Dermestes* sp.	
			Dytiscidae	*Celina* sp.	Diving beetle
				Copelatus chevrolati	
				Copelatus sp.	Diving beetle
				Coptotomus venustus	
				Cybister sp.	
				Dytiscus sp.	Diving beetle
				Eretes sp.	
				Eretes sticticus	
				Heterosternuta diversicornis	
				Hydaticus sp.	
				Hygrotus nubilus	
				Laccophilus fasciatus	
				Laccophilus pictus	
				Laccophilus proximus	
				Laccophilus quadrilineatus	
				Laccophilus sp.	Diving beetle
				Liodessus obscurellus	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Neobidessus sp.	
				Neoporus dimidiatus	
				Oreodytes sp.	Diving beetle
				Platambus semivittatus	
				Rhantus gutticollis	
				Thermonectus marmoratus	
				Thermonectus ornaticollis	
				Thermonectus sp.	
				Uvarus sp.	
				Uvarus spretus	
			Elateridae	*Aeolus* sp.	
				Agriotes sp.	
				Agrypnus rectangularis	
				Conoderus sp.	
				Limonius sp.	
				Megapenthes insignus	
				Melanotus sp.	
				Neotrichophorus sp.	
				Orthostethus infuscatus	
				Pherhimius fascicularis	
				Scaptolenus sp.	
			Elmidae	*Dubiraphia* sp.	
				Stenelmis sp.	Riffle beetle
			Erotylidae	*Pseudischyrus* sp.	
				Tritoma sp.	
			Geotrupidae	*Geotrupes opacus*	
			Gyrinidae	*Dineutus* sp.	Whirligig beetle
				Gyrinus sp.	
			Haliplidae	*Haliplus deceptus*	
				Haliplus sp.	Crawling water beetle
				Haliplus triopsis	
				Haliplus tumidus	
				Peltodytes festivus	
				Peltodytes litoralis	
				Peltodytes sexmaculatus	
				Peltodytes sp.	Crawling water beetle
			Heteroceridae	*Heterocerus* sp.	
			Hybosoridae	*Hybosorus illigeri*	
			Hydrophilidae	*Berosus infuscatus*	
				Berosus peregrinus	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Berosus pugnax	
				Berosus sp.	Water scavenger beetle
				Cymbiodyta sp.	
				Enochrus hamiltoni	
				Enochrus sp.	
				Hydrobius sp.	Water scavenger beetle
				Hydrophilus sp.	
				Hydrophilus triangularis	
				Paracymus sp.	
				Tropisternus collaris	
				Tropisternus lateralis	
				Tropisternus sp.	
			Lampyridae	*Ellychnia* sp.	
				Photinus sp.	
				Pleotomus pallens	
			Languriidae	*Languria laeta*	
				Pharaxonotha kirschii	
			Leiodidae	*Ptomaphagus* sp.	
			Meloidae	*Epicauta apache*	
				Epicauta sp.	
				Nemognatha sp.	
				Pyrota sp.	
			Melyridae	*Attalus rufiventris*	
				Collops balteatus	
				Collops sp.	
			Mordellidae	*Mordella* sp.	
				Mordellistena sp.	
			Noteridae	*Hydrocanthus atripennis*	
				Hydrocanthus sp.	Burrowing water beetle
			Ochodaeidae	*Ochodaeus* sp.	
			Oedemeridae	*Asclera* sp.	
				Oxacis sp.	
				Oxycopis sp.	
				Sparedrus aspersus	
			Phengodidae	*Phengodes* sp.	
			Rhipiceridae	*Sandalus* sp.	
			Scarabaeidae	*Aphodius lividus*	
				Aphonus texanus	
				Ateuchus sp.	
				Canthon sp.	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Canthon viridis	
				Diplotaxis sp.	
				Dyscinetus morator	
				Euphoria fulgida	
				Euphoria kerni	
				Euphoria sepulcralis	
				Melanocanthon granulifer	
				Melanocanthon nigricornis	
				Onthophagus gazella	Dung beetle
				Onthophagus hecate hecate	
				Onthophagus knausi	
				Pelidnota notata	
				Phanaeus vindex	Dung beetle
				Phyllophaga cribrosa	
				Phyllophaga ignava	
				Phyllophaga submucida	
				Phyllophaga torta	
				Platytomus longulus	
			Scraptiidae	*Allopoda* sp.	
			Staphylinidae	*Homaeotarsus* sp.	
				Pinophilus sp.	
				Platydracus sp.	
				Xantholinus sp.	
			Tenebrionidae	*Blapstinus* sp.	
				Eleodes goryi	
				Eleodes sp.	
				Hymenorus sp.	
				Lobopoda sp.	
				Parasida sp.	
				Platydema sp.	
				Pseudocloeon sp.	Mayfly
			Trogidae	*Omorgus punctatus*	
				Omorgus sp.	
				Trox sp.	
				Trox variolatus	
			Trogossitidae	*Temnochila* sp.	
		Dictyoptera: Cockroaches and Mantids			
			Blattellidae	*Parcoblatta bolliana*	Boll's wood cockroach
				Parcoblatta fulvescens	Fulvous wood cockroach

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Parcoblatta pensylvanica	Pennsylvania wood cockroach
				Parcoblatta sp.	Wood cockroach
				Pseudomops septentrionalis	Palebordered field cockroach
			Mantidae	*Stagmomantis carolina*	
			Polyphagidae	*Arenivaga bolliana*	Boll's sand cockroach
				Arenivaga sp.	Sand cockroach
		Diptera: Flies, Gnats, Mosquitoes			
			Asilidae	*Laphria* sp.	
				Leptogaster sp.	
				Tipulogaster glabrata	
			Chaoboridae	*Chaoborus punctipennis*	Phantom midge
			Chironomidae	*Ablabesmyia illinoensis*	
				Ablabesmyia peleensis	
				Ablabesmyia sp.	Midge
				Apedilum subcinctum	
				Chironomus decorus	
				Chironomus tuxis	
				Cladopelma collator	
				Cladopelma sp.	Midge
				Cladotanytarsus sp.	Midge
				Clinotanypus aureus	
				Clinotanypus sp.	Midge
				Corynoneura sp.	
				Cricotopus bicinctus	
				Cricotopus coronatus	
				Cricotopus sp.	
				Cryptochironomus fulvus	
				Cyphomella sp.	
				Dicrotendipes Californicus	
				Dicrotendipes lucifer	
				Dicrotendipes modestus	
				Dicrotendipes neomodestus	
				Dicrotendipes tritomus	
				Endochironomus nigricans	
				Eukiefferiella sp.	
				Glyptotendipes meridionalis	
				Goeldichironomus	
				Kiefferulus dux	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Labrundinia pilosella	
				Larsia decolorata	
				Larsia planensis	
				Lauterborniella agrayloides	Midge
				Micropsectra sp.	
				Nanocladius anderseni	
				Nanocladius balticus	
				Nanocladius distinctus	
				Nilotanypus kansensis	
				Orthocladius mallochi	
				Parachironomus	
				Parametriocnemus lundbeckii	
				Paratanytarsus sp.	
				Paratrichocladius sp.	
				Pentaneura inconspicua	
				Phaenopsectra flavipes	
				Polypedilum flavum	
				Polypedilum illinoense	Midge
				Polypedilum obtusum	
				Polypedilum sulaceps	
				Procladius bellus	
				Procladius sublettei	
				Psectrocladius sordidellus	
				Psectrocladius sp.	
				Psectrocladius vernalis	
				Pseudochironomus rex	
				Pseudochironomus	
				Pseudochironomus sp.	Midge
				Pseudorthocladius uniserratus	
				Pseudosmittia sp.	
				Rheotanytarsus sp.	
				Tanypus concavus	
				Tanypus stellatus	
				Tanytarsus mendax	
				Tanytarsus sp.	Midge
				Zavreliella marmorata	
				Zavreliella marmorata	
			Culicidae	*Aedes epactius*	Mosquito

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Aedes triseriatus	Mosquito
				Aedes vexans	Vexans mosquito
				Aedes zoosophus	Mosquito
				Anopheles	Mosquito
				Anopheles punctipennis	Mosquito
				Anopheles quadrimaculatus	Common malaria mosquito
				Anopheles sp.	Mosquito
				Culex sp.	Mosquito
			Dixidae	*Dixella* sp.	
			Simuliidae	*Simulium* sp.	Blackfly
			Tachinidae	*Menetus* sp. *(snail)*	Snails
			Tipulidae	*Tipula* sp.	Crane fly
		Ephemeroptera: Mayflies			
			Baetidae	*Baetis* sp.	Mayfly
				Callibaetis floridanus	
				Callibaetis sp.	Mayfly
				Centroptilum sp.	Mayfly
				Fallceon quilleri	
			Baetiscidae	*Baetisca* sp.	Mayfly
			Caenidae	*Caenis latipennis*	
				Caenis punctata	
				Caenis sp.	Mayfly
			Ephemeridae	*Hexagenia limbata*	
				Hexagenia sp.	Mayfly
			Heptageniidae	*Stenacron interpunctatum*	
				Stenonema femoratum	
			Isonychiidae	*Isonychia* sp.	Mayfly
		Hemiptera: True Bugs			
			Belostomatidae	*Belostoma bakeri*	
				Lethocerus medius	
			Cicadellidae	*Acinopterus* sp.	
				Agalliota sp.	
				Athysanella sp.	
				Attenuipyga sp.	
				Auridius sp.	
				Balclutha abdominalis	
				Balclutha sp.	
				Chlorotettix sp.	
				Dorycara sp.	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Draeculacephala sp.	
				Empoasca sp.	
				Exitianus sp.	
				Flexamia areolatus	
				Flexamia pictus	
				Flexamia sp.	
				Graminella sp.	
				Gyponana sp.	
				Limotettix sp.	
				Macrosteles sp.	
				Memnonia sp.	
				Mesamia sp.	
				Neoslossonia sp.	
				Parabolocratus sp.	
				Paraphlepsius sp.	
				Polyamia sp.	
				Scaphytopius sp.	
				Sorhoanus sp.	
				Stirellus bicolor	
				Stirellus convexus	
				Stirellus sp.	
				Stragania sp.	
				Texananus sp.	
				Xerophloea sp.	
			Corixidae	*Corixa* sp.	Water boatmen
				Hesperocorixa sp.	
			Gelastocoridae	*Gelastocoris oculatus*	Toad bug
			Gerridae	*Gerris* sp.	Water strider
				Limnoporus sp.	Water strider
				Neogerris hesione	
			Hydrometridae	*Hydrometra australis*	
				Hydrometra sp.	Marsh treader
			Macroveliidae	*Oravelia* sp.	Shore bug
			Mesoveliidae	*Mesovelia* sp.	Water treader
			Naucoridae	*Ambrysus lunatus*	
				Ambrysus sp.	Creeping water bug
				Pelocoris biimpressus	
				Pelocoris sp.	
			Nepidae	*Curicta scorpio*	
				Ranatra nigra	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Ranatra sp.	
				Ranatra texana	
			Notonectidae	*Buenoa* sp.	
				Notonecta sp.	
			Pentatomidae	*Acrosternum hilaris*	
				Murgantia histrionica	Harlequin bug
			Pleidae	*Neoplea striola*	
			Reduviidae	*Arilus cristatus*	Wheel bug
			Veliidae	*Microvelia* sp.	Ripple bug
		Hymenoptera: Wasps, Bees and Ants			
			Andrenidae	*Calliopsis verbenae*	
			Apidae	*Centris atripes*	
				Ceratina shinnersi	Carpenter bee
				Xylocopa virginica	Carpenter bee
			Formicidae	*Aphaenogaster floridana*	
				Aphaenogaster rudis	
				Brachymyrmex depilis	
				Brachymyrmex musculus	
				Camponotus atriceps	Carpenter ant
				Camponotus castaneus	
				Camponotus festinatus	
				Camponotus floridanus	
				Camponotus nearcticus	Carpenter ant
				Camponotus noveboracensis	
				Camponotus pennsylvanicus	Black carpenter ant
				Camponotus sansabeanus	
				Crematogaster ashmeadi	
				Crematogaster laeviuscula	
				Crematogaster lineolata	
				Crematogaster minutissima	
				Crematogaster punctulata	
				Cyphomyrmex wheeleri	
				Dorymyrmex bicolor	
				Dorymyrmex flavus	
				Dorymyrmex insanus	
				Forelius mccooki	
				Forelius pruinosus	
				Formica microphthalma	
				Formica pallidefulva	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Hypoponera gleadowi	
				Hypoponera inexorata	
				Hypoponera opaciceps	
				Hypoponera opacior	
				Hypoponera punctatissima	
				Labidus coecus	
				Monomorium minimum	Little black ant
				Myrmecina americana	
				Myrmecocystus mimicus	
				Myrmica mexicana	
				Neivamyrmex nigrescens	
				Neivamyrmex pilosus	
				Odontomachus clarus	
				Paratrechina parvula	
				Paratrechina terricola	
				Paratrechina vividula	
				Pheidole crassicornis	
				Pheidole dentate	
				Pheidole hyatti	
				Pheidole metallescens	
				Pheidole morrisii	
				Pheidole pelor	
				Pheidole porcula	
				Pheidole sp.	Ants
				Pogonomyrmex barbatus	Red harvester ant
				Pogonomyrmex imberbiculus	
				Smithistruma margaritae	
				Solenopsis geminata	Fire ant
				Solenopsis invicta	Red imported fire ant
				Solenopsis molesta	Thief ant
				Solenopsis texana	
				Strumigenys louisianae	
				Temnothorax subdivitus	
				Tetramorium bicarinatum	Guinea ant
				Tetramorium spinosum	
				Trachymyrmex turrifex	
			Halictidae	*Agapostemon texanus*	
				Agapostemon tyleri	
				Augochlorella aurata	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Augochlorella bracteata	
				Halictus tripartitus	
				Lasioglossum bardus	
				Lasioglossum bruneri	
				Lasioglossum connexus	
				Lasioglossum disparilis	
				Lasioglossum illinoensis	
				Lasioglossum tegularis	
				Lasioglossum texanus	
			Megachilidae	*Anthidium emarginatum*	
				Dianthidium texanum	
				Heriades carinatus	Mason bee
				Heriades variolosus	Mason bee
				Hoplitis pilosifrons	Mason bee
				Stelis lateralis	
			Mutillidae	*Dasymutilla arcana*	Velvet ant
				Dasymutilla bollii	Velvet ant
				Dasymutilla chiron	Velvet ant
				Dasymutilla creon	Velvet ant
				Dasymutilla creusa	Velvet ant
				Dasymutilla dugesii	Velvet ant
				Dasymutilla gorgon	Velvet ant
				Dasymutilla klugii	Velvet ant
				Dasymutilla perilla	Velvet ant
				Dasymutilla scaevola	Velvet ant
				Dasymutilla vesta	Velvet ant
				Ephuta sp.	
				Lomachaeta hicksi	
				Myrmilloides grandiceps	
				Myrmosula parvula	
				Odontophotopsis sp.	
				Photomorphus (Photomorphyus) sp. 1	
				Photomorphus sp.	
				Pseudomethoca bequaerti	
				Pseudomethoca brazoria	
				Pseudomethoca frigida	
				Sphaeropthalma imperialis	
				Sphaeropthalma sp.	
				Timulla barbigera	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Timulla oajaca	
			Sphecidae	*Ammophila breviceps*	
				Ammophila pictipennis	
				Ammophila procera	
				Cerceris bicornuta	
				Cerceris texana	
				Lindenius armaticeps	
				Ochleroptera bipunctatus	
				Oxybelus abdominalis	
				Pluto spangleri	
				Pseudoplisus divisus	
				Solierella sp.	
				Sphex lucae	
				Tachysphex antennatus	
				Tachysphex glabrior	
				Tachysphex krombeiniellus	
				Tachysphex maurus	
			Vespidae	*Polistes apachus*	Paper wasp
				Polistes carolinus	Paper wasp
				Polistes exclamans	Paper wasp
				Polistes metricus	Paper wasp
				Polistes perplexus	Paper wasp
				Vespula squamosa	Yellowjacket
		Lepidoptera: Butterflies and Moths			
			Hesperiidae	*Atalopedes campestris*	Field skipper
				Copaeodes aurantiaca	Western tiny skipper
				Erynnis funeralis	
				Euphyes vestris	Dun sedge skipper
				Hylephila phyleus	Fiery skipper
				Pyrgus albescens	
				Pyrgus communis	Checkered skipper
				Wallengrenia otho	Red broken dash
			Lycaenidae	*Hemiargus isola*	Mexican blue
				Phaeostrymon alcestis	Soapberry hairstreak
				Strymon melinus	Gray hairstreak
			Nymphalidae	*Adelpha bredowii*	The sister
				Anaea andria	Goatweed leafwing
				Asterocampa celtis	Hackberry butterfly
				Chlosyne lacinia	Bordered patch
				Danaus gilippus	Queen butterfly

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Danaus plexippus	Monarch butterfly
				Euptoieta claudia	Variegated fritillary
				Junonia coenia	
				Libytheana carinenta	American snout butterfly
				Megisto cymela	Little wood satyr
				Megisto rubricata	Red satyr
				Phyciodes phaon	
				Vanessa atalanta	Red admiral
				Vanessa cardui	Painted lady
				Vanessa virginiensis	American painted lady
			Papilionidae	*Battus philenor*	Pipevine swallowtail
				Papilio cresphontes	Giant swallowtail
				Papilio polyxenes	Black swallowtail
			Pieridae	*Colias cesonia*	
				Colias eurytheme	Alfalfa caterpillar
				Eurema nicippe	
				Nathalis iole	
				Pontia protodice	
		Neuroptera: Antlions			
			Chrysopidae	*Chrysoperla* sp.	
			Hemerobiidae	*Hemerobius* sp.	
		Odonata: Damselflies and Dragonflies			
			Aeshnidae	*Anax junius*	Common green darner
				Anax longipes	Comet darner
				Anax sp.	Darner
			Calopterygidae	*Hetaerina americana*	American rubyspot
			Coenagrionidae	*Coenagrion* sp.	Bluet
				Enallagma basidens	Double-striped bluet
				Enallagma civile	Familiar bluet
				Enallagma exsulans	Stream bluet
				Enallagma signatum	Orange bluet
				Enallagma sp.	Bluet
				Hesperagrion sp.	Narrow-winged damselfly
			Corduliidae	*Epitheca costalis*	Stripe-winged baskettail
				Epitheca petechialis	Dot-winged baskettail
				Epitheca princeps	Prince baskettail
			Gomphidae	*Arigomphus cornutus*	Horned clubtail
				Arigomphus maxwelli	Bayou clubtail

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Arigomphus sp.	Clubtail
				Gomphus militaris	Sulphur-tipped clubtail
				Phyllogomphoides stigmatus	Four-striped leaftail
			Lestidae	*Archilestes grandis*	Great spreadwing
			Libellulidae	*Celithemis eponina*	Halloween pennant
				Celithemis fasciata	Banded pennant
				Dythemis fugax	Checkered setwing
				Erythemis simplicicollis	Eastern pondhawk
				Libellula croceipennis	Neon skimmer
				Libellula luctuosa	Widow skimmer
				Libellula pulchella	Twelve-spotted skimmer
				Libellula sp.	Skimmer
				Orthemis ferruginea	Roseate skimmer
				Pachydiplax longipennis	Blue dasher
				Pantala flavescens	Wandering glider
				Perithemis sp.	Amberwing
				Perithemis tenera	Eastern amberwing
				Plathemis lydia	Common whitetail
				Sympetrum corruptum	Variegated meadowhawk
				Tramea carolina	Carolina saddlebags
				Tramea lacerata	Black saddlebags
				Tramea onusta	Red saddlebags
		Orthoptera: Grasshoppers and Katydids			
			Acrididae	*Acrolophitus hirtipes*	
				Ageneotettix deorum	
				Amblytropidia mysteca	
				Arphia simplex	
				Arphia xanthoptera	
				Boopedon gracile	
				Campylacantha olivacea	
				Chortophaga viridifasciata	Greenstriped grasshopper
				Dactylotum bicolor	
				Dissosteira carolina	Carolina grasshopper
				Encoptolophus costalis	
				Encoptolophus sp.	
				Eritettix abortivus	
				Hadrotettix trifasciatus	
				Hesperotettix speciosa	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
				Hesperotettix viridis	
				Hippiscus ocelote	
				Hippiscus rugosus	
				Hippopedon capito	
				Lactista azteca	
				Leprus wheelerii	
				Leptysma marginicollis	Slender locust
				Melanoplus angustipennis	
				Melanoplus bispinosus	
				Melanoplus confusus	
				Melanoplus differentialis	Differential grasshopper
				Melanoplus discolor	
				Melanoplus femurrubrum	Redlegged grasshopper
				Melanoplus flabellatus	
				Melanoplus glaucipes	
				Melanoplus packardii	Packard grasshopper
				Melanoplus ponderosus	
				Melanoplus sanguinipes	Migratory grasshopper
				Melanoplus sp.	
				Mermiria bivittata	
				Opeia obscurus	
				Orphulella speciosus	
				Pardalophora saussurei	
				Psoloessa texana	
				Schistocerca americana	American grasshopper
				Schistocerca damnifica	
				Spharagemon bolli	
				Spharagemon cristatum	
				Spharagemon equale	
				Spharagemon sp.	
				Syrbula admirabilis	
				Trachyrhachys kiowa	
				Trimerotropis pallidipennis	
				Xanthippus corallipes	
			Gryllidae	*Gryllus firmus*	
				Gryllus sp.	
				Gryllus texensis	
			Gryllotalpidae	*Scapteriscus borellii*	
			Mogoplistidae	*Cycloptilum squamosum*	

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
			Oecanthidae	*Oecanthus californicus*	
				Oecanthus sp.	Tree cricket
			Rhaphidophoridae	*Ceuthophilus secretus*	
			Tetrigidae	*Paratettix cucullata*	Hooded grouse locust
				Paratettix mexicanus	
			Tettigoniidae	*Arethaea grallator*	
				Arethaea sp.	
				Conocephalus fasciatus	Slender meadow grasshopper
				Conocephalus strictus	Straight-laced meadow grasshopper
				Dichopetala emarginata	
				Pediodectes haldemani	Shield-backed katydid
				Pediodectes stevensoni	
				Scudderia furcata	Forktailed bush katydid
				Scudderia texensis	
			Trigonidiidae	*Allonemobius socius*	
				Eunemobius carolunus	Carolina ground cricket
		Plecoptera: Stoneflies			
			Chloroperlidae	*Haploperla* sp.	Green stonefly
			Leuctridae	*Zealeuctra claasseni*	
				Zealeuctra sp.	
		Trichoptera: Caddisflies			
			Arctopsychidae	*Arctopsyche* sp.	Caddisfly
			Helicopsychidae	*Helicopsyche borealis*	
			Hydropsychidae	*Cheumatopsyche campyla*	
				Cheumatopsyche oxa	
				Cheumatopsyche pettiti	
				Cheumatopsyche rossi	
				Cheumatopsyche sp.	Net-spinning caddisfly
				Hydropsyche simulans	
				Hydropsyche sp.	Net-spinning caddisfly
			Hydroptilidae	*Hydroptila ajax*	
				Hydroptila consimilis	
				Hydroptila sp.	Microcaddisfly
				Ochrotrichia sp.	Microcaddisfly
				Orthotrichia aegerfasciella	
				Orthotrichia sp.	Micro-caddisfly
				Oxyethira sp.	Micro-caddisfly
			Lepidostomatidae	*Lepidostoma* sp.	Caddisfly

H.2 Invertebrates

Phylum	Class	Order	Family	Scientific Name	Common Name
			Leptoceridae	*Ceraclea transversa*	
				Oecetis avara	
				Oecetis cinerascens	
				Oecetis ditissa	
				Oecetis inconspicua	
				Oecetis sp.	Long-horn caddisfly
				Triaenodes sp.	Long-horn caddisfly
				Triaenodes tardus	
			Philopotamidae	*Chimarra feria*	
				Chimarra obscura	
				Chimarra sp.	Fingernet caddisfly
			Polycentropodidae	*Polycentropus centralis*	
				Polycentropus sp.	Caddisfly
Mollusca					
	Bivalvia: Clams, Mussels, and Allies				
		Veneroida: Clams			
			Pisidiidae	*Pisidium* sp.	Peaclam
	Gastropoda: Snails and Allies				
		Basommatophora: Freshwater Snails			
			Physidae	*Physella* sp.	Snail
			Planorbidae	*Helisoma* sp.	Rams horn snail
	Malacostraca: Shrimps and Allies				
		Amphipoda: Amphipods			
			Hyalellidae	*Hyalella azteca*	
				Hyalella sp.	

H.3 Fish

Class/Order	Family	Scientific Name	Common Name
Cypriniformes: Minnows and Allies			
	Cyprinidae	*Cyprinella lutrensis*	Red shiner
		Cyprinus carpio	Common carp
		Notemigonus crysoleucas	Golden shiner
		Pimephales promelas	Fathead minnow
Cyprinodontiformes: Pupfish and Allies			
	Poecilidae	*Gambusia affinis*	Mosquitofish
Perciformes: Perch and Allies			
	Centrarchidae	*Lepomis cyanellus*	Green sunfish
		Lepomis humilis	Orangespotted sunfish
		Lepomis macrochirus	Bluegill
		Lepomis microlophus	Redear sunfish
		Micropterus salmoides	Largemouth bass
		Pomoxis annularis	White crappie
Siluriformes: Catfish			
	Ictaluridae	*Ameiurus melas*	Black bullhead
		Ameiurus natalis	Yellow bullhead
		Ameiurus sp.	Bullhead catfish
		Ictalurus punctatus	Channel catfish

H.4 Amphibians

Class/Order	Family	Scientific Name	Common Name
Anura: Frogs and Toads			
	Anaxyrus	*Anaxyrus nebulifer*	Gulf coast toad
		Anaxyrus sp.	Toads
	Hylidae	*Acris crepitans*	Cricket frog
		Acris crepitans blanchardi	Blanchard's cricket frog
		Pseudacris sp.	Chorus frog
	Microhylidae	*Gastrophryne olivacea*	Great Plains narrowmouth toad
	Lithobates	*Lithobates berlandieri*	Rio Grande leopard frog
		Lithobates blairi	Plains leopard frog
		Lithobates catesbeiana	Bullfrog
		Lithobates sphenocephala	Southern leopard frog

H.5 Reptiles

Class/Order	Family	Scientific Name	Common
Squamata: Lizards and Snakes			
	Colubridae	*Diadophis punctatus arnyi*	Prairie ringneck snake
		Pantherophis guttata emoryi	Great Plains rat snake
		Pantherophis obsolete	Rat snake
		Masticophis flagellum	Coachwhip
		Masticophis taeniatus girardi	Central Texas whipsnake
		Nerodia erythrogaster	Plain-bellied water snake
		Nerodia erythrogaster transversa	Blotched water snake
		Nerodia rhombifer	Diamondback water snake
		Nerodia sp.	Water snakes
		Pituouphis catenifer	Gopher snake
		Salvadora grahamiae	Mountain patch-nosed snake
		Salvadora grahamiae lineata	Texas patch-nosed snake
		Sonora semiannulata	Ground snake
		Thamnophis cyrtopsis	Black-necked garter snake
		Thamnophis marcianus	Checkered garter snake
		Thamnophis proximus	Ribbon snake
		Thamnophis proximus rubrilineatus	Redstripe ribbon snake
	Iguanidae	*Crotaphytus collaris*	Eastern collared lizard
	Leptotyphlopidae	*Leptotyphlops dulcis*	Texas slender blind snake
		Leptotyphlops dulcis dulcis	Plains blind snake
	Phrynosomatidae	*Cophosaurus texanus texanus*	Texas earless lizard
		Phrynosoma cornutum	Texas horned lizard
		Sceloporus sp.	Spiny lizards
		Urosaurus ornatus	Tree lizard
		Sceloporus olivaceus	Texas spiny lizard
		Sceloporus undulatus	Fence lizard
	Scincidae	*Eumeces tetragrammus*	Four-lined skink
		Scincella lateralis	Ground skink
	Teiidae	*Aspidoscelis gularis*	Texas spotted whiptail
	Viperidae	*Crotalus atrox*	Western diamondback rattlesnake
Testudines: Turtles			
	Chelydridae	*Chelydra serpentina*	Snapping turtle
	Emydidae	*Pseudemys texana*	Texas river cooter
		Trachemys scripta	Red-eared slider
		Trachemys scripta elegans	Red-eared slider
	Kinosternidae	*Kinosternon flavescens*	Yellow mud turtle
	Trionychidae	*Apalone spinifera*	Spiny softshell

H.6 Birds

Class/Order	Family	Scientific Name	Common Name
Anseriformes: Ducks and Allies			
	Anatidae	*Aix sponsa*	Wood duck
		Anas acuta	Northern pintail
		Anas americana	American widgeon
		Anas clypeata	Northern shoveler
		Anas crecca	Green-winged teal
		Anas discors	Blue-winged teal
		Anas strepera	Gadwall
		Aythya affinis	Lesser scaup
		Aythya americana	Redhead
		Aythya collaris	Ring-necked duck
		Aythya valisineria	Canvasback
		Bucephala albeola	Bufflehead
		Dendrocygna autumnalis	Black-bellied whistling duck
		Lophodytes cucullatus	Hooded merganser
		Oxyura jamaicensis	Ruddy duck
Apodiformes: Hummingbirds			
	Trochilidae	*Archilochus alexandri*	Black-chinned hummingbird
		Archilochus colubris	Ruby-throated hummingbird
Ciconiiformes: Herons and Allies			
	Accipitridae	*Accipiter cooperii*	Cooper's hawk
		Accipiter striatus	Sharp-shinned hawk
		Buteo jamaicensis	Red-tailed hawk
		Buteo lineatus	Red-shouldered hawk
		Buteo sp.	Hawk
		Buteo swainsoni	Swainson's hawk
		Circus cyaneus	Northern harrier
		Ictinia mississippiensis	Mississippi kite
	Ardeidae	*Ardea alba*	Great egret
		Ardea herodias	Great blue heron
		Butorides virescens	Green heron
		Nycticorax nycticorax	Black-crowned night-heron
	Charadriidae	*Charadrius vociferus*	Killdeer
	Ciconiidae	*Cathartes aura*	Turkey vulture
		Coragyps atratus	Black vulture
	Falconidae	*Caracara cheriway*	Crested caracara
		Falco columbarius	Merlin
		Falco sparverius	American kestrel
	Phalacrocoracidae	*Phalacrocorax auritus*	Double-crested cormorant
	Podicipedidae	*Podilymbus podiceps*	Pied-billed grebe

H.6 Birds

Class/Order	Family	Scientific Name	Common Name
	Scolopacidae	*Actitis macularia*	Spotted sandpiper
		Calidris bairdii	Baird's sandpiper
		Gallinago gallinago	Common snipe
		Scolopax minor	American woodcock
		Tringa melanoleuca	Greater yellowlegs
Columbiformes: Doves and Pigeons			
	Columbidae	*Columba livia*	Rock pigeon
		Columbina inca	Inca dove
		Columbina passerina	Common ground-dove
		Zenaida asiatica	White-winged dove
		Zenaida macroura	Mourning dove
Coraciiformes: Kingfishers and Allies			
	Alcedinidae	*Ceryle alcyon*	Belted kingfisher
Cuculiformes: Cuckoos and Allies			
	Cucilidae	*Coccyzus americanus*	Yellow-billed cuckoo
		Coccyzus erythropthalmus	Black-billed cuckoo
		Geococcyx californianus	Greater roadrunner
Galliformes: Fowl			
	Odontophoridae	*Colinus virginianus*	Northern bobwhite
	Phasianidae	*Meleagris gallopavo*	Wild turkey
Gruiformes: Cranes and Allies			
	Rallidae	*Fulica americana*	American coot
Passeriformes: Songbirds and Allies			
	Aegithalidae	*Psaltriparus minimus*	Bushtit
	Bombycillidae	*Bombycilla cedrorum*	Cedar waxwing
	Cardinalidae	*Cardinalis cardinalis*	Northern cardinal
		Cardinalis sinuatus	Pyrrhuloxia
		Passerina caerulea	Blue grosbeak
		Passerina ciris	Painted bunting
		Passerina cyanea	Indigo bunting
		Spiza americana	Dickcissel
	Certhiidae	*Polioptila caerulea*	Blue-gray gnatcatcher
	Corvidae	*Aphelocoma californica*	Western scrub-jay
		Corvus brachyrhynchos	American crow
		Corvus corax	Common raven
		Cyanocitta cristata	Blue jay
	Emberizidae	*Aimophila cassinii*	Cassin's sparrow
		Aimophila ruficeps	Rufous-crowned sparrow
		Ammodramus leconteii	LeConte's sparrow
		Ammodramus savannarum	Grasshopper sparrow

H.6 Birds

Class/Order	Family	Scientific Name	Common Name
		Amphispiza belli	Sage sparrow
		Amphispiza bilineata	Black-throated sparrow
		Calamospiza melanocorys	Lark bunting
		Chondestes grammacus	Lark sparrow
		Junco hyemalis	Dark-eyed junco
		Melospiza lincolnii	Lincoln's sparrow
		Melospiza melodia	Song sparrow
		Passerculus sandwichensis	Savannah sparrow
		Passerella iliaca	Fox sparrow
		Pipilo chlorurus	Green-tailed towhee
		Pipilo erythrophthalmus	Eastern towhee
		Pipilo fuscus	Canyon towhee
		Pipilo maculatus	Spotted towhee
		Pooecetes gramineus	Vesper sparrow
		Spizella pallida	Clay-colored sparrow
		Spizella passerina	Chipping sparrow
		Spizella pusilla	Field sparrow
		Zonotrichia albicollis	White-throated sparrow
		Zonotrichia leucophrys	White-crowned sparrow
	Fringillidae	*Carduelis pinus*	Pine siskin
		Carduelis psaltria	Lesser goldfinch
		Carduelis tristis	American goldfinch
		Carpodacus mexicanus	House finch
	Hirundinidae	*Hirundo rustica*	Barn swallow
		Petrochelidon pyrrhonota	Cliff swallow
		Progne subis	Purple martin
		Stelgidopteryx serripennis	Northern rough-winged swallow
	Icteridae	*Agelaius phoeniceus*	Red-winged blackbird
		Icterus bullockii	Bullock's oriole
		Icterus galbula	Baltimore oriole
		Icterus spurius	Orchard oriole
		Molothrus ater	Brown-headed cowbird
		Quiscalus mexicanus	Great-tailed grackle
		Quiscalus quiscula	Common grackle
		Sturnella magna	Eastern meadowlark
		Sturnella sp.	Meadowlark
	Laniidae	*Lanius ludovicianus*	Loggerhead shrike
	Mimidae	*Mimus polyglottos*	Northern mockingbird
		Toxostoma curvirostre	Curve-billed thrasher
		Toxostoma rufum	Brown thrasher

H.6 Birds

Class/Order	Family	Scientific Name	Common Name
	Motacillidae	*Anthus spragueii*	Sprague's pipit
	Paridae	*Baeolophus atricristatus*	Black-crested titmouse
		Baeolophus bicolor	Tufted titmouse
		Poecile carolinensis	Carolina chickadee
	Parulidae	*Dendroica cerulea*	Cerulean warbler
		Dendroica coronata	Yellow-rumped warbler
		Dendroica fusca	Blackburnian warbler
		Dendroica magnolia	Magnolia warbler
		Dendroica petechia	Yellow warbler
		Dendroica virens	Black-throated green warbler
		Geothlypis trichas	Common yellowthroat
		Icteria virens	Yellow-breasted chat
		Mniotilta varia	Black-and-white warbler
		Oporornis philadelphia	Mourning warbler
		Oporornis tolmiei	MacGillivray's warbler
		Seiurus aurocapillus	Ovenbird
		Vermivora celata	Orange-crowned warbler
		Vermivora ruficapilla	Nashville warbler
		Wilsonia canadensis	Canada warbler
		Wilsonia pusilla	Wilson's warbler
	Passeridae	*Passer domesticus*	House sparrow
	Regulidae	*Regulus calendula*	Ruby-crowned kinglet
		Regulus satrapa	Golden-crowned kinglet
	Remizidae	*Auriparus flaviceps*	Verdin
	Sturnidae	*Sturnus vulgaris*	European starling
	Thraupidae	*Piranga olivacea*	Scarlet tanager
		Piranga rubra	Summer tanager
	Troglodytidae	*Campylorhynchus brunneicapillus*	Cactus wren
		Thryomanes bewickii	Bewick's wren
		Thryothorus ludovicianus	Carolina wren
		Troglodytes aedon	House wren
	Turdidae	*Catharus guttatus*	Hermit thrush
		Catharus ustulatus	Swainson's thrush
		Sialia sialis	Eastern bluebird
		Turdus migratorius	American robin
	Tyrannidae	*Contopus virens*	Eastern wood pewee
		Empidonax flaviventris	Yellow-bellied flycatcher
		Empidonax minimus	Least flycatcher
		Empidonax sp.	Flycatcher

H.6 Birds

Class/Order	Family	Scientific Name	Common Name
		Empidonax traillii	Traill's flycatcher
		Empidonax traillii	Willow flycatcher
		Empidonax virescens	Acadian flycatcher
		Myiarchus cinerascens	Ash-throated flycatcher
		Myiarchus crinitus	Great crested flycatcher
		Pyrocephalus rubinus	Vermilion flycatcher
		Sayornis phoebe	Eastern phoebe
		Sayornis saya	Say's phoebe
		Tyrannus forficatus	Scissor-tailed flycatcher
		Tyrannus tyrannus	Eastern kingbird
		Tyrannus verticalis	Western kingbird
	Vireonidae	*Vireo atricapillus*	Black-capped vireo
		Vireo bellii	Bell's vireo
		Vireo griseus	White-eyed vireo
		Vireo olivaceus	Red-eyed vireo
		Vireo solitarius	Blue-headed vireo
Piciformes: Woodpeckers and Allies			
	Picidae	*Colaptes auratus*	Northern flicker
		Melanerpes aurifrons	Golden-fronted woodpecker
		Melanerpes carolinus	Red-bellied woodpecker
		Picoides pubescens	Downy woodpecker
		Picoides scalaris	Ladder-backed woodpecker
		Sphyrapicus varius	Yellow-bellied sapsucker
Strigiformes: Owls			
	Caprimulgidae	*Chordeiles minor*	Common nighthawk
		Phalaenoptilus nuttallii	Common poorwill
	Strigidae	*Bubo virginianus*	Great horned owl
		Otus asio	Eastern screech-owl

H.7 Mammals

Class/Order	Family	Scientific Name	Common Name
Artiodactyla: Deer and Allies			
	Cervidae	*Odocoileus virginianus*	White-tailed deer
Carnivora: Carnivores			
	Canidae	*Canis latrans*	Coyote
		Urocyon cinereoargenteus	Gray fox
		Vulpes vulpes	Red fox
	Felidae	*Felis silvestris*	Domestic cat
		Lynx rufus	Bobcat
		Puma concolor	Mountail lion
	Mephitidae	*Conepatus mesoleucus*	Hog-nosed skunk
		Mephitis mephitis	Striped skunk
	Mustelidae	*Taxidea taxus*	American badger
	Procyonidae	*Bassariscus astutus*	Ringtail
		Procyon lotor	Racoon
Chiroptera: Bats			
	Vespertilionidae	*Lasiurus borealis*	Eastern red bat
		Lasiurus cinereus	Hoary bat
		Myotis velifer	Cave myotis bat
		Nycticeius humeralis	Evening bat
Didelphimorphia: Opossum (Marsupials)			
	Didelphidae	*Didelphis virginiana*	Opossum
Insectivora: Shrews and Allies			
	Soricidae	*Cryptotis parva*	Least shrew
Lagomorpha: Rabbits and Allies			
	Leporidae	*Lepus californicus*	Black-tailed jackrabbit
		Sylvilagus floridanus	Eastern cottontail
Rodentia: Rodents			
	Capromyidae	*Myocastor coypus*	Nutria
	Castoridae	*Castor Canadensis*	American beaver
	Erethizontidae	*Erethizon dorsatum*	Porcupine
	Heteromyidae	*Chaetodipus hispidus*	Hispid pocket mouse
		Perognathus merriami	Merriam's pocket mouse
	Muridae	*Baiomys taylori*	Nothern pygmy mouse
		Mus musculus	House mouse
		Neotoma micropus	Southern Plains woodrat
		Peromyscus attwateri	Texas mouse
		Peromyscus boylii	Brush mouse
		Peromyscus leucopus	White-footed mouse
		Peromyscus maniculatus	Deer mouse
		Peromyscus pectoralis	White-ankled mouse

H.7 Mammals

Class/Order	Family	Scientific Name	Common Name
		Reithrodontomys fulvescens	Fulvous harvest mouse
		Reithrodontomys montanus	Plains harvest mouse
		Sigmodon hispidus	Hispid cotton rat
	Sciuridae	*Sciurus niger*	Fox squirrel
Xenarthra: Armadillos			
	Dasypodidae	*Dasypus novemcinctus*	Nine-banded armadillo

Appendix I. Summary of Natural Resources Reports

This document provides a summary of all reports available for this training center from the Natural Resources Program. This summary is current as of 6 March 2009.

I.1 Citations in Chronological Order

Nance and Wermund 1993; Avakian and Sansing 1994; Walker and DeSante 1995; Farquhar, Maresh et al. 1996; Fisher, Mace et al. 1996; Linam, Seaman et al. 1996; Pyle, DeSante et al. 1996; Wolfe, Liu et al. 1996; Pyle, O'Grady et al. 1997; Farquhar, O'Connor et al. 1998; Pyle, Froehlich et al. 1998; Gravatt, Martel et al. 1999; Kuhr 2000; Best, Barr et al. 2001; Turner 2001; Cook 2002; Nott 2002; Turner 2002; Cimprinch 2003; Clayton and Reinecke 2003; Cook 2003; Fischer and Senseman 2003; Lutterschmidt and Cook 2003; Nott, DeSante et al. 2003; Cimprinch 2004; Cook 2004; Cook 2004; Cook 2004; DeSante, Pyle et al. 2004; Dowler, Holm et al. 2004; Cimprinch 2005; Kennedy, Hunter et al. 2005; Pogue 2005; Pyle, Kaschube et al. 2005; Reinecke, Schneider et al. 2005; Cimprinch 2006; Hunter 2006; Leipnik 2006; Nott, Pyle et al. 2006; Ammerman, Dowler et al. 2007; Cimprinch 2007; Hendrickson and Cohen 2007; Turner Environmental 2007; Bethune and Walsh 2008; Breeden 2008; Cimprinch 2008; Cox 2008; Nott, Pyle et al. 2008; Nott, Pyle et al. 2008; Perry 2008; Dowler, Dixon et al. 2009; Harrison and Abbott 2009

I.2 Reports with Abstracts

Ammerman LK, Dowler RC, et al. 2007. Bat diversity and activity: a comparison among Texas Army National Guard sites. San Angelo (TX): Angelo State University.
Texas Army National Guard training centers (Camp Maxey, Camp Bowie, Camp Swift, Camp Bowie, and Camp Mabry) were surveyed for bats using mist nets and ANABAT units during spring, summer, and fall seasons from October 2005-November 2006. A total of 7 species were documented across all 5 sites. Based on mist net captures, Camp Maxey had the highest species diversity (5 species documented) whereas Camp Swift and Camp Mabry had the lowest (a single species was documented at each site). There were 2 county records for Lamar County (Camp Maxey) and 1 county record for Parker County (Camp Bowie). Species occurrence was also recorded at each site with acoustic monitoring. Canonical correspondence analysis of acoustic data revealed no impact due to training on the bat communities. Conservation of wetlands, open water, woodlands, and dead snags are recommended for maintaining bat populations.

Avakian AJ, Sansing M. 1994. Geological and climatic survey, Camp Bowie military reservation, Brown County, Texas. Supplement: Explanatory notes for digital line graph data. Austin (TX): Bureau of Economic Geology, University of Texas at Austin.
This supplement to the main report includes digital line graph data sets with a description of data collection and quality control.

Best RL, Barr CL, et al. 2001. Management practices for red imported fire ant populations on Texas Army National Guard grounds. College Station (TX): Texas Cooperative Extension, Texas A&M University System.
Three Texas Army National Guard (TXARNG) training camps were monitored for red imported fire ant infestation: Camp Swift (Bastrop), Camp Bowie (Brownwood), and Camp Bowie (Mineral Wells). The cantonment area and firing ranges at each training camp were evaluated for fire ant activity and TXARNG personnel were interviewed for information regarding fire ant encounters and/or problems associated with fire ant infestations. Method demonstrations were conducted on the firing ranges to determine the most successful management program for

controlling red imported fire ants.

Bethune K, Walsh M. 2008. Stormwater Pollution Prevention Plan (SWPPP) guidance manual for Camp Bowie. Austin (TX): Watershed Concepts.
The purpose of this guidance manual is to provide familiarity with the National Pollutant Discharge Elimination System (NPDES) and the Texas Pollutant Discharge Elimination System (TPDES) as applicable to construction activities, aid in determining the need for a Stormwater Pollution Prevention Plan (SWPPP), and provide additional guidance in obtaining the General Permit for construction activities. Under the Construction General Permit TXR150000, construction activities from which runoff goes into or adjacent to any waters of the United States are regulated (and therefore the General Permit TXR150000 is required) according to the area of land disturbed. This document is specifically designed for those persons responsible for obtaining the General Permit for Construction Activities (TXR150000) for sites less than 5 acres. It provides the user with guidance on selecting control measures that ensure compliance with the General Permit; however, it is not intended as a design manual for structural stormwater management control measures.

Breeden JB. 2008. Game survey and monitoring plan for Camp Bowie, Camp Bowie, and Camp Maxey. Stephenville (TX): Tarleton State University.
This project was conducted to establish a long-term game population survey and monitoring protocol in order to develop an effective wildlife management plan and monitor population trends. With the exception of Camp Maxey, all deer surveys should be conducted during August or early September. Due to thick vegetation at Camp Maxey, it would be helpful to conduct the deer survey during winter. Visibility measurements should be taken every 3-4 years. Remote cameras could be used as a reliable alternative to spotlight surveys, especially in areas of thick vegetative cover. This would eliminate the concerns of reduced detectability on Camp Bowie and Camp Maxey as well as reduce the travel to each site. However, this may only be practical on small sites. Incidental sighting data can also be helpful in monitoring the population. It seems unlikely that the observed number of wild turkeys was representative of the study sites. Limited time and the large area of the sites made locating wild turkey roosts more difficult than anticipated.

Cimprinch D. 2003. Delineation of habitat and presence surveys for black-capped vireos at Camp Bowie, Brown County, Texas, Spring 2003. Fort Hood (TX): The Nature Conservancy.
This is a delineation of suitable black-capped vireo habitat on Camp Bowie and survey for the presence of the endangered species. The effort identified and mapped 45.0 ha (111 acres) of suitable habitat in 8 patches ranging from 0.4 to 32.3 ha. Although suitable habitat is present, no black-capped vireos were detected; however, 75 other species of birds were observed.

Cimprinch D. 2004. Surveys for the presence of the black-capped vireo at Camp Bowie, Brown County, Texas 2004. Fort Hood (TX): The Nature Conservancy.
Annual survey for the presence of black-capped vireos at Camp Bowie. This year they did not detect any breeding black-capped vireos or any transient individuals. There is the possibility they did not detect transient individuals, but they were present. The surveyors walked transects and used playbacks to solicit responses of black-capped vireos. There is potential habitat at Camp Bowie for black-capped vireos, but they do not seem to be using it. A total of 47 other avian species were detected. The author recommends continuing to improve this habitat, mainly by using prescribed fire.

Cimprinch D. 2005. Surveys for the presence of the black-capped vireo at Camp Bowie, Brown County, Texas 2005. Fort Hood (TX): The Nature Conservancy.

Annual survey for the presence of black-capped vireos (BCV) at Camp Bowie. This year they did not detect any breeding black-capped vireos or any transient individuals. There is the possibility they did not detect transient individuals, but they were present. The surveyors walked transects and used playbacks to solicit responses of black-capped vireos. There is potential habitat at Camp Bowie for black-capped vireos, but they do not seem to be using it. Many patches of habitat were burned during the prescribed fire in winter 2005. The patches show juniper death and substantial resprouting of oaks and will be good BCV habitat in 3-5 years. A total of 43 other avian species were detected.

Cimprinch D. 2006. Surveys for the presence of the black-capped vireo at Camp Bowie, Brown County, Texas 2006. Fort Hood (TX): The Nature Conservancy.
Annual survey for the presence of black-capped vireos at Camp Bowie. This year they did not detect any breeding black-capped vireos or any transient individuals. There is the possibility they did not detect transient individuals, but they were present. The surveyors walked transects and used playbacks to solicit responses of black-capped vireos. There is potential habitat at Camp Bowie for black-capped vireos, but they do not seem to be using it. A total of 42 other avian species were detected.

Cimprinch D. 2007. Surveys for the presence of the black-capped vireo at Camp Bowie, Brown County, Texas 2007. Fort Hood (TX): The Nature Conservancy.
Annual survey for the presence of black-capped vireos at Camp Bowie. This year they banded two black-capped vireo males but neither had a mate or nest. It is possible that one may return next year and attempt to establish a territory again. The surveyors walked transects and used playbacks to solicit responses of black-capped vireos. There is still potential habitat at Camp Bowie for black-capped vireos that is not being used. A total of 53 other avian species were detected.

Cimprinch D. 2008. Surveys for presence of the black-capped vireo at Camp Bowie, Brown County, Texas 2008. Fort Hood (TX): The Nature Conservancy.
In 2008, The Nature Conservancy of Texas again surveyed the 8 patches of habitat for the presence of the black-capped vireo. This report details the findings of those surveys, including the detection of a single male on 1 occasion. Additionally, the report lists all species of birds detected on Camp Bowie by the field crew during the fieldwork for the project.

Clayton L, Reinecke R. 2003. Riparian and pond survey Camp Bowie, Texas. Plano (TX): GeoMarine.
A riparian area and pond survey was conducted at Camp Bowie from 27 January to 1 February 2003 to document the location, extent, and nature of these areas. Sixty-six stream reaches and 81 ponds were evaluated based on vegetation, hydrology, soils, and landscape settings surrounding the areas. Associated conservation issues were documented. The stream reaches and ponds were ranked to prioritize the need of restoration. Recommendations for restoration are provided. All plant species identified were recorded in a master list.

Cook JL. 2004. Chemical control of red imported fire ants at TXARNG training centers. Huntsville (TX): Sam Houston State University.
First, all 3 types of bait (methoprene, abamectin, and mixed) provide control of fire ants. Second, treatments as low as 1 lb./acre give good control. Third, there are occasional failures of treatment regardless of rate and bait. Fourth, fire ants are the first recolonizers of an area that has been treated. Finally, these treatments do eliminate native ants in the treatment area as well as fire ants. More than 120 mounds/acre require treatment at the maximum rate, although in most cases half the label rate is sufficient to achieve control. Within 6 months, the population typically occurs at half original rate. Within 12 months, the population typically occurs at original rate. If treatment

is stopped on the ranges that have been treated for the last 5 years, fire ants will likely return to the high infestation rates prior to treatment. The biological controls currently being released may reduce infestation rate over the long-term and eventually result in less need for treatment, but that may take 5-20 years to be effective.

Cook JL. 2004. Selective application of chemical baits for the management of *Solenopsis invicta* at TXARNG training centers October 2003-September 2004. Huntsville (TX): Sam Houston State University.
Camp Bowie results indicate that fire ants do not occur more than 100 m from a stock tank. Stock tanks that have permanent water have almost solid fire ant populations, while stock tanks with intermittent water have some native species and lower densities of fire ants. Camp Bowie results indicate fire ants over the entire installation with the highest densities on the ranges and along Rock Creek. Camp Swift results indicate 49 species of velvet ants at Camp Swift, a higher diversity than anywhere else in the country. In addition, 2 master's thesis projects are described that are being conducted at Camp Swift (but not funded by the Texas National Guard) in conjunction with the fire ant control project.

Cook TJ. 2002. Application of Microsporidia in the management of *Solenopsis invicta* at Texas Army National Guard training centers, October 2001-September 2002. Huntsville (TX): Sam Houston State University.
Annual summary of monitoring of inoculations of Microsporidia on red imported fire ants. Initial inoculations appear to be spreading. Fire ant mound volume is reduced after infection.

Cook TJ. 2003. Continued application and assessment of Microsporidia in the management of *Solenopsis invicta* at Texas Army National Guard training centers, October 2002-September 2003. Huntsville (TX): Sam Houston State University.
Annual summary of monitoring of inoculations of Microsporidia on red imported fire ants. Results indicate a possible increase in arthropod diversity in the surrounding area after inoculations of fire ants with Microsporidia. The reduction in mound size after inoculation seems to be a weaker correlation than originally indicated. Microsporidia have successfully established at both Camp Bowie and Camp Swift. The infection rate fluctuates but remains present.

Cook TJ. 2004. Continued monitoring of the effect of *Thelohania solenopsae* on *Solenopsis invicta* at two Texas Army National Guard training centers, October 2003-September 2004. Huntsville (TX): Sam Houston State University.
Annual summary of monitoring of inoculations of microsporidia on red imported fire ants. Results this year indicate that the number of colonies infected was higher in the fall, but that within a colony the number of workers infected does not show a seasonal trend. Also, the previous data indicating an increase in ground-dwelling arthropod diversity with increased microsporidia infection is not holding up with additional data.

Cox LW. 2008. TMD Training center deer survey results—Fall 2008. Austin (TX): Cox McLain Environmental Consulting.
White-tailed deer surveys were completed at four TMD training centers (Camp Bowie, Camp Maxey, Camp Swift, and Camp Bowie) September/October 2008. Each survey occurred over 4 nights and were consistent with TPWD survey protocols. Incidental sightings of other mammals were recorded as well.

DeSante DF, Pyle P, et al. 2004. The 2003 report of the Monitoring Avian Productivity and Survivability (MAPS) Program on Texas Army National Guard installations Camp Bowie and Camp Swift. Point Reyes Station (CA): Institute for Bird Populations.

Since 1989, the Monitoring Avian Productivity and Survivorship (MAPS) Program has been provided critical information on bird survivability and productivity. It is a cooperative effort among public and private agencies and individual bird banders in North America to operate a continent-wide network of over 500 constant-effort mist-netting and banding stations. The ultimate objective of the MAPS Program on DoD installations such as Camp Bowie and Camp Swift is to identify generalized management guidelines and formulate specific management actions that can be implemented on military installations and elsewhere to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. Accordingly, 6 MAPS stations each were established in 1994 and operated on Camp Bowie and Camp Swift. No changes in stations were made at Camp Bowie or Camp Swift between 2002 and 2003, although changes between the 2003 and 2004 seasons are currently being considered. This report briefly updates the earlier reports and documents the operation of the 12 MAPS stations on Camp Bowie and Camp Swift during the 2003 breeding season. At Camp Bowie, 3 species emerged as candidates for particular management concern: Bewick's Wren, Field Sparrow, and Painted Bunting. In addition, the data suggested an installation-wide decline in all breeding landbirds at Camp Bowie. Post-breeding fire management practices in old field and scrub/woodland habitats could reset succession and effect local recoveries of the 3 species of concern, while exclusion of cattle grazing from key areas could also be an effective management strategy for these and other species at Camp Bowie. The restoration of wet-season riparian corridors could be another effective management strategy and will require the removal of stock ponds and re-establishment of natural watercourses. At Camp Swift, only 1 species emerged as a candidate for particular management concern: Painted Bunting. Post-breeding fire management practices as opposed to the current spring or fall practices would result in a more natural and diverse cool-season grassland and richer springtime/early summer forb community given adequate winter precipitation. An objective of the MAPS program at both Camp Bowie and Camp Swift is to evaluate the effectiveness of such proposed and on-going management practices, and to modify them according to the adaptive management process in order to achieve the long-term goal of reversing declining populations and maintaining stable or increasing populations of target landbird species.

Dowler RC, Dixon MT, et al. 2009. Survey of the mammals, reptiles, and amphibians of Camp Bowie 2006-2008. San Angelo (TX): Angelo State University.

A mammal, reptile, and amphibian survey was conducted at Camp Bowie from 2006-2008 to update the initial baseline survey conducted in 2002-2003. Similar methods were used as previous study with sampling in all watersheds. This survey documented 5 species of amphibians, 20 species of reptiles, and 24 species of mammals. Two new amphibians were documented, *Pseudacris clarki* and *Bufo nubulifer*, as well as 2 new snakes, *Elaphe emoryi* and *Elaphe obsoleta*. There were 5 new mammals documented with 3 being non-native species (*Felis catus*, *Mus musculus*, and *Myocastor coypus*) and 2 native species (*Canis latrans*, *Neotoma leucodon*). The woodrat (*Neotoma*) was unexpected since it is a west Texas species and this record extends the species range eastward into central Texas. The reduction in grazing by cattle since the last survey should result in a return to some native habitat and the potential for an increase in amphibians, reptiles, and mammals. The discovery of another Texas horned lizard (*Phrynosoma cornutum*) during this survey suggests that multiple areas have the habitat to support horned lizard populations. As reported in the last survey, special conservation monitoring should include areas with active springs. In addition, rocky slopes are now known to have a population of *Neotoma leucodon* should be protected from disturbance. Finally, future mammal surveys should include sampling during the winter months when rodent populations appear to be the highest.

Dowler RC, Holm JA, et al. 2004. Survey of the mammals, reptiles, and amphibians of Camp Bowie. San Angelo (TX): Angelo State University.

This study was undertaken to survey the major habitat types at Camp Bowie for mammals, reptiles, and amphibians. The data should be used in establishing baseline information on species present, habitat association, and relative densities. A total of 59 native species were observed.

Farquhar CC, Maresh J, et al. 1996. Biological inventory of Texas Army National Guard training areas. Austin (TX): Resource Protection Division, Texas Parks and Wildlife Department.
These inventories focused on bird and plant surveys with incidental observations of herptiles and mammals over a 2-year period on several locations. The section for each facility addressed key areas to further survey or key practices or land use that were damaging the resources and recommendations for management.

Farquhar CC, O'Connor KM, et al. 1998. Land condition-trend analysis: Initial inventory and plot establishment, Camp Bowie, Brown County, Texas. Austin (TX): Wildlife Diversity Program, Texas Parks and Wildlife Department.
In 1998, the TPWD was contracted to conduct a Land Condition-Trend Analysis program at Camp Bowie. The purpose was to establish a permanent database for inventorying and monitoring landscape features, and vegetational and wildlife communities in order to track and examine associated land use practices and installation activities. This report summarizes the establishment of 24 core plots and 8 special use plots. Special use plots include: (1) 2 plots to monitor regrowth in a mesquite community following an uncontrolled burn, and (2) 6 plots to estimate and monitor carrying capacity for livestock on state-owned grazed (3 plots) and federally owned non-grazed (3 plots) properties at Camp Bowie.

Fischer J, Senseman G. 2003. Procedures for using high resolution satellite imagery for mapping land cover on Camp Bowie and Camp Swift. Fort Collins (CO): Center for Environmental Management of Military Lands, Colorado State University.
This document details the effort by the Center for Environmental Management of Military Lands to efficiently update a land cover map with remote-sensed data, via automated processing of satellite imagery. This resulted in an update to the existing land cover maps for two Texas Army National Guard installations, Camp Bowie and Camp Swift.

Fisher RS, Mace RE, et al. 1996. Ground-water and surface-water hydrology of Camp Bowie, Brown County, Texas. Austin (TX): Bureau of Economic Geology, University of Texas at Austin.
Ground-water and surface-water investigations of Camp Bowie were conducted to provide the Texas Army National Guard information needed to preserve environmental quality and resources while planning and conducting training and preparedness activities.

Gravatt DA, Martel D, et al. 1999. Delineation of wetlands and other regulated waters: Camp Bowie, waterways experiment station. U.S. Army Engineer Research and Development.
The purpose of this planning level wetland project was to locate and map Waters of the United States regulated by the USACE under Section 404 of the Clean Water Act. Camp Bowie has approximately 66 acres of regulated water bodies, including streams, ponds, lakes, and wetlands.

Harrison JD, Abbott JC. 2009. The use of ants, ground beetles and grasshoppers as indicators of habitat disturbance. Austin (TX) University of Texas at Austin.
Ant (Hymenoptera: Formicidae), ground beetle (Coleoptera: Carabidae) and orthopteroid (grasshoppers and their allies) communities were examined as potential indicators of habitat disturbance on Texas Army National Guard facilities in central Texas. Pitfall and leaf litter collection methods were used to assess community composition and species abundance at bivouac sites at Camp Bowie and Camp Swift. Troop training, soil compaction and ground clearing were major sources of disturbance at sampling sites and were shown to have clear

impacts on these arthropod communities. A variety of statistical measures based on the insect samples were used to assess impact. Ground beetle and orthopteroid response to disturbance suggest an increase in species richness and diversity in regularly disturbed plots, though sampling methods employed in this study did not yield sufficient data for a complete statistical analysis of these 2 taxa. Ant communities showed a less clear response to habitat disturbance as measured by diversity indices, though communities at disturbed plots did show an increase in dominant ant species groups such as the Dominant Dolichoderinae. Changes in functional group relative abundances in disturbed plots showed promise as 1 method of assessing anthropogenic changes. Areas immediately adjacent to these disturbed plots slowly returned to an undisturbed community type as one moves away from the disturbance, suggesting that the bivouac footprint was fairly localized. If properly managed and kept well defined, the bivouac sites can exist with limited impact on surrounding communities. A functional group approach was found to be the best method of assessing local area changes in species composition, while establishing the necessary associations with the wider floral and faunal communities.

Hendrickson D, Cohen A. 2007. General fish surveys on selected Texas National Guard properties. Austin (TX): University of Texas at Austin.
A fish survey was conducted on five Texas Military Forces facilities in Texas including: Camp Mabry (Travis County), Camp Swift (Bastrop County), Camp Bowie (Brown County), Camp Maxey (Lamar County), and Camp Bowie (Parker County). This is the second fish survey completed for the properties. During this survey, 39 species were collected representing 10 families compared to 27 species in 8 families in 1995. New records include *Aplodinotus grunniens*, *Carpiodes carpio*, *Cyprinus carpio*, *Esox niger*, *Etheostoma parvipinne*, *Lepisosteus oculatus*, *Minytrema melanops*, *Notropis texanus*, *Percina macrolepida*, *Percina carbonaria*, *Pomoxis nigromaculatus*, and *Pylodictis olivaris*. Species we were not able to re-collect include *Astyanax mexicanus* and *Pimephales promelas*. There were 3 species that were widely distributed and collected at every base: *Micropterus salmoides*, *Lepomis macrochirus*, and *Gambusia affinis*. The most species-rich family was Centrarchidae and within that, *Lepomis* was the most species-rich genus with eight species. Consistent amongst the 5 bases, diversity ranked highest in perennial streams, lowest in lentic habitats, and intermediate in intermittent streams.

Hunter B. 2006. Analysis of historic aerials of TXNG training centers. Denton (TX): University of North Texas.
Summary of methods used to determine historic land use and land cover at the 4 major training centers for the TMD: Camp Bowie, Camp Swift, Camp Maxey, and Camp Bowie.

Kennedy JH, Hunter B, et al. 2005. Camp Bowie, Brown County, Texas - Arthropoda biodiversity study 2002-2004. Denton (TX): University of North Texas.
The main objective of this project was to inventory the Arthropoda, with an emphasis on insects, at Camp Bowie from October 2002 through August 2004. Arthropods are the most diverse group of animals on the facility and important contributors to ecosystem functioning. Understanding the biodiversity of the arthropods is a critical consideration in the development of management policies. This report makes no pretense that it is a complete survey, which would require years of collection and the efforts of hundreds of taxonomic specialists. It is the goal of this report to provide baseline information for future studies and management decisions. Our results indicate 470 invertebrate species in 19 orders. A comprehensive list of taxa collected is given in Appendix Table 2. Each taxonomic group identified during the study is discussed in the report. General recommendations include protection of streams, seeps, and wetlands, continued management for healthy ecosystems, discontinuation of grazing to allow recovery, development of a terrestrial Index of Biotic Integrity for Camp Bowie, continuation of restoration efforts, and protection of native bees and monitoring of mosquitoes.

Kuhr DD. 2000. Vector-borne disease risk assessment (VBDRA) No. 18-PH-4987-00 Texas Army National Guard 27 Mar - 5 April 2000. Fort McPherson (GA): U.S. Army Center for Health Promotion and Preventive Medicine.
The purpose of the Vector-borne disease risk assessment (VBDRA) was to determine the sero-prevalence of antibodies to Sin Nombre Virus (SNV) and other hantaviruses in the rodent population at the Texas Army National Guard (TXARNG) training centers at Camp Bowie and Camp Barkeley. Sin Nombre Virus is a himan pathogenic hantavirus that may cause death and has occurred in humans in Texas. Of the 38 rodents trapped there was a 0% infection rate. A total of 19 ticks were collected and tested from the presence of human monocytic ehrlichiosis (HME). No HME was detected.

Leipnik MR. 2006. Baseline water quality monitoring project for Texas Army National Guard training areas. Huntsville (TX): Sam Houston State University.
This report summarizes the results of a baseline water quality monitoring project conducted on behalf of the Texas Army National Guard on 4 training areas (Camp Swift, Camp Maxey, Camp Mabry, and Camp Bowie) by Environmental Analytical Lab at Sam Houston State University in Huntsville, Texas. The results are from field data and from analysis of aqueous samples collected at thirteen water monitoring locations across the four training areas. The testing and sampling were conducted over a 2-year period starting in February 2004 and continuing through March of 2006. In total, 7 rounds of visits were made during the Spring, Summer, Fall, and Winter Quarters respectively of each of the years. Most sites were sampled both with a Hydrolab Corporation model 4A water quality probe and with grab surface water samples. These samples were later subjected to detailed laboratory analysis at the TRIES Environmental Analytical Lab for a wide range of naturally occurring constituents and potentially present anthropogenic contaminants. The field results did not indicate any abnormal values, with the exception that the turbidity sensor on several occasions (as noted in the field results database) failed to function. The analytical lab results indicated generally very good water quality in all sampled streams, ponds, tanks, and lakes. The exceptions were detected in the first round of sampling for the upstream and to a lesser extent for the downstream portions of the stream draining from the rendering plant located adjacent to Camp Swift.

Linam GW, Seaman JR, et al. 1996. Aquatic survey results from seven Texas National Guard Training Installations. Austin (TX) Resource Protection Division, Texas Parks and Wildlife Department.
An aquatic survey was conducted in 1996 at Camp Barkley, Camp Bowie, Camp Mabry, Camp Maxey, Camp Swift, and Camp Bowie. This study analyzed physiochemical properties, habitat, contaminants, benthic macroinvertebrate, and fish.

Lutterschmidt WI, Cook JL. 2003. The distributional status and prey base of the Texas horned lizard (*Phrynosoma cornutum*) on Camp Bowie, Brown County, Texas. Huntsville (TX): Sam Houston State University.
The purpose of this study was to use field data on the occurrence, distribution, and abundance of both horned lizards and ants to provide information for future species management at Camp Bowie. Although the areas surveyed on Camp Bowie appear to provide suitable habitat for *Phrynosoma cornutum*, no horned lizards were observed for analyses even though harvester ants were found in abundance within these localities.

Nance HS, Wermund EG. 1993. Geological and climatic survey Camp Bowie military reservation Brownwood, Texas. Austin (TX): Bureau of Economic Geology, University of Texas at Austin.
This report summarizes the physical environment (e.g. wind, temperature, rainfall, soils, geology, and hydrology) of Camp Bowie and available data in 1993. The most substantial impact to the environment at Camp Bowie would be disturbance associated with four quarries. Unauthorized

and unmanaged two-track roads across the uplands have also caused substantial disturbance. Strategies for land management should aim at minimizing erosion, maximizing vegetation cover, and protecting against pollution of streams and ground water. These goals can best be achieved by restricting travel to main roadways whenever possible, bridging streams that are regular traversed with vehicles, discontinuing livestock grazing, and avoiding spillage of contaminants. Regular testing of water quality in camp reservoirs is recommended.

Nott MP. 2002. Climate, weather and landscape effects on landbird survival and reproductive success in Texas. Point Reyes Station (CA): Institute for Bird Populations.
The Institute for Bird Populations (IBP), through its Monitoring Avian Productivity Survivorship (MAPS) Program, collects breeding season banding data from 36 active constant-effort monitoring stations in Texas, including 18 stations divided equally among Camp Swift, Camp Bowie, and Fort Hood. At these 18 stations, since 1994, approximately 8,000 individual birds representing 35 landbird species were banded, identified, and measured. Annual indices of reproductive success and apparent annual survival rates were related to seasonal climate indices and to Texas-wide temperature and precipitation data. Reproductive success, age-class abundance, and avian diversity were related to landscape variables.

Nott MP, DeSante DF, et al. 2003. Management strategies for reversing declines in landbirds of conservation concern on military installations: a landscape-scale analysis of MAPS data. Point Reyes Station (CA): Institute for Bird Populations.
Using 1994-2001 data from the national MAPS program, modeling and data analysis was done to determine the relationship between climate, weather, and management activities to bird survivorship and productivity. Recommendations are made as to how to use this data for land managers and how future MAPS data collection should be targeted. Future emphasis should be placed on documenting species from the Birds Conservation Concern from the USFWS.

Nott MP, Pyle P, et al. 2006. The 2006 report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on Texas Army National Guard installations, Camp Swift and Camp Bowie. Point Reyes Station (CA): Institute for Bird Populations.
The objective of the MAPS Program on DoD installations such as Camp Swift and Camp Bowie is to identify management guidelines and actions that can be implemented on military installations to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. Accordingly, 6 MAPS stations were established in 1994 and operated on Camp Swift and on Camp Bowie. One station was changed in 2004 at Camp Swift. This report briefly updates the earlier reports and documents the operation of the MAPS stations on Camp Swift and Camp Bowie during the 2005 breeding season. The accumulation of data over the years will help document the effects of increased prescribed fire, invasive species control, and brush control on songbirds. At Camp Swift in 2006, 31 species were captured with northern cardinal captured most frequently, followed by white-eyed vireo, painted bunting, Carolina wren, Carolina chickadee, and tufted titmouse. The most abundant breeding species were painted bunting, northern cardinal, white-eyed vireo, and Carolina wren. At Camp Bowie in 2006, 35 species were captured with Painted Bunting captured most frequently, followed by Bewick's wren, northern cardinal, black-crested titmouse, field sparrow, and Rufous-crowned sparrow. The most abundant breeding species were painted bunting, northern cardinal, Bewick's wren, field sparrow, and summer tanager. At Camp Swift, productivity of all species was down in 2006 compared with 2005, except for an increase for painted bunting at drop zone. Survivorship at Camp Swift and Camp Bowie appears to be at least comparable to that of the South-Central Region as a whole.

Nott MP, Pyle P, et al. 2008. The 2007 report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on Texas Army National Guard installations, Camp Swift and Camp Bowie. Point Reyes Station (CA): Institute for Bird Populations.
The objective of the MAPS Program on DoD installations such as Camp Swift and Camp Bowie is to identify management guidelines and actions that can be implemented on military installations to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. Accordingly, 6 MAPS stations were established in 1994 and operated on Camp Swift and on Camp Bowie. One station was changed in 2004 at Camp Swift. This report briefly updates the earlier reports and documents the operation of the MAPS stations on Camp Swift and Camp Bowie during the 2007 breeding season. The accumulation of data over the years will help document the effects of increased prescribed fire, invasive species control and brush control on songbirds. At Camp Swift in 2007, 24 species (in 405 captures) were captured with White-eyed Vireo captured most frequently, followed by northern cardinal, painted bunting, Carolina wren, tufted titmouse, and summer tanager. The most abundant breeding species were White-eyed Vireo, Northern Cardinal, Painted Bunting, and Carolina wren. At Camp Bowie in 2007, 27 species (in 335 captures) were captured with painted bunting captured most frequently, followed by northern cardinal, black-crested titmouse, Rufous-crowned sparrow, and Bewick's wren. The most abundant breeding species were painted bunting, northern cardinal, and summer tanager.

Nott MP, Pyle P, et al. (2008). The 2008 report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on Texas Army National Guard installations, Camp Swift and Camp Bowie. Point Reyes Station (CA) Institute for Bird Populations.
The objective of the MAPS Program on DoD installations such as Camp Swift and Camp Bowie is to identify management guidelines and actions that can be implemented on military installations to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. Accordingly, 6 MAPS stations were established in 1994 and operated on Camp Swift and on Camp Bowie. This report briefly updates the earlier reports and documents the operation of the MAPS stations on Camp Swift and Camp Bowie during the 2008 breeding season. At Camp Swift in 2008, the most abundant breeding species were white-eyed vireo, northern cardinal, painted bunting, and Carolina wren. At Camp Bowie in 2008, the most abundant breeding species were painted bunting, northern cardinal, black-crested titmouse, and Bewick's wren. At Camp Swift, although overall productivity indices decreased by 10.3% since 2007 with effort decreased by 5.6%, but the absolute number of young birds increased by more than 50% in 2008. At Camp Bowie, the overall productivity indices increased by 25.6% since 2007, even with a much lower level of effort, and the absolute number of young birds increased by more than 50%. A wildfire occurred in June 2008 at the Mesquite Flats station at Camp Bowie that allowed for some post-fire evaluation. The post-fire landscape was attractive to several species previously recorded in low numbers, such as Bewick's wren, eastern bluebird, lark sparrow, and ladder-backed woodpecker, and may also have resulted in increased captures of other more commonly captured species, such as northern cardinal and painted bunting. The overall adult capture rate more than doubled after the fire as well.

Perry G. 2008. Horned lizard annual progress report for 2007. Lubbock (TX): Texas Tech University.
This report sums up the field work conducted during 2007, primarily on TMD facilities. We located 12 adult horned lizards at Camp Bowie, and these were divided into 3 geographic clusters separated by 0.5 km or more. In addition, we located 1 nest site and 40 hatchlings emerging from at least 3 clutches. Camp Bowie adults were considerably smaller than those seen at our reference site near Post, TX. This is counter to the pattern predicted by climate and latitude, and we do not yet know if it represents an actual characteristic of the population or a byproduct of the anomalously wet spring of 2007. Of these adults, 6 were large enough to radiotrack.

Pogue DW. 2005. Baseline survey of birds at Camp Maxey. Tyler (TX): University of Texas at Tyler.
The purpose of this project was to conduct a thorough baseline survey of birds at Camp Maxey and produce an inventory of species within the various habitats found on the training center. Specific objectives included: 1) Provide a thorough inventory of birds in a the variety of habitats and evaluate the seasonal use of habitats by bird species; 2) Determine bird species of concern due to limited habitat or occurrence and provide recommendations; 3) Develop sampling protocols appropriate for departmental staff to continue monitoring bird populations; and 4) Produce GIS layers of sampling sites. Management recommendations include installing some permanent sampling points, continuing prescribed fires, and protecting remnant native grasslands.

Pyle P, DeSante DF, et al. 1996. The 1995 annual report of the monitoring avian productivity and survivorship (MAPS) Program on three Texas National Guard and U.S. Army installations: Camp Bowie, Camp Swift, and Fort Hood. Point Reyes Station (CA): Institute for Bird Populations.
The MAPS Program provides standardized population and demographic data for landbirds found on federally managed public lands, such as military installations, national forests, and national parks. We operated 6 MAPS stations on each site from 1994-1995 on Camp Bowie, Camp Swift, and Fort Hood. There were a total of 1909 captures at the 18 stations during 1995. Results from the first 2 years of the MAPS Program at Camp Bowie, Camp Swift, and Fort Hood indicate that population sizes and productivity was lower in 1995 than in 1994.

Pyle P, Froehlich D, et al. 1998. The 1997 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on two Texas Army National Guard installations and one U.S. Army installation: Camps Bowie and Swift and Fort Hood. Point Reyes Station (CA): Institute for Bird Populations.
The MAPS Program provides standardized population and demographic data for landbirds found on federally managed public lands, such as military installations, national forests, and national parks. We operated 6 MAPS stations on each site from 1994-1997 on Camp Bowie, Camp Swift and Fort Hood. Total captures amounted to 489 captures of 38 species at Camp Bowie, 523 captures of 28 species at Camp Swift and 663 captures of 43 species at Fort Hood during the summer of 1997. Breeding adult population sizes at Camp Bowie and Fort Hood declined sharply in 1997, after remaining fairly stable during 1994-1996. Populations at Camp Swift were comparable to those of 1996, after declining slightly during 1994-1996. Productivity at all 3 installations showed recovery over 1996 levels, which were depressed over much of the region but especially at Camp Bowie and Fort Hood. Barring severe climatological effects, we should expect to see elevated breeding populations in 1998 from those of 1997. Four-year trends in adult population size and 4-year patterns of productivity reveal that most species have declined overall between 1994 and 1997. In order to confirm that these declines are due to local land-use practices (as opposed to short-term fluctuations related to environmental factors such as weather), we hope to use weather data and landscape-level habitat data in future analyses. Survival estimates are currently being obtained with reasonable precision and the precision of these estimates will improve with each additional year of data or when combined with mark-recapture data from other stations in North America. We conclude that the MAPS protocol is well suited to provide an important component of long-term ecological monitoring on military installations and recommend that the MAPS Program be continued at these three installations indefinitely into the future.

Pyle P, Kaschube D, et al. (2005). The 2005 report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on Texas Army National Guard installations, Camp Swift and Camp Bowie. Point Reyes Station (CA): Institute for Bird Populations.
The objective of the MAPS Program on DoD installations such as Camp Swift and Camp Bowie is to identify management guidelines and actions that can be implemented on military

installations to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. Accordingly, 6 MAPS stations were established in 1994 and operated on Camp Swift and on Camp Bowie. One station was changed in 2004 at Camp Swift. This report briefly updates the earlier reports and documents the operation of the MAPS stations on Camp Swift and Camp Bowie during the 2005 breeding season. The accumulation of data over the years will help document the effects of increased prescribed fire, invasive species control, and brush control on songbirds. At Camp Swift in 2005, 30 species were captured with northern cardinal captured most frequently, followed by white-eyed vireo, painted bunting, Carolina wren, Carolina chickadee, and tufted titmouse. The most abundant breeding species were painted bunting, northern cardinal, white-eyed vireo, and Carolina wren. At Camp Bowie in 2005, 29 species were captured with Painted Bunting captured most frequently, followed by Bewick's wren, northern cardinal, black-crested titmouse, summer tanager, and Rufous-crowned sparrow. The most abundant breeding species were painted bunting, northern cardinal, Bewick's wren, summer tanager, Rufous-crowned sparrow, and field sparrow. At Camp Bowie, previous data has suggested an installation-wide decline in all breeding landbirds, including three species of management concern (Bewick's wren, field sparrow, and painted bunting). Survivorship at Camp Swift and Camp Bowie appears to be at least comparable to that of the South-Central Region as a whole.

Pyle P, O'Grady DR, et al. 1997. The 1996 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on two Texas Army National Guard and one U.S. Army installation: Camp Bowie, Camp Swift, and Fort Hood. Point Reyes Station (CA): Institute for Bird Populations.

The MAPS Program provides standardized population and demographic data for landbirds found on federally managed public lands, such as military installations, national forests, and national parks. We operated 6 MAPS stations on each site from 1994-1996 on Camp Bowie, Camp Swift, and Fort Hood. There were a total of 1646 captures of 66 species at the 18 stations during 1996. Results from the first 3 years of the MAPS program at Camp Bowie, Camp Swift, and Fort Hood indicate that meaningful indices of adult population size and productivity and important information on annual changes and long-term trends can be obtained for many target species. Survival estimates are currently being obtained with moderate precision, but the precision of these estimates will be greatly improved with additional data over the years or across sites in North America.

Reinecke R, Schneider RL, et al. (2005). Watershed assessment of Camp Bowie, Texas: Including wetland and other waters, erosion features, and watershed health. Baton Rouge (LA) Gulf South Research Corporation and Integrated Environmental Solutions, Inc.

This report documents an evaluation of watersheds, waters, and erosion features at Camp Bowie. The wetland and other waters evaluation identified 90 water features totaling 22.5 acres. There are 3 wetlands, delineated from hydrology and hydrophytic vegetation, totaling 2.0 acres. The other waters (87 features totaling 48.8 acres) were delineated based on the ordinary high watermark. There are approximately 162,249 linear ft. of creeks or streambed that originate with headwaters on Camp Bowie. There were 76 erosion features (totaling 206.5 acres) investigated throughout Camp Bowie. These erosion features were a result of bivouac sites, agriculture (i.e., cultivation or grazing), excavations (i.e., borrow pits), mass grading (i.e., target line construction), natural actions that have been accelerated through past grazing, current and abandoned roads (i.e., tank trails, two-tracks, etc.), utility corridors (i.e., pipelines and high-tension powerlines), and unknown sources. Of the erosion features identified, 5.0 acres were determined to be accelerating, 171.5 acres were determined to be in a static or undetermined condition, and 30.0 acres were stabilizing. Watersheds within Camp Bowie appeared to be in generally good health. Most of the installation is dominated by juniper/oak woodlands,

juniper/oak savannahs, or grasslands. There appears to be adequate cover of vegetation and litter to protect the soils. The adjacent upstream land uses are agricultural and residential, which do not appear to be affecting the overall watershed health at Camp Bowie. The primary areas of concern are the locations where there has been historic grazing on naturally erodible soils. All management at Camp Bowie must consider the soil properties. Seventy percent of the soils at Camp Bowie are problematic since they are gravelly and loamy soils over rock. These soil conditions are relatively fragile, since gravels and loams erode relatively easily once vegetation cover is removed. Restoration of these soils, once erosion begins, is relatively difficult since precipitation events can erode soils faster than vegetation can colonize the sites. Specific management recommendations are presented to ensure good plant and litter cover that minimizes future erosion on Camp Bowie. These recommendations include developing a range management plan and evaluating the stocking rates, implementing buffers around erosion features, implementing buffers around seep grasslands, reseeding or mulching after a training exercise if area is denuded, and developing restoration plans for erosional features.

Turner Environmental Inc. 2007. Rare plant survey, Camp Bowie training center, Brownwood, Brown County, Texas. Baton Rouge (LA): Turner Environmental, Inc.
A rare plant survey was conducted to thoroughly survey Camp Bowie for plant species of concern (threatened, endangered, endemic, or otherwise rare) and provide management recommendations. The field component of the study occurred from October 2005 to November 2006. No new rare species were discovered, however new populations of 2 target species previously known from Camp Bowie, *Dalea hallii* and *Argythamnia aphoroides* were located. There is reasonable likelihood that 2 additional target species, the coral-root orchids *Hexalectris nitida* and *H. warnockii*, may exist on the property although neither species was found. Numerous new species records were noted at the site.

Turner P. 2001. Black-capped vireo (*Vireo atricapillus*) survey results for Camp Bowie, Brown County, 2001. Austin (TX): Druid Environmental.
This report documents the results of a presence/absence survey and habitat survey for black-capped vireos (BCVs) on Camp Bowie during 2001. A total of 95 acres of potential BCV habitat were identified on Camp Bowie, primarily on plateau tops and associated side slopes with limestone outcrops. A single male BCV was documented in May near Devil's River near the state/federal fence line, probably migrating through the area. The apparent absence of nesting BCVs from suitable habitat suggests that habitat patches are either too small or too remote to support a breeding population of BCVs. Soils and climate allow for potential BCV habitat and require minimal additional manipulation to maintain. Prescribed fire would help maintain the habitat in general.

Turner S. 2002. Report of presence/absence surveys for the black-capped vireo (*Vireo atricapillus*) on Camp Bowie, Brown County, 2002. Tuscola (TX) Turner Biological Consulting.
This report documents the results of a presence/absence survey for black-capped vireos (BCVs) on Camp Bowie during 2002. One pair of BCVs and 1 male were documented in May 2004 near the state/federal fence line. The sightings of BCVs suggest that identified habitat may attract some BCVs but may be too small and/or remote to support a nesting population. The sightings this year and last year indicate some late spring migration through this habitat. The site should continue to be monitored another year, and the habitat to the east between the MAPS camp and Devil's River locations should be included in the survey.

Walker BL. DeSante DF. 1995. The 1994 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on three Texas National Guard installations: Camp Bowie, Camp Swift, and Fort Hood. Point Reyes Station (CA): Institute for Bird Populations.

In 1994, 18 MAPS stations were established at Camp Bowie, Camp Swift, and Fort Hood to provide annual indices and estimates of adult population size, post-fledging productivity, adult survivorship, and recruitment into the adult population for various landbird species. There were 5 stations with high population indices, high productivity indices, and high species richness—Devil's Hill and Stonehouse at Camp Bowie, McLaughlin Creek, and Wine Cellar at Camp Swift, and Taylor Field at Fort Hood.

Wolfe DW, Liu C, et al. 1996. Land cover analysis of Texas Army National Guard training centers. Austin (TX): Nature Conservancy of Texas.

This report contains the final results of an analysis of the response of cover types to past, present, and future training activities on Texas Army National Guard training centers (Camps Barkley, Bowie, Mabry, Maxey, and Swift). It also contains recommendations for future conditions for the conservation of significant natural features. Maps showing current land cover, potential natural vegetation, and significant natural features were created over color-infrared aerial photo base maps. A discussion of future conditions, ecosystem management recommendations, biodiversity benefits, and suggested research is provided.

I.3 Theses and Side Projects

Poor II, SL. 2000. Seasonal food habits of the white-tailed deer in the Cross Timbers and Prairies ecological region of Texas. Biological Sciences. San Marcos (TX): Southwest Texas State University: 77 pp.

Master's thesis from Southwest Texas State University on white-tailed deer across the north central portion of Texas. Camp Bowie was one of the sites included in the fieldwork. This thesis focused on seasonal diets and documents food resources available to deer in this region.

Appendix J. Correspondence with Agencies

Appendix K. Integrated Wildfire Management Plan on Record with CFMO/ENV/Natural Resources

K.1 Sample Prescription for Prescribed Fire

K.2 Contact List

CONTACT	PHONE #	PROCEDURE
Inter-agency Contacts		
TCEQ, air quality	325-698-9674	**Prescribed Fire**: Notify by fax or phone within 24 hours of planned ignition.
National Weather Service, Fire Weather Forecaster		
Texas Forest Service HQ		
Intra-agency Contacts		
Training Center Garrison Commander	512-658-4381	**Wildfire**: Contact if > 10 ac or if dozers are needed (App E-2) **Prescribed Fire**: Procedure in SOP (App M, 6.0)
TCGC Plans and Training Officer	512-771-9662	
Environmental Manager	512-782-5753	
WFPC	512-782-6037	
TXARNG Public Affairs Office	512-415-5623	
Emergency Contacts		
Brown Co. Office of Emergency Management	920- 391-7401	**Wildfire**: Contact to inform of wildfires and as needed for support **Prescribed Fire**: Contact within 4 hours of planned ignition. If contingency plan depends on availability of resource, confirm resource availability.
Brown County Sheriff's Office	325-646-5510	
Brownwood Fire Dept.	325-646-6743	
TFS Law Enforcement (Arson)	800-364-3470	
Utilities		
TU Electric	800-585-7902	Contact as needed or as outlined in Incident Action Plan.
Southern Union Gas	940-325-4445	
Southwestern Bell	800-395-0440 888-294-8433	
Media		

		Contact as needed or as outlined in Incident Action Plan.
ESD = (Emergency Services District)		

K.3 National Wildfire Coordinating Group (NWCG) Prescribed Fire Go/No-Go Checklist

NWCG PRESCRIBED FIRE GO/NO-GO CHECKLIST

Yes	No	Questions
		Are ALL fire prescription elements met?
		Are ALL smoke management specifications met?
		Has ALL required current and projected fire weather forecast been obtained and are they it favorable?
		Are ALL planned operations personnel and equipment on-site, available, and operational?
		Has the availability of ALL contingency resources been checked, and are they available?
		Have ALL personnel been briefed on the project objectives, their assignment, safety hazards, escape routes, and safety zones?
		Have all the pre-burn considerations identified in the prescribed fire plan been completed or addressed?
		Have ALL the required notifications been made?
		Are ALL permits and clearances obtained?
		In your opinion, can the burn be carried out according to the prescribed fire plan and will it meet the planned objective?

If all the questions were answered "YES" proceed with a test fire. Document the current conditions, location, and results.

K.3 Organization Assignment List, ICS Form 203

ORGANIZATION ASSIGMENT LIST		1. INCIDENT NAME: Blackwell	2. DATE PREPARED	3. TIME PREPARED
POSITION NAME		4. OPERATIONAL PERIOD (DATE/TIME)		
5. INCIDENT COMMAND AND STAFF		9. Holding Boss		
RXB 2		West Flank (DIVS A)		Type 6 Eng
				Type 6 Eng
				Tractor plow
6. AGENCY REPRESENTATIVES				
AGENCY	NAME			
		East Flank (Divs B)		Type 6 Eng
				Type 6 Eng
7. ignitions Boss				
West flank (Divs A)	Ignition member			
	Ignition member			
East Flank (Divs B)	Ignition Member			
	Ignition Member			
PREPARED BY (RESOURCES UNIT)				

K.4 Sample Assignment List, ICS Form 204

1. BRANCH		2. DIVISION/GROUP		ASSIGNMENT LIST			
3. INCIDENT NAME				4. OPERATIONAL PERIOD			
				DATE		TIME	
5. OPERATIONAL PERSONNEL							
RXB2		DIVISION/GROUP SUPERVISOR					
		AIR TACTIVAL GROUP SUPERVISOR					
6. RESOURCES ASSIGNED TO THIS PERIOD							
STRIKE TEAM/TASK FORCE/RESOURCE DESIGNATOR	EMT	LEADER		NUMBER PERSONS	TRANS. NEEDED	PICKUP PT./TIME	DROP OFF PT./TIME
ENG							
ENG							
Plow							
Ignition crew							
7. CONTROL OPERATIONS							
8. SPECIAL INSTRUCTIONS							

9. DIVISION/GROUP COMMUNICATIONS SUMMARY									
FUNCTION		FREQ.	SYSTEM	CHAN.	FUNCTION		FREQ.	SYSTEM	CHAN.
COMMAND	LOCAL REPEAT				SUPPORT	LOCAL REPEAT			
DIV./GROUP TACTICAL					GROUND TO AIR				
PREPARED BY (RESOURCE UNIT LEADER)			APPROVED BY (PLANNING SECT. CH.)				DATE	TIME	

K.5 Briefing Checklist

Briefing Checklist

- Situation
  - Fire name, location, map orientation, and other incidents in area
  - Terrain infuences
  - Fuel type and conditions
  - Fire weather (previous, current, and expected)
    - Winds, RH, temperature, etc.
  - Fire behavior (previous, current, and expected)
    - Time of day, alignment of slope, wind, etc.

- Mission/Execution
  - Command
    - Incident Commander/Immediate Supervisor
  - Commander's intent
    - Overall strategy/Objectives
  - Specific tactical assignments
  - Contingency plans

- Communications
  - Communication plan
    - Tactical, command, air-to-ground frequencies
    - Cell phone numbers
  - Medivac plan

- Service/Support
  - Other resources
    - Working adjacent and those available to order
    - Aviation operations

- Risk Management
  - Identify known hazards and risks
  - Identify control measures to eliminate hazards/reduce risk
    - MANDATORY – Anchor point and LCES

Identify trigger points for disengagement – evaluation of operation plan

Questions or Concerns?

EVERY FIREFIGHTER IS OBLIGATED TO PAUSE OPERATIONS UNTIL SAFETY CONCERNS ARE ADDRESSED

Appendix L. Priority Invasive Species Summaries

L.1 *Centaurea melitensis* – Maltese Star Thistle

L.1.1 TMD Facilities Affected

- Camp Bowie

L.1.2 Scientific Name: *Centaurea melitensis*

- **Most Accepted Common Name:** Maltese star thistle
- **Other Common Names:** malta centaurea, tocalote

L.1.3 Taxonomic Description

Life Form: herb
Height: 0.1-0.8 m tall
Vegetative Characteristics:
Stems: young stems are reddish brown to light brown, usually pubescent, and about 3 mm in diameter. Older stems are glabrous, hollow, with brownish bark that peels in long strips.
Underground (roots, rhizomes, etc.): rhizomes and runners present
Leaves:
Arrangement: alternate
Type: simple
Sheaths and Ligules (of grasses):
Size:
Margins: basal leaves pinnately lobed, lobes rounded; upper stem leaves linear
Surfaces (pubescence):
Attachment: upper decurrent
Petiole:
Floral Characteristics:
Inflorescence:
Type: solitary
Size: 1 cm wide
Flowers:
Bracts:
Calyx:
Corolla: 10-12 mm long
Color: yellow
Anthers and Ovary: anthers with elongated appendages
Pappus Bristles: pale tan, 1-3 mm long
Fruit Characteristics:
Type: achene
Shape: barrel shaped
Size: 2-3 mm long
Color: grayish to tan
Attachments for Dispersal: short, stiff, pappus bristles covered with microscopic hair-like barbs

L.1.4 Biology and Ecology

Origin: Europe and Africa

Habitat: open, disturbed sites, grasslands, rangeland, open woodlands, fields, pastures, roadsides, and waste places. *C. melitensis* also occurs in cultivated fields and disturbed calcareous soils. Seedlings are most likely to establish in loamy soils.

Distribution:

- Current: widespread in Texas, especially Edwards Plateau; along west coast and elsewhere in United States
- Historical: native to southern Europe

Climatic and Ecological Range:

- Soils:
- Disturbances:
- Temperature:
- Precipitation:
- Soil Moisture:
- Light:
- Other:

Reproduction:

- Type (asexual or sexual): insect pollinated
- Rate:
- Seed Production: highly variable, 1-60 per seed head with 1-100 heads per plant
- Dispersal: contaminated hay and seed; road maintenance; vehicles; animals, specifically cattle; birds

Longevity in Seed Bank:

Germination:

General Impact: when star thistle infestations are high, native species can experience drought conditions even in years with normal rainfall

L.1.5 Control

Considerations: Very little information is available for the management of this species but general recommendations for *Centaurea solstitialis* (yellow star thistle can be applied). An integrated approach is recommended.

Mechanical: Hand pulling, hoeing, weed whipping, tillage on roadsides, or mowing can be effective if small areas are infested and can be monitored. The best time is after the plants have bolted but before they produce viable seed. Mowing can be effective on erect, high-branching plants but not on sprawling plants (conduct at early flowering stage) – timing is crucial.

Cultural: Prescribed fire can be effective if the timing is correct, and it must be at the very early flowering stage prior to viable seed production (this research was done in the west and not in Texas).

Chemical: Clopyralid (Transline®, Stinger®) and picloram (Tordon®) provide post-emergence control of seedlings and rosettes, as well as soil residual activity for at least one season. Clopyralid works at very low rates (1.5-4 oz. a.e./acre), and it does not injure grasses nor some broadleaf species. Control during bolting or bud stage requires a higher rate of application (4 oz. a.e./acre), and application after bud stage is not effective. A surfactant is not necessary but can help in drought conditions and on older plants. Picloram is the most widely used herbicide and acts much like clopyralid, but it gives a broader spectrum of control and has much longer soil residual activity. It is applied with a surfactant at .25-.375 lb. a.e./acre in late winter to spring when plants are still in the rosette through bud formation stages (can provide protective control for about 2-3 years).

Biological: Six insects have become established for the control in the western United States. A Mediterranean rust fungus, *Puccinia jaceae*, is currently under investigation and has not been released for use.

L.1.6 References

The Nature Conservancy: http://tncweeds.ucdavis.edu/esadocs/documnts/lonijap.html

National Biological Information Infrastructure (NBII) and Invasive Species Specialist Group (ISSG): http://invasivespecies.nbii.gov/profiles.html

L.1.7 Local Control Experts

L.2 *Cirsium vulgare* – Bull Thistle

L.2.1 TMD Facilities Affected

- Camp Bowie

L.2.2 Scientific Name: *Cirsium vulgare*

- **Other Scientific Names:** *Carduus lanceolatus*, *Cirsium lanceolatum*
- **Most Accepted Common Name:** Bull Thistle
- **Other Common Names:** common thistle, spear thistle, Scottish thistle

L.2.3 Taxonomic Description

Life Form: biennial, sometimes annual, or monocarpic perennial forb
Height: up to 2 m
Vegetative Characteristics: erect and bushy, has many spreading branches
    Stems: have spiny wings
    Underground (roots, rhizomes, etc.): taproot up to 28 in. long from which lateral roots come off
    Leaves: 3-12 in. long, lance-shaped; leaves are lobed with yellow spines at the end of each lobe
        Arrangement: alternate, pinnately lobed to pinnatifid
        Type: simple
        Size: up to > 35 cm long, gradually smaller towards apex of stem
        Margins: toothed
        Surfaces (pubescence): upper has prickly hairs, while undersides have woolly gray hairs
        Attachment:
        Petiole: sessile or winged
Floral Characteristics:
    Inflorescence: single or double flower heads terminating stems
        Type: disk flowers
        Size: 3.8-5 cm in diameter, and 2.5-5 cm long
    Flowers:
        Bracts: have spiny tips
        Calyx: involucre 2.5-4 cm high
        Corolla: tubular, to 3.5 cm long
        Color: pink to purple
        Anthers and Ovary:
Fruit characteristics:
    Type: achene
    Shape: ovate with plume on one end
    Size: 0.15 cm
    Color: tan/light brown
    Attachments for Dispersal: easily detachable, long, hairy plume

L.2.4 Biology and Ecology

Origin: Eurasia, introduced to the United States several times
Habitat: It is difficult to exclude ecosystems from bull thistle since it has such a wide range of ecological tolerances. Generally, it grows in areas of disturbance where competition with native plants is low.
Distribution: found on every continent excluding Antarctica, generally in the northern and southern temperate zones.
Current: established in all U.S. states

Historical: introduced to the eastern United States during colonial times, and the western United States during the 1800 and 1900s

Climatic and Ecological Range:

Soils: almost absent from clay, and less common in sand and soils with > 30% humus

Disturbances: Thrives in disturbed areas, even small scaled. Tends to grow best in overgrazed rangelands, recently burned areas, clearcuts, pastures, along roads, ditches, and fences.

Temperature:

Precipitation:

Soil Moisture: dry or wet, but best in intermediate moisture

Light: needs sun, does not grow in shaded areas

Fertility: thrives in pastures with nitrogen; no association with potassium or phosphorus content

Other: rare in soils with a pH < 4.8-5.0

Reproduction:

Type (asexual or sexual): sexual

Rate:

Seed Production: each plant is capable of producing up to 10,000 seeds

Dispersal: wind, starting immediately after maturation, 7 to 10 days after flowering, starting with the innermost seeds

Longevity in Seed Bank: Appears to be variable, depending on seed depth in soil. Seeds near the soil surface are susceptible to decomposition or being consumed by organisms. Seeds buried 15 cm into soil have been found to have 50% viability after 3 years. This would not maintain a year-to-year population, unless the soil was disturbed.

Germination: seed viability is high, between 60% and 90%. This is affected by moisture, light availability, gap size, and temperature.

L.2.5 Control

Considerations: Competition with native plants decreases seed viability. With any control method, it is important to ensure native plant success in order to prevent the return of the bull thistle. A combination of the following techniques has been found to be the most effective.

Mechanical: Removal must be conducted 4 years in a row in order to prevent regrowth from the seeds in the soil. Any method that severs the root will kill the thistle. For selective control, use a shovel and cut the plant 1- 2 in. below the soil surface. Most tilling, hoeing, and hand pulling will destroy bull thistle as long as it is done before the plant seeds. Close mowing or cutting of the plants 2 times a season to prevent seed production.

Cultural: Thrives in disturbed areas, even small scaled. Tends to grow best in overgrazed rangelands, recently burned areas, clearcuts, pastures, along roads, ditches, and fences. If seeds are present in seed bank, there is post-fire establishment where native plant competition is low. In areas with an established fire regime and native plants are thriving, bull thistle is not competitive.

Chemical: It has been stated that herbicides are only effective if used in combination with changes in conditions, such as reestablishment of natives. Clopyralid, dicamba, MCPA, picloram, 2,4-D, metsulfuron, and chlorsulfuro have all been found to be effective herbicides against bull thistle. According to Texas A&M's Agricultural Extension the lawn herbicides (isoxaben, 2,4-D, 2,4-D + 2,4-DP + MCPP, 2,4-D + 2,4-DP + MCPP, 2,4-D + dicamba +MCPP +MSMA, 2,4-D + dicamba +MCPP +MSMA) have been successful as well. The best time for application is when the plant is a seedling or in the rosette stage, which is generally spring or autumn. It is important not to apply the herbicide when the temperature is to exceed 80 °F 3 days after application.

Biological: The thistle head weevil, *Rhinocyllus conicus*, larvae eat the seed producing tissue. These are well established in Texas, as well as Georgia, Tennessee, and Virginia. It was originally

introduced from Europe to control musk thistle, but is also used for bull thistle; however, it has been found to be unclear if it is as effective on the bull thistle as it is on musk thistle. There has been some indication of it attacking native thistles that could be rare or threatened. In other states, a combination of the bull thistle gall fly (*Urophora stylata*) and the thistle crown weevil (*Trichosirocalus horridus*) have been found to be effective in reducing bull thistle populations.

L.2.6 References

The Burke Museum of Natural History and Culture:
http://biology.burke.washington.edu/herbarium/imagecollection.php?Genus=Cirsium&Species=vulgare

Missouriplants.com:
www.missouriplants.com/Pinkalt/Cirsium_vulgare_page.html

Robert W. Freckmann Herbarium, University of Wisconsin – Stevens Point:
http://wisplants.uwsp.edu/scripts/detail.asp?SpCode=CIRVUL

Texas Cooperative Extension, The Texas A&M University System
Landscape and Garden Weed Control:
http://sanangelo.tamu.edu/agronomy/garden/utahweed.htm

United States Department of Agriculture, Agricultural Research Service, Germplasm Resources Information Network (GRIN):
http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?104163

Wisconsin Department of Natural Resources:
http://www.dnr.state.wi.us/invasives/fact/thistles_bull.htm

Zouhar, Kris 2002. *Cirsium vulgare*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2007, July 30].
http://www.fs.fed.us/database/feis/plants/forb/cirvul/all.html

L.2.7 Local Control Experts

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L.3 *Ligustrum japonicum* – Japanese privet

L.3.1 TMD Facilities Affected

- Camp Bowie

L.3.2 Scientific Name: *Ligustrum japonicum*

- **Other Scientific Names:** *L. coriaceum*, *L. japonicum* var. *rotundifolium*
- **Most Accepted Common Name:** Japanese privet
- **Other Common Names:** wax-leaf ligustrum, Japanese privet, wax-leaf privet, Japanese ligustrum

L.3.3 Taxonomic Description

Life Form: tree or shrub
Height: 35 ft. maximum
Vegetative Characteristics:
- Stems: single stem; however, in many cases it branches very close to the ground.
  - Underground (roots, rhizomes, etc.): roots
- Leaves:
  - Arrangement: opposite
  - Type: acuminate to nearly obtuse sheaths and ligules (of grasses)
  - Size: 2-4.5 in. long
  - Margins: entire
  - Surfaces (pubescence): glabrous and leathery (top), paler and glabrous with minute black-punctate dots
  - Attachment: petiolate
  - Petiole: short

Floral Characteristics:
- Inflorescence:
  - Type: terminal panicle, broad, loosely flowered
  - Size: 4-8 in. long; 2-6 in. wide
- Flowers:
  - Bracts: none
  - Calyx: 4 lobed, tubular, 1/16 in. long, and glabrous
  - Corolla: 4 reflexed ovate to short-oblong, 1/8-in. long lobes
  - Color: white
  - Anthers and ovary: 2 stamens, 1-4 parted inferior ovary

Fruit Characteristics:
- Type: drupe
- Shape: oval
- Size: 0.25 in. long
- Color: black or blackish blue
- Attachments for dispersal: none

L.3.4 Biology and Ecology

Origin: Korea and Japan
Habitat: seen along roadsides, in old fields and in other disturbed habitats and in a variety of undisturbed natural areas, including bogs, wetlands, floodplains, old fields, calcareous glades and barrens, and mesic hardwood forests

Distribution:
- Current: southeastern United States; up to Virginia
- Historical: gardens and hedge rows in southeast

Climatic and Ecological Range:
- Soils: coarse, medium, and fine texture soils; pH between 5.5 and 6.9
- Disturbances: grows well in both disturbed and undisturbed areas
- Temperature: -13° C (minimum)
- Precipitation: 30-80 in. annually; medium drought tolerance
- Soil Moisture: low moisture use
- Light: very shade tolerant
- Fertility: high
- Other: no anaerobic tolerance; low tolerance to CaCO3; low salinity tolerance

Reproduction:
- Type (asexual or sexual): sexual
- Rate: blooms in late spring (March to May); seeds ripen in September and October, but may remain on the tree well into the winter
- Seed Production: prolific seed producers, up to 4,000 seeds per pound of fruit
- Dispersal: Seeds distributed by frugivorous birds
- Longevity in Seed Bank: 24-36 months

Germination: ideal conditions are 50° F to 86° F for 60 days with a 77% success rate

L.3.5 Control

Considerations: The potential for large-scale restoration of unmanaged natural areas or wildlands infested with *Ligustrum* spp. is low. Restoration potential for managed natural areas or wildlands infested with *Ligustrum* spp. is moderate. If attacked during the early stages of colonization, the potential for successful management is high.

Mechanical: Top removal is appropriate for small populations or environmentally sensitive areas where herbicides cannot be used. Stems should be cut at least once per growing season as close to ground level as possible. Repeated top removal will control the spread of *Ligustrum* spp., but it may not eradicate it. Managers of the Nature Conservancy preserves in Ohio reported eradication of *L. vulgare* after 2 cutting treatments. Plants should be grubbed as soon as they are large enough to grasp but before they produce seeds. Seedlings are best grubbed after a rain when the soil is loose. The entire root must be removed since broken fragments may resprout.

Cultural: Medium fire tolerance

Chemical: This method may be effective for large thickets of *Ligustrum* spp. where risk to non-target species is minimal. Air temperatures should be above 17° C to ensure that herbicides are absorbed. The ideal time to treat is while plants are in leaf in late autumn or early spring but when many native species are dormant. Effective herbicides include glyphosate, triclopyr, and metsulfuron.

Biological: No known biological controls.

L.3.6 References

The Nature Conservancy: http://tncweeds.ucdavis.edu/esadocs/documnts/ailaalt.html

USDA Plants Database: http://plants.usda.gov/cgi_bin/topics.cgi

L.3.7 Local Control Experts

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L.4 *Sorghum halapense* – Johnsongrass

L.4.1 TMD Facilities Affected

- Camp Bowie
- Camp Swift

L.4.2 Scientific Name: *Sorghum halapense*

- **Other Scientific Names:**
- **Most Accepted Common Name:** Johnsongrass
- **Other Common Names:** Egyptian millet

L.4.3 Taxonomic Description

Life Form: graminoid
Height: 1.5-4.5 ft.
Vegetative Characteristics:
    Stems:
        Underground (roots, rhizomes, etc.): extensive roots and rhizomes
    Leaves:
        Arrangement:
        Type:
        Sheaths and Ligules (of grasses): sheath is ribbed and distinguishing
        Size:
        Margins:
        Surfaces (pubescence): a distinctive white mid-rib
        Attachment:
        Petiole:
Floral Characteristics:
    Inflorescence: purple panicle
        Type:
        Size: large
    Flowers:
        Bracts:
        Calyx:
        Corolla:
        Color:
        Anthers and Ovary:
Fruit Characteristics:
    Type: awned
    Shape: ovoid
    Size:
    Color: brown
    Attachments for Dispersal: water, wind, livestock, machinery, birds, vehicular traffic; seeds known to be viable and dormant in seedbank for several years

L.4.4 Biology and Ecology

Origin: thought to be from the Mediterranean
Habitat: low-elevation wet places, irrigation ditches, waste areas, roadsides, cropfields, and other disturbed places in temperate climates

Distribution:
Current:
Historical: throughout the United States and the world in temperate regions
Climatic and Ecological Range:
Soils: adapted to a wide variety of soil types
Disturbances: thrives on disturbances
Temperature: below 13° C inhibits flowering
Precipitation:
Soil Moisture: tolerates drought and inundation
Light: grows vigorously in full sun
Fertility: one plant may produce 200-300 ft. of rhizomes in a month
Reproduction:
Type: sexual and vegetative (by rhizomes)
Rate: rapid
Seed Production: prolific; up to 10 bushels of seed in a single growing season
Dispersal:
Germination:

L.4.5 Control

Considerations: It is virtually impossible to eradicate this species completely. Spot control of individual plants while encouraging native plant establishment is recommended. Disturbances should be minimized.

Mechanical: Mowing the plant for several years weakens it and reduces rhizome growth, but it is unlikely this will control growth or spread as it does not kill the plant. Several fallow plowings during the summer will bring the rhizomes to the surface where they dry out. Plowing is appropriate for older, established plants with extensive rhizome systems in an extremely infested area, but if the machinery is used in areas that are free of Johnsongrass, this practice may actually facilitate its spread. Hoeing is only practical when the plants are very young (under 3 weeks old) and without an extensive rhizome system.

Cultural:

Chemical: Herbicides alone will not eliminate Johnsongrass and yearly applications will be required.

Foliar Sprays: Glyphosate (Roundup™) and dalapon (Dowpon) are the only foliar sprays that are mildly toxic and rapidly degrade in the soil. These chemicals are not specific to grasses and will kill any plant that is sprayed. Glyphosate (Roundup™) is recommended in controlling Johnsongrass in non-agricultural settings, such as training centers. A spot application with a backpack-type glyphosate herbicide application is an efficient way to control small areas. This is most effective when the plants are actively growing and have reached the flowering stage. Blooms should be removed to prevent further dispersal of seeds. Multiple applications for several years will be required. Up to an 85% control rate within the first year of treatments has been observed using this approach. Re-growth is mostly attributed to seeds and unaffected rhizomes. A relatively new herbicide, Poast®, is specific to monocots and may be sprayed on to kill an infested field, but it will also kill all native grasses present. This herbicide is more expensive than the other two. Dalapon should be applied before flowering, early in the growth stage.

Basal Bark Application: N/A
Cut Stump Bark: N/A
Biological: N/A

L.4.6 References

The Nature Conservancy: http://tncweeds.ucdavis.edu/esadocs/documnts/sorghal.pdf

Fire Effects Information System: http://www.fs.fed.us/database/feis/

Native Plants of South Texas: http://uvalde.tamu.edu/herbarium/soha.htm

L.4.7 Local Control Experts

Daniel Dietz
Lady Bird Johnson Wildflower Center
4801 La Crosse Avenue
Austin, Texas 78739
Phone: (512) 292-4200

L.5 *Solenopsis invicta* – Red Imported Fire Ant

L.5.1 TMD Facilities Affected

- Camp Bowie
- Camp Mabry
- Camp Maxey
- Camp Swift
- Fort Wolters (and others)

L.5.2 Scientific Name: *Solenopsis invicta* Buren

- **Most Accepted Common Name:** Red imported fire ant
- **Other Scientific Name(s):** *Solenopsis wagneri* Santschi

L.5.3 Taxonomic Description

Life Form: ant - insect
Size: about 1/8-1/4 in. long, with wide variation in size
Distinguishing/Diagnostic Features: Only the red imported fire ant has a median clypeal tooth and a striated mesepimeron, although these may be difficult to see at first. Other characters that might help in the identification include 1) the antennal scape nearly reaches the vertex, 2) the post-petiole is constricted at back half, and 3) the petiolar process is small or absent. Of all the native fire ants, the southern fire ant (*Solenopsis xyloni*) looks the most like the red imported fire ant. The southern fire ant can be identified by its brown to black color, well-developed petiolar process, and no median clypeal tooth.
Other: Fire ants will crawl up vertical surfaces. Fire ant stings will usually create a blister or pustule filled with white fluid.

L.5.4 Biology and Ecology

Origin: South America, imported in 1930s in ship ballasts
Distribution:
Current (non-native): southeastern United States and most of the way across Texas with occasional pockets further west
Historical (native): South America
Habitat: Mounds can reach a height of 18 in., depending on the type of soil and they are found in all types of soil. They generally do better in open pastures and sunny, grassy places than in thick, shaded woods. Grassy medians of freeways and mowed pipelines and powerline rights of ways provide prime "freeways" for the ants too. Often mounds are located in rotting logs and around stumps and trees. Colonies also can occur in or under buildings. Fire ants live in underground nests that consist of a network of tunnels and chambers that occupy a vertical column 12-18 in. in diameter and approximately 36 in. deep. After cool, rainy, weather in spring and fall, the ants clear blocked tunnels and expand chambers to create a conspicuous mound of loose soil above the nest. The colony dwells in this above ground extension when the temperature there is optimal for brood development. Though above-ground mounds harden and persist in some soil types, their absence does not mean fire ants are not present or receding.
Climatic and Ecological Range:
Soils: any soils
Disturbances: seem to prefer disturbed or landscaped areas

Temperature: appear to be limited by cold winters but are being found further north than was assumed possible

Precipitation: appear to be limited by low rainfall, but the level of rainfall required to support them is unclear

Other:

Food: live and do most of their foraging for food through underground tunnels

Hosts (if any):

Reproduction:

Season: Fire ants reproduce opportunistically when conditions are wet and warm. Mating flights are most common in spring and fall. Males die soon after mating, while the fertilized queen alights to find a suitable nesting site, sheds her wings, and begins digging a chamber in which to start a new colony. Sometimes, several queens can be found within a single nesting site.

Rate/Fecundity: A newly mated queen lays about a dozen eggs. When they hatch 7-10 days later, the larvae are fed by the queen. Later on, a queen fed by worker ants can lay up to 800 eggs per day. Larvae develop 6-10 days and then pupate. Adults emerge in 9-15 days. The average colony contains 100,000 to 500,000 workers and up to several hundred, winged forms and queens.

Behavior: There are two kinds of red imported fire ant colonies—the single queen and multiple queen forms. Workers in single queen colonies are territorial. Workers from multiple queen colonies move freely from one mound to another, which has resulted in a dramatic increase in the number of mounds per acre. Areas infested with single queen colonies contain 40-150 mounds per acre (rarely more than 7 million ants per acre). In areas with multiple queen colonies, there may be 200 or more mounds and 40 million ants per acre.

Development Phases (if any): 1) egg laid by queen; 2) larva hatches and grows through 4 larval developmental stages or instars between which molts of larval skin occur; 3) at 4th molt a pupa is produced; 4) pupa hatched into adult ant.

Dispersal: Colony establishment by winged queens can occur miles beyond source populations. This mode of spread may be promoted by prevailing winds and is the only way that monogyne or single queen colonies reproduce. Polygyne colonies (those with multiple queens/mound) can reproduce by budding off new colonies and spread by walking a few meters per year. Judging from the spread across Texas, natural dispersal was on the order of 10-20 miles (16-32 km)/year. Of course, transport in nursery products spread the ants beyond the boundary of natural dispersal. Flooding causes colonies to leave their mounds and float until they can reach land to establish a new mound.

Life Span: Queen fire ants can live 7 years or more, while worker ants generally live about 5 weeks, although they can survive much longer.

Other: There are 2 basic types of eggs. 1) unfertilized eggs that become males with wings whose only function is to mate with queens; 2) fertilized eggs that become females which are either winged virgin queens or various castes of sterile workers. How the colony feeds and cares for female larvae determines their caste; i.e., whether they behave as workers (all are sterile females) or queens. Male ants develop from unfertilized eggs and therefore possess only one set of chromosomes; i.e. they are haploid. Thus, male ants have no father (but they have a grandfather). Females develop from fertilized eggs and are typical diploids.

L.5.5 Control

Considerations: It is unlikely imported fire ants will ever be eradicated from the United States. At best, they will become a part of the ant communities instead of dominating them. There appears to be some evidence this is happening already due to changes in the native ants. Introduction of biological controls will help that as well.

Mechanical: Boiling water poured on the mound shortly after a rain can remove a mound.

Behavioral: Some native ant species compete with the red imported fire ant for territory and resources, and they are particularly effective predators on newly mated fire ant queens.

Chemical: Amdro® or similar reduces colony quickly. Extinguish® or similar is an insect growth regulator that slows population growth up to 1 year. Boric acid can even be used to reduce colonies. Widespread broadcast baits can severely reduce ALL ants, including native ants, so it is not recommended away from built areas. Use bait applied to specific mounds to distribute chemicals to minimize damage to other ant species. Follow the SOP RIFA Treatments for TMD facilities.

Biological: Some pathogens are known to attack ants, and several have been marketed for fire ant control, including the microsporidian *Thelohania solenopsae*, Pseudomonas bacteria and several parasitic fungi, including *Beuvaria bassiana*, which is currently being evaluated for control. Parasitic nematodes (*Steinernema* spp.) seek out and enter insects, paralyzing them, and developing in their bodies. Species and strains vary in their effectiveness. Strains tested to date caused ants in treated mounds to temporarily move away from the treated mound, but few colonies were actually eliminated. There is great hope for success from the introduction of biological control agents such as parasitic phorid fly species (*Diptera*) currently being released in the United States and showing successful establishment at some locations in Texas. If successfully introduced and established, they are expected to provide only a measure of suppression over large areas, but they will not eradicate the imported fire ant.

L.5.6 References

Texas A&M website: http://fireant.tamu.edu/

UT Austin website: http://uts.cc.utexas.edu/~gilbert/research/fireants/

USDA Species summary: http://www.invasivespeciesinfo.gov/animals/rifa.shtml

L.5.7 Local Control Experts

Local extension office for each site:

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Appendix M. Priority Rare Species Summaries

M.1 *Argythamnia aphoroides* – Hill Country wild mercury

Scientific Name: *Argythamnia aphorides* Muell. Arg.		**Common Name:**	Hill Country wild mercury; shrubby ditaxis
Family:	Euphorbiaceae (Spurge	**Order:**	Euphorbiales
TSN:	184699	**Synonymy:**	*Ditaxis aphoroides* (Muell. Arg.) Pax

Figure M-1. Photo of Hill Country wild mercury on Camp Bowie

Figure M-2. Photo of Hill Country wild mercury on Camp Bowie

Federal Status:	SOC	**State Status:**	none	**Other:**	TX endemic
Global Rank:	G2	**State Rank:**	S2	**Rarity at Facility:**	unknown

M.1.1 Status Summary and Threats

Argythamnia aphoroides is a rare endemic, currently reported to occur in 14 counties of the Edwards Plateau and the southwest part of north central Texas (Carr 2004; Diggs et al 1999). There are more than 6 but fewer than 20 populations known for this species that is listed as a species of concern by the USFWS. It appears to be vulnerable because of habitat loss. The Camp Bowie population represents the most northern site known for this species (Amos 2005).

M.1.2 Distribution

M.1.2.1 Global

Endemic to the Edwards Plateau of central Texas

M.1.2.2 State

Bandera, Bexar, Blanco, Brown, Comal, Gillespie, Hays, Kendall, Kerr, Kimble, Menard, Mills, Tom Green, and Uvalde counties

M.1.2.3 On Camp Bowie

Northwest corner of TA VII; future surveys will determine current distribution

M.1.3 Diagnostic Characteristics

(adapted from Corell & Johnston 1970): Dioecious herbaceous perennial with 10-100 or more erect to ascending, unbranched pubescent stems from a somewhat woody base, usually 2-5 cm tall. Leaves are alternate, simple, sessile, ovate-lanceolate to elliptic, 20-45 mm long and 10-20 mm wide, densely villous with grayish silky hairs, with entire margins. Flowers are unisexual, on separate plants, both types in racemes up to 6 cm long borne from the axils of upper leaves; staminate flowers with 5 lanceolate sepals ca. 4 mm long; petal 5, greenish obovate-cuneate, 4-5 mm long; stamens 8-10; pistillate flowers with 5 lanceolate sepals ca. 5 mm long. Petals are absent. Glands at base of ovary square or rectangular in outline. Fruit is a roughly globose, vaguely 3-lobed, 3-seeded capsule; seeds are spherical, 4-5 mm in diameter (Proceedings from Texas Plant Conservation Conference 2003).

Argythamnia simulans and *A. mercurialina* also occur in central Texas and are similar in size and habitat. The stems and foliage of both of these species are dark green and more or less glabrous, whereas those of *A. aphoroides* appear grayish due to dense silky pubescence. In addition, *A. simulans* and *A. mercurialina* generally produce few (1-10) stems per root crown, whereas *A. aphoroides* usually produces more than 25 and sometimes more than 100 stems per root crown.

M.1.4 Life History

M.1.4.1 Reproduction

Flowers are unisexual and the plants dioecious. Other than floral descriptions, little is known about the reproductive biology (Amos, proposal 2005).

M.1.4.2 Phenology

Flowering April-May, with fruit persisting until midsummer. Recognizable foliage is present for most of the growing season.

M.1.4.3 Mobility/Migration

N/A

M.1.4.4 Habitat

Mostly in bluestem-grama grasslands associated with plateau live oak (*Quercus fusiformis*) woodlands

M.1.4.5 Associated Species

Little bluestem, sideoats grama, plateau live oak, juniper

M.1.4.6 Soil

Mostly on shallow to moderately deep clays and clay loams over limestone on rolling uplands. A few occurrences are in partial shade of oak-juniper woodlands on gravelly soils on rocky limestone slopes.

M.1.5 Management Summary

It is currently not documented how disturbance, such as common military training, may affect *A. aphoroides*. Prescribed fire is used as a management tool at Camp Bowie; however, it is not documented how *A. aphoroides* responds to fire. It is unknown how to provide for conditions for successful recruitment.

M.1.6 Research Needs

Dr. Bonnie Amos with Angelo State University is currently conducting studies on the following general topics that require research: habitat requirements, prescribed fire effects, effects from mowing/grazing, effects from military training; reproductive biology to provide for conditions for successful recruitment that includes floral phenology, breeding system, pollen vectors, seed ecology.

M.1.7 Observations at Camp Bowie

No map available at this time.

Scientific Name	Obs. Date	Source	Voucher ID	Collection
Argythamnia aphoroides	6-Jun-96	Texas Parks & Wildlife	14751	TEX-LL
Argythamnia aphoroides	6-Jun-96	Nature Conservancy	0	
Argythamnia aphoroides	2006	Bonnie Amos		

Table M-1. Observations of *A. aphoroides* at Camp Bowie

M.1.8 References

Amos personal observation/communication

Carr personal observation/communication

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M.2 *Phrynosoma cornutum* – Texas Horned Lizard

Scientific Name:	*Phrynosoma cornutum*	**Common Name:**	Texas horned lizard, horny toad
Family:	Phrynosomatidae	**Order:**	Squamata
TSN:	173938	**Synonymy:**	

Figure M-3. Adult Texas horned lizard, TPWD photo

Figure M-4. Texas horned lizard, TPWD photo

Federal Status:	n/a	**State Status:**	Threatened	**Other:**	
Global Rank:	G4G5	**State Rank:**	S3	**Rarity at Facility:**	Rare

M.2.1 Status Summary and Threats

Widespread and still relatively common in some areas of the south-central United States and northern Mexico; declines have been noted in portions of the range, but it is doing well in many areas; apparently moderately threatened by fire ants, insecticides, loss of habitat, and over collecting. This species apparently has declined in area of occupancy and population size near the northeastern margins of the range in Texas, Oklahoma, and Kansas, but it is doing well in most of the range. Moderate decline to relatively stable (25% change to 50% decline).

Declines may be related to the spread of fire ants, use of insecticides to control fire ants, heavy agricultural use of land and/or other habitat alterations, and over collecting for the pet and curio trade (Price 1990; Carpenter et al. 1993; Donaldson et al. 1994). The widespread use of broadcast insecticides is thought to contribute to declines by directly causing illness or death or indirectly by severely reducing or eliminating harvester ants (Henke and Fair 1998). In the past, this lizard was collected for the pet trade, by Boy Scout troops for trading at jamborees, for the curio trade, and by tourists (Donaldson et al. 1994, Henke and Fair 1998). Mortality from road traffic is also an important local threat in some areas. Males are particularly vulnerable during May-June in Arizona and New Mexico (Sherbrooke 2002). A high level of road mortality may lead to significant local declines.

This species is extremely vulnerable to changes in habitat, especially the loss of harvester ants (Carpenter et al. 1993). Harvester ants comprise up to 69% of the diet (Pianka and Parker 1975), and fire ants are thought to out-compete native harvester ants for food and space (Henke and Fair 1998). This threat may be significant in parts of Texas but probably not elsewhere. Intensive agriculture (plowing) could destroy adults and their eggs (Carpenter et al. 1993, Donaldson et al. 1994) but, according to Henke and Fair (1998), reports of declines due to loss of habitat caused by urbanization, suburban sprawl, and conversion of native rangeland to agricultural crops are mostly unsubstantiated (Henke and Fair 1998).

Habitat alteration, both urban and agricultural, in Texas and the southeastern United States has promoted the spread of a terrible introduced pest, *Solenopsis invicta*, the red imported fire ant. These ants, accidentally introduced from South America, pose a significant threat to all wildlife in the southern United States. Fire ants can kill almost anything given the chance, and they are fierce competitors against native ants that horned lizards require for food. Horned lizards do not eat fire ants probably due to the ants' different natural history than the native harvesting ants, different venom in the sting apparatus, and different nutritional component.

M.2.2 Distribution

M.2.2.1 Global

The range extends from extreme southwestern Missouri and central Kansas to southeastern Colorado, and south and west throughout most of Oklahoma and Texas (including coastal barrier islands), eastern and southern New Mexico, and southeastern Arizona to northeastern Sonora, Chihuahua, and Durango east of Sierra Madre Occidental, Coahuila, Nuevo Leon, Tamaulipas, San Luis Potosi, and Zacatecas (Price 1990). The native eastern limit is uncertain. Records for Missouri and Arkansas have been questioned (now extirpated from Arkansas; Trauth et al. 2004), and possibly the species is not native to Louisiana (Price 1990). This species has been introduced and is established in several areas in the southeastern United States, including North Carolina (Herpetol. Rev. 20:12), Florida (Jensen, 1994; Herpetol. Rev. 25:165), and elsewhere (see Price 1990 for references). Total adult population size is unknown but surely exceeds 10,000 and likely exceeds 100,000. This species can be locally abundant in undeveloped areas with appropriate habitat (Carpenter et al. 1993; Hammerson 1999).

A 1992 Oklahoma survey found the species to be rapidly disappearing in eastern areas of Oklahoma where it was once known to be abundant (Carpenter et al. 1993). A 1993 survey of the northern Flint Hills of Kansas suggested that populations were possibly declining (Busby and Parmalee 1996), and local collectors reported declines in the southeastern portions of Kansas (Bill Busby, pers. comm., 1998). In Colorado, no trend information is available, but recent surveys indicate that the species appears to be locally common and stable (Siemers, pers. comm., 1998; Hammerson 1999). According to Rosen (Herp. Diversity Review 1996), populations are thriving and plentiful in extreme southeastern Arizona. New Mexico densities have not changed historically, and populations are considered stable (Charles Painter, pers. comm., 1998). Its status is unknown in Sonora, Mexico (Andres Villareal Lizarraga, pers. comm., 1998).

M.2.2.2 State

According to Price (1990), the Texas horned lizard has virtually disappeared from Texas east of a line from Fort Worth through Austin and San Antonio to Corpus Christi (formerly widespread and abundant in that area). It has also declined in range and/or abundance in areas where it was formerly common in parts of north-central Texas, the Texas Panhandle, and parts of Oklahoma. Price's conclusions are supported by more recent surveys in Texas, Oklahoma, and Kansas. A 1992 Texas survey found the greatest declines in east Texas (where no individuals were found) and apparent declines also in central Texas. While the species appeared to be doing well in northern and western Texas (Donaldson et al. 1994). Bartlett and Bartlett (1999) stated that the decline may have halted in at least some parts of Texas, and they found numerous individuals in areas where searches in several previous years yielded few. A 1999 survey in Texas was unable to determine if the decline has halted or if it continues today (Henke 2003).

M.2.2.3 On Camp Bowie

Texas horned lizards have been observed infrequently in the last decade at Camp Bowie, but there are abundant harvester ants and excellent habitat. A few captures occurred during planning level surveys in 2002-2003, including juveniles that indicate a reproductive population. Texas horned lizards were considered common in 1996 during original planning level surveys.

M.2.3 Diagnostic Characteristics

The Texas horned lizard is a flat-bodied and spiny lizard with an adult snout-vent length 6.2-12.5 cm, with an average of 6.9 cm (Stebbins 1985; Munger 1984, 1986). The head has numerous horns, all of which are prominent, with 2 central head spines being much longer than any of the others. This lizard is brownish to yellow to gray with 2 rows of fringed scales along each side of the body. On most Texas horned lizards, a light line can be seen extending from its head down the middle of its back (middorsal stripe). It is the only species of horned lizard to have dark brown stripes that radiate downward from the eyes and across the top of the head.

In other words: (1) single pair of occipital spines (2) 2 rows of lateral abdominal fringe scales (3) enlarged modified dorsal scales with 4 distinct keels (4) single row of enlarged gular scales (5) keeled non-mucronate ventral scales (6) postrictal scale absent and (7) white middorsal stripe.

P. cornutum differs from *P. solare* in lacking 4 large horns with bases that touch at the back of the head and from *P. coronatum* in having a single (vs. 2-3) row of enlarged scales on each side of the throat. *P. cornutum* also differs from *P. platyrhinos* in having a double row rather than a single row of pointed fringe scales on each side of the body. Other horned lizards have either much smaller horns or a dark middorsal stripe rather than a pale one.

M.2.4 General Ecology

Desert populations cycle in abundance, possibly following similar cycles of their primary prey (*Pogonomyrmex* harvester ants) (Price 1990). They can be found in arid and semiarid habitats in open areas with sparse plant cover. Because horned lizards dig for hibernation, nesting, and insulation purposes, they commonly are found in loose sand or loamy soils. At least 4 species of horned lizards (but not all species), including *P. cornutum,* squirt blood (up to 1/3 of their blood volume) from their eyes when attacked, especially by canine predators such as foxes and coyotes (Middendorf and Sherbrooke 1992). The canine will drop a horned lizard after being squirted and attempt to wipe or shake the blood out of its mouth, clearly suggesting the fluid has a foul taste.

The main methods of behavioral thermoregulation used by the Texas horned lizard are basking and burrowing. Throughout the morning hours, the lizard angles itself to maximize the amount of heat received when basking in the sun (Heath 1965). In order to keep cool, Texas horned lizards will burrow in the sand or hide in the shade. The burrowing process involves pushing the pointed snout into the sand and moving it from side to side. While continuing this movement, the body is inflated and is moved in the same way until the entire body is covered with sand (Heath 1965). The burrowing process is an important behavior in thermoregulation, since it can protect the lizard from heat or cold depending on the temperature of the soil in which the animal is buried (Potter and Glass 1931).

Hibernation is much like the daily burrowing activities of the lizard. However, during hibernation the animal will slow down its metabolism and can persist for long periods of time without food or water (Potter and Glass 1931). The hibernation season lasts from late summer to late spring (Bockstanz 1998). When they emerge from hibernation, the breeding season begins (Bockstanz 1998).

Another interesting behavior that may explain how it can persist in arid habitats is the process of "rain-harvesting." During heavy rains, the lizard will stand high on its feet, spread the body out flat, and lower the head so that falling rain will be funneled to the mouth through interscalar channels (Sherbrooke 1990).

M.2.5 Life History

M.2.5.1 Reproduction

P. cornutum females lay clutches of 14 to 60 eggs from May-July. Eggs hatch in about 6 weeks (Behler and King 1979). The breeding season begins in late April and continues into July (Seymour 1996). These lizards are oviparous and will lay their eggs in moist, sandy areas (Bartlett 1999). The eggs have a flexible, white shell, which measures 1.5 in.in diameter (Seymour 1996). The incubation period for the eggs is 45-55 days (Bartlett and Bartlett 1999). The hatchlings are approximately 1.25 in. long and are relatively smooth. However, the hatchlings do have the spines around their heads. There is no evidence of parental care for the young, so they must find food and defend themselves against predators immediately after hatching. The age of reproductive maturity is not known; however, they are full-grown adults at 3 years of age (Seymour 1996).

M.2.5.2 Phenology

Diurnal; Hibernates/aestivates. *P. cornutum* is active April to September in the north (Collins 1982, Hammerson 1982). Sometimes found on warm roads at night (Hammerson 1982).

M.2.5.3 Mobility/Migration

It is non-migratory. Home range size and movements seem quite variable. Munger (1984) found that single-season home range size in southern Arizona averaged 3 acres (1.3 ha) in females and 6 acres (2.4 ha) in males. Home range length extended up to about 400 m but often was 100-300 m, and some individuals that were observed more than 30 times moved over an area less than 55 m across. Some individuals tended not to remain in a limited area. Overlap of home ranges occurred but was not extensive.

In southern New Mexico, home range size was about 2 acres (1 ha) or less (Worthington 1972). Whitford and Bryant (1979) recorded movements of 9-91 m per day (average 47 m) in New Mexico. Individuals followed a zig-zag course and rarely crossed their own path.

In Colorado, Montgomery and Mackessy (in Mackessy 1998) reported that a juvenile moved approximately 100 m in 2 days. Another juvenile was recaptured 480 m from its original capture location after 47 days.

In Texas, total area of use varied from 291 square meters (25 days) to 14,690 square meters (116 days). Weekly home ranges appeared to be mobile (Fair and Henke 1999). Annual adult survival rate was between 9% and 54%.

In Oklahoma, average individual daily linear movements for all lizards was 45.0 m (range 10-220 m). Males moved significantly farther than females in but not after May when their average daily movements were very similar. Average individual daily activity area for all lizards was 232.8 square meters (range 1.7-3011.4 sq. m), and males covered drastically larger areas in a day during May than did females (Stark et al. 2005).

M.2.5.4 Barriers to Movement

Busy highway or highway with obstructions such that lizards rarely if ever cross successfully; major river, lake, pond, or deep marsh; urbanized area dominated by buildings and pavement.

M.2.5.5 Habitat

Desert, Grassland/herbaceous, Shrubland/chaparral. *P. cornutum* burrows and/or uses soil, fallen logs, and debris. *P. cornutum* inhabits open arid and semiarid regions with sparse vegetation (deserts, prairies, playa edges, bajadas, dunes, and foothills) with grass, cactus, or scattered brush or scrubby trees (Degenhardt et al. 1996, Bartlett and Bartlett 1999, Hammerson 1999, Stebbins 2003). Soil may vary in texture from sandy to rocky. When inactive, individuals burrow into the soil, enter rodent burrows, or hide under rocks. Sheffield and Carter (1994) reported individuals that climbed 1-2 m up tree trunks when soils were wet after heavy rains. Eggs are laid in nests dug in soil or under rocks (Collins 1982). Since *P. cornutum* has declined extensively in Oklahoma, east Texas, and Arkansas, habitat use in these more forested ecosystems is not well documented.

M.2.5.6 Associated Species

Pogonomyrmex harvester ants are assumed to be an associated species.

M.2.5.7 Food

Invertivore. *P. cornutum* eats mainly ants but also other small insects (Stebbins 1985). The Texas horned lizard eats mainly harvester ants, *Pogonomyrmex* spp., but it will also eat grasshoppers, isopods, beetles, and beetle larvae. In order to obtain enough energy, adult Texas horned lizards must forage from several colonies of harvester ants. The Texas horned lizards' daily activities coincide with the times of highest ant activity (Donaldson, et al. 1994).

M.2.6 Management Summary

In 1967, the Texas legislature passed protective legislation preventing collection, exportation, and sale of *Phrynosoma cornutum* from the state. Prior to this legislation, hundreds of thousands of horned lizards were exported (dead and alive) from Texas every summer to tourists, curiosity seekers and would be pet owners, leading only to demise of the lizards. Prohibitions against collecting and sale continue to be essential to conservation. Management of fire ants and conservation of native ants and habitat are likely essential to maintaining healthy populations.

Little is known about management needs, but increasing numbers of researchers in different parts of their range are conducting research on ecology, life history, and management. They seem dependent upon harvester ants, although maybe not as tightly as previously assumed. They may not survive well in areas with heavy Bermuda grass (similar to quail) and other non-native grasses. They may be dependent upon prescribed fire to maintain the habitat matrix they require. The majority of management recommendations are purely speculative.

M.2.7 Research Needs

Determine the number of populations and abundance. Monitor selected populations across the range to determine trends. Determine threats and monitor the spread of fire ants and their effect.

M.2.8 Observations at Facility

From TMD database

Scientific Name	Source	Obs Date	No Obs	Frequency	Capture Method	Location
Phrynosoma cornutum	Texas Parks & Wildlife	6-Jun-96		Common	Visual	
Phrynosoma cornutum	Robert Dowler	6-Jul-02	1			TA 5
Phrynosoma cornutum	Robert Dowler	17-May-03	1			

Table M-2. Observations of *P. cornutum* on Camp Bowie

M.2.9 References

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Texas Parks & Wildlife Summary: http://www.tpwd.state.tx.us/huntwild/wild/species/thlizard/

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Center for Reptile and Amphibian Conservation and Management: http://herpcenter.ipfw.edu/index.htm?http://herpcenter.ipfw.edu/outreach/accounts/reptiles/lizards/Texas_Horned_Lizard/index.htm&2

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M.3 *Vireo atricapilla* – Black-capped Vireo

Scientific Name:	*Vireo atricapilla*	**Common Name:**	Black-capped Vireo
Family:	Vireonidae	**Order:**	Passeriformes
TSN:	178990	**Synonymy:**	

Figure M-5. Adult Male Black-capped Vireo, TPWD photo

Figure M-6. Male and Female Black-capped Vireo at nest, USFWS photo

Federal Status:	Delisted	**State Status:**	Endangered	**Other:**	
Global Rank:	G3	**State Rank:**	S2B	**Rarity at Facility:**	Rare

M.3.1 Status Summary and Threats

Small breeding range in the south-central United States and adjacent northeastern Mexico. Northernmost breeding populations extirpated, but the known range has increased in the south as a result of recent surveys. Known population size is more than 6,200 pairs, and total population size may be much larger than this. Population trend is not well known, but population size appears to have increased in some areas. Threats include habitat loss and degradation resulting from fire suppression and effects of ungulates and cowbird parasitism. Better information is needed on distribution and abundance in Mexico.

Threats include cowbird parasitism that locally may affect 80% to 100% of nests in most years. The loss of nesting habitat is due to housing development and road construction; over-browsing by domestic livestock, exotic ungulates, and white-tailed deer; vegetation maturation resulting from fire suppression; and range management practices that remove broad-leaved, low woody vegetation.

Habitat alteration by invasive junipers appears to be a major limitation in the maintenance and development of suitable breeding habitats in many portions of the range (USFWS 2007). Juniper invasion into suitable habitats appears to be a function of the combined influence of fire suppression and overgrazing, and it may be further influenced by drought (USFWS 2007). The threat of vegetational succession, particularly invasion by Ashe juniper, is complicated by the requirement of mature oak-juniper woodlands by the endangered golden-cheeked warbler.

Available evidence indicates that extremely high stocking rates of herbivores (especially goats, white-tailed deer, and exotic ungulates) can degrade black-capped vireo breeding habitat. When grazing pressure is reduced, the breeding habitat may recover under some conditions (USFWS 2007).

The density and abundance of domestic livestock, particularly goats, have declined substantially in those regions where this threat was of greatest concern at the time of listing, primarily in the Edwards Plateau and Southwest and Trans-Pecos Regions (USFWS 2007). In contrast, the density and abundance of white-tailed deer and exotic herbivores may have increased in those regions of greatest concern at the time of listing, particularly in the Edwards Plateau of Texas (USFWS 2007).

The threat posed by brood parasitism throughout major portions of the range in Texas has likely lessened since the species was listed, due to a combination of an apparent decrease in cowbird abundance, an apparent increase in black-capped vireo populations, and circumstantial evidence of a reduction in parasitism rates at some locations due to cowbird removal (USFWS 2007). This same threat essentially remains unchanged since the time of listing throughout the species' range in Oklahoma (USFWS 2007).

Red imported fire ants have increased in distribution and abundance since the black-capped vireo was listed. These prey on vireo eggs/young and likely pose an increasing threat (USFWS 2007).

M.3.2 Distribution

M.3.2.1 Global

Historical breeding range extended from south-central Kansas south through central Oklahoma and central and western Texas to southern Coahuila, Nuevo Leon, and Tamaulipas, Mexico, and the southern portion of this range in Mexico was confirmed by recent surveys (USFWS 2007). Present range extends from Blaine County, Oklahoma (2 locations, only 1 of which [Wichita Mountains] has substantial numbers), south through Dallas, the Edwards Plateau, and Big Bend National Park, Texas, and to southern Coahuila, Nuevo Leon, and Tamaulipas, Mexico (USFWS 2007). Winter range is separate from breeding range and extends from southern Sonora, Sinaloa, and western Durango south through western Mexico to Guerrero and southern Oaxaca, but most birds winter in the northern two-thirds of this area (USFWS 2007).

M.3.2.2 State

Black-capped vireos are found throughout the Edwards Plateau and eastern Trans-Pecos regions of Texas.

M.3.2.3 On Facility

Black-capped vireos have nested on Camp Bowie 2 of the last 3 years. Since 2008, there have been observations of lone males on a regular basis. There are several patches of suitable nesting habitat on the installation.

M.3.3 Diagnostic Characteristics

The black-capped vireo (BCVI) is a small, migratory songbird 10-12 cm long (Graber 1957; Grzybowski 1995; Howell and Webb 1995). It is unique among vireos in being sexually dichromatic (Graber 1957) and in showing delayed plumage maturation in first-year males (Rohwer et al. 1980). Mature males are mostly olive green above and white below with faint greenish-yellow flanks (Oberholser 1974; Campbell 1995). The crown and upper half of the head are black, and the partial white eye-ring connects with white lores to form “spectacles.” The bill is black, and the iris is red in mature males and brownish red or amber in females and immatures (Graber 1957; Howell and Webb 1995; Pyle 1997). The plumage of females is duller overall than that of males. The heads of females are dark slate gray (USFWS 1991; Campbell 1995; Grzybowski 1995).

M.3.4 Life History

M.3.4.1 Reproduction

Nesting begins shortly after the females arrive on the breeding grounds (Graber 1961). Males sing to attract mates and defend territories, which usually range in size from 1 or 2 hectares (ha; mean=1.5; Graber 1961) to 10 ha (mean=3.6 ha; Tazik 1991). Pairs form after a brief courtship (less than 1-2 days). Pairs remain socially monogamous throughout the breeding season and select nesting sites together (Grzybowski 1995). It takes 2-9 days for females to construct the cup-shaped nests, which are suspended in the forks of shrubs in dense underbrush from 0.2-3.0 m (usually 0.5-2.0 m) above the ground (Campbell 1995; Grzybowski 1995).

The first egg is usually laid 2 days after nest completion, and additional eggs are laid on each subsequent day (Graber 1961). The first nesting attempt usually results in 3-4 eggs, while later clutches may only contain 2-3 eggs (Campbell 1995). Incubation takes 14-17 days, with both males and females sharing incubation duties. Likewise, both males and females share the responsibility of feeding the chicks, which leave the nest 10-12 days after hatching (Campbell 1995).

M.3.4.2 Phenology

Diurnal

M.3.4.3 Migration

Moore (1938) commented that the scarcity of BCVI records from Sonora suggests that the birds cross the tableland through Chihuahua and descend through the canyons of southwestern Chihuahua and Durango to the coast. Graber (1961) agreed with the idea of such a route, but she visited the area and found no evidence of habitat suitable for BCVIs. Marshall et al. (1985) and Farquhar and Gonzalez (2005) also doubted the likelihood of this migratory route because of the mountainous terrain and the xeric conditions along the way, even though it would be the shortest linear route between the wintering areas and the breeding grounds in Texas and Oklahoma. Graber (1961) stated that scattered records of BCVIs from high elevations (1 as high as 9,500 ft.) suggest the possibility of a migratory route over the mountains. Moore's (1938) proposal was made prior to the discovery of the currently known breeding range in Mexico. Farquhar and Gonzalez (2005) thus suggested that these southern populations might instead migrate across the shrubby, submontane vegetation associated with the Volcanic Belt Pine-Oak Forests. Similarly, Marshall et al. (1985) examined specimen and site records of BCVIs during migration and proposed the possibility of a route around the edge of the plateau to the south, along or parallel to the Sierra Madre Oriental.

Black-capped vireos begin to depart from the breeding grounds in late August and September, with the young birds leaving first, followed by the adult females and then the adult males (Graber 1961; Marshall et al. 1985). In the spring, they arrive on the breeding grounds about a week after the average date of the last frost (Graber 1961), which is usually from mid-March to mid-April in Texas and approximately 10 days later in Oklahoma (Campbell 1995; Grzybowski 1995). Males typically arrive about 1-2 weeks before females and first-year males to select their territories (Graber 1961; Campbell 1995).

M.3.4.3.1 Habitat

Habitat consists of dense low thickets and oak scrub, mostly on rocky hillsides or steep ravine slopes in rugged terrain (Ehrlich et al. 1992). Nesting occurs in areas with clumps of woody vegetation separated by bare ground, rocks, and/or herbaceous vegetation (USFWS 1987), often in areas with sparse *Juniperus*.

In Texas and Oklahoma, nesting territories had relatively high densities of deciduous vegetation (primarily oaks) close to the ground and occurred where variation in relative density measures of woody vegetation was highest (Grzybowski et al. 1994). BCVI avoided higher juniper densities on the Lampasas

Cut Plains and more open areas on the Edwards Plateau. Favorable breeding habitat had 35% - 55% dispersed scrub cover (primarily deciduous) in spatially heterogeneous configurations, with (in most areas) juniper cover well below 10%; however, in the Edwards Plateau region and areas to the southwest junipers may contribute important cover. See Grzybowski et al. (1994) for further details.

In Mexico, this vireo commonly occurs in dense thickets with few spaces between clumps of vegetation (Benson and Benson 1990).

Habitat is naturally maintained by wildfires and grazing animals, which keep vegetation in early successional stage (Matthews and Moseley 1990).

Winter habitat preferences are not well known, but habitats include semiarid tropical scrub (AOU 1983) and appear to be less specific than in summer (Collar et al. 1992)

M.3.4.4 Food

Frugivore, Invertivore. Adult and fledgling BCVI forage for insects within their preferred habitat mostly by gleaning them from vegetation (Graber 1961, p. 332; Grzybowski 1995, p. 5; Houston 2008, p. 23). Males tend to forage higher (> 2 m; 6.6 ft.) in vegetation strata than females in breeding habitats (Grzybowski 1995, p. 5; Houston 2008, p. 17). The need for increased structural heterogeneity in vegetation, including vertical strata above 3 m (10 ft.) may be important for foraging, especially for males and juveniles (Houston 2008, p. 26). The diet of BCVI consists mainly of arthropods, and of those mostly Lepidoptera (butterflies and moths) larvae (Graber 1961, p. 332). They will also supplement the diet with plant matter, mainly seeds (Graber 1961, p. 332; Grzybowski 1995, p. 5). Most foraging in Texas occurs in deciduous vegetation, largely live oak, as well as shin oak, and Texas red oak (Houston 2008, p. 16; Morgan 2012, p. 41). When available, considerable foraging may also occur in Ashe juniper trees (Morgan 2012, p. 41). (Cited from USFWS BCVI SSA 2016, p. 33)

M.3.5 Management Summary

Beneficial management activities include removal of cowbirds from nesting areas. Cowbird removal has been a successful technique, but presently, it benefits only a small portion of the total population (Grzybowski 1991).

Hot fires and bulldozers can be used to create favorable habitat conditions (Grzybowski 1991). Prescribed fire is an important tool in maintaining habitat suitability in Oklahoma and in the eastern portion of the species' range in Texas, whereas in the western portion of the breeding range in Texas and in Mexico, fire is not as important in maintaining habitat suitability (USFWS 2007).

M.3.6 Research Needs

Better information is needed on the magnitude and trends of brood parasitism by the brown-headed cowbird, as well as differences in parasitism rates across the breeding range (USFWS 2007).

M.3.7 Observations at Facility

From TMD database

Date	Source	Easting	Northing	Sex	Age
5/17/2007	The Nature Conservancy	508143	3497190	M	SY
6/14/2007	The Nature Conservancy	508465	3498290	M	SY
4/24/2008	The Nature Conservancy	507592	3498230	M	AHY
5/15/2012	John Maresh	507448	3498370	M	AHY

5/31/2012	John Maresh	508264	3497580	M	AHY
5/14/2012	John Maresh	508079	3497620	M	AHY
5/19/2010	John Maresh	508398	3498380	M	AHY
5/20/2010	John Maresh	507959	3497250	M	AHY
5/17/2001	TNC and Druid	507267	3497990	M	AHY
5/19/2002	Turner	507690	3497140	M/F	AHY
5/29/2014	Brian Knapp	508146	3497210	M	AHY
5/5/2016	Wayne Strebe	505384	3502840	M	AHY
5/16/2016	Wayne Strebe	505415	3502860	M	AHY
5/31/2016	Wayne Strebe	505420	3502860	M	AHY
4/12/2017	Wayne Strebe	505334	3502780	M	AHY
5/24/2017	Wayne Strebe	508111	3497190	M	AHY
5/24/2017	Wayne Strebe	508057	3498360	M	AHY
6/7/2017	Wayne Strebe	507991	3497550	M	AHY
5/2/2018	Wayne Strebe	507940	3497290	M	AHY
4/17/2018	Wayne Strebe	507930	3497640	M	AHY
4/24/2018	Wayne Strebe	507894	3497580	M	AHY

Table M-3. Observations of *V.atricapilla* on Camp Bowie

M.3.8 References

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Texas Parks & Wildlife Summary: http://www.tpwd.state.tx.us/huntwild/wild/species/bcv/

USFWS: https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=B07T

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M.4 *Grus americana* – Whooping Crane

Scientific Name:	*Grus americana*	**Common Name:**	Whooping Crane
Family:	Gruidae	**Order:**	Gruiformes
TSN:	176176	**Synonymy:**	

Figure M-7. Whooping cranes, TPWD Photo

Federal Status:	Endangered	**State Status:**	Endangered	**Other:**	Experimental
Global Rank:	G1	**State Rank:**	S1	**Rarity at Facility:**	Rare

M.4.1 Status Summary and Threats

All whooping cranes alive today have come from the all-time low of 15 whooping cranes wintering at the Aransas National Wildlife Refuge (ANWR) in 1941 (CWS and USFWS 2007, Figure 1). Since then, the Aransas-Wood Buffalo Population (AWBP) has slowly increased due to conservation efforts. These have included a combination of strict legal protection, habitat preservation, and continuous international cooperation between Canada and the United States that has allowed the only remaining wild population to increase steadily to an estimated 279 individuals by April 2011.

The growth of the human population in North America has resulted in significant alteration and destruction of whooping crane habitat. One of the primary reasons for the historic decline of the whooping crane was the settlement of the prairie pothole region, including the conversion of wetlands to agricultural production (Allen 1952) making much of the historic nesting habitat unsuitable for whooping cranes. Disruptive practices included draining, fencing, sowing, and the human activity associated with these actions. Drainage of wetlands also resulted in a tremendous loss of migratory habitat available to whooping cranes. Wetland losses are continuing, especially with the recent increase in crops used for ethanol production (De Fraiture and Berndes 2009).

M.4.2 Distribution

M.4.2.1 Global

(1000-5000 square km [about 400-2000 square miles]) The historical range extended from the Arctic coast of North America south to central Mexico, and from Utah east to New Jersey, South Carolina, Georgia, and Florida. In the 19th and 20th centuries, nesting occurred principally in the region extending from central Canada to the north-central United States (see CWS and USFWS 2007). Current distribution

includes just three populations: (1) the Aransas-Wood Buffalo National Park Population that nests in Wood Buffalo National Park and adjacent areas in Canada (south-central Mackenzie and adjacent northern Alberta) and winters in coastal marshes in Texas, with significant migration stopovers in southern Saskatchewan, Nebraska, Kansas, and Oklahoma; (2) a reintroduced non-migratory Florida Population that occurs in central Florida; and (3) a reintroduced Eastern Migratory Population that migrates between Wisconsin (Necedah National Wildlife Refuge) and Florida (Chassahowitzka NWR) (CWS and USFWS 2007)

M.4.2.2 State

Whooping cranes migrate to Texas' coastal plains near Rockport, in and around Aransas National Wildlife Refuge, from November through March (TPWD 2020).

M.4.2.3 On Facility

Never been observed. Three wetland areas identified as potential migratory stopover habitat in 2015.

M.4.3 Diagnostic Characteristics

The whooping crane is the tallest North American bird. Males, which may approach 1.5 m in height, are larger than females. Adults are snowy white except for black primary feathers on the wings and a bare red face and crown. The bill is a dark olive-gray, which becomes lighter during the breeding season. The eyes are yellow, and the legs and feet are gray-black. Immature cranes are a reddish cinnamon color that results in a mottled appearance as the white feather bases extend. The juvenile plumage is gradually replaced through the winter months and becomes predominantly white by the following spring as the dark red crown and face appear. Yearlings achieve the typical adult appearance by late in their second summer or fall. The life span is estimated to be 22-24 years in the wild. Whooping cranes are omnivorous feeders. They feed on insects, frogs, rodents, small birds, minnows, and berries in the summer. In the winter, they focus on predominantly animal foods, especially blue crabs and clams. They forage for acorns, snails, crayfish and insects in upland areas.

M.4.4 Life History

Reproduction: Whooping cranes are monogamous and form life-long pair bonds but will remate following the death of a mate. Whooping cranes return to the same breeding territory in Wood Buffalo National Park, Canada, in April and nest in the same general area each year. They construct nests of bulrush and lay 1-3 eggs, (usually 2) in late April and early May. The incubation period is about 29-31 days. Whooping cranes will renest if the first clutch is lost or destroyed before mid-incubation. Both sexes share incubation and brood-rearing duties. Despite the fact that most pairs lay 2 eggs, seldom does more than 1 chick reach fledging. Autumn migration begins in mid-September, and most birds arrive on the wintering grounds of ANWR on the Texas Gulf Coast by late October to mid-November. Whooping cranes migrate singly, in pairs, in family groups. or in small flocks, and they are sometimes accompanied by sandhill cranes. They are diurnal migrants, stopping regularly to rest and feed, and use traditional migration staging areas. On the wintering grounds, pairs and family groups occupy and defend territories. Subadults and unpaired adult whooping cranes form separate flocks that use the same habitat but remain outside occupied territories. Subadults tend to winter in the area where they were raised their first year, and paired cranes often locate their first winter territories near their parents' winter territory. Spring migration is preceded by dancing, unison calling, and frequent flying. Family groups and pairs are the first to leave the refuge in late March to mid-April.

Juveniles and subadults return to summer in the vicinity of their natal area, but they are chased away by the adults during migration or shortly after arrival on the breeding grounds. Only 1 out of 4 hatched chicks survive to reach the wintering grounds. Whooping cranes generally do not produce fertile eggs until age 4.

M.4.4.1 Phenology

Diurnal

M.4.4.2 Migration

The whooping crane is a bi-annual migrant, traveling between its summer habitat in central Canada and its wintering grounds on the Texas coast across the Great Plains of the United States in the spring and fall of each year. The migratory corridor runs in an approximately straight line from the Canadian Prairie Provinces of Alberta and Saskatchewan through the Great Plains states of eastern Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. The complete corridor is approximately 3,862 km (2,400 miles) long by 354 km (220 miles) wide, a zone that encompasses 95% of known sightings of whooping cranes. Autumn migration normally begins in mid-September, with most birds arriving on the Texas wintering grounds between late October and mid-November. Whooping cranes migrate south as singles, pairs, in family groups, or as small flocks of 3-5 birds. They are diurnal migrants and stop daily to feed and rest. Local weather conditions influence distance and direction of travel, but whooping cranes generally are capable of reaching the autumn staging grounds in the north central portion of the Saskatchewan agricultural area on the second day of migration, where they remain for 2-4 weeks. The remainder of the migration from Saskatchewan to the wintering grounds is usually rapid, probably weather-induced, and may be completed in a week. Whooping cranes occupy winter areas for almost half a year. Although close association with other whooping cranes is tolerated at times on the wintering grounds, pairs and family groups typically occupy and defend relatively discrete territories. As spring approaches, dancing behavior (running, leaping and bowing, unison calling, and flying) increases in frequency and is indicative of pre-migratory restlessness. Spring migration departure dates are normally between March 25 and April 15, with the last birds usually leaving by May 1.

M.4.4.3 Habitat

The whooping crane breeds, migrates, winters, and forages in a variety of wetland and other habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields. Whooping cranes breed and nest in wetland habitat in Wood-Buffalo National Park, Canada. Bulrush is the dominant vegetation type in the potholes used for nesting, although cattail, sedge, musk-grass, and other aquatic plants are common. Nest sites are primarily located in shallow diatom ponds that contain bulrush. During migration, whooping cranes use a variety of habitats; however, wetland mosaics appear to be the most suitable. For feeding, whooping cranes primarily use shallow, seasonally and semi permanently flooded palustrine wetlands for roosting, and various cropland and emergent wetlands. In Nebraska, whooping cranes also often use riverine habitats. Wintering habitat in the Aransas National Wildlife Refuge, Texas, includes salt marshes and tidal flats on the mainland and barrier islands, dominated by salt grass, saltwort, smooth cordgrass, glasswort, and sea ox-eye.

M.4.4.4 Food

Whooping cranes are omnivorous, probing the soil subsurface with their bills and taking foods from the soil surface or vegetation. Young chicks are fed by their parents. Summer foods include large nymphal or larval forms of insects, frogs, rodents, small birds, minnows, and berries. Foods utilized during migration are poorly documented but include frogs, fish, plant tubers, crayfish, insects, and agricultural grains. The largest amount of time is spent feeding in harvested grain fields. In the winter, whooping cranes forage for blue crabs, clams and the plant wolfberry in the brackish bays, marshes, and salt flats on the edge of the Texas mainland and on barrier islands. Occasionally, cranes fly to upland sites when attracted by fresh water to drink or by foods such as acorns, snails, crayfish and insects, and then return to the marshes to roost. Uplands are particularly attractive when partially flooded by rainfall, when burned to reduce plant cover, or when food is less available in the salt flats and marshes.

M.4.5 Management Summary

The wild whooping crane population is characterized by low numbers, slow reproductive potential, and limited genetic diversity. A stochastic, catastrophic event could eliminate the wild, self-sustaining Aransas-Wood Buffalo population (AWBP). Therefore, the recovery strategy involves: protection and enhancement of the breeding, migration, and wintering habitat for the AWBP to allow the wild flock to grow and reach ecological and genetic stability; reintroduction and establishment of self-sustaining wild flocks within the species' historic range and that are geographically separate from the AWBP to ensure resilience to catastrophic events; and maintenance of a captive breeding flock to protect against extinction. Offspring from the captive breeding population will be released into the wild to establish these populations. Production by released birds and their offspring will ultimately result in selfsustaining wild populations. The continued growth of the AWBP, establishment of additional populations, and maintenance of the captive flock will also address the loss of genetic diversity (CWS and USFWS 2007).

M.4.6 Research Needs

Causes of mortality in wild and captive cranes should continue to be identified and addressed. Frequent monitoring of the birds will be required to detect losses. Such monitoring will require radio tracking or satellite tracking of wild birds in some instances. Further understanding of migration stopover habitat is needed to refine the effectiveness of habitat augmentation and management on the Platte River and elsewhere. Additional research is necessary to refine methods of creating marsh habitat with dredged sediments to ensure long-term benefits to whooping cranes. For captive populations, research needs include refining means of disease prevention, prevention of toe, leg, and wing injuries, gaining knowledge on pairing and promoting early breeding, improvements in use of artificial incubators, improving natural fertility, genetic management, nutrition of captive birds, and behavioral training to promote wildness in birds destined for release in the wild. Research is continuing to refine reintroduction techniques for establishing a second migratory population to promote appropriate migratory behavior and survival. In 2001 the Whooping Crane Health Advisory Team (WCHAT) identified the high priority research needs in captivity as: (1) the effect of West Nile virus on cranes and development of a vaccine; (2) developing a more effective TB test for screening whooping cranes; and (3) developing a fecal corticosterone test to compare levels of stress associated with various management techniques in captivity. Research is also needed on IBD in cranes. Threat Clarification Research Requirements Research already identified is needed to further define potential threats. For example, the impact that anticipated reduced freshwater inflows at ANWR will have on salinity, winter food resources, and population survival needs to be quantified. Continued research on mortality in reintroduced populations is another example. Such losses threaten the success of the reintroductions. Research is also needed to derive techniques to separate family lines so management of the captive flock can be improved to preserve and increase the genetic diversity of the flock (CWS and USFWS 2007).

M.4.7 Observations at Facility

None

M.4.8 References

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