

FORT CUSTER TRAINING CENTER

Integrated Natural Resources Management Plan

AUGUSTA, MICHIGAN | UPDATED 2020



Prepared for:
Michigan Department of Military and Veterans Affairs
Environmental Division
3423 North Martin Luther King Jr Boulevard
Lansing, Michigan 48906



FINAL

**Fort Custer Training Center
Integrated Natural Resources Management Plan
Updated July 2020**

**Michigan Department of Military and Veterans Affairs
Construction and Facilities Management Office
Environmental Division
3423 North Martin Luther King Jr Boulevard
Lansing, Michigan 48906**



UPDATED 2020
INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
FORT CUSTER TRAINING CENTER
MICHIGAN

ARNG SIGNATURE PAGE

This Integrated Natural Resources Management Plan (INRMP) is an update of the 2012 Fort Custer Training Center (FCTC) INRMP that has been reviewed for operation and effect and recommended for update and continued implementation. It meets the requirements for INRMPs as specified in the Sikes Act, as amended (16 US Code [USC] §670a *et seq.*).

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COOPERATING AGENCY SIGNATURE PAGE

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Approving Official:

Date: _____

Michigan Department of Natural Resources

EXECUTIVE SUMMARY

The Integrated Natural Resource Management Plan (INRMP) for Fort Custer Training Center (FCTC) supports the military mission at FCTC using science-based land management in compliance with applicable relevant laws, regulations, and guidance, while ensuring no net loss in the capability to support the military mission. The INRMP is based on an adaptive, ecosystem-scale management approach integrated with the military mission and other stakeholders associated with FCTC.

The Sikes Act Improvement Act (SAIA) of 1997 (16 US Code (USC) §670a et seq., as amended) and Department of Defense (DoD) and Army National Guard (ARNG) Policy requires military installations with significant natural resources to develop an INRMP. There is an active natural resources management program at FCTC to minimize impacts to sensitive natural resources and to maintain the land so it is suitable for military training; therefore, an INRMP was developed to guide this program.

The FCTC INRMP was first completed in 2001, with subsequent updates in 2006 and 2012. This updated INRMP (2020) will take effect once fully signed and remain in effect until updated or revised. This update is the result of a review for operation and effect done by the US Fish and Wildlife Service (USFWS), the Michigan Army National Guard (MIARNG), and the Michigan Department of Natural Resources (MDNR). The review resulted in the desire of the cooperating agencies to update and continue implementing the existing INRMP. No substantive changes were made to the management programs and practices or the objectives and type of projects in this updated INRMP.

FCTC is located in Kalamazoo and Calhoun Counties in the southwest portion of Michigan's Lower Peninsula. The 7,570-acre, federally owned, military training facility is between Interstate-94 to the south and Fort Custer Recreation Area and the Kalamazoo River to the north. More than 6,813 acres are undeveloped and include forests, fens, swamps, and prairie remnants with several high-quality rare communities. The remainder is developed, with a cantonment area and other training infrastructure. The FCTC has populations of 10 state-listed wildlife species and 14 state-listed plant species. In addition, FCTC provides potential habitat for 8 federally listed wildlife species with known populations nearby, although no individuals have been documented on FCTC.

The overall management vision for natural resources on FCTC, when feasible and consistent with the military mission, is to provide resilience needed for climate adaptation; protect and enhance rare species and plant communities; maintain a mosaic of plant communities, including wetland and aquatic habitats; protect and enhance fish and wildlife habitat; maintain forest health using sustainable forestry practices; provide public access; and use management practices that promote biological diversity and support ecological processes.

This vision is supported by goals, objectives and projects in the INRMP, as well as management strategies and practices to achieve these goals. The management is described by the following resource areas, although there is overlap among them: soil conservation; water resources management and wetland protection; vegetation; wildland fire; invasive species; fish and wildlife; threatened and endangered species; outdoor recreation; and climate resilience. Management prescriptions, objectives, and supportive policies are described in Section 3 of the INRMP by resource area. Implementation tables, which detail activities and projects, are provided in Appendix C and are updated annually during the annual review process with USFWS and MDNR.

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1 INRMP OVERVIEW

The purpose of the Fort Custer INRMP is to support the military mission and provide cooperative natural resources management, while ensuring no net loss of training lands and compliance with federal and state laws and regulations.

1.1 PURPOSE AND SCOPE

The purpose of this Integrated Natural Resources Management Plan (INRMP) is to provide a single, comprehensive document to guide the management of natural resources at Fort Custer Training Center (FCTC or Fort Custer), while maintaining no net loss to the military mission. The last INRMP was updated in 2012 (the original INRMP approved in 2001). Fort Custer consists of approximately 7,570 acres in Kalamazoo and Calhoun Counties in southern Michigan. FCTC is federally owned and is operated by the Michigan Department of Military and Veterans Affairs (MDMVA) and the Michigan Army National Guard (MIARNG).

This INRMP is intended to be consistent with the Sikes Act Improvement Act (SAIA) of 1997, 16 US Code (USC) §670a et seq., as amended; Department of Defense Instruction (DoDI) 4715. 03, Natural Resources Conservation Program; Army Regulation (AR) 200-1, Environmental Protection and Enhancement; and the 2019 Army National Guard, Installations & Environment (ARNG I&E) INRMP Policy. An INRMP is required for Fort Custer due to significant natural resources, including the presence of rare species, wildland fire management, and significant vegetation management requirements.

The overall management vision for natural resources on FCTC, when feasible and consistent with the military mission, is to provide resilience needed for climate adaptation; protect and enhance rare species and plant communities; maintain a mosaic of plant communities, including wetland and aquatic habitats; protect and enhance fish and wildlife habitat; maintain forest health using sustainable forestry practices; provide public access; while using management practices that promote biological diversity and support ecological processes.

Goals are based on MDMVA's vision for managing Fort Custer's natural resources. A goal and objectives are identified for each resource area (i.e., soils, water, vegetation, fire, etc...) and provide the framework for the natural resources program. Each goal is supported by objectives tied to criteria and policies for achieving the stated goal. The objectives then drive the development of activities and projects to achieve those objectives.

The goals and objectives in this updated INRMP are a consolidation and continuation of the goals and objectives in the 2001, 2006, and 2012 INRMPs. In some cases, previous goals and objectives have been combined to avoid repetition and some previous projects are now designated as ongoing activities. Goals and objectives are described in **Section 3** and applicable management prescriptions are identified under each technical area. Activities and projects, and the objectives and actions they support, are

described in **Tables C-1 and C-2** in **Appendix C**. The goals, objectives, and associated criteria are presented in review format in **Table C-3** in **Appendix C**.

The INRMP considers resources within the facility on installation, local, regional and national levels. INRMP preparation includes participation from diverse stakeholders including federal, state, and local agency representatives; conservation organizations and other interested individuals and groups.

The most relevant laws, regulations, and policies with respect to natural resources management at FCTC are listed below. A complete summary of all relevant laws, regulations, executive orders, and policies is provided in **Appendix J**.

The **Sikes Act** (and the SAIA) requires an INRMP be written and implemented for all Department of Defense (DoD) installations having significant natural resources and developed cooperatively with USFWS and the state wildlife agency. **AR 200-1, Environmental Protection and Enhancement** addresses the environmental responsibilities of all Army organizations and agencies and provides a framework for the Army Environmental Management System (EMS). This regulation provides guidance on when to develop and implement an INRMP and discusses associated coordination requirements.

The majority of Michigan's environmental acts have been consolidated into the **Natural Resources and Environmental Protection Act (NREPA)**, 1994, Public Act (PA) 451, as amended (Act 451). Act 451 is organized into sections called "Parts. " Details on Michigan's environmental laws, as contained in the NREPA, can be found at <http://legislature.mi.gov/doc.aspx?mcl-act-451-of-1994>.

The **National Environmental Policy Act** of 1969 (NEPA; 42 USC §4321 *et seq.*) requires that federal agencies consider potential environmental consequences of proposed actions. New INRMPs and major revisions of INRMPs require an Environmental Assessment (EA) to meet NEPA requirements per Army National Guard Installations & Environment Directorate (ARNG I&E) Memorandum, 9 April 2012 and Department of the Army Memorandum, 25 May 2006. Minor updates and continued implementation of an existing INRMP do not require an EA or opportunity for public comment.

As required by NEPA and the policies described above, an EA was completed for the original INRMP in 2001 to evaluate the impacts of the actions proposed in the plan. This updated INRMP is not expected to result in biophysical consequences materially different from those anticipated in the original INRMP. Thus, an Environmental Checklist and a Record of Environmental Consideration (REC) will be submitted separately to ARNG I&E that tiers off the original EA. The Environmental Checklist describes the Proposed Action (update and continued implementation of the 2012 INRMP), confirms that the activities in the updated INRMP are addressed in the 2001 INRMP EA, identifies potential impacts to various environmental media, and concludes that a REC is the appropriate level of NEPA documentation. A copy of the REC is included in **Appendix L**.

1.2 RESPONSIBILITIES

1.2.1 MDMVA/MIARNG Statewide

Within the MIARNG, INRMP implementation responsibilities are shared across many lines of authority. Initiation of plan action will typically come from the MIARNG Environmental Division (MIARNG-ENV) through the State Environmental Program Manager, the Installation Environmental Manager, or the staff Natural Resources Specialists.

1.2.1.1 The Adjutant General (TAG)

The TAG is ultimately responsible for MIARNG staff support for the natural resources program at Fort Custer. The Assistant Adjutant General for the Army serves as chairman of MIARNG's Environmental Quality Control Committee. This standing committee provides overall review and direction on all environmental programs of the MIARNG, including natural resource management at Fort Custer.

1.2.1.2 Construction and Facilities Management Officer (CFMO)

The CFMO reports directly to the Assistant Adjutant General for the Army and has state-wide responsibilities. The CFMO office provides a full range of engineering, financial, and environmental functions for all facilities under the jurisdiction of the MIARNG, including Fort Custer. Specific responsibilities include: (1) procurement and contracting, (2) warehousing of materials, (3) facility master planning, and (4) program management requiring construction, base operations, and environmental funding and guidance.

1.2.1.3 State Environmental Program Manager

The State Environmental Program Manager reports to the CFMO and ensures that MIARNG activities comply with environmental laws and land stewardship responsibilities. Additionally, the Environmental Section provides technical expertise and internal guidance to other offices and facilities within the MIARNG. The Environmental Section supports Fort Custer by preparing plans, completing reports, developing projects, conducting or contracting field studies, securing permits, and ensuring compliance with environmental regulations and policy.

1.2.2 Fort Custer

1.2.2.1 Post Commander

The Fort Custer Post Commander is the designated representative of the MIARNG and CFMO for the operation of FCTC. In this capacity, the Post Commander serves as trustee for the natural and cultural resources and is responsible for protecting the quality of the air, land, and water on FCTC. The Post Commander is responsible for all land management, range, and facility operations, and ensures that all relevant environmental laws are communicated and ultimately followed by users of Fort Custer.

1.2.2.2 Director of Public Works (DPW)

The primary responsibilities for the FCTC DPW are the development and overall maintenance of Fort Custer land and facilities and reports to the Post Commander. The DPW ensures that environmental criteria are incorporated into all new and existing construction projects. The DPW works with the FCTC Environmental specialists to complete required NEPA assessments. The DPW has oversight of road maintenance, erosion control measures, landscaping, some pest management, and oversees the wildland fire program.

1.2.2.3 Fort Custer Environmental Section

The FCTC Environmental Section (FCTC-ENV) oversees NEPA compliance and environmental awareness activities on FCTC as well as implementing a variety of environmental programs. FCTC Environmental Site Manager, who reports to statewide Environmental Program Manager, oversees multiple environmental specialists. These specialists include forester, natural resources, fire, water quality, and other environmental expertise. These specialists are supported by technicians to implement specific programs.

1.2.2.4 Integrated Training Area Management (ITAM)

Currently managed through the State Environmental Program Manager, assisted by FCTC natural resources specialists and ITAM technicians.

1.2.2.5 Range Control

Range Control has oversight of day-to-day activities to prevent conflicts among users and to ensure safety of all users. All training is scheduled through Range Control, and FCTC-ENV must coordinate with Range Control for any activities taking place out in the Training Areas (TAs). Range Control plays a key role in fire prevention through range scheduling and the regulation of the use of pyrotechnics. Range Control also plays a role in first response to any wildfires that begin on ranges. They also provide input on vegetation management needs and cooperates on fuel load management related to ranges.

1.2.2.6 Unit Environmental Compliance Officer (UECO)

A Unit Environmental Compliance Officer (UECO) is required for each unit by AR 200-1. In support of this requirement, the MIARNG trains command-selected individuals at each of the MIARNG facilities state-wide with regard to proper environmental conduct ranging from hazardous materials and hazardous waste handling and disposal to pollution prevention practices. Soldiers trained as UECOs are expected to further train other staff members of the parent organization and to keep their command informed in all matters of environmental compliance and potential impact of mission activities.

1.2.3 ARNG

Two ARNG directorates are involved in the management of natural resources: Installations & Environment (ARNG I&E, now known as G-9) and Operations, Training, and Readiness (ARNG TRS). The ARNG I&E is the directorate responsible for environmental matters. ARNG TRS is responsible for training and training site support to include sustainable range management and the ITAM program.

The Natural Resources Manager at ARNG I&E is responsible for reviewing the INRMP and advising the FCTC-ENV before formally submitting the INRMP to USFWS and MDNR. ARNG I&E is responsible for tracking projects, providing technical assistance, quality assurance, and execution of funds.

ARNG I&E also provides policy guidance and resources to create, sustain, and operate facilities that support the Army National Guard. ARNG I&E coordinates proposed construction projects with ARNG TRS and provides design and construction support, as well as environmental management that is directly related to property maintenance (e.g., grounds maintenance, pest control).

1.2.4 Other Agencies

1.2.4.1 United States Army Corps of Engineers (USACE) Responsibilities

The USACE has responsibility for property management on behalf of the US Army and issued the real estate license to the MIARNG. USACE has some responsibility but only regarding the management and sale of marketable natural resources (i. e., forestry, minerals, etc.).

1.2.4.2 Michigan Department of Natural Resources (MDNR) Responsibilities

MDNR is a cooperating agency on this INRMP as the designated state wildlife agency in Michigan. MDNR is also the lead agency generally in Michigan for natural resources law enforcement, consulting forestry, wildland fire, state listed species, and fish and game management (unless superseded by a local entity, like at FCTC). While land ownership on Fort Custer is all federal and, therefore, MDNR has limited direct

responsibilities on FCTC, various MDNR specialists play important roles as cooperating partners in the planning and implementation of the FCTC INRMP.

1.2.4.3 US Fish and Wildlife Service (USFWS) Responsibilities

The USFWS is a cooperating partner in the review of the INRMP, as well as fulfilling Endangered Species Act (ESA) Section 7 consultations with MIARNG and MDMVA. The USFWS also works cooperatively with FCTC-ENV and MIARNG-ENV with respect to managing federally listed species and bald eagles on FCTC.

1.3 REVIEW AND REVISION PROCESS

In accordance with the Sikes Act, DoDI 4715.03, ARNG I&E INRMP Policy (2019), and AR 200-1, there are two components to the INRMP review process. An annual review process occurs each year so all cooperating entities receive an update regarding what has been accomplished in the last year and what is planned for the next year. The review for operation and effect must occur at least every five years and is a more comprehensive review process with USFWS and MDNR to determine if the INRMP as currently written has achieved the goals and objectives established and whether any content needs to be modified. If the natural resources management on Fort Custer changes significantly, a major revision to the INRMP may be required.

1.3.1 Annual Review and Coordination

The INRMP is reviewed annually to ensure the achievement of mission goals, document the implementation of projects, discuss available funding, and establish any necessary new management needs. The FCTC Environmental Site Manager will communicate annually with USFWS, MDNR, and internal stakeholders to review the previous year's INRMP implementation and discuss implementation of upcoming programs and projects. Ideally, this will occur during an annual meeting, but in years where that is not feasible, the annual review may be completed by email or letter correspondence. A memorandum of record detailing the annual review will be prepared by MIARNG and appended in **Appendix L**. The FCTC Environmental Site Manager is responsible for ensuring that annual INRMP reviews are completed, tracked, and reported.

As part of the annual review and as a function of the INRMP, MIARNG will specifically:

- Invite feedback from USFWS, ARNG I&E, and MDNR on the effectiveness of the INRMP;
- Inform USFWS and MDNR which INRMP projects and activities are required to meet current natural resources compliance needs; and
- Document specific INRMP action accomplishments from the previous year and discuss upcoming projects and activities.

Natural resources data and program/project information are available to cooperating agencies. They may request to see project folders or to have a site visit to view natural resources projects in progress at any time.

1.3.2 Review for Operation and Effect

Not less than every five years, the INRMP will be reviewed for operation and effect by all cooperating agencies and internal stakeholders to determine if the INRMP is being implemented, if substantial changes in military scope or natural resource activities have occurred, if the goals and objectives are being met, and if natural resources management is achieving necessary outcomes. The result of the

review for operation and effect is a determination to continue implementation of the existing INRMP with updates or to proceed with a revision. The review for operation and effect may be done as part of every annual review or as a separate, more in-depth process, depending upon the parties involved and their concerns. This review will include a meeting with relevant stakeholders to facilitate discussion. The conclusion of the review will be documented in a jointly executed memorandum, meeting minutes, or in some other way that reflects mutual agreement. **Appendix L** will include any documentation associated with reviews for operation and effect.

If updates are needed, they will be completed by MIARNG and reviewed and approved by all parties. If it is determined that major changes are needed (i.e., sufficient to trigger a full revision and change in natural resources management), all parties will provide input and an INRMP revision and associated NEPA review will occur. The existing INRMP remains operational until the updates or revision is complete and all concurrences are received, as long as all parties agree in writing. Revisions to the INRMP will be reviewed similar to development of the initial INRMP.

1.4 INTEGRATION WITH OTHER PLANS AND PROGRAMS

This INRMP was developed in coordination with other plans that either provide information critical to identifying and prioritizing projects or have processes and protocols integrated with those of the natural resources program. The adaptive management and documentation associated with annual reviews and reviews for operation and effect contribute to the Environmental Management System already in place for the MIARNG.

1.4.1 MDMVA/MIARNG Plans

- **Integrated Pest Management Plan (IPMP, updated 2017):** Statewide pest management plan using integrated pest management (IPM) approach; this includes the management of invasive plant species.
- **Integrated Cultural Resources Management Plan (ICRMP, currently being updated):** Statewide cultural resources management plan that describes cultural resources present on Fort Custer and identifies Standard Operating Procedures (SOPs) to protect and manage cultural resources. These SOPs are applicable to various natural resources management activities, such as prescribed fires, invasive plant control, and revegetation which can cause ground disturbance.
- **Sediment and Erosion Control Guidebook and Procedures (Guidebook, 2018):** Statewide plan for managing and minimizing sediment loss and erosion on MIARNG properties, including FCTC. It includes a number of SOPs and Best Management Practices (BMPs) to be used as applicable.
- **Adaptation Planning for Climate Resilience (2016):** Statewide effort that assessed current conditions, documented planning efforts, and made recommendations to improve resilience for Fort Custer and two other facilities. The report for each facility details an action plan aimed at responding to and preventing the adverse impacts of climate change on the installation as well as in the greater community.

1.4.2 Fort Custer Plans

- **Integrated Contingency Plan (ICP, 2016):** Plan that directs emergency responses to spill events, services as a reference for planning or evaluating measures taken to prevent spills and releases, provides a record of preventative measures taken, and identifies SOPs to ensure compliance.

- **Watershed Management Plan (2002, currently being updated):** Plan that identifies water quality impacts and provides recommendations and BMPs to address them.
- **Forest Management Plan (1999, currently being updated):** Provides a summary of timber stands, identifies needed timber operations, and identifies BMPs for use at FCTC during timber operations.
- **Integrated Wildland Fire Management Plan (2007, currently being updated):** Provides summary of wildland fire responsibilities, processes and priorities; identifies burn units and SOPs associated with wildland fire operations; and presents a prioritized timeline for prescribed fire operations.

1.4.3 ITAM Program

The Sustainable Range Program (SRP) is the Army's overall approach for managing and improving the Army's ranges and training lands for long-term sustainability. One of the core components of the SRP is the ITAM program, which provides for the management and maintenance of training and testing lands by integrating mission requirements with environmental requirements and environmental and natural resources management practices. The ITAM program was instituted at FCTC in 1996, although selected elements of the program were operational before then. ITAM program goals are to:

- Achieve optimal sustained use of lands for realistic training and testing by providing a sustainable core capability that balances usage, condition, and level of maintenance
- Implement a management process that integrates Army training and other mission requirements for land use with sound natural resources management
- Advocate proactive conservation and land management practices by aligning Army land management priorities with the Army training and readiness priorities

The ITAM program is intended to support sustainable use of training and testing lands, by supporting land management through inventorying and monitoring land conditions, integrating training and testing requirements with training land carrying capacity, educating land users to minimize adverse impacts, and providing for training land rehabilitation and maintenance. The ITAM program is an important part of implementing this INRMP, facilitating coordination among the various stakeholders on Fort Custer, and providing information used in adaptive management. The program consists of four components:

- Range and Training Land Assessment (RTLA)
- Land Rehabilitation and Maintenance (LRAM)
- Training Requirements Integration (TRI)
- Sustainable Range Awareness (SRA)

An annual work plan is developed for ITAM at FCTC and provides project/expenditure projections for the upcoming fiscal year (see **Appendix C, Table C-4**). Elements of the ITAM work plan are integrated with this plan to ensure overall consistency in natural resources management on FCTC. RTLA is a program and methodology for collecting, inventorying, monitoring, managing and analyzing tabular and spatial data concerning the land conditions of the installation. The FCTC RTLA program was established in 1998 with 26 core plots and five special use plots. Special use plots change over time and are used for a specific purpose and have limited duration. The first special use plots were established in 1998 and have been used, as needed, since then. A new suite of RTLA metrics has been developed by the MIARNG ITAM program managers utilizing the 'red, amber, green' symbology. The RTLA metrics gauge core ITAM

programs and assess the conditions of bivouacs, land navigation courses, landing zones, and wetland buffers.

The LRAM program began in 1995 at FCTC and provides a preventive and corrective land rehabilitation and maintenance procedure to reduce the long-term impacts of training and testing on the installation. LRAM includes programming, planning, designing, and executing land rehabilitation, maintenance, and reconfiguration projects based on requirements and priorities identified in the TRI and RTLA components of ITAM. The main emphasis of the LRAM program at FCTC has been to rehabilitate degraded trails that cause sedimentation to adjoining streams. The program regularly repairs damage to training areas caused by vehicle traffic. In addition to bivouac development and maintenance and landing zone maintenance, another prime focus of the program has been the restoration of degraded natural prairie lands to enhance open training lands with native tree and grass species in an effort to provide vegetative diversity while ensuring open space in which to train.

TRI is the decision-making procedure that integrates training requirements with land management and training with natural and cultural resources management based on RTLA results and program requirements. The integration of these many requirements occurs through continuous consultation between staff in the operations and training with natural and cultural resource managers and other environmental staff. For the INRMP to be effectively implemented, TRI/ITAM input is essential.

SRA program provides a means to develop and distribute educational materials to land users as well as the local community. Materials cover sound environmental stewardship of natural and cultural resources and reduce the potential for inflicting avoidable impacts. SRA materials are designed to inform land users of restrictions and activities to avoid and prevent damage to natural and cultural resources of the installation. The primary product from the SRA program for Fort Custer is the Soldier Field Care which outlines environmental and safety procedures for transient units visiting the installation.

1.4.4 Michigan's Wildlife Action Plan

Every military installation should evaluate and incorporate any applicable information from the State Wildlife Action Plan into their natural resources management plans and agreements (DoDI 4715. 03). Every state has a Wildlife Action Plan (WAP) that was written in partnership with other agencies (including MIARNG) and serves as a framework for management of wildlife and their habitat, especially for those species that are in decline. During the INRMP update process, the MIARNG consulted the Michigan WAP to ensure INRMP goals, objectives and strategies are consistent with Michigan's overall statewide and site-specific plans. A copy of the Michigan WAP can be found on the MDNR website at https://www.michigan.gov/dnr/0,4570,7-350-79136_79608_83053---,00.html.

The Michigan WAP for 2015-2025 has identified 15 priority habitats/key issues. Of these, seven overlap with habitats on Fort Custer (see the highlighted fields in Table 1). In addition, several focal species identified in the Michigan WAP occur on Fort Custer. **Table 1** summarizes how Fort Custer and the MI WAP habitats overlap.

Key Habitat or Issue	Focal Species
Emerging Diseases	Eastern Massasauga, Northern Long-eared Bat, Indiana Bat, Tri-colored Bat, Little Brown Bat
Great Lakes Marsh & Inland Emergent Wetlands	Black Tern, Black-crowned Night-heron , Eastern Fox Snake, King Rail
Prairies & Savannahs	Karner Blue, Frosted Elfin, Eastern Box Turtle , Rusty-patched Bumble Bee, Blazing Star Borer, Eastern Massasauga, Monarch Butterfly
Large Grasslands	Henslow's Sparrow, Dickcissel, Grasshopper Sparrow, Monarch Butterfly
Littoral Zones	Pugnose Shiner , Starhead Topminnow, Blanchard's Cricket Frog
Floodplain Forests	Cerulean Warbler , Indiana Bat, Copperbelly Water Snake
Fens	Eastern Massasauga, Mitchell's Satyr, Tamarack Tree Cricket, Yellow Rail, Poweshiek Skipperling, Hine's Emerald Dragonfly
Open Dunes & Sand-Cobble Shores	Piping Plover, Common Tern
Dry Northern Forests & Pine Barrens	Kirtland's Warbler, Dusted Skipper, Secretive Locust, Eastern Massasauga
Warmwater Streams & their Headwaters	Orangethroat Darter, Redside Dace, Silver Shiner, Southern Redbelly Dace, Northern Clubshell, Rayed Bean, Riverine Clubtail Dragonfly
Big Rivers	Lake Sturgeon, River Redhorse, Snuffbox
St. Clair – Detroit River System	Lake Sturgeon, Mooneye Northern Madtom, Pugnose Minnow, Mudpuppy
Inland Cisco Lakes	Cisco, Ives Lake Cisco, Siskiwit Lake Cisco
Great Lakes Ciscoes	Cisco, Kiyi, Shortjaw Cisco
Young Forests	Golden-winged Warbler
Source: Derosier et al. 2015 Species in bold have been documented on Fort Custer. Rows in green indicate key habitats or issues present on Fort Custer.	

Fort Custer actively manages its natural resources to protect and conserve the federally protected species and their habitat, such as northern long-eared bat (*Myotis septentrionalis*) and bald eagle (*Haliaeetus leucocephalus*). The other species in these key habitats are state-listed species: Henslow's sparrow (*Ammodramus henslowii*), king rail (*Rallus elegans*), common tern (*Sterna hirundo*), pugnose shiner (*Notropis anogenus*), and Blanchard's cricket frog (*Acris crepitans blanchardi*). There are some species here that are considered potentially occurring on FCTC. **Appendix H** has a listing of all documented and potential federal and state listed species on the installation. Some of these overlap with focal species as identified in the Michigan WAP.

For each key habitat/issue the WAP has a "mini plan" containing specific items related to 'Raising Awareness', 'Law and Policy', and 'Research and Monitoring'. This INRMP contributes to implementing those items, but they are more general in nature. In the mini plan for each key habitat/issue, the relevant conservation actions for this INRMP are 'Land and Water Management' and 'Conservation Designation and Planning' for each of the key habitats relevant to Fort Custer are presented below (Derosier et al. 2015). MIARNG was actively involved in the conversations that lead to these

conservation actions being included in the WAP and supports achieving them at a regional scale. The most relevant conservation actions are included below.

Emerging diseases are directly applicable to bat species occurring on Fort Custer – including potentially the northern long-eared bat (NLEB) and Indiana bat if ever documented on-site. White-nose syndrome is the emergent disease addressed by the Michigan WAP and is of special concern for the federally protected NLEB, although white-nose syndrome may occur in any bat species (Derosier et al. 2015). More details on the NLEB on Fort Custer is provided in **Section 3.8** and **Appendix H**.

Prairies & Savannas

- Goals:
 - Increase quality and maintain existing acres of prairie and savanna.
 - Improve recruitment at long-term management sites for eastern box turtle (*Terrapene carolina carolina*).
 - Maintain and enhance rusty-patch bumblebee and eastern massasauga (*Sistrurus catenatus*) (both potential species for FCTC) habitat.
 - Increase outreach efforts on the monarch butterfly (*Danaus plexippus*) and what people can do to aid conservation.
 - Establish baseline status and distribution for monarch butterfly.
- Land and water management:
 - Conduct habitat management to mimic natural disturbance regimes to maintain species diversity and community structure.
 - Avoid disking remnant prairie and savanna habitats.
 - Use prescribed fire as a management tool and consider burning throughout the year or at varying times to increase plant diversity; include refuge areas in known or suspected focal species sites.
 - When setting back succession and connecting habitats, use a combination method of prescribed fire and then cutting of sub-canopy to more effectively manage red maple invasion.
 - Conduct targeted management in priority locations for high-threat invasive species.
 - Continue early detection and response efforts for invasive species.
 - Implement invasive species decontamination and prevention protocols.
 - Work with private landowners adjacent to public or land conservancy holdings to manage and expand the size of suitable habitats and create connections to other suitable habitats for focal species.
- Conservation designation and planning:
 - Identify high-quality prairies and savannas in climate resilient landscapes and incorporate them into conservation planning and management; currently being developed by The Nature Conservancy (TNC).

Great Lakes Marsh & Inland Emergent Wetlands

- Goals:
 - Increase wetland area and quality to achieve population goals for focal species.
 - Collaborate to pursue wetland goals established within other plans.

- For black tern, black-crowned night heron, and king rail determine key population limiting factors and reverse downward trend and stabilize population.
- Land and water management:
 - Restore, manage, and protect Great Lakes Marsh and Inland Emergent Wetlands on state, federal, and private lands for focal species (focal species found on Fort Custer includes the king rail).
 - Manage for priority invasive species, and address factors causing ecosystem susceptibility to invasion (e.g., degraded water quality, salt from roads, altered flood or hydrological regime).
 - Continue early detection and response efforts for invasive species.
 - Implement Michigan’s Aquatic and Terrestrial Invasive Species State Management Plans.
- Conservation designation and planning:
 - Develop and promote best practices for including important habitat components for focal species during habitat management, similar to the waterfowl management handbook.
 - Identify high-quality Great Lakes Marsh and Inland Emergent Wetlands in climate resilient landscapes and incorporate into conservation planning and management; currently being developed by The Nature Conservancy.
 - Develop best management practices and implement recommendations for climate-smart wetland infrastructure that is engineered to withstand projected extreme precipitation events over the design-life of the project rather than the mean of past precipitation events.

Large Grasslands

- Goals:
 - Increase the size and quality of grassland complexes in southern Michigan for focal species (Henslow’s sparrow, dickcissel (*Spiza americana*), grasshopper sparrow (*Ammodramus savannarum*), monarch butterfly).
 - Stabilize the population trend for Henslow’s sparrow and stabilize or increase the population trend for grasshopper sparrow and dickcissel.
- Land and water management:
 - Increase size of existing large grassland complexes within open landscapes and consider removing hedgerows.
 - Manage for structural and grassland successional diversity across the landscape.
 - Increase forbs component and use local genotypes when planting.
 - Conduct habitat management to mimic natural disturbance regimes using fire and large grazers at different times of year.
 - Prioritize and conduct targeted invasive species management.
 - Implement invasive species decontamination and prevention protocols.
 - Continue early detection and response efforts for invasive species.

Littoral Zones

- Goals:
 - Increase protection of littoral zone habitats including natural shorelines and associated wetlands, native floating, emergent, and submergent vegetation; large wood; and native riparian vegetation.

- Maintain existing populations and develop a better understanding of critical life stage characteristics and habitat use for pugnose shiner.
- Establish a baseline population status and distribution for Blanchard's cricket frog.
- Land and water management:
 - Develop partnerships with lake associations and riparian landowners to protect natural shorelines, large wood, and aquatic vegetation.
 - Implement Michigan's Aquatic Invasive Species State Management Plan.
 - Implement invasive species decontamination and prevention protocols.
 - Continue early detection response efforts for invasive species.
- Conservation designation and planning:
 - Protect natural shorelines, aquatic vegetation, and large wood through the review of environmental permits.
 - Establish conservation guidelines for aquatic plant treatments that achieve landowner goals while maintaining the biological integrity of the lake ecosystem.

Floodplain Forests

- Goals:
 - Identify priority floodplain forests based upon size, connectivity, and quality.
 - Maintain existing large blocks of bottomland and upland forest where cerulean warblers (*Setophaga cerulea*) are known to occur.
 - Stabilize the cerulean warbler population trend in Michigan.
- Land and water management:
 - Restore, maintain, and protect existing floodplain forests, upland buffers, and adjacent wetlands for focal species.
 - Implement best management forestry practices in Floodplain Forests.
 - Conduct targeted invasive species management in priority places for high-threat invasive species.
 - Implement invasive species decontamination and prevention protocols.
 - Continue early detection and rapid response efforts for invasive species; continue management to eradicate feral swine in Michigan.
 - Allow reforestation of fragments within larger targeted forest blocks that are important for focal species.
- Conservation designation and planning:
 - Incorporate floodplain forests and adjacent large forest blocks important to focal species into MDNR master plans, watershed management plans, and other planning efforts.
 - Develop adaptation plans to address loss of plant species due to invasive species, disease, and/or climate change.
 - Identify high-quality Floodplain Forests in climate-resilient landscapes and incorporate into conservation planning and management; currently being developed by The Nature Conservancy.

Fens

- Goals:
 - Increase or maintain quality of fen habitats.

- Complete groundwater watershed mapping for fens in southern Lower Peninsula.
- Maintain known eastern massasauga populations and continue to identify additional populations.
- Land and water management:
 - Conduct habitat management to mimic natural disturbance regimes, control invasive species, and implement timber harvest best management practices.
 - Work with road commissions to develop and/or implement best management practices around important fens.
 - Create opportunities for regular communication and collaboration between land managers to disseminate best management practices and lessons learned for managing fen habitats.
 - Implement invasive species decontamination and prevention protocols.
 - Continue early detection and response efforts for invasive species; continue management to eradicate feral swine in Michigan.
- Conservation designation and planning:
 - Identify fens in climate resilient landscapes and incorporate into conservation planning and management; currently being developed by The Nature Conservancy.

2 INSTALLATION OVERVIEW

2.1 GENERAL DESCRIPTION

FCTC is located in portions of Kalamazoo and Calhoun Counties, in the southwestern lower peninsula of Michigan. The nearest city is Battle Creek, located less than two miles to the northeast. The Kalamazoo-Portage metropolitan area lies 15 miles to the west. It is within 260 miles of six major metropolitan areas including Detroit, Chicago, Indianapolis, Milwaukee and Columbus making it readily accessible to reserve and active forces in the entire Great Lakes region (**Figure 1** and **Map 1, Appendix B** for details).

The installation occupies approximately 7,570 acres of contiguous land, situated between Interstate-94 to the south and Fort Custer Recreation Area (FCRA) and the Kalamazoo River to the north (**Map 2, Appendix B**). More than ninety percent of FCTC is undeveloped, mostly as forests, wetlands, or prairie remnants (**Map 5, Appendix B**). The natural areas include several high quality, rare communities (Legge et al. 1995; DLZ 2005) (see **Appendix G** and **Map 6, Appendix B** for details). The remaining ten percent is developed for training and cantonment areas and occupies the northern-most portion of the post.

FCTC is comprised of 7,570 acres managed by the MIARNG under license from the USACE and is 100% federally owned. MIARNG manages FCTC ranges and training areas and has full natural resource management responsibility. There is no general public recreation at Fort Custer, although there are some limited opportunities for recreation on Fort Custer (see **Section 3.9**).

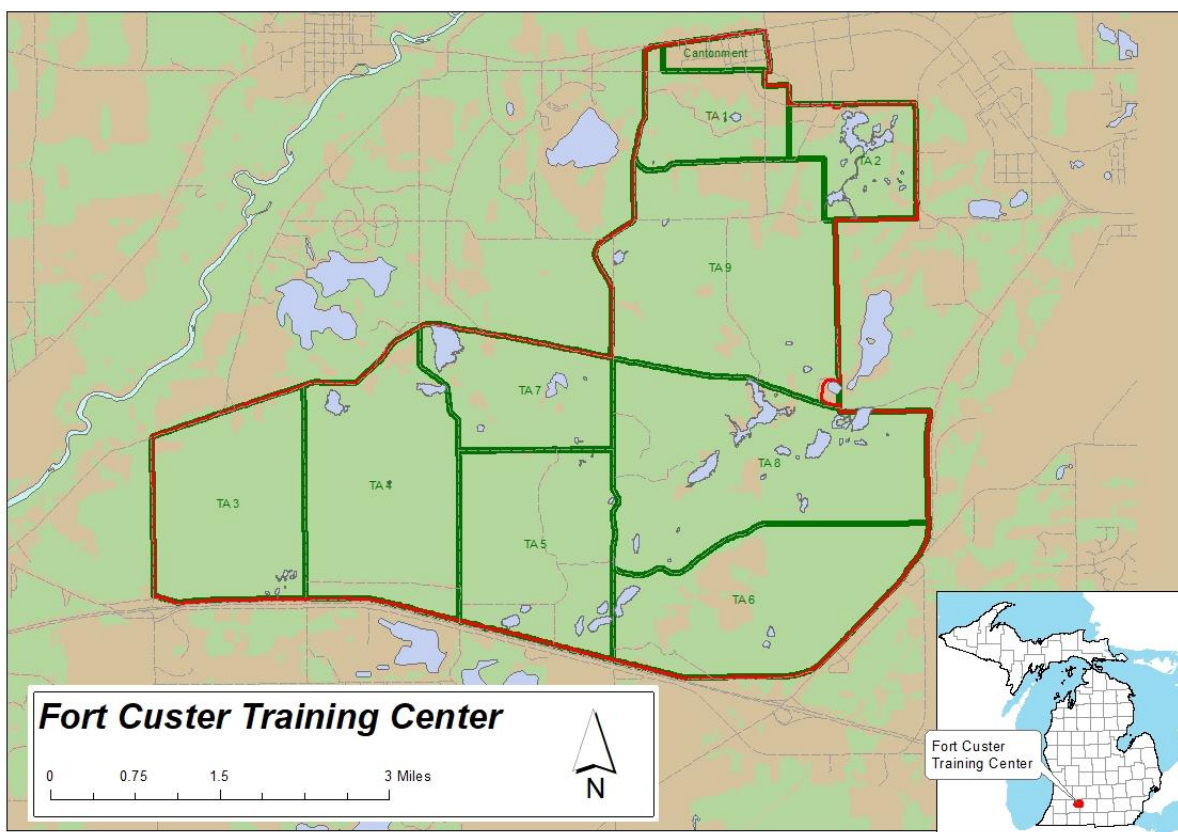


Figure 1. Location and Boundary of Fort Custer Training Center.

2.2 HISTORY OF FORT CUSTER

The military presence at FCTC dates to 1917, when a General Order of the War Department established “Camp Custer”, honoring Michigan native, George Armstrong Custer, an officer of the United States Army from 1861 to 1876. Originally, the “reservation” totaled about 8,300 acres and was designed as an active training and staging facility for World War I combat troops. Nearly 2,000 buildings were erected at the Camp in six months, quickly followed by the arrival of some 36,000 men from Wisconsin and Michigan destined to become the “doughboys” of World War I. Following the Armistice of 1918, Camp Custer became a post-war demobilization center for upwards of 100,000 returning soldiers.

The post was officially renamed Fort Custer in 1940, when it was made into a permanent military installation. Shortly thereafter an additional 6,100 acres of land, primarily farmland, were acquired expanding the base acreage to 14,400. New buildings replaced deteriorating World War I structures and the first division-sized unit, the 5th Infantry Division, trained for World War II. Late in the war, Fort Custer was used as a processing center for prisoners of war. Ultimately, Fort Custer was made an inactive base in 1953, as it no longer trained active Army troops. Many of the buildings erected in 1940 have been renovated with insulation and modern building materials in recent years.

Reallocation of FCTC property to functions other than military training dates to the installation’s post-WWII de-activation. In 1947, 625 acres of land was transferred to the Veteran’s Administration to develop the Fort Custer National Cemetery and the VA hospital. From 1971 to 1973, 3,033 acres were transferred to the State of Michigan to develop the FCRA. In the early 1970’s, nearly 2,600 acres were acquired by the City of Battle Creek to develop the Fort Custer Industrial Park. Approximately 112 acres were relinquished to various municipalities and private interests between 1960 and 1985. Thus, from the 14,400 acres that once made up FCTC, only 7,570 acres remain as part of FCTC.

It is important to note that there is one private inholding within the boundaries of the FCTC. Approximately 2½-acres of the Lawler Cemetery (off Territorial Road) is owned and maintained by Charleston Township. For more on the history of FCTC, see the ICRMP.

2.3 MILITARY MISSION

The MIARNG mission is to provide relevant and ready, operational military forces, consistent with values in support of our state and nation; and to provide support to military personnel, civilian employees, families, retirees, and veterans.

The mission of Fort Custer Training Site Command is to provide a warrior focused training environment in support of deployment operations, unit readiness, homeland security and state emergencies. To support this training, the MIARNG provides resources such as ranges, training areas, road networks, land navigation, Military Operations in Urban Terrain (MOUT) Sites, Training Simulators, Leadership Reaction Course, helicopter landing zones, fuel distribution point, dining facilities, billets, classrooms, chapel, Distance Learning Center, Ammunition Supply Point, and other resources based on the customers’ needs.

Fort Custer supports a wide variety of DoD organizations such as Army/Air National Guard, Active and Reserve forces from all branches of the military, Reserve Officer Training Corps, Junior Reserve Officer Training Corps, Civil Air Patrol, Naval Sea Cadets and Young Marines. The MIARNG also supports foreign military services from Canada and Latvia.

2.4 CURRENT LAND USE

Military training occurs in all seven training areas. TA 1 and 2 are in the developed portion of FCTC (**Map 2, Appendix B**). TA 3 through 7 are approximately 4,075 undeveloped acres comprised of forest (75%), wetlands (~10%), and open lands (15%).

TA 1 and 2 and the cantonment area are approximately 890 developed acres. The 80-acre cantonment area contains most of the buildings on the installation including the headquarters building, lodging-related buildings, classrooms, administration buildings, dining facilities, and facility maintenance buildings. The other 810 acres house the small arms ranges, ammunition storage bunkers, range house, various training houses and courses, and a vehicle recovery area. Light maneuver and occasional bivouac activities also occur in TA 1 and 2.

2.4.1 Training Area

Training Area 1 (412 acres) is adjacent to the cantonment area and is the most developed training area. The northern half contains two training facilities that involve significant foot traffic and are accessed by gravel roads. There is a bivouac area in the southwest corner of this TA, with an adjacent picnic and bivouac area to northeast, which is used by troops and civilians. There is also a special long-term study area for a state listed threatened plant (*Corydalis flavula*; see **Appendix H**). TA 1 is primarily forested with sapling and pole timber, and there is an area of sawtimber used for bivouac.

Training Area 2 (398 acres) is the smallest TA with an extensive array of wetlands. TA 2 is used primarily for vehicle recovery training at an upland site near the eastern boundary. It is also used by bridging units at a dry span site, in a location north of the vehicle recovery site. Armstrong Road forms much of the western boundary, where a helicopter landing zone is located just to the east of the road.

Training Area 3 (802 acres) is on the far west edge of FCTC and contains a large open area on the north edge (approximately 100 acres) and is used extensively for light vehicle maneuver where sight distance and open area is important. Efforts to continue to keep this area open from encroaching woody vegetation are important. The balance of TA 3 is forested with pole and sawtimber and has many good bivouac sites. There are three wetland areas and a stream crossing in this area which needs to be monitored for adverse impacts associated with roadbed erosion and sedimentation to waterways.

Training Area 4 (973 acres) is the largest TA and has open, semi open, and heavily forested areas. The northern part of TA 4 is prairie and provides open space for maneuver. Located in the open area is Lawler (or Territorial Road) Cemetery (see **Map 2, Appendix B**), which is a small 2.5-acre site and the only private in-holding on FCTC. TA 4 contains two small lakes, used for occasional raft exercises and water purification training. There are bivouac sites in TA 4 as well as a compass course and a portion of a land navigation course. The area also contains one of the most unique ecosystems at FCTC, an area of alkaline seeps and rare plants. This unique area is heavily forested with steep hills and cannot be reached by vehicle.

Training Area 5 (822 acres) is used extensively for bivouac and reconnaissance. There is a well-defined gravel road that traverses the area east to west. An area for bivouacking exists to the south of Mott Road and accommodates large units and command post preparation. This TA has a rare wetland fen where only foot traffic is allowed. Open areas on the north are kept open by occasional mowing and heavy use. However, most of the area is forested and is not suitable for more than foot traffic.

Training Area 6 (955 acres) has a wide range of habitats and training uses. The southern half is primarily shrub and sapling size woody vegetation, with many small woodland openings. It also has training locations of open gravel for digging operations. An extensive array of dirt trails makes it suitable for track maneuver also. The northern half is heavily wooded, with bivouac and foot traffic being the primary uses. Within this wooded area is a unique habitat of old timber, steep slopes, and alkaline bogs. Wooded sites in this TA are naturally protected by their configuration of trees, wetlands, and steep slopes, thus limiting training usage to foot traffic only.

Training Area 7 (526 acres) has an abundance of wetlands and unique natural areas. While the northeast corner is used for bivouac sites, most of this area does not favor troop and vehicle movement due to the wetland terrain. Portions of the land navigation course also run through TA 7.

Excluding the post's Impact Area, Training Area 7 contains the only non-wetland area with restrictions to use on the Fort Custer property. This is the prairie vole (*Microtus ochrogaster*) research site of approximately 7 acres in the northern part of TA 7. It is off-limits to all but foot traffic, under requirement of the Michigan Endangered Species Act. This remnant prairie was previously used by vehicles and troops, which are now assigned adjacent bivouac and command center positions. This land reassignment insures that there is no net-loss of training area due to this small off-limits inclusion.

The **Fort Custer Impact Area** (2,601 acres) comprises nearly a third of the acreage of the installation and is the down-range location where range fire usage deposits ammunition. The Impact Area comprises the entirety of the present surface danger zones for all of FCTC ranges. Historically, this is also where the majority of ammunitions fire took place on post. The Impact Area is divided into a north and south unit, where it is bisected by Territorial Road. The 1301-acre north unit of the Impact Area is considered off-limits to all off-road and foot traffic owing to both the danger of encountering unexploded ordnance (UXO) and because fire from the ranges penetrates this area. The hazard associated with the 1300-acre south unit is that of range fire, since practice rounds can travel this distance from the ranges, thus making it part of the surface danger zone as well. There is relatively little likelihood of encountering unexploded ordnance on the south unit of the Impact Area, and so it has been determined safe for travel when the firearms ranges are not in use.

There are three distinct range areas, with a total of 15 ranges (12 are live fire ranges). The small arms ranges are located approximately 0.5 mile due south of the cantonment area (and 1/2 mile south of the nearest public roadway, M-96, or Dickman Road). The types of ammunition fired include ground burst projectile, hand grenade simulators, C-4 demolition and 1-pound TNT charge demolition blocks.

2.4.2 Current Military Training

Training vehicle use is primarily convoy and support vehicle maneuvers. This includes wheeled vehicles, transportation, mechanized infantry, and artillery. These units do considerable driving on the established road system of FCTC to support this training. Off-road tactical vehicle training occurs on secondary trails and open areas in TAs 3, 4, 5, and 6. TA 2 also supports tactical vehicle recovery operations on existing gravel roads and the vehicle recovery training area located there.

Engineer training has a high potential environmental impact during typical training activities. Engineer training at FCTC occurs primarily in TA 6, where earth moving activities can be easily accommodated. Road improvement activities are a common training task and typical field activities include the construction of various features designed to protect troops on the battlefield include the building of

fortifications, emplacements, and obstacles. The standard practice for any activities that cause ground disturbance is that the unit must recover the area before it is cleared for release.

A concrete pad that can be used as a helipad is located immediately south of the cantonment area. Additional field helicopter landing zones (LZs) are located in TA1, TA 3, TA4, TA6 and TA7 for tactical and Nap of the Earth training. There can be as many as 40 flights per day for a wide variety of training purposes.

The training areas provide realistic lands to support a variety of training missions. Training in the undeveloped TAs 3 through 7 consists of company and platoon level training, but can support battalion level training. Bivouac, tactical assembly, land navigation, vehicle maneuver, and field training exercise comprise most of the training activities.

Tactical assembly and bivouac areas in the training areas are typically wooded, dry, and accessible by roads or maneuver trails. These sites are characterized by the clearing of some vegetation, use of various types and sizes of tents, use of semi-permanent chemical latrines, generators to provide any electricity needed, potable water imported from off-site, and exportation of the solid waste generated during exercises. A typical encampment may contain one company or several platoons. Bivouac involves establishment of temporary field quarters consisting of vehicle parking, tents, portable latrines, field mess, and personnel defensive positions.

2.4.3 Potential Future Military Training

Future mission changes will likely result in no tracked vehicle and limited heavy vehicle usage at FCTC. FCTC's mission has changed from artillery/armor to more military police and support missions. Only one unit training in Michigan still has heavy vehicles and they are not expected to train at FCTC. The layout of Range 1 is not expected to change in the next five years and that is the only range that would have impacts on natural resources. To date, there is no master plan regarding future development at FCTC.

2.5 REGIONAL LAND USE

FCTC is located in Kalamazoo and Calhoun Counties in the southwestern portion of Michigan's Lower Peninsula. The most developed cities within the two county areas are Battle Creek (Calhoun County) with a population of 52,347 and the Kalamazoo-Portage metropolitan area (Kalamazoo County) with a total population of 116,554 (2010 census). The City of Battle Creek's boundary lies approximately 1 mile to the east and Kalamazoo-Portage is located approximately 15 miles to the west. Other major populations centers (greater than 50,000) in the region include Lansing and Grand Rapids in Michigan and South Bend/Elkhart/Mishawaka in Indiana.

Presently, regional land use is a mix of urban, suburban, and rural in order of dominance. Land use varies in the area immediately surrounding FCTC. Most adjacent parcels are large land holdings and the majority is public property. The northern boundary of the post along Dickman Road to the Kalamazoo River (less than 1 mile to the north), is owned by the federal government. This 625-acre area includes the Fort Custer National Cemetery and the Veterans Administration Hospital.

Along the northeastern boundary of FCTC lies the 2,340-acre Fort Custer Industrial Park, owned by the City of Battle Creek. The Industrial Park primarily supports light industry, such as Denso Manufacturing of Michigan, which produces heat and air exchange components for cars. A strip of undeveloped wetlands, a small lake and mature woodlot borders the eastern perimeter of the post. A 326-acre Army

Compatible Use Buffer (ACUB) conservation easement parcel and a 570-acre air transportation complex lie to the east that supports Battle Creek Executive Airport at Kellogg Field along with the Michigan Air National Guard Battle Creek Facility and Western Michigan University's College of Aviation.

Lying immediately to the southeast is a small area of residential land, but for the most part the area to the south is devoted to cropland, other agricultural interests and, to the south of Interstate-94, several sand and gravel quarries, and additional light industry (e.g., Eaton Corporation, BFI, etc.). Adjoining FCTC to the west and northwest is the FCRA, managed by MDNR.

Natural areas that occur locally include FCRA, Kalamazoo Nature Center (KNC), Kellogg Biological Station and Bird Sanctuary, Michigan State University's Research Forest, several Southwest Michigan Land Conservancy (SWMLC) parcels and a couple of properties owned by The Nature Conservancy. The FCRA includes habitats similar to typical Michigan farm country with second growth forests and remnant prairie areas. Three man-made lakes are located on the property including Eagle Lake (with a public swimming beach), Whitford/Lawler Lake, and Jackson Hole Lake. All three lakes are used for public fishing. The area has an extensive trail system for hiking, biking and horseback riding. The Kalamazoo River also flows through the property in a westerly direction where it ultimately discharges into Lake Michigan at Saugatuck. At its location near FCRA/FCTC, the river is on average 110 feet wide and four feet deep and the low stream banks are well vegetated with trees (Great Lakes Commission 2000).

From a regional perspective including southwestern Michigan and northern Indiana and northwest Illinois, FCTC and FCRA represent a unique landscape feature. The combined public land area of these two properties supports a large block of contiguous protected land including mesic forests, oak woodland, oak savanna remnants, prairie remnants, scrubland, wetlands and old fields. The size of the forest interior, which provides important habitat for forest-dependent species, is significant from a regional perspective. The FCTC/FCRA complex is one of only three public lands units in the region that provide large blocks of forest interior habitat. The Allegan State Game Area and the Yankee Springs Recreation Area/Barry State Game Area complex are the other properties having extensive forested landscape.

FCTC is also a unique land complex since it contains other important habitat types including globally threatened oak savanna remnants, globally threatened prairie remnants including, mesic prairie and prairie fens. Maintaining forest blocks in association with oak woodlands, savannas, prairies and fens provides an opportunity at FCTC to sustain a functioning, diverse landscape reminiscent of historic conditions. Often in contemporary natural areas management in the region, strategies are limited to a much less dynamic landscape unit because of extant habitat size, cost or land ownership patterns.

2.6 CONSTRAINTS

Potential natural resource constraints to future development and missions at FCTC include both geographic and seasonal constraints. **Table 2** summarizes each sensitive resources and resulting constraint and the geographic constraints are depicted on **Map 11** in **Appendix B**. In addition to the constraints listed in **Table 2**, there are some areas with limited use due to safety from UXO, some of which overlap with these constraints.

Sensitive Resource	Constraint	Approximate Area
Geographic Constraints		
Stream, lake, wetland	No activity (except foot traffic) without prior approval from FCTC ENV and Range Control and potentially a permit from EGLE	710
Water or wetland buffer (400 feet)	Foot traffic only, no development or vehicles without approved EGLE permit	2,061
High quality natural areas (HQNAs)	Foot traffic only (overlaps with water resources and associated buffer)	890
Prairie vole habitat	Foot traffic only	7.5
Pale fumewort habitat	No development without MDNR permit	210
Steep slopes (greater than 10 %)	Foot traffic only	1,150
Territorial Road (Historic Landscape)	No digging, no tree removal, no development	720
Historic cultural resources	Do not damage, no digging within 20 feet, no alteration, and no demolition without FCTC-ENV approval	25
Seasonal Constraints		
Tree removal	No tree removal between 1 April – 1 October, without prior FCTC Environmental approval	6,500
Mowing	Mowing restrictions exist (timing and height) outside the Cantonment Area, depending on location; see Mowing SOP in Appendix K for more details	300

Any impacts to water resources and their associated 400-foot buffer require compliance with state and federal laws and approval through Michigan Department of Environment, Great Lakes & Energy (EGLE) permitting. Typically, any development needs to be outside a 400-foot buffer around the water resources. Most of the current HQNAs overlap with water resources or their buffer, although small areas occur outside the water buffer. These areas are all limited to foot traffic only.

The prairie vole is a state endangered species and the population on FCTC is the only extant population in Michigan. The location of the prairie vole population is off limits to vehicular traffic due to previous permit related to development by MIARNG. Due to projected climate changes, the population on FCTC may become a refugia in the future as other populations are eliminated or decline.

Pale fumewort is a state threatened species and FCTC is one of the few locations in the state. Pale fumewort habitat has no training-related constraints; however, any development or other habitat loss requires a permit through MDNR.

Steep slopes are limited to foot traffic only to prevent erosion and sediment loss. Territorial Road, which is a historic landscape eligible for the National Register of Historic Place, is not to be subject to digging, tree removal, or development without Section 106 consultation with the State Historic Preservation Officer. There are currently no other eligible pre-historic or historic sites on FCTC. There are some other

historic structures that are not eligible for protection, but these structures should be avoided with no damage, digging within 20 feet, or demolition without approval from FCTC Environmental.

In addition to the geographic constraints, there are two seasonal constraints. Tree removal should occur between 1 October and 1 April to prevent impacts to bats and nesting birds, as well as prevent soil damage and reduce spread of tree diseases and pests. If tree removal is required between 1 April and 1 October, FCTC Environmental must approve prior to completion. There are a number of height and season constraints to mowing outside the Cantonment Area; these are all identified in the SOP included in **Appendix K**.

A summary of the physical environment is provided in **Appendix F** and a summary of the biological environment is provided in **Appendix G**.

3 NATURAL RESOURCES MANAGEMENT

This section summarizes each technical area of natural resources management. In each section, relevant management prescriptions, objectives, policies, and actions are presented. Successful implementation of the prescribed fire program, maintenance and restoration of HQNAs, managing for federal and state-listed species and their habitat, control of invasive species, forest management, and continued implementation of the ITAM program are the primary natural resources programs overseen by FCTC-ENV. Additional components of natural resources management, especially related to erosion, invasive species, and wildfire response, are at least partially funded by departments other than FCTC-ENV (see **Section 4.4**).

The goals and objectives in this updated INRMP are a consolidation and continuation of the goals and objectives in the 2012 INRMP. The purpose of the Fort Custer INRMP is to:

- Sustain the overall condition of Fort Custer to ensure no net loss in the capability of the land to support the military mission; and
- Use adaptive management in cooperation with MDNR to
 - enhance native ecosystems and habitats;
 - maintain native flora and fauna;
 - maintain viable populations of listed species with minimal impacts to military training;
 - protect, maintain, and improve wetlands and water resources; and
 - ensure resilience to climate change within the natural resources on Fort Custer.

To accomplish this purpose, goals and objectives were developed for each resource area and are supported by projects and recurring natural resources management activities needed to achieve the management goals. Activities generally refer to in-house, no-cost actions undertaken by MDMVA/MIARNG and Fort Custer personnel. Projects generally refer to actions that are performed by others, usually under contract with MDMVA. Projects can also be completed using Environmental, ITAM, Facilities Management, non-DoD federal funds, various grants, state funds, or by volunteers. Activities and projects associated with the goals and objectives are presented in **Tables C-1 and C-2** in **Appendix C**. A tabular summary of the goals and objectives is presented in **Table C-3** in **Appendix C**. Refer to **Section 4.4** for more details about funding. A complete summary of all relevant laws, regulations, executive orders and policies is provided in **Appendix J**.

Coastal/marine management and Bird Aircraft Strike Hazard (BASH) management are not included in this INRMP because they do not apply to Fort Custer.

Natural Resources Needed to Support the Military Mission

Considerations for future training include vegetation management to both maintain and to create, where needed, additional training maneuver sites at FCTC. For instance, additional emphasis will be placed on managing open areas on post. This management will consist of brush hogging, use of prescribed fires and mowing to reduce the encroachment of brush and woody vegetation from openlands across FCTC. Similarly, vegetation management in forested settings will stress opening of the understory (reducing shrubs and dense sapling stands) to improve bivouac and infantry maneuver training. Any brush or grassland management outside the cantonment area done by anyone besides FCTC-ENV staff must be carefully coordinated with FCTC-ENV. The specific training needs and the required natural resource conditions are summarized in **Table 3**.

Training Type	Required Natural Resources	Management Need to Maintain Training Utility
Small arms ranges	Open space/visible targets	Mowing, tree and shrub removal to maintain
Land navigation	Small trails, difficult terrain, reasonable distance between points	Vegetation management
MOUT	Small trails, capacity to maintain structures	In cantonment area, managed by mowing
Bivouac	Small open areas for staking out equipment, passable trails	Trail management/maintenance, along with brush hogging/prescribed fire to maintain small open patches, forest management
Convoy reaction course	Large, open area with well-maintained trails	Prescribed fire and brush hogging to maintain open space, trail maintenance
Sapper units	Areas of low natural resource value in which combat engineers can practice using earth moving equipment	Unknown

3.1 NATURAL RESOURCES PROGRAM MANAGEMENT

Successfully implementing this INRMP and achieving the goals and objectives requires a complex set of programmatic tools. Some of these are state-wide and apply at all MIARNG installations and some are specific to Fort Custer. Much of the program management is captured as activities in **Table C-1 in Appendix C**, rather than as projects. Undertaking annual coordination with USFWS and MDNR, evaluating whether the objectives are being met, and determining any modifications in the objectives, projects or activities needed is a core function of the natural resources program at Fort Custer.

An essential role of natural resources specialists on FCTC is to participate in various project review processes. This ensures that potential impacts to natural resources are identified, preferably early in any project planning, and allows for time to identify ways to avoid impacts or potential mitigation needed. If impacts are unavoidable, mitigation measures are employed to repair damage to soil, water, vegetation and other habitat components. In the case of training activities, these discussions are undertaken as part of ITAM program and any mitigation of damage is coordinated with ITAM funds. In the case of development, these discussions are part of the Facilities Management review process, which is sometimes at the headquarters level and sometimes at FCTC. In both cases, monitoring of the short and long-term outcomes, both formally and informally, and adaptive management is necessary to ensure that the MIARNG is meeting the goals and objectives identified here.

Historically, some facility improvement projects, such as upgrades to water control structures, have resulted in improved natural resources conditions on FCTC. Opportunities for combined positive benefits will always be sought and implemented when feasible.

3.1.1 Environmental Education and Public Outreach

Environmental awareness and public outreach are important tools for sharing information, ensuring compliance with laws and policies, minimizing adverse effects, and gaining cooperation to achieve the goals and objectives of this INRMP. At Fort Custer, there are two primary programs with different

audiences: environmental awareness for military users (units, leaders, commanders, and training center staff) and public outreach for non-military community members (area residents, hunters, and community groups). These programs are intended to inform about Fort Custer's natural and cultural resources and the measures that are in place to protect and manage them. See **Section 3.7** for information on hunting and fishing and **Section 3.9** for information on other outdoor recreation.

3.1.1.1 Environmental Awareness

There are a number of avenues used by the MIARNG to implement environmental awareness of the users of FCTC. Many of these focus on overall environmental compliance, not just natural resources, while others are specific to natural resources. Soldier Field Cards, Unit Environmental Compliance Officer training, and other general materials and presentations provide general information to keep soldiers safe and ensure compliance with relevant environmental laws. More specific materials and presentations are provided as requested and as needs are identified. Signs are also used throughout FCTC as appropriate.

3.1.1.2 Public Outreach

FCTC participates in many programs for natural resources education and interpretation. Events such as Envirothon, Michigan Youth Challenge field days, field trips for the Michigan Prescribed Fire Council, groups of University students and Wild Ones, National Public Lands Day and other events provide many educational opportunities to many groups. FCTC Environmental will continue these efforts to both educate and provide access for the public to FCTC in a training-friendly manner. See **Section 3.9** for more details.

3.1.1.3 Research and Study

Since FCTC encompasses a large expanse and variety of natural communities, it affords excellent opportunities for research and study. KNC presently conducts research on songbird populations, while population assessments of the state-listed endangered prairie vole continue on a regular basis. Studies of prairie and savanna ecosystems, which are rare natural communities in Michigan, have been completed by Kellogg Biological Station. Several different special plant species have been studied, and the theses and dissertations produced from the research are shared with FCTC. FCTC Environmental will continue to look for opportunities to work with researchers to gain more information on the rare natural resources present at FCTC.

3.1.2 Geographical Information System (GIS) Data Management

GIS is available to FCTC staff for natural resources management planning and decision-making. Data sets on noise, cultural, ecology, environmental hazards, fauna, flora, geology, landforms and soils are among the types of spatial data that are kept in GIS for natural resources management at FCTC. FCTC Environmental has two Trimble GPS units, which are used primarily by natural resource researchers and consultants, as well as FCTC Environmental staff.

MIARNG is required to conform to Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) standards of data collection and practices are currently being instituted to insure that additional data collected by staff as well as contractors conforms to the geodatabase structure set up by ARNG-ILE. FCTC and MIARNG will continue to keep abreast of these changes and maintain conformance with the current standards.

3.1.3 Natural Resources Law Enforcement

Fort Custer security personnel cooperate with the local MDNR Law Enforcement District conservation office to address natural resources law enforcement issues. Generally, MDNR conservation officers have primary responsibilities for addressing violations of natural resources-related laws. However, violations of internal policies (e.g., no digging areas, no vehicle areas) are addressed internally with MIARNG.

3.1.4 Natural Resources Management Staff and Training

Adequate training of natural resources personnel is important to the success of military sustainability and land management. The continuing professional development of natural resources management staff will greatly enhance the effectiveness of this INRMP. This requires maintaining staff knowledge through training and participation in conferences and workshops. When the MIARNG does not have expertise or staff in-house to complete projects, other agencies and contractors are used, including MDNR personnel, experts from regional universities and non-profits, and private contractors.

3.1.5 Fort Custer Objectives and Policies

GOAL PROGRAM MANAGEMENT (PM): Manage natural resources compatible with and supporting the military mission while complying with applicable federal, military, and state laws, regulations, and policies.

- OBJECTIVE PM1: Implement INRMP to enhance the land and military mission and result in no net loss of land availability.
- OBJECTIVE PM2: Maintain appropriate state and federal permits related to natural resources management, including water and wildlife management issues.
- OBJECTIVE PM3: Continue internal environmental awareness program to minimize adverse environmental impacts.
- OBJECTIVE PM4: Continue public outreach in coordination with other regional entities as available and appropriate.
- OBJECTIVE PM5: Continue to cooperate with other agencies and local landowners on regional land and natural resources management efforts.
- OBJECTIVE PM6: Maintain and improve GIS data and availability of use for natural resources management and other planning.

Laws, Policies, and Guidance:

- AR 200-1, Army policies, and DoD instructions as relevant
- See **Appendix J** for relevant state and federal regulations and policies

3.2 SOIL CONSERVATION

Soil conservation on Fort Custer consists of protecting soil resources, identifying areas prone to soil erosion, and preventing soil erosion. This minimizes impacts to military facilities, water, and wildlife habitat. Standard practices and facilities that protect soil and reduce sediment throughout FCTC, include critical area seeding, stormwater retention basins, grass-paver blocks, and curb and gutter systems. For

the most part, the soils at Fort Custer have a high-medium wind erosion potential and a slight-moderate water erosion potential. The main soil associations at Fort Custer (approximately 60 percent of the installation) are Oshtemo and Spinks. A detailed description of Fort Custer soils is presented in **Appendix F** and soil associations are illustrated in **Map 3 in Appendix B**. A summary of key legislation can be found in **Appendix J**.

Fort Custer has developed an Integrated Contingency Plan (ICP; 2016), in accordance with the Clean Water Act (CWA) Section 311(j) and Michigan Public Act 399. This a key part of the pollution prevention and spill management program, which is important for soil conservation and for water resources protection.

Since 1994, an on-going program to control roadway run-off and sedimentation to streams has been coordinated between FCTC and the Potawatomi Resource Conservation Development Council. Small erosion issues occur at various road crossings of streams or wetlands; these areas were generally small and limited to the immediate area of the crossing. This program has been discontinued, although other sediment control monitoring and repair efforts continue. Other sedimentation problems occur at some interior wetland areas where a lack of vegetation on the perimeter slopes, most likely a result of past agricultural use or historical military training, has resulted in the sediment impacting local areas of wetlands. Regular monitoring for erosion and sedimentation issues is undertaken at FCTC. Any areas identified as a source of concern are further evaluated and corrective measures are implemented.

The following sections outline Fort Custer's soil conservation and sediment management approach, beginning with general management prescriptions, and outlining MIARNG soil conservation goals, objectives, policies, and associated actions to protect and enhance soil resources.

3.2.1 Management Prescriptions for Soil Conservation

General management guidelines are compiled from the BMP Manuals from MDNR, Michigan Department of Transportation (MDOT), EGLE, and MIARNG for soil and water quality document. In addition, MIARNG plans, survey summary reports (listed in **Appendix D**), and various DoD, MIARNG and MDMVA policies (**Section 1.7** and **Appendix J**), as applicable. The ICP outlines the containment and response procedure(s) so that soils and waters are protected (DLZ 2016).

Many of the management prescriptions for water resources (**Section 3.3**) are also applicable to soil conservation. BMPs are implemented to ensure that soil-disturbing projects do not contribute sediment to water bodies. The MDMVA Guidebook is the first stop for identifying relevant BMPs. For activities not included in the MDMVA Guidebook, the other Michigan manuals identify BMPs that are proven in Michigan.

- **MDMVA: *Soil Erosion and Sedimentation Control Guidebook and Procedures*** was updated in 2018 and provides information to planners and contractors to assist with preventing soil erosion during construction projects. MDMVA is an Authorized Public Agency (APA) with authority to write, authorize and enforce soil erosion and sediment control plans used in new construction or any activity that is greater than 5 acres or within 500 feet of a wetland resource. BMPs in this guidebook include temporary stream crossing, permanent seeding, check dam, streambank biostabilization, wattles, stabilized construction access, and more (MDMVA 2018).
- **MDNR and EGLE Forestry:** The BMPs described in the *Michigan Forestry Best Management Practices for Soil and Water Quality* was revised in 2018. This manual focuses on soil and water quality and

describes forestry BMPs and laws and regulations that may apply. Types of BMPs include pre-harvest planning, harvesting in riparian zones, harvest techniques, reforestation, and wildfire damage control.

https://www.michigan.gov/deq/0,4561,7-135-3313_3682_3714-118554--,00.html) (MDNR and MDEQ 2018).

- **EGLE General:** *MDEQ Nonpoint Source Best Management Practices Manual* (see **Section 3.3**) is also relevant for soils. Its purpose is to prevent sediment from entering waterways. Types of BMPs described in this manual include dust control, soil management to encourage vegetation growth, grading management, land clearing management, streambank stabilization, sediment basins, and more. (https://www.michigan.gov/deq/0,4561,7-135-3313_71618_3682_3714-118554--,00.html) (MDEQ 2018).
- **Michigan DoT:** *Soil Erosion and Sedimentation Control Manual* was last updated in 2006 and serves as a guide for proper techniques during project development and delivery. Types of BMPs in this manual include vegetated buffer strips, intercepting ditches, energy dissipators, stream relocation, check dams, and more. (https://www.michigan.gov/documents/2006_SESC_Manual_165226_7.pdf) (MDOT 2006).

Based on the activity and the soils at a particular location, different BMPs will be appropriate to minimize and manage sediment and erosion. The BMP manuals/guidebooks listed above should be referenced as needed to identify the most appropriate BMP(s). The following are management prescriptions protect soils on FCTC:

- **Water Crossings:**
 - Watercourse crossing BMPs are being updated and were not available at the time of this writing (notice posted on MDNR's website 10/12/2018 for the Nonpoint Source Manual).
 - Wetland crossings should only be carried out when no other alternative is viable. The narrowest portion of the wetland should be used, and crossings should be planned during times of the year when the wetland is drier. Constant saturation may require equipment mats to prevent compaction.
 - See **Section 3.3** (Water Resources Management)
- **Forestry:**
 - Pre-harvest planning and land clearing should include a thorough site assessment and tree tagging for those trees to be removed.
 - Phase large-scale sites to minimize disturbance and revegetate areas as the project progresses.
 - Riparian zones should be protected with multi-zoned filter strips when possible. Filter strips should be planted and/or maintained with native species.
 - Revegetation should begin with the preservation of woody species if possible. New plantings should take into consideration soil conditions and should occur in the spring or fall with native species. Ground cover and new planting protections should be in place.
 - See **Section 3.3** (Water Resources) and **Section 3.4** (Vegetation)
- **General:**
 - For all new projects, design infrastructure and projects to avoid problems by choosing appropriate materials, grading and protecting the site properly, etc.

- Stage and schedule projects with consideration to weather and site conditions, use diversions to prevent water entering site from causing erosion, and prevent off-site sedimentation with silt fencing, grade stabilization structures, or sediment basins around the perimeter of construction sites.
- Ensure that adequate soil cover is in place in the short term through revegetation and soil stabilization following any soil disturbance. 00
- Prevent or minimize erosion to the maximum extent possible, use native plants for erosion control outside of areas with turf grasses.
- Address erosion areas with routine, low cost maintenance efforts, such as temporary closure, application of hay or other stabilization materials, and revegetation.
- Use wildlife-friendly erosion control (i.e., products that do not contain plastic netting) in sensitive wildlife habitats or near known wildlife populations, and elsewhere when feasible.
- Identify any sensitive resources (i.e., steep slopes, unstable soil, water resources) and incorporate buffers wherever possible.
- Road Maintenance:
 - Repair, re-route, or close roads with soil erosion and sedimentation problems, failed bridges or culverts, or other safety issues.
 - Exercise caution when maintaining roads within the 400 feet of water resources, especially when utilizing calcium chloride for fugitive dust control.
 - Inspect and spot-check routine road maintenance projects of roads and trails near water bodies on a periodic basis.
- Construction:
 - Prevent sediment originating from projects from leaving project sites through the implementation of BMPs.
- Monitoring: Monitoring of sediment loss and sites with erosion, as well as the effectiveness of BMPs used is a key part of adaptive management and successful management of soils.

3.2.2 Fort Custer Objectives and Policies

GOAL SO: Manage Fort Custer soils to prevent sediment loss, minimize erosion, and support military mission

- OBJECTIVE SO1: Manage construction, roads/trails, slopes, and exposed soils to minimize erosion and soil loss and comply with all regulations and permitting
- OBJECTIVE SO2: Ensure the long-term use of military training areas, primarily through addressing chronic and/or historic erosion issues and promoting awareness of erosion and sediment controls
- OBJECTIVE SO3: Continue pollution prevention programs to prevent contamination of soils and water resources

Laws, Policies, and Guidance:

- State Law: Soil Erosion and Sedimentation Control Act (1994 Public Act 451 Part 91; See **Appendix J**)

- Develop or use existing soil and water quality BMPs from MDOT, EGLE, and MDNR Forestry Division as relevant to the activity to prevent and control erosion and protect sensitive resources and habitats (MDOT 2006; MDNR and MDEQ 2018)
- Implement the ICP and Watershed Management Plan
- Applications for earth-disturbing activities proposed by Training Units are submitted to the FCTC-ENV, who then issues the permits
- All earth-moving projects are reviewed by FCTC-ENV
- Disturbances greater than 5 acre in size or within 500 feet of a wetland resources must develop and implement a Soil and Sediment Erosion Control Plan and comply with Section 401 of the CWA, while maximizing use of native plants during revegetation and wildlife-friendly erosion control measures
- Minimize the exposure of bare soil during any wildland fire operations
- Keep all vehicles on established roadways and trails
- Keep all vehicles hauling petroleum and related products in the cantonment area in designated refueling areas. Refueling can ONLY be conducted in the field with:
 - Proper spill prevention best management practices implemented and spill control materials on-hand
 - Secondary containment properly in-place
 - More than 400 feet from a lake, pond, stream or wetland
- Wash vehicles at the washrack location in the cantonment area

3.3 WATER RESOURCES MANAGEMENT AND WETLAND PROTECTION

Fort Custer’s water resources management is closely aligned with its soil conservation program (**Section 3.2**). Water quality management on Fort Custer focuses on monitoring water quality in lakes, streams, and wetlands, protecting groundwater and drinking water supplies, and preventing spills (see the Integrated Contingency Plan for more details). Water Quality Standards are the foundation of the water quality-based pollution control program mandated by the CWA and Michigan’s Water Quality Standards outlined in Act 451 (see **Appendix J**). Water Quality Standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions such as antidegradation policies to protect waterbodies from pollutants. All designated uses for water bodies must be protected under law, and those include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or coldwater fish, other indigenous aquatic life and wildlife, fish consumption, partial body contact recreation, and total body contact recreation from May 1 to October 31.

Monitoring of groundwater testing wells continues on a yearly basis from the current 30 wells, as well as surface waters and sediments associated with the FCTC range complex. This monitoring is for lead levels in the ground and surface waters as required by the posts Due Care Plan, which is updated as needed, for ranges.

The cantonment area at FCTC has the potential to impact water quality due to the nature of maintenance and storage activities taking place there. The potential risk to surface water has been reduced by containing storm water runoff. Surface water runoff from most of the cantonment area is collected by a system of detention and catch basins into several retention basins. The creation of these

retention basins has eliminated the historical diversion of surface runoff from the developed areas to adjacent wetland areas and lakes. Both the ICP and the Watershed Management Plan are in effect that aim to reduce impacts from spills and stormwater, respectively.

There are several streams and small lakes present on FCTC, along with wetlands that cover more than 700 acres of land (10% of the installation). The wetlands are particularly rich in diversity, with 13 different wetland types ranging from bogs to forested wetlands and include open water and vernal wetlands. Surface waters are described in detail in **Appendix H** and shown on **Map 4 in Appendix B**. Wetland communities are described in detail in **Appendix G** and shown on **Map 5 in Appendix B**.

In the last twenty years, improvements to water control structures have been completed in TA2, TA7, and TA8, in cooperation with various partners and using grant funds. MIARNG and its partners inspect and evaluate water control structures as needed to maintain the wetlands associated with these structures and remain in compliance with permitted wetland control structure parameters.

Projected climate changes (**Appendix I**) indicate that there will be increased extreme precipitation events and changes in both summer and winter precipitation patterns. The extreme events (i.e., flooding) have the possibility of negatively impacting water resources due to increased sedimentation and risk of failure of infrastructure. The MIARNG will need to evaluate infrastructure and BMPs in use as precipitation patterns change to ensure minimal adverse impacts and continued compliance with permits, policies, and laws. The current climate projections do not indicate a significant adverse effect on the water available for the wetlands, streams and lakes on FCTC. If increased summer droughts do occur, they could limit the distribution of aquatic species dependent on perennial water, but the water resources themselves are likely to persist.

The following sections outline Fort Custer's water resources management and wetland protection approach, beginning with general management prescriptions and outlining water resources goals, objectives, policies, and associated actions to protect and enhance water resources.

3.3.1 Management Prescriptions for Surface Waters and Wetlands

General management guidelines are taken from EGLE and MDNR. Michigan assesses functions and values of streams and rivers through the Surface Water Assessment Section program. This program oversees the protection of the quality of surface waters throughout the State of Michigan through water quality standards and monitoring to ensure they are being met (www.mi.gov/waterquality). Michigan was the first state (and is one of only two states) to have received authorization from the federal government to administer the federal wetland program. Because of this approval, wetlands, lakes, and streams permits issued by EGLE under state law also provide federal approval (www.mi.gov/wetlands). For an area to be classified as a delineated wetland, prior to determining jurisdictional status, three conditions must be present: (1) wetland hydrology; (2) hydric soil; and (3) hydrophytic vegetation. Areas that may be periodically wet, but that do not meet all three criteria, are not classified as "delineated" wetlands. Furthermore, the Michigan Rapid Assessment Method for Wetlands (MiRAM) is a tool to determine the functions and values of a particular delineated wetland and to assign a rating level to that wetland compared to other wetlands of similar type. MiRAM offers a relatively rapid assessment of wetland functions and values, but it is not intended to modify the existing regulatory process in Michigan or replace more detailed quantitative measures of ecosystem function, such as Indices of Biological Integrity (IBI), Floristic Quality Assessment or other detailed ecological studies.

Many of the management prescriptions for soil resources (**Section 3.2**) are also applicable to water resources. BMPs are implemented to ensure that soil-disturbing projects do not contribute sediment to water bodies. The following sources can be used to identify BMPs that are proven in Michigan.

- MDMVA: *Soil Erosion and Sedimentation Control Guidebook and Procedures* (MDMVA 2018) has established procedures for managing erosion and sedimentation associated with construction and other activities on all MDMVA facilities, including FCTC.
- MDMVA: FCTC Watershed Management Plan (MDMVA 2002) is currently being updated and identifies potential sources of water quality impacts and potential BMPs to minimize and mitigate those impacts as well as outline projects to restore a more natural hydrologic function to impaired resources.
- MDNR Forestry and EGLE: The BMPs described in the *Michigan Forestry Best Management Practices for Soil and Water Quality* was revised in 2018 (MDNR and MDEQ 2018). This manual focuses on soil and water quality and describes forestry BMPs and laws and regulations that may apply. Relevant BMPs include pre-harvest planning, harvesting in riparian zones, harvest techniques, reforestation, and wildfire damage control.

The following management is required to protect and enhance surface water resources, including wetlands.

- General:
 - Maintain geomorphic and biological characteristics of special aquatic features (e.g., wetlands, important in-stream habitat, nursery habitat in lakes), including the hydrologic connectivity between watersheds and within surface waters, to provide for the needs of aquatic-dependent species.
 - Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature.
 - Identify measures to protect water resources from proposed activities during project planning and environmental review.
 - Undertake ecological restoration, when possible, to maintain, restore or enhance water quality and riparian and aquatic habitat.
 - Identify appropriate restoration methods in: (1) areas with excessive compaction, (2) areas with lowered water tables, (3) areas that are either actively down cutting or that have historic gullies, or (4) former drainage ditches.
 - Identify management practices (e.g., road maintenance, recreational use, prescribed fire, timber harvest techniques) that may be contributing any observed degradation and coordinate to modify practices to reduce impacts.
 - Continue coordinating with MDNR and the river/lake associations to jointly implement BMPs, retrofit/upgrade existing infrastructure, and identify other actions that will improve the water resources on and adjacent to Fort Custer.
 - Educate military users and visitors on Fort Custer about the benefits of healthy water resources.
 - Maintain water table in overwintering habitat for eastern massasauga (see Section 3. 8).
 - Protect vulnerable and ecologically important habitats such as isolated wetlands and headwater streams.

- Surface waters are likely to be impacted by climate change through increases in average water temperature (as well as changes in extreme temperatures). As climate projections improve, evaluate which surface waters are most likely to be impacted and identify potential mitigation actions.
- Streams:
 - Any management of/changes to stream banks should use practices based on natural plantings and biodegradable materials.
 - Restore and improve habitat for native fish and trout streams.
 - Forestry equipment or skid logs must be moved across a stream only on a permitted bridge, culvert, or ford crossing. Sizing and detailing of these structures should follow MDNR and EGLE BMPs.
 - Stream crossings should be constructed using a pipe culvert installation or a portable bridge, if possible, and crossings should occur at right angles, preferably at a riffle (i. e., the shallow areas of the stream).
 - Permits from the state (EGLE and MDNR) may be required for stream crossings (permit information is available at www.michigan.gov/jointpermit).
 - See **Section 3.2.1** (Soil Conservation).
- Riparian Management Zones (RMZs) (also known as buffer strips, filter strips, or streamside management areas or zones):
 - Extra precaution will be used when carrying out timber harvests and other forest management in RMZs (including both sides of streams and around the perimeter of bodies of open water (e. g. lakes and open water wetlands).
 - See **Section 3.2.1** (Soil Conservation).
- Road construction for water quality protection:
 - The forest road system should be designed to the best standards possible before any road construction begins to avoid sediment entering forest streams due to roads.
 - Adhere to land contours and keep slopes between 2% to 10%. Soils with severe erosion hazard should be kept to a grade of 8% or less. Greater slopes should be kept to very short distances (see BMP manuals for guidance).
 - Maintain a minimum distance of 100 feet from water bodies (e. g. lake, stream, or wetland).
 - See Streams, above.
 - See **Section 3.2.1** (Soil Conservation).
- Wetlands (including fens and bogs):
 - Timber harvest activity immediately adjacent to wetlands may encounter weak soils that are highly susceptible to rutting. When harvesting occurs adjacent to these features, ground and vegetation disturbance within the wetland area should be avoided.
 - To prevent sedimentation or excessive nutrient delivery into wetlands, timber harvests should be avoided along slopes immediately above and leading into wetlands.
 - See HQNA management in **Section 3.4** for HQNA wetlands.
- Restoration and maintenance/monitoring:
 - For any activities that adversely affect streams, implement mitigation measures and short-term restoration actions to prevent long-term declines in coordination with FCTC-ENV. For unexpected impacts, identify immediate and long-term restoration needed to recover the area impacted in coordination with FCTC-ENV.

- Continue monitoring program related to: water quality; shoreline and streambank erosion; effects of any restoration or mitigation; and habitat conditions within streams, lakes and wetlands.
- Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features. Consider incorporating water table elevation monitoring into annual monitoring plans.

3.3.2 Fort Custer Objectives and Policies

GOAL Water Resources (WA): Protect water quality and manage water resources, including wetlands, so they remain resilient and with no net loss of acreage or functions and values

- OBJECTIVE WA1: Maintain all surface water with high water quality and in compliance with designated uses (also see Objectives SO1-3)
- OBJECTIVE WA2: Minimize impacts from military training and development to water resources, including wetlands and buffers, and comply with all laws and regulations pertaining to wetlands, streams, floodplains and other regulated water bodies (also see Objective SO1)
- OBJECTIVE WA3: Preserve water resources to protect functions and values and fish and wildlife habitat, with no net loss of training opportunities

Laws, Policies, and Guidance:

- NREPA, 1994, PA 451, as amended (see **Appendix J**):
 - New or upgraded stream crossing or stream bank stabilization activities require three statutes of NREPA: Part 31 (Water Resources Protection); Part 91 (Soil Erosion and Sedimentation Control); and Part 301 (Inland Lakes and Streams)
 - Part 303 (Wetlands Protection) and Part 305 (Natural Rivers), may also apply if a stream crossing occurs in a wetland or on designated Natural River system
 - A EGLE/USACE Joint Permit Application must be completed for Parts 31, 301, and 303
- Implement the Watershed Management Plan
- Any action affecting water resources, including wetlands, will require review by FCTC-ENV in accordance with AR 200-1, Michigan Act 451 (NREPA) and the CWA.
- Avoid, minimize and mitigate for losses of wetlands and other water resources as required by Executive Order (EO) 11990 (Protection of Wetlands)
- Continue implementing existing water quality protection programs
- Revegetate/restore priority areas with appropriate regional, native species
- Continue to regulate, repair, and monitor stream crossings within designated approved crossing locations
- Locate water drafting sites to avoid adverse effects to in-stream flows and depletion of pool habitat (especially during wildfire season)
- Prevent disturbance to streambanks and natural lake and pond shorelines from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines (10 percent in areas occupied by sensitive species)

- Design stream crossings to minimize disruption of natural hydrologic flow paths, including minimizing diversion of streamflow and interception of surface and subsurface water and design for at least the 100-year flood, including bedload and debris
- Avoid wetlands or minimize effects to natural flow patterns in wetlands
- Avoid road construction and other vehicular activity in meadows
- No fueling, digging, or earth-moving activities are allowed within 400 feet of any lake, pond, stream or wetlands
- Digging with hand tools is allowed during training events more than 400 feet from any lake, pond, stream or wetland. Fill in holes before demobilizing
- Vehicular maneuvers are prohibited in wetlands and bodies of water
- No cutting trees within 150 feet of any lake, pond, stream or wetland

3.4 VEGETATION MANAGEMENT

Vegetation and forest lands at Fort Custer are managed to maximize the ecological health of the installation while minimizing impacts to the military mission. The vegetative communities at FCTC are important military training assets and contain high quality natural areas. Some forested areas do generate commercial timber when that is aligned with this INRMP. In addition to military training and commercial benefits, vegetative communities are managed to maximize beneficial habitat for wildlife (especially rare and sensitive species) (**Sections 3.7 and 3.8**); and minimize potential negative impacts from fire (**Section 3.5**), forest pests (**Section 3.6**), and invasive species (**Section 3.6**).

The current vegetation on Fort Custer is primarily forest (> 80%), with some grasslands and shrublands, with a total of 21 vegetative community alliances (Thomas et al. 2009). The vegetative communities are discussed in more detail in **Appendix G**. Approximately 60% of FCTC is re-growth forest that is in the process of recovering; these areas require active management to minimize the density of invasive species and to ensure the communities transition to healthy, diverse and more open forests. Historically, grasslands and more open communities were more common. The projections for the future climate indicate this region will be warmer and likely with drier summers (**Appendix I**). For both of these reasons, transitioning the vegetation on FCTC to more grasslands and open woodlands is an identified management goal.

To that end, the MIARNG will need to determine the desired configuration and/or acres of grassland, savanna and forest, based on climate resilience, training needs, habitat needs, and carbon sequestration potential. Both prairies and forests can serve as effective carbon sinks when they are robust and healthy. HQNAs are always the first priority for vegetation management for a wide variety of reasons, with prescribed fire as a primary management tool.

To complicate this process (or possibly facilitate achieving the desired conditions), novel vegetative communities may result from changing climate conditions and it may not be possible to maintain historic species compositions in all communities. However, the high quality vegetation (both in HQNAs and elsewhere) on FCTC can serve as seed banks and refugia as vegetation adjusts over the next century. Unfortunately, it is hard to predict some of those changes (a notable exception to this is temperature-sensitive dominant tree species). The increased growing season and increased atmospheric carbon, often a limiting factor in plant growth, are both likely to favor some species over others and there is not enough data at this point to determine what the result will be on plant communities.

There is an ongoing project to update the mapping of the vegetative communities and HQNAs and management for them. There are currently eight HQNAs identified, mostly wetlands and related habitat. HQNAs on Fort Custer are primarily located south of Territorial Road (**Map 6, Appendix B**). There is an active timber harvesting program at FCTC and the Forest Management Plan is currently being updated. There have been many surveys that include plants and/or vegetation since 1995. **Appendix D** includes abstracts from reports and **Appendix E** contains a compiled plant species list. **Appendix G** provides more details on the historic and current vegetation, HQNAs, and invasive plant species.

Several other resources, such as soils (**Section 3.2**), water (**Section 3.3**), wildland fire (**Section 3.5**), invasive species (**Section 3.6**), and threatened and endangered species habitat (**Section 3.8**) overlap with vegetation management.

3.4.1 Timber Harvesting and Forestry Program

It is US Army's policy is to maintain, restore, and manage its forestlands using an ecosystem framework (AR 200-1). Forest ecosystem management at FCTC is designed to support military training needs while sustaining the biological diversity of forest-dependent plant and animal species, protecting soil and water resources, and providing for public recreation. For this reason, providing for harvests of commercial timber is not the objective of forest management at FCTC, although timber harvest occasionally occur when compatible with the goals in this INRMP (AR-200-1, Chapter 4-3).

Standing timber is considered real property and the USACE Chiefs of Real Estate have been delegated the duties of bid solicitation, bid openings, appraisals, awarding leases or contracts, establishing lease agreements, collecting and reporting proceeds, contract administration, and inspections on US Army lands. FCTC is federally-owned and timber harvest support is provided by the Louisville District of USACE. The FCTC forestry program operates under auspices of the Department of the Army's Conservation Reimbursable Fee Collection Program. The proceeds from timber sales are collected and deposited by USACE in to Army General Fund Budget Clearing Account. Installations are able to request funds from timber sales via two funding mechanisms: Automatically Reimbursable Account and Forestry Reserve Account.

A Timber Inventory and Forest Management Plan is required by AR 200-1 and is intended to be revised every ten years. A Timber Inventory and Forest Management Plan was first completed in 1990 and updated in 1999. An updated Timber Inventory was completed in 2017, with the Forest Management Plan in progress. The forest stand inventory provides information about stand age and density, species composition, age class distribution and basal area at the stand level. This information can be used along with other vegetation and natural resource management methods to shift stand species and age class composition, or identify stands that may need some form of management action or investigation.

For policies related to forestry and timber harvesting, see **Section 3.4.7**.

3.4.1.1 Historic Timber Harvests

The earliest records of timber harvest sales date to 1961, with the first USACE contract for a timber sale dated 1964. FCTC-ENV records indicate that the USACE has contracted a total of 26 individual timber sales through 2019. There are records for three timber harvests that do not have USACE documentation (1961-1963). The MIARNG has developed a database for these historic timber harvests in terms of year sold, board footage, acreage, sale amount, buyer, and location. When available, data on species classes

by diameter at breast height, and number of trees. Location of these timber harvests are also recorded in the MIARNG GIS database. **Table 4** summarizes the historic harvest data known for FCTC.

Decade	Number of Harvests	Total Acres	Total Board Feet (thousands)
1960s*	7	376	762.212
1970s	3	98	231.216
1980s	4	171	615.99
1990s	0	0	0
2000s	5	852	945.192
2010s	8	549	1460.661
* includes 4 timber harvests that are outside the current installation boundary but within the historic Fort Custer Reserve Forces Training Area.			

3.4.1.2 Current Management Situation

Until recently, management of FCTC's forests has focused primarily on timber production and harvest, although intermittently. There are eight forest compartments (the same boundaries as the TAs) with 10 to 50 stands per compartment for a total of 192 individual stands. Based on the Timber Inventory in 2017, there are nine general forest types present at FCTC: oak/hickory, mixed hardwoods, mixed oak, northern hardwoods, black locust/black cherry, aspen, lowland hardwoods, black walnut, and pine/conifer. As part of the Timber Inventory, each forest compartment (excepting the duded impact area, TA 9) were sampled to determine species composition, stand density, stand type, invasive species presence or absence, and size class distribution. This data will be used to generate stand prescriptions for future forest management actions and update the Forest Management Plan for the installation. Some stands are identified as non-forestry stands and are not managed for timber harvests (i.e., no-cut zones).

Timber harvests were curtailed after 1990, as additional analyses were needed to understand the impacts of timber harvests on the environment at FCTC. This coincided with the shift from a focus on timber production to general forest management. A number of biological surveys better documented the various resources present within the forests at FCTC and the need for more complex management of the forests. Timber harvests are now continuing but with more consideration for sensitive resources.

Presently, the desired condition for FCTC's forests is closer to the original landscape patterns that juxtaposed oak forests with oak-openings and prairies on drier sites and grading into forests of more shade-tolerant tree species in moister soil conditions found in stream bottoms, coves and north-facing slopes. This landscape outcome is likely to be facilitated by the climate changes projected to occur in the next 10-40 years for the region.

3.4.1.3 Harvest Planning Process

Forestry operations at the installation will follow guidelines set forth by the most recent edition of *Michigan Forestry Best Management Practices for Soil and Water Quality* (MDNR and MDEQ 2018) with additional BMPs identified for specific harvests. Other measures taken to reduce adverse impacts from timber harvests include the following:

- Pre-harvest planning: Collect of information about the area to be harvested. Identify BMPs to protect soil, water quality, and sensitive resources. Identify best location(s) for roads and skid trails associated with harvesting. Complete survey of proposed timber harvest for gaps in existing data, particularly wetlands, HQNAs, rare species habitat, steep slopes, and ingress/egress locations with lowest impacts.
- Equipment exclusion zones: Identify equipment exclusion zones prior to the tallying and marking of timber by the USACE or consulting forester. Typical exclusion zones are 100 feet from top of bank for water resources, with increased buffers with steeper slopes (see the Forestry BMPs Manual from MDNR and MDEQ, 2018). Exclusion zones may also include areas to protect other sensitive habitat, cultural resources, or significant soldier training areas. Final equipment exclusion zones will be based on the resources present within the proposed harvest area. Zones will be marked by FCTC-ENV staff using flagging or spray paint and noted in the USACE invitation for bids.
- Establish main forest haul routes and landings: FCTC-ENV staff will work with the USACE or consulting forester to establish ingress and egress points to the harvest area from the maintained road network, based on information in steps above.
- Map skid trails: After the timber harvest, map the skid trails and note areas that need rehabilitation with photographs and GIS data.
- Reseeding and closure of skid trails and landings: FCTC-ENV will reseed skid trails and landings with appropriate seed to mitigate erosion. Access to the area will be blocked once seeded. Monitoring and follow up treatment will occur as needed, especially for invasive plants.
- Post-harvest monitoring and treatment: FCTC-ENV and/or consulting forester will collect data (a combination of photographic, basal area, or regeneration) to verify if the timber harvest has met the goals of the timber harvest prescription. Post-harvest data collection will occur for a minimum of two years after harvest. Results will be used to improve BMPs, buffers, and rehabilitation methods.
- Stands with wetland resources: At least 82 forest stands are known to have water resources and will require equipment exclusion zones and/or special considerations. See above for minimum buffer distances.

3.4.1.4 Management Prescriptions for the Forestry Program

The following management reduces forest fragmentation and degradation of high-quality forest ecosystems, while also restoring the mosaic of community types that existed in the area before settlement by Europeans, while encouraging resiliency within forest communities to respond to changing climate patterns.

- Protect and enhance HQNAs, including leaving a buffer around HQNAs during timber harvests (see **Section 3.4.2** below for more details).
- Update the Forest Management Plan to reflect current conditions and priorities. Generate list of timber stands and timber stand improvements to achieve desired conditions and vegetation objectives. In particular, identify those stands where basal area exceeds 100 square feet/acre, favor oak/hickory regeneration and/or oak savannah establishment, do not encompass remnant high quality stands, have limited wetland resources, and promote alternative forestry methodologies.
- Manage forest stands for older trees by preserving existing older and late-successional stands and allowing many second growth stands to mature.

- Cutting practices will allow for regrowth of oak and hickory species, which are shade intolerant trees. Group selection, shelterwood cuts, and small (< 5-acre) clear-cuts may be used as harvest practices. Cutting regimes will be chosen to mimic natural disturbances, similar to insect outbreaks, wind throws, wildfires and other events that regenerated the oak/hickory community.
- When natural disturbances occur, their impact and size will be considered and timber harvest return intervals will be adjusted accordingly. Alternatively, where the intent is specifically to manage for shade tolerant forest communities and is ecologically justified, selection cuts generally will be the preferred form of silvicultural treatment.
- Existing “core forest area” will be identified and retained to provide a large block of unfragmented interior forest that connects with the FCRA and ultimately the Kalamazoo River riparian forest. This core forest area will comprise the forested reach of the Impact Area and will tend towards older trees (80 to 200+ years old) and more closed-canopied conditions (~ 75 percent closure overall. Specific practices to restore the core forest area will include prescribed burning, invasive species control, individual tree harvest, and tree felling or girdling with trees to remain on-site.
- Specific prescriptions will be developed based on the data from the updated timber inventory, coupled with training needs and forest ecology priorities. In addition, the presence of HQNAs, management priorities for the understory, and the preservation of relatively undisturbed and healthy stands of trees will be incorporated into prescriptions.
- Develop forestry prescriptions that help establish and support climate resilient forest communities. Identify forest stands that are likely to be most resilient to climate change and develop prescriptions that will help expedite and support resiliency.
- Over the majority of FCTC’s forests, single tree selection, shelterwood harvests and clear-cuts are predicted to be the most frequently used silvicultural treatments in forest areas, outside of the core forest reserve or anticipated future core reserves.
- Remove individual trees to reduce black locust, red maple or other undesirable trees from invading the understory of oak forest communities. Black locust and red maple, in particular, may be cut and the stump painted with herbicide to reduce suckering and regrowth from the stump. Other trees may be girdled to create snags. Trees will usually be left on site to contribute coarse woody debris to the forest ecosystem, which allows continuation of a host of important biological and physical processes.
- Complete analysis of pre- and post-harvest data for bird populations.
- Regularly review data from historic timber harvest stands (bird, vegetation, timber, and water resources condition) and evaluate stand condition relative to the prescription targets. Use results to inform future prescriptions and modify BMPs. Use this information to identify post-harvest actions that further support management targets.
- Develop post-harvest management actions that support timber stand improvements, invasive species treatment goals and refine best management practices.
- Continue to incorporate timber stands as part of RTLA monitoring program and use data to evaluate trends in forest community.
- Promote and support innovative forestry practice techniques and technologies to improve our BMPs and prescriptions.
- Develop deeper connections with the forest product sector to maximize utilization.
- Control of forest insects and diseases take a measured approach that uses principles of integrated pest management (see **Section 3.6** for more detail). The measures to be undertaken are as follows:

- Annual drive-through and walking inspections will be conducted and results formally documented to identify any insect, disease or invasive species problems.
- When possible, conduct aerial survey during the growing season to better identify any forest health problems.
- Conduct gypsy moth egg mass surveys biennially to monitor populations of the insect.
- Conduct gypsy moth defoliation assessments in conjunction with MDNR gypsy moth aerial surveillance.
- Prevent infection of trees by oak wilt and other diseases by avoiding tree damage, especially during the growing season, and maintain fire intervals that help suppress oak wilt infection.
- Coordinate with MDNR or other agencies as appropriate if any forest health issues or forest pests are identified.

3.4.2 High Quality Natural Areas

Initial management of HQNAs focused on habitat restoration and enhancement benefiting threatened and endangered species, namely implementing prescribed burning for prairie vole (*Microtus ochrogaster*) habitat and conducting surveys for pale fumewort (*Corydalis flavula*).

Management objectives identified in 2005 included reintroducing fire, controlling invasive plants, controlling woody encroachment into herbaceous areas, protecting threatened and endangered species, and monitoring these management activities to ascertain effectiveness and further work (DLZ 2005). Site-specific management plans and monitoring protocols were developed for each high quality habitat unit to achieve the desired goal of protecting, enhancing and perpetuating the unique landscape features located at FCTC (DLZ 2005).

In 2009, an assessment of the efficacy of management of the eight HQNAs was conducted, along with a synthesis of other ecological studies conducted on Fort Custer and surveys for rare or previously undocumented plant species (Cohen et al. 2009). Management recommendations were updated and provided specific measures and species to target, both for removal (invasives) and restoration (natives). All HQNAs have permanent monitoring plots and methodologies established.

The HQNA boundaries outlined in 2005 include two thresholds: 1) a core protection area and 2) a management boundary. The core protection area includes the HQNA itself, along with a perimeter buffer area. The additional buffer area was deemed important because it provides additional spatial separation from potential encroachments.

HQNAs will be actively managed using several techniques, including reintroducing fire where applicable, controlling invasive plants, controlling woody plant encroachment, protecting threatened and endangered species, and monitoring the effects of management and land use activities. Only timber management techniques proven to not increase invasive plants will be used within 700 feet of an HQNA.

HQNAs are typically protected from routine bivouac and maneuver training activities and use of these areas is limited to foot traffic only. These areas are identified with buffers on maps and shown as 'foot traffic only' areas (see **Section 2.6**). HQNA use restrictions are incorporated into facility land use guidance documents (for training and for other users) to institutionalize protection of the natural areas.

Casual use during managed hunting periods will likely not present any problems. During public hunting, ground blinds of natural vegetation are sometimes built for temporary use and materials are

redistributed throughout the forest after use. Use of the natural areas for scientific study would generally be compatible with overall management goals as long as the study protocol does not require changes in management that would negatively impact the health of the plant communities.

3.4.2.1 Management Prescriptions for HQNAs

Several reports have evaluated the HQNAs and provided management recommendations since the 1990s. There is an ongoing project to update these again and should be complete in late 2020. **Table 5** summarizes the current information on the HQNAs, their acreage, and the most current management priorities. For more details on the HQNAs, see **Appendix G** and **Table G-2**.

Table 5. Management Summary for HQNAs on Fort Custer		
Name	Acres	Management Needed and Policies to Reduce Impacts
Dry-Mesic Southern Forests	Cemetery Complex Ridge	33 <ul style="list-style-type: none"> Continue use of seasonally varied prescribed fire to maintain open understory and encourage oak regeneration Control invasive species (multiflora rose, Japanese barberry, privet, and garlic mustard) to reduce seedbank Exclude logging (including salvage); exclude foot traffic Monitor for oak regeneration; if none in 10 years, evaluate needed changes Rare plants: Showy orchis, American ginseng, and goldenseal present
	Whitman Lake Woods	114 <ul style="list-style-type: none"> Continue use of seasonally varied prescribed fire to maintain open understory and encourage oak regeneration Control invasive species (glossy buckthorn and garlic mustard) to reduce seedbank Exclude logging (including salvage); exclude foot traffic Monitor for oak regeneration; if none in 10 years, evaluate needed changes
Mesic Sand Prairie	Mott Road Prairie	2.5 <ul style="list-style-type: none"> Continue use of seasonally varied (not just early spring) prescribed fire to maintain open understory and encourage native plant regeneration. Monitor resprouting woody species and saplings and alter prescribed fire seasonal application as needed. Control invasive species to reduce seedbank; treat purple loosestrife with spot treatments of herbicide and/or hand pulling Minimize foot traffic and exclude vehicular traffic
Prairie Fen	Mott Road Fen	7 <ul style="list-style-type: none"> Continue seasonally varied prescribed fire, coordinating timing with nearby uplands. Reduce invasive plants through prescribed fire and spot treatment with herbicide; glossy buckthorn clusters should be cut and treated with herbicide; purple loosestrife should be removed with biocontrol, spot treatment and/or hand pulling; black alder should be removed immediately before it can spread Minimize foot traffic and exclude vehicular traffic Avoid timber harvest in nearby uplands to reduce impact on hydrologic regime
	Territorial Road Fen	8 <ul style="list-style-type: none"> Continue seasonally varied prescribed fire, coordinating timing with nearby uplands Narrow-leaved cat-tail is present and can spread quickly following fire – monitor closely, spot treat, and avoid burring until it is removed Reduce invasive plants using spot treatment with herbicide; glossy buckthorn clusters should be cut and treated with herbicide; purple loosestrife should be removed with biocontrol, spot treatment and/or hand pulling Minimize foot traffic and exclude vehicular traffic Avoid timber harvest in nearby uplands to reduce impact on hydrologic regime

Table 5. Management Summary for HQNAs on Fort Custer

Name		Acres	Management Needed and Policies to Reduce Impacts
	Whitman Lake Fen	13	<ul style="list-style-type: none"> ▪ Continue seasonally varied prescribed fire, coordinating timing with nearby uplands ▪ Narrow-leaved cat-tail is present and can spread quickly following fire – monitor closely, spot treat, and avoid burring until it is removed ▪ Reduce invasive plants using spot treatment with herbicide; glossy buckthorn clusters should be cut and treated with herbicide; purple loosestrife should be removed with biocontrol, spot treatment and/or hand pulling ▪ Minimize foot traffic and exclude vehicular traffic ▪ Monitor beaver activity for impacts to fen ▪ Avoid timber harvest in nearby uplands to reduce impact on hydrologic regime
Southern Hardwood Swamp	Cemetery Complex Seeps	9	<ul style="list-style-type: none"> ▪ Allow natural processes (i.e., windthrow, flooding, and fire) to operate without intervention (e.g. salvage logging) ▪ Do not apply prescribed fire ▪ Control invasive plants and reduce woody growth using a combination of cutting and herbicide application ▪ Foot traffic should be minimized within seepage areas and exclude vehicular traffic throughout ▪ Avoid timber harvest in nearby uplands to reduce impact on hydrologic regime
Southern Wet Meadow	42 nd Road Seep	4	<ul style="list-style-type: none"> ▪ Continue seasonally varied prescribed fire, coordinating timing with nearby uplands ▪ Reduce invasive plants using prescribed fire and spot treatment with herbicide; glossy buckthorn clusters should be cut and treated with herbicide; purple loosestrife should be removed with biocontrol, spot treatment and/or hand pulling ▪ Foot traffic should be minimized within seepage areas and exclude vehicular traffic throughout ▪ Avoid timber harvest in nearby uplands to reduce impact on hydrologic regime

Source: Cohen et al. 2009

Changes in climate, particularly that result in changes in water tables, could impact these HQNAs, although a certain amount of fluctuation throughout the year is part of the historic hydrological regime. A significant reduction in water table levels, changes in timing of rainfall, and increased temperature would likely to affect species range and the ecosystem as a whole (see **Appendix I** for more details about climate projections). Another potential impact of climate change on these HQNAs is an increase in diversity and density of invasive plants, which would require additional monitoring and removal efforts.

3.4.2.2 Old-Growth Stands

While not officially HQNAs, there are a number of forest stands that have not been harvested for at least 100 years. These areas serve as important areas for refugia of rare plants and as seed sources for plants sensitive to disturbance. These stands should be protected whenever possible and some activities should be limited. These areas have recently been defined and management recommendations are still being identified.

3.4.3 Vegetation Monitoring

Long-term vegetation monitoring continues on Fort Custer, with focused efforts for specific concerns. Detrimental effects to vegetation from training and from invasive plants should be addressed early and proactively. Monitoring for signs of invasive plants and pest invasion (e.g., oak wilt, Asian long-horned

beetle, etc.) should occur during the course of normal activity and as a routine part of assessing ecosystem health and carrying out adaptive management.

Of special note for monitoring and potential vegetation management issues are the following:

- If rare plants and community composition are being affected by deer, additional management of the deer population may be needed. **Section 3.7** discusses this in more detail.
- In HQNAs, changes in species composition should be monitored to track the rare plant species present there, detect changes that might indicate disease, note early instances of non-native species establishment, and record disturbance regimes (e.g. fire).
- Detection of invasive plants should be identified early through regular monitoring, especially in open grassland areas and in HQNAs. **Section 3.6** discusses this in more detail.
- Vegetation monitoring should occur in any areas where there is regular training off-road (either with vehicles or on foot) to ensure there are no long-term adverse effects from training.
- Monitor forest conditions and understory development, particularly in areas essential for military training.

3.4.4 Other Vegetation Resources

Cutting of firewood is allowed at FCTC, on a permit basis only and only for non-commercial uses. Cutting is restricted to downed trees and to a quantity considered sufficient for personal use only (generally up to one full cord of wood per day). Fees may be collected for firewood, at an amount determined by the post commander. See the Firewood SOP in **Appendix K**.

Seed collection in cooperation with partners may be undertaken; typically, a proportion of seed collected will be used for restoration projects on FCTC.

Permits and payment are not required for visitors gathering berries and/or mushrooms (or other fruiting bodies of wild plants) in small quantities suitable for personal consumption. However, only people with existing access to FCTC can participate (similar to fishing described in **Section 3.7**), unless specific arrangements are made with FCTC-ENV. For more on food gathering and outdoor recreation, see **Section 3.9**.

3.4.5 Grounds Maintenance

Urban forestry is an intermittent program undertaken in cooperation with the Facilities Engineering department. Urban forestry on Fort Custer has focused on reintroducing native trees and plants and using them to landscape for energy efficiency in heating and cooling. This program will continue as long as funding remains available.

Mowing of native plantings in the cantonment area or any mowing in other portions of the installation must be coordinated with FCTC-ENV and must follow the Mowing SOP (MIARNG 2019). In general, mowing is avoided during critical nesting and breeding seasons, from late May through June. Mowing should occur during the dormant season for plants, typically September to end of March, when mowing is taking place outside of the cantonment area, pollinator areas and roadsides. The Mowing SOP includes details for paved roadways, unpaved roadways, and for various sensitive resources areas. The sensitive resource area SOP elements are summarized below.

Mowing of natural areas, including ranges, landing zones, field training areas, bivouac, and similar areas is required at intervals depending on intensity of use and will be kept between 6-12 inches (MIARNG 2019). FCTC is designated as having Eastern Massasauga Rattlesnake (EMR) habitat, and the EMR is a federally threatened species. Specific standards for mowing during the active season for EMR are contained in the Fort Custer Mowing SOP (MIARNG 2019). The following procedures have been put in place for different areas outside of the cantonment area. All are from the FCTC Mowing SOP, which is included in **Appendix K** (MIARNG 2019).

Care should be taken to avoid mowing invasive plant species. In the case that they are encountered, hand pulling and/or herbicide spot treatments should be undertaken (see Section 3.6).

Prairies and pollinator areas within the cantonment area:

- Coordinated with ENV and mow only when vegetation height is 17" or greater
- Allow pollinators to escape mower blades by using a flushing bar on the mower and by mowing at reduced speeds (less than 8 miles/hour)
- Minimum mowing height is 12"
- Mowing should occur in patches where possible to preserve pollinator habitat
- Following seeding, do not mow for 2-3 years unless absolutely necessary

3.4.6 Management Prescriptions for Revegetation, Landscaping, and Ecological Restoration

Revegetation of disturbed areas and ecological restoration of larger areas are important parts of long-term vegetation management. Project climate changes include increasing temperatures in all seasons, with decreasing precipitation in the middle of the growing season, and decreased upper soil moisture. This means that incorporating drought-tolerant plants and techniques will be important during any revegetation, new landscaping, or ecological restoration projects.

Below are management prescriptions for revegetation, restoration, and landscaping.

- Landscaping recommendations for Michigan can be found at https://www.canr.msu.edu/home_gardening/index.
- Revegetation after a disturbance (e.g., forest management, fire, or military training) is discussed in several BMP manuals previously discussed in **Sections 3.2 and 3.3**.
- Emphasize native plants and minimize invasive plants through planning and quick action following a disturbance event such as timber harvesting, wildfire, or construction.
- Design landscaping to be suitable to the specific site and appropriate for the use and operation of the facility.
- Minimize use of water by planting drought-tolerant and low water use native plants for landscaping.
- Implement water-efficient practices, use efficient irrigation systems and recycled water, and use landscaping to conserve energy.
- Limit turf areas where practical to reduce water use and maintenance requirements.
- Use wood mulch instead of rock mulch when practical.
- Prevent expansion of nonnative plants into native plant areas by using regionally native plants for landscaping where practicable.
- Reuse landscape trimmings on site as appropriate.
- Use porous pavement when possible to support water infiltration.
- See **Sections 3.2 and 3.3** (Soil and Water Resources, respectively).

The invasive plants listed for the Southern Lower Peninsula in *Meeting the Challenge of Invasive Plants: A Framework for Action* should not be used on FCTC (Higman and Campbell 2009; available at https://www.michigan.gov/documents/dnr/Invasives_strategy_final_289799_7.pdf). In addition, the Prohibited Species List (MDARD et al. 2019) are not acceptable for landscaping planting within Fort Custer. Additional information is available at <https://www.michigan.gov/invasives/>. All non-native grasses (except those used for lawns/turf) are also not acceptable for landscape planting. Suitable native plants can be found at <http://www.plantnative.org/rpl-mimnwi.htm> or https://www.canr.msu.edu/nativeplants/plant_facts/local_info/south_lower_peninsula.

3.4.7 Fort Custer Objectives and Policies

GOAL VE: Manage different habitats (grasslands, wetlands, and forests) to promote native species, resilient communities, and support military training

- OBJECTIVE VE1: Maintain biodiversity and key attributes of HQNAs
- OBJECTIVE VE2: Conduct forestry activities, including timber harvests, in a manner that supports military training, protects against wildfire, invasive plants, and forest pests, and provides resilient ecosystems with regionally appropriate biodiversity
- OBJECTIVE VE3: Maintain wetlands and riparian zones, their functions and values, and associated ecosystem services
- OBJECTIVE VE4: Maintain open landscapes (i.e., grasslands and shrublands) to support military mission and promote habitat and pollinator diversity
- OBJECTIVE VE5: Ensure grounds maintenance, new construction, and landscaping do not increase invasive plants or negatively impact biodiversity

Laws, Policies, and Guidance:

- No tree cutting, clearing and grubbing without prior approval from the FCTC-ENV.
- Native plants and communities shall be maintained, enhanced, and restored to conserve their biodiversity and health with HQNAs as priorities for protection and restoration.
- Vegetation management includes maintaining the natural disturbance processes, while maintaining intact functional landscapes, ecosystems, and communities.
- Re-establish native vegetation following site disturbance using appropriate seeding specification in any areas with ground disturbance.
- Grounds will be maintained at the levels and intensities necessary to meet the designated use, protect and enhance natural resources, and ensure a pleasing appearance with the natural landscape.
- Invasive plants will not be used in landscaping or revegetation projects.
- Characteristics of stands that may be given preference in designations as old-growth stands are as follows:
 - Adjacent to or within recreational areas, water or travel influence zones, wetlands, or natural areas.

- Poorly accessible stands.
- Stands that are known to contain specific, unique, or unusual ecological conditions, or threatened or endangered species.
- Forestry and timber harvesting policies
 - No cutting of trees between 1 April and 1 October to prevent the spread of oak wilt (as well as to avoid impacts to bats and migratory birds).
 - No cutting trees within 150 feet of any lake, pond, stream or wetland.
 - Foot traffic only in HQNAs. Only timber management techniques proven to not increase invasive plants will be used within 700 feet of an HQNA.
 - Military training and related activities shall follow a “Leave No Trace” policy.
 - No harvest of trees will occur during the period 1 April to 1 October, to prevent spread of tree diseases and minimize disturbance of nesting birds and roosting bats.
 - To preserve potential rare bat roost habitat, no standing dead trees or trees with peeling bark, large crevices or cavities will be removed.
 - No timber cutting or any vegetation management practices that cause soil disturbance or significantly open the forest canopy will be allowed within 100 feet of a stream, lake, or wetland. Buffers around wetlands and waterbodies will be maintained as described in *Michigan Forestry Best Management Practices for Soil and Water Quality* (MDNR and MDEQ 2018), with a minimum of 100 feet above top of bank and adjusted for slope. Ensure that no shading is removed to mitigate for increased water temperatures from climate change.
 - Operations are to be started and completed while the ground is frozen. In rare instances decisions to operate during non-frozen ground conditions will be made on a case-by-case basis, in consultation with FCTC Environmental staff.
 - Precautions will be taken to avoid or minimize operations during wet weather to minimize damage to the soils and the biological resources of the timber stands. Enforcement of current contract provisions should minimize negative impacts.
 - Logs will not be staged in wetlands.
 - All timber cutting will make use of existing roads only, and skid trails are not allowed on slopes with a grade of 18 percent or more. The minimum number of skid trails will be developed to avoid unnecessary understory disturbance, and skid trails will be repaired following the harvest using native seed appropriate for the area.
 - Protective buffers will be maintained around HQNAs to prevent spread of invasive species following a timber harvest into an HQNA.
 - Protective buffers will be maintained around archeological and/or historic sites as identified by the MIARNG Cultural Resources Manager. Should significant archeological and/or historic sites be discovered during a timber operation, activity will cease and the FCTC Environmental Manager will be immediately notified.

3.5 WILDLAND FIRE MANAGEMENT

For millennia before European settlement, fire had an important historic role in influencing the landscapes found at FCTC. Fire, whether ignited naturally or anthropogenically (by Native Americans), moved through the landscape as fuel, topography and weather allowed. Over time plant communities adapted to and thrived in an environment of periodic landscape fire. Recent modeling taking into account climate and

temperature show a historical fire regime for the area surrounding FCTC likely to have been a fire return interval of roughly 10 to 12 years regionally (Guyette et al. 2012), although local habitats may have been prone to higher fire return intervals. Changing climate conditions may also increase the risk of wildfires and increase the severity of wildfires (see **Appendix I**). Projected changes including more summer droughts which is likely to increase the risk of fires, combined with the increased carbon and temperature resulting in greater biomass.

Therefore, fire is an important ecological element for the various fire-dependent habitats at Fort Custer, including wetlands, fens, prairies, oak savannas, oak woodlands and even some mesic forests. In areas where fire-adapted plant communities are present, MIARNG implements a prescribed fire program to mimic the historic extent and periodicity of landscape fire. Prescribed fire is an important tool to manage vegetation for training purposes and to promote perimeter security. Prescribed fire may also be used to manage fuel loading in forest units; complete site preparation for planting; promote habitat for threatened or endangered species; or to control invasive exotic plants.

An Integrated Wildland Fire Management Plan (IWFMP) provides authority and program overview for the wildland fire program at Fort Custer and is in the process of being updated. The IWFMP identifies the many fundamental processes and standards needed to manage wildland fire and successfully and safely implement the program on Fort Custer. Those details are not repeated here; this INRMP focuses on the goals and objectives of the wildland fire program relative to natural resources on FCTC.

The IWFMP was written originally in 2007 to provide a comprehensive plan for prescribed burning at FCTC for multiple objectives. Prescribed fire has been used since 2003 to manage rare species habitat at Lawler Prairie and the prairie vole sites. Beginning in 2004, prescribed fires were also completed in the HQNAs. Between 2007-2018, there were between 0 to 3,300 acres burned each year. The typical annual plan is to complete 3-5 burns covering between 500-2,500 acres each year. Weather, staffing, and other logistics can affect whether this is accomplished or not in any given year.

The results of monitoring the effects of prescribed fire indicate that fire is an important influence in maintaining the viability of these unique landscape features. In fact, plants new to the FCTC species list have been found within the burn areas. Focused on the HQNAs, these burns helped both in restoration efforts and invasive plant control.

A summary of key legislation is in **Appendix J**, and many of the wildland fire management topics overlap with soils (**Section 3.2**), water resources management (**Section 3.3**), and vegetation management (**Section 3.4**). There are also some species-specific limitations related to prescribed fire identified in **Section 3.8**.

Wildfire Response

Fire is a key ecological disturbance necessary for restoring or maintaining some of the communities present on Fort Custer. At the same time, wildfires can pose a natural hazard on Fort Custer in terms of lost training time, public safety, and property damage. Although there are fire starts from military training due to pyrotechnics on ranges (about 20-30 per year), there are no other known wildfires that have occurred at FCTC. When fire danger is high, MIARNG and/or Range Control may restrict the use of pyrotechnics or other ammunition-based training that can start wildfires. Wildfire danger is typically high in the spring and late summer.

The threat of adverse impacts from wildfire to the mission and natural resources is minimal as most of the systems at FCTC are fire-dependent and ranges are managed to reduce damage from fire starts. Therefore, fire generally has a beneficial effect on FCTC rather than an adverse one.

Range Control and DPW provides initial response to fire starts on ranges. If needed, the FCTC Prescribed Burn Manager and/or local fire department(s) will be requested to provide assistance.

Prescribed Fires for Mission and Ecological Purposes

Prescribed fire will continue to be an important land management tool to achieve natural resources management objectives and maintain lands for military training. Coordination with stakeholders and adjacent property owners will assure that the purposes and outcomes of the burn program are effectively communicated to address concerns. Prescribed fire objectives include restoring ecological processes, controlling exotic plants, reducing fuel loading in forest and woodlands, preparing sites for planting, and controlling vegetation to improve security along the facility perimeter.

Given the fire-dependent vegetation types present on Fort Custer, many areas are reliant upon prescribed fire for ecosystem health and maintenance of biodiversity and community structure. A large portion of FCTC is second growth forest that will benefit from prescribed fire to reduce competition in the understory and favor oak trees in the canopy. Prescribed fire is an important tool for reducing fuel loads in areas prone to wildfires, particularly in and near ranges.

Prescribed fire has occurred on Fort Custer for decades, with burns generally conducted in the spring and early summer with the main objectives of these burns have been to reduce fuel loads and maintain firebreaks. With increasing use for ecological objectives, increased use of summer fires are planned. The planning process and specific procedures for prescribed fire are identified in the IWFMP.

Priority areas generally include the HQNAs and listed species habitats. Range-related burns have dual benefits of reducing fuel loading and fire risk from military training but also ecological benefits for maintaining open landscapes in a region where forests dominant the landscape. Several of the rare species and habitats on Fort Custer are fire-dependent and prescribed fire is the best way to manage them. There are also some species-specific limitations related to prescribed fire identified in **Section 3.8**.

The FCTC Prescribed Burn Manager, assisted by contracted support from outside agencies, is the lead for prescribed fire. DPW wildland firefighters might participate in prescribed fires, when appropriate.

Fuel Loading and Firebreak Management

On Fort Custer, it is common for prescribed burns to reduce the fuel load for warm season fires. In addition, as discussed above, timber harvesting, and thinning occur on the installation and can also reduce fuel loads (see **Section 3.4**). While down and dead wood are retained in most cases to provide habitat for wildlife, in other cases these fuels may be removed to improve fire control efforts.

Firebreaks are an essential tool when conducting prescribed burns and suppressing wildfires. The firebreaks on FCTC are already in place and consist of the roads, trails, and established firebreaks. It is rare that a new firebreak or a temporary firebreak is needed. *Michigan Forestry BMPs for Soils and Water Quality* (MDNR & MDEQ 2018) provides guidance on how to design and maintenance fire breaks while minimizing impacts to soils and water.

Erosion control is a major concern when exposing bare soil during fire control activities. See **Sections 3.2 and 3.3** for more information on BMPs and management activities related to this issue.

Fuel load and firebreak management is primarily undertaken by facilities management but FCTC Environmental staff may assist where needed to support natural resources objectives.

Fire Monitoring

An annual prescribed fire monitoring program has been undertaken for more than 10 years. Within the next few years, the data will be analyzed to identify patterns in response to fire from invasive plant species, rare plant species, and overall vegetation composition. FCTC Environmental is the lead for monitoring results of the prescribed fire program.

3.5.1 Management Prescriptions for Wildland Fire

Areas on Fort Custer that traditionally are priorities for prescribed fire include rare species habitat and HQNAs. Some areas will be burned more often than others due to either the military use (e.g., range complexes) or the vegetation type (e.g., fire-dependent HQNA). See the IWFMP for more details on the necessary staffing, equipment, and training to safely and successfully implement the wildland fire program. The IWFMP also provides details about individual burn units and a 20-year plan for prescribed burning on FCTC.

The IWFMP provides more detailed priorities, standards, processes, fire history, policies, and management prescriptions. Wildland fire policies and management relevant to natural resources include:

- General:
 - Have available two crews with six people and a brush truck each, either with internal resources or supplemented by contractors.
 - Implement between 1,000-3,000 acres of prescribed fire per year, which is approximately 5-12 burns per year.
 - Continue fire weather monitoring and communications protocol to determine when conditions are favorable for wildfires and alert all FCTC users of potential fire hazards. Range Control modifies allowed activities accordingly.
 - Training in fire prevention and reporting procedures for relevant MIARNG staff as needed.
 - Maintain HQNAs and rare species habitat.
 - Post-wildfire management activities should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, and minimizing adverse effects from the existing road network (see **Sections 3.3 and 3.4**)
- Wildfire Response:
 - Each wildfire will be evaluated and may be allowed to burn within a burn unit as long as burn objectives would be met. If a wildfire is deemed a risk because of a potential threat to people, property or becoming unmanageable, control efforts will be applied.
 - Recognize that increased urbanization in close proximity or within FCTC will present more wildland/urban interface challenges to wildfire suppression.
 - Avoid excessive dozer use in response to wildfire.
- Prescribed Fire for Mission and Ecological Purposes:

- When feasible, reintroduce fire into hardwood forests to encourage oak regeneration and to discourage competition.
- When feasible, incorporate fire as a tool to restore or maintain oak openings.
- Determine prescribed fire and fuel load management needs based on vegetation community, rare species, and military use and prioritize necessary actions annually.
- Prescribed fires are conducted on a rotating basis to reduce fuel loads, maintain firebreaks, and to provide adjacent refugia for mobile species and sufficient seed sources for vegetation recovery.
- Use prescribed fires in the forest stands to reduce competition for the growth of desired herbaceous and woody vegetation and for site preparation for forest regeneration.
- Use prescribed fires in grassland areas to control encroachment by brush and trees.
- Use prescribed fires in conjunction with silvicultural prescriptions to reduce fuel loads, especially to reduce the potential for large crown fires.
- Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation.
- In burn plans, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.
- Fuel Loading and Firebreak Management:
 - Reduce excessive fuel loads for priority community types to reduce the risk of catastrophic wildfires.
 - Snags and large woody debris management should be a balance of ecological benefit and reducing fuel loads.
- Monitoring
 - A post burn season meeting should be conducted with staff to review the progress of the season and to address program changes to enhance safety or productivity.
 - Post-burn summaries should document the results of the burn (total acres, intensity, fire effects, weather conditions, etc).
 - Continue post-burn monitoring to confirm that management objectives for each burn are being achieved.
 - Evaluate overall program at least every 5 years to confirm that overall desired ecological, mission, and fuel loading objectives are being achieved.
 - Measurements should be based on qualitative criteria and supported with photographic documentation, focusing on each burn unit.

3.5.2 Fort Custer Objectives and Policies

GOAL WILDLAND FIRE (FI): Manage wildland fire to support military training while reducing risks and maintaining ecological health, ecosystem services, native biodiversity, and structural diversity

- **OBJECTIVE FI1:** Ensure IWFMP implemented, all requirements are met, and coordination with partners continues

- OBJECTIVE FI2: Maintain wildfire response capabilities on Fort Custer as identified in IWFMP and in coordination with partners
- OBJECTIVE FI3: Reduce risk of catastrophic and/or uncontrolled wildfires
- OBJECTIVE FI4: Use prescribed fire to support military training, ecological health, biodiversity, and rare species

Laws, Policies, and Guidance:

- All policies identified in the IWFMP, including training, incident command, approvals, and prescription requirements, including:
 - Fire suppression will be the first response to wildfires on Fort Custer except in those cases when it is possible to allow wildfires to burn out on their own in areas where that will be beneficial to native species and without risk to people or property
 - Provide wildland fire training to MIARNG and partner personnel as appropriate. Follow training requirements in the IWFMP
 - Fort Custer and partners will continue to cooperate on prescribed burns or fuels reduction, as personnel and equipment are available
 - Maintain trained and experienced fire team with adequate equipment
 - Implement the 20-year burn plan
 - Maintain mutual aid agreements
 - Implement smoke management as needed
- Use prescribed fire to maintain healthy conditions in fire-adapted habitats, improve HQNAs, promote habitat for rare species, reduce density of invasive plants, and to maintain fuel breaks
- Continue post-burn monitoring program to ensure objectives are met, with no adverse effects on rare species or increases in invasive species
- Continue education efforts of Fort Custer personnel and neighbors of the presence and ecological role of fire and how to help prevent damaging wildfires
- Reduce the risk of large crown fires by managing fuel loads
- Limit and monitor the use of incendiary devices, ordnance, explosives, live ammunition, pyrotechnics and campfires during periods of fire restriction
- Continue collaborating with other agencies to encourage land owners and residents within the wildland-urban interface to reduce excessive fuel loads and to establish “defensible space” around structures
- Control access to FCTC and maintain a secure perimeter
- No open fires are allowed during fire restrictions
- The use of pyrotechnics is weather-dependent and must be approved by Range Control

3.6 INVASIVE SPECIES AND INTEGRATED PEST MANAGEMENT

The State of Michigan has an invasive species program that is implemented by the Michigan Departments of Agriculture & Rural Development (MDARD), MDNR, and EGLE. This program aims to prevent new introductions, limit the spread of established species, detect and respond to new invasions, and manage and control established species (Michigan’s Invasive Species Program 2018). Michigan’s

Aquatic Invasive Species (AIS) State and Terrestrial Invasive Species (TIS) state management plans serve as the foundation for this work (MDEQ et al. 2013; MDARD et al. 2018). The state maintains a watch list of current invasive species by taxa and partners with many local agencies and nonprofit groups to conduct monitoring and control activities. MIARNG participates in MDNR's Cooperative Invasive Species Management Areas program and uses the Early Detection, Rapid Response (EDRR) framework to guide implementing invasive species management. As the climate changes, invasive plant distributions may change rapidly in response, with some species declining locally and others increasing. Sharing data with other agencies will be important to ensure regional priorities are updated as needed.

Fort Custer follows the MIARNG IPMP when carrying out activities to control animal and plant pest species on the installation (DLZ 2017). The IPMP emphasizes prevention and control of pests through a wide range of options, with pesticide application being a last resort. As with all invasive species and pests, coordination and cooperation with regional and state groups, including MDNR and the Midwest Invasive Species Information Network (MISIN) (<https://www.misin.msu.edu/>), are cost- and time-effective when conducting monitoring and controlling. Due to the diversity of types of management, recommendations are broken into five sections: terrestrial plants, forest pests, pest-borne diseases, aquatic pests, and other pests. A summary of priority invasive species and potential species is provided in **Appendix G**. A complete species list, which includes priority invasive plant species, tree diseases and invasive insects, and invasive animals, can be found in **Appendix E**.

Invasive species management and pest management at Fort Custer is based on implementing EDRR and using the lowest-impact control measures necessary for control. Invasive species have been actively managed at on Fort Custer since early 1990s, with projects completed annually for high priority species, particularly in HQNAs. Integrated pest management involves four primary control strategies: mechanical and physical control (physical removal or exclusion of pests), cultural control (altering the environment to make it less suitable or attractive to the pest), biological control (use of other organisms that control the pest), and chemical control (use of pesticides and herbicides). For the purposes of this INRMP, we focus on those invasive species and pests which can have an impact on Fort Custer's natural resources.

No invasive species or pest management operations are conducted that are likely to have a negative impact on endangered or protected species or their habitats without prior approval from the MIARNG Environmental Manager (EM) and the National Guard Bureau (NGB) Pest Management Consultant (DLZ 2017).

Coordination with both state and federal authorities, as well as local groups and agencies, is key to success for regional control of invasive species and forest pests. Coordination with multiple regional entities and non-profit organizations helps ensure that priority species for management on Fort Custer are aligned with regional priorities and that efforts on Fort Custer are done in conjunction with larger regional efforts. MIARNG/MDMVA is a stakeholder agency in the Michigan Invasive Species Coalition (MISC), and participates in the statewide Michigan Invasive Species Coalition and the local cooperative invasive species management areas (CISMAs) guided by MISC. More information about MISC can be found at <https://www.michiganinvasives.org/>. FCTC will continue to cooperate with state-level coordination efforts in order to get the best, most efficient control for our invasive species.

3.6.1 History of Invasive Species Control on FCTC

Initially, the invasive plant species on FCTC were evaluated in the HQNAs using the Alien Plant Ranking System (DLZ 2005). The analysis resulted in an evaluation of species based on three criteria: their current impact in the natural areas, their ability to be a management problem and the probability for their control. The results of the ranking analysis show that glossy buckthorn (*Rhamnus frangula*), purple loosestrife (*Lythrum salicaria*) and garlic mustard (*Alliaria petiolata*) provide the most significant threat to the integrity of the natural areas at FCTC. See **Section G.3** for a summary of all the studies relating to invasive plants.

More recently, MIARNG has changed focus in dealing with invasive species on FCTC and is now using methods outlined in MDNR's *Meeting the Challenge of Invasive Plants: A Framework for Action*. This strategic plan has Early Detection and Rapid Response as the cornerstone, with prioritization considered for each region of Michigan.

Recent invasive species control efforts include:

- Galerucella beetles were released to control the purple loosestrife populations on post. Monitoring was maintained from 2002-2010. Given the success of the biocontrol, monitoring was discontinued while hands-on chemical management is used in areas that have light infestations. Beetle propagation and release will continue as funding permits.
- Shrub removal was done by hand in 2004 in several sites including the Lawler prairie and the mesic prairie.
- Since 2007, several key sites have received many person-hours of invasive plant removals, particularly in areas where prescribed fire is not feasible (due to geomorphology, lack of fuel on the ground, etc).
- MIARNG is also making use of large brush-hog type machinery to clear out the mesic prairie and other sites in need of shrub removal as needed.
- Rose rosette disease is on the post and appears to be reducing invasive rose populations. FCTC Environmental will continue monitoring this trend and will facilitate spread to more areas impacted by invasive roses when feasible.
- Prescription burns continue to be used in the HQNAs, not only to help in restoration efforts (see **Section 3.4**), but also for invasive plant control. In areas where prescribed burns have been conducted, effective invasive plant control has been observed. Amur honeysuckle and multiflora rose have been effectively top killed in large areas where sufficient light fuels were present. Even low intensity burns have effectively eliminated areas of tender garlic mustard rosettes. Follow-up spot control may be required to eliminate Amur honeysuckle. Garlic mustard requires repeat burns to reduce the seed bank, which is reported to be viable for up to five years.
- Great Lakes Ecological Management (GLEM) has conducted invasive plant treatments at FCTC since 2011. These treatments have occurred consistently at Whitman Lake and Mott Fen and sporadically elsewhere on the installation.
- MIARNG is working with Animal Protection and Health Inspection Services (APHIS) to manage the mute swan populations.
- An aquatic invasive animal survey (e.g., fish, mussels and crustaceans) is planned to identify threats and opportunities in aquatic habitats on FCTC.

Monitoring for invasive species occurs in conjunction with other monitoring, particularly the fire effects monitoring. The fire effects monitoring is providing data about how plants are responding to fire over time and how to modify management to reduce spread and density of invasive plants. An ongoing vegetation survey by Michigan Natural Features Inventory (MNFI) (expected completion 2021) is evaluating several aspects of the current vegetation, including HQNAs, priority invasive species and associated management prescriptions.

As new methods and technology become available, FCTC staff will insure that they stay on the cutting edge of invasive species management. Participation in state and regional invasive species networks and management initiatives will keep staff educated in the latest and greatest tools, and to stay abreast of new threats that emerge.

Invasive species management overlaps with soils (**Section 3.2**), water resources (**Section 3.3**), vegetation (**Section 3.4**), wildland fire (**Section 3.5**), fish and wildlife management (**Section 3.7**), and rare species management (**Sections 3.8**).

3.6.2 Management Prescriptions for Invasive Species

Categories of management in this section include terrestrial plants, aquatic plants and animals, forest pests, pest-borne diseases, and other pests. General management for invasive species and pest management include:

- Work with adjacent property owners to stay abreast of regional issues and pool resources when attempting to detect invasions early on.
- Projected climate changes (**Appendix I**) may mean rapid changes in the success of invasive plants and animals on FCTC and in the region.
- Implement control measures as adaptive management results in updated priorities and new methods are developed.
- Prioritize management to focus on those sensitive resources most easily protected and those invasive species where control is most likely to be successful; limited resources are available to control invasive species and they should be focused on actions with most likely chance of success.
- Develop an internal policy to manage invasive seeds and other propagules related to military equipment entering Fort Custer.

Terrestrial Plants

The purpose of terrestrial invasive plant management is to reduce threats to natural communities and native species, particularly in HQNAs. General management prescriptions are compiled from the Draft Michigan's Terrestrial Invasive Species State Management Plan (MDARD et al. 2018), Fort Custer reports (Wick 2016; Kornoelje 2017), priority lists (**Appendix G**), and the various DoD, MIARNG, and Fort Custer policies, as applicable. **Tables G-4 and G-5 in Appendix G** summarize the full suite of priority invasive plants, from those documented on Fort Custer, those documented in Michigan but not at Fort Custer, and those not yet documented in Michigan. The following are the priority terrestrial invasive plants already documented at Fort Custer:

- High
 - Reed phragmites – may increase with climate change, previous control efforts have reduced to small infestations

- Japanese barberry
- Oriental bittersweet
- Multiflora rose
- Autumn olive
- Glossy buckthorn
- Reed canary grass – may increase with climate change
- Medium
 - Tree of heaven
 - Spotted knapweed
 - Honeysuckles (red, Amur, Morrow, hybrids) – some of these may increase with climate change
 - Black locust
 - Narrow-leaved cattail
- Low (due to low impacts or due to inability to control)
 - Norway maple
 - Dame’s rocket
 - Garlic mustard – previous control effects have reduced to minimal impacts
 - Canada bluegrass
 - White sweet clover
 - St John’s wort

There are several priority species that have not yet been documented on Fort Custer, but which are surveyed for every year to facilitate early treatment (see **Table G-4 in Appendix G**). Any new species that are documented will be evaluated and their priority for treatment will be adjusted accordingly. While the projected increases in temperature may favor invasive plants, it is not believed that many of the documented or potential terrestrial plants are likely to increase substantially as a result of climate change (except as noted above; see **Table G-4 in Appendix G**).

Several invasive plants are found throughout FCTC and these species cause impacts to military missions due to the large thorns and dense growth pattern of the species. In addition to removing these species to reduce impacts to native species, it benefits military training to have these species controlled for ease of traversing the woodlands. Bivouac uses and land navigation are two of the primary training missions at FCTC and both of these can be impacted substantially by invasive plants.

Management actions for terrestrial invasive plants include:

- Complete surveys annually in order to carry out the EDRR program for priority invasive plants. These priority targets are updated annually based on current conditions.
- Invasive plants in HQNAs are the highest priority although generally they are minimal in density and have a high probability of successful management as long as maintenance control activities continue.
- Only forest management techniques proven to minimize invasive plants can be used within 700 feet of an HQNA.
- Reduce invasive plants in corridors that connect HQNAs.
- Particular attention should be paid to roads during monitoring and control efforts, since infestations at access points and smaller order roads will require long-term management.

- Minimize disturbance of soils, especially in areas where invasive plant species do not have a foothold.
- Continue ongoing efforts to control invasive plants, monitor following any forest or fire management, and ensure that any forestry and fire operations address any invasive plants afterwards.
- A reevaluation of the past management should be conducted within the next few years as funding allows.

Aquatic Plant and Animal Pests

Little is known invasive aquatic plants at FCTC, although purple loosestrife is documented on site and control measures have already been taken for this species as it impacts HQNAs. Suggestions for locations for further beetle treatments are provided in the latest invasive plant survey (Kornoelje 2017).

A survey specific to aquatic invasive plants will start soon and priorities for these species will be updated once complete. A survey for aquatic animals is also planned and any invasive aquatic animals documented will be evaluated for management at that time. Unlike terrestrial invasive plants, many of the potential aquatic invasive plants are likely to respond positively to warming temperatures and other projected climate changes. This makes this group an important target for surveys and better understanding of their current distribution on Fort Custer as they are likely to increase as a management concern as more species move north.

As with terrestrial plants, above, general management actions were compiled from the Michigan's Aquatic Invasive Species State Management Plan (MDEQ et al. 2013), priority lists (**Appendix G**), and the various DoD, MIARNG, and Fort Custer policies, as applicable. **Tables G-4 and G-5 in Appendix G** contains the current list of invasive aquatic species that are priorities for management due to the ecological threats they pose. Management actions for aquatic invasive plants include:

- Ensure that any equipment (military, biological surveys, etc.) used in any water resources are cleaned before and after use to prevent spread.
- Minimize disturbances in and near water resources to prevent new establishment by invasive plants.
- Complete survey of aquatic invasive plants and identify priority species and areas.
- Reduce invasive plants in corridors that connect HQNAs.

Forest Pests

Forest pests have not been a major issue for natural resource management on Fort Custer, with oak wilt, gypsy moth, and emerald ash borer (EAB) being documented on site (**Appendix G**). Projected climate changes of reduced annual snowfall and warmer winters may increase the presence of forest pests and allow warmer weather forests pests to move north.

Oak wilt is the highest priority forest pest at FCTC. Gypsy moths do occur on FCTC and whenever an outbreak occurs FCTC Environmental coordinates with MDNR and United States Forest Service (USFS) as needed to manage the outbreak. EAB are established at FCTC and little can be done to reduce their impacts at this time, although ash trees were not historically a major component of forest diversity. Management actions were taken from the IPMP (DLZ 2017) and MDNR Forest Health website (https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_81077---,00.html).

Management actions for forest pests include:

- Maintain partnerships with local MDNR and/or USACE forestry staff and participate in regional working groups to stay up-to-date on the latest issues and outbreaks in forest pests.
- Use the DoD-US Forest Service Memorandum of Agreement (1990) for Forest Health Protection projects when needed.
- Report any disease or pest outbreaks noted immediately to other forest resource specialists and managers and seek their input on management decisions and dilemmas.
- Where disease infestation or fire/windthrow disturbance mortality is extensive, pre-salvage or salvage of forest products may be appropriate.
- Use legal chemical pesticides which are reasonably cost effective, meet management objectives, and optimize the natural mortality factors in the ecosystem to reduce or maintain populations of organisms at tolerable or endemic levels. Economic, ecological, and social values will be used in determining tolerable levels.
- Use legal alternatives to chemical pesticides which are reasonably cost effective and available and meet management objectives. When chemical pesticides are used, the least toxic, most effective, narrowest spectrum products labeled for the target species should be selected.
- If using biological controls to kill pests, use only host-specific predators, parasites and pathogens with proven effectiveness and approved by APHIS.
- Use silvicultural management to manipulate the environment to make it more favorable for desirable plant growth and less favorable for pest growth.
- Use cultural controls, such as good site selection or planting resistant varieties, to prevent pest populations from building to unacceptable levels.
- Monitor forests on at least annually either specifically for forest pests or during the course of other natural resource management activities (e.g., taxa surveys, prescribed burn activities, or invasive plant control measures).
- Encourage mixed age classes in all vegetation types, but especially in oak stands. Advanced age in oak stands means that oak wilt is a higher risk.
- Track information about forest pests new to the region or increased outbreaks of established as a result of changing climate.

Pest-Borne Diseases Affecting Humans

Pest-borne diseases of concern at Fort Custer have traditionally been Lyme disease, West Nile virus, and hantavirus (**Appendix G**). As with forest pests, projected climate changes of reduced annual snowfall and warmer winters may increase the viability of the diseases and increase the abundance and distribution of their hosts.

Monitoring and close communication with the Michigan Department of Health and Human Services are important for rapid response when necessary. The MIARNG State Surgeon will remain aware of any new disease vectors entering the area and assess and disseminate any surveillance and control measures deemed necessary. Management actions for pest-borne diseases include:

- Advise those working outside for long periods of time of their increased risk for infection with mosquito and tick-borne illnesses

- Educational materials for soldiers, staff, and recreationists should be maintained, distributed, and permanently displayed in order to inform people about minimizing risk and exposure. These materials should be updated on a regular basis.
- Landscaped areas should be kept well-mown, trees and shrubs should be kept trimmed and away from trails and structures, and frequently-used items (e. g. playscapes, decks, walking paths) should be located away from woodland edges and kept in a well-maintained or mulched area free of leaf litter.
- Standing water should be changed every 2-4 days. Large debris harboring rainwater or snowmelt should be removed.

Other Pests

Terrestrial invasive animals are not a significant concern on Fort Custer. A small population of feral cats exists on FCTC and sporadically they are trapped and spayed or removed. However feral hogs (*Sus scrofa*) have the potential to become a major concern. If feral hogs do invade FCTC, MIARNG will have to implement a management program to prevent damage on Fort Custer. Regular monitoring and reporting along with a rapid response are recommended for other pests on Fort Custer as identified in **Appendix G**.

3.6.3 Fort Custer Objectives and Policies

GOAL INVASIVE SPECIES (IN): Minimize impacts of invasive and pest species using an integrated pest management approach.

- OBJECTIVE IN1: Continue early detection and rapid response to reduce and eliminate new invasive species in both aquatic and terrestrial areas.
- OBJECTIVE IN2: Minimize impacts of invasive species and pests on the military mission, native species, and sensitive natural resources.
- OBJECTIVE IN3: Minimize impacts of forest pests on the military mission, forest composition, and sensitive natural resources.
- OBJECTIVE IN4: Minimize exposure to dangerous diseases by users of Fort Custer.

Laws, Policies, and Guidance:

- Comply with federal and state laws, such as Noxious Weed Control Act, Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and other laws and regulations described in **Appendix J**.
- Implement IPMP:
 - All pesticide use and storage will be compliant with the IPMP, permits, labels, and relevant laws and regulations.
 - Maximize integrated strategies and minimize pesticide use when possible.
- Continue early control and rapid response to invasive species and pests.
- No cutting of trees during the growing season (1 April to 1 October) to prevent the spread of oak wilt (as well as minimize impacts to bats and migratory birds).

- Work cooperatively with state agencies and individual counties to prevent the introduction and establishment of noxious weed infestations, control existing infestations, and share resources and expertise.
- During planning for any management, conduct a noxious weed risk assessment and incorporate mitigation and control as needed into any action. During any management actions, ensure that all equipment is weed-free.
- Priority areas for annual monitoring and treatment are wetlands and riparian zones, HQNAs, and rare plant communities.
- Establish policies and procedures to keep military vehicles clean of invasive plant species propagules.
- Do not use invasive plants in landscaping or revegetation.

3.7 FISH AND WILDLIFE MANAGEMENT

Fish and wildlife management at Fort Custer maintains and restores natural habitat for native fish and wildlife in a manner consistent with accepted scientific principles, in compliance with federal and state laws and other land use agreements and as required by the SAIA and other DoD regulations and policies (**Appendix J**). Military and land management practices influence wildlife numbers and species composition, particularly vegetation management and prescribed burning (**Sections 3.4 and 3.5**).

Presently, the approach to managing the fish and wildlife resources on FCTC is to maintain the overall integrity and diversity of existing habitats and to reduce overabundant or nuisance populations of wildlife through hunting opportunities or other means of population control. There are localized and event-specific wildlife enhancement activities, such as bat boxes and osprey platforms. These are associated typically with a specific event, like National Public Lands Day or another outreach or outdoor recreation activity.

The vegetation management programs at FCTC actively improves wildlife habitat. Prescribed burns for management of the HQNAs have resulted in plant community changes that provide improved habitat conditions for a whole suite of animal species. The prescribed burns have resulted in lifting lower limbs and top-killing over-abundant woody saplings. Burns also reduce multiflora rose, Amur honeysuckle, and garlic mustard; all exotic plants that adversely impact woodland plant communities. This allows for increased light levels at the woodland floor. The net effect in the ground layer is an increase in fine fuel species (e.g., woodland sedges), an increase in forb abundance, and an increase in the number of overall flower stems. These plant community changes promote an increase in invertebrate diversity and abundance resulting in more food at the base of the food chain with an upward rippling effect.

At an installation-wide scale, MIARNG is concerned that the mosaic of natural communities existing on post adequately support animal populations, combined with management of animal species when abundant populations negatively impact training. This means that some species may require management to increase their numbers, while other over-abundant animals need to be controlled due to negative ecological impacts or mission impacts.

Climate changes over the next several decades are likely to result in changes in animal distributions, especially in migratory animals. There have already been documented shifts in bird distributions that shows a shift gradually northward. Data from the regular surveys will be valuable in tracking changes,

both for species shifting out of the region to the north and those shifting into the region from the south. These changes may also result in changes in non-native animal distribution and abundance.

3.7.1 Hunting

Hunting can serve to both reduce overabundance of game species (and sometimes invasive wildlife) and provide outdoor recreation opportunities as mandated by the Sikes Act. Hunting occurs through organized events open to the public and is available to people with existing access to FCTC (i.e., those with military identification). More information and applications are available at <http://fortcusterhunt.org/>.

There are three regular annual hunting events, although occasional other organized hunts may occur. One organized hunt is the Freedom Hunt, which was expanded in 2007 to include an entire weekend and includes catered banquets, merchandise giveaways, range time for hunters, lodging, meals, guides, etc. All provided free of charge to the hunters. There are approximately 50 hunters supported by about 50-80 volunteers each year. This event is supported entirely by community sponsors.

A second organized hunt is in the spring for youth hunters to hunt wild turkeys and started in 2001. It was expanded after collaborating with the National Wild Turkey Federation. Data collected by MDNR over several years, including translocating turkeys from FCTC to restock other locations, indicated that approximately 30 turkeys could be harvested per year. During this youth hunt, 5 turkeys are typically harvested each year by approximately 10 hunters. Since the spring turkey hunting season runs from late April through late May, it avoids the most active period of training at FCTC (summer through early fall).

The third and largest annual, organized hunt began in 1985 and occurs one weekend in November during firearm season. This event includes firearm opportunities on 6,333 acres of FCTC (excludes the North Impact Area and the cantonment area). This is organized into six separate hunt areas. Each area is kept below a maximum safe number of hunters, based on an assessment of terrain and vegetation density factors. This approach not only provides for a safe hunt, but also allows the harvest to satisfactorily reduce and stabilize the herd. Management of the hunt itself requires considerable assistance from citizen volunteers and MIARNG personnel. Approximately 150-250 hunters participate each year and success is variable. An MDNR conservation officer assists with law enforcement during this event.

MIARNG completed a formal evaluation and report of the installation's deer herd size and general health, as well as age and sex composition, in 2010. The analysis also evaluated the effects of the present herd size on vegetation and ecological communities. The data indicated the deer population was not currently having obvious negative effects on vegetation on FCTC, but recommended continued deer harvesting.

3.7.2 Nuisance Wildlife

Hunting opportunities for other species of wildlife that are abundant, over-abundant or reaching nuisance levels may be considered as needed. Feral hogs are present near FCTC and if these become established on FCTC, control activities will be undertaken using professionals with experience removing this species. It is likely that incidental kills during other hunting activities would be allowed, in compliance with state hunting laws. A nuisance individual or species is generally defined as one that causes unacceptable damage or risk of damage to a natural or man-made element. This could include being a carrier of disease, causing disruption of a hydrologic regime, destruction of vegetation, or

flooding of a road or facility. Population control of over-abundant or nuisance non-game wildlife (such as woodchuck and pigeon) would generally be performed on an as-need basis and as outlined the IPMP. Control in this manner would pertain only to those species not covered by game laws or other wildlife management regulations.

Presently raccoons are the only game species known to reach nuisance levels regularly on FCTC. Raccoons are known to eat turtle eggs (including rare box turtle eggs) and cause breeding failures in ground nesting birds, including data collected on FCTC. Signs of racoon damage are noted during bird, reptile, and amphibian surveys. There are occasional racoon hunts and/or professional trapping on FCTC when necessary to reduce the population. Alternative control strategies will continue to be evaluated for this species.

3.7.3 Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act, which is administered by USFWS. Regular monitoring of migratory breeding birds has been conducted at FCTC since 2001. For breeding birds, the current point counts and area searches are conducted every 3-5 years to assess population trends over time, with the original baseline of four consecutive years of data. This has been augmented with the Monitoring Avian Productivity and Survivorship (MAPS) Program, which is a continent-wide network of hundreds of constant-effort mist netting stations. Analyses of the resulting banding data provide critical information relating to the ecology, conservation, and management of North American landbird populations, and the factors responsible for changes in their populations. For more information on MAPS, visit <http://www.birdpop.org/maps.htm>. There is currently a contract to analyze all the years of migratory bird data from FCTC and identify any trends and patterns in the data. Once that information is available, management prescriptions may be developed.

FCTC and FCRA provides a large, mostly contiguous forest canopy that provides important refuge for many species of birds, which would otherwise not be present in this very populated and developed portion of the state. Because FCTC appears to serve as a major population center for several grassland and forest dependent species of birds, studies are currently underway to help determine regionally-scaled land management strategies that will ensure species' habitats are sustained, at least at FCTC.

MIARNG has undertaken regular avian point count surveys in forest areas surrounding harvested stands. Pre-cut and post-cut point count surveys (generally one year before, one year after) are conducted as a means to assess changes in bird species composition and abundance relative to changes in habitat caused by timber harvests. One important question to be addressed will be the effects of cutting on brown-headed cowbird (*Molothrus ater*) numbers and nest parasitism. These studies, along with information from on-going habitat data collections, will be critical in defining vegetation management objectives that sustain and improve populations of breeding birds inhabiting the forests, grasslands, and wetlands of FCTC. The pre- and post-timber harvest data has not yet been analyzed but this analysis is ongoing with other projects.

MIARNG anticipates continuing with migratory bird surveys in some form on an annual basis and the results will continue to contribute to adaptive management on FCTC.

3.7.4 Other Wildlife

Annual frog and toad monitoring using standard MDNR methods on two MDNR survey routes was implemented to complement the more comprehensive herptile surveys. The data from this monitoring

was submitted to the MDNR Herp Atlas (<https://www.miherpatlas.org/>). Data from these surveys can be used to assess changes in long-term population trends at FCTC, regionally and statewide, and can be used to compare with other statewide or regional census data for tracking population trends at a larger scale. Acoustic data loggers will be used in the future to continue this data collection.

3.7.5 Fish and Aquatic Invertebrates

Active management of fish and other aquatic resources is not presently occurring at FCTC. There are two reasons for this – lack of accessible aquatic habitat and the inability to conduct biological surveys due to presence of unexploded ordnance. There is some perennial open water, several perennial streams, and several types of wetlands that provide fish habitat. The limited surveys that have been completed, including some eDNA surveys, have generated a fish species list, provided in **Appendix H**. Additional surveys of aquatic species are planned for the near future.

Fishing currently is allowed on FCTC, but only in limited areas, due to water quality concerns. The fishing program is run as a Morale, Welfare and Recreation (MWR) program and is limited to people with identification that allow access to FCTC.

3.7.6 Management Prescriptions for Fish and Wildlife

The Michigan WAP contains a framework for conserving wildlife and their habitats through cooperative partnerships throughout the state (Derosier et al. 2015), as discussed in **Section 1.8.3**. Although the WAP focuses on key habitats and focal species (e.g. SGCN and “featured species”) within those habitats, the management strategy for fish and wildlife at FCTC focuses more on habitat protection and restoration overall than on individual fish and wildlife populations. However, it is helpful to consider the areas of focus for other agencies.

General management prescriptions are compiled from Michigan’s WAP, biological reports (**Appendix D**), and the various DoD, MIARNG, and MDNR policies, as applicable. Note: There is no airfield at Fort Custer, so BASH management is not included in this INRMP.

Below are discussions on managing fish and wildlife habitat and game population management.

Managing Habitat to Benefit Fish and Wildlife

Managing vegetation focuses on implementing forest management and prescribed burns that provide for a diversity of vegetative types in order to provide a range of habitats for fish and wildlife. The forest should have an adequate mix of young timber stands, bogs, openings, and old-growth. Snag and den trees are important, as well as a variety of shrubs, grasses, forbs, and herbs. Both game and non-game species will benefit from these management strategies. As discussed in **Sections 3.4, 3.5 and 3.6**, vegetation management at FCTC involves forest management, prescribed burning, clearing and mowing, invasive species removal, and ecological restoration. Most vegetation management is done through prescribed burning. See **Section 3.8** for management of protected species.

Fish and wildlife habitat management prescriptions include:

- Continue prescribed burning to maintain HQNAs and improve native vegetative communities.
- Continue vegetation management described in **Section 3.4**.
- Minimize roadside mowing during bird nesting season.

- Do not remove trees between 1 April and 1 October to prevent spread of tree diseases and minimize disturbance of nesting birds and roosting bats. If an emergency removal, the tree and immediate area must be surveyed for active bat roosts, bird nests, or turtle nests to verify their absence before removal. If any present, coordination with USFWS may be necessary.
- Continue wetland protection management as an important component of managing fish and wildlife (see **Section 3.3**).
- Maintain riparian vegetation and protect wetland areas from ground disturbance and invasive species.
- Maintain healthy native aquatic plant communities in order to support the populations of native fish.
- Protect and restore aquatic habitat to protect fish by preventing removal of vegetation, erosion, loss of downed timber, warming temperatures, poor water quality, changes in stream flow, and blockage of fish passage. In particular, maintain shading over streams to help minimize impacts from increased temperatures occurring as part of climate change.
- Fish and other aquatic species will be particularly vulnerable to climate change due to sensitivity to changes in water temperature, peak flows, and flooding. Vulnerability assessments for these species should be reviewed as climate projections and species data improves for the region and the assessments are updated by other agencies.

Game Management

Common game species present on FCTC that are managed by the State of Michigan includes white-tailed deer, wild turkey, and waterfowl, as well as small game species and animals trapped for their furs (MDNR 2019). See MDNR for more information at https://www.michigan.gov/dnr/0,4570,7-350-79119_79147---,00.html. While these are all legal game species in Michigan, the only game species actually hunted on FCTC are white-tailed deer, turkey, and occasionally racoon. Management actions for game species include:

- Assess deer herd every 5-10 years for size, age structure, and health.
- Manage deer for a population level that prevents damage to rare plants and habitats.
- Implement hunting requirements to encourage improvements to the deer herd.

3.7.7 Fort Custer Objectives and Policies

GOAL FISH AND WILDLIFE (FW): Manage fish and wildlife, including game species, and their habitat to maintain healthy populations without interfering with the military mission.

- OBJECTIVE FW1: Manage populations of priority game species as part of regional management plans, in coordination with MDNR and without impacting the military mission.
- OBJECTIVE FW2: Maintain healthy populations of native fish and wildlife species, with targeted management for priority species, without impacting the military mission.
- OBJECTIVE FW3: Maintain diverse, high-quality fish and wildlife habitat with associated corridors, without impacting the military mission.

Laws, Policies, and Guidance:

- Do not handle or collect any fish and wildlife, other than those allowed through the hunting and fishing programs
- Ensure stream crossings (including culverts) do not create barriers to upstream or downstream passage for aquatic-dependent species
- No tree removal between 1 April and 1 October to prevent spread of tree diseases and minimize disturbance of nesting birds and roosting bats (except for emergency removals with FCTC-ENV approval)
- Follow Mowing SOP to minimize impacts to ground-nesting migratory birds and other wildlife
- Use professional experts for removal of nuisance wildlife as primary means of control
- Policies related to hunting
 - Hunters must have appropriate hunting permit/license from MDNR
 - All hunters must complete hunter's orientation
 - Comply with any off-limits areas
 - Standing trees and branches may not be cut
 - Blinds must be dismantled at end of hunting season
 - Remove all trash and material; leave no trace
 - Anyone who does not comply with policies will be subject to banning or other actions
 - No dogs may be used or brought onto Fort Custer
 - No trapping or small game hunting without prior approval
- Policies related to fishing
 - Active duty military personnel are not required to obtain a fishing license; others must have current Michigan fishing license
 - Comply with any off-limits areas
 - Standing trees and branches may not be cut
 - Must check in and check out daily and exit prior to dusk
 - Live bait fish may not be used
 - Remove all trash and material; leave no trace
 - Anyone who does not comply with policies will be subject to banning or other actions

3.8 THREATENED AND ENDANGERED SPECIES MANAGEMENT

As required by ESA, Michigan Endangered Species Act (MESA), and DoD and MIARNG policies and regulations, federally and state listed threatened and endangered species and their habitats are protected and managed on Fort Custer. The MIARNG and Fort Custer staff work closely and cooperatively with the USFWS and the MDNR for listed species management, as appropriate.

Surveys of all taxa have spanned several decades and are summarized in **Appendix D**. All known special status species, their federal and state status, and a species summary for each is presented in **Appendix H**. Overlapping with rare species management is water resources (**Section 3.3**), vegetation (**Section 3.4**), and fish and wildlife management (**Section 3.7**). Key legislation related to listed species can be found in **Appendix J**.

This section provides management summaries for state listed species and then federally listed species. **Appendix H** provides more details on each species including surveys and population history.

There are 10 federally protected or state listed and 15 state species of concern wildlife species documented on Fort Custer. In addition, there are 8 potential federally listed wildlife species that merit management consideration. There are 14 state listed and 8 state species of concern plant species documented on Fort Custer.

The listed wildlife species documented on Fort Custer include:

- Bald eagle – federally protected (BGEPA), state species of concern
- Henslow’s sparrow – state endangered
- Trumpeter swan (*Cygnus buccinator*) – state threatened
- Merlin (*Falco columbarius*) – state threatened
- King rail – state threatened
- Cerulean warbler – state threatened
- Common tern – state threatened
- Prairie vole – state endangered
- Blanchard’s cricket frog – state threatened
- Pugnose shiner – state endangered

The listed plant species (all state threatened) documented on Fort Custer include:

- Beaked agrimony (*Agrimonia rostellata*)
- Cut-leaved water parsnip (*Berula erecta*)
- American chestnut (*Castanea dentata*)
- Pale fumewort
- Upland boneset (*Eupatorium sessilifolium*)
- Queen-of-the-prairie (*Filipendula rubra*)
- Showy orchis (*Galearis spectabilis*)
- Stiff gentian (*Gentianella quinquefolia*)
- Downy sunflower (*Helianthus mollis*)
- Goldenseal (*Hydrastis canadensis*)
- Virginia flax (*Linum virginianum*)
- Red mulberry (*Morus rubra*)
- American ginseng (*Panax quinquefolius*)
- Lesser ladies-tresses (*Spiranthes ovalis*)

The potential federally listed wildlife species identified for Fort Custer include:

- Indiana bat (*Myotis sodalis*) – federally threatened
- Northern long-eared bat – federally endangered
- Eastern massasauga – federally threatened
- Copperbelly water snake (*Nerodia erythrogaster neglecta*) – federally threatened
- Rusty-patched bumblebee (*Bombus affinis*) – federally endangered
- Karner blue butterfly (*Lycaeides melissa samuelis*) – federally endangered
- Mitchell’s satyr butterfly (*Neonympha mitchellii mitchellii*) – federally endangered
- Poweshiek skipperling (*Oarisma poweshiek*) – federally endangered

The state species of concern wildlife species documented on Fort Custer include:

- Little brown bat (*Myotis lucifugus*)
- Tricolored bat (*Perimyotis subflavus*)
- Cooper's hawk (*Accipiter cooperii*)
- Grasshopper sparrow
- Northern harrier hawk (*Circus cyaneus*)
- Osprey (*Pandion haliaetus*)
- Prothonotary warbler (*Protonotaria citrea*)
- Hooded warbler (*Setophaga citrina*)
- Golden-winger warbler (*Vermivora chrysoptera*)
- Dickcissel
- Eastern box turtle
- Blanding's turtle (*Emydoidea blandingii*)
- Sprague's pygarcia (*Pygarcia spraguei*)
- Tiger spiketail dragonfly (*Cordulegaster erronea*)
- Leafhopper (*Flexamia reflexa*)
- Watercress snail (*Fontigens nickliniana*)

The state species of concern plant species documented on Fort Custer include:

- Leadplant (*Amorpha canescens*)
- White false indigo (*Baptisia alba* var. *macrophylla*)
- False boneset (*Brickellia eupatorioides*)
- Sedge (*Carex amphibola*)
- Field dodder (*Cuscuta campestris*)
- Wahoo (*Euonymus atropurpurea*)
- Brown widelip orchid (*Liparis lilifolia*)
- Prairie dropseed (*Sporobolus heterolepis*)

A regular monitoring program is the foundation for the conservation of listed and other rare species at FCTC. Regular surveys and monitoring provides an ongoing check of rare species status, providing an "early warning" of any observable problems with these species occurrences on post. The biological surveys from 1993 through 1995 provided the baseline for the presence, location, and population size of all sensitive species. Annual bird surveys and updated surveys specific to rare species have been completed that assist with documenting changes in rare species populations on Fort Custer. The rare species monitoring is focused on: 1) the status of rare species relative to baseline conditions and any observation of site disturbance in known or potential high quality habitat; 2) overall population trends based on habitat conditions and species abundance; and 3) the need for changes in land use and natural resource management, as a result of the findings.

MIARNG generally surveys for listed plants and wildlife occur every 3-5 years, while special concern species are generally surveyed as part of other planning level surveys. Rare plant surveys are generally qualitative assessments of plant vigor, abundance, and habitat conditions conducted at a minimum every 5 years during the peak flowering period of each plant, using established MNFI methods for the

target species at the time of the survey. Wherever monitoring results indicate rare species may be experiencing impacts associated with training, land use or land management activities, MIARNG will seek to better determine the cause and mitigate adverse impacts.

3.8.1 Management Prescriptions for Threatened and Endangered Species

3.8.1.1 General Management

This section is divided into four sections: general, federally protected species, state listed species, and state species of concern. General management for all rare species includes:

- Conduct regular monitoring of protected species, based on USFWS and MDNR guidelines and consultation.
- Implement an education and outreach program to educate both users (military and public) of Fort Custer and surrounding landowners.
- Cooperate with USFWS, MDNR, and other cooperating partners for surveys, education, and management of rare species.
- Only use pesticides, fertilizers, and other chemicals in accordance with federal and state laws and the MIARNG IPMP.
- Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas,
- Continue to identify projects that gather more data on federally listed species, particularly when that data can assess potential impacts from military training or if it may modify the conditions placed on military training, cooperating with other agencies as appropriate.
- Review forest management operations for potential conflicts between rare species and proposed forest operations following the guidance in MDNR's *Approach to the Protection of Rare Species on State Forest Lands*, especially when listed species are present or past surveys have indicated a possibility of their presence.
- Employ industry-accepted BMPs, where it does not conflict with military training, to prevent birds from colliding with or being electrocuted by utility lines, towers and poles; to prevent birds from colliding with windows; and to minimize impacts of night lighting on wildlife.
- Incorporate information and recommendations from the climate change focus groups that Fort Custer will be hosting over the next few years for listed species sensitive to climate change.

3.8.1.2 Federal Endangered Species Act Listed Species

There are eight federally listed species with the potential to occur on Fort Custer that are protected under the Endangered Species Act. Management prescriptions for each of those species are identified below. Some of these species already have active surveying and management activities on Fort Custer, while other species have had less focus since being listed or identified as a potential species. All these species are likely to be adversely impacted by projected climate change.

Northern long-eared bat: No confirmed presence in surveys in 2005 or 2015, but very likely to occur in this region and potential foraging and roosting habitat occurs on FCTC. Management is similar to Indiana bat below.

Indiana bat: Not documented in 1993, 2004, or 2015 bat surveys, but there are colonies nearby and marginal potential roosting habitat occurs on FCTC. Management for both bat species includes:

- Update bat survey every 5 years following current USFWS survey guidelines.
- Forestry operations will be conducted only during the period 1 October through 1 April, to prevent spread of tree diseases and minimize disturbance of nesting birds and roosting bats. Procedures for cutting individual standing trees are described below.
- In the course of planning for all timber harvests, trees that are judged suitable for roosting Indiana bats (standing trees with loose or peeling bark, cavities and/or significant crevices) or northern long-eared bats (similar to Indiana but will use snags and more isolated trees) will be marked and retained where feasible and consistent with military training, installation safety, and control of invasive trees.
- Suitable roost trees that have fallen to the ground may be removed without restriction.
- Infrequently during the “no cut” period (1 April to 1 October), suitable roost trees may need to be removed as part of land management. This includes trees that present a safety hazard, imminent risk of facility damage, obstruction of access to training. If either bat species is documented on-site, then the last four steps below will be adhered to if this situation occurs.
 - Before trees are felled, FCTC Environmental will determine if they are potential bat roost trees or if they contain active bird nests. If there are no active bird nests and they do not meet the bat roost tree characteristics (standing trees with peeling bark and/or cavities and significant crevices) then they can be cut down and removed.
 - If the tree(s) appear to be potential roost trees, then an “exit survey” will need to be conducted before any trees can be felled and removed.
 - The exit survey consists of observing the potential roost trees at dusk (approximately 3/4-hour before and after sunset) for one night. If no bats are seen exiting the trees, then they can be felled. If bats are seen leaving the trees, a bat expert must perform identification of the bat species.
 - If the species found using the trees are not Indiana bat or northern long-eared bat, then the trees can be felled. If either bat species is identified, MIARNG cannot take any action that would destroy the tree or harm or harass the bat, and either removal must be delayed until after October 1 or Section 7 consultation must be initiated with USFWS.

Eastern massasauga rattlesnake: The eastern massasauga rattlesnake is known to occur locally, with two populations just outside the boundary of FCTC, and high-quality potential habitat occurs on site. Various surveys have been undertaken for them over the last two years, but they have not been documented. FCTC Environmental staff use *Environmental Screening for Eastern Massasauga Rattlesnake in Michigan, March 14, 2017* to evaluate potential impacts to eastern massasauga rattlesnake. Currently, FCTC has some areas considered Tier 2 habitat, but no Tier 1 habitat. For these areas, the MIARNG will follow the BMPs included in the *Environmental Screening* when feasible.

MIARNG includes information on the eastern massasauga rattlesnake in all FCTC environmental briefings. Management prescriptions were developed based on MDNR and USFWS recommendations, which includes (Derosier et al. 2015; MDNR 2016; USFWS 2016):

- Continue surveying for species in most likely habitat during optimal time period (the best opportunity being warm days in early spring through summer during the gestation period, and late fall surveys), using current USFWS protocols.

- Use of prescribed fire with restrictions during emergent season (typically March/April), in areas where species is documented.
- Mowing is allowed but with restrictions regarding grass height and emergent season, in areas where species is documented.
- Broad applications of chemical control products in forests are prohibited.
- Collection, release, relocation, and persecution of this species are prohibited.
- Wetland habitat loss and fragmentation should be avoided.
- Development and new road/trail construction should be avoided in occupied habitat.
- Avoid altering hydrology that could result in drought or artificial flooding, particularly in occupied overwintering habitat (if any documented).
- Plan habitat management and forestry carefully to avoid impacting snakes at different stages throughout the year (if occupied habitat identified).
- Continue educating users (public and military) and identifying protected areas to minimize incidental take and mortality of individual snakes.
- Create and distribute existing eastern massasauga identification and information card for FCTC.

Copperbelly water snake: This snake occurs in wetlands and has not been documented on FCTC. The management actions are to continue implementing wetland protection measures as described in **Section 3.3**.

Rusty-patched bumblebee: This species was recently listed and little is known about the potential for the species and suitable habitat on FCTC. The management actions are to complete ongoing bee-specific surveys and to continue vegetation management that improves prairie habitat on FCTC as described in **Section 3.4**.

Karner blue butterfly (KBB): Surveys have been conducted on FCTC for this species regularly since 1994. The highest quality potential habitat occurs in TAs 7, 8, and 9. Disturbance and training mission impacts are negligible to nonexistent in potential habitat. Surveys on FCTC have been conducted in historical oak openings at FCTC, during the known flight period of the species in an attempt to find the adult butterfly as well as its host plant, wild lupine. However, due to the presence of unexploded ordnance in much of the potential habitat, surveys and prescribed fire to improve the habitat has been limited and will remain so. Management for KBB focuses on habitat management and increasing the host plant (wild lupine). These management prescriptions include:

- Continue prescribed fire to maintaining and expanding the savanna and barrens habitat.
- Continue prescribed fire program to increase wild lupine populations, which have already responded positively on FCTC as result of prescribed fire.
- Reduce impacts from black raspberry (*Rubus occidentalis*), sassafras (*Sassafras albidum*), spotted knapweed (*Centaurea maculosa*), and other early successional plants in areas with lupines.
- Regular surveys are not recommended at this time as the nearest population is several miles away. If significant changes in the lupine population occur, a survey update would be merited (Cole-Wick 2018).
- If KBB are documented on FCTC, consider ways to expand prescribed fire into the impact area.
- If agreement can be reach with USFWS, the reintroduction of KBB would be considered as long as their presence would not impact training.

Mitchell's satyr butterfly (MSB): Surveys for this species have occurred regularly over the last 20 years and no individuals have been documented. Surveys will continue, as required by USFWS. Four high-quality fen sites of sufficient size to support populations of Mitchell's satyrs have been identified (KNC 2015). Potential habitat lies in the fens occurring in TAs 5, 6, 7, 8 and 9.

MIARNG is in the process of working with NGB, Army Deputy Chief of Staff for Installations, USFWS and FCTC staff to potentially reintroduce the MSB onto FCTC with proper legal protections and conditions to ensure such a release would not have any impacts on training or other installation missions. The site identified for reintroduction is a duded impact area (from WWII era) in TA9 and will likely never experience significant habitat loss. It contains a large, contiguous area of the preferred habitat with required host plant species. The same conditions occur at other potential release sites within the impact area. Additional information is included in the reintroduction plan currently being reviewed and approved by the various parties. Management for MSB on FCTC includes:

- Continue process to evaluate and possibly reintroduce MSB to FCTC.
- Continue managing the fens that provide high quality potential habitat, in particular reducing invasive plants. These fens are considered HQNAs and recommendations are provided in **Section 3.4**.

Poweshiek skipperling: Surveys have been completed for this species, sometimes in conjunction with KBB and/or MSB surveys, but none have been documented on FCTC. Potential habitat lies in TAs 5, 6, 7, 8 and 9. Management includes continuing surveys and managing prairie fens as identified in **Sections 3.3 and 3.4**.

3.8.1.3 Bald and Golden Eagle Protection Act

Only one federally protected species has been documented on FCTC: the bald eagle protected under the Bald and Golden Eagle Protection Act.

Bald eagle: There has generally been a bald eagle nest on Fort Custer most years over the last decade. This nest has been in a similar location most years and is monitored during the annual bird surveys. Guidelines and management on FCTC (based on USFWS recommendations for bald eagles during the nesting season in the Midwest, USFWS 2018) include the following:

- Non-motorized disturbances by humans (e.g., hiking, fishing, or camping) should stay at least 330 feet from any nests.
- Motorized activity, such as snowmobiles and off-road vehicles, should stay at least 330 feet from active nest(s). In open areas with little vegetation and increased visibility and exposure to noise, stay at least 660 feet from the nest.
- Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.
- Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.
- To avoid collisions, locate any towers and power lines away from nests, foraging areas, and communal roost sites.
- Where bald eagles are likely to nest in human-made structures (e.g., towers), equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting

platforms that will safely accommodate bald eagle nests without interfering with structure performance.

- Do not intentionally feed bald eagles.

3.8.1.4 *State Listed Wildlife Species*

All these species are likely to be adversely impacted by projected climate changes.

Prairie vole: The approximately 7 acre prairie vole site is posted as a no-entry area due to the particular vulnerability of the site to usage by heavy vehicles. The prairie vole has been monitored on FCTC over the last 25 years, beginning in 1995 and continuing through 2017. Continued monitoring of the prairie vole and its grassland habitat will be conducted every 3-5 years, contingent upon funding, in accordance with the methods already established unless new methods are identified that increase effectiveness and efficiency. Management for prairie vole includes continuing population and habitat monitoring and reduction of woody plants if they encroach on prairie vole habitat (Cooper 2000).

Cerulean warbler: Cerulean warbler populations have been declining at a precipitous rate most years, has been petitioned for listing twice, and MIARNG regularly supports studies to understand the population and habitat needs. Since 1997, population trends, distribution, and estimated survival rates of the cerulean warblers on FCTC have been monitored annually. The cerulean warbler has been documented on FCTC consistently since then, with the most recent results below:

- Breeding bird survey estimated the population size to be 46 males (Miller et al. 2002)
- Recent surveys documented 30 singing males in 2017 and 36 singing males in 2018 (Brenneman et al. 2017, 2018)
- Project on FCTC included the first radiotag ever on a female cerulean warbler
- Generally, nest along Longman Road, in mesic deciduous forest in TA 3 and 7

Management for cerulean warblers includes (Miller et al. 2008; Baldy et al. 2011; KNC 2013):

- Maintain 70% canopy cover over a solid hectare per mating pair in occupied habitat
- Use selective cutting to favor large, old trees in occupied habitat
- Minimize edge habitat to reduce nest parasitism
- Reduce locust density and increase oak, black walnut, and black cherry density
- Reduce disturbance in potential habitat, including reducing roadside mowing and adding buffers during timber harvests
- Continue annual or biennial population surveys

Henslow's sparrow: This species was documented only once in 2006. Management includes continued surveys and manage grasslands as described in **Section 3.4**.

Trumpeter swan, merlin, king rail, common tern, Blanchard's cricket frog, pugnose shiner: These species all use wetlands, open water, shorelines, islands, and other water-related habitat. None of these species currently have site-specific management plans for FCTC, as adverse effects from training are unlikely due to the water-related habitats generally avoided for training use and the fragile nature of these habitats might be damaged by the studies necessary to develop species-specific plans.

Management for these wetland and water-dependent species includes:

- Monitoring of trumpeter swans will continue using visual observations to detect attempted nesting twice during the breeding season (early April through late May)
- Continue removing mute swans to minimize competition with trumpeter swans
- Conduct fish surveys through FCTC to better determine understand pugnose shiner
- Document rare bird and frog species as part of ongoing surveys as relevant
- Implement protective measures described in **Sections 3.2 and 3.3** and habitat management described in **Section 3.4**

3.8.1.5 State Listed Plant Species

Of the 23 state listed (threatened or endangered) animal and plant species occurring at FCTC, currently only two have formal management plans written – the state listed endangered prairie vole (*Microtus ochrogaster*) (Cooper 2000) and the threatened plant, pale fumewort (*Corydalis flavula*) (Higman 1997). The core component of each plan is population and habitat monitoring. Neither plan recommended active management except when monitoring indicated either woody plants were encroaching on prairie vole habitat or annual quantitative monitoring showed pale fumewort reduced by 20 percent between any two years of monitoring.

Pale fumewort: Pale fumewort is monitored with annual quantitative survey at dedicated long-term locations, along with annual qualitative survey of all occurrences, installation-wide. The pale fumewort has been monitored annually since 1995. Control of garlic mustard began in 1998 and it has been significantly reduced in pale fumewort habitat. **Appendix H** summarizes the various studies for this species.

There are six known locations (northeast corner of TA2; northeast corner of TA1, southwest of the intersection of Longman Road and Territorial Road on the border with Fort Custer Recreation Area; along Augusta-Climax Road in TAs 7 and 4 in the Impact Area; and northeast of the intersection of Armstrong Road and Territorial Road in the Impact Area), with as few as 1,000 plants and as many as 10,000 plants in each location (Bassett 2016). The overall trend since 1995 indicates a declining population across FCTC, based on the permanent plots.

Invasive plants, particularly black locust and garlic mustard, are present in these areas and potentially contributing to population declines. However, recent data from garlic mustard control plots does not show a clear impact on pale fumewort populations (Bassett 2016). Pale fumewort populations at FCTC are almost entirely limited to sandy uplands dominated by the invasive black locust, which is not its typical habitat. Based on locations on neighboring FCRA, the species occurs in the terraces above floodplains without any black locust (Bassett 2016).

Management includes continuing garlic mustard control efforts and continuing to document the effects. Removing black locust and restoring a plant community with more native species appears to be a higher management priority based on recent results. Black locust should be removed using the “drill and fill” technique combined with planting native species in the understory and restoring oak openings when feasible.

Beaked agrimony, goldenseal, Virginia flax, upland boneset, American ginseng: These species are found in oak forests. Some more in riparian and some more upland, but they all appear to benefit from prescribed fire. With Virginia flax not being documented on FCTC until after prescribed fire was reinitiated in its habitat. Management for these plants includes:

- Continue prescribed fire, including increasing seasonal diversity, and monitor for effects from fire and adjust accordingly
- Continue invasive plant control
- Limit ground disturbance in known habitat
- Determine if seed collection and propagation might be effective at increasing the populations into new areas

Showy orchis, red mulberry, cut-leaved water parsnip, American chestnut: These species prefer wet areas, ranging from floodplain forests to wetlands. The American chestnut is currently only found in the Cantonment Area but prefers intermittent wetlands in natural vegetation. Management for these plants includes:

- Maintain buffers around water resources
- Monitor populations and identify any negative impacts (e.g., invasive plants)
- Mitigate any negative impacts if identified

Queen-of-the-prairie, stiff gentian: These two species prefer alkaline fens, although queen-of-the-prairie is sometimes found in drier areas. Management for these plants includes:

- Maintain buffers around water resources
- Implement a prescribed fire regime designed to maintain fens

Downy sunflower, lesser ladies-tress: These two plants are prairie species that prefer sandy soils. These two species are also expected to respond positively to projected climate changes. Management for these plants includes:

- Continue prescribed fire, including increasing seasonal diversity, and monitor for effects from fire and adjust accordingly
- Remove woody encroachment

3.8.1.6 *State Species of Concern*

In addition to the federal and state listed species, there are 23 state species of special concern known to occur on Fort Custer. While not afforded legal protection under MESA, many of these species have declining or relict populations in the state. Should these species continue to decline, they could be recommended for listing. In many cases, natural resources management benefiting federal and state listed species will also benefit these species. It is also possible these species might serve as good indicator species of the habitats they use. They are generally more common than listed species and increases in their populations may be a good indicator that management is improving the vegetative communities. However, this connection is still being researched in Michigan. See **Appendix H** for a complete list of species of special concern and a summary of their populations on FCTC.

Little brown bat, tricolored bat: These bats have different requirements from the Indiana bat and NLEB described previously. Little brown bats forage in every habitat type and have been known to roost in many different locations including man-made structures. Management includes:

- Maintain buffers around water resources to ensure healthy aquatic insect populations
- Continue prescribed fire with a seasonal mosaic to support healthy terrestrial insect populations
- Implement forestry practices as described in this INRMP

- Survey any buildings before demolition or alteration to ensure no bats are present

Cooper's hawk, northern harrier hawk, and osprey: These raptors have different habitat requirements but similar management:

- Verify no active nests between April and July before disturbing trees
- Maintain healthy fish and wildlife populations (see management in **Section 3.7**)

Prothonotary warbler, hooded warbler: Both of these species are found in floodplain forests. However, prothonotary warblers are very rare on FCTC and use holes in trees for nesting while hooded warblers are fairly common on FCTC and use saplings and shrubs for nesting. The primary management for these species is to maintain the buffers around water resources.

Eastern box turtle: This turtle species is reasonably common and found in a variety of habitats on FCTC. They are known to move around substantially during their active season. Previous studies have examined the effects of fire on this species and found that prescribed fire in occupied habitat during the early days of the active season when the turtles are still sluggish was associated with higher damage than later in the season. They need open sandy soils for nesting; this habitat type requires prescribed fire to prevent vegetation encroachment and conversion to unsuitable habitat. Management for this turtle includes:

- Continue prescribed fire to maintain habitat
- Avoid early spring burns until turtles are more active and avoid burns from June through July in occupied habitat to protect nests
- Use backing burns in known habitat to limit damage to turtles

Blanding's turtle, tiger spiketail dragonfly, watercress snail: These aquatic species are all found in a variety of water resources on FCTC. Management for these species includes:

- Maintain buffers around water resources
- Coordinate with regional efforts to protect groundwater, water resources, and natural hydrology

Grasshopper sparrow, dickcissel, leafhopper: These species are all prairie species that benefit from any vegetation management for prairies. Management includes:

- Continue prescribed fire, including increasing seasonal diversity (although avoid May – July to protect nesting birds), and monitor for effects from fire and adjust accordingly
- Remove woody encroachment
- Continue invasive plant control

Golden-winged warbler: This species only occurs as a migrant on FCTC. It generally uses oak openings during the breeding season, but may be use more habitat types during migration. Management for this species includes all the management that benefits migratory birds generally (see **Section 3.7.6**)

Sprague's pygarcia: This moth uses oak barrens and the host plant is spurge. The primary management is to continue prescribed fire with increased seasonal diversity to maintain oak areas.

Leadplant, white false indigo, false boneset, field dodder, prairie dropseed: These plants all prefer prairies and fields, with some species doing well along roadsides and other disturbed areas. Management for these plants includes:

- Continue prescribed fire, including increasing seasonal diversity, and monitor for effects from fire and adjust accordingly
- Remove woody encroachment
- Invasive plant control

Sedge (*Carex amphibola*), wahoo: These plants prefer floodplain forests. Management includes:

- Maintain buffer around water resources
- Introduce prescribed fire, although research is still ongoing about the timing of fire to benefit these species

Brown widelip orchid: This plant prefers mesic forests. Management includes:

- Maintain buffer around water resources
- Invasive plant control

3.8.1.7 *Monarch butterflies and bees*

While the monarch butterfly is not a state-listed species nor an official candidate species, the species has been petitioned for listing and is under review by the USFWS. In addition, several bee species are also being monitored, some have been petitioned and are under review. Due to the precipitous population declines of the monarchs and several bees, it is likely that at least some species may be listed in the near future. Comprehensive surveys for bees have been begun at FCTC. Once complete, more detailed recommendations will be developed. Based on current information, the management prescriptions include, and would generally benefit most insect pollinators:

- Continue management related to grasslands and oak openings to expand and improve these areas
- Increase herbaceous and understory diversity of native plants, both in natural areas and in landscaped areas
- Review updated management recommendations from Monarch Joint Venture (<https://monarchjointventure.org/news-events/news/revise-handout-mowing-and-management-best-practices-for-monarchs>) and implement as appropriate for FCTC
 - Use mowing to reduce woody encroachment, but rarely while monarchs are present (1 April – 15 October)
 - Mow monarch habitat in sections rather than all at once
- Incorporate pollinator-friendly BMPs as relevant for land management at FCTC (<https://www.fs.fed.us/wildflowers/pollinators/BMPs/>)
 - Identify foraging, nesting, and overwintering habitat
 - Manage invasive species
 - Use roadsides as pollinator habitat (see the Mowing SOP in **Appendix K** for FCTC)

3.8.2 Fort Custer Objectives and Policies

GOAL THREATENED AND ENDANGERED SPECIES (TE): Manage threatened and endangered listed species using an ecosystem approach, while supporting the military mission.

- OBJECTIVE TE1: Maintain federally listed species and their habitat, minimize impacts to federally listed species and their habitat, and complete required consultations, while minimizing impacts to military mission.
- OBJECTIVE TE2: Monitor and maintain state-listed species and their habitat, while minimizing impacts to military mission.

Laws, Policies, and Guidance:

- Fort Custer has established a mandatory, ongoing rare species awareness training program for personnel who may have contact with listed species or their habitat. The training covers the following topics:
 - Identification of listed species and markings that identify restricted areas
 - Actions necessary to avoid injury to listed species and their habitat
 - Pertinent requirements of the ESA and MESA and applicable regulations
 - Importance of protecting listed species and biological diversity
 - Mission activities must be consistent with the conservation of listed species and critical habitats
- Appropriate permits are required by anyone handling or surveying listed species from USFWS, MDNR, or other agencies as necessary
- Evaluate protective measures and management priorities based on new data and modify as needed, while minimizing impacts to military training
- Implement a 1,500 feet vertical and lateral buffer around active bald eagle nests
- Implement protective measures and management as identified for specific species
- Continue regular surveys to understand rare species populations

3.9 OUTDOOR RECREATION

In addition to issues of public safety and military security, public access and recreation must be managed within the limitations of the FCTC mission, the availability of personnel, and the carrying capacity of the land. Owing to these considerations, Fort Custer has limited outdoor recreation opportunities. There are two public recreation categories: 1) single day use by small groups or individuals (generally requiring no user fee), and 2) programmed or special events, involving many people, often for several days, and typically involving a user fee. Day use is generally easier to accommodate. Any use of the ranges is coordinated through the range staff.

Public visitation generally is limited to daylight hours. Recreation access is allowed only through the entrance at Denso Road, and with clearance from FCTC Headquarters. Should conflicts arise between a request for public use and military training, military needs always take precedence over public use.

Some public uses of FCTC are not allowed in any capacity, due to existing hazards at defined locations on the post. For example, fishing is limited to only a few locations outside of impact areas and UXO areas.

Minimizing adverse impacts to natural resources also impose restrictions on public use. Some activities known to cause resource damage are either limited or precluded outright:

- Off-road-vehicles (ORVs): Known source of soil erosion, destruction of vegetation, and disruption to wildlife behavior. These resource impacts along with the lack of FCTC staff to adequately control ORVs means their use must be restricted. Presently at FCTC, ORVs are limited to seasonal use by legally licensed handicapped hunters, and infrequent official use by staff or contractors. Restrictions to ORV use are consistent with DoD guidance and AR 200-1.
- Mountain biking and horseback riding: Can cause natural resource damages with unsupervised use. These activities are limited to programmed events that can be managed to limit adverse impacts.
- Collection of non-cultivated, wild plants: Collection of whole plants (native species) is unlikely to be approved unless a compelling benefit can be identified. Exceptions may be made for members of Native American tribes, with coordination with FCTC-ENV. In no instance will it be permissible to commercially collect any state- or federally-listed threatened or endangered, proposed, candidate, special concern, or other designated rare or sensitive species.

3.9.1 Recreational Day Use

Recreation day use is limited to people with a military or other identification that allows access to Fort Custer. All public visitors intending to access or use the installation for recreational purposes for a single day during daylight hours will adhere to the following procedures:

- All recreational users of the post must enter through the main gate off Denso Road and report directly to Operations Staff in the Headquarters. Recreational users must sign the clipboard in Headquarters to indicate when they arrived, their estimated time of departure, and upon leaving, their actual time of departure.
- Recreational users should call in advance to make arrangements for day use of the post. Day users will be accommodated dependent on available staff resources and whether other activities would present a conflict with the requested use.
- Recreational users of FCTC must abide by all Michigan fish and game laws, as well as additional environmental laws, which prohibit harm to migratory birds, sensitive species of plants and animals, or impairments to wetlands, soil, air or water quality. Any use affecting the environment at FCTC, that has not specifically been authorized, will require an advance request for approval by the Post Commander and FCTC-ENV.
- Failure to observe these guidelines will be sufficient reason for expulsion from the post as well as denial of future use.

3.9.2 Special Events

Special events often involve groups of 15 people or more, are fairly structured, last from ½ day to several days, and are planned well in advance. Advance arrangements are made with a Facilities Request Form and include a user fee and are coordinated with the FCTC Range Control Staff. Within this category there are two sub-classifications: 1) Reserved and 2) Accommodated.

Reserved events are those that generally would merit equal consideration with most military training needs. Reserved events are those strictly required to meet a regulation or to sustain the natural resources. Once scheduled, generally they cannot be rescheduled, unless there is a unique or

unforeseen military need that cannot be otherwise met. Reserved Uses will be scheduled well in advance of the proposed activity.

Alternatively, accommodated events are those pre-scheduled special events that may be rescheduled by the routine training needs of the military. Nonetheless, every effort should be made by Range Control Staff to avoid such scheduling conflicts. Accommodated events might include Boy Scout camp-outs, police search and rescue exercises, or special educational events.

For any programmed use, the requesting group provides a point of contact as well as volunteers who will run the event. Special events are more likely to be scheduled if it is arranged to avoid peak training periods or areas of concentrated training use. Organizers of special events will use the following procedures:

- Contact the FCTC Range Control staff to preliminarily discuss the group's plans and obtain the Facilities Request Form.
- Complete a Facilities Request Form and submit it to the FCTC Operations staff. The Facilities Request Form must indicate dates and locations of activities, estimated number of event participants, number of volunteers available to run the event, and a leader or point of contact for the event.
- FCTC staff will determine whether the event can be scheduled during the requested time, at the desired location, and decide appropriate fees, if applicable. Regardless of the determination, the event's Point of Contact is briefed on the decision. If a conflict exists with prior-scheduled military training, FCTC staff will suggest alternative dates or locations. If there is no conflict, arrangements are finalized and the event is added to the FCTC Training Area schedule.
- Once the event is scheduled every effort should be made to accommodate the event around training needs. If the event unavoidably must be canceled, the point of contact should be notified 30 days in advance of the event.
- The group is responsible for leaving all facilities and Training Areas in the condition in which they were found. A member of the FCTC staff will complete a checkout with the group's leader, to be sure sites and facilities are left in good order. Costs to repair damaged facilities or to remediate site impacts are the group's responsibility.

3.9.3 Types of Recreation at FCTC

DoD and Army regulations mandate that public recreation opportunities be provided on military bases, when feasible and without causing conflicts to the military mission. Recreational use may be either non-consumptive or consumptive. Non-consumptive uses are natural resource-oriented activities that do not involve significant removal of resources. Pursuits such as bird watching, nature photography, research, or hiking are examples of non-consumptive uses. Alternatively, hunting, trapping, and gathering of mushrooms and berries would be considered consumptive uses.

The following non-consumptive uses have and/or are likely to occur at FCTC:

- Educational programs: field trips coordination with local schools; presentations usually focus on the environmental, historical, or military elements of the post.
- Nature camps: week-long programs associated with Battle Creek schools
- Naturalist programs: naturalist training and experience in partnership with KNC

- Michigan Youth Challenge Academy: program for young people between the ages of 16 through 18 values, life skills, education, and self-discipline necessary to succeed as productive citizens; MIARNG-ENV and FCTC-ENV staff assist with the environmental component of this program; cadets have the opportunity to learn about a wide array of natural resource issues, research, and occupation opportunities
- Natural Resources Field Trips: Local, regional, and state groups in coordination with professional organizations and other groups to learn about natural resources and their management at FCTC
- Military museum: A military museum displays the military equipment used throughout the period FCTC has been in operation, as well as photographs, letters and other memorabilia. This will be a natural springboard into programs describing the role of the military today, and the mission of FCTC.
- Cultural Resources Field Trips: Similar to natural resources field trips, various groups in coordination with professional organizations and other groups to learn about cultural resources on FCTC.
- National Public Lands Day
- Research: There are several research programs ongoing at FCTC, some funded by MIARNG and others funded by other sources; specific topics change over time and several graduate projects have been completed based on research completed at FCTC
- Bird watching: Bird watching typically is a casual activity done by people in small groups and requires no established facilities. Occasionally groups, such as the Audubon Society, organize bird watching events. For example, Audubon's Annual Christmas Bird Count has become a regular, nationwide event to survey over-wintering birds. Local chapters have conducted this effort for decades on FCTC. Partners-in-Flight organizes an annual bird watch and educational program called International Migratory Bird Day and designed to teach the public about the critical conservation needs of birds. The event is held anytime from the second through the third weeks of May, to coincide with peak spring migrations of songbirds. Either of these types of activities could be readily accommodated at FCTC, provided volunteers are available from the interested groups and MIARNG staff is available to oversee the event.

The following consumptive uses have and/or are likely to occur at FCTC:

- Hunting and fishing (see **Section 3.7**)
- Mushroom hunting and berry harvesting: Mushroom hunting, berry picking, and collecting of other wild edible plants is one of the most popular day uses pursued by the public. Permits and payment is not required and visitors may gather berries and mushrooms (or other fruiting bodies of wild plants) in quantities suitable for personal consumption. This is limited to people who have existing access to FCTC although arrangements could be made through FCTC-ENV for members of the general public. These are limited to a few areas open to users without requiring Range Control approval. In addition, members of Native American tribes can harvest food, with coordination with FCTC-ENV.
- Firewood collection (see **Section 3.4**)

3.9.4 Management Prescriptions for Recreation

Management related to recreation on Fort Custer includes:

- Maintain areas identified as suitable for various outdoor recreational activities.
- Identify recreational use that may be contributing to environmental and ecological degradation and coordinate to modify practices to reduce impacts.

- Provide educational signs and/or materials as appropriate in order to educate recreational users on potential safety concerns and conflicting activities. This is especially true for HQNAs (see **Section 3.4**).

3.9.5 Fort Custer Objectives and Policies

GOAL RECREATION (RE): Provide recreational opportunities for social and economic benefit to the public without interfering with the military mission or causing damage to sensitive natural or cultural resources.

- OBJECTIVE RE1: Provide high-quality outdoor recreational opportunities, without causing damage to sensitive resources or the military mission.

Laws, Policies, and Guidance:

- Follow approval and scheduling procedures described above.
- No open fires are allowed during fire restrictions.
- Maintain signs and gates needed to prevent conflicts with military use and sensitive resources.
- Policies related to firewood collection and mushroom/berry gathering
 - Comply with any off-limits areas
 - Standing trees and branches may not be cut
 - Must check in and check out daily and exit prior to dusk
 - Remove all trash and material; leave no trace
 - Anyone who does not comply with policies will be subject to banning or other actions

3.10 CLIMATE RESILIENCE AND REGIONAL GROWTH

The recently updated guidance for DoD INRMPs added a requirement to address climate change in INRMPs (DoD 2018). Michigan's climate has been warming, and current projections are that the state will continue to warm 10 times as quickly in the next 30 years than it has in the last 100 years (Hoving et al. 2013). This trend will impact ecosystems and the species that inhabit them by shifting species ranges, impacting the seasonality and intensity of weather events, among other potential impacts. The Michigan WAP identifies climate change as one of the primary stressors affecting wildlife, and ranks wildlife vulnerability according to the adaptive capacity of their habitat (i. e., low vulnerability ranking indicates that the habitat has a high adaptive capacity and the potential impacts of climate change will be relatively positive, and vice versa) (Derosier et al. 2015).

In 2016, MIARNG/MDMVA completed *Adaptation Planning for Climate Resilience*, which assesses current conditions, documents planning efforts, and makes recommendations to improve climate resilience (MIARNG & LIAA 2016). Several partner agencies were involved in the drafting of the plan, including Michigan Office of the Great Lakes, Michigan Climate Coalition, Michigan Environmental Council, MDNR, EGLE, Michigan State University, the University of Michigan, Michigan State Police-Emergency Management Division, the Great Lakes Integrated Sciences and Assessment Program, and the Natural Resources Conservation Service.

Climate resilience overlaps with all natural resource issues, but especially relevant are wildland fire (**Section 3.5**), invasive species and pest management (**Section 3.6**), and vegetation management (**Section 3.4**). **Appendix G** contains a summary of historical and regional climate trends.

3.10.1 Management Prescriptions for Climate Resilience

In addition to the *Adaptation Planning for Climate Resilience*, MIARNG has a *Sustainable Energy and Conservation Plan*, which outlines goals for reducing energy and water consumption, reducing greenhouse gas emissions, and provides a plan for energy independence (MIARNG 2014). There are several recommendations and target goals in both documents which provide installation-specific management for improving resiliency and contributing to changes necessary to cope with climate change.

The primary concerns specifically for natural resources were the concern about increased wildfires and the capacity to manage them and the lack of knowledge about which species and communities are most vulnerable to change. Neither of these can be addressed by the MIARNG, MDMVA, or MDNR alone. Regional analysis and responses are necessary to create the resiliency to minimize adverse impacts. In conjunction with staff from Camp Grayling (another MIARNG training site), MDNR, US Geological Survey, National Oceanic and Atmospheric Administration, and other cooperating agencies, Fort Custer staff are participating in regional planning and cooperative efforts to identify actions that increase resilience. These are important collaborations that will need to continue to protect Fort Custer as a resource for military training.

Using the Climate Change Vulnerability Index (CCVI) developed by NatureServe, MNFI's analysis suggests that 17% of terrestrial game species and 61% of terrestrial and aquatic Species of Greatest Conservation Need (SGCN) are vulnerable to climate change (Hoving et al. 2013). As these analyses continue at a regional level, actions should be identified relevant to the species and conditions at Fort Custer.

In the report summarizing climate adaptation planning completed in 2016, the following goals related to natural resources were identified to support increasing climate resiliency at and around FCTC (MIARNG 2016):

- Goal: Better manage the urban tree canopy in surrounding communities to maximize cooling and flood control. Actions include adding trees in areas to assist passive cooling and planting more trees in the urban matrix.
- Goal: Enhance management of natural resources. Actions relating to this goal include identifying climate stressors, priority areas for habitat connectivity, prevent future flooding, incorporate climate change into INRMP, work with partners for watershed scale resource enhancement.
- Goal: Identify and reduce the vulnerability of existing and new homes and infrastructure to impacts of heavy rain, flooding, high wind, and severe winter storms both on and near the installation. Actions include assessing impacts from MIARNG activities that disrupt stormwater infiltration, update flood maps, and address soil erosion issues at FCTC.

This INRMP supports achieving all three of these *Adaptation Planning* (MIARNG 2016) goals, although these goals also capture activities outside the installation boundaries. The INRMP, by definition, enhances management of natural resources on FCTC and this update incorporates climate change and climate stressors into the priorities, activities, and projects.

Continued climate changes may present forest managers with challenges to achieving desired future conditions outlined in forest management plans. MDNR lists three actions that may be explored when adapting to these changes, including resistance, resilience, and response actions (MDNR 2013). Actions will need to be taken on a case-by-case basis, as some forests resources may do better with preparation and strengthening their defenses, some forest resources may fare better planning for future projected change, and still others may benefit from a combination of both. Other approaches are possible when considering adaptive management to climate change in the region, and information is constantly being generated to this end. For more on MDNR efforts related to forest planning and climate change, see https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_86280---,00.html. Overall, it is expected that dominant species in the forests in Michigan will shift northward, with more oaks and fewer conifers as the temperature continues to increase.

The following is a list of management prescriptions identified so far for FCTC:

- Continue regional collaborations with federal, state, local, and non-profit agencies to analyze trends, update models, plan and implement actions.
- Develop a scaled model specific to Fort Custer to aid future planning.
- As vulnerability assessments are completed/updated, evaluate results for species and communities at Fort Custer that might be at risk and identify potential actions to mitigate.
- Complete vulnerability assessments for communities and species at FCTC based on scaled model.
- Prepare wildfire responders for the fire behavior results of increased temperatures, extreme heat, drought, and lower water levels through training and equipment needs.
- High water levels may impact maneuverable areas and result in expanded wetlands, and regulatory impacts to training areas could occur.
- Anticipate changes in forest health should heat-stressed trees be more susceptible to forest pests and invasive plant species.
- Identify actions to protect forest resources as climate conditions change.
- Continue EDRR program to identify new invasions and respond quickly.
- Prioritize rare species that have potential to persist in spite of climate change.
- Prioritize invasive species with potential for control under changing climate conditions.
- Recognize that novel vegetative communities may form and, as much as possible, identify those novel communities that are likely to become the new 'normal' for FCTC.
- Protect HQNAs as refugia and connectivity sources for existing native species.

3.10.2 Fort Custer Objectives and Policies

GOAL CLIMATE CHANGE (CC): Mitigate the effects of climate change on the natural resources at Fort Custer and increase resiliency in order to support the military mission.

- OBJECTIVE CC1: Protect natural resources sensitive to climate change and increase ecological resiliency on Fort Custer.
- OBJECTIVE CC2: Continue participating in regional efforts to increase resiliency in all arenas to support the military mission.

Laws, Policies, and Guidance:

- Collaborate with established partners to improve models, assess vulnerabilities, and develop graphical depictions of the potential impacts from climate change on Fort Custer.
- Cultivate and expand partnerships for collaboratively addressing regional climate change issues, as needed and feasible.
- Provide for the management of threatened, endangered, and other special status species such that changes in distribution and abundance may be understood in the context of climate change.
- Prioritize invasive species control to account for species where control is not possible and those species where early control will have long-term benefits.

4 PLAN IMPLEMENTATION

4.1 PROJECT IMPLEMENTATION AND PRIORITIZATION

Management goals and objectives were developed through a thorough evaluation of the natural resources present on FCTC. In accordance with AR 200-1 and the principles of adaptive ecosystem management, subject areas were identified and management activities developed by an interdisciplinary team of ecologists, biologists, geologists, planners, and environmental scientists. Additional recommendations are sought regularly from various stakeholders during informal conversations and formal meetings every year. **Section 3** presents the management prescriptions and strategies based on the professional opinions and information gathered from various MIARNG directorates, FCTC staff, MDNR, USFWS, as well as other federal, state, and local agencies and non-profit groups with an interest in the management of natural resources on Fort Custer.

This INRMP will be implemented through the various policies and programs described throughout the document and by accomplishing the goals and objectives as described in **Section 3**. The implementation schedule, project and activity lists, and how the projects relate to INRMP implementation are detailed in **Tables C-1 and C-2** in **Appendix C**.

This INRMP is a living document that is based on short-, medium-, and long-term planning horizons. Short-term tasks include activities and projects that are planned to occur in less than 5 years, while medium-term tasks include activities and projects in a 6- to 10-year period. Long-term tasks can be scheduled beyond 10 years. Goals, objectives, and tasks should be revised over time to reflect evolving environmental conditions, adaptive management, and the completion of tasks as the INRMP is implemented.

An INRMP is considered implemented if an installation (AR 200-1):

- Actively requests, receives, and uses funds for priority projects and activities
- Ensures sufficient numbers of professionally trained natural resources management staff are available to perform the tasks required by the INRMP
- Coordinates annually with cooperating agencies and completes a review for operation and effect at least every five years
- Documents specific INRMP activities and projects undertaken each year
- Evaluates effectiveness of past and current management activities and adapts appropriately to implement future actions

Natural resources and land use management issues are not the only factors contributing to the development and implementation of the INRMP. Range management and other seemingly unrelated issues affect implementation. Funding for INRMP implementation is not limited to environmental funds.

Table C-1 provides an overview of recurring natural resource management activities. These activities are generally performed in-house by Fort Custer or MIARNG staff. The implementation schedule and planned projects for this updated INRMP are detailed in **Table C-2**, which will be used to develop budget requests and schedule annual project requirements. Funding requests will be submitted in accordance with current ARNG-ILE procedures for conservation projects.

The Office of Management and Budget considers funding for the preparation and implementation of this INRMP, as required by the SAIA, to be a high priority. However, the reality is that not all of the projects and programs identified in this INRMP will receive immediate funding. Projects need to be funded consistent with timely execution to meet future deadlines. Projects are generally prioritized with respect to compliance. Highest priority projects are projects related to recurring or current compliance, and these are generally scheduled earliest. As such, these projects have been placed into three priority-based categories: (1) high priority projects which are essential for maintaining compliance or for successful natural resources management, (2) medium priority projects with no immediate compliance requirement or less impact on the natural resources, and (3) low priority projects with a natural resources benefit but no legal driver. The prioritization of the projects is based on need, legal drivers, and ability to further implement the INRMP.

Recurring requirements include projects and activities needed to cover the recurring costs that are necessary to meet applicable compliance requirements (federal and state laws, regulations, Presidential EOs, and DoD policies) or which are in direct support of the military mission. Recurring costs include manpower, training, supplies, permits, fees, sampling, reporting, record keeping, and maintenance of equipment.

4.2 INSTALLATION PLANNING AND PROJECT REVIEW PROCESS

The primary, formal review process for evaluating for potential environmental impacts is completion of the Army National Guard (ARNG) REC. This is mostly used for new construction, significant maintenance projects, and major training activities. Routine training and maintenance proceed unless an unusual environmental impact is identified. Range Control approves every training request and flags those requests that involve tree cutting, significant ground disturbance, or other unusual activities and coordinates with FCTC-ENV for review and approval.

In all cases, if any permits or further NEPA analysis is needed to conduct the proposed activity, then the relevant process is undertaken.

4.3 COOPERATIVE AGREEMENTS, PARTNERSHIPS, AND REGIONAL PLANNING

Intra- and inter-agency cooperation, coordination, and communication at the federal, state, and local levels (e. g. USFWS and MDNR) are requisite to the success of the INRMP. USFWS and MDNR review the INRMP and its implementation.

Additional technical assistance, however, is sometimes needed and can be sought from federal and state agencies, universities, and non-governmental groups. More than half of this additional help is expected to be satisfied through contractual arrangements – either with private consultants or with governmental or non-governmental conservation organizations. Regional governmental and non-governmental organizations with which FCTC has a history of contracting with includes the MDNR, MNFI, Kalamazoo Nature Center, and USACE.

Additional technical assistance is also available through the following two DoD initiatives.

- DoD Partners in Amphibian and Reptile Conservation (PARC) - initiative to support management of reptiles and amphibians on military installations. More information at <http://www.dodnaturalresources.net/DoD-PARC.html>.

- DoD Partners in Flight (PIF) – initiative to support management of birds on military installations. It is part of the international PIF partnership and facilitates connections between DoD entities and other PIF partners. More information at <http://www.dodpif.org/>.

The DoD and subcommand entities have Memorandums of Understanding (MOUs), Memorandums of Agreement (MOAs), and other cooperative agreements with other federal agencies, conservation and special interest groups, and various state agencies in order to provide assistance with natural resources management at installations across the US. Generally, these agreements allow installations and agencies or conservation and special interest groups to obtain mutual conservation objectives and are updated or modified as needed. Currently, Fort Custer does not have any site-specific MOU or MOAs applicable to natural resources management. Any MOUs or MOAs that become established for wildland fire management will be identified in the IWFMP once complete.

Coordination takes place with key managers and landowners of nearby public and private property, such as the Manager of the Fort Custer Recreation Area, the Manager of the Fort Custer National Cemetery, and the Supervisor of Battle Creeks Parks and Recreation Department. The Kalamazoo Nature Center, Kellogg Biological Station, and Michigan Natural Features Inventory staff also contribute expertise to both the planning and implementation of the FCTC INRMP. In addition, FCTC has a long history of a working relationship with MDNR for a range of natural resources.

4.4 FUNDING

Implementation of this INRMP is subject to the availability of funding. The installation requests project validation and funding through the ARNG I&E. Funding sources for specific projects can be grouped into three main categories by source: ARNG funds, other federal funds, and non-federal funds. This is not an all-inclusive list of funding sources and available sources and criteria can change from year to year. When activities or projects cannot be completed due to lack of funding or other reasons, the MIARNG will review the INRMP to determine whether adjustments are necessary.

4.4.1 ARNG and DoD Funds

Environmental funds from ARNG I&E typically can be used for core natural resources activities and projects. Further guidance is provided in funding documents issued yearly. DoDI 4715. 03 also describes activities and projects that may be funded with Environmental funds within the DoD.

In addition to Environmental funds, Installation and ITAM funds can also be used to implement INRMP activities and projects. Installation funds support facilities operation and maintenance, including facility planning, maintenance of roads and trails, vegetation management, pest management, construction, and master planning. Installation funds can also be used for pest and noxious weed control, invasive species control, facilities vegetation control and controlled burns to manage vegetation and fuels on training areas and ranges. ITAM funds can be used for monitoring, habitat restoration, land management and water quality improvements related directly to military training.

The following natural resources management areas can be addressed with multiple funding sources: erosion control, invasive species management, and wildland fire. However, the type of funding used for these management areas depends on purpose. Current guidance should be referred to annually to determine the most appropriate source of funding for a specific activity or project.

The DoD Legacy Resource Management Program provides financial assistance for natural and cultural resources management efforts on DoD land. Legacy priority projects include regional ecosystem management initiatives, habitat preservation efforts, invasive species control, and/or rare species management. Legacy funds are generally awarded to projects that offer multiple installation applicability.

4.4.2 Other Federal Funds

Cooperative agreements may be made with state or local governments, non-governmental organizations, and individuals for the improvement of natural resources or to foster research on military facilities. The USFWS is a cooperator in the development and implementation of the INRMP. In this capacity, the USFWS may facilitate access to matching funds and services. In addition, the following federal partnerships are also beneficial to natural resources management and protection at FCTC.

- **US Forest Service.** The US Forest Service provides funds annually and expertise as needed related to Forest Health Protection projects, as part of the MOA between DoD and US Forest Service (1990).
- **NRCS.** The NRCS can assist the MIARNG with management of erosion and soil resources, and produce engineering designs, construction/material specifications and estimated costs for high priority erosion sites.
- **United States Department of Agriculture (USDA)-APHIS Wildlife Services Division.** The Wildlife Services Division of USDA-APHIS provides federal leadership in managing problems caused by wildlife and can provide technical assistance to resource owners on a variety of methods that can be used to resolve problems.

4.4.3 Non-Federal Funds

Opportunities exist to use state or local funds or private grants to support INRMP projects, particularly those relating to rare species, invasive species, public access or natural resources education. For example, Public Lands Day grants are relatively easy to obtain and can be used for signs, native plant landscaping, trail construction and other similar activities using the assistance of volunteers. Non-federal partnerships are beneficial to natural resources management and protection at FCTC; they include:

- **Kalamazoo Nature Center.** KNC has been a significant partner for completing both biological surveys and implementing natural resources management (e.g., invasive species control, prescribed fire).
- **Universities.** Several universities have a history of cooperating with MIARNG for undertaking research relevant to natural resources and their management on FCTC. These relationships and agreements will continue, which provides valuable data and expertise to improve natural resources management on FCTC.

4.5 MONITORING INRMP IMPLEMENTATION

The ultimate successful implementation of this INRMP is realized in no net loss in the capability of Fort Custer training lands to support the military mission, while at the same time providing effective natural resources management. Initiation of projects is one measure that is used to monitor INRMP implementation, but it does not give the total picture of the effectiveness of the natural resources management program. Natural resources management is not simply the sum total of projects, interagency coordination, or program funding and staffing. A significant portion of INRMP implementation is done through internal coordination with regards to training site operations and land

use decision making. This type of implementation cannot be measured by project implementation or funding levels. It is evidenced by such things as the ability to continually train, sustainable land use, ongoing regulatory compliance, retention of species diversity, protection of surface water quality, and the acknowledgement of sustainable natural resources management by partnering conservation agencies and other interested organizations and individuals.

With this INRMP update, success criteria are explicitly stated for each goal and/or objective. This creates a transparent process for assessing INRMP implementation for all parties. The effectiveness of the INRMP as a mission enabling conservation tool will be decided by mutual agreement of USFWS, MDNR, and MDMBA during annual reviews and/or reviews for operation and effect.

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APPENDIX A

ACRONYMS

ACUB	Army Compatible Use Buffer
AERO	Army Environmental Reporting Online
AIS	Aquatic Invasive Species
APHIS	Animal Protection and Health Inspection Services
AR	Army Regulations
ARNG	Army National Guard
ARNG I&E	Army National Guard Installations & Environment Directorate
ARNG TRS	Operations, Training, and Readiness Directorate
BASH	Bird Aircraft Strike Hazard
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practice
CC	Climate Change
CCAA	Candidate Conservation Agreement with Assurances
CCVI	Climate Change Vulnerability Index
CEQ	Council on Environmental Quality
CFMO	Construction and Facilities Management Officer
CH	critical habitat
CISMA	cooperative invasive species management area
CMIP	Coupled Model Intercomparison Project
CONUS	Contiguous United States
COOP	Cooperative Observer Program
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DLZ	DLZ Michigan, Inc.
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DPW	Director of Public Works
EA	Environmental Assessment
EAB	emerald ash borer
eDNA	Environmental DNA
EDRR	Early Detection, Rapid Response
EHD	Epizootic Hemorrhagic Disease
EM	Environmental Manager
EMR	Eastern Massasauga Rattlesnake
EMS	Environmental Management System
Envirologic	Envirologic Technologies, Inc.

EO	Executive Order
ESA	Endangered Species Act
EV	Extremely Vulnerable
FCRA	Fort Custer Recreation Area
FCTC	Fort Custer Training Center
FCTC-ENV	Fort Custer Training Center Environmental Division
FE	federally endangered
FI	Wildland Fire
FIFRA	Federal Insecticide Fungicide and Rodenticide
FNSI	Finding of No Significant Impact
FT	federally threatened
FW	Fish and Wildlife
FY	Fiscal Year
GCM	Global Climate Model
GIS	Geographical Information System
GLEM	Great Lakes Ecological Management
GLISA	Great Lakes Integrated Sciences + Assessments Center
HCP	Habitat Conservation Plan
HQ	Headquarters
HQNA	High Quality Natural Area
HUC	Hydrological Unit Code
HV	Highly Vulnerable
ICP	Integrated Contingency Plan
ICRMP	Integrated Cultural Resources Management Plan
ICTP	International Centre for Theoretical Physics
IL	Increase Likely
IN	Invasive Species
INRMP	Integrated Natural Resources Management Plan
IPaC	USFWS Official Species List
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
ITAM	Integrated Training Area Management
IWFMP	Integrated Wildland Fire Management Plan
KBB	Karner blue butterfly
KNC	Kalamazoo Nature Center
LCTA	Land Condition Trend Analysis
LRAM	Land Rehabilitation and Maintenance
LZ	Landing Zone
MAPS	Monitoring Avian Productivity and Survivorship
MDARD	Michigan Departments of Agriculture & Rural Development
EGLE	Michigan Department of Environment, Great Lakes & Energy

MDEQ	Michigan Department of Environmental Quality (now EGLE)
MDHHS	Michigan Department of Health and Human Services
MDMVA	Michigan Department of Military and Veterans Affairs
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MESA	Michigan Endangered Species Act
MIARNG	Michigan Army National Guard
MIARNG-ENV	Michigan Army National Guard Environmental Division
MiRAM	Michigan Rapid Assessment Method for Wetlands
MISC	Michigan Invasive Species Coalition
MISIN	Midwest Invasive Species Information Network
MNFI	Michigan Natural Features Inventory
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain
MSB	Mitchell's satyr butterfly
MSU	Michigan State University
MV	Moderately Vulnerable
MWR	Morale, Welfare and Recreation
NEPA	National Environmental Policy Act of 1969
NGB	National Guard Bureau
NHD	National Hydrography Dataset
NIACS	Northern Institute of Applied Climate Sciences
NLEB	Northern Long-Eared Bat
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NREPA	Natural Resources and Environmental Protection Act – Michigan State Law
NVC	National Vegetation Classification
NWI	National Wetlands Inventory
ORV	Off Road Vehicle
PA	Public Act
PARC	Partners in Amphibian and Reptile Conservation
PEM	Pulustrine emergent
PFO	Palustrine forested
PIF	Partners in Flight
PM	Program Management
PS	Presumed Stable/Not Vulnerable
PSS	Palustrine scrub-shrub
RE	Recreation
REC	Record of Environmental Consideration
RMSF	Rocky Mountain Spotted Fever
RMZ	Riparian Management Zones

RTLA	Range and Training Land Assessment
SAIA	Sikes Act Improvement Act of 1997
SC	state species of special concern
SE	state endangered
SGCN	Species of Greatest Conservation Need
SOP	Standard Operating Procedures
SRA	Sustainable Range Awareness
SRP	Sustainable Range Program
ST	state threatened
SWMLC	Southwest Michigan Land Conservancy
TA	Training Area
TAG	The Adjutant General
TE	Threatened and Endangered
TIS	Terrestrial Invasive Species
TNC	The Nature Conservancy
TRI	Training Requirements Integration
UECO	Unit Environmental Compliance Officer
US	United States
USACE	United States Army Corps of Engineers
USC	US Code
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	US Geological Survey
UXO	Unexploded ordnance
WA	Water Resources
WAP	Wildlife Action Plan
WEG	wind erodibility groups
WNV	West Nile Virus

APPENDIX B MAPS

Map 1 – Location

Map 2 – Facility and Training Areas

Map 3 – Soils

Map 4 – Water Resources

Map 5 – Vegetation/Land Cover (MNFI)

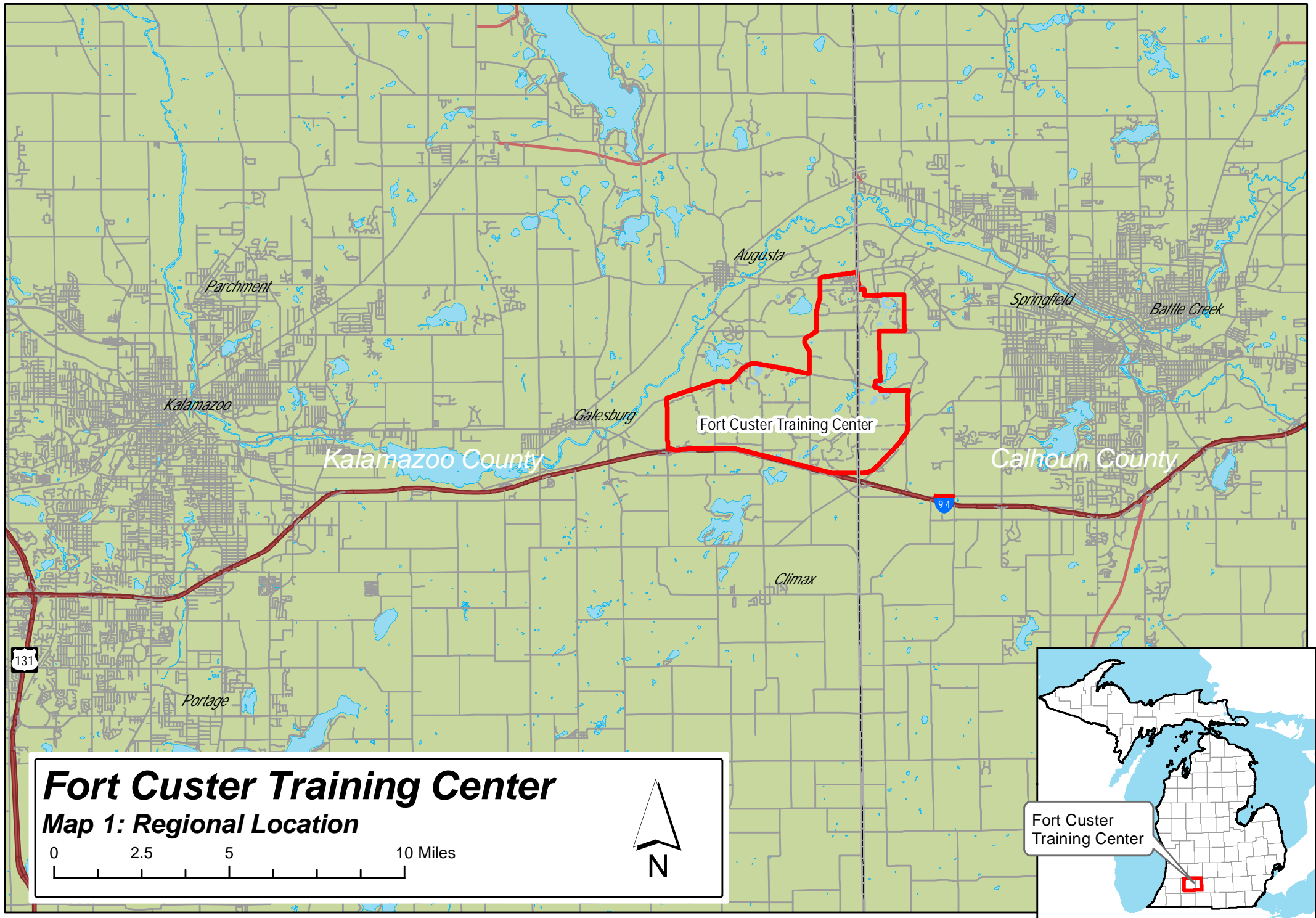
Map 6 – High Quality Natural Areas

Map 7 – Historic (circa 1800) Vegetation

Map 8 – Burn Units

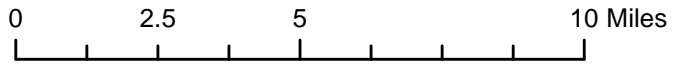
Map 9 – Timber Inventory

Map 10 – Constraints



Fort Custer Training Center

Map 1: Regional Location



Fort Custer Training Center

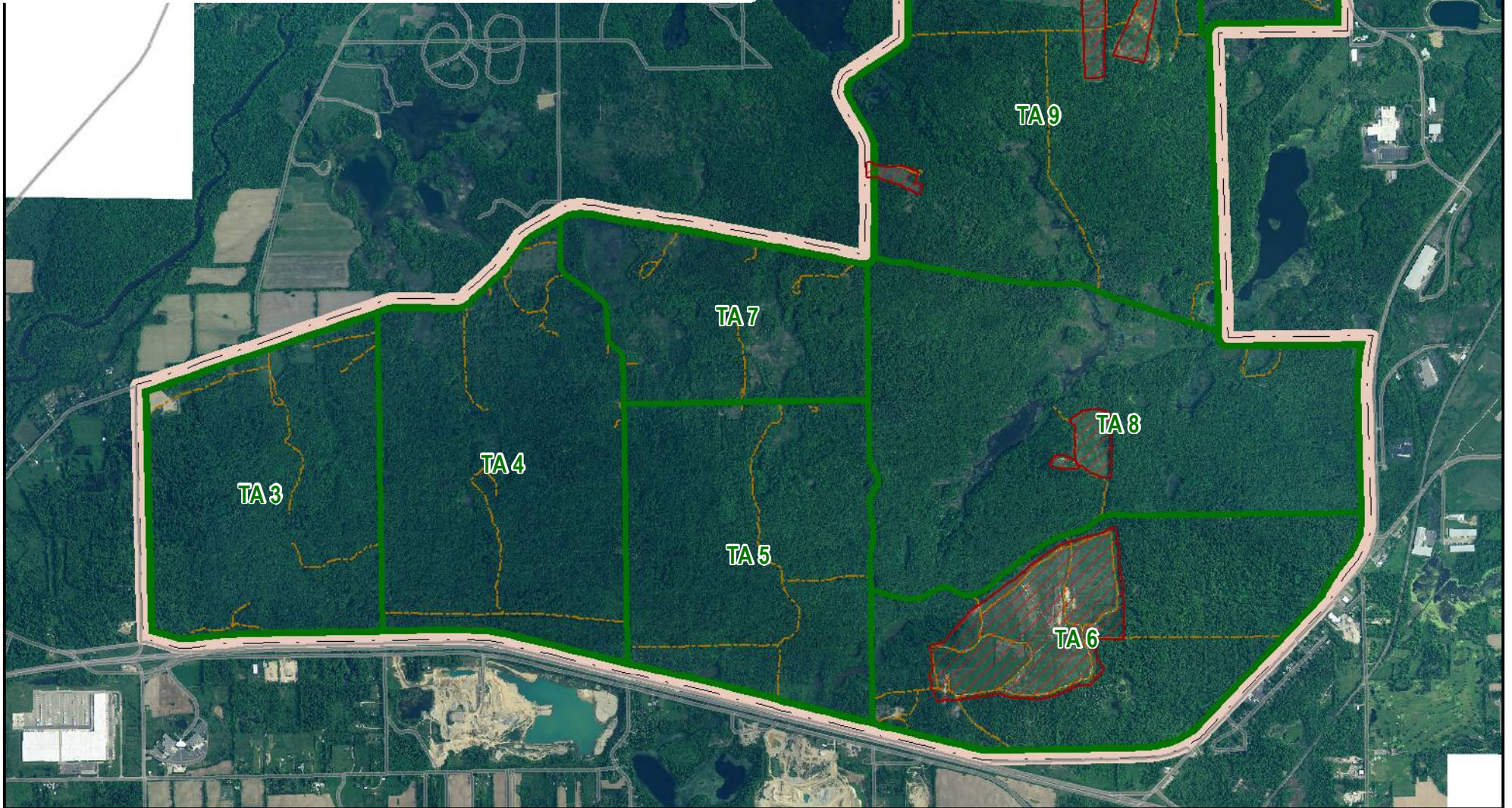
Map 2: Facilities and Training Areas

The map below depicts current ranges and training areas across the installation.

Key to Symbols

- Maneuver Trails
- Fort Custer Boundary
- Training Area Boundary
- Range Facilities

1 Mile





Fort Custer Training Center


Map 3: Soil Types and Distribution

The map below depicts soil types and distribution across the installation.

Key to Symbols

 Open Water


 Fort Custer Boundary

 Training Area Boundary

Generalized Soil Type

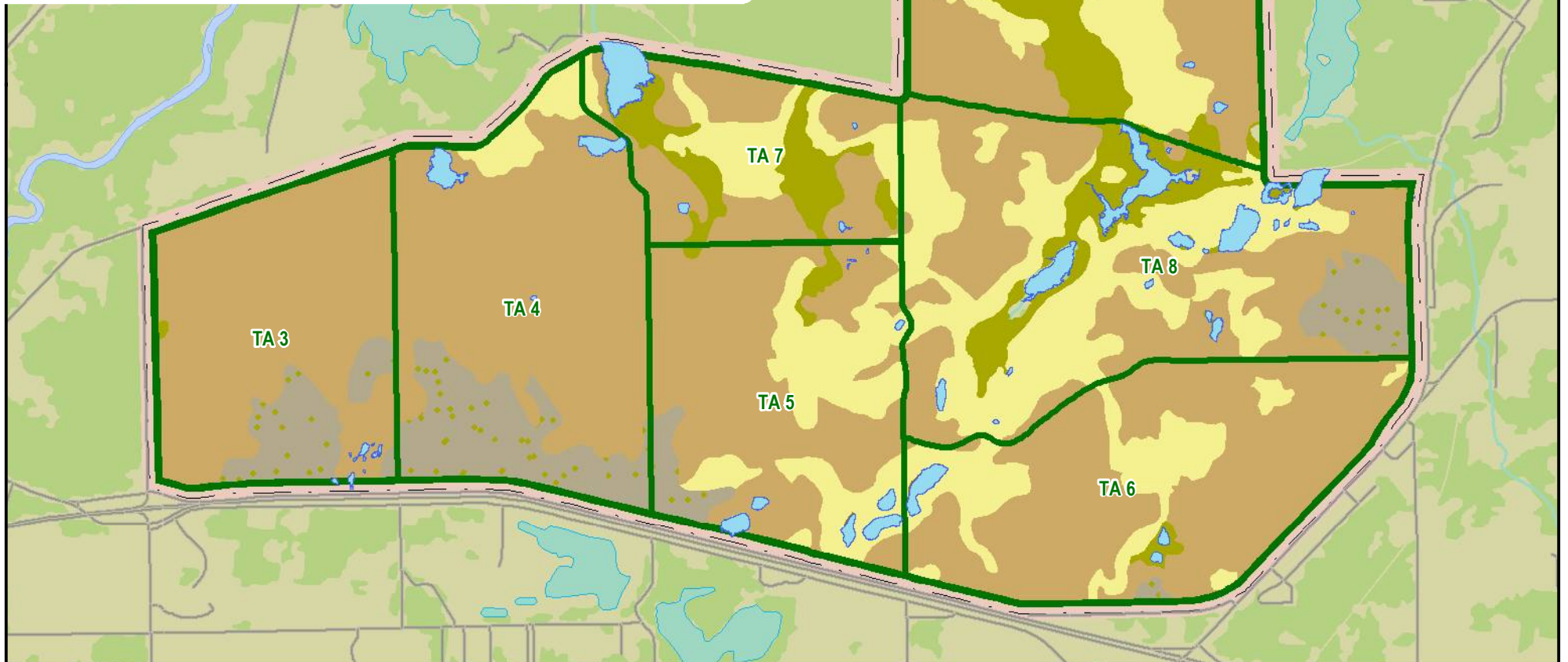
 Sandy Loam

 Loam

 Loamy Sand

 Muck

 Other (Histosols & Entisols)



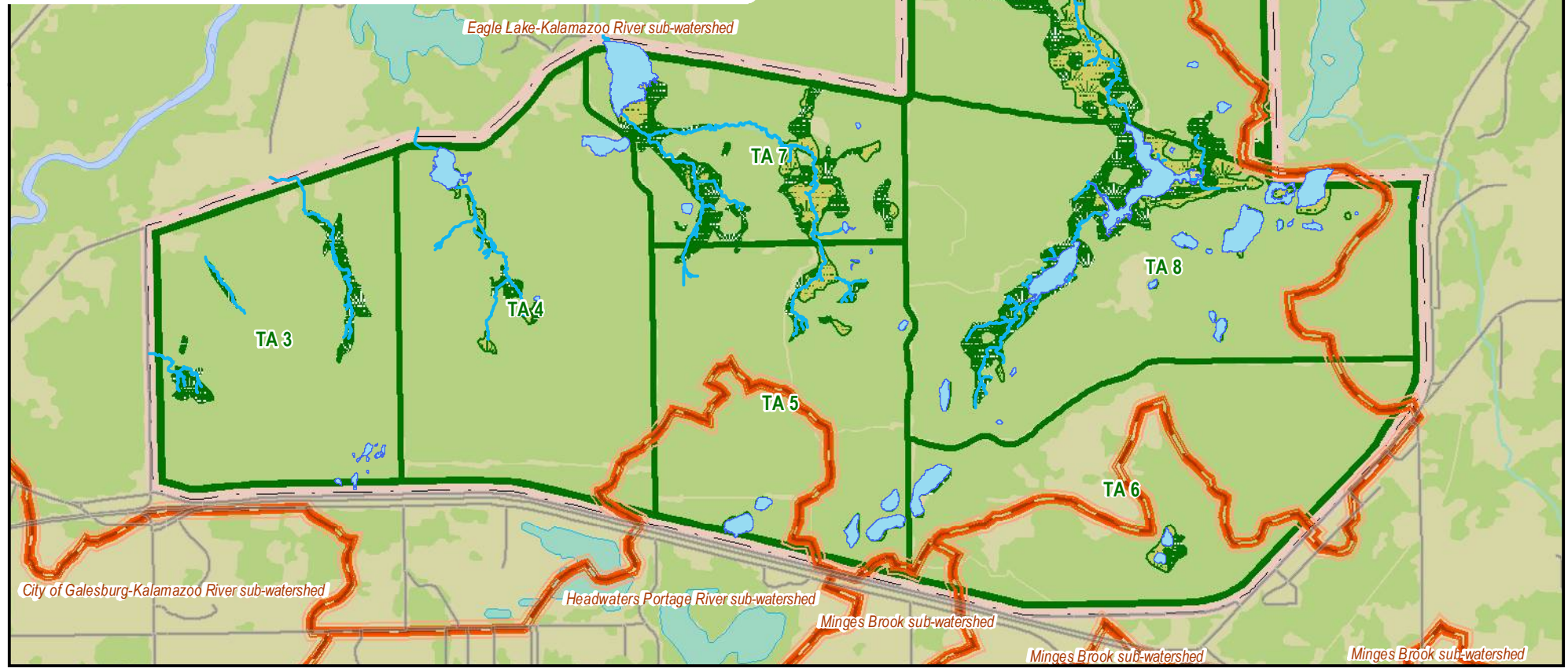
Fort Custer Training Center

Map 4: Water Resources

The map below depicts wetland types and distribution across the installation.

Key to Symbols

- Streams
- Open Water
- Watershed Boundaries (HUC 12)
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Fort Custer Boundary
- Training Area Boundary



























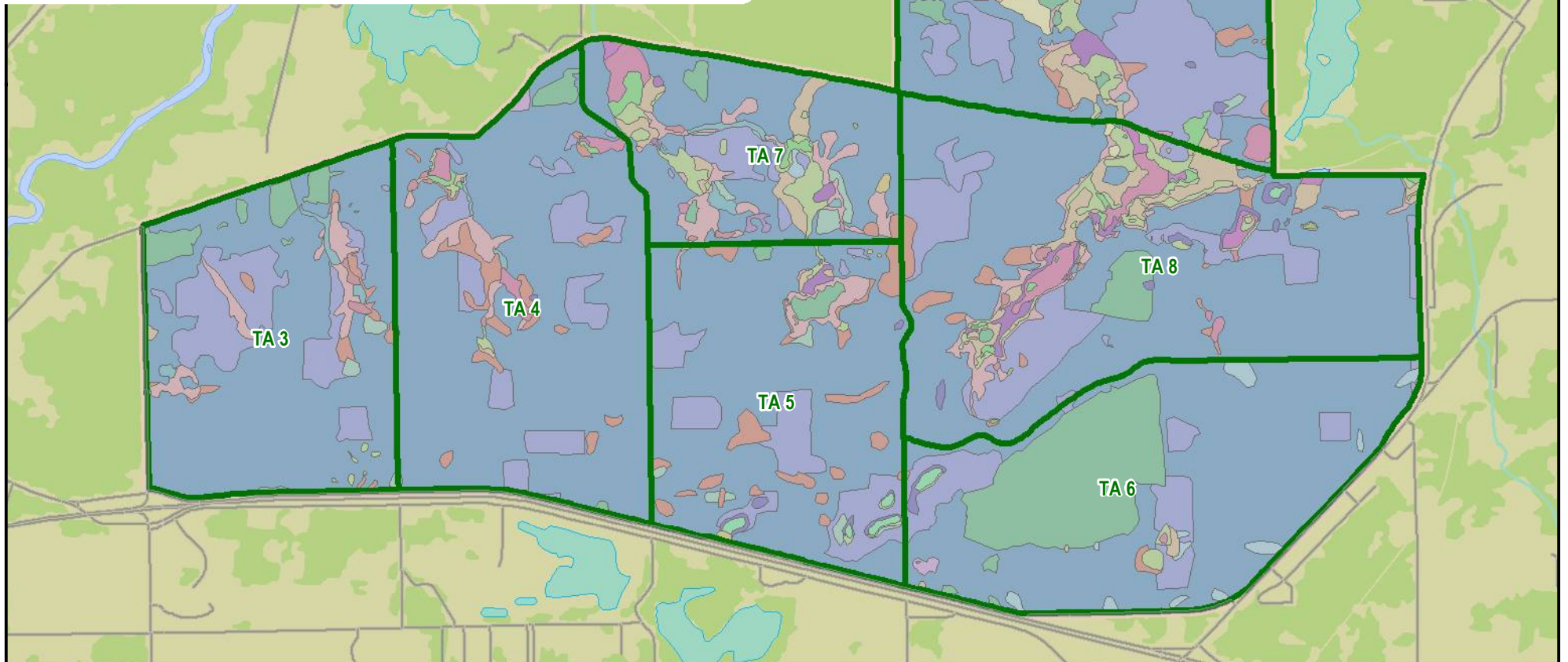
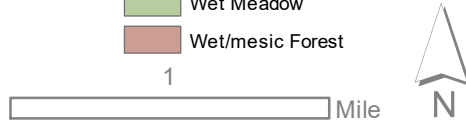
Fort Custer Training Center

Map 5: Vegetation / Land Cover

The map below depicts current natural community types and distribution across the installation.

Key to Symbols

Community Type					
	Bog		Inundated Shrub Swamp		Prairie Fen
	Developed		Mesic Forest		Shrubby Swamp
	Dry-mesic prairie		Mesic Sand Prairie		Submergent Marsh
	Emergent Marsh		Mesic Savanna		Swamp Forest
	Flatwoods		Oak-Hickory Woodland		Tamarack Swamp
	Floodplain Forest		Old Field		Vernal Pool
	Forest		Open Seep		Wet Meadow
	Forested Seep		Open Water		Wet/mesic Forest





Fort Custer Training Center

Map 6: High Quality Natural Areas

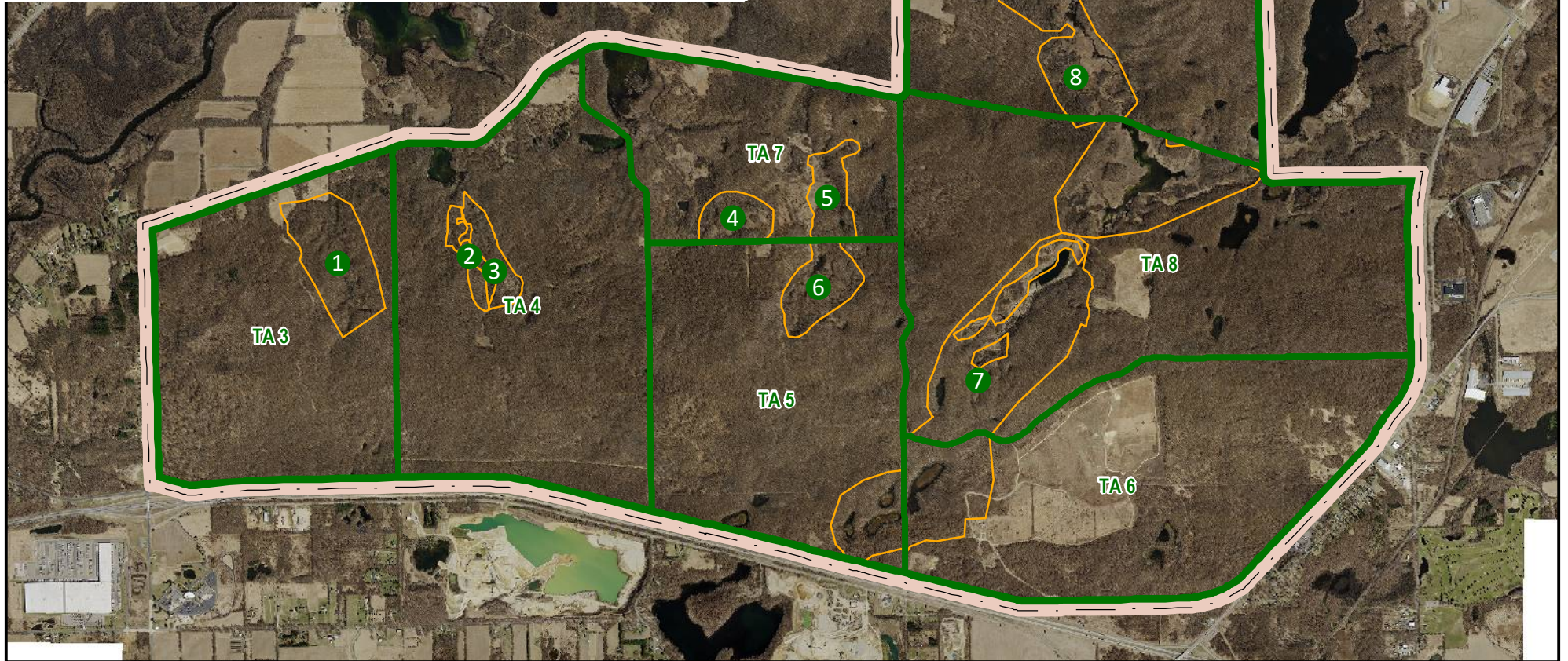
The map below depicts high quality natural areas across the installation.

Key to Symbols

- ① 42nd Street Seeps
- ② Cemetary Ridge
- ③ Cemetary Seeps
- ④ Mott Road Mesic Prairie
- ⑤ Mott Road North Fen Complex
- ⑥ Mott Road South Fen Complex
- ⑧ Territorial Road Fen Complex
- ⑦ Whitman Lake Woods & Fen Complex

-  Fort Custer Boundary
-  Training Area Boundary

 1 Mile





Fort Custer Training Center


Map 7: Historic Vegetation circa 1800

The map below depicts land cover types and distribution circa 1800 across the installation.

Key to Symbols

 Open Water

 Fort Custer Boundary

 Training Area Boundary

Land Cover Type

 BEECH, SUGAR MAPLE, BASSWOOD FOREST

 LOWLAND HARDWOOD

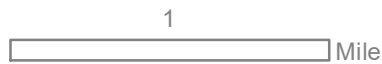
 OAK OPENING

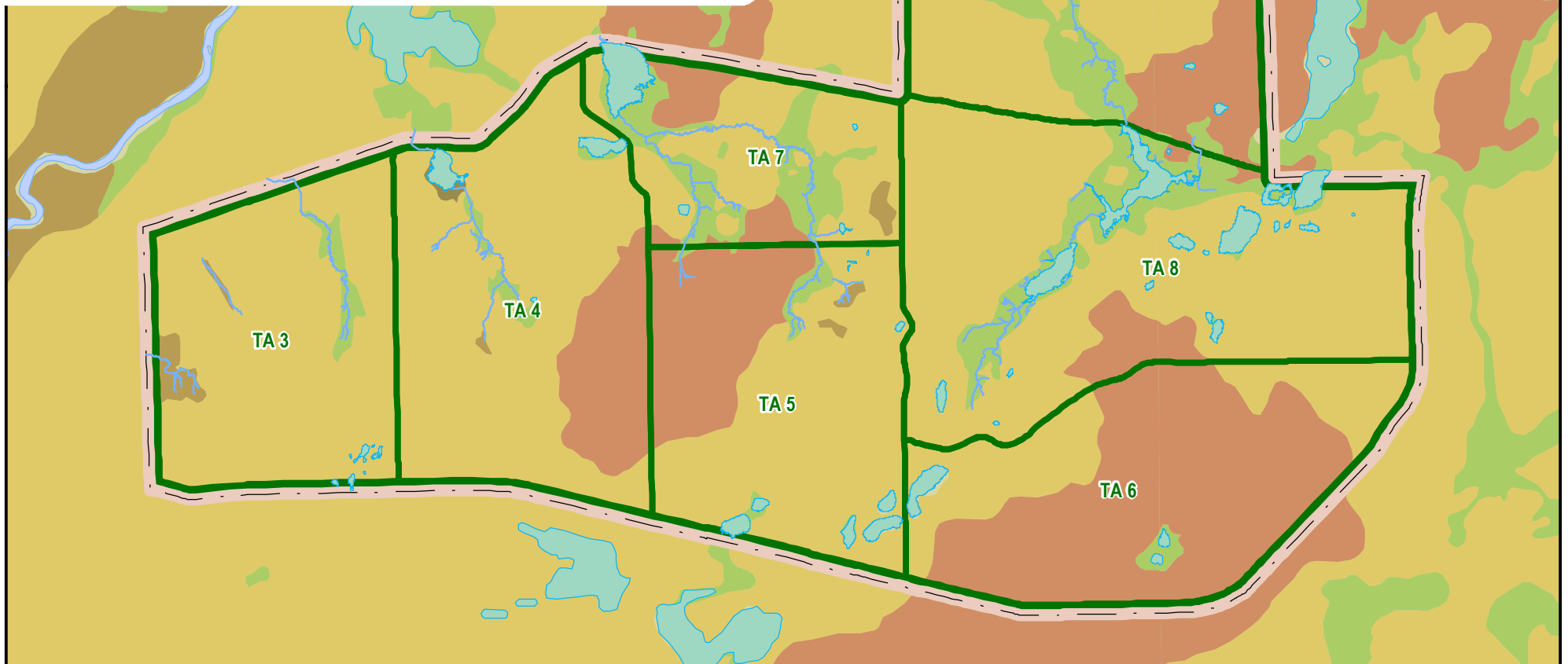
 BOG

 WHITE OAK, BLACK OAK, HICKORY FOREST

 EMERGENT MARSH

 INLAND WET PRAIRIE

 1 Mile



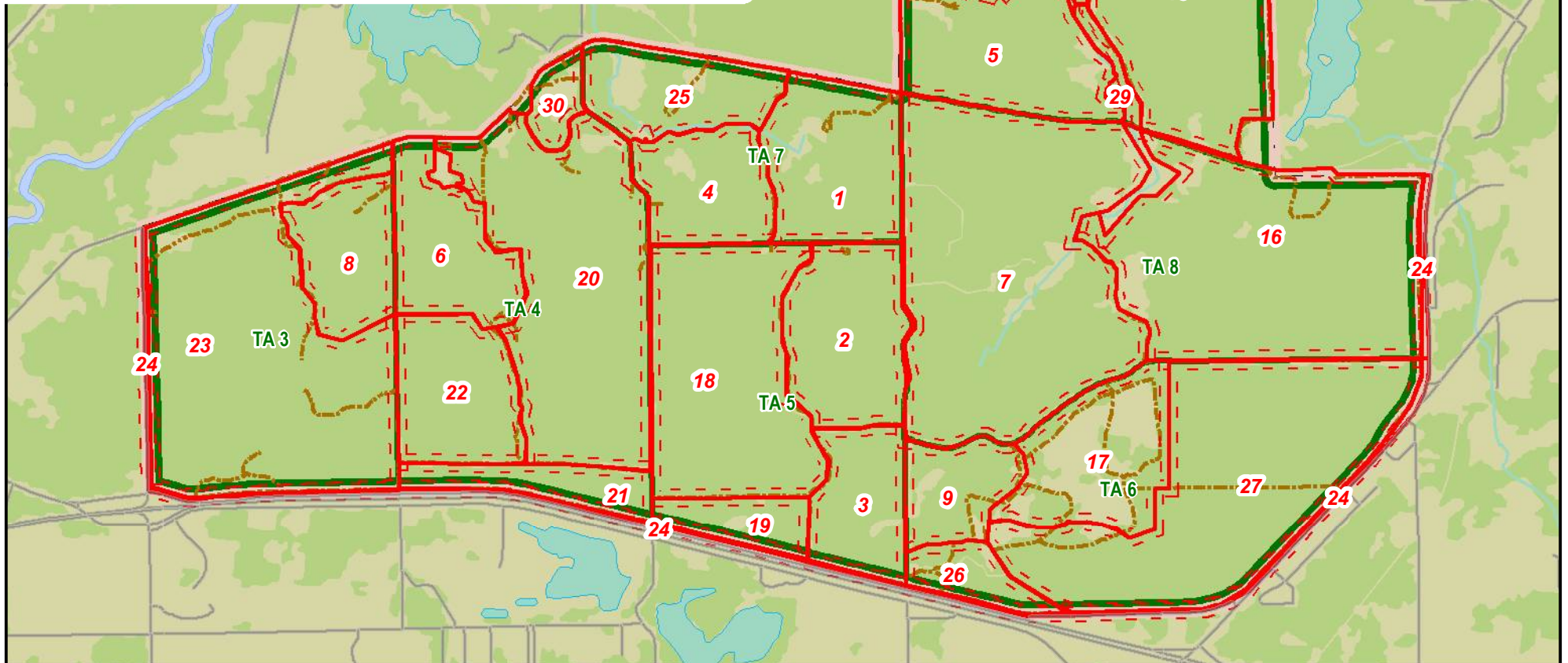
Fort Custer Training Center

Map 8: Fire Management Units

The map below depicts current fire management units across the installation.

Key to Symbols

- Maneuver Trails
- Fort Custer Boundary
- Training Area Boundary
- Fire Management Units



Fort Custer Training Center

Map 9: Forest Inventory

The map below depicts current forest type and distribution across the installation.

Key to Symbols

--- Maneuver Trails

Fort Custer Boundary

Training Area Boundary

ForestType

Aspen/Mixed Hardwood

Black Cherry

Black Cherry/Oak

Black Locust/Black Cherry

Black Walnut

Black Walnut/Mixed Hardwood

Central Hardwood

Cherry

Mixed Hardwood

Mixed Hardwood/Pine

Mixed Oak

Oak/Aspen

Oak/Hickory

Oak/Mixed Hardwood

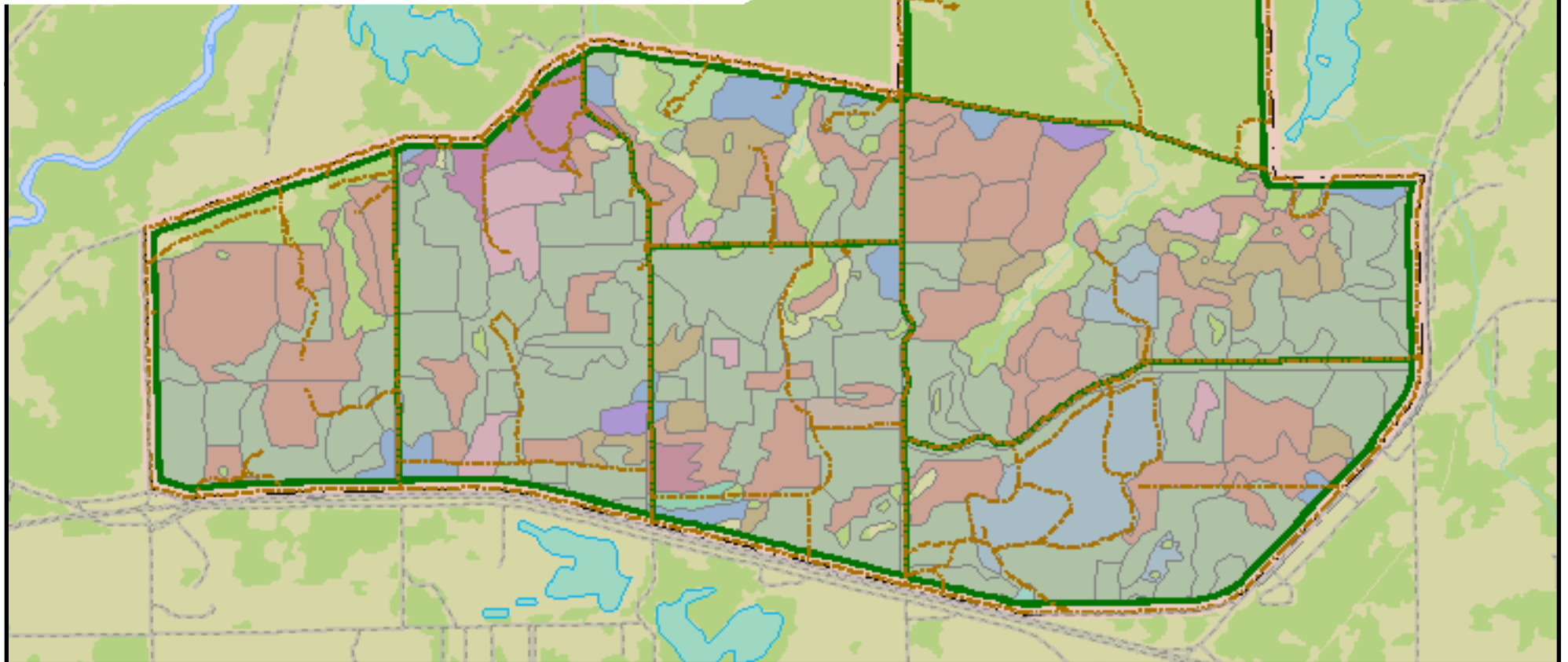
Open Dryland

Open Ground

Upland Brush

1

Mile



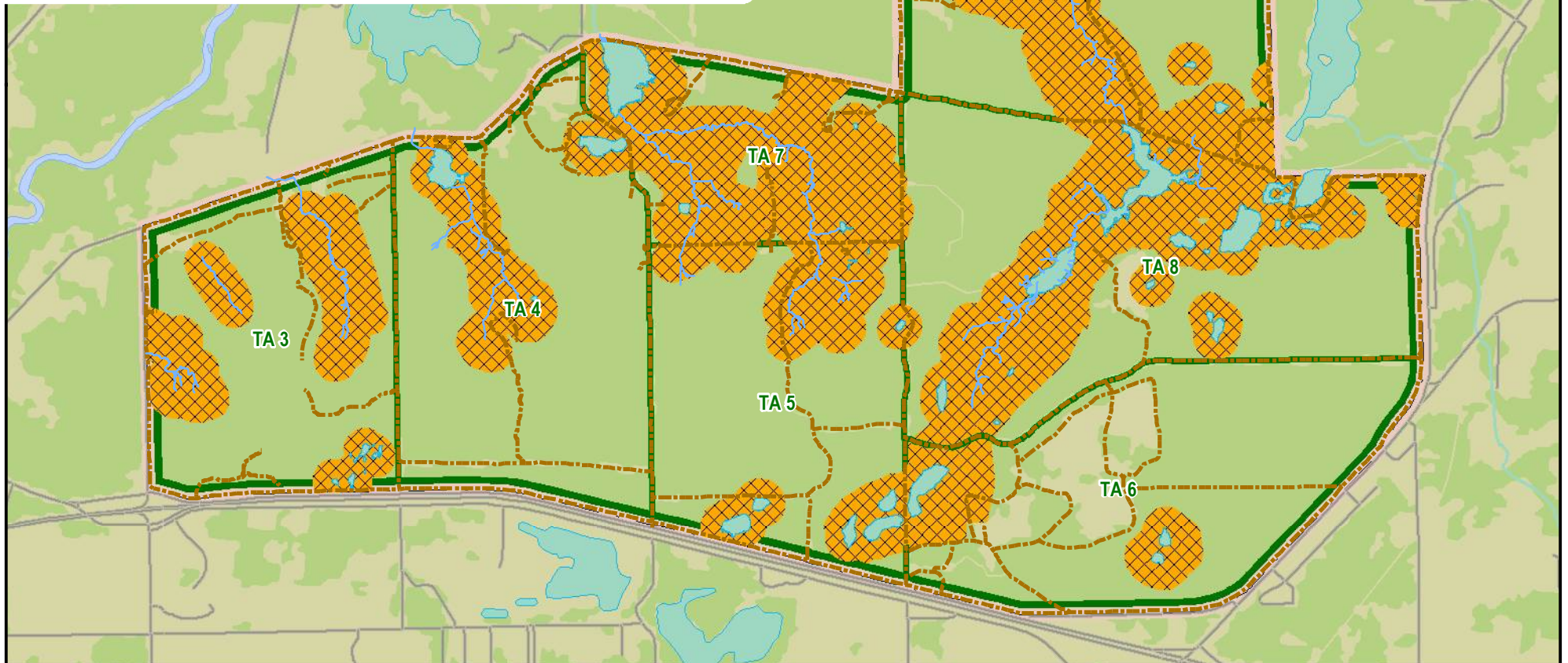
Fort Custer Training Center

Map 11: Training Constraints

The map below depicts training restrictions across the installation. Orange hashed areas generally represent areas of foot-traffic only.

Key to Symbols

- Maneuver Trails
- Training Constraint (Foot traffic only)
- Fort Custer Boundary
- Training Area Boundary



APPENDIX C IMPLEMENTATION TABLES

Table C-1 – Activities

Table C-2 – Projects

Table C-3 – Goals, Objectives, and Criteria

Table C-4 – ITAM Annual Work Plan

Tables C-1 and C-2 can be used for projections as well as for documenting completed items during annual reviews. Table C-3 can be used for annual and especially 5-year reviews, but color coding according to criteria for each Goal and Objective. Table C-4 is updated annually and reflects that fiscal year's spending plan for ITAM.

Table C-1. Routine MDMVA Activities for Fort Custer INRMP Implementation

Activity	Priority	Objective(s) in Section 3	MDMVA Program	Timing	Man-Hours/Year	Funds	Projected/Completed											
							FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	
PM1.1	0	PM1	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
PM1.2	0	PM1	ENV	As Needed														
PM1.3	0	PM1	ENV, ITAM	Annually			X	X	X	X	X	X	X	X	X	X	X	X
PM1.4	0	PM1	ENV	As Needed														
PM1.5	0	PM1	ENV	As Needed														
PM1.6	0	PM1	MDMVA	As Needed														
PM1.7	0	PM1	ENV	As Needed														
PM1.8	0	PM1	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
PM1.9	0	PM1	ENV	Every 5 years						X						X		
PM1.10	1	PM1	ENV	As Needed														
PM1.11	0	PM1, All objectives	ENV	As Needed														
PM2.1	0	PM2	ENV	As Needed														
PM2.2	0	PM2	ENV, ITAM, DPW	As Needed														
PM2.3	0	PM2	ENV	As Needed														
PM3.1	0	PM1, PM3	ENV, ITAM	As Needed														
PM3.2	0	PM1, PM3	ENV, ITAM	Every 5 years														
PM3.3	0	PM1, PM3	ENV, ITAM	As Needed		\$ 250												
PM3.4	0	PM1, PM3	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
PM3.5	0	PM1, PM3	ENV, ITAM	As Needed		\$ 250												
PM3.6	0	PM1, PM3	ENV, ITAM	As Needed		\$ 250												
PM3.7	0	PM1, PM3	ENV, ITAM	As Needed		\$ 1,000												
PM3.8	0	PM1, PM3	ENV, ITAM	As Needed		\$ 1,000												
PM3.9	0	PM1, PM3, PM4	ENV	As Needed		\$ 1,000												
PM4.1	0	PM1, PM4	ENV	As Needed														
PM4.2	0	PM1, PM4	ENV	As Needed		\$ 200												
PM5.1	0	PM1, PM5	ENV	As Needed														
PM5.2	0	PM1, PM5	ENV	As Needed														
PM5.3	0	PM1, PM5	ENV	As Needed														
PM6.1	0	PM1, PM6	ENV, ITAM	As Needed		\$ 5,000												

Table C-1. Routine MDMVA Activities for Fort Custer INRMP Implementation

Activity	Priority	Objective(s) in Section 3	MDMVA Program	Timing	Man-Hours/Year	Funds	Projected/Completed											
							FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	
PM6.2	0	PM1, PM6	ENV, ITAM	As Needed														
PM6.3	0	PM1, PM6	ENV, ITAM	As Needed														
SO1.1	0	SO1	ENV, DPW	Ongoing														
SO1.2	0	SO1	ENV, ITAM, DPW	As Needed														
SO1.3	0	PM1, PM3, SO1	ENV, ITAM, DPW	As Needed														
SO2.1	0	PM1, SO2	ENV, ITAM, DPW	Annually			X	X	X	X	X	X	X	X	X	X	X	X
SO2.2	0	PM1, SO2	ENV, ITAM, DPW	Annually			X	X	X	X	X	X	X	X	X	X	X	X
SO2.3	0	PM1, PM6, SO2	ENV, ITAM, DPW	Ongoing														
SO3.1	0	SO3	ENV, DPW	Ongoing														
WA1.1	0	PM1, SO3, WA1	ENV, DPW	Ongoing														
WA2.1	0	PM6, WA2	ENV	As Needed														
WA2.2	0	PM2, WA2	ENV	As Needed														
WA2.3	0	SO2, WA2, VE3	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
WA2.4	0	PM1, SO1, SO2, SO3, WA1, WA2	ENV, DPW	Ongoing														
VE1.1	0	PM1, PM6, VE1, VE2, VE3, VE4	ENV	As Needed														
VE2.2	0	WA1, VE2, TE1, TE2	ENV	Ongoing														
VE2.3	0	VE2, TE1, TE2	ENV	Ongoing														
VE3.1	0	WA1, VE1, VE2, TE1, TE2	ENV	Ongoing														
VE4.1	0	VE5, IN2, FW2	ENV, DPW	Ongoing														
VE4.2	0	VE5, IN2, FW2	ENV, DPW	As Needed														
VE4.3	0	VE5, RE1	ENV, DPW	As Needed														
VE5.1	0	PM3, VE1, VE4, VE5, FW2, TE2	ENV	As Needed														
VE5.2	0	PM3, VE1, VE4, VE5	ENV, DPW	As Needed														
FI1.1	0	PM1, FI1, FI2, FI3, FI4	ENV, DPW, Range Control	Ongoing														
FI1.2	0	FI1, FI2, FI3	ENV, DPW, Range Control	Annually		\$ 5,000	X	X	X	X	X	X	X	X	X	X	X	X
FI1.3	0	FI1, FI2, FI3, FI4	ENV, DPW, Range Control	Ongoing														
FI1.4	0	PM6, FI1, FI2, FI3	ENV, DPW, Range Control	Annually			X	X	X	X	X	X	X	X	X	X	X	X
FI1.5	0	FI1, FI3, FI4	ENV, DPW, ITAM	Ongoing														

Table C-1. Routine MDMVA Activities for Fort Custer INRMP Implementation

Activity	Priority	Objective(s) in Section 3	MDMVA Program	Timing	Man-Hours/Year	Funds	Projected/Completed											
							FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	
F11.6	0	F11, F13, F14	ENV	Ongoing														
F11.7	0	PM5, F11, F12, F13, F14	ENV, DPW	As Needed														
F11.8	0	PM5, F11, F12, F13, F14	ENV, DPW	As Needed														
F11.9	0	PM1, F11, F13, F14	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
F12.1	0	F11, F12, F13, F14	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
F12.2	0	F11, F12, F13, F14	ENV, DPW	Ongoing		\$15,000												
F13.1	0	F11, F13	ENV, Range Control	As Needed														
F13.2	0	F11, F13	ENV	As Needed														
F14.1	0	PM6, F11, F14	ENV	As Needed														
F14.2	0	PM5, F11, F14	ENV, DPW	As Needed														
F14.3	0	F11, F14	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
IN1.1	0	PM1, IN1, IN2, IN3, IN4	ENV, DPW	Annually			X	X	X	X	X	X	X	X	X	X	X	X
IN1.2	0	IN1, IN2, IN3	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
IN1.3	0	IN1, IN2, IN3, IN4	ENV	Ongoing														
IN1.4	0	IN1, IN2, IN3, IN4	ENV	As Needed														
IN1.5	0	PM1, IN1, IN2, IN3	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
IN1.6	1	IN1, IN2, PM5	ENV	As Needed														
IN2.1	0	IN2	ENV, DPW, ITAM	As Needed														
IN2.2	0	IN2	ENV, DPW	Ongoing														
IN2.3	0	IN1, IN2	ENV	As Needed														
IN3.1	0	IN3	ENV	As Needed														
IN4.1	1	PM3, IN4	ENV	As Needed														
FW1.1	0	FW1	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
FW2.1	0	FW1, FW2, FW3	ENV	As Needed														
FW3.1	0	FW1, FW2, FW3	ENV	As Needed														
FW3.2	0	FW1, FW2, FW3	ENV	As Needed														
FW3.3	0	FW1, FW2, FW3	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
TE1.1	0	PM1, TE1, TE2	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X
TE1.2	0	TE1, TE2	ENV	As Needed														
TE1.3	0	PM6, TE1, TE2	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X	X

Table C-1. Routine MDMVA Activities for Fort Custer INRMP Implementation																	
					Projected/Completed												
Activity	Priority	Objective(s) in Section 3	MDMVA Program	Timing	Man-Hours/Year	Funds	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
TE1.4	0	PM1, PM6, TE1, TE2	ENV	As Needed													
TE1.5	0	TE1	ENV	As Needed													
TE1.6	0	TE1, TE2	ENV, DPW	As Needed													
TE2.1	0	PM5, TE2	ENV	Annually			X	X	X	X	X	X	X	X	X	X	X
RE1.1	0	RE1	ENV, MWR	As Needed													
RE1.2	1	RE1, PM1, VE1, FW1, TE1, TE2	ENV, DPW, MWR, Range Control	As Needed													
CC2.1	0	PM1, PM5, CC1, CC2	ENV, DPW	Annually			X	X	X	X	X	X	X	X	X	X	X

Table C-2. Proposed Projects for Fort Custer INRMP Implementation						Project Funding (Completed for Past FY, Estimated for Future FY)										
Project	Priority	Objective(s) in Section 3	MDMVA Funding	Projected Date	Project Number	TBD FY	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
PM3.10	0	PM3, SO1, SO3, WA2, VE5, IN1, TE1, TE2, RE1	ENV, ITAM	As Needed		\$ 1,500										
PM4.3	0	PM4, PM5, WA3, VE3, VE5, FI2, FI3, FI4, IN1, FW3, TE1, TE2, RE1	ENV	As Needed		\$ 1,500										
PM5.5	1	PM5, WA1, WA3, VE1, FI3, IN2, FW2, FW3, TE1, TE2	ENV, DPW	As Needed												
PM6.4	1	PM6, SO2, WA2, VE3, VE4, FW3, TE1, TE2, RE1	ENV	2024							\$ 35,000					
SO1.4	1	SO1, WA2, IN1, IN2, VE3, FW3	ENV, DPW	2021				\$ 40,000					\$ 40,000			
SO1.5	1	SO1, SO2, WA1, WA2, VE3, FW3	ENV, ITAM, DPW	Annually		\$ 20,000										
SO1.6	1	SO1, SO2, WA1, WA2, WA3, VE1, VE3, FW3, TE1, TE2	ENV, DPW	Every other year				\$ 15,000		\$ 15,000		\$ 15,000		\$ 15,000		\$ 15,000
WA1.2	1	SO1, SO2, WA1, VE1, TE1, TE2, CC1	ENV	Annually			\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
WA2.5	1	SO1, SO2, WA1, WA2, WA3, VE1, VE3, FW3, TE1, TE2, RE1	ENV, DPW	2021				\$ 120,000						\$ 120,000		
WA2.6	1	PM2, SO1, SO2, WA1, WA2	ENV	As Needed		\$ 15,000										
WA3.1	1	WA2, WA3, VE1, VE3, FW3, TE1, TE2	ENV, DPW	Annually			\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000
WA3.2	1	WA3, VE1, VE3, TE1, TE2	ENV	2021				\$ 75,000						\$ 10,000		
VE1.2	1	VE1, VE3, VE4, FW3, TE1, TE2	ENV	2023						\$ 75,000					\$ 75,000	
VE1.3	1	VE1, VE2, VE3, VE4, FW3, TE1, TE2	ENV	2025								\$ 75,000				
VE1.4	1	VE1, VE2, VE3, VE4, WA3, TE1, TE2, FW2	ENV, Forestry, ITAM	2023						\$ 40,000					\$ 40,000	
VE1.5	1	VE1, VE2, VE3, WA3, TE1, TE2, FW2	ENV	Annually			\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000
VE1.6	1	SO1, SO2, VE1, VE3, FW3	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
VE2.4	1	VE2, VE1, FW3, TE1, TE2	Forestry	2028	Reimbursable										\$ 50,000	
VE2.5	1	VE2, VE1, FW3, TE1, TE2	Forestry	2020	Reimbursable											
VE2.6	1	VE2, VE1, FW3, TE1, TE2	ENV, Forestry	Every other year				\$ 40,000		\$ 10,000		\$ 10,000		\$ 10,000		\$ 10,000
VE2.7	1	VE2, VE1, IN2, FW3, TE1, TE2	Forestry	As Needed	Reimbursable	\$ 30,000										
VE2.8	1	VE2, VE1, WA3, FW3, TE1, TE2	Forestry	Every other year	Reimbursable			\$ 25,000		\$ 25,000		\$ 25,000		\$ 25,000		\$ 25,000
VE3.2	1	VE3, WA3, FW3, TE1, TE2	ENV	As Needed		\$ 25,000										

Table C-2. Proposed Projects for Fort Custer INRMP Implementation						Project Funding (Completed for Past FY, Estimated for Future FY)										
Project	Priority	Objective(s) in Section 3	MDMVA Funding	Projected Date	Project Number	TBD FY	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
VE4.1	1	Complete management to maintain or expand grasslands and oak openings, such as woody removals, mowing, prescribed fire, and invasive species control	ENV	As Needed		\$ 25,000										
VE5.4	1	Establish new or convert old landscaping to native plants	ENV, DPW	As Needed		\$ 5,000										
FI1.10	1	Evaluate fuel loading, fire risk, sensitive species and habitats, infrastructure, military use, and other concerns to identify appropriate methods, fire return intervals, and priority locations for prescribed fire	DPW, Range Control, ENV	Annually			\$ 5,000									
FI3.3	0	Maintain existing firebreaks, as identified in IWFMP, using methods with least adverse effects	DPW, Range Control, ENV	As Needed		\$ 10,000										
FI3.4	1	Reduce range-related fuel loads with prescribed fires (up to 500 acres per year or at least 5 high priority locations per year)	DPW, Range Control, ENV	Annually												
FI4.4	1	Conduct prescribed fires annually (up to 3500 acres per year or at least 5 high priority locations per year) to manage for rare species, HQNAs, military use, and specific habitats	ENV, DPW	Annually												
FI4.5	1	Assess wildfire areas post-fire and rehabilitate any soil or vegetation damage as needed	ENV, DPW	As Needed		\$ 15,000										
FI4.6	1	Conduct post-burn monitoring in areas of prescribed burning every year	ENV	Annually			\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
FI4.7	1	Update burn priorities every 5 years, based on fuel loading, fire risk, sensitive species and habitats, infrastructure, military use, and other concerns	ENV, DPW	2025								\$ 20,000				
IN1.7	1	Survey for new locations or new invasive species and monitor known populations and/or past treatment areas, and maintain associated GIS data	ENV	Annually			\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
IN1.8	1	Implement a rapid response to new invasive species when possible	ENV, DPW	As Needed		\$ 10,000										
IN2.4	1	Develop and implement annual work plan for controlling invasive species based on priority species and locations	ENV, DPW	Annually			\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000
IN2.5	1	Monitor results of control efforts, primarily by analyzing changes in populations and density of invasive plants.	ENV, DPW	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
IN2.6	1	Evaluate boat ramps, water access points, roads, and trails as vectors for spreading invasive plants and identify mitigation measures, in conjunction with annual surveys	ENV, DPW	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
IN2.7	1	Identify priority areas for multiflora rose control, including use of the fungal biocontrol and implement control measures every 3 years	ENV	2023						\$ 15,000			\$ 15,000			\$ 15,000
IN2.8	1	Continue coordinating with APHIS for control of mute swan	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
IN3.2	1	Survey and monitor forest communities for forest pest and pathogens	ENV, MWR, MDNR	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
IN3.3	1	Implement treatment and suppression of forest pests and pathogens as needed, based on surveys and monitoring	ENV, MWR, MDNR	As Needed		\$ 50,000										
IN3.4	1	Execute any actions needed to mitigate or limit impacts from forest pests	ENV	As Needed		\$ 25,000										
IN4.2	1	Undertake risk evaluations and/or surveys to identify need and appropriate measures to implement for any emerging disease	ENV	As Needed		\$ 10,000										
FW1.2	2	Conduct annual deer and turkey hunts	ENV, MWR, MDNR	Annually												
FW1.3	1	Analyze deer harvest data annually and modify permits as needed	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
FW1.4	1	Assess deer herd every 10 years to document age structure, condition, and impacts to vegetation	ENV	Every 10 years				\$ 10,000								
FW1.5	1	Implement a comprehensive tracking system for all deer harvest data	ENV	2022					\$ 20,000							
FW1.6	1	Control raccoon population by conducting a raccoon hunt/removal event	ENV	As Needed		\$ 15,000										
FW2.2	1	Update comprehensive mammal surveys every 10 years, assuming no new rare species are documented	ENV	2021				\$ 75,000								
FW2.3	1	Conduct comprehensive bird survey every 5 years, including winter, night, raptor, waterfowl, and other speciality bird surveys	ENV	2023						\$ 75,000					\$ 75,000	

Table C-2. Proposed Projects for Fort Custer INRMP Implementation						Project Funding (Completed for Past FY, Estimated for Future FY)										
Project	Priority	Objective(s) in Section 3	MDMVA Funding	Projected Date	Project Number	TBD FY	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
FW2.4	1	FW2, TE1, TE2	ENV	Annually			\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000
FW2.5	1	FW2, TE1, TE2	ENV	2020			\$ 60,000					\$ 60,000				
FW2.6	1	FW2, TE1, TE2	ENV	Annually		\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
FW2.7	1	FW2, TE1, TE2	ENV	2021				\$ 50,000								
FW2.8	1	FW2, TE1, TE2	ENV	2025								\$ 80,000				
FW2.9	1	FW2, TE1, TE2	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
TE1.7	1	TE1	ENV	2021				\$ 35,000			\$ 35,000			\$ 35,000		
TE1.8	1	TE1	ENV	2021				\$ 35,000			\$ 35,000			\$ 35,000		
TE1.9	1	TE1	ENV	2021				\$ 35,000			\$ 35,000			\$ 35,000		
TE1.10	1	TE1	ENV	2020			\$ 20,000		\$ 20,000		\$ 20,000		\$ 20,000		\$ 20,000	
TE1.11	1	TE1	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
TE1.12	1	TE1, TE2	ENV	2022					\$ 75,000							
TE1.13	1	TE1, TE2	ENV	2022					\$ 75,000							
TE1.14	0	TE1, TE2, IN2	ENV	As Needed		\$ 35,000										
TE2.2	1	TE2	ENV	Annually			\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
TE2.3	1	TE2	ENV	2023						\$ 25,000					\$ 25,000	
TE2.4	1	TE2	ENV	2021				\$ 25,000			\$ 25,000			\$ 25,000		
TE2.5	1	TE2	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
TE2.6	1	TE2	ENV	2022					\$ 15,000			\$ 15,000			\$ 15,000	
TE2.7	0	TE2	ENV	Annually			\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
TE2.8	1	TE2	ENV	2028											\$ 80,000	
TE2.9	1	TE1, TE2	ENV	2024							\$ 15,000					\$ 15,000
RE1.3	0	RE1 PLUS LOTS OTHERS	ENV, DPW, MWR, Range Control	Annually			\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500
RE1.4	1	PM4, PM5, RE1	ENV	As Needed		\$ 500										
CC1.1	1	CC1, CC2, TE1, TE2, FW1, FW2	ENV	2020												
CC1.2	1	CC1, CC2, TE1, TE2, FW1, FW2	ENV, DPW	2020												
CC1.3	1	CC1, CC2, TE1, TE2, FW1, FW2	ENV, DPW	2021												
CC1.4	1	CC1, CC2, PM1	ENV, DPW	2022												
CC1.5	1	CC1, CC2, FW2, TE1, TE2, IN1, IN2	ENV	Annually												
CC2.2	1	CC1, CC2, FW2, TE1, TE2, IN1, IN2	ENV	Annually												

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP						Review for Operation and Effect (Green, Amber, Red)				
Objective	Criteria: Green	Criteria: Amber	Criteria: Red	Data Source(s)	FY	FY	FY	FY	FY	
Goal PM: Manage natural resources compatible with and supporting the military mission while complying with applicable federal, military, and state laws, regulations, and policies										
PM1	Implement INRMP to enhance the land and military mission and result in no net loss of land availability	INRMP reviews completed on schedule; maintain above 95% obligation rate; no vacant positions in natural resources; no additional restrictions on training lands from natural resources	INRMP reviews less than 6 months overdue; maintain above 60% obligation rate; temporary vacant position in natural resources; temporary or small (less than 10 acres) additional restriction on training lands from natural resources	INRMP annual review or ROE more than 6 months overdue; less than 60% obligation rate; vacant position in natural resources for more than 6 months; permanent or large (greater than 10 acres) additional restriction on training lands from natural resources						
PM2	Maintain appropriate state and federal permits related to natural resources management, including water and wildlife management issues	No permit violations, notice of violations, or lack of permits when necessary	Temporary permit violation, corrected notice of violation, or missing permit obtained	Permit violation, lack of permit when needed, uncorrected notice of violation						
PM3	Continue internal environmental awareness program to minimize adverse environmental impacts	All materials current and readily available; all requested/required training conducted; all UECOs certified	More than 50% requested/required training completed; more than 75% of UECOs certified	Materials out of date; less than 50% of requested/required training completed; less than 75% of UECOs certified						
PM4	Continue public outreach in coordination with other regional entities as available and appropriate	All materials current and readily available; present during at least 1 public event annually	n/a	Materials out of date or not available to the public; no public presentations within last 18 months						
PM5	Continue to cooperate with other agencies and local landowners on regional land and natural resources management efforts	Participate in regional meetings/planning (at least 2 annually); undertake at least 1 cooperative project annually	Participated in only one regional meeting annually	No participation in any regional efforts or cooperative projects						
PM6	Maintain and improve GIS data and availability of use for natural resources management and other planning	All natural resources GIS data is current and updated in master database	Less than 3 natural resources datasets are outdated	More than 3 natural resources datasets are outdated						
Goal SO: Manage Fort Custer soils to prevent sediment loss, minimize erosion, and support military mission										
SO1	Manage construction, roads/trails, slopes, and exposed soils to minimize erosion and soil loss and comply with all regulations and permitting	All exposed soils are managed with appropriate BMPs; no erosion is resulting in sediment loss; no notice of violations	Temporary (less than one week) failure of a BMP before correction; small (less than 1/10 acre) erosion feature resulting in sediment loss no more than 20 feet from site; only one notice of violation, corrected within one week	Long-term (more than one week) failure of BMP; large (greater than 1/10 acre) erosion feature resulting in sediment loss extending more than 20 feet from site; one or more notices of violation and/or not corrected within one week						
SO2	Ensure the long-term use of military training areas, primarily through addressing chronic and/or historic erosion issues and promoting awareness of erosion and sediment controls	Total area impacted by erosion not increased, including streambanks; no area closures due to erosion; all awareness materials include soil conservation	Small (less than 5 acre) increase in area impacted by erosion; only temporary closure (less than one year) due to erosion	Large (greater than 5 acre) increase in area impacted by erosion; long-term closure (more than one year) of area to military training due to erosion; soil conservation lacking in key awareness materials						
SO3	Continue pollution prevention programs to prevent contamination of soils and water resources	No violations of SWPPP, ICPs, or other pollution prevention	Violation of SWPPP, ICPs, or other pollution prevention but in process of correction	Uncorrected violation SWPPP, ICPs, or other pollution prevention						
Goal WA: Protect water quality and manage water resources, including wetlands, so they remain resilient and with no net loss of acreage or functions and values										
WA1	Maintain all surface water with high water quality and in compliance with designated uses	No violations of surface water quality standards	Violation(s) of surface water quality standards but in process of correction	Uncorrected violation(s) of surface water quality standards						
WA2	Minimize impacts from military training and development to water resources, including wetlands and buffers, and comply with all laws and regulations pertaining to wetlands, streams, floodplains and other regulated water bodies	No impacts to water resources and all necessary permits obtained	Impact to water resources, but in process of mitigation and/or permitting	Loss of water resources due to military training or development and/or uncorrected impacts without a permit						

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP						Review for Operation and Effect (Green, Amber, Red)				
Objective	Criteria: Green	Criteria: Amber	Criteria: Red	Data Source(s)	FY	FY	FY	FY	FY	
WA3	Preserve water resources to protect functions and values and fish and wildlife habitat, with no net loss of training opportunities	No loss of area or functions and values (per Section 404 criteria); no loss of fish and wildlife habitat; no negative change in native communities	Temporary loss of area or functions and values (per Section 404 criteria); temporary loss of fish and wildlife habitat; temporary negative change in native communities	Uncorrected/permanent loss of area or functions and values (per Section 404 criteria); temporary loss of fish and wildlife habitat; temporary negative change in native communities						
Goal VE: Manage different habitats (grasslands, wetlands, and forests) to promote native species, resilient communities, and support military training										
VE1	Maintain biodiversity and key attributes of high quality natural areas (HQNAs)	No loss of rare species or communities; no decline in key attributes	Temporary or reversible loss of rare species or decline in key attributes, with a plan to mitigate adverse effect	Permanent loss of rare species or decline/loss of key attribute; temporary loss but with no plans to mitigate adverse effect						
VE2	Conduct forestry activities, including timber harvests, in a manner that supports military training, protects against wildfire, invasive plants, and forest pests, and provides resilient ecosystems with regionally appropriate biodiversity	No military training conflicts or loss of biodiversity/ecosystem service	Temporary (scheduling or less than one year) military training conflict or loss of biodiversity/ecosystem service, with a plan to mitigate adverse effect	Forest area unsuitable for military training (for more than a year) as a result of forestry or long-term loss of biodiversity/ecosystem service						
VE3	Maintain wetlands and riparian zones, their functions and values, and associated ecosystem services	No loss of rare species or communities; no decline in key attributes	Temporary or reversible loss of rare species or decline in key attributes, with a plan to mitigate adverse effect	Permanent loss of rare species or decline/loss of key attribute; temporary loss but with no plans to mitigate adverse effect						
VE4	Maintain open landscapes (i.e., grasslands and shrublands) to support military mission and promote habitat and pollinator diversity	No loss of existing open landscapes; implementation of all planned projects annually to maintain and/or expand open landscapes	No loss of existing open landscapes but less than 50% of planned projects completed	Loss of existing open landscapes; no planned projects were completed						
VE5	Ensure grounds maintenance, new construction, and landscaping do not increase invasive plants or negatively impact biodiversity	No new invasive plants present in maintained areas	Increase in invasive plants, but a plan developed to address the increase	Increase in invasive plants that are impacting native vegetation and no plan to address them						
Goal FI: Manage wildland fire to support military training while reducing risks and maintaining ecological health, ecosystem services, native biodiversity, and structural diversity										
FI1	Ensure IWFMP implemented, all requirements are met, and coordination with partners continues	All standards met; all records complete and updated; all staffing and training requirements completed	Some standards, recordkeeping, staffing, or training not fully implemented but there is a plan to remedy within 1 year	One or more requirements are not being met and there is no plan to remedy within the next year						
FI2	Maintain wildfire response capabilities on Fort Custer as identified in IWFMP and in coordination with partners.	Fort Custer equipment and personnel meet standards; all wildfires are managed with no escapes	Fort Custer equipment and/or personnel do not meet standards, but plan to remedy is in place; uncontrolled wildfire(s) but caused no damage to people or infrastructure	Fort Custer equipment and/or personnel do not meet standards and no plans to remedy; uncontrolled wildfire(s) that caused damage to people or infrastructure						
FI3	Reduce risk of catastrophic and/or uncontrolled wildfires	No catastrophic or uncontrolled wildfires; planned fuel load and firebreak management completed	Uncontrolled wildfire(s) contained and limited in impact; more than 50% of planned fuel load and firebreak management completed	Uncontrolled wildfire(s) impacted resources; less than 50% of planned fuel load and firebreak management completed						
FI4	Use prescribed fire to support military training, ecological health, biodiversity, and rare species	Prescribed burns applied on more than 75% of planned acres annually	Prescribed burns applied on more than 50% of planned acres annually	Prescribed burns applied on less than 50% of planned acres annually						
Goal IN: Minimize impacts of invasive and pest species using an integrated pest management approach										
IN1	Continue early detection and rapid response to reduce and eliminate new invasive species in both aquatic and terrestrial areas.	No new invasive species detected and/or established; annual monitoring completed	New invasive species detected but treatment underway; annual monitoring completed	New invasive species detected and either no treatment or treatment unsuccessful; annual monitoring not completed						
IN2	Minimize impacts of invasive species and pests on the military mission, native species, and sensitive natural resources.	Complete at least 90% of planned annual treatment of priority species and areas	Complete at least 50% of planned annual treatment of priority species and areas	Complete less than 50% of planned treatment of priority species and areas						
IN3	Minimize impacts of forest pests on the military mission, forest composition, and sensitive natural resources.	No damage to forests; no impacts to rare habitat or species; no impacts to the mission from forest pests	Temporary damage to forests, rare habitats or species, or impacts to the mission from forest pests	Permanent damage to forests, rare habitats or species, or impacts to the mission from forest pests						

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP

Table C-3. Summary of Goals, Objectives and Criteria for Fort Custer INRMP						Review for Operation and Effect (Green, Amber, Red)				
Objective	Criteria: Green	Criteria: Amber	Criteria: Red	Data Source(s)	FY	FY	FY	FY	FY	
IN4	Minimize exposure to dangerous diseases by users of Fort Custer.	No outbreaks of illnesses; all educational materials updated and available	Small outbreak or educational materials not fully updated and only partially available	Major outbreak; educational materials not updated or available						
Goal FW: Manage fish and wildlife, including game species, and their habitat to maintain healthy populations without interfering with the military mission										
FW1	Manage populations of priority game species as part of regional management plans and without impacting the military mission.	All game species populations are healthy, no concerns have been identified, and no conflicts with military training or infrastructure have occurred	One or more game species populations are either too high or too low, or mission activities have been temporarily impacted by a game species or its management	Multiple game species populations are either too high or too low, or mission activities have been impacted significantly by a game species or its management						
FW2	Maintain healthy populations of native fish and wildlife species, with targeted management for priority species, without impacting the military mission.	Surveys indicate healthy populations of diverse native species, species management actions implemented as planned, and no conflicts with military training or infrastructure have occurred	Species surveys and/or species management temporarily delayed (less than 5 years), or mission activities have been temporarily impacted by a non-game species or its management	Species surveys and/or species management delayed more than 5 years, or mission activities have been impacted significantly by a non-game species or its management						
FW3	Maintain diverse, high-quality fish and wildlife habitat with associated corridors, without impacting the military mission.	Surveys indicate appropriate mix of habitat and corridors, habitat management actions implemented as planned, and no conflicts with military training or infrastructure have occurred	Habitat surveys and/or habitat management temporarily delayed (less than 5 years), or mission activities have been temporarily impacted by habitat management	Habitat surveys and/or habitat management delayed more than 5 years, or mission activities have been impacted significantly by habitat management						
Goal TE: Manage threatened and endangered listed species using an ecosystem approach, while supporting the military mission										
TE1	Maintain federally listed species and their habitat, minimize impacts to federally listed species and their habitat, and complete required consultations, while minimizing impacts to military mission.	No decline of populations, loss of core habitat, compliance with all Section 7 requirements, and no loss of military training/land	Temporary decline of population(s) or core habitat, temporary non-compliance with all Section 7 requirements, and/or temporary loss of military training/land	Permanent decline of population(s) or core habitat, notice of violation from USFWS, and/or permanent loss of military training/land						
TE2	Monitor and maintain state-listed species and their habitat, while minimizing impacts to military mission.	No decline of populations, loss of core habitat, and no loss of military training/land	Temporary decline of population(s) or core habitat and/or temporary loss of military training/land	Permanent decline of population(s) or core habitat and/or permanent loss of military training/land						
Goal RE: Provide recreational opportunities for social and economic benefit to the public without interfering with the military mission or causing damage to sensitive natural or cultural resources.										
RE1	Provide high-quality outdoor recreational opportunities, without causing damage to sensitive resources or the military mission.	No decline in recreational availability; no damage to sensitive resources from recreation; no conflicts with military training; more than 80% planned activities completed annually	Temporary closures to recreation outside of the Recreation Plan; temporary damage to sensitive resources; no conflicts with military training; more than 50% planned activities completed annually	Loss of recreational availability; permanent damage to sensitive resources; conflicts with military training; less than 50% planned activities completed annually						
Goal CC: Mitigate the effects of climate change on the natural resources at Fort Custer and increase resiliency in order to support the military mission.										
CC1	Protect natural resources sensitive to climate change and increase ecological resiliency on Fort Custer.	No loss of rare species or habitats; no decline in formerly common species; implement at least 80% of planned actions related to climate resilience	Reduction of a climate sensitive species or habitat; small decline in a formerly common species; implement less than 80% of planned actions relating to climate resilience	Loss of a climate sensitive species or habitat; major decline in a formerly common species; implement less than 50% of planned actions relating to climate resilience						
CC2	Continue participating in regional efforts to increase resiliency in all arenas to support the military mission.	Participate in at least 1 regional planning effort related to climate resilience	n/a	No participation in any regional planning efforts related to climate resilience						

Table C-4. Fort Custer ITAM Work Plan, FY20 (updated annually)			
Project #	Project Title	Project Description	TCM R Validated Amount
CUS2020002	Maintain 10 miles of maneuver trail	This project addresses sources of erosion and disrepair on sections of trail that are heavily used. In-house assets provided by DPW and contract labor will grade, scrape and infill sections of trail needing the most attention. This project will also purchase stabilized gravel and soil erosion control measures.	\$70,576.61
CUS2020003	Maintain 6 Bivouac Areas for a Total 30 Acres.	This activity covers 6 bivouac sites of approximately 30 acres total. Repair erosion damage, reseed, and mow bivouac areas on Post to assist troops staying afield during Field Training Exercises. Focus on existing sites needing repair. May also include, mowing, brush hog, forestry mower and landscape rake used. Apply 2-4D or Round-Up if needed for weed control.etc. Additional equipment and labor provided by DPW	\$8,296.28
CUS2020004	Reconfigure 10 acre Bivouac Area in Training Area 4A	This 10 acre bivouac area was underused and as a result the area is filled with undesirable and very thick underbrush. Activity will require stump removal and vegetation removal, application of herbicide and reseed. Reconfiguring this assembly area will facilitate usage of the nearby compass course and land navigation areas per TRI directives.	\$5,804.44
CUS2020005	Maintain 3 Landing Zones at 4 acres each	Landing zones become overgrown with both woody and ground-level vegetation. 2 to 3 times during the summer months we will mow, brush, treat with herbicide and/or FECON each landing zone to maintain the sites. Additional equipment and labor provided by DPW.	\$11,230.31
CUS2020006	Maintain 90 acres of Land Navigation 5 Course via vegetation control	Control thorny brush for visibility per TC25-1 guidelines around land navigation and compass course in Training area 1-2. This will require clearing encroaching vegetation using hand tools, brush hogging, herbicide and contract LRAM crews. The goal will be to reduce brush and increase visibility in select sections that can be complimented by prescribed fire and forestry programs. The area includes approximately 90 acres.	\$20,673.19
CUS2020007	RTLA plan development and field work	This project will synthesize previous RTLA data and develop a forward-looking assessment plan that centers on current and future TRI directives. The project will also contain field work to continue RTLA assessments from previous years. The project will fund a 2-person field crew over the summer months and assess the efficacy of LRAM projects and gauge usage patterns and training area impacts. SOPs attached.	\$27,850.55
CUS2020008	Maintain dust control on 5 miles of maneuver trail	Treat approximately 5 miles of maneuver trails for dust control twice annually to maintain. Fine dust on trails result in significant safety hazards during dry portions of the year. A secondary benefit to dust control is reduced trail maintenance requirements. Equipment, labor and materials will be provided by contract for application of treatment. Total cost for dust control is cost-shared with Environmental Office and DPW.	\$21,984.22
CUS2020009	Reconfigure 0.25 miles of maneuver trail in Training Area 4A/4C	The maneuver trail in Training Area 4A/4C has seen significant damage from mounted maneuvers, but also from migrating stream channel. The trail currently is adjacent to the stream channel and associated wetlands. This project would remove and restore the old road grade and re-route the trail to avoid wetland impacts. Total maneuver trail mileage is approximately 0.25 miles. This will also require coordination with Range Control to relocated a mounted land navigation point.	\$35,177.03
CUS2020010	Reconfigure 10 acre training site in Training Area 3A	This project addresses a training site that has been denuded by TAACOM training exercises and has become a potential erosion hazard. It will address reseeding, grading to ensure proper drainage.	\$30,504.23
CUS2020011	Replant 25 acre bivouac	This project will plant a 25 acre bivouac area. This is a relatively new bivouac area that is the product of a forestry salvage operation after a large-scale wind event.	\$13,358.25
CUS2020012	Reconfigure Landing Zone 6 - leveling and hardening	This project addresses landing zone 6 which has a low area where the rotors are too close to the ground. We will bring in fill to level the site and use contract bulldozer operator to level the site. This will also help reduce / eliminate erosion on site.	\$17,519.76

Level 0 – Recurring conservation requirements that maintain compliance with federal laws and regulations; funding likely

Level 1 – Non-recurring conservation requirements that fix noncompliance; funding possible

Level 2 – Non-recurring conservation requirement that prevent noncompliance; generally not funded

Level 3 – Non-recurring conservation requirement that enhance the environment; generally not funded

It is important to note, that on a yearly basis, only Level 0 and 1 are generally considered for funding; Level 1s are less likely to get funded than Level 0s, which have a high likelihood of being funded.

Goals and Objectives Abbreviations

PM=Program Management

SO=Soils Management

WA=Water Resources Management

VE= Vegetation Management

FI=Wildland Fire Management

IN=Invasive Species Management

FW=Fish and Wildlife Management

TE=Rare Species Management

RE=Recreation

CC=Climate Change/Resiliency

Priority

0 = Recurring

1 =

2 =

3 =

Potential Agencies

Indicates the agency(agency) that could lead the project. This could be as sole lead or as cost-share or co-lead relationship as well as sole lead. In the case of Fort Custer, it is often parcel dependent, if not a facility-wide effort.

APPENDIX D
REPORT ABSTRACTS

Altus, S., Porter, M., Keith, R., & Tsao, J. (2018). *Changes in Tick Populations Parasitizing Birds in Southwestern Michigan*. Kalamazoo Nature Center and Michigan State University.

Wild birds may play an important role in the dissemination of ticks across the landscape, facilitating the spread of a variety of tick-borne diseases, including those that pose risks to both human and animal health. The blacklegged tick (*Ixodes scapularis*) is the vector for Lyme disease, caused by *Borrelia burgdorferi*, which is the most prevalent human vector-borne disease in North America. While *I. scapularis* is the primary vector that transmits Lyme disease to humans, other tick species can maintain the pathogen in enzootic cycles. The first established *I. scapularis* populations in southwestern Michigan were discovered in 2002, but was not detected at Fort Custer Training Center until 2004, with subsequent populations of *I. scapularis* ticks found both on and off host. Since Lyme disease has been emerging in Michigan over the past 30 years, understanding the spatial distribution of disease risk and role of wildlife in disseminating ticks over geographic space is essential for tick-borne disease risk assessment, and the protection of public health. This study describes the ticks parasitizing passerine birds over time at two study sites in southwestern Michigan, Fort Custer Training Center (FCTC) and nearby Kalamazoo Nature Center (KNC). We hypothesized that there would be an increase over time in the prevalence of infestation with *I. scapularis* larvae and nymphs as previously seen in coastal regions of southwestern Michigan. Given the zoonotic nature of this pathogen, monitoring tick populations for pathogen prevalence is essential for identifying risk and targeting interventions.

Baldy, J. J., Brenneman, J., Keith, B., Keith, R., & Wenger, T. (2011). *Avian Field Studies at the Army National Guard Fort Custer Training Center, August, Michigan: Field Season 2010*. Kalamazoo Nature Center.

Avian field studies have been ongoing at FCTC since 1997. 2010 species monitoring consisted of point counts designed for abundance and diversity estimates, the final year of a three-year color-banding project on the cerulean warbler, and Monitoring Avian Productivity and Survivorship (MAPS) banding project. Point counts were conducted and allow for a comparison of populations over the course of the project. These data reflect regional trends as well as the reaction of species to management activities. Several changes are incorporated that reflect the updated detection distance values published over the past 10 years. This was the final year of a 3-year color-banding project to determine the survival rate of cerulean warblers during migration. Of the 46 birds color-banded from 2007 to 2009, eleven were re-sighted in 2010. Three returned to the same territory as originally banded; two birds were re-sighted less than 1000m of their original banding location; two approximately 1000m away; while four moved nearly 2000 m. This was the second year of a five-year Monitoring Avian Productivity and Survivorship (MAPS) at FCTC. Three locations were run once every 10 days from 31 May to 8 August. A total of 603 individuals of 44 species were captured. The 3 most common species were gray catbird, yellow warbler and common yellowthroat.

Bassett, T. (2016). *Report on 2016 Corydalis flavula surveys at Fort Custer Training Center and adjacent areas, and summaries of 2007-2016 monitoring*. Native Connections.

Native Connections has provided annual monitoring of the State-threatened plant, *Corydalis flavula* (yellow fumewort), at Fort Custer Training Center since 2007. Here, we provide a report on status surveys conducted in 2016 ('Qualitative Assessment'). We also provide brief summaries of two long-term quantitative monitoring efforts ('Macroplot Monitoring' and 'Garlic Mustard Removal'). These

summaries provide general conclusions - more detailed analysis of this valuable long-term dataset will be provided at a later date. Finally, we report on initial findings from a newly initiated effort ('Kalamazoo River Floodplain').

Bassett, T. (2007). 2007 Rare Plant Status Surveys, Fort Custer Training Center. Native Connections.

The status of 15 rare plant species on FCTC was evaluated in 2007. The descriptions below describe the habitat (in terms of landscape position, soils, hydrology and associated groundlayer, understory and overstory species) and the condition (status) of each species at Fort Custer Training Center (FCTC).

Bassett, T. (2015). 2015 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (6 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2015.

Bassett, T. (2014). 2014 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (6 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2014.

Bassett, T. (2013). 2013 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (6 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2013.

Bassett, T. (2010). Update on 2010 Corydalis project at Fort Custer Training Center. Native Connections.

Native Connections began a project in May 2010 to provide a comprehensive picture of the status of the State-threatened plant, *Corydalis flavula*, at Fort Custer Training Center (FCTC) and surrounding properties under State ownership. The comprehensive nature of the project was required in large part by the proposed construction of two new structures on portions of *C. flavula* populations. The three goals were: 1) Conduct a comprehensive survey of all potential *C. flavula* habitat across FCTC, Fort Custer Recreation Area (FCRA), Hart's Lake Property (HLP), and Fort Custer National Cemetery (FCNC); 2) Conduct annual monitoring at the existing permanent plot in Area 1 and set up an additional permanent plot and conduct monitoring; and 3) Set up and monitor several smaller plots to gauge the effect of garlic mustard on *C. flavula* populations.

Bassett, T. (2012). 2012 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (6 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2012.

Bassett, T. (2008). 2008 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (5 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2008.

Bassett, T. (2009). 2009 Qualitative Assessment of Corydalis flavula at Fort Custer Training Center. Native Connections.

Summary of population surveys (5 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2009.

Bernatas, S. (2007). *Aerial Infrared Deer Survey, Ft Custer Recreation Site, MI. Vision Air Research, Inc.*

Vision Air Research, Inc. was retained by Michigan State University to conduct a survey for white-tailed deer for the Ft Custer Recreation Site, MI. The study area comprised the Ft Custer Recreation Area located approximately 12 miles east of Kalamazoo, MI. The goal of the forward-looking infrared survey was to enumerate the deer detected.

Brenneman, J., Baldy, J., Keith, R., Keith, B., & Wenger, T. (2010). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Field Season 2009.* Kalamazoo Nature Center.

Avian nesting success research at Fort Custer Training Center (FCTC) over the last 10 years, from 2000-2009, has shown that this site represents a net sink for the Hooded Warbler. The Wood Thrush, however, is in the low estimated range for break-even. The dominant cause of nest failure is predation, averaging 43% over the years. Observed nest parasitism by Brown-headed Cowbirds averages 37% with rates as high as 80% in 2004 for the Hooded Warbler. Unique findings in 2009 include a reduced hatching rate, possibly due to environmental stress. Parasitism rates in the Hooded Warbler are still high at 65%. This was the first year of a 5-year study Monitoring Avian Productivity and Survivorship (MAPS) at FCTC. Three locations were selected and run once every 10 days from 31 May to 8 August. A total of 820 individuals of 43 species were captured. The 3 most common species were Yellow Warbler, Gray Catbird and Song Sparrow. This was the second year of a 3-year color-banding project at FCTC to determine the survival rate of Cerulean Warblers during migration. A total of 16 Cerulean Warblers were captured from 1 May through 22 June 2009. Of the birds color-banded in 2007-2008, 8 were re-sighted in 2009. Six birds were re-sighted within 200 m of their original banding location; while two moved more than 1,000 m.

Brenneman, J., Keith, R., & Keith, B. (2016). *Avian Field Studies at the Fort Custer Training Center, Augusta, Michigan, 2015 Annual Report.* Kalamazoo Nature Center.

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2015. Field work in 2015 focused on five themes: Avian Point Counts, Marshbird Monitoring, Cerulean Warbler Color Banding, the Lark Sparrow, and Monitoring Avian Productivity and Survivorship (MAPS).

Brenneman, J., Keith, R., & Keith, B. (2019). *Avian Field Studies at the Fort Custer Training Center, August, Michigan, 2018 Annual Report.* Kalamazoo Nature Center.

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2018. This report is broken into five major sections including Avian point counts, Marsh bird surveys, Cerulean Warbler monitoring, MAPS banding and Motus Tower migration monitoring.

Brenneman, J., Keith, R., & Keith, B. (2017). *Avian Field Studies at the Fort Custer Training Center, Augusta, Michigan, 2016 Annual Report.* Kalamazoo Nature Center.

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2016. Field work in 2016 focused on five themes: Avian Point Counts, Avian Changes in Response to Management and Natural

Disaster, Cerulean Warbler Color Banding, Marshbird Monitoring, and Monitoring Avian Productivity and Survivorship (MAPS).

Brenneman, J., Keith, R., & Keith, B. (2018). *Avian Field Studies at the Fort Custer Training Center, August, Michigan, 2017 Annual Report*. Kalamazoo Nature Center.

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2017. Field work in 2017 focused on four themes: Avian Point Counts, Marshbird Monitoring, Cerulean Warbler Color Banding, and Monitoring Avian Productivity and Survivorship (MAPS).

Brenneman, J., Keith, R., Keith, B., & Vormwald, L. (2015). *Avian Field Studies at the Fort Custer Training Center, August, Michigan, 2014 Annual Report*. Kalamazoo Nature Center.

When the KNC first began the FCTC bird surveys, the site supported one of the largest populations of Cerulean and Hooded Warblers in Michigan. During the 1997 breeding season, it was estimated that 46 Cerulean and 78 Hooded Warbler males were present, and probable territories were mapped using sightings from point counts and area searches. We use these numbers as our baseline population estimate for subsequent years. Numbers of singing male Cerulean Warblers have since fallen to around 30, while numbers of singing male Hooded Warblers have fluctuated between 70 and 80. Another widely used method of obtaining and disseminating information on bird abundance and trends is North American Monitoring Avian Productivity and Survivorship (MAPS) program. KNC began using MAPS protocol for bird banding at FCTC in 2009 and has assisted collaborators in Gathering data for additional projects. This report is broken into four major sections including avian point counts, marsh bird surveys, Cerulean Warbler monitoring, and MAPS banding. Following this summary, we make several management recommendations based on our research.

Brenneman, J., Keith, R., & Reding, S. (2017). *Bald Eagle Nesting Report at Fort Custer Training Center, Kalamazoo Valley Bird Observatory and Kalamazoo Nature Center*.

Some Bald Eagles are bothered by noise or human activity but these eagles have successfully nested in the same tree since at least 2011. At this time there are no observable adverse effects on the successful breeding of Bald Eagles from the activities conducted by Fort Custer Training Center. The Bald Eagle nest in Fort Custer Training Center is located in the restricted area within the safety range (compartment 8) of the firing range (compartment 9), so access to the nesting site is limited. This Eagle nest location was first discovered in the fall of 2009, and we first observed young during the summer of 2011. This nest became dislodged in July of 2012 and was rebuilt in the same tree and successfully used for the breeding season of 2013. Unfortunately, this nest fell again in August 2017 and was not used in 2018.

Buehler, D. A., Giocomo, J. J., Jones, J., Hamel, P. B., Rogers, C. M., Beachy, T. A., Varble, D. W., Nicholson, C. P., Roth, K. L., Barg, Je., Robertson, R. J., Robb, J. R., & Islam, K. (2008). Cerulean warbler reproduction, survival, and models of population decline. *The Journal of Wildlife Management*, 72(3), 646–653. <https://www.srs.fs.usda.gov/pubs/30759/>

We present and compare demographic data for cerulean warblers (*Dendroica cerulea*) from 5 study sites across the range of the species from 1992 to 2006. We conducted field studies to collect data on daily nest survival, nest success, and young fledged per successful nest, and we used data to estimate fecundity. Daily nest survival, nest success, young fledged, and fecundity varied widely across the

cerulean range and among years. Study sites in agriculture-dominated landscapes (Mississippi Alluvial Valley, IN, and MI, USA) had negative growth rates in all years monitored because measured values of nest success and young produced per successful nest were incapable of offsetting apparent mortality. Ontario (Canada) and Tennessee (USA) populations had greater nest success and fecundity but still appeared to be incapable of producing stable populations ($k \approx 1$) under field-measured and assumed conditions. We had survival data only for one site (Ontario); thus, additional survival data are greatly needed to enable more reliable estimates of population growth. Conservation strategies for cerulean warblers in agriculture-dominated landscapes (e.g., Mississippi Alluvial Valley, IN, and MI) may require major landscape-level habitat reconfiguration to change agriculture-dominated landscapes to forest-dominated landscapes to increase fecundity. Conservation strategies in predominantly forested landscapes in the core of the range (e.g., TN) require a focus on minimizing habitat loss and developing management prescriptions capable of improving fecundity. In both cases, based on sensitivity and elasticity analyses, efforts to improve survival during the nonbreeding season would have the greatest positive effect on population growth.

CEC. (2015). *Indiana Bat (*Myotis sodalis*) and Northern Long-eared Bat (*Myotis septentrionalis*) Presence/Probable Absence Survey Report, Fort Custer Training Center. Civil & Environmental Consultants, Inc.*

A second season of surveys was conducted to demonstrate the presence/probable absence of Indiana bats (*Myotis sodalis*) and northern long-eared bats (*M. septentrionalis*) within the FCTC, located in Calhoun and Kalamazoo counties, Michigan. The site is one of several potential sites being considered for future development of a missile defense system by the U.S. Department of Defense (USDOD). The 2015 acoustic survey for bats was initiated at the request of the USDOD to ensure equal survey efforts were being completed at all potential development sites.

Cohen, J. G., O'Connor, R. P., Barton, B. J., Cuthrell, D. L., Higman, P. J., & Enander, H. D. (2009). *Fort Custer Vegetation and Natural Features Survey 2007-2008 Report (Report 2009-04). Michigan Natural Features Inventory.*

The primary objective of this project was to reassess the impact of management activities on known natural features and provide recommendations for management conflicts relating to these features. In addition, findings from other ecological studies conducted at Fort Custer were reviewed, surveys for potential new natural communities and rare species were conducted, and vascular plant taxa not previously recorded during MNFI's 1995 work were collected and vouchered. A total of 31 new plant species were found during the surveys bringing the total known flora for Fort Custer to 835 species.

Cole-Wick, A. (2018). *Evaluation of Fort Custer Training Center for Presence of the Federally Endangered Karner Blue Butterfly. Kalamazoo Nature Center.*

Here we report on 2018 surveys for the Federally Endangered Karner blue butterfly (*Lycaeides melissa samuelis*) in oak savanna and barrens at Fort Custer Training Center (FCTC). The purpose of this study was to survey for adult Karner blues and the presence of the butterfly's host plant (wild blue lupine; *Lupinus perennis*) at FCTC. While the Karner blue's host plant exists in small populations at FCTC, we did not find any Karner blues. We conclude that the lack of abundance of wild blue lupine currently present at FCTC is not sufficient to support the endangered butterfly. Herein, we review our findings from this

year, as well as previous research we conducted, which shows the presence of *Formica* ant species, which are necessary for the survival for the butterfly. When possible, we surveyed for all other Lepidoptera, including two rare species that share the same habitat and host plant with the Karner blue: *Persius duskywing* (*Erynnis persius persius*) and frosted elfin (*Callophyrus irus*). We did not find these species either, however, we would recommend more targeted surveys to conclude that they are indeed absent from FCTC. Herein we recommend future management, restoration, and lepidopteran research opportunities for FCTC.

Colliton, R. J. (2007). 2007 Management Report: Fort Custer Training Center. Kalamazoo Nature Center, Southwest Corner Cluster.

The Southwest Corner Cluster's Southwest Action Team was contracted to implement the management of invasive species at high quality sites within the training area. This report contains management objectives based on the 2005 DLZ report Resource Management in High Quality Natural Areas, conversations with training center staff, and in-field conditions. The report also contains sections on management techniques and outcomes, describing specific measures taken to meet objectives and the results of those measures. Four high-threat invasive species were targeted at four high-quality sites. Invasive species were treated with two active chemicals triclopyr and glyphosate.

Cooper, J. L. (1997). Monitoring for the prairie vole, *Microtus ochrogaster*, at Fort Custer Training Center: 1997 Progress Report (MNFI 1997-03). Michigan Natural Features Inventory.

The prairie vole population at FCTC is the only known extant population of this state threatened species in Michigan. A monitoring program was initiated in 1995 to assess training activities on the prairie vole population and its habitat. The population in the study area varied from 1994 to 1997, with declines noted during that time period. There is, however, additional potential habitat nearby on FCTC. The change in abundance levels may reflect a natural population cycle for the prairie vole. Meadow vole populations seem to show evidence of a cyclic population as well on the monitoring site.

Cooper, J. L. (2000). Monitoring (1995-1999) and Management Recommendations for the Prairie Vole (*Microtus ochrogaster*) at Fort Custer Training Center. Michigan Natural Features Inventory.

The prairie vole population at FCTC is the only known extant population of this state threatened species in Michigan. A monitoring program was initiated in 1995 to assess training activities on the prairie vole population and its habitat. Four treatment units were defined for monitoring purposes in the main study site, a field containing the known prairie vole population. These units were trapped from 1995 through 1999. The meadow vole population seems to show evidence of a cyclic population. The primary objective of management at the site should be to maintain the current open herbaceous condition. Monitoring and adaptive management should be undertaken to determine the most appropriate vegetation management techniques for maintaining the prairie vole population.

DLZ. (2009). 2008 Prescription Burn Monitoring, at Fort Custer Training Center, Augusta, Michigan. DLZ Michigan, Inc.

In summary, the 2008 burn season was very successful both from a burn production standpoint and from a continued positive trend in the ecological health of the plant communities as a result of the reintroduction of landscape fire. The enhanced level of monitoring moves in a positive direction of

documenting the changes resulting from the burns. The first fire in a burn unit is the easiest to rationalize after the extended period of fire suppression over the last 100-200 years. Now that the plant communities in the management areas are responding, documenting thoughtful observations will help establish a proper fire return interval in the future. This program is fast approaching a quarter completion of the initial 20-year plan. The results provide a great amount of information for land managers throughout the Midwest and Great Lakes states.

DLZ. (2005). *Resource Management in High Quality Natural Areas, Fort Custer Training Center, Augusta, Michigan (Issue January)*. DLZ Michigan and Potawatomi RC & D.

The intent of this effort as a planning level document is to propose activities that are optimal in addressing the health and protection of the natural areas. Contemporary fragmented natural areas require active management to reverse negative plant community trends resulting from land use impacts and the lack of landscape influences that perpetuated the historic landscape. Although many conservative plants still exist in the FCTC natural areas, there are many subtle negative trends apparent at the sites. Under a thoughtful management program, the sites can be restored to a more historically accurate dynamic state. The physical appearance of the sites will likely change as a result of proposed management activities. The character of plant community strata will change with the herbaceous layer benefiting from increased light levels resulting in robust grass, sedge and forb growth. Transition zones between plant community types and hydrologic regimes will widen with transitions occurring more softly. It is anticipated that implementation of the management recommendations will increase plant community diversity and expand the cover of conservative plant species. Continued monitoring of the plant communities following management activities will document progress and provide clues to adjustments needed in the management protocols overtime.

DLZ. (2015). *Wetland Delineation Report*. DLZ Michigan and Potawatomi RC & D.

A jurisdictional wetland delineation was performed within the proposed boundaries associated with the proposed Contiguous United States (CONUS) Interceptor Missile Defense project. The project is located at the Fort Custer Training Center, Augusta, Michigan. The study area is within the Eagle Lake-Kalamazoo River, Harts Lake-Kalamazoo River, Headwaters Portage River, and Minges Brook watersheds. The conclusions of this report are considered preliminary until verified by the U.S. Army Corps of Engineers. Field review of the Site 1 area identified 20.25 acres of wetlands. Field review of the Site 2 identified 77.93 acres of wetlands. In the MAB and ISF areas, 7.86 acres of wetlands were identified. The area of wetlands located within the two Site areas, expansion areas, and MAB area is not representative of impacts that may occur if the project proceeds to construction. In many instances, minor modifications to the location of the facilities can avoid or reduce wetland impacts. If relocation of facilities is not feasible, justification will need to be provided during the permitting phase if the project advances to construction.

DLZ. (2005). *Wetland Delineation Report, Fort Custer Training Center, Augusta, Michigan*. DLZ Michigan and Potawatomi RC & D.

A total of 20 wetlands have been identified within the project area in 2005, totaling 29.73 acres. Six wetlands were classified as palustrine emergent (PEM), seven as palustrine scrub-shrub (PSS), one as palustrine forested (PFO), four as a combination of PEM/PSS, and the remaining two wetlands were

classified as a combination of PSS/PFO. All the wetlands in the project area are regulated under Part 303, Wetlands Protection, of the NREPA by the Michigan Department of Environmental Quality. In addition, the three drains located within the project area may be regulated under Part 301, Inland Lakes and streams of the NREPA. Any future impacts to the delineated features will require permits from the MDEQ. The MDEQ is the regulatory authority in the project area and as such is charged with the decision as to the jurisdictional status of the areas, the type of permits required should impacts be proposed, and the determination of the appropriate mitigation for proposed impacts.

DLZ. (2009). *Fort Custer Training Center, 2009 Burn Monitoring, Final Report.* DLZ Michigan, Inc.

Fort Custer Training Center contracted with DLZ Michigan, Inc. in 2009 for prescription burn services, including providing a burn leader to assist the FCTC burn crew, a DLZ burn crew, and monitoring of prescribed burn effects. This report is a brief narrative documenting the monitoring efforts of a post-burn evaluation of the fifteen burn management areas burned in the 2009 season. In summary, the 2009 burn season was again very successful both from a burn production standpoint and from a continued positive trend in the ecological health of the plant communities as a result of the reintroduction of landscape fire. The level of monitoring continues to document the positive changes resulting from the burns. The first fire in a burn unit is the easiest to rationalize after the extended period of fire suppression. Now that the plant communities in the management areas are responding to fire influence, documenting observations will help establish a proper fire return period for the units into the future. This program is fast approaching completing a quarter of the initial 20-year plan. The results achieved at FCTC provide a great amount of information for land managers throughout the Midwest considering large scale land management.

DLZ Michigan Inc., & Potawatomi RC&D. (2010). *2010 Prescription Burn Monitoring, Fort Custer Training Center.* DLZ Michigan, Inc. and Potawatomi RC & D.

Map and data sheets from prescribed burn monitoring at Fort Custer Training Center in 2010.

Duddleson, R. (2015). *Targeted Phase I Archaeological Survey of Select Areas at Fort Custer Army National Guard Training Center.* Orbis Environmental Consulting.

The purpose of this project was to work is to clarify ambiguous, missing, destroyed or misidentified archaeological sites at six (6) locations for which there are historic records at the Fort Custer Training Center. Orbis reviewed records on file at the Michigan Historical Center in Lansing, the Kalamazoo County Library, and at FCTC. Orbis performed the fieldwork in November 2014. Vegetation across the project area included, mixed hardwood forest, occasional shrub/scrub, and forested wetlands. Orbis was not able to locate sites near the decommissioned well location on Whitman Lake, nor where structures appear on the 1937 USACE Map along Route 12. As such we recommend no further work is necessary in these locations. Conditions at the previously known sites appear generally consistent with previous surveys, though Orbis noted some minor discrepancies in the description of some of the features. Nevertheless, none of these changes affect the previous interpretations of these sites or their status for listing in the National Register of Historic Places. We recommend no further archaeological work for these sites.

Envirologic. (2000). *Summary Report: Land Condition Trend Analysis (LCTA) Short-Term Monitoring Activities, Fort Custer Training Center, Summer 2000.* Envirologic Technologies, Inc.

Envirologic Technologies, Inc. (Envirologic) completed the second annual Short-Term Monitoring inventory. The Short-Term inventory is intended to detect changes in land use, disturbance, ground cover, canopy cover, and woody plant density. Relevant updates have been made to the LCTA notebook and data from all three years (1998 - 2000) is currently being adapted to a GIS database using ArcView.

Envirologic. (2001). *Summary Report: Land Condition Trend Analysis (LCTA) Short-Term Monitoring Activities, Fort Custer Training Center, Summer 2001.* Envirologic Technologies, Inc.

Envirologic Technologies, Inc. (Envirologic) completed the third annual Short-Term Monitoring inventory. The Short-Term inventory is intended to detect changes in land use, disturbance, ground cover, canopy cover, and woody plant density. The information collected during the Short-Term inventory is similar to that of the Long-Term or Initial inventories, but is less detailed. A Long-Term inventory is required within 3-5 years after the Initial inventory is completed. The Fort Custer Long-Term Inventory is scheduled to begin in the summer of 2003.

Envirologic. (2002). *Summary Report: Land Condition Trend Analysis (LCTA) Short-Term Monitoring Activities, Fort Custer Training Center, Summer 2002.* Envirologic Technologies, Inc.

Envirologic Technologies, Inc. (Envirologic) completed the fourth annual Short-Term Monitoring inventory. The Short-Term inventory is intended to detect changes in land use, disturbance, ground cover, canopy cover, and woody plant density.

Evans, N. T., Li, Y., Renshaw, M. A., Olds, B. P., Deiner, K., Turner, C. R., Jerde, C. L., Lodge, D. M., Lamberti, G. A., & Pfrender, M. E. (2017). Fish community assessment with eDNA metabarcoding: Effects of sampling design and bioinformatic filtering. *Canadian Journal of Fisheries and Aquatic Sciences*, 74(9), 1362–1374. <https://doi.org/10.1139/cjfas-2016-0306>

Traditional fisheries assessments that rely on capture of organisms often underestimate true species richness. eDNA metabarcoding is an alternative tool, which infers species richness by collecting and sequencing DNA present in the ecosystem. Our objective was to determine how spatial distribution of samples and “bioinformatic stringency” affected eDNA-metabarcoding estimates of species richness compared to capture-based estimates in a 2.2-ha reservoir (Lawler Pond on Fort Custer Training Center). When bioinformatic criteria required species to only be detected in a single sample, eDNA metabarcoding detected all species captured with traditional methods plus an additional 11 non-captured species. However, when we required species to be detected with multiple markers and in multiple samples, eDNA metabarcoding detected only seven of the captured species. Our analysis of the spatial patterns of species detection indicated that eDNA was distributed relatively homogeneously throughout the reservoir, except near the in-flowing stream. We suggest that interpretation of eDNA metabarcoding data must consider the potential effects of water body type, spatial resolution, and bioinformatic stringency.

FCTC. (2016). *Fort Custer Massasauga Surveys 2014-2016.*

In our final years of the surveying, at Fort Custer we decided to try a couple of different approaches. First, we decided to focus our attention on the Impact Area and the wetland complexes around TA 7. Second, we decided to see if we could get some additional experienced eyes on site. Our target areas were the wetland complexes and adjacent uplands providing the best habitat and mix of elements for

the rattlesnakes to thrive. It is my professional opinion that the Eastern Massasauga Rattlesnake may have been extirpated from the Fort Custer Training Center due to past land use such as agriculture including farming in the wetlands, damming up creeks for road crossings and lake creation which could have decimated many fens, and various military uses such as aerial bombardment.

Fettinger, J. L. (2005). *Comprehensive Population and Habitat Surveys for the Karner Blue (*Lycaeides melissa samuelis*) in Michigan: Final Report (MNFI Report Number 2005-08)*. Michigan Natural Features Inventory.

This report summarizes the study methods and findings most relevant to Habitat Conservation Plan (HCP) development and implementation, wildlife managers, and others that are involved in the conservation of Karner blue in Michigan. Detailed methods and results of the first three years of this study are presented in annual reports prepared for the Michigan Department of Natural Resources (MDNR). and reports from previous survey efforts. Five main deficiencies in our knowledge were identified through this analysis: 1) many known occurrences had not verified in four or more years (old data), 2) insufficient survey effort in the Ionia, Muskegon and Newaygo RUs due to fragmented ownership, 3) insufficient survey efforts in potential habitat outside the known distribution of the butterflies 4) unknown quality of habitat within occupied sites, and 5) unknown threats to Karner blue populations. Karner blue presence or absence. In all, surveyors searched for Karner blue and lupine within 3,966 ha (9,801 ac) in the Lower Peninsula, re-verified Karner blue presence at 79 previously known occurrences, discovered 43 new Karner blue occurrences, and documented six township records. In addition, surveyors located over 320 ha (791 ac) of previously unknown habitat. Geographic Information System (GIS). New and updated occurrences were used to create maps of current Karner blue distribution in Michigan. Habitat data were collected within 146 Karner blue occupied sites and compared with data from 112 sites where only lupine was observed. Sites with <50% canopy closure that are within 1000m of occupied habitat and contain dense lupine in addition to diverse flowering plant species are of high quality for Karner blue.

Fuller, L. M., Morgan, T. R., & Aichele, S. S. (2006). *Wetland Delineation with IKONOS High-Resolution Satellite Imagery, Fort Custer Training Center, Battle Creek, Michigan, 2005. Scientific Investigations Report 2006-5051*. US Geological Survey. <https://pubs.usgs.gov/sir/2006/5051/>

The National Wetlands Inventory (NWI) data have been the primary wetland-boundary resource for wetlands on FCTC, but a check on scale and accuracy of the wetland boundary information was needed. In cooperation with FCTC, the US Geological Survey (USGS) used an early spring IKONOS pan-sharpened satellite image to delineate the wetlands and create a more accurate wetland map for the FCTC. The USGS tested automated approaches (supervised and unsupervised classifications) to identify the wetland areas from the IKONOS satellite image, but the automated approaches alone did not yield accurate results. To ensure accurate wetland boundaries, the final wetland map was manually digitized on the basis of the automated supervised and unsupervised classifications, in combination with NWI data, field verifications, and visual interpretation of the IKONOS satellite image. The final wetland areas digitized from the IKONOS satellite imagery were similar to those in NWI; however, the wetland boundaries differed in some areas, a few wetlands mapped on the NWI were determined not to be wetlands from the IKONOS image and field verification, and additional previously unmapped wetlands not recognized by the NWI were identified from the IKONOS image.

Fuller, L. M., Morgan, T. R., & Aichele, S. S. (2006). *Wetland Delineation with IKONOS High-Resolution Satellite Imagery, Fort Custer Training Center, Battle Creek, Michigan, 2005. Scientific Investigations Report 2006-5051*. US Geological Survey. <https://pubs.usgs.gov/sir/2006/5051/>

The National Wetlands Inventory (NWI) data have been the primary wetland-boundary resource for wetlands on FCTC, but a check on scale and accuracy of the wetland boundary information was needed. In cooperation with FCTC, the US Geological Survey (USGS) used an early spring IKONOS pan-sharpened satellite image to delineate the wetlands and create a more accurate wetland map for the FCTC. The USGS tested automated approaches (supervised and unsupervised classifications) to identify the wetland areas from the IKONOS satellite image, but the automated approaches alone did not yield accurate results. To ensure accurate wetland boundaries, the final wetland map was manually digitized on the basis of the automated supervised and unsupervised classifications, in combination with NWI data, field verifications, and visual interpretation of the IKONOS satellite image. The final wetland areas digitized from the IKONOS satellite imagery were similar to those in NWI; however, the wetland boundaries differed in some areas, a few wetlands mapped on the NWI were determined not to be wetlands from the IKONOS image and field verification, and additional previously unmapped wetlands not recognized by the NWI were identified from the IKONOS image.

Gibbons, J. W., Buhlmann, K. A., Tuberville, T. D., Scott, D. E., Greene, J. L., Ryan, T., Leiden, Y., Mills, T., & Metts, B. (2000). *Population Status and Habitat Requirements of Blanding's Turtle (*Emydoidea blandingi*) in a Southern Michigan Marsh after 36 Years of Study*.

The May-June 2000 study focused on determining habitat characteristics of juvenile Blanding's turtles and dispersal distances of adults resulted in the capture of 246 freshwater turtles, including 19 Blanding's turtles. The information gathered provides insights into the ecology of Blanding's turtles in a southern Michigan marsh believed to be a viable, self-sustaining population. In addition, a 36-year data set including the captures and recaptures of 422 Blanding's turtles was compiled for analysis.

Gibson, J. (2009). *Influence of prescribed fire on a midwestern population of the eastern box turtle, *Terrapene c. carolina. Purdue University.**

The Eastern Box Turtle, *Terrapene c. carolina*, is experiencing population declines across much of its range. Prescribed fire is used as a habitat management and conservation tool but little is known about the direct and indirect effects of fire on this species. To address this deficit, we used radiotelemetry to investigate the movements and habitat preferences of a population of *T. c. carolina* in southern Michigan. Because prescribed fire is used at the study site, we also assessed fire-related injury and mortality and examined whether fire indirectly influenced the movements, spatial ecology, and habitat use of Eastern Box Turtles. In our study, early-season, low-intensity, prescribed fires caused direct mortality and injury to Eastern Box Turtles. Fire-related mortality of turtles within burn areas was 10% in 2007 and 13% in 2008, and occurred both during the burn and post-burn as a direct result of fire-induced injuries. Approximately 13% of all *T. c. carolina* captured incidentally throughout the course of this study showed evidence of fire-related injuries. Turtles that sustained extensive burn injuries changed their patterns of movements and habitat use compared to their unburned year, and exhibited low area use fidelity between years. Our observations indicate that use of mesic areas appears to be important to turtles with burn injuries. Intraspecific differences in patterns of movement appeared to be most influenced by sex-specific reproductive activities and the spatial arrangement of habitats used for

nesting. Female box turtle activities were characterized by large area use and movements, as well as distinct differences in activity between nesting- and post-nesting periods. Males used significantly smaller areas, moved less, and maintained relatively constant activity between nesting- and post-nesting periods. Adult classes exhibited high area use fidelity between years. Juveniles displayed highly variable movements and area use, however they generally displayed one of two movement patterns: relatively sedentary movements and small area use with considerable location fidelity between years, or exploratory/dispersal movements with little overlap in area use between years. Prescribed fire did not influence the landscape-scale habitat use patterns of turtles not directly injured by fire. Landscape-scale habitat use revealed extensive use of forested habitats, and emphasized the importance of open herbaceous habitats. Our analyses underscored that...

GLEM. (2017). *2017 Work Completed for CGJMTC and FCTC*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Summary of herbicide and other treatment of invasive plants in 2017 at Camp Grayling Joint Maneuver Training Center (Frog Lake, Portage Creek, Lovell's Fen, Cannon Creek) and Fort Custer Training Center (Whitman Lake, North Mott Fen, and two other areas associated with Whitman Lake), Michigan.

GLEM. (2016). *2016 Work Completed as of 22 July 2016 for CGJMTC and FCTC*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Summary of herbicide and other treatment of invasive plants in 2016 at Camp Grayling Joint Maneuver Training Center (Frog Lake, Portage Creek, Lovell's Fen, Cannon Creek, and two other areas) and Fort Custer Training Center (Whitman Lake, North Mott Fen, and two other areas), Michigan.

GLEM. (2015). *Summary of Land Management at Fort Custer Training Center for 2014 & 2015*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Summary of herbicide and other treatment of invasive plants in 2014 and 2015 at Fort Custer Training Center (Whitman Lake, Mott Fen), Michigan.

GLEM. (2015). *2015 Camp Grayling and Ft. Custer Training Center Herbicide Usage*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Totals for herbicide applied by GLEM for invasive plant management in 2015 at Camp Grayling Joint Maneuver Training Center and Fort Custer Training Center, Michigan.

GLEM. (2011). *Summary of Land Management at Fort Custer Training Center for 2010 & 2011*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Summary of herbicide and other treatment of invasive plants in 2010 and 2011 at Fort Custer Training Center (Whitman Lake, Mott Fen), Michigan.

GLEM. (2018). *2018 Work Completed for CGJMTC and FCTC*. Great Lakes Ecological Management, Kalamazoo Nature Center.

Summary of herbicide and other treatment of invasive plants in 2018 at Camp Grayling Joint Maneuver Training Center (Frog Lake, Portage Creek, Lovell's Fen) and Fort Custer Training Center (Whitman Lake, North Mott Fen, and two other wetlands), Michigan.

Gross, K. L., Hammond, M., & Suding, K. N. (2002). *Pre- and Post-fire Monitoring of Prescribed Burns in Fens and Prairie-savannas at the Fort Custer Training Center (FCTC), Augusta, Michigan.*

Not available

Gross, K. L., & Suding, K. N. (2002). *Site-specific ecological restoration plans for prairie-savanna and prairie-fen communities at the Fort Custer Training Center (FCTC), Augusta, Michigan.* Kellogg Biological Station and Michigan State University.

This report provides a summary and synthesis of our research to develop ecologically based site-specific plans for the restoration and management of prairie savanna and fen communities at the Fort Custer Training Center (FCTC) in Augusta, Michigan. Our research focused first on documenting patterns of variation in the vegetation and soils of sites that had been identified by the MNFI as high quality prairie communities (the Mott Road Fen and Prairie) and prairie savanna management units that had been recommended for restoration. Concurrently, we conducted an experimental evaluation of potential management tools that could be used to restore the prairie savanna sites and create a landscape with greater abundance of native species, and reduced invasive exotics, that would enhance and protect the diversity of the high quality communities. We have summarized these results in a section on management recommendations to restore and enhance the prairie savanna and fen communities at the FCTC. An important lesson to be taken from our research is that there is NOT one overall 'best management plan' for restoration of the prairie savanna sites at the FCTC. Our experimental results show that the variability in vegetation composition, plant productivity and soils within and among of the prairie savanna units will influence the effectiveness of different management treatments. The major protective recommendations are to limit access and control and remove invasive species. We have also recommended a monitoring and assessment program to measure the effects of restoration and management at these sites.

Higman, P. J. (1997). *Monitoring and Management Plan for Corydalis flavula (pale corydalis, state threatened) in Fort Custer Training Center.* Michigan Natural Features Inventory.

Pale corydalis is a woodland and prairie forb that is rare within Michigan and is state threatened. A floristic inventory of FCTC in 1993-1994 documented four new state occurrences of this species. A construction project will impact the largest known population on FCTC. This management plan and regional survey is a condition of the take permit for impacting that population. A state status survey was conducted in 1995, with only 3 of 8 occurrences still extant. An additional population was documented in Fort Custer Recreation Area. The FCTC population is one of the largest known populations in the state and lies at heart of the limited range of the species in Michigan. This plan summarizes current knowledge and provides management and monitoring objectives.

Humphries, J. T. (2011). *Balancing White-tailed Deer Ecology with Michigan National Guard Training at Fort Custer Training Center in Augusta, MI.* Michigan State University.

White-tailed deer (*Odocoileus virginianus*) herbivory can influence the forest structure and composition. The hunter harvest period of white-tailed deer of approximately 75 days (the length of the season is subject to some minor annual variations) cannot take place since the FCTC functions as a military installation and needs dictate limited access to hunters, confounding the MDMVA's ability to meet their management goals. I evaluated the effectiveness of the current 5-day hunter harvest period by

quantifying deer herbivory effects on structure and composition of forest types, and developed a suite of deer population indices. I captured, aged, ear-tagged and radio-collared 66 deer during winter from 2004 to 2008, and 14 neonatal fawns during spring in 2006 and 2007. The annual survival rate varied among the groups (adult females = 0.756, adult males = 0.493, yearling females = 0.443, yearling males = 0.379, fawns = 0.289). The short hunter harvest period is an effective and integral component of the ecosystem restoration and rehabilitation efforts of FCTC.

Humphries, J. T., Winterstein, S. R., Campa III, H., & Riley, S. J. (2011). *White-tailed Deer Populations Demographics*. Michigan State University.

Michigan State University performed a five-year (2004 – 2008) study on white-tailed deer (*Odocoileus virginianus*) at Fort Custer Training Center (FCTC) in Augusta, Michigan. The primary mission of the FCTC confounds management of the deer herd, since the traditional deer herd management technique of an extended hunting season is impossible to implement while maintaining base security and training schedules. The primary challenge facing the MDMVA in managing the deer herd will be to maintain an appropriately sized deer harvest.

Hyde, D., Richards, M., & Koziatek, R. (2017). *Territorial Road Fen - Fort Custer Training Center. Draft: Five Year Management Plan for the Mitchell's Satyr: 2017 – 2021*. Michigan Army National Guard; Michigan Natural Features Inventory; Kalamazoo Nature Center.

Draft Management Plan for Mitchell's satyr habitat associated with the Territorial Road Fen on Fort Custer Training Center. 5 Year Goals 1. Maintain prairie fen habitat by removing and treating invasive species in the prairie fen and adjacent uplands through the use of prescribed fire, cutting and herbicide treatments, and biocontrol. 2. Maintain cover of native shrub and tree species (approximately 40%-60%) in the fen and evaluate the success of management actions. 3. Monitor and protect the hydrology that supports the prairie fen, including management of beaver and other hydrological alterations. 4. Work cooperatively with the USFWS to introduce captive-reared Mitchell's satyr to Territorial Road Fen. 5. Monitor and evaluate population status annually to determine if the introduction is successful and whether they are colonizing other areas within the larger wetland complex. 6. Secure funding to support fen restoration and management activities. Ultimate Long-term Goals 1. Maintain prairie fen habitat and adjacent uplands with less than 10% cover of invasives. 2. Restore/protect natural processes to prevent succession of prairie fen to shrub carr. 3. Continue to monitor and protect hydrology that supports the prairie fen. 4. Conduct regular monitoring of Mitchell's satyr and fen habitat and make recommendations to support long-term viability of this population and associated habitat. 5. Secure long-term funding to maintain fen restoration and management activities.

Kahmark, K., & Kohler, S. (2005). *Fort Custer Training Center Baseline Surface Water Study*. Western Michigan University.

The primary goal of this study is the future protection of the natural communities along the riparian areas and wetland corridors within the facility as well as the surface waters outside the boundaries of the through the characterization of surface waters, sediment, and ecological biota. This surface water program allows natural resources personnel to compare and assess water quality results of specific constituents to regulatory criteria for surface water and sediments. Additionally, baseline analyses may assist in the identification of specific surface water human and aquatic health concerns. Sediment and

surface waters were sampled for inorganic constituents, hardness, nutrient levels, and other physicochemical parameters throughout FCTC. Visual stream assessments, a benthos survey, and fish surveys were performed on the appropriate lengths of several streams were logged at three streams during the summer. As part of a public outreach, students participated in the sampling.

Katovich, S., & O'Brien, J. (1998). *Tree Health Assessment, Fort Custer Training Center, August, Michigan*. US Department of Agriculture, Forest Service.

This report should serve as a useful reference in the development and analysis of an overall management plan for the natural forested communities located on the Fort Custer Training Center. It should provide information on what insects, pathogens and other disturbance agents will affect trees on the property in future years. The possible roles that most of these agents play will vary depending upon the management practices followed.

Kinsman-Costello, L. E., O'Brien, J., & Hamilton, S. K. (2014). Re-flooding a Historically Drained Wetland Leads to Rapid Sediment Phosphorus Release. *Ecosystems*, 17(4), 641–656.
<https://doi.org/10.1007/s10021-014-9748-6>

Wetland restoration provides many benefits, but re-flooding historically drained land can have unintended negative consequences, including phosphorus (P) release from sediments. To investigate the effects of re-flooding on P cycling, this study monitored a restoration in Michigan that back-flooded old drainage ditches and re-flooded former wetland soils. Immediately after re-flooding, previously exposed sediments released substantial amounts of P to the water column. Soluble reactive phosphorus (SRP) concentrations in re-flooded areas were as high as 750 µg P l⁻¹. At peak P concentrations, there were about 20 times more SRP and 14 times more total P in the surface water than in the much smaller flooded area that existed before re-flooding. Prolific growth of filamentous algae and duckweed was observed in subsequent summers. Sedimental analyses suggest that most of the P released originated from iron-bound fractions. The highest SRP concentrations occurred during the first year when surface water dissolved oxygen was low (<5.5 mg l⁻¹). Similarly, low oxygen in the second year after flooding was not associated with such high P concentrations. After 1 year postflooding, SRP concentrations remained below 50 µg P l⁻¹ (but still high enough to produce eutrophic conditions) until the end of sampling about 15 months after re-flooding. When re-flooding historically drained soils, managers should consider the potential for sediment P release to jeopardize restoration goals and therefore should incorporate longer term monitoring of water quality into restoration plans. Knowledge of sediment P amounts and forms can indicate the potential for P release to overlying water. © 2014 Springer Science+Business Media New York.

KNC. (2015). *2014 and 2015 surveys for Mitchell's satyr (*Neonympha mitchelli mitchelli*) and Poweshiek skipperling (*Oarisma poweshiek*) at Fort Custer Training Center, Calhoun & Kalamazoo Counties, Michigan: 2015 Final Report*. Kalamazoo Nature Center.

KNC staff with specialized expertise surveyed prairie fens at FCTC for the presence of two prairie fen obligate butterfly species, the Mitchell's satyr (*Neonympha mitchelli mitchelli*) and Poweshiek skipperling (*Oarisma poweshiek*). In addition to surveying for the presence of the butterflies, surveys included a review of the prairie fens and ranked them for habitat suitability (high, medium, and low quality). A total of 11 fens were surveyed, with four fens ranked as having high quality habitat and four

fens being classified as medium quality. High and medium quality fens house sufficient host plant species and habitat characteristics suitable for the species to potentially occupy this habitat (total of 164.48 acres). Three sites were classified as low quality (37.3 acres) and were not surveyed in 2015 due to a lack of host plant and/or fen indicator species for either butterfly species. The surveys found neither butterfly species in the areas surveyed. Reintroduction of the Mitchell's satyr to the wetlands in FCTC should be considered by FCTC land managers and the USFWS's Mitchell's Satyr Working Group. Habitat is only superficially suitable for the Poweshiek skipperling due to a lack of mat muhly grass (*Muhlenbergia richardsonis*) in FCTC.

KNC. (2012). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Field Season 2011 - Fall Avian Migration and Stopover Study*. Kalamazoo Valley Bird Observatory, Kalamazoo Nature Center.

Fort Custer Training Center (FCTC) is a 7,600-acre site with high quality habitat for avian species. From the period of 25 August to 30 October of 2011, 1,858 birds of 69 species were captured, including 41 species which were primarily observed as migrants. Among these migrants, 10 species had more than 50 individuals banded which were analyzed for patterns of stopover and weight gain. Though opportunities for same season recapture events are limited we found stopover events common for White-throated Sparrow, Ruby-crowned Kinglet, and Hermit Thrush. Mass gain was documented in Hermit Thrush and Lincoln's Sparrow. Other species, despite having more initial captures were rarely or never recaptured. These species were analyzed according to a condition index by time and date of capture. Weight gain was found to be 2%/hour for Nashville Warbler, Magnolia Warbler, and Golden-crowned Kinglet. Small, yet significant gains were found for the Nashville Warbler and the Yellow-rumped (Myrtle) Warbler when examined on a daily basis, indicating undocumented stopover could occur at FCTC, though not at the banding site. Differential migration was observed for the Tennessee Warbler with males being observed earlier in the season, and for the Ruby-crowned Kinglet, with females being observed earlier in the season. This study contributed data to a tick study funded by Michigan State University and Michigan Lyme Disease Association, 189 vials of ticks were collected from birds during the banding process for a cooperative study and found *Ixodes scapularis*, a vector for Lyme Disease, to be the most prevalent among the species collected. The density of infected *Ixodes scapularis* nymphs is closely associated with human infection risk (Diuk-Wasser et al. 2012). The large percentage of *Ixodes scapularis* located in our study will make it possible to further assess the human infection risk present at FCTC.

KNC. (2012). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Field Season 2011*. Kalamazoo Valley Bird Observatory, Kalamazoo Nature Center.

Avian field studies have been ongoing at FCTC since 1997, providing a good baseline and history in which to place current results. Two parts of the 2011 field work were geared towards the continued monitoring and furthering of knowledge about a state threatened species present on the property, the Cerulean Warbler. Part I is the continuation of the mark-resight study of the Cerulean Warbler population, with additional information collected during the banding process on wing morphology. We determined one year survival to be about 40%, primary projection among males averaged 25%, with an average wing area of 26.5 cm, and a wing loading of 0.18 grams/cm. With 24 males banded, and several males present but not captured, likely more than 50 individuals were present in 2011. Part II utilized field observation targeted at identifying forest resources and characteristics utilized by the species, and

a study of the management history, to determine how prime areas utilized by the Cerulean Warbler developed following agricultural use in the WW II era. Foraging was most frequently documented in oak and Black Walnut. Nest materials collected included: the material of the Eastern Tent Caterpillar nest, a saprophytic fungus which grows on elm species, and Summer Grape. One key reason this area is Cerulean Warbler habitat today stems from the first developed management plan; crop trees which were beneficial for the Cerulean Warbler were encouraged in remnant woodlots. Part III summarizes the third year of the Monitoring Avian Productivity and Survivorship (MAPS) program. In 2011, 519 new birds were banded, along with 181 same season re-captures. Additionally, 85 birds banded in the two previous field seasons of this study returned to FCTC and were captured.

KNC. (2017). *Prescribed Fire Monitoring at Fort Custer Training Center. Kalamazoo Nature Center.*

In order to extend the utility of prescribed fire at the facility, the current burn program should be paired with a fire monitoring plan. Monitoring and subsequent inventory after a prescribed fire allows for accurate assessment of fire effects, ecosystem benefits, burn success, and the appraisal of future burn plans. The five objectives briefly stated are: reintroduce fire to the landscape at FCTC, increase oak (*Quercus* sp.) regeneration in forests at FCTC, decrease invasive species cover in the high quality natural areas at FCTC, reduce the mean fuel load by 50-80% post-burns, and continually revisit program objectives and the burn plan after consideration of fire monitoring data. Using Geographic Information System (GIS) three habitat types were chosen to monitor within the 42 plots. Herbaceous wetland (9 plots), mixed hardwood forest (25 plots), and savanna/prairie (8 plots) monitoring types were the three selected natural community types determined to be of conservation concern at FCTC. Averages and summaries for baseline data collected in 2017 are provided in this report.

KNC. (2013). *Avian Field Studies at the Army National Guard Fort Custer Training Center August, Michigan: Field Season 2012. Kalamazoo Valley Bird Observatory, Kalamazoo Nature Center.*

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2012. Field work in 2012 focused on six themes. First we report on a continued a long-term study, determining Cerulean Warbler survival and habitat use. Inter-annual survival varies by age, highest for birds banded as SY, at 48%. Site loyalty seems to be around 80%. The next two segments report on two groups of birds which are not commonly reported using standard point count methods, specialized methods were used to determine the status of nocturnal and marsh birds. Nocturnal birds located on the property were Eastern Whip-poor-will, Barred Owl, and Eastern Screech Owl. Among the 10 secretive marsh species which were located, we document three new species for the property; American Coot, Common Gallinule, and Least Bittern. Fourth, is a study on changes in the avian community in response to harvest or storm damage. We found great turnover within the avian community, but avian diversity remained high in these areas. Disturbance led to positive responses of Blue-Gray Gnatcatcher, Baltimore Oriole, and Mourning Warbler. Negative responses were observed from Veery and Wood Thrush. Three of these reactions were positive, with species occupying or increasing post-disturbance. Fifth, we report the results of an ongoing study in its fourth year, the Monitoring Avian Productivity and Success (MAPS) program. Last, we address a tick study for which we collected data during the MAPS season field work. Though final results will be published by an associated research partner, preliminary results will be presented here.

KNC. (2014). *Avian Field Studies at the Fort Custer Training Center, August, Michigan. Kalamazoo Valley Bird Observatory, Kalamazoo Nature Center.*

This report summarizes avian studies at Fort Custer Training Center (FCTC) in 2013. This field work focused on 4 themes. First we report on the range wide point counts that have been performed every 2-3 years. This study includes population estimates, diversity, abundance and response to management and natural disturbances. Second we report on the long-term study of Cerulean Warblers survival rates and habitat use. Inter-annual survival varies with age and birds banded as SY have the highest at 45%. Site loyalty is shown to be around 88%. Third we report on the results of an ongoing Monitoring and Productivity Survivorship (MAPS) bird banding project that is in its fifth year. Last we report on a pair of radio tagged Brown-headed Cowbirds that were tracked during the summer months to confirm use and movement of Cowbirds at FCTC.

KNC. (2019). *Prescribed Fire at FCTC: Summary Report of Activities*. Kalamazoo Nature Center. Kalamazoo, MI.

Summary of prescribed fire services provided by Kalamazoo Nature Center to Fort Custer Training Center from 2017-2019.

Kornoelje, A. (2017). *Fort Custer Training Center Invasive Species Survey, 2016*. Kalamazoo Nature Center. Kalamazoo, MI.

FCTC illustrates a facility committed to aligning sustained, responsible land and resource management with its training mission and function. Ecological studies documenting the biodiversity of flora and fauna, the high quality ecological communities, and any listed species have been conducted at FCTC since 1994. The primary objective of this Invasive Species Survey was to comprehensively review any invasive species populations that persist within high quality areas (HQAs). KNC focused efforts within HQAs, noting conditions in actively managed areas, and details prioritization and recommendations for control within this report. Invasive species widespread throughout Michigan, such as glossy buckthorn (*Rhamnus frangula*), autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), and Oriental bittersweet (*Celastrus orbiculata*), represent the majority of the invaders that need to be controlled at FCTC. As designated by Higman 2009, most of the species observed fall into Action Category "C list"; further described as medium to high threat; widespread; no action required; may choose to control based on specific management goals and situations.

Kurta, A., & Foster, R. (2005). *A Survey of Bats at Fort Custer: Using Acoustic and Mist-netting Techniques*. Eastern Michigan University.

Throughout North America, many populations of bats are in decline, and over 50% of all species are considered endangered or threatened at either the state or national level. In Michigan, there are nine species of bat and one (Indiana bat, *Myotis sodalis*) is the only mammal on the federal list of endangered species that actually breeds in Lower Michigan and is a widespread resident in southern Michigan. The eastern pipistrelle (*Pipistrellus subflavus*) is currently listed as a MDNR Species of Special Concern and the evening bat (*Nycticeius humeralis*) is being considered for designation as state threatened. During summer 2005, we surveyed the bat population at Fort Custer, using mist-netting and acoustic techniques. The eastern pipistrelle was definitely detected at Fort Custer. Although Indiana bats were not detected at Fort Custer, the wide distribution of this species in southern Lower Michigan makes it likely that a maternity colony exists nearby. We recommend that future surveys occur at intervals of 5 years if possible.

Kurta, A., Foster, R., & Winhold, L. (2006). *An Acoustic Survey of the Whitman Lake Area in Summer 2006: A Search for Eastern Pipistrelles*. Eastern Michigan University.

In summer 2005, we performed a survey of bats at Fort Custer, using acoustic techniques and mist-netting. During 20 nights of netting, we captured 121 bats, all of which were big brown bats (*Eptesicus fuscus*; 79%) and red bats (*Lasiurus borealis*; 21%). In addition, we placed ultrasonic detectors at 20 additional sites throughout the facility. The acoustic survey also indicated that big brown bats and red bats were the two most common species, accounting for 94% of all files that were recorded. However, we also detected a few calls made by unidentified *Myotis*, the hoary bat (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipistrellus subflavus*).

Kurta, A. (1993). *A Survey of Bats at the Fort Custer Training Center with Emphasis on the Federally Endangered Indiana Bat (Myotis sodalis)* MISSING FILE. Eastern Michigan University.

As of 1993, no study had ever examined the status of bat populations at Fort Custer. Documented records of the Indiana bat existed for many areas close to Fort Custer. In 1993, we conducted a field survey to (a) determine what bat species lived at the Fort Custer Training Center, (b) analyze habitat suitability for the endangered Indiana bat, and (c) locate and describe the roosts of any Indiana bats that were captured. In summary, (1) overall bat activity in upland sites at Fort Custer is at least equal to bat activity over rural streams in region; (2) big brown bat and red bat are the two most common bat species at Fort Custer like the region; (3) no Indiana bats were captured during this study, and there is no evidence that the species roosts on the property; (4) little preferred foraging habitat (floodplain forests) for the Indiana bat at Fort Custer; and (5) only low density, isolated pockets of suitable roosting habitat exist on Fort Custer.

Lannoo, M. J., Petersen, C., Lovich, R. E., & Phillips, C. (2014). *Department of Defense Amphibian Disease Survey: Natural Resource Manager Training and Data Collection (Project Number 12-426)*. Department of Defense Legacy Resource Management Program.

As an extension of previous studies conducted in 2009 and 2011 (Legacy Projects 09-423 and 11-423), a goal of this investigation was to conduct additional surveys for the chytrid fungus, *Batrachochytrium dendrobatidis* (Bd) on Department of Defense (DoD) lands. Unlike earlier surveys where one researcher went to multiple military sites to sample amphibians for Bd, in this study we trained natural resource managers at multiple military installations to collect field data simultaneously. As a result, Bd was sampled at more than three times the number of military sites than in our previous surveys. In order to standardize the data collection effort, we developed an amphibian swabbing training video and datasheet and conducted three online training sessions for project volunteers. In addition, volunteers received a field swabbing kit containing all the materials need to collect field data. We mailed 71 field swabbing kits to military installations in 37 states within the continental United States (U.S.) and three countries outside the United States (Guam, Spain, and Okinawa). Fifty-two military sites returned kits containing 944 samples. Positive Bd results were detected in 226 samples (24.2 percent) and 70 percent of the military sites sampled contained at least one positive result for Bd. A total of 57 amphibian species were sampled during this investigation. Of these species, 16 tested positive for Bd. Results are consistent with our previous surveys, confirming that Bd is present on DoD installations in the continental United States extending from coast to coast. Although Bd is present on the majority of the military sites tested in this study, at this time, the fungus does not appear to be having a negative

impact on amphibian species (zoospore levels were not at levels to become the disease chytridiomycosis). The results of this study support the hypothesis that Bd can today be considered endemic (likely to have spread through North America decades ago) rather than epidemic (spreading as a wave and wiping out individuals, populations, and species in its path).

Legge, J. T. (2002). *Prairie Vole (Microtus ochrogaster) Monitoring at Fort Custer Training Center. Michigan Natural Features Inventory.*

This report summarizes the sixth season of monitoring of the FCTC prairie vole population, conducted in 2002, three years after the most recent monitoring year. Methods followed those used in previous years.

Legge, J. T. (1996). *Monitoring for the prairie vole, Microtus ochrogaster, at Fort Custer Training Center: 1996 Progress Report (MNFI 1996-07).* Michigan Natural Features Inventory.

The prairie vole population at FCTC is the only known extant population of this state threatened species in Michigan. A monitoring program was initiated in 1995 to assess training activities on the prairie vole population and its habitat. Four treatment units are being monitored. In addition, supplemental surveys were conducted in nearby locations with habitats potentially suitable for prairie voles. Supplemental surveys were completed in 1996 within proposed burn units to determine whether prairie voles were present or absent, but none were captured.

Legge, J. T. (1995). *Monitoring for the prairie vole, Microtus ochrogaster, at Fort Custer Training Center: 1995 Progress Report (MNFI 1995-12).* Michigan Natural Features Inventory.

The prairie vole population at FCTC is the only known extant population of this state threatened species in Michigan. The population occupies a degraded field which has been heavily used for military training activities. A monitoring program was initiated in 1995 to assess training activities on the prairie vole population and its habitat. Four treatment units were identified: little or no recent impacts; significant impact in mid-1994; single, severe impact in mid-1995; and significant ongoing impacts. In addition, supplemental surveys were conducted in nearby locations with habitats potentially suitable for prairie voles.

Legge, J. T., Higman, P. J., Comer, P. J., Penskar, M. R., & Rabe, M. L. (1995). *A Floristic and Natural Features Inventory of Fort Custer Training Center, Augusta, Michigan (Report 1995-13).* Michigan Natural Features Inventory, Natural Heritage Program, MDNR Wildlife Division.

This report contains the result of a two-year inventory of the natural features of Fort Custer Training Center (FCTC) in southwestern Lower Michigan. Comprehensive inventories of the flora and natural communities, including wetlands, in addition to animal surveys targeted for listed species were conducted by MNFI. Current land cover and use is compared to pre-settlement vegetation to provide ecological context and to clarify the types of changes that have occurred over the past 150 years. Specific land management recommendations are then developed for the restoration of significant natural community types. Specific management recommendations are also provided for each rare species and quality natural community found at FCTC and are incorporated into the restoration recommendations where appropriate.

Legge, J. J. T. (2003). *Prairie Vole (*Microtus ochrogaster*) Monitoring at Fort Custer Training Center*. Michigan Department of Military Affairs.

Not available

Legge, J. T. (2007). *Prairie Vole (*Microtus ochrogaster*) Monitoring at Fort Custer Training Center*. Michigan Department of Military Affairs.

This report summarizes the eleventh season of monitoring of the FCTC prairie vole population, conducted in 2007. Methods followed those used in previous years. On April 16, 2007, the entire monitoring site was subject to a prescribed burn. No other intentional changes to management of the site occurred.

Li, Y., Evans, N. T., Renshaw, M. A., Jerde, C. L., Olds, B. P., Shogren, A. J., Deiner, K., Lodge, D. M., Lamberti, G. A., & Pfrender, M. E. (2018). Estimating fish alpha- and beta-diversity along a small stream with environmental DNA metabarcoding. *Metabarcoding and Metagenomics*, 2, e24262. <https://doi.org/10.3897/mbmg.2.24262>

Environmental DNA (eDNA) metabarcoding has been increasingly applied to biodiversity surveys in stream ecosystems. In stream networks, the accuracy of eDNA-based biodiversity assessment depends on whether the upstream eDNA influx affects downstream detection. Biodiversity assessment in low-discharge streams should be less influenced by eDNA transport than in high-discharge streams. We estimated α - and β -diversity of the fish community from eDNA samples collected in Eagle Creek (Fort Custer Training Center, Michigan, USA) from its headwaters to its confluence with a larger river. We found that α -diversity increased from upstream to downstream and, as predicted, we found a significant positive correlation between β -diversity and physical distance (stream length) between locations indicating species turnover along the longitudinal stream gradient. Sample replicates and different genetic markers showed similar species composition, supporting the consistency of the eDNA metabarcoding approach to estimate α - and β -diversity of fishes in low-discharge streams.

Miller, M. E., Adams, Jr., R. J., & Brenneman, J. (2008). *Cerulean Warblers at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Population Trends, Distribution, and Management Recommendations*. Kalamazoo Nature Center.

Research over the years 1997 to 2007 has confirmed the presence of a breeding population of Cerulean Warbler (*Dendroica cerulea*), with an estimated population of 63 to 86. This is an important breeding population within southwest Michigan. The breeding population of Cerulean Warbler at FCTC has oscillated over the years but no discernable trend over that time is statistically supported. The stands in which Cerulean Warblers have established breeding territories are identified and some shifts in their patterns of usage over the years are noted. Cerulean warblers tend to use black locust, black walnut, and black cherry for both nest trees and foraging in greater proportion than these species prevalence at FCTC. They also tend to nest in colonies, with a number of males having territories immediately adjoining each other. Another strong tendency is alignment of territories across or adjacent to roads or natural openings. Management recommendations include selective cutting to favor large, old trees in stands known to be cerulean warbler habitat; preservation of tree species, primarily black locust, black walnut, and black cherry, known to be locally favored by cerulean warblers for nesting and foraging; and continued monitoring of cerulean warbler populations at FCTC.

Miller, M. E., Adams, R. J., & Brenneman, J. (2004). *Avian Field Studies at the Army National Guard Fort Custer Training Center, August, Michigan: Field Season 2004*. Kalamazoo Nature Center.

KNC conducted avian studies at FCTC from May 29 through July 9, 2004. KNC surveyed the breeding bird population using standard 10-minute point count techniques. A total of 288 points were surveyed using avian point count methodology. There were 94 bird species detected on these counts, 93 of which were thought to have bred. A total of 6621 individual birds were tallied. The most abundant species in decreasing order of number of detections were Brown-headed Cowbird, American Goldfinch, American Robin, Eastern Wood-Pewee, Cedar Waxwing, Veery, Indigo Bunting, Red-eyed Vireo, Rose-breasted Grosbeak, Scarlet Tanager, Northern Cardinal, Ovenbird, Blue Jay, Field Sparrow, Acadian Flycatcher, Red-winged Blackbird, Wood Thrush, Gray Catbird, Yellow Warbler, Eastern Towhee, and Black-capped Chickadee. Nature Center staff focused additional survey efforts on the birds within the tank range and those portions of compartment 6 slated for selective harvest. From May 7 through August 9, 2004, staff also searched for and monitored nests of four migrant passerine birds that build open-cup nests: Wood Thrush, Hooded Warbler, Acadian Flycatcher and Cerulean Warbler. This is the fifth year for this study. The Cerulean Warbler was added in 2004 because of continuing long-term population declines and its Special Concern status in Michigan, and is discussed fully in a separate report. Data on vegetation and habitat variables were also collected at each nest in order to better understand the nest site preferences of the focal species on the site and to clarify the influence of non-native plant species—particularly multiflora rose—on nest success. Despite extremely high Brown-headed Cowbird numbers, and a 2004 parasitism rate of 79% for the Hooded Warbler, cowbird parasitism does not appear to be the primary cause of the low reproductive success of the focal species. High predation pressure seems to be the primary cause of nest failures at Fort Custer. This installation represents a net population sink for the Hooded Warbler, Wood Thrush and Acadian Flycatcher.

Miller, M. E., Adams, R., & Brenneman, J. (2002). *Avian Field Studies at the Army National Guard Training Center, Augusta, Michigan: Field Season 2002*. Kalamazoo Nature Center.

Kalamazoo Nature Center (KNC) conducted two avian studies at FCTC from May 27 through July 12, 2002. KNC surveyed the breeding bird population using standard 10-minute point count techniques. There were 94 bird species detected on these counts, 88 of which were thought to have bred. Our population estimate for the Fort Custer installation is approximately 14,700 breeding pairs of 88 species. This is equivalent to 195 pairs per 40 hectares (100 acres). The Shannon Diversity Index and Evenness Index are broadly similar to those throughout southwest Michigan. The most abundant species (over 500 pairs) based on population estimates in descending order are Brown-headed Cowbird, Cedar Waxwing, Black-capped Chickadee, Rose-breasted Grosbeak, Red-eyed Vireo, Tufted Titmouse, Indigo Bunting, Eastern Wood-Pewee and White-breasted Nuthatch. Species designated as Michigan Special Concern included Hooded Warbler, Cerulean Warbler, Grasshopper Sparrow, Marsh Wren and Cooper's Hawk. The state Threatened Trumpeter Swan which nested on Harts Lake adjacent to the site was not recorded on point counts. Ten "Partners in Flight" Michigan high priority species (score 20 or more) were noted on the point counts including five species with population estimates over 100 pairs: Field Sparrow, Acadian Flycatcher, Blue-winged Warbler, Baltimore Oriole and Cerulean Warbler. It is these species for which Fort Custer represents the most critical breeding habitat, and for which management considerations are most pressing. From May 4 through August 9, 2002, staff also searched for and monitored nests of four migrant passerine birds that build open-cup nests: Wood Thrush, Hooded

Warbler, Field Sparrow, and Acadian Flycatcher. This is the third year that this study focused on these species. No measured factors of nest position or habitat were found to have any correlation to nest success, including nesting in non-native plant species. Our data do not support the idea that cowbird parasitism is responsible for the low reproductive success our focal species are experiencing despite extremely high populations of the Brown-headed Cowbird. High predation pressure seems to be the primary cause of nest failures at Fort Custer. This installation represents a net population sink for the three forest-nesting bird species among our focal species; only for the Field Sparrow is it a net population source.

Miller, M. E., Adams, R. J., & Brenneman, J. (2006). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Field Season 2006*. Kalamazoo Nature Center.

KNC conducted avian studies at FCTC from 4 June through 4 July 2006. KNC surveyed the breeding bird population using standard 10-minute point count techniques. A total of 286 points were surveyed using avian point count methodology. There were 94 bird species detected on these counts, 93 of which were thought to have bred. A total of 7521 individual birds were tallied. The most abundant species in decreasing order of number of detections were Brown-headed Cowbird, American Goldfinch, American Robin, Eastern Wood-Pewee, Cedar Waxwing, Veery, Indigo Bunting, Red-eyed Vireo, Rose-breasted Grosbeak, Scarlet Tanager, Northern Cardinal, Ovenbird, Blue Jay, Field Sparrow, Acadian Flycatcher, Red-winged Blackbird, Wood Thrush, Gray Catbird, Yellow Warbler, Eastern Towhee, and Black-capped Chickadee. From 8 May through 11 August 2006, staff also searched for and monitored nests of three migrant passerine birds that build open-cup nests: Wood Thrush, Hooded Warbler, and Acadian Flycatcher. This is the eighth year for this study. The nest productivity study has continued to provide additional information on annual variation in productivity, predation rates, possible causes of predation, and incidence of brood parasitism by the Brown-headed Cowbird for the first three focal species. High predation pressure seems to be the primary cause of nest failures at Fort Custer. This installation probably represents a net population sink for the Hooded Warbler, Wood Thrush, and Acadian Flycatcher.

Miller, M. E., Adams, R. J., & Brenneman, J. (2005). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: Field Season 2005*. Kalamazoo Nature Center.

KNC conducted avian studies at FCTC from May 18 through August 19, 2005. KNC searched for and monitored nests of four migrant passerine birds that build open-cup nests: Wood Thrush, Hooded Warbler, Acadian Flycatcher and Cerulean Warbler. This is the sixth year for this study. Despite extremely high Brown-headed Cowbird numbers, and a 200 parasitism rate of 59% for the Hooded Warbler, cowbird parasitism does not appear to be the primary cause of the low reproductive success of the focal species. High predation pressure seems to be the primary cause of nest failures at Fort Custer. This installation represents a net population sink for the Hooded Warbler, Wood Thrush and Acadian Flycatcher. On June 17, 2005, staff surveyed the breeding bird population of eight previously-established points using standard 10-minute point count techniques. These points are within the tank range and those portions of Compartment 6 which had been selectively harvested. These observations permit comparisons of bird populations between years (2004-2005) and treatment effects (pre-and post-harvest).

Miller, M. E., Adams, R. J., & Brenneman, J. (2003). *Avian Field Studies at the Army National Guard Fort Custer Training Center, August, Michigan, Field Season 2003*. Kalamazoo Nature Center.

KNC conducted two avian studies at FCTC from May 27 through July 12, 2003. KNC surveyed the breeding bird population using standard 10 minute point count techniques. A total of 100 points were censused using avian point counts. There were 75 bird species detected on these counts, 71 of which were thought to have bred. A total of 1638 individual birds were tallied. The most abundant species in decreasing order of abundance are Brown-headed Cowbird, Eastern Wood-pewee, American Robin, American Goldfinch, Ovenbird, Indigo Bunting, Blue Jay, Gray Catbird, American Crow, Rose-breasted Grosbeak, Field Sparrow, Veery, and Wood Thrush. The 100 points represent a subset, stratified by habitat, of the 292 points originally defined at Fort Custer for avian point counts. From May 22 through August 2, 2003, staff also searched for and monitored nests of three migrant passerine birds that build open-cup nests: Wood Thrush, Hooded Warbler, and Acadian Flycatcher. This is the fourth year that this study focused on these species. The study was continued to provide information on annual variation in productivity, predation rates, possible causes of predation, and incidence of brood parasitism by the Brown-headed Cowbird for the three focal species. Our data do not support the idea that cowbird parasitism is responsible for the low reproductive success our focal species are experiencing despite extremely high populations of the Brown-headed Cowbird. High predation pressure seems to be the primary cause of nest failures at Fort Custer. This installation represents a net population sink for the three forest-nesting bird species among our focal species.

Miller, M. E., Adams, R. J., Brenneman, J., Wenger, T., & Baldy, J. (2007). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: 2007 Field Season and 1997-2007 Summary Report*. Kalamazoo Nature Center.

Avian research at Fort Custer Training Center on nests of four focal species over the last eight years has shown that this site represents a net sink for Wood Thrush, Acadian Flycatcher, and Hooded Warbler, and a net source for Field Sparrow. The dominant cause of nest failure is predation with nest parasitism by Brown-headed Cowbirds representing between 4% and 55%, depending on species, of the effect of predation. Most of the nest situation and landscape variables measured do not correlate with nest success. One significant (though small) effect was a positive correlation of percentage of canopy cover with number of fledglings produced per nest in Wood Thrush. Point counts conducted over the last eleven years have demonstrated that this site is a very important area for breeding birds of many forest-nesting species within southwest Michigan. As the forest within Fort Custer matures, bird numbers within the breeding season appear to be increasing over the period of this study. Fort Custer is an important refuge in a region largely denuded of its original forest cover for species such as Eastern Wood-Pewee, Gray Catbird, Scarlet Tanager, Wood Thrush, and others whose populations are considered to be in overall decline. Fort Custer is an especially important site for the Cerulean Warbler, a species of special concern.

Miller, M. E., Brenneman, J., Baldy, J., Wenger, T., & Adams Jr, R. J. (2009). *Avian Field Studies at the Army National Guard Fort Custer Training Center, Augusta, Michigan: 2008 Field Season*. Kalamazoo Nature Center.

Avian research at Fort Custer Training Center species over the last eight years has shown that this site represents a net sink for Wood Thrush, Acadian Flycatcher, and Hooded Warbler, and a net source for

Field Sparrow. The dominant cause of nest failure is predation. Nest parasitism by Brown-headed Cowbirds is between 4% and 55%, depending on species, of the effect of predation. Most of the nest situation and landscape variables measured do not correlate with nest success. Point counts conducted over the last 12 years have demonstrated that this site is important for many forest-nesting species in southwest Michigan. As the forest within Fort Custer has matured over the period of this study, breeding populations appear to be increasing. We also found that point counts from wetland habitats recorded significantly more species and individuals than other habitat types. Fort Custer is an important refuge in a region largely denuded of its original forest cover for species whose populations are considered to be in overall decline such as Eastern Wood-Pewee, Gray Catbird, Scarlet Tanager, Wood Thrush. Fort Custer is an especially important site for the Cerulean Warbler, a species of special concern. FCTC

Miller, M. E., Ferguson, C. H., & Adams, R. J. (2002). *Breeding Bird Abundance, Diversity, and Habitat Use at the Army National Guard Fort Custer Training Center, Augusta, Michigan, Field Season 1997 through 1999*. Kalamazoo Nature Center.

KNC conducted fieldwork at FCTC from June 2, 1997 through July 8, 1999 surveying the breeding bird population using point count and area search techniques. The Fort Custer area constitutes one of the few large heavily forested areas in southwestern Michigan. A total of 16516 individual birds (mostly singing males) were detected during area searches over the three field seasons for an average of 5505 per year. 292 points were established for avian point counts; 103 species were detected during point counts for a total of 18073 birds. Our final population estimate for the Fort Custer installation is approximately 11,000 breeding pairs in 113 species. This is equivalent to 145 pairs per 40 hectares (100 acres).

Native Connections. (2007). *2007 Karner Blue Butterfly Surveys, Fort Custer Training Center. Native Connections*.

Data sheet summarizing areas surveyed and lupine populations at FCTC in 2007.

Native Connections. (2009). *2009 Karner Blue Butterfly Surveys, Fort Custer Training Center. Native Connections*.

Lupine mapping occurred within eight known populations of wild lupine in Maneuver Area 9. The extent of some of these populations was found to be greater than previously expected, perhaps due to two consecutive years of prescribed fire in Area 9. Additional populations of wild lupine in Area 9 and elsewhere have been noted, and should be mapped in 2009. Some lupine populations appear to have expanded from previous years, and no populations appear to have decreased. Surveys for Karner Blue butterflies took place in and between known large patches of wild lupine in Maneuver Area 9. Surveys were initiated one to two weeks after butterflies were observed flying in known populations in the Allegan State Game Area. No Karner Blue butterflies were observed during either flight period.

Native Connections. (2008). *2008 Karner Blue Butterfly Surveys, Fort Custer Training Center. Native Connections*.

Lupine mapping occurred within eight known populations of wild lupine in Maneuver Area 9. The extent of some of these populations was found to be greater than previously expected, perhaps due to two

consecutive years of prescribed fire in Area 9. Additional populations of wild lupine in Area 9 and elsewhere have been noted, and should be mapped in 2009. Casual walk-through surveys also took place within three days of each survey, with one observer, in the known population of wild lupine in southern Area 7. Surveys were initiated one to two weeks after butterflies were observed flying in known populations in the Allegan State Game Area. No Karner Blue butterflies were observed during either flight period.

Native Connections. (2007). *Qualitative Monitoring: Corydalis flavula, FCTC. Native Connections.*

Summary of population surveys (4 locations) for *Corydalis flavula* (pale flumewort) at FCTC in 2007. A spotty burn may be beneficial and burning adjacent areas that are not locust-dominated may also be beneficial. Generally absent under dense conifers. May be more common on south facing slopes and in areas with medium depth leaf litter and other herbaceous plants.

Native Connections. (2009). *2009 Deer Exclosure Monitoring, Fort Custer Training Center. Native Connections.*

The vegetation of the eight deer exclosures were sampled per the "Vegetation Sampling Standard Operating Procedure" developed by Joel Humphries of Michigan State University. Sampling took place between 6 and 21 July 2009. One rare plant species was observed during the surveys. 2 individuals of *Liparis liliifolia* were seen five meters west and 1.5 meters south from the NE corner of exclosure 3.

Nuzzo, V. (1998). *Habitat Requirements of Yellow Fumewort (Corydalis flavula) at Fort Custer Training Center. Natural Area Consultants.*

Not available

O'Brien, M. F., O'Brien, D. S., & Craves, J. A. (2017). *Cordulegaster erronea* Hagen in Sels (Tiger Spiketail) Rediscovered in Michigan (Odonata: Cordulegastridae). *The Great Lakes Entomologist*, 50(1), Article 1. <http://scholar.valpo.edu/tgle/vol50/iss1/1%0A>

Cordulegaster erronea Hagen in Selys (Tiger Spiketail) has been included on the list of Michigan Odonata based on one specimen collected in 1934. In 2016, the species was found in Kalamazoo County, Michigan. It is the least abundant *Cordulegaster* species in Michigan, and the habitat requirements in Michigan are compared with known *C. erronea* habitats in Ohio and New Jersey.

Pope III, H. H., Seckinger Jr., E. W., & Scott, S. J. (1995). *Historic Landscape Assessment of the Fort Custer Segment of Territorial Road. Us Army Corps of Engineers, Mobile District.*

This report assesses the potential of the Fort Custer segment of the Territorial Road for nomination to the National Register of Historic Places. Identifying a historic landscape requires establishing a historic context which associates it with a period of time within the framework of the area's history and development. Regional history, site specific history, historic maps, surveys, legal records and other pertinent information are researched to document and authenticate the landscape's historic value.

Powless, D., Adams, R. J., Miller, M. E., Benson, T., Simoes, J., & Brown, L. (2001). *Reproductive Success, Brood Parasitism, and Nest Predation of Acadian Flycatcher, Field Sparrow, Hooded Warbler and Wood Thrush at the Army National Guard Fort Custer Training Center, August, Michigan, During the Summer of 2000. Kalamazoo Nature Center.*

Kalamazoo Nature Center conducted fieldwork at FCTC from May 2 through August 15, 2000, in search of the nests of four migrant passerine birds that build open-cup nests: Wood Thrush, Hooded Warbler, Field Sparrow, and Acadian Flycatcher. This study was conducted to provide information on productivity, predation rates, possible causes of predation, and incidence of brood parasitism by the Brown-headed Cowbird for the four focal species. Information on vegetation and habitat variables was also collected at each nest in order to better understand the nest site preferences of the four species on the site and to understand the influence of non-native species—particularly multiflora rose—on nest success. In 2000, we studied the breeding productivity for several key forest and early successional species to determine reproductive success at Fort Custer and provide a basis for comparison with known source and sink locations from the literature. The information presented here is intended to aid conservation and management decisions for priority species such as the Hooded Warbler and the Cerulean Warbler—species of special concern in Michigan—which breed in fairly large numbers on the site.

Rogers, C. M. (2006). Nesting Success and Breeding Biology of Cerulean Warblers in Michigan. *The Wilson Journal of Ornithology*, 118(2), 145–151. <https://doi.org/10.1676/05-032.1>

The Cerulean Warbler (*Dendroica cerulea*) is a Nearctic-Neotropical migratory bird species that has declined significantly over the long-term. Poor reproductive success may be an important factor contributing to the observed decline, but reproductive output has been measured for very few breeding populations. From 2003 to 2005, I intensively monitored 22–23 breeding territories/year in each of two large forest habitats in southwestern Michigan: oak (*Quercus* spp.) hickory (*Carya* spp.) (2003: Barry State Game Area) and black locust- (*Robinia pseudoacacia*) black cherry (*Prunus serotina*) (2004–2005: Fort Custer U.S. Army Michigan National Guard Reservation). I also gathered descriptive data on non-song vocalizations and age of territorial males. I describe four distinctive call notes, by sex, including the social and environmental contexts in which they were used. Using two independent methods of aging, there was a strong preponderance of after-second-year males at both study sites. Only 9 (n = 7 nests), 12 (n = 14), and 30 (n = 25) fledglings were produced during the 2003, 2004, and 2005 breeding seasons, respectively. Nest heights were the highest recorded for this species (mean = 19–20 m). During the same period, male reproductive success was 0.30, 0.32, and 0.80 male fledglings/breeding male and 0.60, 0.63, and 1.58 fledglings/breeding pair. Productivity estimates, not thought to be self-sustaining, were even lower than those of a well-studied Cerulean Warbler population in southern Ontario. Thus, reproductive output was low in two geographic regions—representing three different forest types—in the northern portions of the Cerulean Warbler’s breeding range. The preponderance of after-second-year males at the Michigan study sites and in southern Ontario suggests a need for regional models of Cerulean Warbler population dynamics.

Roloff, G. J. (2005). *Raptor Inventory at Fort Custer Training Center*. Wildlife and Ecology Consulting Services LLC.

The purpose of the raptor inventory is to provide FCTC personnel with information on the raptor species using and nesting on the project area, with specific emphasis on threatened or endangered species, so that appropriate management plans can be formulated. Specific objectives included 1) Document the raptor species; 2) Collect information (e.g., nesting activity, habitat use) on species that are protected; 3) Locate and map nest locations of threatened or endangered raptor species; and 4) Develop management plans for threatened or endangered raptor species on FCTC. Multiple survey techniques were used over 4.5 months, with 11 documented raptor species. No protected species were

documented nesting on FCTC. Two protected species (merlin and osprey) were confirmed using FCTC. Red-tailed hawks and turkey vulture were documented nesting on FCTC. The high population of racoons may be adversely affecting the raptor population on FCTC.

Shu-Guang, L. (2015). *Groundwater Modeling at the FCTC Site: Assessing the Impact of the Proposed Site Development on Prairie Fen Hydrology (Presentation)*. Michigan State University.

We have conducted a systematic assessment of the groundwater hydrology at the Fort Custer Training Center (FCTC) site at both a local and regional scale with an emphasis on the wetland hydrology. In particular, we have developed a hierarchy of groundwater models that enabled detailed simulation of the groundwater flow patterns, water tables, recharge areas, and seepage extent and fluxes, taking into account both local and regional stresses under both predevelopment and post-development conditions.

Stoyhoff, N. A. (1983). *Whitman Lake Wetland: A Floristic and Phytogeographic Analysis*. Michigan State University.

The Whitman Lake wetland on FCTC provides a unique opportunity for study, because the surrounding area was first settled in the mid-1800's and extensively farmed only until 1917. In 1917, a large parcel of land containing this wetland was leased and eventually purchased by the federal government for FCTC, resulting in limited human impacts since then. A sizable portion of this wetland is Salix and Cornus shrubs (shrub-carr) and small portion dominated by sedges, although there is also a large fen community. The fen community of the Whitman Lake wetland has three species listed as threatened in Michigan (*Berula erecta var incisum*, *Filipendula rubra*, *Sporobolus heterolepis*). Further, the fen community surrounding Whitman Lake is composed of three zones of vegetation which change with distance and elevation. This study compiled information from 11 fens and compared to aggregate data.

SWMLC. (2005). *Mitchell's Satyr Butterfly and Habitat Survey of Fort Custer Training Center, Final Report, 2003-2005*. Southwest Michigan Land Conservancy.

This is the Final Report for the three year project to survey for the Mitchell's satyr butterfly within existing fen wetland habitat throughout FCTC and identify appropriate habitat, characterize its features and evaluate suitability for the Mitchell satyr. During the project, SWMLC evaluated, surveyed, and mapped ten wetland complexes covering over 140 acres throughout FCTC. Based on the 2004 surveys, the four sites that contained enough size and quality of prairie fen capable of supporting populations of Mitchell's satyrs became the focus of the 2005 field season. Surveyors continued searching for Mitchell's satyrs while documenting the location and level of infestation of invasive species using GPS units. In this final field season there were no Mitchell's satyrs identified at the four sites. During the three years of surveying there were no Mitchell's satyrs identified at FCTC.

Tanis, M. (2011). *2010 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center*. Envirollogic Technologies, Inc.

The five special use plots located within the high quality areas were surveyed in 2010, using the long-term survey methods. The following activities were completed at Fort Custer Training Center during the 2010 field season: Photo monitoring and vegetation monitoring in two management areas (Barren and Lawler prairies); Vegetation monitoring and special use plot monitoring within specific areas of the convoy reaction course; Mesic prairie photo monitoring; Purple Loosestrife photo monitoring;

Monitoring of the five special use plots installed in high natural quality areas in 2008; Vegetation monitoring within timber harvest areas in Training Areas 3 and 6 ; Vegetation monitoring and special use plot monitoring within the proposed timber harvest areas. As a result of these surveys it does not appear that any substantial changes have occurred that would impact military training. It does appear the aggressive use of prescribed fire has positively affected the installation by opening up the forest floor and by stunting both the growth of invasive species and sapling reproduction.

Tanis, M. (2009). *2008 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Envirollogic Technologies, Inc.*

The following activities were completed at Fort Custer Training Center during the 2008 field season: Photo monitoring and vegetation monitoring in two prescribed burn areas (Barren and Lawler); Vegetation monitoring and special use plot monitoring within specific areas of the convoy reaction course; Mesic prairie photo monitoring; Purple loosestrife photo monitoring; Installation of five new special use plots in high natural quality areas. Results identified similar vegetation as the previous year with the addition of several new native plant species. It is evident that the work conducted by the environmental department (i.e., seeding, plantings, burns, discing, and weed control) in the convoy reaction course has helped to convert portions into the semblance of a native prairie. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable and is not adversely impacted by the training activities at the site.

Tanis, M. (2006). *2006 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Envirollogic Technologies, Inc.*

The following activities were completed at Fort Custer Training Center during the 2006 field season: A short-term monitoring event was completed on all 30 plots in 2006; Photo monitoring and vegetation monitoring in two prescribed burn areas (Barren and Lawler); Vegetation monitoring and special use plot monitoring within specific areas of the convoy reaction course; Mesic prairie photo monitoring; Purple loosestrife photo monitoring. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable and is not adversely impacted by the training activities at the site.

Tanis, M. (2006). *2005 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Envirollogic Technologies, Inc.*

The following document reviews field activities completed at Fort Custer Training Center (FCTC) during 2005 as part of the Range and Training Land Assessment (RTLA) Program. The 2005 RTLA of the Fort Custer Training Center consisted of the construction of two special use plots within the tank range. The special use plots will be used to better identify trends within the newly constructed training area. Vegetation monitoring was completed within the tank range. Results identified similar vegetation as the previous year with the addition of a few plant species previously seeded. Photographic monitoring was completed in two prescribed burn areas (Barren and Lawler) to track changes in vegetation. Results identified little change within the Lawler area and the Barren area identified signs of the prescribed burns stunting young woody vegetation growth along the edges of the prairie, however, the prescribed burn does not appear to have killed off the woody plants in these areas. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable.

Tanis, M. (2010). *2009 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center*. Envirologic Technologies, Inc.

The following document reviews field activities completed at Fort Custer Training Center during the 2009 field season as part of the Range and Training Land Assessment Program. The following activities were completed during the 2009 field season: Short-term surveys of the 26 core plots located throughout the FCTC; Photo monitoring and vegetation monitoring in two prescribed burn areas; Vegetation monitoring and special use plot monitoring within specific areas of the convoy reaction course; Mesic prairie photo monitoring; Purple Loosestrife photo monitoring; Monitoring of the five special use plots installed in high natural quality areas in 2008. As a result of these surveys it does not appear that any substantial changes have occurred that would impact military training. It does appear the aggressive use of prescribed fire has positively affected the spread and growth of multiflora rose. However, it also appears that the prescribed fire has reduced sapling reproduction and growth. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable and is not adversely impacted by the training activities at the site.

Tanis, M. (2003). *2003 Land Condition Trend Analysis (LCTA) Summary Report of Fort Custer Training Center*. Envirologic Technologies, Inc.

Envirologic Technologies, Inc. (Envirologic) completed the fifth annual Short-Term Monitoring inventory. The Short-Term inventory is intended to detect changes in land use, disturbance, ground cover, canopy cover, and woody plant density. The LCTA data collected on Fort Custer Training Center from 1998 through 2003 indicate that no dramatic changes have occurred. Overall, the general condition of the land and vegetation at FCTC appears to be stable. Furthermore, the quality of the natural resources measured as part of the LCTA program is high.

Tanis, M. (2005). *2004 Long-Term Land Condition Trend Analysis (LCTA) Summary Report*. Envirologic Technologies, Inc.

The following document reviews data collected at Fort Custer Training Center from 1998 through 2004, as part of the Land Condition-Trend Analysis (LCTA) Program. The LCTA program monitors change in land use, vegetation, soil erosion, and wildlife populations. The information collected can then be used to document trends on which management decisions can be based. The purpose of this report is to summarize data that has been collected in 2004 and previous years, and identify any trends that would potentially affect the capacity of the fort to support training activities. Data accumulated between 1998 and 2003 have identified very little change in the quality of training land.

Thomas, S. A., Cohen, J. G., & Enander, H. D. (2009). *Mapping Plant Alliances of the Fort Custer Training Center (Report Number 2009-10)*. Michigan Natural Features Inventory.

In 2009 the Michigan Natural Features Inventory (MNFI) created a digital map of plant alliances at FCTC. This work involved a combination of natural community interpretation, GIS modeling, aerial photograph interpretation, extensive ground truthing, and map production. This report provides description of the methods employed to develop FCTC's plant alliance map, results, summary of findings, and discussion of the map's limitations and applications.

Tobin, E. (2005). *Herps of Fort Custer*.

In 2004 we spent over a thousand man-hours surveying of 7,500 acres of Fort Custer. We surveyed in almost all weather conditions and at all hours of the day and night. We surveyed every training area multiple times to be sure we got good coverage of the area. In doing so we found 29 species of Reptiles and Amphibians throughout the base. Many of which were not found in previous surveys by MNFI. Of the 29 different species I have marked four in particular that may need special attention. They are the Eastern Box Turtle, the Blanding's Turtle, the Leopard Frog, and the Cricket Frog. Three of these species are also the three species of Special Concern found on the base. In each of their accounts I have explained their risks to their populations or have offer management recommendations to assist in reducing the risk to these populations.

Wick, A. A. (2016). *Prescribed Fire Monitoring at Fort Custer Training Center: 2016*. Kalamazoo Nature Center.

Vital to the success of FCTC's land management is the incorporation of prescribed fire. The four objectives are as follows: reintroduce fire to the landscape at FCTC, increase oak (*Quercus* sp.) regeneration in forests at FCTC, decrease invasive species cover in the high quality natural areas at FCTC, reduce the mean fuel load by 50-80% post-burns, and continually revisit program objectives and the burn plan after consideration of fire monitoring data. Three habitat types were chosen to monitor within the 33 burn units at FCTC in 2016: grassland wetland, mixed hardwood forest, and savanna/prairie. This report serves primarily as a methods report to outline the fire monitoring protocol to be used at FCTC. Influential results will show after subsequent prescribed fires and monitoring in coming years.

Wick, A. A., & Bhullar, A. (2015). *Surveys at Fort Custer Training Center for the Federally Endangered Karner Blue Butterfly and Suitable Habitat*. Kalamazoo Nature Center.

Here we report results from surveys for the presence of Karner blue butterfly (*Lycaeides melissa samuelis*; KBB) populations and suitable habitat for the federally endangered butterfly at FCTC. The primary purpose of this study was to survey for the presence of KBBs at FCTC. After not finding KBB individuals at FCTC in 2013, we completed a second investigation in 2014. In 2014 we examined key components required for KBB presence in oak savanna habitats; such as the presence of ant species that tend to KBB larvae, its host plant (wild lupine; *Lupinus perennis*), and other habitat components such as canopy cover and groundcover. In order to investigate KBB habitat requirements we present a comparative study of oak savanna sites at Allegan State Game Area (ASGA); a regional stronghold for the endangered KBB, and FCTC; a site with no KBBs but potentially available habitat. While the butterfly's host plant, wild lupine, must be present for KBB's survival, it is also necessary that a particular suite of ant symbiont species are present to protect KBB larvae. This mutualistic relationship cannot be overlooked when considering sites for suitability for the KBB. Although lower in abundance, we found that FCTC has a higher diversity of KBB ant symbionts than ASGA. We further conclude that lupine habitat at FCTC suffers from a lack of prescribed fire and/or manual management of shrub and tree encroachment. These trees and shrubs crowd out lupine and other nectar sources, especially in the latter parts of the summer during the second KBB flight. In order for current wild lupine populations at FCTC to remain viable to potentially support the KBB, it is necessary that oak savanna habitat at FCTC is managed aggressively with fire and/or manual shrub and tree removal.

Wick, A., & Kornoelje, A. (2014). *Surveys for two federally endangered butterflies, Mitchell's satyr (*Neonympha mitchelli mitchelli*) and Poweshiek skipperling (*Oarisma poweshiek*), at Fort Custer Training Center: 2014 Interim Report. Kalamazoo Nature Center.*

KNC surveyed prairie fens at FCTC for the presence of two prairie fen obligate butterfly species, the Mitchell's satyr (*Neonympha mitchelli mitchelli*) and Poweshiek skipperling (*Oarisma poweshiek*), both of which are listed as Federally Endangered. Due to a late start in 2014, we were unable to survey for the entire flight season. In addition to surveying for the presence of the butterflies, we surveyed prairie fen and ranked it for habitat suitability. We ranked four fens as high quality, three fens as medium quality. High and medium quality fens house sufficient host plants and habitat for the species to potentially occupy this habitat. Out of ten sites we surveyed, we ranked three sites as low quality and recommend removing them from the list of possible habitat for the target butterfly species because of a lack of host plant and fen indicator species.

Yocum, B., & Tanis, M. (2014). *2013 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Envirollogic Technologies, Inc.*

The following document reviews field activities completed at FCTC during the 2013 field season as part of the RTLA Program. The following activities were completed at FCTC during the 2013 field season: Monitoring nine special use plots ; Long-term vegetation monitoring of core plots 2, 13, 19, 20 and 21; Photo and vegetation monitoring at eight plots in the Barren and Lawler prairies; Mesic prairie photo monitoring; Floristic Quality Assessment monitoring within older timber harvest areas in Training Areas 3, 4 and 6. As a result of these surveys it does not appear that any substantial changes have occurred that would impact military training. Windstorm damage is localized. It appears that prescribed burning has positively affected the installation by creating habitat diversity. In some areas the fire is responsible for opening up the forest floor while in other areas it is stunting the growth of invasive species and stimulating sapling reproduction.

Yocum, B. J. (2018). *2018 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Envirollogic Technologies, Inc.*

RTLC monitoring has been conducted at FCTC since 1998. The following activities were completed at FCTC during the 2016 field season: Monitoring nine special use plots; Long-term vegetation monitoring of core plots 4, 6, 8, 9, 27, and 28; Vegetation monitoring in two timber harvest areas in TA4; Photo and vegetation monitoring at eight plots in the Barren and Lawler prairies; Mesic prairie photo monitoring; Training accessibility monitoring in Training Area 7. The 2018 RTLA field season consisted of the completion of long-term surveys of nine special use plots including five in high-quality natural areas, two in the CRC, and two relatively new plots in timber harvest areas within TA-4. In addition, the revised vegetation data process was conducted at five core plots. Photographic monitoring was conducted on several photo points within two prairie-savannas and the mesic prairie. It does not appear that any substantial changes have occurred that would impact military training. It appears that prescribed burning has positively affected the installation by creating habitat diversity. A pilot project to monitor the effects of burning on training accessibility has begun with a particular interest in the potential negative effects. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable and is not adversely impacted by the training activities at the site.

Yocum, B. J., & Tanis, M. (2015). *2014 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center*. Envirologic Technologies, Inc.

The following document reviews field activities completed at FCTC during the 2014 field season as part of the RTLA Program. The following activities were completed at FCTC during the 2014 field season: Monitoring nine special use plots; Long-term vegetation monitoring of core plots 3, 11, 24, 25, 26 and 29; Photo and vegetation monitoring at eight plots in the Barren and Lawler prairies; Mesic prairie photo monitoring; Floristic Quality Assessment monitoring within older timber harvest areas in Training Area 4. As a result of the 2014 survey activities it does not appear that any substantial changes have occurred that would impact military training. Windstorm damage is localized. It appears that prescribed burning has positively affected the installation by creating habitat diversity. In some areas the fire is responsible for opening up the forest floor while in other areas it is stunting the growth of invasive species and stimulating sapling reproduction.

Yocum, B. J., & Tanis, M. (2016). *2015 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center*. Envirologic Technologies, Inc.

The following document reviews field activities completed at FCTC during the 2015 field season as part of the RTLA Program. The following activities were completed at FCTC during the 2015 field season: Monitoring nine special use plots; Long-term vegetation monitoring of core plots 1, 14, 15, 18 and 30; Photo and vegetation monitoring at eight plots in the Barren and Lawler prairies; Mesic prairie photo monitoring; Training accessibility monitoring in Training Area 7. As a result of the 2015 survey activities it does not appear that any substantial changes have occurred that would impact military training. Windstorm damage is localized and some salvage logging of downed trees has continued. It appears that prescribed burning has positively affected the installation by creating habitat diversity. In some areas the fire is responsible for opening up the forest floor while in other areas it is stunting the growth of invasive species and stimulating sapling reproduction. A pilot project to monitor the effects of burning on training accessibility (i.e., stimulating thorny plants both native and non-native) has begun with a particular interest in the potential negative effects. Overall, the general condition of the land in the areas where the surveys were completed appears to be stable and is not adversely impacted by the training activities at the site. Efforts

Yocum, B. J., & Tanis, M. (2017). *2016 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center*. Envirologic Technologies, Inc.

The following document reviews field activities completed at FCTC during the 2016 field season as part of the RTLA Program. The following activities were completed at FCTC during the 2016 field season: Monitoring nine special use plots; Long-term vegetation monitoring of core plots 4, 6, 8, 9, 27, and 28; Vegetation monitoring in two timber harvest areas in TA4; Photo and vegetation monitoring at eight plots in the Barren and Lawler prairies; Mesic prairie photo monitoring; Training accessibility monitoring in Training Area 7.

APPENDIX E
SPECIES LISTS

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Listed

FE = federally endangered, FT = federally threatened, CH = critical habitat (under Endangered Species Act)

BGEPA = Bald and Golden Eagle Protection Act

SE = state endangered, ST = state threatened, SC = state species of concern (under Michigan law)

Invasive

Non-native = species that is not native to the region

Invasive = non-native species that is considered invasive at Fort Custer

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Adoxaceae	<i>Sambucus nigra ssp. canadensis</i>	Common Elder, Elderberry	-	-
Adoxaceae	<i>Viburnum acerifolium</i>	Maple-Leaved Viburnum	-	-
Adoxaceae	<i>Viburnum lentago</i>	Nannyberry	-	-
Adoxaceae	<i>Viburnum opulus</i>	European highbush cranberry	-	Non-Native
Adoxaceae	<i>Viburnum opulus var. americanum</i>	Highbush cranberry	-	-
Adoxaceae	<i>Viburnum rafinesquianum</i>	Downy arrow wood	-	-
Alismataceae	<i>Alisma plantago-aquatica</i>	Water Plantain	-	-
Alismataceae	<i>Sagittaria latifolia</i>	Wapato, Duck-Potato, Common Arrowhead	-	-
Amaranthaceae	<i>Amaranthus albus</i>	Tumbleweed	-	-
Amaranthaceae	<i>Chenopodium album</i>	Lambs-Quarters, Pigweed	-	Non-Native
Amaranthaceae	<i>Chenopodium simplex</i>	Maple-Leaved Goosefoot	-	-
Amaranthaceae	<i>Cycloloma atriplicifolium</i>	Winged Pigweed	-	Non-Native
Anacardiaceae	<i>Rhus copallina</i>	Winged sumac	-	-
Anacardiaceae	<i>Rhus glabra</i>	Smooth sumac	-	-
Anacardiaceae	<i>Rhus typhina</i>	Staghorn Sumac	-	-
Anacardiaceae	<i>Toxicodendron radicans</i>	Poison ivy	-	-
Anacardiaceae	<i>Toxicodendron rydbergii</i>	Poison Ivy	-	-
Anacardiaceae	<i>Toxicodendron vernix</i>	Poison sumac	-	-
Annonaceae	<i>Asimina triloba</i>	Pawpaw	-	-
Apiaceae	<i>Angelica atropurpurea</i>	Purplestem Angelica	-	-
Apiaceae	<i>Berula erecta</i>	Cut-leaf water parsnip	ST	-
Apiaceae	<i>Cicuta bulbifera</i>	Water Hemlock	-	-
Apiaceae	<i>Cicuta maculata</i>	Water Hemlock	-	-
Apiaceae	<i>Cryptotaenia canadensis</i>	Honewort	-	-
Apiaceae	<i>Daucus carota</i>	Wild Carrot, Queen-Anne's-Lace	-	Non-Native
Apiaceae	<i>Erigenia bulbosa</i>	Harbinger of spring	-	-
Apiaceae	<i>Osmorhiza claytonii</i>	Hairy Sweet-Cicely	-	-
Apiaceae	<i>Osmorhiza longistylis</i>	Smooth sweet cicely	-	-
Apiaceae	<i>Oxypolis rigidior</i>	Cowbane	-	-
Apiaceae	<i>Sanicula canadensis</i>	Black snakeroot	-	-
Apiaceae	<i>Sanicula gregaria</i>	Black snakeroot	-	-
Apiaceae	<i>Sanicula trifoliata</i>	Black snakeroot	-	-
Apiaceae	<i>Taenidia integerrima</i>	Yellow pimpernel	-	-
Apiaceae	<i>Torilis japonica</i>	Hedge-Parsley	-	Non-Native
Apiaceae	<i>Zizia aurea</i>	Golden alexanders	-	-
Apocynaceae	<i>Apocynum cannabinum</i>	Indian Hemp	-	-
Apocynaceae	<i>Asclepias amplexicaulis</i>	Clasping Milkweed	-	-
Apocynaceae	<i>Asclepias exaltata</i>	Poke Milkweed	-	-
Apocynaceae	<i>Asclepias incarnata</i>	Swamp Milkweed	-	-
Apocynaceae	<i>Asclepias syriaca</i>	Common Milkweed	-	-
Apocynaceae	<i>Asclepias tuberosa</i>	Butterfly-Weed	-	-
Apocynaceae	<i>Asclepias viridiflora</i>	Green Milkweed	-	-
Apocynaceae	<i>Vinca minor</i>	Common Periwinkle	-	Non-Native
Aquifoliaceae	<i>Ilex opaca</i>	American Holly	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Aquifoliaceae	<i>Ilex verticillata</i>	Michigan Holly, Winterberry, Black-Alder	-	-
Araceae	<i>Arisaema dracontium</i>	Green dragon	-	-
Araceae	<i>Arisaema triphyllum</i>	Jack-In-The-Pulpit, Indian-Turnip	-	-
Araceae	<i>Peltandra virginica</i>	Arrow arum	-	-
Araceae	<i>Spirodela polyrhiza</i>	Greater Duckweed	-	-
Araceae	<i>Symplocarpus foetidus</i>	Skunk-Cabbage	-	-
Araceae	<i>Wolffia columbiana</i>	Common water meal	-	-
Araceae	<i>Wolffia punctata</i>	Dotted water meal	-	-
Araliaceae	<i>Aralia nudicaulis</i>	Wild Sarsaparilla	-	-
Araliaceae	<i>Aralia racemosa</i>	Spikenard	-	-
Araliaceae	<i>Panax quinquefolius</i>	American ginseng	ST	-
Araliaceae	<i>Panax trifolius</i>	Dwarf Ginseng	-	-
Aristolochiaceae	<i>Asarum canadense</i>	Wild ginger	-	-
Asparagaceae	<i>Asparagus officinalis</i>	Asparagus	-	Non-Native
Asparagaceae	<i>Convallaria majalis</i>	Lily of the valley, Lily-of-the-valley	-	Non-Native
Asparagaceae	<i>Muscari botryoides</i>	Grape hyacinth	-	Non-Native
Asparagaceae	<i>Ornithogalum umbellatum</i>	Star of Bethlehem	-	Non-Native
Asparagaceae	<i>Smilacina racemosa</i>	False spikenard	-	-
Asparagaceae	<i>Smilacina stellata</i>	Starry false solomon seal	-	-
Asparagaceae	<i>Yucca filamentosa</i>	Yucca	-	Non-Native
Asphodelaceae	<i>Hemerocallis fulva</i>	Orange day lily, Orange day-lily	-	Non-Native
Aspleniaceae	<i>Asplenium platyneuron</i>	Ebony spleenwort	-	-
Asteraceae	<i>Achillea millefolium</i>	Common yarrow	-	Invasive
Asteraceae	<i>Ambrosia artemisiifolia</i>	Annual Ragweed	-	Invasive
Asteraceae	<i>Ambrosia psilostachya</i>	Western Ragweed	-	-
Asteraceae	<i>Ambrosia trifida</i>	Giant ragweed	-	Non-Native
Asteraceae	<i>Antennaria neglecta</i>	Cat's Foot	-	-
Asteraceae	<i>Antennaria parlinii</i>	Smooth Pussytoes	-	-
Asteraceae	<i>Arctium minus</i>	Common Burdock	-	Non-Native
Asteraceae	<i>Arnoglossum plantagineum</i>	Prairie Indian plantain, Tuberous Indian plantain	SC	
Asteraceae	<i>Artemisia campestris</i>	Wild Wormwood	-	-
Asteraceae	<i>Aster ciliolatus</i>	Northern heart leaved aster	-	-
Asteraceae	<i>Aster laevis</i>	Smooth aster	-	-
Asteraceae	<i>Aster lanceolatus</i>	Eastern lined aster	-	-
Asteraceae	<i>Aster lateriflorus</i>	Side flowering aster	-	-
Asteraceae	<i>Aster macrophyllus</i>	Big leaved aster	-	-
Asteraceae	<i>Aster novae-angliae</i>	New england aster	-	-
Asteraceae	<i>Aster oolentangiensis</i>	Prairie heart leaved aster	-	-
Asteraceae	<i>Aster pilosus</i>	Hairy aster	-	-
Asteraceae	<i>Aster puniceus</i>	Swamp aster	-	-
Asteraceae	<i>Aster sagittifolius</i>	Arrow leaved aster	-	-
Asteraceae	<i>Aster umbellatus</i>	Tall flat top white aster	-	-
Asteraceae	<i>Bidens cernua</i>	Nodding Beggar-Ticks	-	-
Asteraceae	<i>Bidens cernuus</i>	Nodding Bur-marigold	-	Non-Native

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Asteraceae	<i>Bidens connatus</i>	Purple stemmed tickseed	-	-
Asteraceae	<i>Bidens coronatus</i>	Tall swamp marigold	-	-
Asteraceae	<i>Bidens frondosus</i>	Common beggar ticks	-	Non-Native
Asteraceae	<i>Bidens polylepis</i>	Ozark Tickseed Sunflower	-	-
Asteraceae	<i>Brickellia eupatorioides</i> [<i>Kuhnia eupatorioides</i>]	False boneset	SC	-
Asteraceae	<i>Centaurea jacea</i>	Brown knapweed	-	Non-Native
Asteraceae	<i>Centaurea maculosa</i>	Spotted bluet, spotted knapweed	-	Invasive; Non-Native
Asteraceae	<i>Chondrilla juncea</i>	Skeleton weed	-	Non-Native
Asteraceae	<i>Chrysanthemum leucanthemum</i>	Ox eye daisy	-	Non-Native
Asteraceae	<i>Cichorium intybus</i>	Chicory, Blue-Sailors	-	Non-Native
Asteraceae	<i>Cirsium arvense</i>	Canada Thistle, Field Thistle	-	Non-Native
Asteraceae	<i>Cirsium discolor</i>	Pasture thistle	-	-
Asteraceae	<i>Cirsium muticum</i>	Swamp Thistle	-	-
Asteraceae	<i>Cirsium vulgare</i>	Bull Thistle	-	Non-Native
Asteraceae	<i>Conyza canadensis</i>	Horseweed	-	-
Asteraceae	<i>Coreopsis tripteris</i>	Tall coreopsis	-	-
Asteraceae	<i>Crepis tectorum</i>	Hawk's Beard	-	Non-Native
Asteraceae	<i>Erechtites hieraciifolius</i>	Fireweed	-	-
Asteraceae	<i>Erigeron annuus</i>	Daisy Fleabane	-	-
Asteraceae	<i>Erigeron philadelphicus</i>	Common Fleabane, Philadelphia Fleabane	-	-
Asteraceae	<i>Erigeron strigosus</i>	Daisy Fleabane	-	-
Asteraceae	<i>Eupatorium perfoliatum</i>	Boneset	-	-
Asteraceae	<i>Eupatorium purpureum</i>	Purple joe pye weed	-	-
Asteraceae	<i>Eupatorium rugosum</i>	White snakeroot	-	-
Asteraceae	<i>Eupatorium sessilifolium</i>	Upland boneset	-	-
Asteraceae	<i>Euthamia graminifolia</i>	Grass-Leaved Goldenrod	-	-
Asteraceae	<i>Eutrochium maculatum</i>	Joe-Pye-Weed	-	-
Asteraceae	<i>Gnaphalium macounii</i>	Clammy cudweed	-	-
Asteraceae	<i>Gnaphalium obtusifolium</i>	Old field balsam	-	-
Asteraceae	<i>Helenium flexuosum</i>	Sneezeweed	-	-
Asteraceae	<i>Helianthus decapetalus</i>	Pale sunflower	-	-
Asteraceae	<i>Helianthus divaricatus</i>	Woodland sunflower	-	-
Asteraceae	<i>Helianthus giganteus</i>	Tall sunflower	-	-
Asteraceae	<i>Helianthus mollis</i>	Downy sunflower	ST	-
Asteraceae	<i>Helianthus strumosus</i>	Pale leaved sunflower	-	-
Asteraceae	<i>Hieracium aurantiacum</i>	Orange Hawkweed, Devil's-Paintbrush	-	Non-Native
Asteraceae	<i>Hieracium caespitosum</i>	King Devil, Yellow Hawkweed	-	Non-Native
Asteraceae	<i>Hieracium gronovii</i>	Hairy Hawkweed	-	-
Asteraceae	<i>Hieracium longipilum</i>	Long bearded hawkweed	-	-
Asteraceae	<i>Hieracium piloselloides</i>	Glaucus King Devil, Yellow Hawkweed	-	Non-Native
Asteraceae	<i>Hieracium scabrum</i>	Rough Hawkweed	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Asteraceae	<i>Hypochaeris radicata</i>	Cat's-Ear, Spotted Cat's Ear	-	Non-Native
Asteraceae	<i>Krigia biflora</i>	False Dandelion	-	-
Asteraceae	<i>Krigia virginica</i>	Dwarf Dandelion	-	-
Asteraceae	<i>Lactuca biennis</i>	Tall Blue Lettuce	-	-
Asteraceae	<i>Lactuca canadensis</i>	Wild Lettuce, Tall Lettuce	-	-
Asteraceae	<i>Lactuca saligna</i>	Willow lettuce	-	Non-Native
Asteraceae	<i>Liatris aspera</i>	Rough blazing star	-	-
Asteraceae	<i>Liatris scariosa</i>	Northern Blazing-Star	-	-
Asteraceae	<i>Matricaria discoidea</i>	Pineapple-Weed	-	-
Asteraceae	<i>Polymnia canadensis</i>	Leafcup	-	-
Asteraceae	<i>Prenanthes altissima</i>	Tall white lettuce	-	-
Asteraceae	<i>Ratibida pinnata</i>	Yellow coneflower	-	-
Asteraceae	<i>Rudbeckia fulgida</i>	Black-Eyed Susan	-	-
Asteraceae	<i>Rudbeckia hirta</i>	Black-Eyed Susan	-	-
Asteraceae	<i>Rudbeckia laciniata</i>	Tall Coneflower, Cut-Leaf Coneflower	-	-
Asteraceae	<i>Rudbeckia triloba</i>	Three lobed coneflower	-	-
Asteraceae	<i>Senecio aureus</i>	Golden ragwort	-	-
Asteraceae	<i>Senecio pauperculus</i>	Balsam ragwort	-	-
Asteraceae	<i>Solidago altissima</i>	Tall Goldenrod	-	-
Asteraceae	<i>Solidago caesia</i>	Blue stemmed goldenrod	-	-
Asteraceae	<i>Solidago canadensis</i>	Canada Goldenrod	-	-
Asteraceae	<i>Solidago gigantea</i>	Late Goldenrod	-	-
Asteraceae	<i>Solidago hispida</i>	Hairy Goldenrod	-	-
Asteraceae	<i>Solidago juncea</i>	Early Goldenrod	-	-
Asteraceae	<i>Solidago nemoralis</i>	Gray Goldenrod, Old-Field Goldenrod	-	-
Asteraceae	<i>Solidago ohioensis</i>	Ohio goldenrod	-	-
Asteraceae	<i>Solidago patula</i>	Rough-Leaved Goldenrod, Swamp Goldenrod	-	-
Asteraceae	<i>Solidago riddellii</i>	Riddell's goldenrod	-	-
Asteraceae	<i>Solidago rugosa</i>	Rough-Leaved Goldenrod	-	-
Asteraceae	<i>Solidago speciosa</i>	Showy Goldenrod	-	-
Asteraceae	<i>Solidago uliginosa</i>	Bog Goldenrod	-	-
Asteraceae	<i>Solidago ulmifolia</i>	Elm leaved goldenrod	-	-
Asteraceae	<i>Sonchus arvensis</i>	Field Sow Thistle, Perennial Sow-Thistle	-	Non-Native
Asteraceae	<i>Sonchus asper</i>	Prickly sow thistle	-	Non-Native
Asteraceae	<i>Taraxacum officinale</i>	Common dandelion	-	Non-Native
Asteraceae	<i>Tragopogon dubius</i>	Fistulous Goat's Beard; Goat's Beard	-	Non-Native
Asteraceae	<i>Tragopogon pratensis</i>	Common Goat's Beard	-	Non-Native
Asteraceae	<i>Vernonia missurica</i>	Missouri ironweed	-	-
Athyriaceae	<i>Athyrium filix-femina</i>	Lady Fern	-	-
Athyriaceae	<i>Athyrium pycnocarpon</i>	Narrow leaved spleenwort	-	-
Athyriaceae	<i>Athyrium thelypteroides</i>	Silvery spleenwort	-	-
Balsaminaceae	<i>Impatiens capensis</i>	Spotted Touch-Me-Not	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Berberidaceae	<i>Berberis thunbergii</i>	Japanese Barberry	-	Invasive
Berberidaceae	<i>Caulophyllum thalictroides</i>	Blue Cohosh	-	-
Berberidaceae	<i>Podophyllum peltatum</i>	May apple	-	-
Betulaceae	<i>Alnus glutinosa</i>	Black Alder	-	-
Betulaceae	<i>Betula pumila</i>	Bog birch	-	-
Betulaceae	<i>Betula pendula</i>	European white birch	-	Non-Native
Betulaceae	<i>Betula pumila</i>	Bog Birch, Dwarf Birch	-	-
Betulaceae	<i>Carpinus caroliniana</i>	Hornbeam, Blue-Beech	-	-
Betulaceae	<i>Corylus americana</i>	Hazelnut	-	-
Betulaceae	<i>Ostrya virginiana</i>	Ironwood, Hop-Hornbeam	-	-
Bignoniaceae	<i>Campsis radicans</i>	Trumpet vine; trumpet creeper	-	Non-Native
Bignoniaceae	<i>Catalpa speciosa</i>	Northern catalpa	-	-
Blechnaceae	<i>Woodwardia virginica</i>	Virginia chain fern	-	-
Boraginaceae	<i>Hackelia virginiana</i>	Beggar's lice	-	-
Boraginaceae	<i>Hydrophyllum appendiculatum</i>	Great waterleaf	-	-
Boraginaceae	<i>Myosotis scorpioides</i>	Forget me not	-	Non-Native
Brassicaceae	<i>Alliaria petiolata</i>	Garlic Mustard	-	Invasive
Brassicaceae	<i>Alyssum alyssoides</i>	Pale Alyssum	-	Non-Native
Brassicaceae	<i>Arabidopsis thaliana</i>	Mouse-Ear Cress	-	Non-Native
Brassicaceae	<i>Arabis canadensis</i>	Sickle pod	-	-
Brassicaceae	<i>Arabis glabra</i>	Tower mustard	-	-
Brassicaceae	<i>Barbarea vulgaris</i>	largeleaf wild indigo; yellow mustard cress	-	Non-Native
Brassicaceae	<i>Berteroa incana</i>	Hoary Alyssum	-	Non-Native
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's-Purse	-	Non-Native
Brassicaceae	<i>Cardamine bulbosa</i>	Spring cress	-	-
Brassicaceae	<i>Cardamine douglassii</i>	Pink spring cress	-	-
Brassicaceae	<i>Cardamine hirsuta</i>	Hoary bitter cress; Bitter Cress	-	Non-Native
Brassicaceae	<i>Cardamine pennsylvanica</i>	Pennsylvania Bitter Cress	-	-
Brassicaceae	<i>Cardamine pratensis</i>	Cuckoo flower	-	-
Brassicaceae	<i>Dentaria diphylla</i>	Two leaved toothwort	-	-
Brassicaceae	<i>Dentaria laciniata</i>	Cut leaved toothwort	-	-
Brassicaceae	<i>Hesperis matronalis</i>	Dame's rocket	-	Non-Native
Brassicaceae	<i>Lepidium campestre</i>	Field Cress	-	-
Brassicaceae	<i>Lepidium densiflorum</i>	Small Peppergrass	-	-
Brassicaceae	<i>Lepidium virginicum</i>	Common peppergrass	-	-
Brassicaceae	<i>Nasturtium officinale</i>	Watercress; Water Cress	-	Non-Native
Brassicaceae	<i>Rorippa palustris</i>	Yellow Cress	-	-
Brassicaceae	<i>Sisymbrium altissimum</i>	Tumble Mustard	-	Non-Native
Brassicaceae	<i>Sisymbrium officinale</i>	Hedge Mustard	-	Non-Native
Campanulaceae	<i>Campanula americana</i>	Tall bellflower	-	-
Campanulaceae	<i>Campanula aparinoides</i>	Marsh Bellflower	-	-
Campanulaceae	<i>Campanula rotundifolia</i>	Bluebell, Harebell	-	-
Campanulaceae	<i>Lobelia inflata</i>	Indian-Tobacco	-	-
Campanulaceae	<i>Lobelia kalmii</i>	Kalm's Lobelia, Brook Lobelia, Bog Lobelia	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Campanulaceae	<i>Lobelia siphilitica</i>	Great Blue Lobelia	-	-
Campanulaceae	<i>Lobelia spicata</i>	Pale Spiked Lobelia	-	-
Campanulaceae	<i>Specularia perfoliata</i>	Venus's looking glass	-	-
Cannabaceae	<i>Celtis occidentalis</i>	Hackberry	-	-
Cannabaceae	<i>Humulus lupulus</i>	Common Hops, Hops	-	-
Caprifoliaceae	<i>Lonicera dioica</i>	Red honeysuckle	-	Invasive
Caprifoliaceae	<i>Lonicera maackii</i>	Amur honeysuckle	-	Invasive
Caprifoliaceae	<i>Lonicera morrowii</i>	Morrow honeysuckle	-	Invasive
Caprifoliaceae	<i>Lonicera xbella</i>	Hybrid honeysuckle	-	Invasive
Caryophyllaceae	<i>Arenaria serpyllifolia</i>	Thyme-Leaved Sandwort	-	Non-Native
Caryophyllaceae	<i>Cerastium semidecandrum</i>	Small Mouse-Ear Chickweed	-	-
Caryophyllaceae	<i>Dianthus armeria</i>	Deptford Pink	-	Non-Native
Caryophyllaceae	<i>Saponaria officinalis</i>	Bouncing Bet, Soapwort	-	Non-Native
Caryophyllaceae	<i>Scleranthus annuus</i>	Knawel	-	Non-Native
Caryophyllaceae	<i>Silene antirrhina</i>	Sleepy Catchfly	-	-
Caryophyllaceae	<i>Silene pratensis</i>	White catchfly; White cockle	-	Non-Native
Caryophyllaceae	<i>Silene vulgaris</i>	Bladder Champion	-	-
Caryophyllaceae	<i>Stellaria longifolia</i>	Long-Leaved Chickweed	-	-
Caryophyllaceae	<i>Stellaria media</i>	Common chickweed	-	Non-Native
Celastraceae	<i>Celastrus orbiculata</i>	Oriental bittersweet	-	Invasive
Celastraceae	<i>Celastrus scandens</i>	Climbing Bittersweet, American Bittersweet	-	-
Celastraceae	<i>Euonymus alatus</i>	Winged Euonymus; Winged Wahoo	-	Non-Native
Celastraceae	<i>Euonymus atropurpurea</i>	Wahoo; burning bush	SC	-
Celastraceae	<i>Euonymus obovata</i>	Running strawberry bush	-	-
Ceratophyllaceae	<i>Ceratophyllum demersum</i>	Coontail	-	-
Ceratophyllaceae	<i>Ceratophyllum echinatum</i>	Spiny hornwort	-	-
Cistaceae	<i>Helianthemum canadense</i>	Common rockrose	-	-
Cistaceae	<i>Lechea villosa</i>	Hairy pinweed	-	-
Cleomaceae	<i>Polanisia dodecandra</i>	Clammy-Weed	-	-
Commelinaceae	<i>Tradescantia ohiensis</i>	Common spiderwort	-	-
Convallariaceae	<i>Maianthemum canadense</i>	Canada Mayflower, False Solomon-Seal	-	-
Convallariaceae	<i>Polygonatum biflorum</i>	Solomon seal	-	-
Convallariaceae	<i>Polygonatum pubescens</i>	Downy Solomon Seal	-	-
Convallariaceae	<i>Uvularia grandiflora</i>	Bellwort	-	-
Convolvulaceae	<i>Calystegia sepium</i>	Hedge bindweed	-	Non-Native
Convolvulaceae	<i>Cuscuta campestris</i>	Field dodder	SC	-
Convolvulaceae	<i>Cuscuta cephalanthi</i>	Buttonbush dodder	-	-
Convolvulaceae	<i>Cuscuta gronovii</i>	Common dodder	-	-
Cornaceae	<i>Cornus alternifolia</i>	Alternate-Leaved Dogwood, Pagoda Dogwood	-	-
Cornaceae	<i>Cornus amomum</i>	Pale Dogwood, Silky Dogwood	-	-
Cornaceae	<i>Cornus florida</i>	Flowering dogwood	-	-
Cornaceae	<i>Cornus foemina</i>	Gray Dogwood	-	-
Cornaceae	<i>Cornus sericea</i>	Red-Osier	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Crassulaceae	<i>Sedum telephium</i>	Live forever	-	Non-Native
Cucurbitaceae	<i>Sicyos angulatus</i>	bur-cucumber	-	-
Cupressaceae	<i>Juniperus virginiana</i>	Red cedar	-	-
Cupressaceae	<i>Thuja occidentalis</i>	Arbor Vitae, White-Cedar, Cedar	-	-
Cyperaceae	<i>Carex aggregata</i>	Sedge	-	-
Cyperaceae	<i>Carex albursina</i>	Sedge	-	-
Cyperaceae	<i>Carex amphibola</i>	Sedge	SC	-
Cyperaceae	<i>Carex annectens</i>	Sedge	-	-
Cyperaceae	<i>Carex aquatilis</i>	Sedge	-	-
Cyperaceae	<i>Carex bebbii</i>	Sedge	-	-
Cyperaceae	<i>Carex bicknellii</i>	Sedge	-	-
Cyperaceae	<i>Carex blanda</i>	Sedge	-	-
Cyperaceae	<i>Carex brevior</i>	Sedge	-	-
Cyperaceae	<i>Carex bromoides</i>	Sedge	-	-
Cyperaceae	<i>Carex buxbaumii</i>	Sedge	-	-
Cyperaceae	<i>Carex cephalophora</i>	Sedge	-	-
Cyperaceae	<i>Carex comosa</i>	Sedge	-	-
Cyperaceae	<i>Carex crinita</i>	Sedge	-	-
Cyperaceae	<i>Carex cristatella</i>	Sedge	-	-
Cyperaceae	<i>Carex cryptolepis</i>	Sedge	-	-
Cyperaceae	<i>Carex diandra</i>	Sedge	-	-
Cyperaceae	<i>Carex flava</i>	Sedge	-	-
Cyperaceae	<i>Carex frankii</i>	Frank's sedge	-	-
Cyperaceae	<i>Carex gracillima</i>	Sedge	-	-
Cyperaceae	<i>Carex granularis</i>	Sedge	-	-
Cyperaceae	<i>Carex grisea</i>	Sedge	-	-
Cyperaceae	<i>Carex hirsutella</i>	Sedge	-	-
Cyperaceae	<i>Carex hirtifolia</i>		-	-
Cyperaceae	<i>Carex hitchcockiana</i>	Sedge	-	-
Cyperaceae	<i>Carex hystericina</i>	Sedge	-	-
Cyperaceae	<i>Carex interior</i>	Sedge	-	-
Cyperaceae	<i>Carex jamesii</i>	James' sedge	-	-
Cyperaceae	<i>Carex lacustris</i>	Sedge	-	-
Cyperaceae	<i>Carex laevivaginata</i>	Sedge	-	-
Cyperaceae	<i>Carex laxiculmis</i>	Sedge	-	-
Cyperaceae	<i>Carex leptalea</i>	Sedge	-	-
Cyperaceae	<i>Carex lupulina</i>	Sedge	-	-
Cyperaceae	<i>Carex muehlenbergii</i>	Sedge	-	-
Cyperaceae	<i>Carex pellita</i>	Sedge	-	-
Cyperaceae	<i>Carex pennsylvanica</i>	Sedge	-	-
Cyperaceae	<i>Carex plantaginea</i>	Plaintainleaf sedge	-	-
Cyperaceae	<i>Carex prairea</i>	Sedge	-	-
Cyperaceae	<i>Carex pseudocyperus</i>	Sedge	-	-
Cyperaceae	<i>Carex radiata</i>	Straight styled wood sedge	-	-
Cyperaceae	<i>Carex rosea</i>	curly-Styled Wood Sedge	-	-
Cyperaceae	<i>Carex sartwellii</i>	Sedge	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Cyperaceae	<i>Carex scoparia</i>	Sedge	-	-
Cyperaceae	<i>Carex sparganioides</i>	Sedge	-	-
Cyperaceae	<i>Carex spicata</i>	Sedge	-	-
Cyperaceae	<i>Carex sterilis</i>	Sedge	-	-
Cyperaceae	<i>Carex stipata</i>	Sedge	-	-
Cyperaceae	<i>Carex stricta</i>	Sedge	-	-
Cyperaceae	<i>Carex swanii</i>	Sedge	-	-
Cyperaceae	<i>Carex tetanica</i>	Sedge	-	-
Cyperaceae	<i>Carex tribuloides</i>	Sedge	-	-
Cyperaceae	<i>Carex utriculata</i>	Sedge	-	-
Cyperaceae	<i>Carex vulpinoidea</i>	Sedge	-	-
Cyperaceae	<i>Cladium mariscoides</i>	Twig-Rush	-	-
Cyperaceae	<i>Cyperus bipartitus</i>	Brook Nut Sedge	-	-
Cyperaceae	<i>Cyperus diandrus</i>	Umbrella sedge	-	-
Cyperaceae	<i>Cyperus filiculmis</i>	Slender sand sedge	-	-
Cyperaceae	<i>Cyperus houghtonii</i>	Smooth Sand Sedge	-	-
Cyperaceae	<i>Cyperus strigosus</i>	Long scaled nut sedge	-	-
Cyperaceae	<i>Dulichium arundinaceum</i>	Three-Way Sedge	-	-
Cyperaceae	<i>Eleocharis elliptica</i>	Golden-Seeded Spike Rush	-	-
Cyperaceae	<i>Eleocharis erythropoda</i>	Spike-Rush	-	-
Cyperaceae	<i>Eleocharis intermedia</i>	Spike-Rush	-	-
Cyperaceae	<i>Eleocharis obtusa</i>	Spike-Rush	-	-
Cyperaceae	<i>Eleocharis rostellata</i>	Spike rush	-	-
Cyperaceae	<i>Eriophorum viridicarinatum</i>	Green-Keeled Cotton-Grass	-	-
Cyperaceae	<i>Rhynchospora capillacea</i>	Beak rush	-	-
Cyperaceae	<i>Schoenoplectus acutus</i>	Hardstem Bulrush	-	-
Cyperaceae	<i>Schoenoplectus pungens</i>	Threesquare	-	-
Cyperaceae	<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush	-	-
Cyperaceae	<i>Scirpus atrovirens</i>	Bulrush	-	-
Cyperaceae	<i>Scirpus cyperinus</i>	Wool-Grass	-	-
Cyperaceae	<i>Scirpus pendulus</i>	Bulrush	-	-
Cyperaceae	<i>Scleria verticillata</i>	Nut rush	-	-
Cystopteridaceae	<i>Cystopteris bulbifera</i>	Bulblet Fern	-	-
Dennstaedtiaceae	<i>Pteridium aquilinum</i>	Bracken Fern	-	-
Dioscoreaceae	<i>Dioscorea villosa</i>	Wild yam	-	-
Droseraceae	<i>Drosera rotundifolia</i>	Round-Leaved Sundew	-	-
Dryopteridaceae	<i>Dryopteris carthusiana</i>	Spinulose Woodfern; Toothed wood-fern	-	Non-Native
Dryopteridaceae	<i>Dryopteris cristata</i>	Crested Shield Fern	-	-
Dryopteridaceae	<i>Dryopteris goldiana</i>	Goldie's woodfern	-	-
Dryopteridaceae	<i>Dryopteris intermedia</i>	Evergreen Woodfern	-	-
Dryopteridaceae	<i>Polystichum acrostichoides</i>	Christmas fern	-	-
Elaeagnaceae	<i>Elaeagnus umbellata</i>	Autumn Olive	-	Invasive
Equisetaceae	<i>Equisetum arvense</i>	Common Horsetail	-	-
Equisetaceae	<i>Equisetum fluviatile</i>	Water Horsetail	-	-
Equisetaceae	<i>Equisetum hyemale</i>	Scouringrush horsetail	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Equisetaceae	<i>Equisetum laevigatum</i>	Smooth scouring rush	-	-
Equisetaceae	<i>Equisetum variegatum</i>	Variiegated scouring rush	-	-
Ericaceae	<i>Chamaedaphne calyculata</i>	Leatherleaf	-	-
Ericaceae	<i>Chimaphila maculata</i>	Spotted wintergreen	-	-
Ericaceae	<i>Gaylussacia baccata</i>	Huckleberry, Crackleberry	-	-
Ericaceae	<i>Monotropa hypopithys</i>	Pinesap	-	-
Ericaceae	<i>Monotropa uniflora</i>	Indian-Pipe	-	-
Ericaceae	<i>Pyrola elliptica</i>	Large-Leaved Shinleaf	-	-
Ericaceae	<i>Vaccinium corymbosum</i>	Smooth highbush blueberry	-	-
Ericaceae	<i>Vaccinium myrtilloides</i>	Velvetleaf Blueberry, Canada Blueberry	-	-
Euphorbiaceae	<i>Acalypha rhomboidea</i>	Three Sided Mercury	-	-
Euphorbiaceae	<i>Euphorbia corollata</i>	Flowering Spurge	-	-
Euphorbiaceae	<i>Euphorbia cyparissias</i>	Cypress Spurge	-	Non-Native
Euphorbiaceae	<i>Euphorbia maculata</i>	Spotted Spurge	-	-
Euphorbiaceae	<i>Euphorbia nutans</i>	Eyebane	-	Non-Native
Euphorbiaceae	<i>Euphorbia vermiculata</i>	Hairy spurge	-	-
Fabaceae	<i>Amorpha canescens</i>	Lead plant	SC	-
Fabaceae	<i>Amphicarpaea bracteata</i>	Hog peanut	-	-
Fabaceae	<i>Apios americana</i>	Groundnut	-	-
Fabaceae	<i>Baptisia alba var. macrophylla</i>	White false indigo	SC	-
Fabaceae	<i>Cercis canadensis</i>	Redbud	-	-
Fabaceae	<i>Coronilla varia</i>	Crown vetch	-	Non-Native
Fabaceae	<i>Desmodium canadense</i>	Showy tick trefoil	-	-
Fabaceae	<i>Desmodium ciliare</i>	Hairy tick trefoil	-	-
Fabaceae	<i>Desmodium glutinosum</i>	Clustered leaved tick trefoil	-	-
Fabaceae	<i>Desmodium illinoense</i>	Prairie tick trefoil	-	-
Fabaceae	<i>Desmodium marilandicum</i>	Small leaved tick trefoil	-	-
Fabaceae	<i>Desmodium nudiflorum</i>	Naked tick trefoil	-	-
Fabaceae	<i>Desmodium paniculatum</i>	Panicled tick trefoil	-	-
Fabaceae	<i>Desmodium rotundifolium</i>	Round leaved tick trefoil	-	-
Fabaceae	<i>Desmodium sessilifolium</i>	Sessile leaved tick trefoil	-	-
Fabaceae	<i>Gleditsia triacanthos</i>	Honey locust	-	-
Fabaceae	<i>Lathyrus latifolius</i>	Perennial Pea, Everlasting Pea	-	Non-Native
Fabaceae	<i>Lathyrus palustris</i>	Marsh pea	-	-
Fabaceae	<i>Lathyrus venosus</i>	Veiny pea	-	-
Fabaceae	<i>Lespedeza capitata</i>	Round headed bush clover	-	-
Fabaceae	<i>Lespedeza hirta</i>	Hairy bush clover	-	-
Fabaceae	<i>Lespedeza intermedia</i>	Bush clover	-	-
Fabaceae	<i>Lespedeza virginica</i>	Slender bush clover	-	-
Fabaceae	<i>Lupinus perennis</i>	Wild lupine	-	-
Fabaceae	<i>Medicago lupulina</i>	Black Medick	-	Non-Native
Fabaceae	<i>Medicago sativa</i>	Alfafa		Non-Native
Fabaceae	<i>Melilotus alba</i>	White Sweetclover		Non-Native
Fabaceae	<i>Melilotus officinalis</i>	Yellow Sweetclover		Non-Native
Fabaceae	<i>Robinia hispida</i>	Bristly locust	-	Non-Native
Fabaceae	<i>Robinia pseudoacacia</i>	Black Locust	-	Invasive

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Fabaceae	<i>Tephrosia virginiana</i>	Goat's rue	-	-
Fabaceae	<i>Trifolium arvense</i>	Rabbitfoot Clover	-	Non-Native
Fabaceae	<i>Trifolium campestre</i>	Low hop clover	-	Non-Native
Fabaceae	<i>Trifolium dubium</i>	Little hop clover; Hop clover	-	Non-Native
Fabaceae	<i>Trifolium hybridum</i>	Alsike Clover	-	Non-Native
Fabaceae	<i>Trifolium pratense</i>	Red Clover	-	Non-Native
Fabaceae	<i>Trifolium repens</i>	White Clover	-	Non-Native
Fabaceae	<i>Vicia americana</i>	American vetch	-	-
Fabaceae	<i>Vicia caroliniana</i>	Pale or wood vetch	-	-
Fabaceae	<i>Vicia villosa</i>	Hairy Vetch	-	Non-Native
Fagaceae	<i>Castanea dentata</i>	American chestnut	ST	-
Fagaceae	<i>Fagus grandifolia</i>	American Beech	-	-
Fagaceae	<i>Quercus alba</i>	White Oak	-	-
Fagaceae	<i>Quercus macrocarpa</i>	Bur oak	-	-
Fagaceae	<i>Quercus rubra</i>	Red Oak	-	-
Fagaceae	<i>Quercus velutina</i>	Black Oak	-	-
Gentianaceae	<i>Frasera caroliniensis</i>	American columbo	-	-
Gentianaceae	<i>Gentiana andrewsii</i>	Bottle gentian	-	-
Gentianaceae	<i>Gentianella quinquefolia</i>	Stiff gentian	ST	-
Gentianaceae	<i>Gentianopsis crinita</i>	Fringed gentian	-	-
Gentianaceae	<i>Gentianopsis procera</i>	Small fringed gentian	-	-
Geraniaceae	<i>Erodium cicutarium</i>	Stork's-Bill, Alfileria	-	-
Geraniaceae	<i>Geranium maculatum</i>	Wild geranium	-	-
Geraniaceae	<i>Geranium robertianum</i>	Herb Robert	-	-
Grossulariaceae	<i>Ribes americanum</i>	Wild Black Currant	-	-
Grossulariaceae	<i>Ribes cynosbati</i>	Wild Gooseberry, Prickly Gooseberry	-	-
Grossulariaceae	<i>Ribes hirtellum</i>	Swamp Gooseberry	-	-
Haloragaceae	<i>Myriophyllum verticillatum</i>	Water milfoil	-	-
Hamamelidaceae	<i>Hamamelis virginiana</i>	Witch-Hazel	-	-
Hydrocharitaceae	<i>Elodea canadensis</i>	Common Waterweed	-	-
Hydrocharitaceae	<i>Najas flexilis</i>	Slender Naiad	-	-
Hydrocharitaceae	<i>Najas guadalupensis</i>	Southern naiad	-	-
Hydrocharitaceae	<i>Najas marina</i>	Spiny naiad	-	-
Hypericaceae	<i>Hypericum ascyron</i>	Giant st. John's wort	-	-
Hypericaceae	<i>Hypericum majus</i>	Larger Canada St. John's-Wort	-	-
Hypericaceae	<i>Hypericum mutilum</i>	Weak st. John's wort	-	-
Hypericaceae	<i>Hypericum perforatum</i>	Common St. John's-Wort	-	Non-Native
Hypericaceae	<i>Hypericum punctatum</i>	Spotted St. John's-Wort	-	-
Hypericaceae	<i>Triadenum fraseri</i>	Marsh St. John's-Wort	-	-
Hypoxidaceae	<i>Hypoxis hirsuta</i>	Star grass	-	-
Iridaceae	<i>Iris virginica</i>	Southern blue flag	-	-
Juglandaceae	<i>Carya cordiformis</i>	Bitternut hickory	-	-
Juglandaceae	<i>Carya glabra</i>	Pignut hickory	-	-
Juglandaceae	<i>Carya ovata</i>	Shagbark hickory	-	-
Juglandaceae	<i>Juglans cinerea</i>	Butternut	-	-
Juglandaceae	<i>Juglans nigra</i>	Black walnut	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Juncaceae	<i>Juncus acuminatus</i>	Sharp fruited rush	-	-
Juncaceae	<i>Juncus brachycephalus</i>	Rush	-	-
Juncaceae	<i>Juncus dudleyi</i>	Dudley's rush	-	-
Juncaceae	<i>Juncus effusus</i>	Soft-Stemmed Rush	-	-
Juncaceae	<i>Juncus nodosus</i>	Joint rush	-	-
Juncaceae	<i>Juncus tenuis</i>	Path rush	-	-
Juncaceae	<i>Juncus torreyi</i>	Torrey's rush	-	-
Juncaceae	<i>Luzula multiflora</i>	Common wood rush	-	-
Juncaginaceae	<i>Triglochin palustris</i>	Slender bog arrow grass	-	-
Lamiaceae	<i>Clinopodium vulgare</i>	Wild-Basil, Dog-Mint	-	-
Lamiaceae	<i>Collinsonia canadensis</i>	Richweed	-	-
Lamiaceae	<i>Glechoma hederacea</i>	Ground-Ivy, Creeping Charlie, Gill-over-the-ground	-	Non-Native
Lamiaceae	<i>Lamium purpureum</i>	Purple dead nettle	-	Non-Native
Lamiaceae	<i>Leonurus cardiaca</i>	Motherwort	-	Non-Native
Lamiaceae	<i>Lycopus americanus</i>	Common Water Horehound	-	-
Lamiaceae	<i>Lycopus uniflorus</i>	Northern Bugle Weed	-	-
Lamiaceae	<i>Mentha arvensis</i>	Wild mint	-	-
Lamiaceae	<i>Mentha spicata</i>	Spearmint	-	Non-Native
Lamiaceae	<i>Monarda fistulosa</i>	Wild-Bergamot	-	-
Lamiaceae	<i>Monarda punctata</i>	Dotted Mint, Horse Mint	-	Non-Native
Lamiaceae	<i>Nepeta cataria</i>	Catnip, Catmint	-	Non-Native
Lamiaceae	<i>Prunella vulgaris</i>	Self-Heal, Heal-All, lawn prunella	-	Non-Native
Lamiaceae	<i>Pycnanthemum virginianum</i>	Common mountain mint	-	-
Lamiaceae	<i>Satureja hortensis</i>	Savory	-	-
Lamiaceae	<i>Scutellaria galericulata</i>	Marsh Skullcap	-	-
Lamiaceae	<i>Scutellaria lateriflora</i>	Mad-Dog Skullcap	-	-
Lamiaceae	<i>Stachys hyssopifolia</i>	Hyssop hedge nettle	-	-
Lamiaceae	<i>Teucrium canadense</i>	Wood-Sage	-	-
Lauraceae	<i>Lindera benzoin</i>	Spicebush	-	-
Lauraceae	<i>Sassafras albidum</i>	Sassafras	-	-
Lemnaceae	<i>Lemna minor</i>	Small duckweed	-	-
Lemnaceae	<i>Lemna trisulca</i>	Star duckweed	-	-
Lentibulariaceae	<i>Utricularia gibba</i>	Humped Bladderwort	-	-
Lentibulariaceae	<i>Utricularia intermedia</i>	Flat-Leaved Bladderwort	-	-
Lentibulariaceae	<i>Utricularia minor</i>	Small Bladderwort	-	-
Lentibulariaceae	<i>Utricularia vulgaris</i>	Common Bladderwort	-	-
Liliaceae	<i>Allium tricoccum</i>	Ramps, Wild Leek	-	-
Liliaceae	<i>Allium vineale</i>	Field Garlic, Wild Garlic	-	Non-Native
Liliaceae	<i>Lilium michiganense</i>	Michigan lily	-	-
Limnanthaceae	<i>Floerkea proserpinacoides</i>	False mermaid	-	-
Linaceae	<i>Linum virginianum</i>	Slender yellow flax, Virginia flax	ST	-
Linderniaceae	<i>Lindernia dubia</i>	False pimpernel	-	-
Lycopodiaceae	<i>Diphasiastrum digitatum</i>	Ground-Cedar	-	-
Lythraceae	<i>Decodon verticillatus</i>	Whorled Loosestrife, Swamp Loosestrife	-	-
Lythraceae	<i>Lythrum salicaria</i>	Purple Loosestrife	-	Invasive

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Family	Scientific Name	Common Name	Listed	Invasive
Magnoliaceae	<i>Liriodendron tulipifera</i>	Tulip tree	-	-
Malvaceae	<i>Abutilon theophrasti</i>	Velvet Leaf	-	Non-Native
Malvaceae	<i>Malva neglecta</i>	Common Mallow, Cheeses	-	Non-Native
Malvaceae	<i>Tilia americana</i>	Basswood, Linden	-	-
Menispermaceae	<i>Menispermum canadense</i>	Moonseed	-	-
Molluginaceae	<i>Mollugo verticillata</i>	Carpetweed	-	-
Montiaceae	<i>Claytonia caroliniana</i>	Carolina Spring-Beauty	-	-
Moraceae	<i>Maclura pomifera</i>	Osage orange	-	-
Moraceae	<i>Morus alba</i>	White mulberry	-	Non-Native
Moraceae	<i>Morus rubra</i>	Red mulberry	ST	-
Myrsinaceae	<i>Lysimachia ciliata</i>	Fringed Loosestrife	-	-
Myrsinaceae	<i>Lysimachia lanceolata</i>	Lance leaved loosestrife	-	-
Myrsinaceae	<i>Lysimachia quadriflora</i>	Prairie Loosestrife, Four-Flowered Loosestrife	-	-
Myrsinaceae	<i>Lysimachia quadrifolia</i>	Whorled Loosestrife, Four-Leaved Loosestrife	-	-
Myrsinaceae	<i>Lysimachia terrestris</i>	Swamp-Candles	-	-
Myrsinaceae	<i>Lysimachia thysiflora</i>	Tufted Loosestrife	-	-
Nartheciaceae	<i>Aletris farinosa</i>	Colic root	-	-
Nymphaeaceae	<i>Nuphar advena</i>	Yellow pond lily	-	-
Nymphaeaceae	<i>Nymphaea odorata</i>	Sweet-Scented Waterlily	-	-
Oleaceae	<i>Fraxinus americana</i>	White Ash	-	-
Oleaceae	<i>Fraxinus nigra</i>	Black Ash	-	-
Oleaceae	<i>Fraxinus pennsylvanica</i>	Red ash	-	-
Oleaceae	<i>Fraxinus quadrangulata</i>	Blue ash	-	-
Oleaceae	<i>Syringa vulgaris</i>	Common Lilac	-	Non-Native
Onagraceae	<i>Circaea lutetiana</i>	Enchanter's-Nightshade	-	-
Onagraceae	<i>Epilobium coloratum</i>	Cinnamon Willow-Herb	-	-
Onagraceae	<i>Epilobium hirsutum</i>	Great hairy willow herb	-	Non-Native
Onagraceae	<i>Epilobium leptophyllum</i>	Fen Willow-Herb	-	-
Onagraceae	<i>Epilobium strictum</i>	Downy willow herb	-	-
Onagraceae	<i>Ludwigia palustris</i>	Water-Purslane	-	-
Onagraceae	<i>Oenothera biennis</i>	Common Evening-Primrose	-	Non-Native
Onocleaceae	<i>Matteuccia struthiopteris</i>	Ostrich Fern	-	-
Onocleaceae	<i>Onoclea sensibilis</i>	Sensitive Fern	-	-
Ophioglossaceae	<i>Botrychium dissectum</i>	Cut leaved grape fern	-	-
Ophioglossaceae	<i>Botrychium multifidum</i>	Leather grape fern	-	-
Ophioglossaceae	<i>Botrychium virginianum</i>	Rattlesnake fern	-	-
Orchidaceae	<i>Aplectrum hyemale</i>	Putty root	-	-
Orchidaceae	<i>Corallorhiza maculata</i>	Spotted Coral-Root	-	-
Orchidaceae	<i>Corallorhiza odontorhiza</i>	Fall Coral-Root	-	-
Orchidaceae	<i>Cypripedium acaule</i>	Moccasin Flower, Pink Lady-Slipper, Stemless Lady-Slipper	-	-
Orchidaceae	<i>Cypripedium calceolus var. parviflorum</i>	Small yellow lady's slipper	-	-
Orchidaceae	<i>Cypripedium calceolus var. pubescens</i>	Large yellow lady's slipper	-	-

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Family	Scientific Name	Common Name	Listed	Invasive
Orchidaceae	<i>Cypripedium parviflorum</i>	Yellow Lady-Slipper	-	-
Orchidaceae	<i>Cypripedium reginae</i>	Showy Lady-Slipper, Queen's Lady-Slipper	-	-
Orchidaceae	<i>Galearis spectabilis</i>	Showy orchis	ST	-
Orchidaceae	<i>Liparis lilifolia</i>	Lily leaved twayblade	SC	-
Orchidaceae	<i>Liparis loeselii</i>	Loesel's twayblade	-	-
Orchidaceae	<i>Platanthera hyperborea</i>	Tall northern bog orchid	-	-
Orchidaceae	<i>Platanthera lacera</i>	Ragged Fringed Orchid, Green-Fringed Orchid	-	-
Orchidaceae	<i>Platanthera psycodes</i>	Purple Fringed Orchid	-	-
Orchidaceae	<i>Spiranthes cernua</i>	Nodding Ladies'-Tresses	-	-
Orchidaceae	<i>Spiranthes lacera</i>	Slender Ladies'-Tresses	-	-
Orchidaceae	<i>Spiranthes ochroleuca</i>	Yellow ladies' tresses or Yellow nodding ladies' tresses	-	-
Orchidaceae	<i>Spiranthes ovalis</i>	Oval ladies' tresses	ST	-
Orchidaceae	<i>Spiranthes romanzoffiana</i>	Hooded Ladies'-Tresses	-	-
Orobanchaceae	<i>Agalinis purpurea</i>	Purple False Foxglove	-	-
Orobanchaceae	<i>Aureolaria flava</i>	Smooth False Foxglove	-	-
Orobanchaceae	<i>Aureolaria pedicularia</i>	Annual false foxglove	-	-
Orobanchaceae	<i>Conopholis americana</i>	Squaw-Root	-	-
Orobanchaceae	<i>Epifagus virginiana</i>	Beech-Drops	-	-
Orobanchaceae	<i>Pedicularis canadensis</i>	Wood betony	-	-
Orobanchaceae	<i>Pedicularis lanceolata</i>	Swamp betony	-	-
Osmundaceae	<i>Osmunda cinnamomea</i>	Cinnamon fern	-	-
Osmundaceae	<i>Osmunda claytoniana</i>	Interrupted Fern	-	-
Osmundaceae	<i>Osmunda regalis</i>	Royal Fern	-	-
Oxalidaceae	<i>Oxalis fontana</i>	Yellow wood sorrel	-	Non-Native
Oxalidaceae	<i>Oxalis stricta</i>	Yellow Wood-Sorrel	-	-
Papaveraceae	<i>Corydalis flavula</i>	Yellow harlequin, yellow flumewort	ST	-
Papaveraceae	<i>Dicentra canadensis</i>	Squirrel-Corn	-	-
Papaveraceae	<i>Dicentra cucullaria</i>	Dutchman's-Breeches	-	-
Papaveraceae	<i>Sanguinaria canadensis</i>	Bloodroot	-	-
Parnassiaceae	<i>Parnassia glauca</i>	Grass-Of-Parnassus	-	-
Phrymaceae	<i>Mimulus ringens</i>	Monkey-Flower	-	-
Phrymaceae	<i>Phryma leptostachya</i>	Lopseed	-	-
Phytolaccaceae	<i>Phytolacca americana</i>	Pokeweed	-	-
Pinaceae	<i>Abies balsamea</i>	Balsam Fir	-	-
Pinaceae	<i>Larix laricina</i>	Larch, Tamarack	-	-
Pinaceae	<i>Picea abies</i>	Norway spruce	-	Non-Native
Pinaceae	<i>Picea glauca</i>	White Spruce	-	-
Pinaceae	<i>Pinus banksiana</i>	Jack Pine	-	-
Pinaceae	<i>Pinus resinosa</i>	Red Pine	-	-
Pinaceae	<i>Pinus strobus</i>	White Pine	-	-
Pinaceae	<i>Pinus sylvestris</i>	Scots Pine, Scotch Pine	-	Non-Native
Plantaginaceae	<i>Chelone glabra</i>	Turtlehead	-	-
Plantaginaceae	<i>Linaria canadensis</i>	Blue toadflax	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Plantaginaceae	<i>Penstemon digitalis</i>	Foxglove beard tongue	-	-
Plantaginaceae	<i>Penstemon hirsutus</i>	Hairy beard tongue	-	-
Plantaginaceae	<i>Penthorum sedoides</i>	Ditch stonecrop	-	-
Plantaginaceae	<i>Plantago aristata</i>	Buckthorn	-	-
Plantaginaceae	<i>Plantago lanceolata</i>	Narrowleaf plantain, English plantain, Ribgrass	-	Non-Native
Plantaginaceae	<i>Plantago rugelii</i>	Rugel's Plantain, Red-Stalked Plantain	-	-
Plantaginaceae	<i>Veronica anagallis-aquatica</i>	Water Speedwell	-	-
Plantaginaceae	<i>Veronica arvensis</i>	Field Speedwell, Corn Speedwell	-	Non-Native
Plantaginaceae	<i>Veronica officinalis</i>	Common Speedwell	-	-
Plantaginaceae	<i>Veronica peregrina</i>	Purslane Speedwell, Neckweed	-	-
Plantaginaceae	<i>Veronicastrum virginicum</i>	Culver's root	-	-
Platanaceae	<i>Platanus occidentalis</i>	Sycamore	-	-
Poaceae	<i>Agropyron repens</i>	Quack grass	-	Non-Native
Poaceae	<i>Agropyron smithii</i>	Smith's wheat grass	-	Non-Native
Poaceae	<i>Agropyron trachycaulum</i>	Slender wheat grass	-	-
Poaceae	<i>Agrostis gigantea</i>	Redtop	-	-
Poaceae	<i>Agrostis perennans</i>	Autumn Bent, Upland Bent	-	-
Poaceae	<i>Agrostis scabra</i>	Ticklegrass	-	-
Poaceae	<i>Agrostis stolonifera</i>	creeping bentgrass	-	Invasive
Poaceae	<i>Andropogon gerardii</i>	Big Bluestem, Turkey Foot	-	-
Poaceae	<i>Andropogon scoparius</i>	Little bluestem grass	-	-
Poaceae	<i>Andropogon virginicus</i>	Broom sedge	-	-
Poaceae	<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass	-	Non-Native
Poaceae	<i>Aristida basiramea</i>	Fork-Tipped Three-Awned Grass	-	-
Poaceae	<i>Aristida purpurascens</i>	Three awned grass	-	-
Poaceae	<i>Arrhenatherum elatius</i>	Tall oatgrass	-	Non-Native
Poaceae	<i>Brachyelytrum erectum</i>	Long Awned Wood Grass	-	-
Poaceae	<i>Bromus ciliatus</i>	Fringed Brome	-	-
Poaceae	<i>Bromus inermis</i>	Smooth Brome, Hungarian Brome	-	Non-Native
Poaceae	<i>Bromus japonicus</i>	Japanese Brome	-	Non-Native
Poaceae	<i>Bromus latiglumis</i>	Ear Leaved Brome	-	-
Poaceae	<i>Bromus mollis</i>	Soft chess	-	Non-Native
Poaceae	<i>Bromus pubescens</i>	Canada brome	-	-
Poaceae	<i>Bromus racemosus</i>	Smooth chess	-	-
Poaceae	<i>Bromus squarrosus</i>	Brome	-	Non-Native
Poaceae	<i>Bromus tectorum</i>	Downy Chess, Cheat Grass, Downy brome	-	Non-Native
Poaceae	<i>Calamagrostis canadensis</i>	Blue-Joint	-	-
Poaceae	<i>Calamagrostis inexpansa</i>	Bog reedgrass	-	-
Poaceae	<i>Cenchrus longispinus</i>	Sandbur, Sandspur	-	-
Poaceae	<i>Cinna latifolia</i>	Wood Reedgrass	-	-
Poaceae	<i>Coelorachis cylindrica</i>	Joint Grass, cylinder jointtail grass	-	Non-Native
Poaceae	<i>Dactylis glomerata</i>	Orchardgrass	-	Invasive

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Poaceae	<i>Danthonia spicata</i>	Poverty Grass, Oatgrass	-	-
Poaceae	<i>Deschampsia cespitosa</i>	Hair Grass	-	-
Poaceae	<i>Deschampsia flexuosa</i>	Hair grass	-	-
Poaceae	<i>Digitaria ischaemum</i>	Smooth Crab Grass	-	Non-Native
Poaceae	<i>Digitaria sanguinalis</i>	Hairy Crab Grass	-	Non-Native
Poaceae	<i>Echinochloa crusgalli</i>	Barnyard grass	-	Non-Native
Poaceae	<i>Echinochloa muricata</i>	Barnyard Grass	-	-
Poaceae	<i>Echinochloa walteri</i>	Salt marsh cockspur grass	-	-
Poaceae	<i>Eleusine indica</i>	Goose grass	-	Non-Native
Poaceae	<i>Elymus riparius</i>	Riverbank wild rye	-	-
Poaceae	<i>Elymus villosus</i>	Silky wild rye	-	-
Poaceae	<i>Elymus virginicus</i>	Virginia Wild-Rye	-	-
Poaceae	<i>Eragrostis cilianensis</i>	Stink grass	-	Non-Native
Poaceae	<i>Eragrostis minor</i>	Low Love Grass	-	Non-Native
Poaceae	<i>Eragrostis pectinacea</i>	Love Grass	-	-
Poaceae	<i>Eragrostis spectabilis</i>	Tumble Grass, Purple Love Grass	-	-
Poaceae	<i>Festuca arundinacea</i>	Tall fescue	-	-
Poaceae	<i>Festuca octoflora</i>	Six weeks fescue	-	-
Poaceae	<i>Festuca ovina</i>	Sheep fescue	-	Non-Native
Poaceae	<i>Festuca pratensis</i>	Meadow fescue	-	-
Poaceae	<i>Festuca rubra</i>	Red Fescue	-	-
Poaceae	<i>Festuca subverticillata</i>	Nodding Fescue	-	-
Poaceae	<i>Glyceria canadensis</i>	Rattlesnake Grass	-	-
Poaceae	<i>Glyceria striata</i>	Fowl Manna Grass	-	-
Poaceae	<i>Hystrix patula</i>	Bottlebrush grass	-	-
Poaceae	<i>Leersia oryzoides</i>	Cut Grass	-	-
Poaceae	<i>Leersia virginica</i>	White grass	-	-
Poaceae	<i>Leptoloma cognatum</i>	Fall witch grass	-	-
Poaceae	<i>Lolium perenne</i>	Ryegrass, Perennial rye grass	-	Non-Native
Poaceae	<i>Muhlenbergia frondosa</i>	Common satin grass	-	-
Poaceae	<i>Muhlenbergia glomerata</i>	Marsh Wild-Timothy	-	-
Poaceae	<i>Muhlenbergia mexicana</i>	Leafy Satin Grass	-	-
Poaceae	<i>Muhlenbergia racemosa</i>	Marsh Muhly	-	-
Poaceae	<i>Muhlenbergia schreberi</i>	Nimblewill	-	-
Poaceae	<i>Panicum capillare</i>	Witch Grass	-	-
Poaceae	<i>Panicum clandestinum</i>	Panic grass	-	-
Poaceae	<i>Panicum depauperatum</i>	Panic grass	-	-
Poaceae	<i>Panicum dichotomiflorum</i>	Panic grass	-	-
Poaceae	<i>Panicum dichotomum</i>	Panic grass	-	-
Poaceae	<i>Panicum implicatum</i>	Panic grass	-	-
Poaceae	<i>Panicum latifolium</i>	Broad leaved panic grass	-	-
Poaceae	<i>Panicum oligosanthos</i>	Panic grass	-	-
Poaceae	<i>Panicum praecocius</i>	Panic grass	-	-
Poaceae	<i>Panicum sphaerocarpon</i>	Round fruited panic grass	-	-
Poaceae	<i>Panicum virgatum</i>	Switch Grass	-	-
Poaceae	<i>Paspalum ciliatifolium</i>	Hairy lens grass	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Poaceae	<i>Phalaris arundinacea</i>	Reed Canary Grass	-	Invasive
Poaceae	<i>Phleum pratense</i>	Timothy	-	Non-Native
Poaceae	<i>Phragmites australis</i>	Invasive Phragmites, Giant Reed	-	Invasive
Poaceae	<i>Poa annua</i>	Annual Bluegrass	-	Non-Native
Poaceae	<i>Poa compressa</i>	Canada Bluegrass	-	Non-Native
Poaceae	<i>Poa pratensis</i>	Kentucky Bluegrass	-	-
Poaceae	<i>Poa trivialis</i>	Bluegrass	-	Non-Native
Poaceae	<i>Puccinellia pallida</i>	Puccinellia	-	-
Poaceae	<i>Setaria glauca</i>	Yellow foxtail	-	Non-Native
Poaceae	<i>Setaria viridis</i>	Green Foxtail	-	Non-Native
Poaceae	<i>Sorghastrum nutans</i>	Indian Grass	-	-
Poaceae	<i>Spartina pectinata</i>	Cordgrass	-	-
Poaceae	<i>Sphenopholis intermedia</i>	Slender Wedgegrass	-	-
Poaceae	<i>Sporobolus cryptandrus</i>	Sand Dropseed	-	-
Poaceae	<i>Sporobolus heterolepis</i>	Sand Dropseed, Prairie Dropseed	SC	-
Poaceae	<i>Sporobolus neglectus</i>	Small Rush Grass	-	-
Poaceae	<i>Stipa avenacea</i>	Black oatgrass	-	-
Poaceae	<i>Tridens flavus</i>	Purpletop	-	-
Poaceae	<i>Zizania palustris</i>	Northern Wild-Rice, Wild-Rice	-	-
Polemoniaceae	<i>Phlox divaricata</i>	Woodland phlox	-	-
Polemoniaceae	<i>Phlox paniculata</i>	Garden phlox	-	Non-Native
Polemoniaceae	<i>Phlox pilosa</i>	Prairie phlox	-	-
Polygalaceae	<i>Polygala polygama</i>	Racemed milkwort	-	-
Polygalaceae	<i>Polygala sanguinea</i>	Field milkwort	-	-
Polygonaceae	<i>Polygonum amphibium</i>	Water smartweed	-	-
Polygonaceae	<i>Polygonum aviculare</i>	Knotweed	-	Non-Native
Polygonaceae	<i>Polygonum convolvulus</i>	False buckwheat, Black bindweed	-	Non-Native
Polygonaceae	<i>Polygonum hydropiper</i>	Water pepper	-	-
Polygonaceae	<i>Polygonum hydropiperoides</i>	Water pepper	-	-
Polygonaceae	<i>Polygonum lapathifolium</i>	Nodding smartweed	-	-
Polygonaceae	<i>Polygonum pensylvanicum</i>	Bigseed smartweed	-	-
Polygonaceae	<i>Polygonum persicaria</i>	Lady's thumb, Spotted ladythumb, Heart's ease, lady's-thumb	-	Non-Native
Polygonaceae	<i>Polygonum punctatum</i>	Smartweed, Water-pepper	-	Non-Native
Polygonaceae	<i>Polygonum sagittatum</i>	Arrow leaved tear thumb	-	-
Polygonaceae	<i>Polygonum scandens</i>	False buckwheat	-	-
Polygonaceae	<i>Polygonum tenue</i>	Slender knotweed	-	-
Polygonaceae	<i>Polygonum virginianum</i>	Jumpseed	-	-
Polygonaceae	<i>Rumex acetosella</i>	Red sorrel, Sheep sorrel	-	Non-Native
Polygonaceae	<i>Rumex crispus</i>	Curly dock	-	Non-Native
Polygonaceae	<i>Rumex obtusifolius</i>	Bitter sock	-	Invasive
Polygonaceae	<i>Rumex orbiculatus</i>	Great Water Dock	-	-
Pontederiaceae	<i>Pontederia cordata</i>	Pickerel weed	-	-
Potamogetonaceae	<i>Potamogeton foliosus</i>	Leafy Pondweed	-	-

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Family	Scientific Name	Common Name	Listed	Invasive
Potamogetonaceae	<i>Potamogeton friesii</i>	Fries's Pondweed	-	-
Potamogetonaceae	<i>Potamogeton gramineus</i>	Pondweed	-	-
Potamogetonaceae	<i>Potamogeton illinoensis</i>	Illinois Pondweed	-	-
Potamogetonaceae	<i>Potamogeton natans</i>	Pondweed	-	-
Potamogetonaceae	<i>Potamogeton pectinatus</i>	Sago pondweed	-	-
Potamogetonaceae	<i>Potamogeton pusillus</i>	Small pondweed	-	-
Potamogetonaceae	<i>Potamogeton zosteriformis</i>	Flat-Stemmed Pondweed	-	-
Pteridaceae	<i>Adiantum pedatum</i>	Maidenhair Fern	-	-
Ranunculaceae	<i>Actaea pachypoda</i>	White Baneberry, Doll's-Eyes	-	-
Ranunculaceae	<i>Anemone canadensis</i>	Canada anemone	-	-
Ranunculaceae	<i>Anemone cylindrica</i>	Thimbleweed	-	-
Ranunculaceae	<i>Anemone quinquefolia</i>	Wood Anemone	-	-
Ranunculaceae	<i>Anemone virginiana</i>	Thimbleweed	-	-
Ranunculaceae	<i>Anemonella thalictroides</i>	Rue Anemone	-	-
Ranunculaceae	<i>Aquilegia canadensis</i>	Wild Columbine	-	-
Ranunculaceae	<i>Caltha palustris</i>	Marsh-Marigold, Cowslip	-	-
Ranunculaceae	<i>Clematis virginiana</i>	Virgin's Bower	-	-
Ranunculaceae	<i>Hepatica americana</i>	Round-Lobed Hepatica	-	-
Ranunculaceae	<i>Hydrastis canadensis</i>	Goldenseal	ST	-
Ranunculaceae	<i>Isopyrum biternatum</i>	False rue anemone	-	-
Ranunculaceae	<i>Ranunculus abortivus</i>	Small-Flowered Buttercup	-	-
Ranunculaceae	<i>Ranunculus hispidus</i>	Swamp Buttercup	-	-
Ranunculaceae	<i>Ranunculus pennsylvanicus</i>	Bristly Crowfoot	-	-
Ranunculaceae	<i>Ranunculus recurvatus</i>	Hooked Crowfoot	-	-
Ranunculaceae	<i>Ranunculus sceleratus</i>	Cursed Crowfoot	-	-
Ranunculaceae	<i>Thalictrum dasycarpum</i>	Purple Meadow-Rue	-	-
Ranunculaceae	<i>Thalictrum dioicum</i>	Early meadow rue	-	-
Rhamnaceae	<i>Ceanothus americanus</i>	New Jersey Tea	-	-
Rhamnaceae	<i>Rhamnus alnifolia</i>	Alder-Leaved Buckthorn	-	-
Rhamnaceae	<i>Rhamnus cathartica</i>	Common buckthorn	-	Non-Native
Rhamnaceae	<i>Rhamnus frangula</i>	Glossy buckthorn	-	Invasive
Rosaceae	<i>Agrimonia gryposepala</i>	Tall Agrimony	-	-
Rosaceae	<i>Agrimonia parviflora</i>	Swamp agrimony	-	-
Rosaceae	<i>Agrimonia pubescens</i>	Soft agrimony	-	-
Rosaceae	<i>Agrimonia rostellata</i>	Beaked agrimony	-	-
Rosaceae	<i>Amelanchier arborea</i>	Juneberry	-	-
Rosaceae	<i>Amelanchier laevis</i>	Smooth Shadbush	-	-
Rosaceae	<i>Amelanchier spicata</i>	Shadbush Serviceberry	-	-
Rosaceae	<i>Crataegus calpodendron</i>	Hawthorn	-	-
Rosaceae	<i>Crataegus crus-galli</i>	Cockspur thorn	-	-
Rosaceae	<i>Crataegus holmesiana</i>	Hawthorn	-	-
Rosaceae	<i>Crataegus margaretta</i>	Hawthorn	-	-
Rosaceae	<i>Crataegus monogyna</i>	English hawthorn, Hawthorn, Thornapple	-	Non-Native
Rosaceae	<i>Dasiphora fruticosa</i>	Shrubby Cinquefoil	-	-
Rosaceae	<i>Filipendula rubra</i>	Queen of the prairie	ST	-
Rosaceae	<i>Fragaria virginiana</i>	Wild Strawberry	-	-

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Family	Scientific Name	Common Name	Listed	Invasive
Rosaceae	<i>Geum aleppicum</i>	Yellow Avens	-	-
Rosaceae	<i>Geum canadense</i>	White Avens	-	-
Rosaceae	<i>Malus coronaria</i>	American crab apple	-	-
Rosaceae	<i>Malus pumila</i>	Apple	-	Non-Native
Rosaceae	<i>Malus toringo</i>	Toringo crab apple	-	Non-Native
Rosaceae	<i>Potentilla argentea</i>	Silvery cinquefoil	-	Non-Native
Rosaceae	<i>Potentilla arguta</i>	Tall or prairie cinquefoil	-	-
Rosaceae	<i>Potentilla fruticosa</i>	Shrubby cinquefoil	-	-
Rosaceae	<i>Potentilla norvegica</i>	Rough cinquefoil	-	-
Rosaceae	<i>Potentilla palustris</i>	Marsh cinquefoil	-	-
Rosaceae	<i>Potentilla recta</i>	Rough-Fruited Cinquefoil	-	Non-Native
Rosaceae	<i>Potentilla simplex</i>	Old-Field Cinquefoil, Common Cinquefoil	-	-
Rosaceae	<i>Prunus avium</i>	Sweet Cherry	-	Non-Native
Rosaceae	<i>Prunus mahaleb</i>	Perfumed Cherry	-	-
Rosaceae	<i>Prunus serotina</i>	Wild Black Cherry	-	-
Rosaceae	<i>Prunus virginiana</i>	Choke Cherry	-	-
Rosaceae	<i>Rosa carolina</i>	Pasture rose	-	-
Rosaceae	<i>Rosa multiflora</i>	Multiflora Rose	-	Invasive
Rosaceae	<i>Rosa palustris</i>	Swamp Rose	-	-
Rosaceae	<i>Rubus allegheniensis</i>	Common Blackberry	-	-
Rosaceae	<i>Rubus flagellaris</i>	Northern Dewberry	-	-
Rosaceae	<i>Rubus hispidus</i>	Swamp Dewberry	-	-
Rosaceae	<i>Rubus occidentalis</i>	Black raspberry	-	-
Rosaceae	<i>Rubus pensilvanicus</i>	Dewberry	-	-
Rosaceae	<i>Rubus pubescens</i>	Dwarf Raspberry	-	-
Rosaceae	<i>Rubus strigosus</i>	Wild red raspberry	-	-
Rosaceae	<i>Sorbus decora</i>	Mountain ash	-	-
Rosaceae	<i>Spiraea alba</i>	Meadowsweet	-	-
Rosaceae	<i>Spiraea x vanhouttei</i>	Bridal wreath	-	Non-Native
Rubiaceae	<i>Cephalanthus occidentalis</i>	Buttonbush	-	-
Rubiaceae	<i>Galium aparine</i>	Annual bedstraw	-	-
Rubiaceae	<i>Galium asprellum</i>	Rough bedstraw	-	-
Rubiaceae	<i>Galium boreale</i>	Northern bedstraw	-	-
Rubiaceae	<i>Galium circaezans</i>	White wild licorice	-	-
Rubiaceae	<i>Galium lanceolatum</i>	Yellow Wild Licorice	-	-
Rubiaceae	<i>Galium obtusum</i>	Wild madder	-	-
Rubiaceae	<i>Galium palustre</i>	Marsh bedstraw	-	-
Rubiaceae	<i>Galium pilosum</i>	Hairy bedstraw	-	-
Rubiaceae	<i>Galium tinctorium</i>	Stiff bedstraw	-	-
Rubiaceae	<i>Galium trifidum</i>	Small bedstraw	-	-
Rubiaceae	<i>Galium triflorum</i>	Fragrant Bedstraw	-	-
Rubiaceae	<i>Mitchella repens</i>	Partridge-Berry	-	-
Rutaceae	<i>Zanthoxylum americanum</i>	Prickly-Ash	-	-
Salicaceae	<i>Populus deltoides</i>	Cottonwood	-	-
Salicaceae	<i>Populus grandidentata</i>	Large-Tooth Aspen, Big-Tooth Aspen	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Salicaceae	<i>Populus tremuloides</i>	Quaking Aspen	-	-
Salicaceae	<i>Salix bebbiana</i>	Beaked Willow, Bebb's Willow	-	-
Salicaceae	<i>Salix candida</i>	Sage Willow, Hoary Willow	-	-
Salicaceae	<i>Salix discolor</i>	Pussy Willow	-	-
Salicaceae	<i>Salix eriocephala</i>	Willow	-	-
Salicaceae	<i>Salix exigua</i>	Sandbar Willow	-	-
Salicaceae	<i>Salix sericea</i>	Silky willow	-	-
Salicaceae	<i>Salix serissima</i>	Autumn Willow	-	-
Santalaceae	<i>Comandra umbellata</i>	Bastard-Toadflax, Star-Toadflax	-	-
Sapindaceae	<i>Acer negundo</i>	Box Elder	-	-
Sapindaceae	<i>Acer nigrum</i>	Black Maple	-	-
Sapindaceae	<i>Acer platanoides</i>	Norway Maple	-	-
Sapindaceae	<i>Acer rubrum</i>	Red Maple	-	-
Sapindaceae	<i>Acer saccharinum</i>	Silver Maple	-	-
Sapindaceae	<i>Acer saccharum</i>	Sugar Maple, Hard Maple	-	-
Sarraceniaceae	<i>Sarracenia purpurea</i>	Pitcher-Plant	-	-
Saxifragaceae	<i>Heuchera americana</i>	Alum root	-	-
Saxifragaceae	<i>Mitella diphylla</i>	Bishop's-Cap	-	-
Saxifragaceae	<i>Saxifraga pensylvanica</i>	Swamp saxifrage	-	-
Scrophulariaceae	<i>Scrophularia lanceolata</i>	Early Figwort	-	-
Scrophulariaceae	<i>Scrophularia marilandica</i>	Late figwort	-	-
Scrophulariaceae	<i>Verbascum blattaria</i>	Moth mullein	-	Non-Native
Scrophulariaceae	<i>Verbascum thapsus</i>	Mullein, Flannel Plant, Common Mullein	-	Non-Native
Selaginellaceae	<i>Selaginella eclipes</i>	Selaginella	-	-
Simaroubaceae	<i>Ailanthus altissima</i>	Tree of heaven, Tree-of-heaven	-	Non-Native
Smilacaceae	<i>Smilax lasioneura</i>	Carrion flower	-	-
Smilacaceae	<i>Smilax tamnoides</i>	Bristly green brier	-	-
Solanaceae	<i>Physalis heterophylla</i>	Clammy ground cherry	-	-
Solanaceae	<i>Solanum carolinense</i>	Horse nettle	-	-
Solanaceae	<i>Solanum dulcamara</i>	Climbing nightshade	-	Invasive
Solanaceae	<i>Solanum physalifolium</i>	Hairy nightshade	-	Non-Native
Solanaceae	<i>Solanum ptychanthum</i>	Black Nightshade	-	-
Staphyleaceae	<i>Staphylea trifolia</i>	Bladdernut	-	-
Thelypteridaceae	<i>Thelypteris hexagonoptera</i>	Broad beech fern	-	-
Thelypteridaceae	<i>Thelypteris palustris</i>	Marsh Fern	-	-
Trilliaceae	<i>Trillium cernuum</i>	Nodding Trillium	-	-
Trilliaceae	<i>Trillium grandiflorum</i>	Common Trillium	-	-
Typhaceae	<i>Sparganium americanum</i>	American Bur-Reed	-	-
Typhaceae	<i>Sparganium chlorocarpum</i>	Green fruited bur reed	-	-
Typhaceae	<i>Typha angustifolia</i>	Narrow-Leaved Cat-Tail	-	Invasive
Typhaceae	<i>Typha latifolia</i>	Common Cat-Tail, Broad-Leaved Cat-Tail	-	-
Ulmaceae	<i>Ulmus americana L.</i>	American Elm	-	-
Ulmaceae	<i>Ulmus glabra</i>	Wych Elm, Witch Elm	-	Non-Native
Ulmaceae	<i>Ulmus rubra</i>	Slippery elm	-	-
Urticaceae	<i>Boehmeria cylindrica</i>	False nettle	-	-

Table E-1. Plant Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Urticaceae	<i>Laportea canadensis</i>	Wood nettle	-	-
Urticaceae	<i>Parietaria pensylvanica</i>	Pellitory	-	-
Urticaceae	<i>Pilea fontana</i>	Bog Clearweed	-	-
Urticaceae	<i>Urtica dioica</i>	Stinging Nettle	-	Non-Native
Valerianaceae	<i>Valeriana uliginosa</i>	Swamp Valerian	-	-
Verbenaceae	<i>Verbena bracteata</i>	Prostrate Vervain, Creeping Vervain	-	-
Verbenaceae	<i>Verbena hastata</i>	Blue Vervain	-	-
Verbenaceae	<i>Verbena stricta</i>	Hoary Vervain	-	-
Verbenaceae	<i>Verbena urticifolia</i>	White vervain	-	-
Violaceae	<i>Viola arvensis</i>	Field pansy	-	-
Violaceae	<i>Viola canadensis</i>	Canada Violet	-	-
Violaceae	<i>Viola cucullata</i>	Marsh Violet	-	-
Violaceae	<i>Viola lanceolata</i>	Lance-Leaved Violet	-	-
Violaceae	<i>Viola macloskeyi</i>	Smooth White Violet	-	-
Violaceae	<i>Viola pubescens</i>	Yellow Violet	-	-
Violaceae	<i>Viola rostrata</i>	Long-Spurred Violet	-	-
Violaceae	<i>Viola sagittata</i>	Arrow-Leaved Violet	-	-
Violaceae	<i>Viola sororia</i>	Common blue violet	-	-
Violaceae	<i>Viola striata</i>	Cream violet	-	-
Vitaceae	<i>Parthenocissus inserta</i>	Thicket creeper	-	-
Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia Creeper	-	-
Vitaceae	<i>Vitis aestivalis</i>	Summer grape	-	-
Vitaceae	<i>Vitis riparia</i>	River-Bank Grape	-	-

Family	Scientific Name	Common Name	Listed	Invasive
Canidae	<i>Canis latrans</i>	Eastern Coyote	-	
Canidae	<i>Urocyon cinereoargenteus</i>	Grey Fox	-	
Canidae	<i>Vulpes vulpes</i>	Red Fox	-	
Castoridae	<i>Castor canadensis</i>	American Beaver	-	
Cervidae	<i>Odocoileus virginianus</i>	White-tailed Deer	-	
Cricetidae	<i>Microtus ochrogaster</i>	Prairie Vole	SE	
Cricetidae	<i>Microtus pennsylvanicus</i>	Meadow Vole	-	
Cricetidae	<i>Ondatra zibethicus</i>	Common Muskrat	-	
Cricetidae	<i>Peromyscus leucopus</i>	White-footed Deermouse	-	
Cricetidae	<i>Peromyscus maniculatus</i>	North American Deermouse	-	
Cricetidae	<i>Synaptomys cooperii</i>	Southern Bog Lemming	-	
Didelphidae	<i>Didelphis virginiana</i>	Virginia Opossum	-	
Dipodidae	<i>Zapus hudsonius</i>	Meadow Jumping Mouse	-	
Erethizontidae	<i>Erethizon dorsatum</i>	Common Porcupine	-	
Leporidae	<i>Sylvilagus floridanus</i>	Eastern Cottontail	-	
Mephitidae	<i>Mephitis mephitis</i>	Striped Skunk	-	
Muridae	<i>Mus musculus</i>	House Mouse	-	Non-native
Mustelidae	<i>Mustela frenata</i>	Long-tailed Weasel	-	
Procyonidae	<i>Procyon lotor</i>	Raccoon	-	
Sciuridae	<i>Glaucomys volans</i>	Southern Flying Squirrel	-	
Sciuridae	<i>Ictidomys tridecemlineatus</i>	Thirteen-lined Ground Squirrel	-	
Sciuridae	<i>Marmota monax</i>	Woodchuck	-	
Sciuridae	<i>Sciurus carolinensis</i>	Eastern Gray Squirrel	-	
Sciuridae	<i>Sciurus niger</i>	Eastern Fox Squirrel	-	
Sciuridae	<i>Tamias striatus</i>	Eastern Chipmunk	-	
Sciuridae	<i>Tamiasciurus hudsonicus</i>	North American Red Squirrel	-	
Soricidae	<i>Blarina brevicauda</i>	Northern Short-tailed Shrew	-	
Soricidae	<i>Sorex cinereus</i>	Masked Shrew	-	
Suidae	<i>Sus scrofa</i>	Feral Hog		Non-native
Talpidae	<i>Condylura cristata</i>	Star-nosed Mole	-	
Talpidae	<i>Scalopus aquaticus</i>	Eastern Mole	-	
Vespertilionidae	<i>Eptesicus fuscus</i>	Big Brown Bat	-	
Vespertilionidae	<i>Lasiurus borealis</i>	Eastern Red Bat	-	
Vespertilionidae	<i>Lasiurus cinereus</i>	Hoary Bat	-	
Vespertilionidae	<i>Myotis lucifugus</i>	Little Brown Bat	SC	
Vespertilionidae	<i>Myotis septentrionalis</i>	Northern Long-eared Bat	FT, SC	
Vespertilionidae	<i>Myotis sodalis</i>	Indiana Bat	FE, CH, SE	
Vespertilionidae	<i>Perimyotis subflavus</i>	Tricolored bat, Eastern pipistrelle	SC	

Table E-3. Reptile and Amphibian Species Documented on Fort Custer

Reptiles - Family	Scientific Name	Common Name	Listed	Invasive
Chelydridae	<i>Chelydra serpentina</i>	Snapping Turtle	-	
Colubridae	<i>Coluber constrictor foxii</i>	Blue Racer	-	
Colubridae	<i>Heterodon platyrhinos</i>	Eastern Hognose Snake	-	
Colubridae	<i>Lampropeltis triangulum triangulum</i>	Eastern Milk Snake	-	
Colubridae	<i>Nerodia sipedon sipedon</i>	Northern Water Snake	-	
Colubridae	<i>Storeria dekayi</i>	Dekay's Brown Snake	-	
Colubridae	<i>Thamnophis sauritus septentrionalis</i>	Northern Ribbon Snake	-	
Colubridae	<i>Thamnophis sirtalis sirtalis</i>	Eastern Garter Snake	-	
Colubridae	<i>Pantherophis spiloides</i>	Gray Ratsnake	SC	
Emydidae	<i>Chrysemys picta</i>	Painted Turtle	-	
Emydidae	<i>Emydoidea blandingii</i>	Blanding's Turtle	SC	
Emydidae	<i>Graptemys geographica</i>	Northern Map Turtle	-	
Emydidae	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	SC	
Emydidae	<i>Trachemys scripta elegans</i>	Red-Eared Slider	-	
Kinosternidae	<i>Sternotherus odoratus</i>	Common Musk Turtle	-	
Trionychidae	<i>Apalone spinifera</i>	Spiny Softshell Turtle	-	
Viperidae	<i>Sistrurus catenatus</i>	Eastern Massasauga Rattlesnake	FT, SC	
Amphibians - Family	Scientific Name	Common Name	Rarity	Invasive
Ambystomatidae	<i>Ambystoma laterale</i>	Blue-Spotted Salamander	-	
Ambystomatidae	<i>Ambystoma maculatum</i>	Spotted Salamander	-	
Ambystomatidae	<i>Ambystoma tigrinum tigrinum</i>	Eastern Tiger Salamander	-	
Bufo	<i>Anaxyrus americanus americanus</i>	Eastern American Toad	-	
Hylidae	<i>Acris crepitans blanchardi</i>	Blanchard's Cricket Frog	ST	
Hylidae	<i>Hyla versicolor</i>	Eastern Gray Treefrog	-	
Hylidae	<i>Pseudacris crucifer crucifer</i>	Northern Spring Peeper	-	
Hylidae	<i>Pseudacris triseriata</i>	Western Chorus Frog	-	
Plethodontidae	<i>Plethodon cinereus</i>	Red-Backed Salamander	-	
Ranidae	<i>Lithobates catesbeianus</i>	Bullfrog	-	
Ranidae	<i>Lithobates clamitans</i>	Green Frog	-	
Ranidae	<i>Lithobates palustris</i>	Pickerel Frog	-	
Ranidae	<i>Lithobates pipiens</i>	Northern Leopard Frog	-	
Ranidae	<i>Lithobates sylvaticus</i>	Wood Frog	-	

Table E-4. Fish Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Amiidae	<i>Amia calva</i>	Bowfin	-	-
Catostomidae	<i>Erimyzon sucetta</i>	Lake chubsucker	-	-
Catostomidae	<i>Hypentelium nigricans</i>	Hogsucker	-	-
Catostomidae	<i>Moxostoma anisurum</i>	Silver redhorse		
Catostomidae	<i>Moxostoma erythrurum</i>	Golden redhorse	-	-
Catostomidae	<i>Catostomus commersonii</i>	White sucker	-	-
Centrarchidae	<i>Ambloplites rupestris</i>	Rock bass	-	-
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	-	-
Centrarchidae	<i>Lepomis gibbosus</i>	Pumpkinseed	-	-
Centrarchidae	<i>Lepomis gulosus</i>	Watermouth sunfish	-	-
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	-	-
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth bass	-	-
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	-	-
Cottidae	<i>Cottus bairdii</i>	Mottled sculpin	-	-
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin shiner	-	-
Cyprinidae	<i>Cyprinus carpio</i>	Common carp	-	Non-native
Cyprinidae	<i>Luxilus cornutus</i>	Common shiner	-	-
Cyprinidae	<i>Nocomis biguttatis</i>	Horny head chub	-	-
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden shiner	-	-
Cyprinidae	<i>Notropis anogenus</i>	Pugnose shiner	SE	-
Cyprinidae	<i>Notropis heterodon</i>	Blackchin shiner	-	-
Cyprinidae	<i>Notropis stramineus</i>	Sand shiner	-	-
Cyprinidae	<i>Phoxinus eos</i>	Northern redbelly dace	-	-
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow	-	-
Cyprinidae	<i>Rhinichthys atratulus</i>	Blacknose dace	-	-
Cyprinidae	<i>Rhinichthys cataractae</i>	Longnose dace	-	-
Cyprinidae	<i>Semotilus atromaculatus</i>	Creek chub	-	-
Esocidae	<i>Esox americanus</i>	Grass pickerel	-	-
Esocidae	<i>Esox americanus</i>	American pickerel	-	-
Ictaluridae	<i>Ameiurus natalis</i>	Yellow bullhead	-	-
Ictaluridae	<i>Ameiurus nebulosus</i>	Brown bullhead	-	-
Ictaluridae	<i>Ictalurus punctatus</i>	Channel catfish	-	-
Ictaluridae	<i>Noturus flavus</i>	Stonecat	-	-
Percidae	<i>Etheostoma caeruleum</i>	Rainbow darter	-	-
Percidae	<i>Etheostoma exile</i>	Iowa darter	-	-
Percidae	<i>Etheostoma microperca</i>	Least darter	-	-
Percidae	<i>Etheostoma nigrum</i>	Johnny darter	-	-
Percidae	<i>Perca flavescens</i>	Yellow perch	-	-
Percidae	<i>Percina maculata</i>	Blackside darter	-	-
Salmonidae	<i>Salmo trutta</i>	Brown trout	-	Non-native
Salmonidae	<i>Salvelinus fontinalis</i>	Brook trout	-	-
Umbridae	<i>Umbra limi</i>	Central mudminnow	-	-

Table E-5. Bird Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	MBTA	Invasive
Accipitridae	<i>Accipiter cooperii</i>	Cooper's Hawk	SC	Yes	
Accipitridae	<i>Accipiter striatus</i>	Sharp-shinned Hawk	-	Yes	
Accipitridae	<i>Buteo jamaicensis</i>	Red-tailed Hawk	-	Yes	
Accipitridae	<i>Buteo lagopus</i>	Rough-legged Hawk	-	Yes	
Accipitridae	<i>Buteo lineatus</i>	Red-shouldered Hawk	ST	Yes	
Accipitridae	<i>Buteo platypterus</i>	Broad-winged Hawk	-	Yes	
Accipitridae	<i>Circus cyaneus</i>	Northern Harrier	SC	Yes	
Accipitridae	<i>Haliaeetus leucocephalus</i>	Bald Eagle	SC, BGEPA	Yes	
Accipitridae	<i>Aquila chrysaetos</i>	Golden eagle	-	Yes	
Alaudidae	<i>Eremophila alpestris</i>	Horned Lark	-	Yes	
Alcedinidae	<i>Megaceryle alcyon</i>	Belted Kingfisher	-	Yes	
Anatidae	<i>Aix sponsa</i>	Wood Duck	-	Yes	
Anatidae	<i>Anas americana</i>	American Wigeon	-	Yes	
Anatidae	<i>Anas clypeata</i>	Northern Shoveler	-	Yes	
Anatidae	<i>Anas discors</i>	Blue-winged Teal	-	Yes	
Anatidae	<i>Anas platyrhynchos</i>	Mallard	-	Yes	
Anatidae	<i>Anas rubripes</i>	American Black Duck	-	Yes	
Anatidae	<i>Anas strepera</i>	Gadwall	-	Yes	
Anatidae	<i>Aythya affinis</i>	Lesser Scaup	-	Yes	
Anatidae	<i>Aythya collaris</i>	Ring-necked Duck	-	Yes	
Anatidae	<i>Branta canadensis</i>	Canada Goose	-	Yes	
Anatidae	<i>Bucephala albeola</i>	Bufflehead	-	Yes	
Anatidae	<i>Bucephala clangula</i>	Common Goldeneye	-	Yes	
Anatidae	<i>Cygnus buccinator</i>	Trumpeter Swan	ST	Yes	
Anatidae	<i>Cygnus olor</i>	Mute Swan	-		Invasive
Anatidae	<i>Mergus merganser</i>	Common Merganser	-	Yes	
Anatidae	<i>Mergus serrator</i>	Red-breasted Merganser	-	Yes	
Anatidae	<i>Oxyura jamaicensis</i>	Ruddy Duck	-	Yes	
Anseriformes	<i>Anas acuta</i>	Northern pintail	-	Yes	
Anseriformes	<i>Anas crecca</i>	Green-winged teal	-	Yes	
Anseriformes	<i>Lophodytes cucullatus</i>	Hooded merganser	-	Yes	
Apodidae	<i>Chaetura pelagica</i>	Chimney Swift	-	Yes	
Ardeidae	<i>Ardea alba</i>	Great Egret	-	Yes	
Ardeidae	<i>Ardea herodias</i>	Great Blue Heron	-	Yes	
Ardeidae	<i>Butorides virescens</i>	Green Heron	-	Yes	
Ardeidae	<i>Nycticorax nycticorax</i>	Black-crowned night heron		Yes	
Bombycillidae	<i>Bombycilla cedrorum</i>	Cedar Waxwing	-	Yes	
Caprimulgidae	<i>Caprimulgus vociferus</i>	Eastern Whip-poor-will	-	Yes	
Caprimulgidae	<i>Chordeiles minor</i>	Common Nighthawk	-	Yes	
Cardinalidae	<i>Cardinalis cardinalis</i>	Northern Cardinal	-	Yes	
Cardinalidae	<i>Passerina cyanea</i>	Indigo Bunting	-	Yes	
Cardinalidae	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	-	Yes	
Cardinalidae	<i>Piranga olivacea</i>	Scarlet Tanager	-	Yes	
Cardinalidae	<i>Piranga rubra</i>	Summer Tanager	-	Yes	
Cardinalidae	<i>Spiza americana</i>	Dickcissel	SC	Yes	
Cathartidae	<i>Cathartes aura</i>	Turkey Vulture	-	Yes	

Table E-5. Bird Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	MBTA	Invasive
Certhiidae	<i>Certhia americana</i>	Brown Creeper	-	Yes	
Charadriidae	<i>Charadrius vociferus</i>	Killdeer	-	Yes	
Columbidae	<i>Zenaida macroura</i>	Mourning Dove	-	Yes	
Columbidae	<i>Columba livia</i>	Rock pigeon	-		
Corvidae	<i>Corvus brachyrhynchos</i>	American Crow	-	Yes	
Corvidae	<i>Cyanocitta cristata</i>	Blue Jay	-	Yes	
Cuculidae	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	-	Yes	
Cuculidae	<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo	-	Yes	
Falconidae	<i>Falco columbarius</i>	Merlin	ST	Yes	
Falconidae	<i>Falco sparverius</i>	American Kestrel	-	Yes	
Fringillidae	<i>Haemorhous mexicanus</i>	House Finch	-	Yes	
Fringillidae	<i>Haemorhous purpureus</i>	Purple Finch	-	Yes	
Fringillidae	<i>Spinus tristis</i>	American Goldfinch	-	Yes	
Gaviformes	<i>Gavia immer</i>	Common Loon	-	Yes	
Gruidae	<i>Antigone canadensis</i>	Sandhill Crane	-	Yes	
Hirundinidae	<i>Hirundo rustica</i>	Barn Swallow	-	Yes	
Hirundinidae	<i>Progne subis</i>	Purple Martin	-	Yes	
Hirundinidae	<i>Riparia riparia</i>	Bank Swallow	-	Yes	
Hirundinidae	<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow	-	Yes	
Hirundinidae	<i>Tachycineta bicolor</i>	Tree Swallow	-	Yes	
Icteridae	<i>Agelaius phoeniceus</i>	Red-winged Blackbird	-	Yes	
Icteridae	<i>Dolichonyx oryzivorus</i>	Bobolink	-	Yes	
Icteridae	<i>Euphagus carolinus</i>	Rusty Blackbird	-	Yes	
Icteridae	<i>Icterus galbula</i>	Baltimore Oriole	-	Yes	
Icteridae	<i>Molothrus ater</i>	Brown-headed Cowbird	-	Yes	
Icteridae	<i>Quiscalus quiscula</i>	Common Grackle	-	Yes	
Icteridae	<i>Sturnella magna</i>	Eastern Meadowlark	-	Yes	
Icteridae	<i>Icterus spurius</i>	Orchard Oriole	-	Yes	
Icteriidae	<i>Icteria virens</i>	Yellow-breasted Chat	-	Yes	
Laridae	<i>Larus argentatus</i>	Herring Gull	-	Yes	
Laridae	<i>Larus delawarensis</i>	Ring-billed Gull	-	Yes	
Laridae	<i>Sterna hirundo</i>	Common Tern	ST	Yes	
Laridae	<i>Chlidonias niger</i>	Black tern	SC	Yes	
Mimidae	<i>Dumetella carolinensis</i>	Gray Catbird	-	Yes	
Mimidae	<i>Mimus polyglottos</i>	Northern Mockingbird	-	Yes	
Mimidae	<i>Toxostoma rufum</i>	Brown Thrasher	-	Yes	
Odontophoridae	<i>Colinus virginianus</i>	Northern Bobwhite	-		
Pandionidae	<i>Pandion haliaetus</i>	Osprey	SC	Yes	
Paridae	<i>Baeolophus bicolor</i>	Tufted Titmouse	-	Yes	
Paridae	<i>Poecile atricapillus</i>	Black-capped Chickadee	-	Yes	
Parulidae	<i>Cardellina canadensis</i>	Canada Warbler	-	Yes	
Parulidae	<i>Cardellina pusilla</i>	Wilson's Warbler	-	Yes	
Parulidae	<i>Geothlypis formosa</i>	Kentucky Warbler	-	Yes	
Parulidae	<i>Geothlypis philadelphia</i>	Mourning Warbler	-	Yes	
Parulidae	<i>Geothlypis trichas</i>	Common Yellowthroat	-	Yes	
Parulidae	<i>Mniotilta varia</i>	Black-and-white Warbler	-	Yes	

Table E-5. Bird Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	MBTA	Invasive
Parulidae	<i>Oporornis agilis</i>	Connecticut Warbler	-	Yes	
Parulidae	<i>Oreothlypis peregrina</i>	Tennessee Warbler	-	Yes	
Parulidae	<i>Oreothlypis ruficapilla</i>	Nashville Warbler	-	Yes	
Parulidae	<i>Parkesia motacilla</i>	Louisiana Waterthrush	-	Yes	
Parulidae	<i>Parkesia noveboracensis</i>	Northern Waterthrush	-	Yes	
Parulidae	<i>Protonotaria citrea</i>	Prothonotary Warbler	SC	Yes	
Parulidae	<i>Seiurus aurocapilla</i>	Ovenbird	-	Yes	
Parulidae	<i>Setophaga americana</i>	Northern Parula	-	Yes	
Parulidae	<i>Setophaga caerulescens</i>	Black-throated Blue Warbler	-	Yes	
Parulidae	<i>Setophaga castanea</i>	Bay-breasted Warbler	-	Yes	
Parulidae	<i>Setophaga cerulea</i>	Cerulean Warbler	ST	Yes	
Parulidae	<i>Setophaga citrina</i>	Hooded Warbler	SC	Yes	
Parulidae	<i>Setophaga coronata</i>	Yellow-rumped Warbler	-	Yes	
Parulidae	<i>Setophaga dominica</i>	Yellow-throated Warbler	-	Yes	
Parulidae	<i>Setophaga fusca</i>	Blackburnian Warbler	-	Yes	
Parulidae	<i>Setophaga magnolia</i>	Magnolia Warbler	-	Yes	
Parulidae	<i>Setophaga palmarum</i>	Palm Warbler	-	Yes	
Parulidae	<i>Setophaga pensylvanica</i>	Chestnut-sided Warbler	-	Yes	
Parulidae	<i>Setophaga petechia</i>	Yellow Warbler	-	Yes	
Parulidae	<i>Setophaga pinus</i>	Pine Warbler	-	Yes	
Parulidae	<i>Setophaga ruticilla</i>	American Redstart	-	Yes	
Parulidae	<i>Setophaga striata</i>	Blackpoll Warbler	-	Yes	
Parulidae	<i>Setophaga tigrina</i>	Cape May Warbler	-	Yes	
Parulidae	<i>Setophaga virens</i>	Black-throated Green Warbler	-	Yes	
Parulidae	<i>Vermivora chrysoptera</i>	Golden-winged Warbler	-	Yes	
Parulidae	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	-	Yes	
Parulidae	<i>Helmitheros vermivorum</i>	Worm-eating Warbler	-	Yes	
Parulidae	<i>Vermivora celata</i>	Orange-crowned Warbler	-	Yes	
Parulidae	<i>Vermivora chrysoptera x Vermivora cyanoptera</i>	Brewster's warbler (hybrid)	-	Yes	
Parulidae	<i>Vermivora chrysoptera x Vermivora cyanoptera</i>	Lawrence's warbler (hybrid)	-	Yes	
Passerellidae	<i>Ammodramus henslowii</i>	Henslow's Sparrow	SE	Yes	
Passerellidae	<i>Chondestes grammacus</i>	Lark Sparrow	-	Yes	
Passerellidae	<i>Junco hyemalis</i>	Dark-eyed Junco	-	Yes	
Passerellidae	<i>Melospiza georgiana</i>	Swamp Sparrow	-	Yes	
Passerellidae	<i>Melospiza lincolni</i>	Lincoln's Sparrow	-	Yes	
Passerellidae	<i>Melospiza melodia</i>	Song Sparrow	-	Yes	
Passerellidae	<i>Passerculus sandwichensis</i>	Savannah Sparrow	-	Yes	
Passerellidae	<i>Passerella iliaca</i>	Fox Sparrow	-	Yes	
Passerellidae	<i>Pipilo erythrophthalmus</i>	Eastern Towhee	-	Yes	
Passerellidae	<i>Pooecetes gramineus</i>	Vesper Sparrow	-	Yes	
Passerellidae	<i>Spizella pallida</i>	Clay-colored Sparrow	-	Yes	
Passerellidae	<i>Spizella passerina</i>	Chipping Sparrow	-	Yes	
Passerellidae	<i>Spizella pusilla</i>	Field Sparrow	-	Yes	

Table E-5. Bird Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	MBTA	Invasive
Passerellidae	<i>Spizelloides arborea</i>	American Tree Sparrow	-	Yes	
Passerellidae	<i>Zonotrichia albicollis</i>	White-throated Sparrow	-	Yes	
Passerellidae	<i>Zonotrichia leucophrys</i>	White-crowned Sparrow	-	Yes	
Passerellidae	<i>Ammodramus savannarum</i>	Grasshopper Sparrow	SC	Yes	
Passeridae	<i>Passer domesticus</i>	House Sparrow	-		Non-native
Passeriformes	<i>Spinus pinus</i>	Pine siskin	-	Yes	
Pelecaniformes	<i>Ixobrychus exilis</i>	Least bittern		Yes	
Phalacrocoracidae	<i>Phalacrocorax auritus</i>	Double-crested Cormorant	-	Yes	
Phasianidae	<i>Bonasa umbellus</i>	Ruffed Grouse	-		
Phasianidae	<i>Meleagris gallopavo</i>	Wild Turkey	-		
Phasianidae	<i>Phasianus colchicus</i>	Ring-necked Pheasant	-		
Picidae	<i>Colaptes auratus</i>	Northern Flicker	-	Yes	
Picidae	<i>Dryocopus pileatus</i>	Pileated Woodpecker	-	Yes	
Picidae	<i>Melanerpes carolinus</i>	Red-bellied Woodpecker	-	Yes	
Picidae	<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	-	Yes	
Picidae	<i>Picoides pubescens</i>	Downy Woodpecker	-	Yes	
Picidae	<i>Picoides villosus</i>	Hairy Woodpecker	-	Yes	
Piciformes	<i>Sphyrapicus varius</i>	Yellow-bellied sapsucker	-	Yes	
Podicipedidae	<i>Podilymbus podiceps</i>	Pied-billed Grebe	-	Yes	
Poliptilidae	<i>Poliptila caerulea</i>	Blue-gray Gnatcatcher	-	Yes	
Rallidae	<i>Fulica americana</i>	American Coot	-	Yes	
Rallidae	<i>Porzana carolina</i>	Sora	-	Yes	
Rallidae	<i>Rallus limicola</i>	Virginia Rail	-	Yes	
Rallidae	<i>Gallinula galeata</i>	Common gallinule	-		
Rallidae	<i>Rallus elegans</i>	King Rail	-	Yes	
Recurvirostridae	<i>Recurvirostra americana</i>	American avocet	-	Yes	
Regulidae	<i>Regulus calendula</i>	Ruby-crowned Kinglet	-	Yes	
Regulidae	<i>Regulus satrapa</i>	Golden-crowned Kinglet	-	Yes	
Scolopacidae	<i>Actitis macularius</i>	Spotted Sandpiper	-	Yes	
Scolopacidae	<i>Gallinago delicata</i>	Wilson's Snipe	-	Yes	
Scolopacidae	<i>Scolopax minor</i>	American Woodcock	-	Yes	
Scolopacidae	<i>Tringa flavipes</i>	Lesser Yellowlegs	-	Yes	
Scolopacidae	<i>Tringa melanoleuca</i>	Greater Yellowlegs	-	Yes	
Scolopacidae	<i>Tringa solitaria</i>	Solitary Sandpiper	-	Yes	
Sittidae	<i>Sitta carolinensis</i>	White-breasted Nuthatch	-	Yes	
Strigidae	<i>Bubo virginianus</i>	Great Horned Owl	-	Yes	
Strigidae	<i>Megascops asio</i>	Eastern Screech-Owl	-	Yes	
Strigidae	<i>Strix varia</i>	Barred Owl	-	Yes	
Strigiformes	<i>Aegolius acadicus</i>	Northern saw-whet owl	-	Yes	
Sturnidae	<i>Sturnus vulgaris</i>	European Starling	-		Invasive
Trochilidae	<i>Archilochus colubris</i>	Ruby-throated Hummingbird	-	Yes	
Troglodytidae	<i>Cistothorus palustris</i>	Marsh Wren	SC	Yes	
Troglodytidae	<i>Cistothorus platensis</i>	Sedge Wren	-	Yes	
Troglodytidae	<i>Thryothorus ludovicianus</i>	Carolina Wren	-	Yes	
Troglodytidae	<i>Troglodytes aedon</i>	House Wren	-	Yes	

Table E-5. Bird Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	MBTA	Invasive
Troglodytidae	<i>Troglodytes hiemalis</i>	Winter Wren	-	Yes	
Turdidae	<i>Catharus fuscescens</i>	Veery	-	Yes	
Turdidae	<i>Catharus guttatus</i>	Hermit Thrush	-	Yes	
Turdidae	<i>Catharus minimus</i>	Gray-cheeked Thrush	-	Yes	
Turdidae	<i>Catharus ustulatus</i>	Swainson's Thrush	-	Yes	
Turdidae	<i>Hylocichla mustelina</i>	Wood Thrush	-	Yes	
Turdidae	<i>Sialia sialis</i>	Eastern Bluebird	-	Yes	
Turdidae	<i>Turdus migratorius</i>	American Robin	-	Yes	
Tyrannidae	<i>Contopus cooperi</i>	Olive-sided Flycatcher	-	Yes	
Tyrannidae	<i>Contopus virens</i>	Eastern Wood-Pewee	-	Yes	
Tyrannidae	<i>Empidonax alnorum</i>	Alder Flycatcher	-	Yes	
Tyrannidae	<i>Empidonax flaviventris</i>	Yellow-bellied Flycatcher	-	Yes	
Tyrannidae	<i>Empidonax minimus</i>	Least Flycatcher	-	Yes	
Tyrannidae	<i>Empidonax traillii</i>	Willow Flycatcher	-	Yes	
Tyrannidae	<i>Empidonax virescens</i>	Acadian Flycatcher	-	Yes	
Tyrannidae	<i>Myiarchus crinitus</i>	Great Crested Flycatcher	-	Yes	
Tyrannidae	<i>Sayornis phoebe</i>	Eastern Phoebe	-	Yes	
Tyrannidae	<i>Tyrannus tyrannus</i>	Eastern Kingbird	-	Yes	
Vireonidae	<i>Vireo flavifrons</i>	Yellow-throated Vireo	-	Yes	
Vireonidae	<i>Vireo gilvus</i>	Warbling Vireo	-	Yes	
Vireonidae	<i>Vireo olivaceus</i>	Red-eyed Vireo	-	Yes	
Vireonidae	<i>Vireo philadelphicus</i>	Philadelphia Vireo	-	Yes	
Vireonidae	<i>Vireo grisues</i>	White-eyed Vireo	-	Yes	
Vireonidae	<i>Vireo solitarius</i>	Blue-headed Vireo	-	Yes	

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Acrididae	<i>Chorthippus curtipennis</i>	Marsh Meadow Locust	-	-
Acrididae	<i>Chortophaga viridifasciata</i>	Green-striped Locust	-	-
Acrididae	<i>Melanoplus bivittatus</i>	Two-striped Locust	-	-
Acrididae	<i>Melanoplus confusus</i>	Little Locust	-	-
Acrididae	<i>Melanoplus femurrubrum</i>	Red-legged Locust	-	-
Acrididae	<i>Melanoplus sanguinipes</i>	Migratory Locust	-	-
Acrididae	<i>Melanoplus viridipes</i>	green legged locust	-	-
Acrididae	<i>Stethophyma gracile</i>	Northern Sedge Locust	-	-
Aeshnidae	<i>Anax junius</i>	Green Darner dragonfly	-	-
Aeshnidae	<i>Boyeria spp.</i>	dragonfly	-	-
Asellidae	<i>Lirceus spp.</i>	isopod crustacean	-	-
Baetidae	<i>Baetis brunneicolor</i>	Blue-winged rusty dun mayfly	-	-
Baetidae	<i>Baetis spp. 1</i>	mayfly species	-	-
Baetidae	<i>Baetis spp. 2</i>	mayfly species	-	-
Baetidae	<i>Callibaetis spp.</i>	mayfly species	-	-
Belastomatidae	<i>Belastoma spp.</i>	giant water bug	-	-
Brachycentridae	<i>Brachycentrus spp.</i>	humpless casemaker caddisfly	-	-
Buprestidae	<i>Agrilus planipennis</i>	Emerald ash borer	-	Invasive
Calopterygidae	<i>Calopteryx maculata</i>	Ebony Jewelwing damselfly	-	-
Calopterygidae	<i>Calopteryx spp.</i>	damselfly	-	-
Cercopidae	<i>Lepyrania quadrangularis</i>	Diamond-backed Spittlebug	-	-
Cercopidae	<i>Philaenus spumarius</i>	Meadow Spittlebug	-	-
Chrysomelidae	<i>Altica knabii</i>	Leaf Beetle	-	-
Chrysomelidae	<i>Babia quadriguttata</i>	leaf beetle	-	-
Chrysomelidae	<i>Capraita subvittata</i>	Leaf Beetle	-	-
Chrysomelidae	<i>Chaetocnema pulicaria</i>	Corn Flea Beetle	-	-
Chrysomelidae	<i>Cryptocephalus venustus</i>	leaf beetle	-	-
Chrysomelidae	<i>Deloyala guttata</i>	Mottled Tortoise Beetle	-	-
Chrysomelidae	<i>Diabrotica barberi</i>	Northern Corn Rootworm	-	-
Chrysomelidae	<i>Diabrotica undecimpunctata howardi</i>	Spotted Cucumber Beetle	-	-
Chrysomelidae	<i>Exema canadensis</i>	Warty leaf beetle	-	-
Chrysomelidae	<i>Grantiana pallidula</i>	Eggplant Tortoise Beetle	-	-
Chrysomelidae	<i>Lexiphanes saponatus</i>	leaf beetle	-	-
Chrysomelidae	<i>Mantura chrysanthemii</i>	leaf beetle	-	-
Chrysomelidae	<i>Nodonota margaretae</i>	Leaf Beetle	-	-
Chrysomelidae	<i>Ophraella cribrata</i>	leaf beetle	-	-
Chrysomelidae	<i>Ophraella notata</i>	leaf beetle	-	-
Chrysomelidae	<i>Pachybranchis trinotatus</i>	leaf beetle	-	-
Chrysomelidae	<i>Physonota unipunctata</i>	Horsemint Tortoise Beetle	-	-
Chrysomelidae	<i>Sumitrosis inaequalis</i>	leaf beetle	-	-
Chrysomelidae	<i>Trirhabda borealis</i>	leaf beetle	-	-
Chrysomelidae	<i>Trirhabda canadensis</i>	Goldenrod Leaf Beetle	-	-
Cicadellidae	<i>Amblysellus curtisii</i>	Leafhopper	-	-
Cicadellidae	<i>Amplicephalus inimicus</i>	Leafhopper	-	-
Cicadellidae	<i>Amplicephalus osiborn</i>	Leafhopper	-	-
Cicadellidae	<i>Athysanus argentarius</i>	Leafhopper	-	-

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Cicadellidae	<i>Aulacizes irrorata</i>	leafhopper	SC	-
Cicadellidae	<i>Chlorotettix galbanatus</i>	Leafhopper	-	-
Cicadellidae	<i>Chlorotettix tergatus</i>	Leafhopper	-	-
Cicadellidae	<i>Chlorotettix unicolor</i>	Leafhopper	-	-
Cicadellidae	<i>Commellus comma</i>	leafhopper	-	-
Cicadellidae	<i>Deltocephalus flavocostatus</i>	leafhopper	-	-
Cicadellidae	<i>Doratura sylvata</i>	leafhopper	-	-
Cicadellidae	<i>Driotura gammaroides</i>	leafhopper	-	-
Cicadellidae	<i>Eutettix borealis</i>	leafhopper	-	-
Cicadellidae	<i>Exitianus exitiosus</i>	leafhopper	-	-
Cicadellidae	<i>Flexamia delongi</i>	leafhopper	-	-
Cicadellidae	<i>Flexamia reflexus</i>	leafhopper	SC	-
Cicadellidae	<i>Graminella nigrifrons</i>	Leafhopper	-	-
Cicadellidae	<i>Gypona melanota</i>	Leafhopper	-	-
Cicadellidae	<i>Idiodonus kennekotii</i>	Leafhopper	-	-
Cicadellidae	<i>Jikardia olitoria</i>	Leafhopper	-	-
Cicadellidae	<i>Laevicephalus acus</i>	Leafhopper	-	-
Cicadellidae	<i>Laevicephalus unicoloratus</i>	Leafhopper	-	-
Cicadellidae	<i>Neokolla hieroglyphica</i>	Leafhopper	-	-
Cicadellidae	<i>Stirellas bicolor</i>	Leafhopper	-	-
Cicadellidae	<i>Tylozagus bifida</i>	Leafhopper	-	-
Cicadellidae	<i>Xestocephalus superbus</i>	Leafhopper	-	-
Coenagrionidae	<i>Agria spp.</i>	fly	-	-
Coenagrionidae	<i>Enallagma spp.</i>	bluet damselfly	-	-
Cordulegastriidae	<i>Cordulegaster erronea</i>	Tiger spiketail	SC	-
Cordulegastriidae	<i>Cordulegaster maculata</i>	Twin-spotted spiketail	-	-
Cordulegastriidae	<i>Cordulegaster spp.</i>	Dragonfly	-	-
Corydalidae	<i>Nigronia spp.</i>	Fishfly	-	-
Cossidae	<i>Prionoxystus robiniae</i>	Carpenter worm moth	-	-
Dryopidae	<i>Helichus spp.</i>	water beetle	-	-
Dytiscidae	<i>Agabus spp.</i>	water beetle	-	-
Elmidae	<i>Dubiraphia minima</i>	Riffle Beetle	-	-
Elmidae	<i>Macronychus glabratus</i>	Riffle Beetle	-	-
Elmidae	<i>Macronychus spp.</i>	beetle	-	-
Elmidae	<i>Dubiraphia spp.</i>	beetle	-	-
Elmidae	<i>Stenelmis spp.</i>	beetle	-	-
Empididae	<i>Hemerodromia spp.</i>	dance fly	-	-
Erebidae	<i>Ciseps fulvicollis</i>	Yellow Collared Scape Moth	-	-
Erebidae	<i>Ctenucha virginica</i>	Virginia Ctenucha	-	-
Erebidae	<i>Grammia anna</i>	Anna Tiger Mother	-	-
Erebidae	<i>Grammia williamsii</i>	William's Tiger Moth	-	-
Erebidae	<i>Halysidota tessellaris</i>	Banded Tussock Moth	-	-
Erebidae	<i>Haploa lecontei</i>	Leconte's Haploa	-	-
Erebidae	<i>Haploa reversa</i>	Reversed Haploa	-	-
Erebidae	<i>Lymantria dispar</i>	Gypsy moth	-	Invasive
Erebidae	<i>Pygarctia spraguei</i>	Sprague's Pygarctia	SC	-

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Erebidae	<i>Spilosoma dubia</i>	Dubious Tiger Moth	-	-
Gammaridae	<i>Gammarus pseudolimnaeus</i>	amphipod	-	-
Geometridae	<i>Campaea perlata</i>	Pale Beauty	-	-
Geometridae	<i>Euchlaena serrata</i>	Saw-wing Moth	-	-
Geometridae	<i>Eusarca confusaria</i>	Confused Eusarca	-	-
Geometridae	<i>Haematopis grataria</i>	Chickweed Geometer	-	-
Geometridae	<i>Prochoerodes lineola</i>	Large Maple Spanworm Moth	-	-
Geometridae	<i>Scopularia limboundata</i>	Large Lace Border	-	-
Gerridae	<i>Gerris spp.</i>	water beetle	-	-
Gomphidae	<i>Progomphus stylurus</i>	common sand dragon	-	-
Gryllidae	<i>Gryllus pennsylvanicus</i>	Fall Field Cricket	-	-
Gryllidae	<i>Oecanthus nigricornis</i>	Black-horned Tree Cricket	-	-
Gryllidae	<i>Oecanthus niveus</i>	Narrow-winged Tree Cricket	-	-
Gryllidae	<i>Oecanthus quadripunctatus</i>	Four Spotted Tree Cricket	-	-
Haliplidae	<i>Peltodytes spp.</i>	crawling water beetles	-	-
Helicopsychidae	<i>Helicopsyche</i>	snail case caddisfly	-	-
Heptageniidae	<i>Stenonema spp.</i>	Mayfly species	-	-
Hesperiidae	<i>Ancyloxypha numitor</i>	Least skipper	-	-
Hesperiidae	<i>Anatrytone logan</i>	Delaware Skipper	-	-
Hesperiidae	<i>Epargyreus clarus</i>	Silver-spotted Skipper	-	-
Hesperiidae	<i>Erynnis juvenalis</i>	Juvenal's Dusky Wing Skipper	-	-
Hesperiidae	<i>Erynnis martialis</i>	Mottled Dusky Wing Skipper	-	-
Hesperiidae	<i>Euphyes conspicua</i>	Black dash	-	-
Hesperiidae	<i>Euphyes dion</i>	dion skipper	-	-
Hesperiidae	<i>Euphyes vestris metacomet</i>	dun skipper	-	-
Hesperiidae	<i>Hesperia sassacus</i>	Indian skipper	-	-
Hesperiidae	<i>Poanes massasoit</i>	mulberry wing	-	-
Hesperiidae	<i>Polites coras</i>	Peck's skipper	-	-
Hesperiidae	<i>Polites orgenes</i>	cross line skipper	-	-
Hesperiidae	<i>Polites themistocles</i>	tawny edged skpper	-	-
Hesperiidae	<i>Pompeius verna</i>	little glassy wing	-	-
Hesperiidae	<i>Pyrgus communis</i>	Common checkered skipper	-	-
Hesperiidae	<i>Thorybes bathyllus</i>	southern cloudy wing	-	-
Hesperiidae	<i>Thorybes pylades</i>	northern cloudy wing	-	-
Hesperiidae	<i>Thymelicus lineola</i>	European skipper	-	-
Hesperiidae	<i>Wallengrenia egerement</i>	northern broken dash	-	-
Hydrobiidae	<i>Fontigens nickliniana</i>	Watercress Snail	SC	-
Hydrophilidae	<i>Hydrobius spp.</i>	beetle	-	-
Hydropsychidae	<i>Diplectrona spp.</i>	net-spinning caddisfly	-	-
Hydropsychidae	<i>Cheumatopsyche spp.</i>	net-spinning caddisfly	-	-
Hydropsychidae	<i>Hydropsyche spp.</i>	net-spinning caddisfly	-	-
Lasiocampidae	<i>Malacosmoma americanum</i>	eastern tent caterpillar moth	-	-
Lasiocampidae	<i>Phyllodesma americana</i>	lappet moth	-	-
Lasiocampidae	<i>Tolype velleda</i>	loarge tolype	-	-
Lepidostomatidae	<i>Lepidostoma spp.</i>	case maker caddisfly	-	-
Leptoceridae	<i>Oecetis spp.</i>	long-horned caddisfly	-	-

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Libellulidae	<i>Celithemis eponina</i>	Halloween Pennant	-	-
Libellulidae	<i>Erythemis simplicicollis</i>	eastern pondhawk	-	-
Libellulidae	<i>Libellula cyanea</i>	spangled skimmer	-	-
Libellulidae	<i>Libellula incesta</i>	slaty skimmer	-	-
Libellulidae	<i>Libellula luctuosa</i>	widow skimmer	-	-
Libellulidae	<i>Libellula lydia</i>	dragonfly	-	-
Libellulidae	<i>Pachydiplax longipennis</i>	blue dasher	-	-
Libellulidae	<i>Perithemis tenera</i>	eastern amberwing	-	-
Libellulidae	<i>Sympetrum rubicundulum</i>	ruby meadowhawk	-	-
Libellulidae	<i>Sympetrum vicinum</i>	autumn meadowhawk	-	-
Libytheinae	<i>Lebytheana bachmanii</i>	Eastern snout butterfly	-	-
Limnephilidae	<i>Pycnopsyche</i>	caddisfly	-	-
Lycaenidae	<i>Celastrina argiolus</i>	Spring azure	SC	-
Lycaenidae	<i>Celastrina lucia</i>	Northern spring azure	-	-
Lycaenidae	<i>Celastrina neglecta</i>	Summer azure	-	-
Lycaenidae	<i>Everes comyntas</i>	Eastern Tailed Blue	-	-
Lycaenidae	<i>Harkenclenus thus titus</i>	coral hairstreak	-	-
Lycaenidae	<i>Lycaena phlaeas americana</i>	American copper	-	-
Lycaenidae	<i>Satyrium edwardsii</i>	Edward's hairstreak	-	-
Lycaenidae	<i>Satyrium calanus</i>	Banded hairstreak	-	-
Lycaenidae	<i>Satyrium ligarops strigosum</i>	striped hairstreak	-	-
Lycaenidae	<i>Strymon melinus humuli</i>	gray hairstreak	-	-
Miridae	<i>Adelphocoris lineolatus</i>	leaf bug	-	-
Miridae	<i>Europiella bakeri</i>	leaf bug	-	-
Miridae	<i>Lopidea instabilis instabilis</i>	leaf bug	-	-
Miridae	<i>Lygus lineolaris</i>	tarnished plant bug	-	-
Miridae	<i>Monalocoris americanus</i>	leaf bug	-	-
Miridae	<i>Ortholomus scolopax</i>	leaf bug	-	-
Miridae	<i>Phytocoris tibialis</i>	leaf bug	-	-
Miridae	<i>Plagiognathus politus flaveolus</i>	leaf bug	-	-
Miridae	<i>Trigonotylus coelisticalium</i>	Leaf Bug	-	-
Noctuidae	<i>Abagrotis alternata</i>	greater red dart	-	-
Noctuidae	<i>Acronicta albarufa</i>	noctuid moth	-	-
Noctuidae	<i>Agrotis ipsilon</i>	ipsilon dart	-	-
Noctuidae	<i>Agrotis verabilis</i>	venerable dart	-	-
Noctuidae	<i>Agrotis vetusta</i>	old man dart	-	-
Noctuidae	<i>Aletia oxygala</i>	noctuid moth	-	-
Noctuidae	<i>Anagrapha falcifera</i>	celery looper moth	-	-
Noctuidae	<i>Apamea lignicolora</i>	wood colored apamea	-	-
Noctuidae	<i>Caenurgina crassicscula</i>	clover looper moth	-	-
Noctuidae	<i>Caenurgina erchta</i>	forage looper moth	-	-
Noctuidae	<i>Catocala cara</i>	darling underwing	-	-
Noctuidae	<i>Cosmia calami</i>	American dun bar	-	-
Noctuidae	<i>Euagrotis forbesi</i>	noctuid moth	-	-
Noctuidae	<i>Euagrotis illapsa</i>	snowy dart	-	-
Noctuidae	<i>Eudryas grata</i>	beautiful wood nymph	-	-

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Noctuidae	<i>Euxoa tessellata</i>	tessellate dart	-	-
Noctuidae	<i>Idia aemula</i>	coomon idia	-	-
Noctuidae	<i>Ipimorpha pleonectusa</i>	even lined sallow	-	-
Noctuidae	<i>Lacinipolia renigera</i>	bristly cutworm moth	-	-
Noctuidae	<i>Leucania commoides</i>	noctuid moth	-	-
Noctuidae	<i>Nephelodes minians</i>	bronzed cutworm moth	-	-
Noctuidae	<i>Panopoda carneicosta</i>	brown panopoda	-	-
Noctuidae	<i>Papaipema arctivorens</i>	northern burdock borer moth	-	-
Noctuidae	<i>Peridroma saucia</i>	variegated cutworm moth	-	-
Noctuidae	<i>Pseudaletia unipuncta</i>	armyworm moth	-	-
Noctuidae	<i>Spodoptera frugiperda</i>	fall armyworm moth	-	-
Noctuidae	<i>Sunira bicolorago</i>	bicolored sallow	-	-
Noctuidae	<i>Xestia badinodis</i>	pale banded dart	-	-
Noctuidae	<i>Xestia dolosa</i>	greater black letter dart	-	-
Noctuidae	<i>Xestia normaniana</i>	Norman's dart	-	-
Noctuidae	<i>Xestia smithii</i>	Smith's dart	-	-
Nymphalidae	<i>Asterocampa celtis</i>	hackberry butterfly	-	-
Nymphalidae	<i>Asterocampa clyton</i>	Tawny emperor	-	-
Nymphalidae	<i>Cercyonis pegala</i>	common wood nymph	-	-
Nymphalidae	<i>Chlosyne nycteis ncyteis</i>	slivery checkerspot	-	-
Nymphalidae	<i>Danaus plexippus</i>	Monarch	Under Review	-
Nymphalidae	<i>Euphydryas phaeton</i>	Baltimore checkerspot	-	-
Nymphalidae	<i>Limnitis arthemis astyanax</i>	red spotted purple	-	-
Nymphalidae	<i>Limnitis archippus</i>	viceroy	-	-
Nymphalidae	<i>Megisto cymela</i>	Little Wood Satyr	-	-
Nymphalidae	<i>Nymphalis antiopa</i>	mourning cloak	-	-
Nymphalidae	<i>Nymphalis milberti</i>	Milbert's tortoiseshell	-	-
Nymphalidae	<i>Phyciodes tharos</i>	pearl crescent	-	-
Nymphalidae	<i>Polygonia comma</i>	hop merchant; Eastern comma	-	-
Nymphalidae	<i>Polygonia interrogationis</i>	Question mark	-	-
Nymphalidae	<i>Polygonia progne</i>	gray comma	-	-
Nymphalidae	<i>Satyroides appalachia leeuwi</i>	Appalachian eyed brown	-	-
Nymphalidae	<i>Satyroides eurydice</i>	Eyed brown	-	-
Nymphalidae	<i>Speyeria aphrodite</i>	aphrodite fritillary	-	-
Nymphalidae	<i>Speyeria cybele</i>	great spangled fritillary	-	-
Nymphalidae	<i>Vanessa atalanta</i>	red admiral	-	-
Nymphalidae	<i>Vanessa virginiensis</i>	American painted lady	-	-
Papilionidae	<i>Papilio glaucus</i>	tiger swallowtail	-	-
Papilionidae	<i>Papilio polyxenes</i>	black swallowtail	-	-
Papilionidae	<i>Papilio troilus</i>	spicebush swallowtail	-	-
Pentatomidae	<i>Acrosternum hilare</i>	green stinkbug	-	-
Pentatomidae	<i>Banasa dimidiata</i>	stinkbug	-	-
Pentatomidae	<i>Euschistus servus</i>	Stink Bug	-	-
Pentatomidae	<i>Euschistus tristigmatus idus</i>	stinkbug	-	-
Pentatomidae	<i>Euschistus variolarius</i>	stinkbug	-	-
Pentatomidae	<i>Halyomorpha halys</i>	Brown marmorated stink bug	-	Invasive

Table E-6. Invertebrate Species Documented on Fort Custer

Family	Scientific Name	Common Name	Listed	Invasive
Pentatomidae	<i>Mormidea lugens</i>	stinkbug	-	-
Pentatomidae	<i>Podisus maculiventris</i>	stinkbug	-	-
Pentatomidae	<i>Thyanta custator accerra</i>	stinkbug	-	-
Philopotamidae	<i>Chimarra spp.</i>	little black caddisfly	-	-
Pieridae	<i>Colias eurytheme</i>	alfalfa butterfly	-	-
Pieridae	<i>Colias philodice</i>	clouded sulfur	-	-
Pieridae	<i>Pieris rapae</i>	cabbage butterfly	-	Non-native
Pieridae	<i>Pontia protodice</i>	checkered white	-	-
Rhopalidae	<i>Harmostes reflexulus</i>	Scentless Plant Bug	-	-
Saturniidae	<i>Anisota virginiensis</i>	pink striped oakworm moth	-	-
Saturniidae	<i>Automeris io</i>	io moth	-	-
Scarabaeidae	<i>Ateuchus histeroides histeroides</i>	scarab beetle	-	-
Scarabaeidae	<i>Canthon nicricornis</i>	scarab beetle	-	-
Scarabaeidae	<i>Dialytes truncatus</i>	scarab beetle	-	-
Scarabaeidae	<i>Onthophagus hecate</i>	scarab beetle	-	-
Scarabaeidae	<i>Onthophagus striatulus</i>	scarab beetle	-	-
Scarabaeidae	<i>Onthophagus tuberculifrons</i>	scarab beetle	-	-
Scarabaeidae	<i>Popillia japonica</i>	scarab beetle	-	-
Scarabaeidae	<i>Trox capillaris</i>	scarab beetle	-	-
Scarabaeidae	<i>Trox variolatus</i>	scarab beetle	-	-
Sialidae	<i>Sialis spp.</i>	alderfly	-	-
Silphidae	<i>Necrophylla americana</i>	Carrion Beetle	-	-
Silphidae	<i>Nicrophorus pustulatus</i>	burying beetle	-	-
Silphidae	<i>Nicrophorus tomentosus</i>	burying beetle	-	-
Silphidae	<i>Nicrophorus orbicollis</i>	burying beetle	-	-
Silphidae	<i>Oiceoptomoa inaequale</i>	carrion beetle	-	-
Silphidae	<i>Oiceoptomoa noveboracense</i>	carrion beetle	-	-
Simuliidae	<i>Simulium spp.</i>	black fly	-	-
Sphingidae	<i>Ceratonia catalpae</i>	catalpa sphinx	-	-
Sphingidae	<i>Darapsa myron</i>	Virginia creeper sphinx	-	-
Sphingidae	<i>Paonias myops</i>	small eyed sphinx	-	-
Taltridae	<i>Hyalala azteca</i>	amphipod	-	-
Tetrigidae	<i>Tetrix subulata</i>	slender grouse locust	-	-
Tettigoniidae	<i>Amblycorpha oblongifolia</i>	oblong winged katydid	-	-
Tettigoniidae	<i>Conocephalus bervipennis</i>	short winged meadow katydid	-	-
Tettigoniidae	<i>Conocephalus fasciatus</i>	slender meadow katydid	-	-
Tettigoniidae	<i>Conocephalus nigropleurum</i>	black sided meadow katydid	-	-
Tettigoniidae	<i>Conocephalus strictus</i>	straight lanced meadow katydid	-	-
Tettigoniidae	<i>neoconocephalus ensiger</i>	sword bearing conehead	-	-
Tettigoniidae	<i>Orchelimum gladiator</i>	meadow katydid	-	-
Tettigoniidae	<i>Orchelimum nigripes</i>	black legged meadow katydid	-	-
Tettigoniidae	<i>Orchemilum gladiator</i>	Gladiator Meadow Katydid	-	-
Tettigoniidae	<i>Scudderia curvicauda</i>	curve tailed bush katydid	-	-
Tettigoniidae	<i>Scudderia furcata</i>	fork tailed busy katydid	-	-
Tettigoniidae	<i>Scudderia texensis</i>	Texas Bush Katydid	-	-

APPENDIX F
PHYSICAL ENVIRONMENT

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F.1 LANDFORMS, GEOLOGY AND SOILS

The University of Michigan delineated the state's 91 physiographic regions (Schaetzl et al. 2013). Fort Custer is located within the Battle Creek Hills in the Southern Lower Peninsula Hills and Plains physiographic region, which is characterized by hills and rolling landscapes associated with glacial activities and large stream valleys and lakes (Schaetzl et al. 2013). There are two large streams in the region - the St. Joseph River and the Kalamazoo River – along with many small streams. Many of the small streams originate within wetlands on the outwash plain. Sandy and loamy sediment dominates the landscape, with well drained upland soils formed in glacial outwash and sandy river valleys (Schaetzl et al. 2013). The Kalamazoo Interlobate ranges in elevation from 750 to 1,280 feet (USDA 2019a).

Michigan's Northern Lower Peninsula was completely glaciated during the Late Wisconsinan period. Common glacial landforms in this region include lake plain, outwash plain, end moraine and ground moraine. The geology underlying Fort Custer is the result of the latest episode of continental glaciation, with no exposed bedrock (Albert 1995). Thus, glacial till and outwash are the major parent materials for the soils of Fort Custer, a result of soil-forming factors operating on the glaciofluvial parent materials (USDA 2018).

The bedrock geology of the area consists entirely of Mississippian age shale, overlain by glacial drift of widely varying depths (Albert 1995). FCTC lies in the southwestern outwash plain, the Kalamazoo Interlobate Subsection (VI.2), which formed between the three major glacial lobes that occupied Lake Michigan, Lake Erie, and the Saginaw Bay basins. This plain encompasses numerous small lakes, wetlands, and small ridges of ground moraine. Slope classifications range from a rather flat 0 to 6 percent, to a very steep 18 to 40 percent slope on the steeper portions of the Tekonska moraine, which comprises most of FCTC's uplands (Legge et al. 1995). The installation covers a 250-foot elevation difference, ranging from 810 feet near Eagle Lake to 1,060 feet above mean sea level in the impact area.

Soils that form from outwash and morainic glacial materials are principally well- or moderately well drained loamy sands. The Oshtemo and Spinks soils are the most common soils present at FCTC, making up over 60 % of the soils present at FCTC (**Map 3, Appendix B**).

a) The Oshtemo series comprises over 50% of the soil on the camp. Oshtemo soils are well drained, with moderately rapid permeability in the upper loamy materials and very rapid permeability in the lower sandy materials. Water erosion potential is slight except on slopes greater than 12% and the soil is moderately erodible by wind in exposed sites.

b) The Spinks series makes up roughly 12% of the soils on the installation. Spinks soils are also well drained with moderately rapid permeability. They are highly erodible by wind in exposed sites.

These soils, along with the Kalamazoo loam and Boyer sandy loam soils, (~ 16% of FCTC) are all well-drained soils typically found on upland plains, terraces, ridges or slopes. These soil types are considered highly erodible as determined by soil texture, rainfall and position of the soil unit on the landscape (USDA 2018). The majority of the remaining soil types at FCTC are the very poorly drained Houghton and Adrian muck soils (~ 8%). These muck soils are typically formed in glacial ice-block kettles, abandoned stream channels, and other depressional areas with poor drainage, and are generally associated with

wetlands. They also support the extensive wetland complexes found in the eastern portion of FCTC, and in other locations throughout FCTC (**Map 3, Appendix B**).

Wind erosion is dependent on characteristics of climate, soil and vegetation. The wind velocity, direction, duration, and turbulence are important determinants of erosion. As wind velocity and duration of turbulence increases, the quantity of soil loss increases. The wind erosion potential is particularly dependent on the length of unprotected area relative to wind direction and on the amount of protective vegetation on the surface. The water erosion potential is dependent on the percent and length of slope, the rainfall intensity, the vegetative cover, and specific soil characteristics like texture. Water erosion increases as slope and rainfall increase and as the vegetative cover and soil particle size decrease.

Soils are assigned to wind erodibility groups (WEG) of 1 to 8 based on the texture of the surface layer. A WEG value of 1 refers to soils consisting of very fine, fine, and medium sand, which erode easily. A WEG value of 8 refers to soils consisting of very wet or stony soils, which are not subject to erosion.

A complete list of the soils found at Fort Custer is shown in **Table F-1**, including the corresponding water and wind erodibility classifications. Soils are assigned to wind erodibility groups (WEG) of 1 to 8 based on the texture of the surface layer. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. For the most part, the soils at FCTC have a high wind erosion potential and a low water erosion potential.

Soil Series, Percent Slope	Acres	Water Erosion Potential	Wind Erodibility Index Group
Adrian muck, 0 to 1 percent slopes	9	Slight	2
Aquents and Histosols ponded	10	Slight	8
Boyer sandy loam, 0 to 6 percent slopes	290	Slight	3
Boyer sandy loam, 12 to 18 percent slopes	99	Moderate	3
Boyer sandy loam, 18 to 40 percent slopes	153	Moderate	3
Boyer sandy loam, 6 to 12 percent slopes	103	Slight	3
Brady sandy loam, 1 to 4 percent slopes	1	Slight	3
Coloma loamy sand, 0 to 6 percent slopes	45	Slight	2
Coloma-Boyer loamy sands, 6-12 percent slopes	34	Slight	2
Coloma loamy sands, 12 to 18 percent slopes	35	-	2
Gilford fine sandy loam, gravelly substratum	26	Slight	3
Gilford sandy loam	11	Slight	3
Glendora sandy loam	33	Slight	3
Hillsdale sandy loam, 0 to 6 percent slopes	3	Slight	3
Houghton and Sebewa soils, ponded	7	Slight	2
Houghton muck, 0 to 1 percent slopes	444	Slight	2
Houghton muck, undrained	114	Slight	8
Kalamazoo loam, 2 to 6 percent slopes	391	Slight	5
Kalamazoo loam, 6 to 12 percent slopes	131	Slight	5
Matherton loam, 0 to 3 percent slopes	6	Slight	5
Oshtemo sandy loam, 0 to 6 percent slopes	1599	Slight	3
Oshtemo sandy loam, 12 to 18 percent slopes	419	Moderate	3

Table F-1. Soil Types of Fort Custer Training Center, MI

Soil Series, Percent Slope	Acres	Water Erosion Potential	Wind Erodibility Index Group
Oshtemo sandy loam, 18 to 35 percent slopes	519	Moderate	3
Oshtemo sandy loam, 18 to 40 percent slopes	2	Moderate	3
Oshtemo sandy loam, 6 to 12 percent slopes	1,380	Slight	3
Spinks loamy sand, 0 to 6 percent slopes	95	Slight	2
Spinks loamy sand, 12 to 18 percent slopes	554	Moderate	2
Spinks loamy sand, 18 to 40 percent slopes	64	Moderate	2
Spinks loamy sand, 6 to 12 percent slopes	223	Slight	2
Spinks-Coloma loamy sands, 18 to 35 percent slopes	625	Moderate	2
Udipsamments and Udorthents, nearly level to steep	2	Slight	1
Urban land-Oshtemo complex, 0 to 6 percent slopes	2	Not Rated	Not Rated
Water	75	Not Rated	Not Rated
Total	7,504		
Sources: USDA 2018, 2019b and FCTC GIS Data 2019			

F.2 WATER RESOURCES

The ecoregion mapped and classified based on climate, physiography, soils, and natural vegetation at Fort Custer is in the Battle Creek/Elkhart Outwash Plain ecoregion (Level IV). Within this ecoregion, FCTC is located in an area called the Kalamazoo Interlobate Subsection (VI.2), which has an abundance of marshes and lakes. Streams in this region are rich with outwash deposits from prehistoric glacial activity, which provide for stable flows in the region's streams and rivers. Stream quality is generally better than in nearby ecoregions, but channelization and the removal of riparian vegetation have degraded both aquatic and terrestrial stream habitats.

F.2.1 GROUNDWATER

Groundwater recharge is generally rapid due to the high permeability of the sandy soils. The regional hydrogeology of the area consists of both glacial outwash and bedrock aquifers. Deposits of unconsolidated glacial drift constitute the location of the principal aquifer in the region. Precipitation moves readily down through the glacial drift and into the principal aquifer, the Marshall sandstone formation. The aquifer is composed of unsorted silty, bouldery gravels, as well as beds and lenses of poorly sorted stratified gravel, sand, and silt. Groundwater movement is finally impeded by the low permeability of the Coldwater shale formation. The depth to these two formations is highly variable, even across short horizontal distances. The glacial aquifer is approximately 150-200 feet thick and in the fen areas it is approximately 70-100 feet thick (Shu-Guang 2015). This complex hydrogeology provides the water source that maintains the wetlands, seeps and fens in the natural areas located in FCTC.

There is a high degree of linkage between surface and ground waters, with groundwater discharge to streams, rivers, lakes, and wetlands being common and primary source of flow into these surface waters. The overall pattern of groundwater flow at and around the site is similar to that of the overland flow in that it moves towards the Kalamazoo River, and recharge in the area is higher than in most other watersheds in Michigan due to the sand and gravel deposits (Shu-Guang 2015). Groundwater recharge is

facilitated by large areas of very permeable Oshtemo complex soils lying over the northern third of the site. Historically, the natural hydrology of the site was predominantly driven by infiltration and base flow discharge. Land use changes, initiated by agricultural practices, have over time promoted surface runoff of precipitation. However, the historical infiltration processes have been reestablished since the establishment of FCTC for military use.

Various groundwater and water quality evaluations have been completed at FCTC and resulted in a Watershed Management Plan, which is in the process of being updated (DLZ 2002).

F.2.2 SURFACE WATER

Fort Custer is situated in the Kalamazoo Watershed (Hydrological Unit Code [HUC] 04050003) as shown on **Map 4 in Appendix B**. The majority of FCTC is within the Eagle Lake-Kalamazoo River watershed (HUC 040500030508). The eastern boundary is in the Harts Lake-Kalamazoo River watershed (HUC 040500030503). A small portion of the southern boundary is in the Headwaters Portage River watershed (HUC 40500010501), and an even smaller portion of the southern boundary is in Minges Brook watershed (HUC 040500030410) (USGS 2019a, 2019b).

The site is drained by three first-order streams (with two flowing off-site to Eagle Lake and the other through New Lake and then to Jackson Hole Lake off-site). The portions of FCTC in the Eagle Lake-Kalamazoo River watershed all drain to the north, by way of Whitman Lake, three streams (unnamed in National Hydrography Dataset [NHD]), or several wetland complexes. These mostly pass through three lakes located just north of FCTC (Eagle Lake, Whitford Lake, or New Lake) and then into the Kalamazoo River. The portions along the eastern and southern boundary in other watersheds also drain eventually to the Kalamazoo River, with the exception of the small area in the Headwaters of Portage River which drains to the south into a different watershed (HUC 04050001).

The three headwater streams on FCTC originate in wetlands or small hillside seeps (**Map 4, Appendix B**). Whitman Lake is the most significant open water body contained within FCTC and lies about three miles due south of the Dickman Road entrance, within the Impact Area. At least five other small, permanent lakes occur on post.

The lakes of FCTC, like Whitman Lake, are surrounded by extensive wetlands (**Map 4, Appendix B**) and are associated with the biologically diverse prairie fens of the installation. There are two small lakes: one unnamed 3.5-acre lake and Whitman Lake, which is roughly 4.7 acres. There are 15 additional small freshwater ponds on the installation. Mitchell's Pond is in TA7 and Lawler Pond is in TA4. Several seasonal ponds occur in the south-central portion of FCTC and appear to be glacial kettle formations. Wetlands on FCTC are common and abundant and are associated with lakes and drainages on the installation. These are discussed further in **Section F.3.3**.

Fort Custer has a history of stormwater runoff issues and an increase in precipitation will have an adverse effect on the installation (MIARNG 2016). On one occasion, severe rain events caused flooding on the installation's training grounds and ranges as well as flood damage to surrounding residences.

F.2.3 WETLANDS

As described above, the groundwater surfaces all over FCTC in several seeps that feed many wetland complexes. All but a few of these flow to the north into the Kalamazoo River (**Map 4, Appendix B**). Overland flow contributes, to a lesser extent, to the surface hydrology of FCTC, primarily in some of the areas with less permeable, silty clay loam soils. All wetlands are freshwater emergent and freshwater forested/shrub wetlands (Fuller et al. 2005; USFWS 2019a). A delineation completed in 2014 on only a southern portion of FCTC identified over 106 acres of wetlands (DLZ 2015). Freshwater emergent and freshwater forested/shrub wetlands.

More than 130 wetland features have been identified on FCTC, totaling over 650 acres. Present on FCTC are palustrine emergent (PEM), palustrine forested (PFO), and palustrine shrub wetlands (PSS). Wetlands are regulated under Part 303, Wetlands Protection, of the NREPA by the Michigan Department of Environmental Quality. In addition, some areas may be regulated under Part 301, Inland Lakes and streams of the NREPA. Any future impacts to the delineated wetland features will require permits from the MDEQ. The MDEQ is the regulatory authority in the project area and as such is charged with the decision as to the jurisdictional status of the areas, the type of permits required should impacts be proposed, and the determination of the appropriate mitigation for proposed impacts.

Current NWI data indicates six types of emergent wetlands (PEM), two types of forested wetlands (PFO), and four types of scrub-shrub wetlands (PSS). The largest contiguous wetland is a freshwater forested/shrub wetland (PSS1C) that is just over 81 acres, surrounding Whitman Lake (**Map 4, Appendix B**). Most of the wetlands are associated with the river drainages of the Kalamazoo River. **Table F-2** summarizes the wetlands documented on Fort Custer Training Center.

Wetland Type	Cowardin Categories	Area (acres)	No. of Features
Freshwater Emergent (PEM)	PEMB, PEMC, PEMCd, PEMCh, PEMF, PEMFd	237	59
Freshwater Forested Wetland (PFO)	PFO1C, PFO1Cd	226	46
Freshwater Shrub Wetland (PSS)	PSS1C, PSS1Ch, PSS1F, PSS3B	193	33
<i>Total</i>		<i>656</i>	<i>138</i>
*Cowardin categories are from Cowardin et al. 1979. Source: (Cowardin et al. 1979; DLZ 2015; FCTC GIS data 2019)			

In 2005, US Geological Survey (USGS) completed an accuracy assessment of the NWI data for FCTC (Fuller et al. 2006). USGS used IKONOS infrared imagery and map analysis to determine how closely the USFWS NWI data matched this more current and higher resolution data. The differences in delineations were minor. The results were then used to update the NWI data. This research confirmed that further on the ground delineations were an unnecessary expense given the accuracy of the remotely sensed data.

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APPENDIX G

BIOLOGICAL ENVIRONMENT

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G.1 ECOREGION

Fort Custer is located in the Southern Michigan/Northern Indiana Drift Plains Ecological Region (Level III), which occupies southern lower Michigan (Omerlink and Bryce 2010). The Level III ecoregion has an abundance of marshes and lakes and many types of landforms and soils. Fort Custer is in the Battle Creek/Elkhart Outwash Plain ecoregion (Level IV) of the of the Kalamazoo Interlobate Subsection.

The Kalamazoo Interlobate Subsection formed approximately 13,000 to 16,000 years ago between three major glacial lobes. FCTC is included in the northeastern most extension of flat glacial plain 150 miles in length sometimes referred to as the “Prairie Peninsula”. This sub-subsection lies within a 750-1,050 ft range of elevation and is underlain by Mississippian-age shale (Albert 1995). It is a broad, flat plain that served as a major drainage way for receding Pleistocene glacier. The coarse and permeable substrate in this area is a source of groundwater and supported Michigan’s largest concentration of dry tallgrass prairies, though wet prairies were also common. The climate is warmer here than the rest of the state.

The Kalamazoo River flows through a large outwash channel, and outwash deposits are most well represented at the north end of FCTC and on the adjacent FCRA. The gently rolling Tekonska moraine, with cobbly, loamy, and sandy loam soils typifies much of the more rugged upland portions of FCTC property. Along the edge of the end moraine, the lakes and wetlands of FCTC developed where irregular ice-contact topography was subsequently overlain with organic deposits (Legge et al. 1995b). Fire suppression, logging and land use change altered the ecosystem significantly following the establishment of settlements by Europeans and the inclusion of Michigan in the Northwest Territory in the late 1700s. By the early 1800s, European immigrants had settled much of the area and altered the ecosystem significantly.

FCTC exists within the Humid Temperate Domain, Hot Continental Division, Eastern Broadleaf Forest, Great Lakes moderated climate, within the Southern Lower Michigan ecological section, and the Kalamazoo Interlobate subsection (Albert 1995). The annual average precipitation for Calhoun and Kalamazoo Counties is approximately 37 inches (NRCS 2015). The Great Lake influence on the climate of FCTC is buffered by an approximate distance of 64 km (40 miles) from Lake Michigan’s shore, and most precipitation is associated with passing cold fronts or air mass instability rather than lake-effect showers. The growing season is about 151 days and average extreme annual minimum temperature is 9 F° (Albert 1995; Legge et al. 1995b). Projected change in average temperature for the area surrounding FCTC is expected to be between 4.5 and 5°F, with a 2 – 4 inch change in average annual precipitation, and continued extension of the growing season for the time period 2041 – 2070 (See **Appendix I** for more on climate change projections).

G.2 HISTORIC VEGETATION

Around 1800, vegetation types of Level IV ecoregion where Fort Custer is situated are mapped (Map 7 in Appendix B) as containing oak hickory forest, mixed oak forest, beech-sugar maple forest, oak savanna, oak openings, and prairie in upland areas, and mixed hardwood swamp, mixed conifer swamp, wet prairie, lakes, bogs, and shrub swamp/emergent marsh in wetland areas (Cohen et al. 2009). Distribution of these vegetative communities was impacted by patterns of surface fire, hydrology,

topography, and Native American activities. Within FCTC, oak-hickory forest was often on hill slopes and ridges and was the predominant mapped cover type (approximately 60%). Oak openings or mixed oak savanna were often mapped on flat-to-gently-rolling uplands and covered approximately 25% of FCTC. Throughout FCTC, scattered wetlands occur in drainage ways or depressions. Most wetlands were mapped as mixed hardwood swamps (often within narrower drainage channels) or shrub swamp/emergent marshes (often within broader drainage channels), but small areas of bog and lake were also mapped within depressions (Comer et al. 1995; Legge et al. 1995b).

The most extensive and reliable written accounts of vegetation occurring in the region prior to European-American settlement are those from notes included with the original land surveys conducted in the area between 1820 and 1835. Through careful analysis of these notes (Legge et al. 1995b), ten different natural communities (Map 7 in Appendix B) have been described as occurring in the area of FCTC (Comer et al. 1995). Table G-1 lists the ten types of pre-European settlement (about 1800) vegetation that occurred on Fort Custer Training Center.

Vegetation Type	Acres
White Oak, Black Oak, Hickory	4,924
Oak Opening	1,789
Emergent Marsh	531
Alder/Willow/Bog Birch Thicket	136
Lowland Hardwood	84
Lake or Pond	22
Bog	11
Beech/Sugar Maple/Basswood	< 1
Herbaceous Upland Grassland	< 1
Inland Wet Prairie	< 1
	TOTAL 7,497
Source: (Comer et al. 1995)	

The oak openings had perhaps only a few white oak (*Quercus alba*), black oak (*Quercus velutina*), and bur oak (*Quercus macrocarpa*) per acre. In some settings, the forest was said to have a “park-like” appearance with very little mid-story vegetation and prairie plants at the ground level, but a nearly closed, overstory canopy. The openings could range from small grassy glades in a forested matrix to the much larger and drier oak barrens having a few scattered oaks per acre. In addition to the dominant oak-hickory forests and oak openings, various other upland communities were present, including mesic-southern forests dominated by beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), basswood (*Tilia americana*), tulip tree (*Liriodendron tulipifera*), and black walnut (*Juglans nigra*). Dry sand prairies and dry southern forests dominated by black oak were common on sandy outwash deposits and south-facing slopes.

Wetlands accounted for 15% of the area (Legge et al. 1995b), classified today as southern hardwood swamps, prairie fens, tamarack swamps, southern wet meadows, or southern shrub-carr communities (Legge et al. 1995b). An isolated eastward extension of the tallgrass prairies was present on FCTC, called dry oak openings, sand prairies, or wet prairie fens. These eastern-most grasslands were thought to

have developed during a drier climatic period about 8,000 to 4,000 years ago when frequent wildfires swept the land, making it suitable for the establishment of prairie plants (Legge et al. 1995b). These ecosystems are now globally imperiled due largely to the discontinuation of fire as a land management tool, active suppression of wildfires in what are now suburban settings, and the prior conversion of prairies to agricultural land.

Beginning in the early 1830's, uplands were converted from forest or openings to agricultural production, small homesteads, or small population centers (specifically Harmonia and Lawler's Corners within the boundaries of FCTC). Much of the farming continued at least through 1917, when most of the current property was acquired to develop Camp Custer at the onset of World War I. Farming and grazing eventually caused extensive soil erosion on the sandy Oshtemo soils (see Physical Environment, **Appendix F**). In addition to altering the native communities of FCTC, past practices such as fire suppression and the introduction of non-native plant species have severely impaired the present potential for ecosystem restoration.

Soil erosion has reduced or eliminated the seedbanks of native plants. The lack of a native plant seedbank, in combination with the invasive character of many non-indigenous plants (e.g., garlic mustard (*Alliaria petiolata*) and multiflora rose (*Rosa multiflora*)), makes the process of re-establishing natural communities a labor-intensive and difficult undertaking. Although some upland forests were retained by settlers along fencerows and in woodlots, their structure and species composition was greatly altered by the practice of logging for timber and firewood. The practice of fire suppression in the uplands has allowed woody vegetation to invade grassland communities. As a result, the prairie fens, oak openings, and sand prairies have become forested or shrub communities due to lack of fire.

Prior land use has likely altered FCTC's wetlands. Sedimentation of wetlands has undoubtedly taken place as adjacent uplands were plowed, grazed, and partially denuded of topsoil. Normal precipitation events easily displaced the light soils common at FCTC down slope into the wetlands. This inadvertent filling of wetlands had led to changes in the plant composition of these systems.

G.3 CURRENT VEGETATION

FCTC supports 21 natural vegetation community types (Thomas et al. 2009), with 873 vascular plant species – approximately 30% of the known plants of Michigan – documented on FCTC during various surveys starting in the 1990s (see species list in **Appendix E**). This finding is indicative of the significant habitat diversity present at FCTC. At the same time, the non-native plant species on the installation is roughly 17% of all plants, reflecting the extensive human disturbance at Fort Custer. A total of 21 state-listed or special concern plants have been identified over the years, some of them reconfirmations of previous survey results. More detail on rare plants is provided in **Appendix H** and a summary of all biological surveys on FCTC is provided in **Appendix D**.

A detailed map of plant communities at FCTC was created in 2009 (see **Map 5, Appendix B**) and uses both the Michigan vegetation classification and the National Vegetation Classification (NVC), which is a central organizing framework for documentation, inventory, monitoring, and study of vegetation in the US. Utilizing the NVC provides a thorough understanding of the ecosystems of FCTC and provides a snapshot of the conditions for and monitoring changes in the vegetation and setting management goals and priorities. In 2009, there were 21 plant alliances mapped at FCTC, with natural areas comprising

about 30% of FCTC (Thomas et al. 2009). As shown in **Map 5** and summarized in **Table G-2**, the current natural vegetation on FCTC is mostly forest.

MNFI Natural Community	NVC Classifications¹	Acres	% Land Area
<i>Terrestrial/Prairie</i>	<i>Temperate Grassland & Shrubland Formation/Central Tallgrass Prairie Group</i>	3	<1
Dry-mesic Prairie	A4047 Central Dry Sand & Gravel Tallgrass Prairie Alliance CEGL002210 Midwest Dry-Mesic Sand Prairie Association	0.4	< 1
Mesic Sand Prairie⁺	A4057 Central Mesic Tallgrass Prairie Alliance CEGL005096 Midwest Mesic Sand Tallgrass Prairie Association	2.6	< 1
<i>Terrestrial/Savanna</i>	<i>Cool Temperate Forest & Woodland Formation/Central Midwest Oak Openings & Barrens Group</i>	126	1
Bur Oak Plains	A3256 Tallgrass Bur Oak Openings Alliance CEGL002020 North-Central Bur Oak Openings Association	25.6	< 1
Oak Barrens	A1492 Black Oak - Northern Pin Oak Barrens Alliance CEGL002492 Black Oak / Lupine Barrens Association	100.8	1
<i>Terrestrial/Forest</i>	<i>Cool Temperate Forest & Woodland Formation</i>	1,140	15
Dry-mesic Southern Forest⁺	North-Central Oak - Hickory Forest & Woodland Group A3323 North-Central White Oak - Hickory Forest Alliance CEGL002068 Midwestern Glaciated White Oak - Red Oak Forest Association	883.8	12
Mesic Southern Forest	North-Central Beech - Maple - Basswood Forest Group A3226 Sugar Maple - American Beech Forest Alliance CEGL005013 Glaciated Midwest Beech - Sugar Maple Forest Association	39.6	< 1
	North-Central Beech - Maple - Basswood Forest Group A0220 Sugar Maple - American Basswood - Northern Red Oak Forest Alliance CEGL005017 Red Oak - Sugar Maple - Elm Forest Association	216.9	3
<i>Terrestrial/Forest</i>	<i>Cool Temperate Forest & Woodland Formation/ Eastern North American Native Ruderal Forest Group</i>		
Regrowth Forest	A3228 Ruderal Tuliptree - Black Walnut - Black Locust Forest Alliance is a possible alliance, with several possible associations depending on land management history.	4,721.7	63
<i>Palustrine/Forested Wetland</i>	<i>Temperate Flooded & Swamp Forest Formation</i>	277	4
Wet-mesic Flatwoods	Central Interior-Appalachian Flatwoods & Swamp Forest Group A0329 North-Central Wet Oak Flatwoods & Swamp Forest Alliance CEGL005037 Northern Great Lakes Flatwoods Association	13.1	< 1
Floodplain Forest	Silver Maple - Green Ash - Sycamore Floodplain Forest Group A3708 Red Maple - Green Ash Floodplain Forest Alliance CEGL002014 Central Green Ash - Elm - Hackberry Floodplain Forest Association	33.5	< 1

Table G-2. Current Vegetation on Fort Custer Training Center, MI

MNFI Natural Community	NVC Classifications ¹	Acres	% Land Area
Southern Hardwood Swamp	Laurentian-Acadian Alkaline Swamp Group A0347 Black Ash - Red Maple Swamp Forest Alliance CEGL002071 Red Maple - Ash - Birch Swamp Forest Association	207.0	3
	Central Interior-Appalachian Flatwoods & Swamp Forest Group A3881 Red Maple - Ash - Swamp White Oak Swamp Forest Alliance CEGL005038 Maple - Ash - Elm Swamp Forest Association	22.5	< 1
Rich Tamarack Swamp	Laurentian-Acadian Alkaline Swamp Group A0347 Black Ash - Red Maple Swamp Forest Alliance CEGL005232 Southern Tamarack - Red Maple Rich Swamp Forest Association	1.1	< 1
Palustrine/Shrub Wetland	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation/Midwest Wet Prairie, Wet Meadow & Shrub Swamp Group	203	3
Southern Shrub-Carr	A4378 Midwest Mixed Shrub Swamp Alliance CEGL002186 Red-osier Dogwood - Willow Midwest Shrub Swamp Association	134.5	2
Inundated Shrub Swamp	A4378 Midwest Mixed Shrub Swamp Alliance CEGL002190 Midwest Buttonbush Shrub Swamp Association	23.8	< 1
Palustrine/Marsh	Temperate to Polar Freshwater Aquatic Vegetation Formation	156	2
Submergent Marsh	Eastern North American Freshwater Aquatic Vegetation Group A4064 Water-lily - Pond-lily Aquatic Vegetation Alliance CEGL002562 Northern Water-lily Aquatic Wetland Association	18.2	< 1
Southern Wet Meadow ⁺ or Emergent Marsh	Midwest Wet Prairie, Wet Meadow & Shrub Swamp Group A4105 Midwest Sedge - Bluejoint Wet Meadow Alliance CEGL002258 Upright Sedge Wet Meadow Association (non-isolated, free draining)	105.6	1
	A4105 Midwest Sedge - Bluejoint Wet Meadow Alliance CEGL002258 Upright Sedge Wet Meadow Association (isolated, inundated)	32.3	< 1
Palustrine/Marsh	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation	66	< 1
Emergent Marsh	Eastern North American Freshwater Marsh Group A1436 Cattail - Bulrush Mixed Deep Marsh Alliance CEGL002229 Midwest Mixed Emergent Deep Marsh Association	48.2	< 1
Southern Wet Meadow⁺	North-Central & Northeastern Seep Group A3374 Northern Calcareous Seep Alliance CEGL002385 Skunk-cabbage Seepage Meadow Association	17.3	< 1
Palustrine/Bog	Temperate to Polar Bog & Fen Formation/Eastern North American Boreal Bog & Acidic Fen Group		
Bog	A3450 Subboreal Leatherleaf Acidic Shrub Bog & Fen CEGL005092 Midwest Leatherleaf Shrub Kettle Bog	11.2	< 1

MNFI Natural Community	NVC Classifications¹	Acres	% Land Area
<i>Palustrine/Fen</i>	<i>Temperate to Polar Bog & Fen Formation/Midwest Prairie Alkaline Fen Group</i>		
Prairie Fen⁺	A3704 Midwest Prairie Fen Alliance CEGL005139 Shrubby-cinquefoil / Sedge Prairie Fen Association	33.0	< 1
<i>Palustrine</i>			
Vernal Wetland	No matching NVC alliance for these six small wetland areas	1.6	< 1
Other			
Field		558.9	7
Developed		172.7	2
Source: (Thomas et al. 2009)			
+ MNFI Natural Community that is also considered a high-quality natural area (see section G.3.4).			
¹ NVC Formations, Groups, Alliances, and Associations based on usnvs.org data in September 2019 (v2.03) crosswalked with the older NVC alliances (about 2009 version) identified in MNFI summaries and the descriptions in Thomas et al. 2009.			

From 2000 – 2016, a total of at least 20 surveys focusing on vegetation on Fort Custer have been conducted, covering a range of topics from overall vegetation to wetland delineations (see **Appendix D** for a complete list of surveys). One comprehensive vegetation survey was completed in 1995 and another in 2009. In addition, four years of US Army LCTA program (2000-2004) and nine years of RTLA (2005-2016¹) reports were also completed, providing plant data over a period of 16 years. See **Appendix D** for abstracts for each of these reports.

Comprehensive Surveys

Information and surveys for vegetation on Fort Custer have been completed over several years beginning in 1995 and have resulted in the following reports.

- Legge, J. T., Higman, P. J., Comer, P. J., Penskar, M. R., & Rabe, M. L. 1995. A Floristic and Natural Features Inventory of Fort Custer Training Center, Augusta, Michigan (Report 1995-13). Lansing, MI.
- Cohen, J.G., O'Connor, R.P., Barton, B.J., Cuthrell, D.L., Higman, P.J., and Enander, H.D. 2009. Fort Custer Vegetation and Natural Features Survey 2007-2008 Report (Report 2009-04). Lansing, MI.
- Thomas, S. A., Cohen, J. G., & Enander, H. D. 2009. Mapping Plant Alliances of the Fort Custer Training Center (Report Number 2009-10). Lansing, MI.
- From 1998 – ongoing, annual surveys of established plots using standardized plant data collection methods (as part of LCTA/RTLA program) have been completed to assess various management issues (Envirologic 2000, 2001, 2002; Tanis 2003, 2005, 2006a, 2006b, 2009, 2010, 2011; Yocum and Tanis 2014, 2015, 2016, 2017; Yocum 2018).

Rare Plants and High Quality Natural Areas

Rare plants and HQNAs were surveyed as part of the comprehensive natural features inventories mentioned above. Species-specific surveys and surveys specific to HQNAs have also been conducted at FCTC and are summarized in the following reports.

¹ Missing reports for years 2007 and 2012.

- Legge, J. T., Higman, P. J., Comer, P. J., Penskar, M. R., & Rabe, M. L. 1995. A Floristic and Natural Features Inventory of Fort Custer Training Center, Augusta, Michigan (Report 1995-13). Lansing, MI.
- Higman, P.J. 1996. Monitoring and Management Plan for *Corydalis flavula* (pale corydalis, state threatened) in Fort Custer Training Center MISSING FILE. Michigan Natural Features Inventory, Lansing, MI.
- Higman, P.J. 1997. Monitoring and Management Plan for *Corydalis flavula* (pale corydalis, state threatened) in Fort Custer Training Center. Michigan Natural Features Inventory, Lansing, MI.
- Nuzzo, V. 1998. Habitat Requirements of Yellow Fumewort (*Corydalis flavula*) at Fort Custer Training Center. Natural Area Consultants, Groton, NY.
- DLZ. 2005. Resource Management in High Quality Natural Areas, Fort Custer Training Center, Augusta, Michigan. Lansing, MI.
- Bassett, T. 2007. 2007 Rare Plant Status Surveys, Fort Custer Training Center. Native Connections, Three Rivers, MI.
- Bassett, T. 2008 – 2016. Multiple qualitative assessments of *Corydalis flavula* on Fort Custer.
- Cohen, J. G., O'Connor, R. P., Barton, B. J., Cuthrell, D. L., Higman, P. J., & Enander, H. D. 2009. Fort Custer Vegetation and Natural Features Survey 2007-2008 Report (Report 2009-04). Lansing, MI.
- RTLA has ongoing monitoring in special use plots located in HQNAs that have been taking place since 2006.
 - Tanis, M. (2006, 2009, 2010, and 2011). 2006, 2008, 2009, and 2010 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Kalamazoo, MI.
 - Yocum, B.J., & Tanis, M. (2014, 2015, 2016, and 2017). 2013, 2014, 2015, and 2016 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Kalamazoo, MI.
 - Yocum, B. J. (2018). 2018 Range and Training Land Assessment (RTLA) Summary Report of Fort Custer Training Center. Kalamazoo, MI.
- Wick, A. A. 2016. Prescribed Fire Monitoring at Fort Custer Training Center: 2016. Kalamazoo, MI.

G.3.1 TERRESTRIAL

Upland, dry plant communities on Fort Custer cover approximately 1,269 acres. These plant communities are further divided into prairies, savannas (oak openings) and forests, with the latter being the most abundant (**Table G-2**).

G.3.1.1 Prairie

Prairies make up the fewest number of acres, only 3 acres total, of any of the plant communities on Fort Custer and are considered rare globally as well as rare within the state of Michigan.

Dry-mesic Prairie

These prairies occur only in a very small area of FCTC, taking up less than one half acre. They occur on uplands in dry mesic, sandy or gravelly loam soils and have been almost completely eliminated in the state of Michigan with the exception of railroad rights-of-way near agricultural areas (Kost et al. 2007). The community represents the stands of open grassland that occurred in association with historic oak openings throughout much of southern Lower Michigan. These oak openings and grasslands were the landscape mosaic historically maintained by fire and are the model for restoration as the vegetation communities recover from decades of land conversion and fire suppression. The most common

herbaceous species in this community include leadplant (*Amorpha canescens*, state special concern), thimbleweed (*Anemone cylindrica*), butterfly weed (*Asclepias tuberosa*), smooth aster (*Symphotrichum laeve*), and daisy fleabane (*Erigeron strigosus*) (Kost et al. 2007). Oak species in dry-mesic prairies, such as white oak, were historically maintained in a shrubby form or in widely scattered open growth forms due to frequent (annual) fires.

Mesic Sand Prairie

Mesic sand prairie is a native grassland community occurring on sandy loam, loamy sand, or sand soils on nearly level glacial outwash plains and lakeplains in both the northern and southern Lower Peninsula. Sites that support mesic sand prairie experience fluctuating water tables, with relatively high water tables occurring in the spring followed by drought conditions in late summer and fall. Thus, the community contains species from a broad range of moisture classes but is dominated by species of upland affinity. Dominant grasses include little bluestem (*Andropogon scoparius*), big bluestem (*Andropogon gerardii*), and Indian grass (*Sorghastrum nutans*) (Kost et al. 2007).

G.3.1.2 Oak Openings

Oak-dominated herbaceous areas, or oak savannas, occur commonly in openings and grasslands at FCTC. Most of these areas were oak opening and prairie communities prior to European settlement, maintained by regular application of fire by Native Americans, but today they are largely woody herbaceous communities, grasslands, and old (successional) fields dominated by non-native grasses and weedy forbs. These communities can support a variety of weedy species alongside plants more characteristic of the prairie and oak opening/oak savanna that once prevailed at FCTC. Much of this acreage is likely a degraded representation of what would have been historic oak savanna woodlands.

Many of the areas are sites that would elsewhere be described as upland brush. These areas are dominated by woody vegetation, with native species such as seedling red, black, and scarlet oak (*Quercus* spp.) trees, hawthorn (*Crataegus* sp), and black raspberry (*Rubus occidentalis*) and non-native species such as multiflora rose, Amur honeysuckle (*Lonicera maackii*), and autumn olive (*Elaeagnus umbellata*) being common. Many of the representative native plant species in these areas have been replaced due to agricultural land use. Of all the community types represented at FCTC, these are in the most degraded state from the standpoint of ecological integrity and usefulness for training. The degradation has come about as a result of fire suppression, former farming practices, and present-day damage to soils from training-related erosion, compaction, and impacts from off-road tracked vehicle use. This has led to the encroachment of woody species, a reduction in the native seedbank from erosion, and the establishment of fire-intolerant, non-native plant species.

Important herbaceous plant associates of these prairie communities include little bluestem, big bluestem, Pennsylvania sedge (*Carex pensylvanica*), bush clovers (*Lespedeza* spp.), blazing stars (*Liatris aspera* and *L. cylindracea*), tall coreopsis (*Coreopsis tripteris*), and pale-leaved sunflower (*Helianthus strumosus*). White, black and red oaks along with pignut hickory (*Carya glabra*) are found in scattered clumps or glades specific to the oak openings and oak barrens (Legge et al. 1995b).

Bur Oak Plains

This vegetation type has been impacted by decades of fire suppression and land conversion and occurs on FCTC as forested uplands covering 25 acres. Historically, it occurred as an oak savanna. Soils in bur

oak plains are mesic, occasionally dry-mesic or wet-mesic sandy loam or loam. Bur oak plains occur on broad, flat ridges or shallow swales. Common species include bur oak, white oak, hickories (*Carya* spp.), and black walnut (Thomas et al. 2009).

Oak Barrens

Oak barrens occupy over 100 acres on FCTC and are a fire-dependent savanna type dominated by oaks, having between 5 and 60% canopy, with or without a shrub layer. Oak barrens are found on droughty soils and occur on level to slightly undulating glacial outwash in southern Lower Michigan. Changes over the decades have occurred as a result of fire suppression, leading to a transition from oak barrens to dry-mesic southern forest in many places (Kost et al. 2007). Black oak and white oak are dominant overstory species, and the herbaceous understory is composed of species associated with both prairie and forest communities (Kost et al. 2007).

G.3.1.3 Forests

Approximately 70% of FCTC is forest, which is unique in this region of Michigan, where development and agriculture have created an otherwise urban/suburban/agricultural land matrix. As shown in **Table G-2**, two distinct upland forest occur at FCTC (Thomas et al. 2009). Forested wetlands, of which there are four types on FCTC, are discussed in **Section G.3.2.1**.

The most common upland forest community is the oak forest of the Dry-Mesic Southern Forest type, which makes up the largest area of natural forest on FCTC. The other forest type in uplands is the Mesic Southern Forest. Upland savannas are discussed in **Section G.3.1.2** as Oak Openings. Approximately 4,722 acres (or about 63%) of FCTC occurs in some transitional stage of one of these forest types due to previous disturbance (e.g. logging, agriculture, etc.) and are currently categorized as ‘potential plant alliance’ and discussed in **Section G.3.3**. (Thomas et al. 2009).

Dry-Mesic Southern Forest

As discussed in **Section G.3.1.2** Oak Openings, the once-prevalent oak-hickory forest is represented today at FCTC by various transitional stages of oak-hickory forest regeneration. The most common forest type at FCTC is the Dry-Mesic Southern Forest, which makes up more than 800 acres of upland forests on the installation (> 75%). These forests exist mainly on glacial outwash or coarse-textured end moraines at FCTC. Several examples of relatively biologically intact Dry-Mesic Southern Forest occur at FCTC in association with steeper topography where farming would have been less likely or absent. On average, trees in many of these stands are older, large trees (greater than 20 inches in diameter at breast height), and two of these tracts are identified as HQNAs by MNFI (Legge et al. 1995b). Characteristically, dominant trees in Dry-Mesic Southern Forests include northern red oak (*Quercus rubra*) and white oak in the canopy, with associated species being wild black cherry (*Prunus serotina*), black oak, and sassafras (*Sassafras albidum*). Important subdominant species include red maple (*Acer rubrum*), sugar maple, pignut hickory, white ash (*Fraxinus americana*), and scarlet oak (*Quercus coccinea*). Characteristic understory species include spicebush (*Lindera benzoin*), flowering dogwood (*Cornus florida*), ironwood (*Ostrya virginiana*), and white ash saplings. Dominant ground cover plants include May apple (*Podophyllum peltatum*) and sweet cicely (*Osmorhiza claytonii*). Characteristic species of the ground cover include Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), common trillium (*Trillium grandiflorum*), enchanter’s nightshade (*Circaea lutetiana*), yellow violet (*Viola pubescens*), and jumpseed (*Polygonum virginianum*). Local dominants

in more mesic pockets include wild ginger (*Asarum canadense*) and wood nettle (*Laportea canadensis*) (Thomas et al. 2009).

Mesic Southern Forests

Mesic southern forests are found at FCTC primarily in localized habitats within the larger Dry-Mesic Southern Forest communities. Typically, these locations are at the base of north-facing slopes or in pockets of heavy soils often found in conjunction with wetlands. Here, sugar maple, tulip tree, white ash, and beech replace oaks as the dominant trees, with subdominants being red maple, wild black cherry, hickory, and an occasional white oak. The rich moist soil of this community supports a lush ground flora of spring ephemerals such as wild ginger, spring beauty (*Claytonia virginica*), round-lobed hepatica (*Hepatica americana*), and rue anemone (*Anemonella thalictroides*) (Legge et al. 1995b).

G.3.2 PALUSTRINE

Wetlands on FCTC cover more than 700 acres of land, which is approximately 10% of the installation (DLZ 2005a; Fuller et al. 2005; Thomas et al. 2009). These wetlands are rich in diversity, with 13 different wetland types ranging from bogs to forested wetlands, and include open water and a vernal wetland. These wetlands are core habitat for many of the rare species on the installation. Wetlands and associated aquatic communities of FCTC present the greatest species diversity and least amount of human disturbance of any of the ecological communities on the post. Wetlands discussed in this section include forested, shrubby, and herbaceous wetlands.

G.3.2.1 Forested Wetlands

The four wetland forest types on FCTC are Wet-mesic Flatwoods, Floodplain Forest, Southern Hardwood Swamp, and Rich Tamarack Swamp.

Wet Mesic Flatwoods

These wetland forests are usually characterized by clayey soils in flat areas or pit and mound topography. Common species include bitternut hickory (*Carya cordiformis*), red maple, red oak, swamp white oak (*Quercus bicolor*), spicebush, golden ragwort (*Senecio aureus*), skunk cabbage (*Symplocarpus foetidus*), and Pennsylvania sedge.

Floodplain Forest

Floodplain Forest occurs on wet terraces adjacent to streams. Areas tend to be flat or gently sloped, with common species being American elm (*Ulmus americana*), basswood, black walnut, hackberry (*Celtis occidentalis*), tulip tree, poison ivy, and skunk cabbage. In areas of higher elevation, common species also include sugar maple, black cherry, and red oak.

Southern Hardwood Swamp

This is the most common wet forest type. The Southern Hardwood Swamp makes up about 3% of the installation and almost 30% of all wetland areas mapped (Thomas et al. 2009). These are forested or shrubby wetlands with groundwater flow at or below the surface. Common species include red oak, musclewood (*Carpinus caroliniana*), chinquapin oak (*Quercus muehlenbergii*), American elm, green ash (*Fraxinus pennsylvanica*), shagbark hickory (*Carya ovata*), swamp white oak, spicebush, skunk cabbage and sharp-lobed hepatica (*Hepatica acutiloba*).

Rich Tamarack Swamp

This is a forested and shrubby wetland with high water tables or seasonal inundation. Topography is flat and common species include tamarack (*Larix laricina*), peach-leaved willow or black willow (*Salix nigra*), American elm, red maple, pussy willow (*Salix discolor*), silky dogwood (*Cornus amomum*), poison sumac (*Toxicodendron vernix*), bluejoint grass (*Calamagrostis canadensis*), and wool-grass (*Scirpus cyperinus*).

G.3.2.2 Shrub Wetland

Southern Shrub-Carr

This plant community is a persistent successional shrub community that occurs as bands along streams, rivers, and lakes within herbaceous wetlands (i.e., southern wet meadow, prairie fen, and wet-mesic prairie) and forested wetlands (i.e. southern hardwood swamp). It occurs on saturated, organic soil and is characterized by fluctuating water levels and poor drainage conditions. Southern shrub-carr is found primarily south in Lower Michigan. The dominant species are willows (*Salix* spp.), dogwoods, winterberry (*Ilex verticillata*), and bog birch (*Betula pumila*).

Inundated Shrub Swamp

This plant community is dominated by shrubs tolerant of wet conditions in moderately disturbed environments and is almost constantly inundated. Soils are typically impermeable because of a clay layer. Although trees may be present, the dominant vegetation type is shrubs, and the herbaceous layer is very thin. Shrubs typically comprise 40 – 90% vegetative cover, and common species includes buttonbush (*Cephalanthus occidentalis*), willow, red-osier dogwood (*Cornus sericea*), winterberry, black chokeberry (*Aronia prunifolia*), swamp dewberry (*Rubus hispidus*), and swamp rose (*Rosa palustris*). Shrub cover can range from 40 to 90%, with an average

G.3.2.3 Marsh, Bog, and Fen

Southern Wet Meadow

Southern wet meadow is an open, groundwater-influenced (minerotrophic), sedge-dominated wetland that occurs in central and southern Lower Michigan. Open conditions are maintained by seasonal flooding, beaver activity, and fire. Tussock sedge (*Carex stricta*) dominate the community (Kost et al. 2007).

Emergent Marsh

This vegetation type commonly occurs in low areas adjacent to lakes and streams in shallow water. Emergent narrow- and broad-leaved herbs and grass-like plants as well as floating-leaved herbs are common plants, including water plantains (*Alisma subcordatum* and *A. triviale*), sedges, spike-rushes (*Eleocharis* spp.), pond-lilies (*Nuphar* spp.), pickerel weed (*Pontederia cordata*), arrowheads (*Sagittaria* spp.), bulrushes (*Schoenoplectus* spp.), and cattails (*Typha* spp.)

Submergent Marsh

This vegetation type is similar to emergent marsh, except the water levels are deep to sometimes shallow. Submergent marsh can cover the surfaces of small, shallow lakes and ponds up to 30 feet in depth. Submergent vegetation can also form dense beds along the margins of slow-moving streams, or form open, less diverse plant beds in more rapidly flowing streams. Common submergent plants include common waterweed (*Elodea canadensis*), water star-grass (*Heteranthera dubia*), coontail (*Ceratophyllum demersum*), bladderworts (*Utricularia* spp.), and water-celery (*Vallisneria americana*).

Bog

Bogs are low in nutrients and are comprised of acidic, saturated peat and the prevalence of sphagnum mosses and ericaceous shrubs. They occur in kettle depressions on pitted outwash and moraines and in flat areas and shallow depressions on glacial outwash. Fire and flooding are the main natural disturbance factors. Bogs are characterized by a continuous carpet of sphagnum moss (*Sphagnum magellanicum*, *S. angustifolium*, and *S. fuscum*), a species-poor herbaceous layer, low ericaceous, evergreen shrubs, and widely scattered and stunted conifer trees. Dominant plant species include sphagnum moss, a shrub layer dominated by leatherleaf (*Chamaedaphne calyculata*) and many different heath species.

Prairie Fen

Prairie fen is a wetland community dominated by sedges, grasses, and other graminoids that occurs on moderately alkaline organic soil and marl south of the climatic tension zone in southern Lower Michigan. This vegetative community occurs where cold, calcareous, groundwater-fed springs reach the surface. The flow rate and volume of groundwater through a fen strongly influence vegetation patterning; thus, the community typically contains multiple, distinct zones of vegetation, some of which contain prairie grasses and forbs. The community is frequently found along both small lakes and the upper reaches of streams and rivers. Upland areas are oak forests, historically oak openings. These plant communities are complex, made of many different zones (flat, sedge meadow, marl flat, etc.) and with high species diversity.

G.3.2.3 Vernal Wetland

These are six small wetland areas with sandy clay bottoms imbedded in different vegetation communities, mostly forest but one is surrounded by shrub swamp.

G.3.3 OTHER

This category captures all other vegetation types that do not fit into an established MNFI category.

G.3.3.1 Regrowth Forest

By acreage, the largest category is the potential plant alliance, areas which were originally wooded (i.e., forest, savanna, or barrens) but were cleared for agriculture and now contain fairly young native and/or non-native trees (Thomas et al. 2009). Currently, these areas consist of young red maples, black oaks, sassafras, or stands of young black locust and do not easily map to existing MNFI or NVC communities. Continued management of these areas could encourage them to shift toward the native oak communities.

G.3.3.2 Field

Fields on FCTC consist of areas containing native and/or non-native grass, herbaceous, and shrub species. These fields are usually dry- mesic with sandy soils on flatter areas and could remain grasslands or shift into woodlands depending upon management. Some of these areas have been planted with native prairie grass to facilitate recovery.

G.3.3.3 Developed

Developed areas, also referred to as turf and/or landscaped areas, are located primarily in the cantonment area and around the range facilities. It is the responsibility of FCTC Environmental (ENV)

and Department of Public Works (DPW) to implement the FCTC Mowing SOP (MIARNG 2019) and to follow the MDMVA's 2014 Integrated Pest Management Plan and Integrated Pest Management (IPM) standards (DLZ 2017). Per ARMY TM 5-630, Section 15-13 Mowing, mowing on Fort Custer will support training as well as protect wildlife and habitat.

It is necessary for turf areas in the cantonment area and roadside areas to be mowed regularly during the growing season. Fence lines for Fort Custer are mown bi-weekly through the growing season (March through September) with an herbicide consistent with label usage to avoid extensive trimming (DLZ 2017). These frequently-mown areas are kept below eight inches in height to discourage wildlife from using them and to maintain their compact and low-growth formation (MIARNG 2019), preventing harm to wildlife during mowing and preventing habitat from growing in those area where regular mowing is needed for safety and maintenance reasons.

Fort Custer supports habitat restoration for pollinators and protection of their habitat (MIARNG 2019). For areas planted as pollinator habitat, mowing takes place with a push bar in front of the mower to flush wildlife, occurs at a slow rate of speed, and is either cut higher than for turf grass (minimum of 12 to 16 inches) or is mown in patches to ensure that some pollinator habitat is left intact (MIARNG 2019). Mowing is discouraged for 2 to 3 years following seeding. There are small areas that are landscaped with native plants within the cantonment area which provide habitat for pollinators and provide native seed sources. The plants selected are native to southwest Michigan with local genotypes whenever possible.

Although mowing does not occur frequently in natural areas of Fort Custer, it is necessary to maintain roadside safety, road shoulders, ranges, bivouac areas, and to manage fuels for wildfire prevention. In natural areas, mowing is avoided completely from late May through June on the installation. Strategies to minimize wildlife impacts in natural areas are the same as for the pollinator habitats within the cantonment area (i.e. push bars, slow rate of speed, etc.). Specific policies and management actions for mowing and vegetation management in natural areas can be found in **Section 3.4.1** of the INRMP.

G.4 HIGH QUALITY NATURAL AREAS

There are eight HQNAs identified within the boundaries of Fort Custer totaling more than 300 acres, with many being wetlands (Legge et al. 1995a; DLZ 2005b; Cohen et al. 2009). As mentioned in **Section G.3.**, wetlands and associated aquatic communities have the highest species diversity and least amount of human disturbance at FCTC. Protection and management of these eight HQNAs is viewed as very important to retaining the native biological diversity of the state as well as the region. In total, six surveys have built on each other to provide the information available to date on HQNAs at Fort Custer (Legge et al. 1995c; Gross and Suding 2002; Gross et al. 2002; DLZ 2005b; Cohen et al. 2009). The most detailed descriptions of the eight HQNAs are provided in the original 1994 survey (Legge et al. 1995a), revisited and updated a decade later (DLZ 2005b), with an update in 2009 that targeted previously omitted species and focused on identifying new areas (Cohen et al. 2009). The primary objective of this project was to reassess the impact of management activities on known natural features and provide recommendations for management conflicts relating to these features. In addition, findings from other ecological studies conducted at Fort Custer were reviewed, surveys for potential new natural communities and rare species were conducted, and vascular plant taxa not previously recorded during MNFI's 1995 work were collected and vouchered. A total of 31 new plant species were found during the

surveys bringing the total known flora for Fort Custer to 835 species (Cohen et al. 2009). HQNAs have been designated as such because the minimal amount of disturbance and high degree of native species composition and structure present in these areas. Partial restoration of these communities is possible, and HQNAs commonly contain rare species. The assessment of these natural communities takes into account the global and statewide rarity of these ecosystems. Of the eight HQNAs on FCTC, four are globally vulnerable and eight are vulnerable in the State of Michigan. The areas defined as HQNAs will change over time as ecological restoration is completed and new data becomes available.

The HQNAs include a variety of community types including dry-mesic southern forests, mesic sand prairies, prairie fen, southern hardwood swamp and southern wet meadow. Four sites, totaling approximately 180 acres, have sufficient abundance and richness of the historic prairie species to still be considered true prairie or oak savanna remnants. Mott Road Prairie is one of the largest and best-known examples of an extant mesic prairie found in the state. It is the only upland prairie found at FCTC that is also considered a HQNA (Legge et al. 1995b). Prairie fens account for three of the eight HQNAs on FCTC and they are all associated with tributaries of the Kalamazoo River and/or from hillside seeps and springs. These areas are depicted on **Map 6 in Appendix B. Table G-3** includes a summary of each of the HQNAs. Additional information on management of these areas is provided in **Section 3.4.1**.

Table G-3. High Quality Natural Areas on Fort Custer Training Center, Michigan

Name	Community Type	Acres	Rank	Conservation Value	Location
Cemetery Complex Ridge	Dry-Mesic Southern Forest	33	G4S3	<ul style="list-style-type: none"> ▪ Large metapopulation of goldenseal which extends into the Cemetery Complex Seeps ▪ American ginseng common at headwaters with showy orchis on slopes 	TA 4
Whitman Lake Woods	Dry-Mesic Southern Forest	114	G4S3	<ul style="list-style-type: none"> ▪ Beaked agrimony present in the southern location ▪ Vernal pools in northern location ▪ Beaver activity near Whitman Lake 	Impact Area, TA 5 and 6
Mott Road Prairie	Mesic Sand Prairie (formerly dry-mesic sand prairie)	2.5	G2S1	<ul style="list-style-type: none"> ▪ Reclassified as mesic sand prairie following 2008 survey ▪ One of only eight occurrences in Michigan 	TA 7
Mott Road Fen	Prairie Fen	7	G3S3	<ul style="list-style-type: none"> ▪ New occurrence of goldenseal found in southern portion ▪ Cut-leaf water parsnip present ▪ sphagnum hummocks and ant mounds are present. 	TA 5 and 7
Territorial Road Fen	Prairie Fen	8	G3S3	<ul style="list-style-type: none"> ▪ Newly documented (2008 survey). ▪ New occurrence of Virginia flax ▪ Leadplant (special concern) was reconfirmed in this area ▪ Beaver activity has altered hydrology in the area 	Impact Area, TA 8 and 9
Whitman Lake Fen	Prairie Fen	13	G3S3	<ul style="list-style-type: none"> ▪ Upland boneset (state threatened) was found in 2007 on the west side of this HQNA. ▪ Queen-of-the-prairie (state threatened) occurs on the northwestern shore of Whitman Lake ▪ Cut-leaf water parsnip (state threatened) present ▪ Beaver activity has altered hydrology in the area and promoted marsh and meadow habitat. 	Impact Area/TA 8
Cemetery Complex Seeps	Southern Hardwood Swamp	9	G3S3	<ul style="list-style-type: none"> ▪ New occurrence of red mulberry (state threatened) found ▪ Cut-leaf water parsnip (state threatened) found ▪ Very large metapopulation of goldenseal (state threatened) was reconfirmed in this area and extends into the Cemetery Complex Ridge 	TA 4

Table G-3. High Quality Natural Areas on Fort Custer Training Center, Michigan

Name	Community Type	Acres	Rank	Conservation Value	Location
42nd Road Seep	Southern Wet Meadow	4	G4S3	<ul style="list-style-type: none"> ▪ New occurrence of goldenseal (state threatened) found ▪ Reclassified as southern wet meadow after 2008 surveys 	TA 3
Total		190.5			
<p>RANK G1 = critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. G2 = imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range. G3 = either very rare and local throughout its range or found locally in a restricted range or because of other factor(s) making it vulnerable to extinction throughout its range. G4 = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. S1 = critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation in the state. S2 = imperiled in state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. S3 = rare or uncommon in state. Source: (DLZ 2005b; Cohen et al. 2009; Kornoelje 2017)</p>					

Cemetery Complex Ridge is a high-quality example of Dry-mesic Southern Forest, with inclusions of Mesic Southern Forest. It occurs on moderate to steep slopes adjacent to Cemetery Complex Seeps (high-quality southern hardwood swamp). It is a second growth forest with many trees more than 130 years old and large diameter oaks dominating the overstory. Seeps occur at the base of slopes and support the Cemetery Complex Seeps. A very large metapopulation of goldenseal (state threatened) was reconfirmed in this area and extends into the Cemetery Complex Seeps. American ginseng (*Panax quinquefolius*; state threatened) are common in the headwaters, while showy orchis (*Galearis spectabilis*; state threatened) occurs on slopes. Prescribed fire has been reintroduced to reduce invasive plants.

Whitman Lake Woods, similar to Cemetery Complex Ridge, is a high quality example of Dry-mesic Southern Forest (<https://mnfi.anr.msu.edu/communities/description/10685/Dry-mesic-Southern-Forest>). This HQNA occurs in two large blocks; the northern portion is adjacent to the Whitman Lake Fens and the southern portion is located just below it adjacent to kettle depressions near the FCTC boundary. The northern portion contains many vernal pools underlain by clay. Both locations are dominated by large-diameter oaks, and prescribed fire has been reintroduced, reducing the density of understory vegetation.

Mott Road Prairie is a newly-documented mesic sand prairie (formerly dry-mesic sand prairie), a community that is extremely rare in the state of Michigan (only eight are documented in the state of Michigan) (<https://mnfi.anr.msu.edu/communities/description/10696/Mesic%20Sand%20Prairie/>). This HQNA is located in a depression that was located in a historic oak opening. It was likely grazed or plowed in the past. Many forbs and scattered patches of grass make up this community and it has high species diversity with fluctuating water levels.

Mott Road Fen is high quality example of prairie fen (<https://mnfi.anr.msu.edu/communities/description/10667/Prairie%20Fen/>). This HQNA occurs in two patches on either side of Mott Road on sloping peat with groundwater-fed streams and many seeps in central west portion of the installation. Recent reintroduction of fire has reduced woody species, improved diversity, and expanded the extent of the HQNA. Deep peat, groundwater minerals, and other conditions create a highly diverse community with structural heterogeneity, composed of unique and well-developed sphagnum moss hummocks and structural heterogeneity. Several state threatened species are present in this community.

Territorial Road Fen is a vulnerable community both globally and in the state of Michigan (<https://mnfi.anr.msu.edu/communities/description/10667/Prairie%20Fen/>); it was documented as a new HQNA in 2008 surveys and occurs in the Impact Area in the north central portion of the installation, along a stream drainage. The source of water for this community groundwater fed streams and seeps on sloping peat mounds. It is a highly diverse community as with other fens on FCTC. This HQNA is characterized by soils with deep peat, groundwater minerals, and other conditions creating sphagnum hummocks. Prescribed fire application has reduced woody vegetation and increased diversity. A new occurrence of Virginia flax (state threatened) was found in a narrow band of forest on a west-facing slope. Leadplant (state special concern) was reconfirmed and has expanded as a result of prescribed burns in this HQNA.

Whitman Lake Fen is a prairie fen fed by groundwater-fed streams and seeps (<https://mnfi.anr.msu.edu/communities/description/10667/Prairie%20Fen/>). Several patches of prairie fen on sloping peat mounds in this HQNA and to the east of the Whitman Lake Woods. Deep peat, groundwater minerals, and other conditions creating sphagnum hummocks, and ant mounds are present. The combination of prescribed fire, beaver activity, and soil conditions provide the structural heterogeneity that results in a highly diverse plant community, which has expanded in size.

Cemetery Complex Seeps is a community rare in Michigan and globally rare (<https://mnfi.anr.msu.edu/communities/description/10655/Southern%20Hardwood%20Swamp/>). It is a narrow drainage between steeply sloped uplands. It is highly diverse, made up of a mosaic of calcareous seeps and rich, mesic southern forest. The Cemetery Complex Seeps are located adjacent to Cemetery Complex Ridge (high-quality dry-mesic southern forest) and contains inclusions of mesic southern forest. This HQNA is made up of many braided streams that drain downhill into a creek that forms at the base of the slopes in the western portion of the installation. This drainage should be protected in conjunction with the adjacent Cemetery Complex Ridge. Prescribed burns should be scheduled in this HQNA carefully to avoid negative impacts to rare plants; the newly-discovered occurrence of red mulberry was found to be top-killed after an early spring prescribed burn.

42nd Road Seep is the only southern wet meadow on FCTC and is one of only 21 occurrences in Michigan; it was previously classified as prairie fen but based on hydrology, soils, and vegetation it was reclassified (<https://mnfi.anr.msu.edu/communities/description/10657/Southern%20Wet%20Meadow/>). This HQNA occurs in a narrow drainage channel that occurs on the far east side of the installation in two pockets. Groundwater seepage supports southern wet meadow intermixed with southern shrub-carr and southern hardwood swamp. This HQNA is diverse and is dominated by herbaceous species.

The State of Michigan's Wildlife Action Plan (WAP) values the preservation and restoration of HQNAs. The WAP management recommendations are discussed in **Section 1.4.4** of the INRMP.

G.5 INVASIVE SPECIES

Given the historical land use (extensive plowing and land-clearing), current land use (training and management), location, and climate, numerous invasive species have become established on FCTC. Several have been documented and a number of others have the potential to occur. Invasive plant surveys and control measures have been occurring on a semi-regular basis for more than 20 years on FCTC (see report summaries in **Appendix D**). As a result of these activities, purple loosestrife (*Lythrum salicaria*) is now considered either extirpated from FCTC or require only minimal maintenance due to the use of the biocontrol beetle *Galerucella calmriensis*. Phragmites (*Phragmites australis*) has been significantly reduced on the installation. An integrated pest management approach is always used to manage invasive species, along with the early detection and treatment.

A changing climate in Michigan, trending to warmer and possibly wetter weather (see **Appendix I**), will affect the spread and impact of invasive species. Climate modeling combined with known information about invasive species can help identify which invasive species may be pre-adapted to a climate similar to Michigan's current and future climate. The threat caused by invasive species can be ranked based on their natural history, how current invasive species expand their distribution, and whether or not they

are already present within the state. Wisconsin has already completed such an evaluation for plant species. Given that its climate is very similar to Michigan, we have imported climate risk information for invasive species in **Table G-4** below.

G.5.1 INVASIVE PLANTS

Fort Custer has documented 151 species of non-native plants and 16 species of these are priority non-native, invasive plants. The number of invasive plants on FCTC is less than 2% of the total number of plants documented on the installation (see **Appendix E** for a complete species list). The greatest concern for invasive plants at Fort Custer is when they occur in or near HQNAs, where invasive plants can have a significant negative impact on native plants and animals. Because of this, the latest invasive plant species survey focused on HQNAs, but also included previously unsurveyed areas and updated existing data (Kornoelje 2017).

Invasive species have been noted as an issue on FCTC since the first comprehensive survey was conducted in 1995. Reports summarizing invasive plant surveys include the following (see **Appendix D** for abstracts for each report):

- Kornoelje, A. 2017. Fort Custer Training Center Invasive Species Survey, 2016. Kalamazoo, MI.
- Wick, A. A. 2016. Prescribed Fire Monitoring at Fort Custer Training Center: 2016. Kalamazoo, MI.
- Cohen, J.G., O'Connor, R.P., Barton, B.J., Cuthrell, D.L., Higman, P.J., and Enander, H.D. 2009. Fort Custer Vegetation and Natural Features Survey 2007-2008 Report (Report 2009-04). Michigan Natural Features Inventory, Lansing, MI.
- Gross, K.L., and Suding, K.N. 2002. Site-specific ecological restoration plans for prairie-savanna and prairie-fen communities at the Fort Custer Training Center (FCTC), Augusta, Michigan. Kellogg Biological Station and Michigan State University, Hickory Corners, MI.
- GLEM has conducted invasive plant treatments since 2011. These treatments have occurred consistently at Whitman Lake and Mott Fen and sporadically elsewhere on the installation.
 - GLEM. (2011). Summary of Land Management at Fort Custer Training Center for 2010 & 2011. Kalamazoo, MI.
 - GLEM. (2015). Summary of Land Management at Fort Custer Training Center for 2014 & 2015. Kalamazoo, MI.
 - GLEM. (2016). 2016 Work Completed as of 22 July 2016 for CGJMTC and FCTC. Kalamazoo, MI.
 - GLEM. (2017). 2017 Work Completed for CGJMTC and FCTC. Kalamazoo, MI.
 - GLEM. (2018). 2018 Work Completed for CGJMTC and FCTC. Kalamazoo, MI.
- DLZ. 2005. Resource Management in High Quality Natural Areas, Fort Custer Training Center, Augusta, Michigan. DLZ Michigan and Potawatomi RC & D, Lansing, MI.
- Legge, J. T., Higman, P. J., Comer, P. J., Penskar, M. R., & Rabe, M. L. 1995. A Floristic and Natural Features Inventory of Fort Custer Training Center, Augusta, Michigan (Report 1995-13). Lansing, MI.
- Invasive plant surveys on FCTC have been conducted alongside long term, annual surveys of established plots from 1998 – 2018 as part of the RTLA program to assess various management issues (Envirologic 2000, 2001, 2002; Tanis 2003, 2005, 2006a, 2006b, 2009, 2010, 2011; Yocum and Tanis 2014, 2015, 2016, 2017; Yocum 2018).

Table G-4 summarizes the known and potential priority invasive plant species on FCTC, along with their climate response/risk and state ranking. Every species has a summary on the MISIN website and the

hyperlink is provided as part of the scientific name in the table. **Table G-5** identifies those invasive plants not yet documented in Michigan, but if they were to occur would be considered a priority for management at FCTC.

Table G-4. Priority Invasive Plant Species for Fort Custer Training Center, Michigan				
Common Name Scientific Name	Climate Risk (Y/N)	State Rank¹	Fort Custer	Abundance²
Terrestrial Plants				
Norway maple <i>Acer platanoides</i>	N	-	Documented	-
Tree of heaven <i>Ailanthus altissima</i>	N	-	Documented	Rare in forested areas
Garlic mustard <i>Alliaria petiolate</i>	N	-	Documented	Common
European alder <i>Alnus glutinosa</i>	N	-	Potential	-
Japanese barberry <i>Berberis thunbergii</i>	N	-	Documented	Rare to Common
Flowering rush <i>Butomus umbellatus</i>	N	Restricted	Potential	-
Oriental bittersweet <i>Celastrus orbiculate</i>	N	-	Documented	Rare to Common
Spotted knapweed <i>Centaurea stoebe</i>	N	Prohibited, Noxious Weed	Documented	Common in grassland areas
European swamp thistle <i>Cirsium palustre</i>	N	-	Potential	-
<i>Dioscorea oppositifolia</i>	N	Watch List	Potential	-
Russian olive <i>Elaeagnus angustifolia</i>	Y ^A	-	Potential	-
Autumn olive <i>Elaeagnus umbellata</i>	N	Restricted	Documented	Rare to Common
Leafy spurge <i>Euphorbia esula</i>	N	Prohibited, Noxious Weed	Potential	-
Reed mannagrass <i>Glyceria maxima</i>	N	-	Potential	-
Baby's breath <i>Gypsophila paniculata</i>	N	-	Potential	-
Giant hogweed <i>Heracleum mantegazzianum</i>	N	Prohibited	Potential	-
Dame's rocket <i>Hesperis matronalis</i>	N	-	Documented	Common in open areas
St. John's wort <i>Hypericum perforatum</i>	N	-	Documented	Rare to Common
Himalayan balsam <i>Impatiens glandulifera</i>	N	Watch List	Potential	-
Red honeysuckle <i>Lonicera dioica</i>	N	-	Documented	-

Table G-4. Priority Invasive Plant Species for Fort Custer Training Center, Michigan

Common Name Scientific Name	Climate Risk (Y/N)	State Rank ¹	Fort Custer	Abundance ²
Amur honeysuckle Lonicera maackii	N	-	Documented	-
Morrow honeysuckle Lonicera morrowii	N	-	Documented	-
Hybrid honeysuckle/Bells honeysuckle Lonicera x bella	N	-	Documented	-
Honeysuckle <i>Lonicera spp.</i>	N and Y* ^C	-	Potential	-
White sweet clover Melilotus alba	N	-	Documented	Common
Wild parsnip Melilotus officinalis	N	-	Potential	-
Japanese stiltgrass <i>Microstegium vimineum</i>	N	Watch List	Potential	-
Starry stonewort <i>Nitellopsis obtusa</i>	N	Prohibited	Potential	-
Reed canary grass <i>Phalaris arundinacea</i>	Y ^A	-	Documented	-
Invasive phragmites, giant reed Phragmites australis	Y ^A	Restricted	Top Priority, Documented	Occasional
Canada bluegrass Poa compressa	N	-	Documented	Occasional to Common
Japanese knotweed Polygonum cuspidatum	N	Prohibited	Potential	-
Giant knotweed Polygonum sachalinensis	N	-	Potential	-
Kudzu Pueraria montana var. lobata	N	Watch List	Potential	-
Common buckthorn Rhamnus cathartica	N	-	Potential	-
Glossy buckthorn Frangula alnus	N	-	Documented	Rare to Common
Black locust Robinia pseudoacacia	N	-	Documented	Common sometimes entire overstory
Multiflora rose Rosa multiflora	N	-	Documented	Rare to Common
Climbing nightshade Solanum dulcamara	Y ^A	-	Documented	Common
Common chickweed <i>Stellaria media</i>	Y ^A	-	Documented	Common
Red clover Trifolium pratense	Y ^A	-	Documented	Common

Table G-4. Priority Invasive Plant Species for Fort Custer Training Center, Michigan

Common Name Scientific Name	Climate Risk (Y/N)	State Rank ¹	Fort Custer	Abundance ²
Narrow-leaved cattail Typha angustifolia	N	-	Documented	Occasional to Common
Common periwinkle Vinca minor	N	-	Potential	-
Black swallow-wort Vincetoxicum nigrum	N	-	Potential	-
Pale swallow-wort Vincetoxicum rossicum	N	-	Potential	-
Aquatic Plants				
Common yarrow Achillea millefolium	Y ^A	-	Documented	Occasional to Common
Redtop Agrostis gigantea	Y ^A	-	Documented	Occasional to Common
Wild garlic <i>Allium vineale</i>	Y ^B	-	Potential	-
European alder Alnus glutinosa	Y ^A	-	Documented	Occasional to Common
Annual ragweed <i>Ambrosia artemisiifolia</i>	Y ^A	-	Documented	Common
Orchardgrass Dactylis glomerata	Y ^A	-	Documented	Occasional to Common
European frog-bit Hydrocharis morsus-ranae	N	Watch List, Prohibited, Noxious Weed	Potential	-
Purple loosestrife Lythrum salicaria	N	Restricted	Documented	Occasional to Common
European water clover Marsilea quadrifolia	Y ^B	Watch List	Potential	-
Parrot feather Myriophyllum aquaticum	Y ^C	Watch List, Prohibited	Potential	-
Eurasian watermilfoil Myriophyllum spicatum	N	Restricted	Potential	-
White mulberry Morus alba	Y ^A	-	Documented	Occasional to Common
Yellow floating heart <i>Nymphoides peltata</i>	N	Watch List, Prohibited	Potential	-
Water lettuce <i>Pistia stratiotes</i>	N	Watch List	Potential	-
Curly pondweed <i>Potamogeton crispus</i>	N	Restricted	Potential	-
Curly dock Rumex crispus	Y ^A	-	Documented	Occasional to Common

Table G-4. Priority Invasive Plant Species for Fort Custer Training Center, Michigan

Common Name Scientific Name	Climate Risk (Y/N)	State Rank ¹	Fort Custer	Abundance ²
<p>¹ State Rankings are provided by Michigan Department of Agriculture under the Natural Resources and Environmental Protection Act (451 of 1994, as amended); Part 413, Section 324.41301 defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species; Part 33, Section 33 defines permitted actions and procedures for the treatment of aquatic nuisance species; Noxious Weeds under Michigan Law: Michigan Seed Law (Act 329 of 1965) and Regulations 715 (Under Act 329) Seed Law Implementation.</p> <p>² Priority species identified and abundance summarized in Kornoelje 2017.</p> <p>^A On the list of top 20 threatening aquatic and wetland species already in Wisconsin. No similar evaluation exists for Michigan.</p> <p>^B On the list of top 20 threatening aquatic and wetland species yet to enter Wisconsin. No similar evaluation exists for Michigan.</p> <p>^C On the list of species which may become problematic under future climates.</p> <p>*<i>Lonicera sempervirens</i></p> <p>Noxious Weeds: https://www.michigan.gov/mdard/0,4610,7-125-1569_16993-11250--,00.html</p> <p>Watch List: https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html</p> <p>Laws: https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html</p> <p>Sources: (Wick 2016; Kornoelje 2017; MDARD 2017; Granberg 2018; MISIN 2018; USFWS 2018a; Michigan Invasive Species Program 2018)</p>				

Table G-5. Priority Invasive Plant Species Not Yet Found in Michigan		
Scientific Name Common Name	Climate Risk (Y/N)	State Rank¹
Terrestrial Plants		
Asiatic sand sedge <i>Myriophyllum aquaticum</i>	Y ^C	Watch List
Mile-a-minute weed <i>Persicaria perfoliatum</i>	N	Watch List
Aquatic Plants		
Sessile joyweed <i>Alternanthera sessilis</i>	Y ^C	-
Small carpetgrass <i>Arthraxon hispidus</i>	Y ^C	-
Giant reed <i>Arundo donax</i>	Y ^C	-
Orange eye butterflybush <i>Buddleja davidii</i>	Y ^C	-
Brazilian elodea <i>Egeria densa</i>	Y ^B	Watch List, Prohibited
Water hyacinth <i>Eichhornia crassipes</i>	N	Watch List
Hydrilla <i>Hydrilla verticillata</i>	N	Watch List, Prohibited
Swamp morning-glory <i>Ipomoea aquatica</i>	Y ^C	-
Stinking willie <i>Jacobaea vulgaris</i>	Y ^B	-
Japanese clover <i>Kummerowia striata</i>	Y ^C	-
Chinese privet <i>Ligustrum sinense</i>	Y ^B	-
Pestilence wort <i>Petasites hybridus</i>	Y ^B	-
Oriental lady's thumb <i>Polygonum caespitosum</i>	Y ^B	-
Tall buttercup <i>Ranunculus acris</i>	Y ^A	-
Wine raspberry <i>Rubus phoenicolasius</i>	Y ^B	-
Pale dock <i>Rumex altissimus</i>	Y ^B	-
Arrowhead <i>Sagittaria sagittifolia</i>	Y ^B	-
White willow <i>Salix alba</i>	Y ^A	-
Weeping willow <i>Salix babylonica</i>	Y ^B	-
Kariba-weed <i>Salvinia molesta</i>	Y ^C	-

Table G-5. Priority Invasive Plant Species Not Yet Found in Michigan		
Scientific Name Common Name	Climate Risk (Y/N)	State Rank ¹
Water soldier <i>Stratiotes aloides</i>	N	Watch List, Prohibited
Smallflower tamarisk <i>Tamarix parviflora</i>	Y ^C	-
Water chestnut <i>Trapa natans</i>	Y ^B	Watch List, Prohibited
<p>¹ State Rankings are provided by Michigan Department of Agriculture under the Natural Resources and Environmental Protection Act (451 of 1994, as amended); Part 413, Section 324.41301 defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species; Part 33, Section 33 defines permitted actions and procedures for the treatment of aquatic nuisance species; Noxious Weeds under Michigan Law: Michigan Seed Law (Act 329 of 1965) and Regulations 715 (Under Act 329) Seed Law Implementation.</p> <p>^A On the list of top 20 threatening aquatic and wetland species already in Wisconsin. No similar evaluation exists for Michigan.</p> <p>^B On the list of top 20 threatening aquatic and wetland species yet to enter Wisconsin. No similar evaluation exists for Michigan.</p> <p>^C On the list of species which may become problematic under future climates.</p> <p>Noxious Weeds: https://www.michigan.gov/mdard/0,4610,7-125-1569_16993-11250--,00.html Watch List: https://www.michigan.gov/invasives/0,5664,7-324-68002_74188--,00.html Laws: https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html Source: (MDARD 2017; Granberg 2018; MISIN 2018; USFWS 2018a; Michigan Invasive Species Program 2018)</p>		

Invasive plant species widespread throughout Michigan, such as glossy buckthorn, autumn olive, multiflora rose, and Oriental bittersweet, represent the majority of priority invasive plant species on FCTC. Japanese stilt grass is established in forests south of the state and is on the watch list for FCTC.

The most common invasive species in HQNAs on FCTC are garlic mustard, Japanese barberry, Oriental bittersweet, autumn olive, invasive phragmites, glossy buckthorn, multiflora rose, purple loosestrife, and narrow-leaved cattail (Kornoelje 2017), although these species occur throughout FCTC to varying degrees. Invasive plants are also documented as part of the prescribed burn monitoring program. Oriental bittersweet, garlic mustard, and multiflora rose were the three most common invasive shrubs in forested areas, while autumn olive was a common invasive present in the grasslands areas (Wick 2016).

Galerucella beetles have been released to control the purple loosestrife populations on the installation, with regular monitoring between 2002-2010. The beetles have proven to be a successful biocontrol for purple loosestrife. Suggestions for locations for further beetle treatments are provided in the latest invasive plant survey (Kornoelje 2017). Invasive plants that continue to present a significant problem are wetland species such as glossy buckthorn and phragmites.

Invasive plant management is discussed further in **Section 3.6** of the INRMP.

G.5.2 TREE DISEASES AND PESTS

Threats to forest health are present in every forest community. Abiotic (e.g. weather, climate, soil type) and biotic (e.g. species competition, wildlife damage, human usage) factors can influence or predispose both individual trees or a forest community to infestation. In response, trees and forests have developed responses to combat health threats. However, introduced pests, both insects and pathogens, and stresses induced by a changing climate challenge a forest's normal response actions. As such Michigan's forests face an existential threat to their productivity and sustainability. The forested landscape of Fort Custer is no exception, so the Environmental staff actively monitor for threats to forest health that can potentially outpace a forest's native ability to cope with and weather pests and pathogens.

The Fort Custer Environmental office works with local, regional and federal partners to monitor for potential forest pathogens and pests. Fort Custer is federal land and is slated for forest pest and disease inventory in 2020, in cooperation with the US Department of Agriculture as part of the Forest Health Protection Program. Certified consulting foresters for Fort Custer regularly monitor for pests and pathogens while helping execute the forestry program on the installation. FCTC Environmental staff are updated regularly by MDNR Forestry, as well as invasive species public outreach notices and online groups.

The forest pests and pathogens listed in this section, if left unchecked or unnoticed, have the potential to change the forest composition in the southwest Michigan with potentially negative results to forest composition, structure and productivity. **Table G-6** summarizes the priority tree diseases and insect tree pests identified in the Michigan invasive rankings and whether the species has been documented on FCTC.

Table G-6. Priority Tree Diseases and Invasive Insects for Fort Custer Training Center, MI				
Scientific Name	Common Name	Trees Affected	State Rank¹	Fort Custer²
Tree Diseases				
<i>Bretziella fagacearum</i>	Oak wilt	Red oaks	-	Top Priority, Documented
<i>Cryptococcus fagisuga</i> + <i>Neonectria spp.</i>	Beech Bark Disease (BBD)	Beech trees	-	Monitoring
<i>Geosmithia morbida</i> *	Thousand Cankers Disease	Black walnuts	Watch List	Monitoring
Insect Tree Pests				
<i>Adelges piceae</i> *	Balsam woolly adelgid	True fir trees	Watch List	-
<i>Agrilus planipennis</i>	Emerald ash borer	Ash trees	Prohibited	Documented
<i>Anoplophora glabripennis</i> *	Asian long-horned beetle	Many tree species, prefers maples	Watch List, Prohibited	Priority
<i>Lycorma delicatula</i> *	Spotted lanternfly	Commercial fruit trees; oak, willow, maple, sycamore	Watch List	Watch list
<i>Lymantria dispar</i>	Gypsy moth	Many tree species, prefers oak and aspen	-	Documented
*Indicates species is not yet detected in Michigan				

¹State Rankings are provided by Michigan Department of Agriculture under the Natural Resources and Environmental Protection Act (451 of 1994, as amended); Part 413, Section 324.41301 defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species; Part 33, Section 33 defines permitted actions and procedures for the treatment of aquatic nuisance species; Noxious Weeds under Michigan Law: Michigan Seed Law (Act 329 of 1965) and Regulations 715 (Under Act 329) Seed Law Implementation.

² Documented indicates species known to occur on Fort Custer.

Diseases: https://www.michigan.gov/invasives/0,5664,7-324-68002_71242---,00.html

Watch List: https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html

Laws: <https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html>

Source: (Michigan's Invasive Species Program 2018)

Oak Wilt kills healthy red oaks. White oaks can also be affected but are more resistant and less vulnerable to mortality from the disease. Once a red oak becomes infected with the oak wilt fungus, the tree will die, and there is no treatment to save the infected tree. Once an oak wilt infection is confirmed, however, treatments are available to save surrounding oaks and stop the spread of this disease.

Oak wilt moves slowly on its own through root systems and travels short distances overland when new spores are moved by beetles from an infected tree to a freshly pruned or injured tree. Oak wilt can be moved long distances when people move infected firewood from one location to another. Look for red oaks that suddenly drop their leaves in the summer. The disease spreads, killing nearby oaks from one year to the next. Currently, oak wilt is generally distributed throughout the Midwest and Texas.

The MDNR has documented oak wilt in Kalamazoo County with many sites near the Fort Custer Training Center, including on the FCRA (see the [MDNR Oak Wilt Mapper](#) for latest data). Fort Custer prevents the spread of oak wilt by disallowing the cutting of trees when they are vulnerable during the growing season (April 1 to October 1).

Emerald ash borer (EAB) is an exotic insect from Asia. The EAB is a wood-boring beetle that was first discovered in Michigan the summer of 2002 near Detroit. The adult EAB is dark metallic green in color, one half-inch in length and one-sixteen-inch wide and is 100% fatal to ash trees. There is currently no effective control of the EAB other than quarantine to prevent its spread. Under the quarantine it is illegal to transport ash wood products or any hardwood firewood out of the quarantined areas. The entire lower peninsula of Michigan is under quarantine, and so all of Fort Custer is included (MDARD 2016). EAB has killed a majority of the mature ash trees that were present on Fort Custer, but they did not represent a large fraction of the Fort Custer forest community prior to EAB arrival. Young ash trees continue to sprout, but upon reaching mid-maturity are taken by EAB.

Asian long-horned beetle – Working with partners at Michigan State University and the Calhoun Conservation District, Fort Custer Environmental staff support annual monitoring of forest insects, with a focus on beetles, at the Harts Lake property that is contiguous to the eastern boundary of the installation.

Gypsy moth is a non-native insect that has the potential to have a significant impact on natural resources at Fort Custer. Oak leaves are a favorite food of this pest and Fort Custer's oak-dominated forests are particularly vulnerable to defoliation. Fort Custer has monitored gypsy moth in the past using fall egg mass surveys and summer canopy defoliation assessments, but they are not prevalent at this time. The moth is known to be present on the post and outbreaks requiring control have occurred near and across the installation. When egg mass counts make it necessary to treat this pest with control

agents, FCTC coordinates with the USFS and the Michigan Department of Agriculture. The control agent used in the past was an aerial spraying of the microbial insecticide, *Bacillus thuringiensis var. kurstaki*. This biological control agent is available by a variety of manufacturers and has been used extensively in suppression of gypsy moth in Michigan. Other biological control methods available include the pathogenic fungus, *Entomophaga maimaiga*, and the nucleopolyhedrosis virus. However, the extent of control offered by these two pathogens has not been solidly established. The use of a chemical insecticide such as diflubenzuron is also available as a treatment option.

G.5.3 INVASIVE ANIMALS

Michigan has a list of prohibited terrestrial and aquatic animals that have been confirmed in the state. Some of these species may be present or are likely to occur in the near future on Fort Custer. These species also have the potential to cause ecological degradation through competition with other species for resources or by disturbing soils or impacting forest composition (e.g. windfall and erosion caused by widespread tree death due to forest pests). **Table G-7** summarizes the priority animals identified in for Fort Custer.

Scientific Name	Common Name	State Rank ¹	Fort Custer
Birds			
<i>Cygnus olor</i>	Mute swan	Established	Documented
<i>Felis catus</i>	Feral cats	-	Documented
<i>Orconectes rusticus</i>	Rusty crayfish	Restricted	-
<i>Passer domesticus</i>	House sparrow	-	Documented
<i>Phasianus colchicus</i>	Ring-neck pheasant	-	Documented
<i>Sturnus vulgaris</i>	European starling	-	Documented
<i>Sus scrofa</i>	Feral hog	Prohibited	-
¹ State Rankings are provided by Michigan Department of Agriculture under the Natural Resources and Environmental Protection Act (451 of 1994, as amended) Part 413, Transgenic and Nonnative Organisms. Annually, species may be added, deleted or re-classified by the legislature based on recommendations from the Natural Resources Commission or the Commission of Agriculture and Rural Development in consultation with the departments of Natural Resources and Agriculture and Rural Development. This list acts as a first line of prevention and awareness, with other supporting activities strengthening this effort. Source: (MDARD et al. 2018; Michigan Invasive Species Program 2018)			

FCTC is working in partnership with other agencies to manage invasive animal populations. Additional invasive animals are identified at <https://www.michigan.gov/invasives/0,5664,7-324-68002---,00.html>. At this time, most of the species included in **Table G-7** are considered established and management is not likely to change their status.

G.5.4 PEST-BORNE DISEASES

Pest-borne diseases are those diseases that are carried by pests and insects and affect humans. Sometimes these are called vector-borne diseases. The most common pest-borne diseases around FCTC, the host species, and a link for further information are below.

Documented in Michigan:

- Lyme disease/blacklegged tick (*Ixodes scapularis*) - www.michigan.gov/lyme
- West Nile virus/mosquitoes - www.michigan.gov/westnile
- Eastern equine encephalitis/mosquitoes - https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_77442---,00.html
- Rocky Mountain Spotted Fever (RMSF) (rare)/American dog tick (*Dermacentor variabilis*) and lone star tick (*Amblyomma americanum*) - www.michigan.gov/rmsf
- Anaplasmosis/blacklegged tick and the western blacklegged tick - https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_77938---,00.html
- Tularemia (*Francisella tularensis*) (“rabbit fever”)/mites, ticks, flies, midges, blackflies, fleas, mosquitoes and lice² - https://www.michigan.gov/dnr/0,4570,7-350-79136_79608_85016-27293--,00.html
- Ehrlichiosis (*Ehrlichia chaffeensis*, *E. ewingii*, or *E. muris eauclairensis*)/lone star tick and blacklegged tick - https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_78018---,00.html
- Epizootic Hemorrhagic Disease (EHD)/biting flies (*Culicoides* spp.) - https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_80928---,00.html

Possible in Michigan:

- Hantaviruses - <https://www.uofmhealth.org/health-library/hw191131>

With climate change and the anticipated increased temperatures in Michigan, it is expected the pest-borne diseases will shift distribution or increase in prevalence. For example, an outbreak of EHD in Michigan in 2012 was linked to abnormally hot and dry weather (Hoving et al. 2013).

Direct Impacts to Humans

Lyme Disease is caused by the bacterium *Borrelia burgdorferi* and is transmitted to humans through the bite of infected blacklegged (deer) ticks (*Ixodes scapularis*). Typical symptoms include fever, headache, fatigue, and a characteristic “bullseye” skin rash. Untreated, Lyme disease can infect joints, the heart, and the nervous system.

The number of confirmed cases of Lyme disease in Michigan over a period of ten years has more than doubled, jumping from 55 confirmed cases in 2006 to 159 in 2016 (CDC 2017). This disease is growing in the number of diagnosed cases per year in Michigan. According to the Michigan Department of Health and Human Services (MDHHS), Calhoun and Kalamazoo Counties are counties with known risks of lyme disease in 2019, either due to field collected black-legged ticks carrying the Lyme bacteria or from at least 2 confirmed local exposures (MDHHS 2019). Consult the MDHHS website for the most current information at www.michigan.gov/lyme.

West Nile virus (WNV) is most commonly transmitted to humans by mosquitoes. WNV sometimes causes a fever and rarely causes neurological disorders, with the risk being higher in those individuals over age 60. In Michigan, outbreaks of WNV have been occurring every summer since 2002. Urban areas in Southeastern Lower Michigan and Western Lower Michigan have historically seen the most West Nile

² Rabbits become infected by any number of these types of arthropods.

virus activity. The risk of infection is highest for people who work outside or participate in outdoor activities because of greater exposure to mosquitoes.

In 2018, there was one confirmed case of WNV in Kalamazoo County (MDHHS 2018). For the most current information on WNV in Michigan, see the MDHHS website at www.michigan.gov/westnile.

Rocky Mountain Spotted Fever (RMSF) is a bacterial disease caused by the bacterium, *Rickettsia rickettsia* transmitted by ticks, most commonly the American dog tick (*Dermacentor variabilis*). The American dog tick is very common in Michigan, but RMSF is rarely reported to in the state. For the most current information on RMSF in Michigan, see the MDHHS website at https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_78010---,00.html.

Anaplasmosis is caused by the bacterium *Anaplasma phagocytophilum* and is also transmitted by the bite of an infected tick, particularly the blacklegged tick (*Ixodes scapularis*) and the western blacklegged tick (*Ixodes pacificus*). This disease is characterized by fever, chills, and muscle aches. For the most current information on anaplasmosis in Michigan, see the MDHHS website at https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_77938---,00.html.

Ehrlichiosis is broadly applied to multiple different infections transmitted by an infected tick, particularly lone star tick. The disease is characterized by fever, headache, chills, and muscle aches. For the most current information on anaplasmosis in Michigan, see the MDHHS website at https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_78018---,00.html.

Indirect Impacts to Humans (Relevant for Hunters)

Tularemia (also called rabbit fever) is usually transmitted from rabbits to humans through dressing or skinning infected rabbits, although occasionally it is transmitted directly to humans through the bite of an arthropod. It is transmitted to rabbits via the bite of a variety of arthropods (e.g. ticks, mites, lice). For the most current information on rabbit fever in Michigan, see the MDHHS website at <https://www.michigan.gov/michiganprepares/0,4621,7-232--384956--,00.html>.

Chronic Wasting Disease³ is a contagious, neurological disease that affects deer, elk and moose. It causes a degeneration of the brain resulting in emaciation (abnormally thin), abnormal behavior, loss of bodily functions and death. CWD is fatal to the infected animal, but it does not transmit to humans. More information can be found on MDNR's website at https://www.michigan.gov/dnr/0,4570,7-350-79136_79608_90516---,00.html.

EHD is a viral infection carried by biting flies (*Culicoides* spp.) afflicting wild ruminants, mostly deer. Infected animals usually succumb to the infection, which causes acute hemorrhages. Meat can still be consumed in these animals and there is no evidence that the virus causing the disease infects humans. More information can be found on MDNR's website at https://www.michigan.gov/emergingdiseases/0,4579,7-186-76711_80928---,00.html.

Other Pest-Borne Diseases

There is a risk for other diseases carried by pests in Michigan, including hantaviruses and human ehrlichiosis. Hantaviruses³ are pathogens carried by, and transmitted to humans, from rodents. Humans

³ Chronic Wasting Disease is not transmitted by a vector, but it is included here as a relevant emerging disease.

can contract hantavirus infection when they come into contact with infected rodents or their urine and droppings. Ehrlichiosis is a term is broadly applied to multiple different infections; *Ehrlichia chaffeensis* and *Ehrlichia ewingii* are transmitted by the lone star tick (*Amblyomma americanum*) in the southeastern and southcentral US and the tick that transmits *Ehrlichia muris-like* has yet to be determined.

G.6 FISH AND WILDLIFE

Fish and wildlife management are tied in closely with vegetation management. Early successional forests (brushlands and timber types resulting from clearcutting or fire) provide valuable plant communities for many key wildlife game species, as well as many non-game wildlife species. More mature forests and later successional stages of the forest provide habitat for numerous other types of game and non-game wildlife species. It is important to realize the management of various cover types or featured wildlife game species also benefit a host of other game and non-game species. Because of this close association between wildlife and various cover types, wildlife species and populations are good indicators of habitat and ecosystem quality.

G.6.1 SURVEY HISTORY

A variety of surveys have been completed over the years, and these are summarized with abstracts in **Appendix D**. From 1998 – ongoing, annual surveys of established plots using standardized data collection methods (as part of LCTA/RTLA program) have been completed to assess various management issues (Envirologic 2000, 2001, 2002; Tanis 2003, 2005, 2006a, 2006b, 2009, 2010, 2011; Yocum and Tanis 2014, 2015, 2016, 2017; Yocum 2018).

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G.6.2 WILDLIFE

Comprehensive animal surveys on Fort Custer have been conducted by MNFI (Legge et al. 1995b; Cohen et al. 2009). The survey completed in 1995 targeted federally or state listed species, but all animals observed during those surveys were recorded. The updated inventory conducted in 2009 focused on rare species potentially occurring at FCTC. In 2009, a total of 407 species were documented – the current number is 500. Surveys conducted in recent years have focused on rare species that are or may be present at FCTC. There are several rare wildlife species documented on Fort Custer that are summarized in **Appendix H**. A comprehensive species list for FCTC can be found located in **Appendix E**.

Hunting and fishing opportunities at FCTC are limited. The public, through an application process, is eligible to hunt deer in the fall and turkey in the spring, and deer hunting permits are distributed in partnership with MDNR. Through FCTC's partnership with local conservation groups, spring and fall events are also held for youth and disabled hunters to hunt. These events are in addition to the general public hunting opportunities that are offered during these time frames.

Mammals have been surveyed over the years at FCTC, and currently 36 species have been documented. None of these species are federally listed, and the prairie vole (*Microtus ochrogaster*) and two other bat species are species of concern. Several special studies on white tailed deer (*Odocoileus virginianus*) ecology, forest composition, and military training have been conducted at Fort Custer.

Annual frog and toad monitoring as part of an MDNR effort and regular herptile surveys occurred on a regular basis on Fort Custer. Annual frog and toad surveys will continue using dataloggers starting in 2020. Amphibians and reptiles at Fort Custer currently total 31 documented species during two comprehensive herptile surveys and some species-specific surveys for the eastern box turtle (*Terrapene carolina carolina*) (2 reports), Blanding's turtle (*Emydoidea blandingii*) (1 report) and eastern massasauga rattlesnake (*Sistrurus catenatus*) (1 report), although the rattlesnake itself has not been documented on Fort Custer.

Migratory birds are common on Fort Custer, and several decades of avian surveys and monitoring have occurred on the installation to estimate populations, document habitats, assess the impacts of timber harvesting and training, and document how populations are changing over time. More reports (25) on birds have been generated at Fort Custer than any other animal taxa group. There are currently 204 documented species of bird on FCTC, with 17 species designated as rare. For breeding birds, the current point counts and area searches are conducted triennially, and FCTC participates in The Monitoring Avian Productivity and Survivorship (MAPS) Program. The king rail (*Rallus elegans*) was thought to be extirpated from the region, but after habitat management changes, it has returned to the area.

There are 228 species of invertebrates that have been documented on FCTC. A total of eight taxa-specific surveys have been completed for invertebrates on the installation. There are six rare insects documented on Fort Custer and one mollusk. Several rare butterflies have been surveyed for on the installation but have not been documented (e.g., KBB (*Lycaeides melissa samuelis*) and Powesheik skipperling (*Oarisma poweshiek*)).

G.6.3 FISH

Although the Kalamazoo River does not flow through Fort Custer Training Center, several tributaries, ponds, and associated wetlands are present on the installation. There is a limited amount of open water habitat for fish. This lack of accessible aquatic habitat is confounded by unexploded ordnance (UXO) present in these areas. Active management of fish and other aquatic resources is not presently occurring at FCTC, but surveys for aquatic animals and plants are planned in the near future (**Appendix C**).

Despite these limitations, there are 13 species of fish that have been documented on Fort Custer. One rare fish, the pugnose shiner, has been documented on base. There are several rare wildlife species documented on Fort Custer that are summarized in **Appendix H**. A comprehensive species list for FCTC can be found located in **Appendix E**.

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APPENDIX H
THREATENED AND ENDANGERED SPECIES

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H.1 DOCUMENTED ANIMALS

This section summarizes the documented rare animals of Fort Custer that are federally listed, state listed, and state species of special concern. In addition to rarity rankings for these species is their climate vulnerability ranking. Chapter 3 of the INRMP further discusses the factors that make these species less climate resilient and management recommendations to reduce stressors. In **Section H.1.1** and **Section H.1.2**, a table is presented followed by text discussing habitat preferences and history of documentation on Fort Custer. For all species, the MNFI link providing species summaries, habitat preferences, and county records is contained in a hyperlink embedded in the common name.

H.1.1 THREATENED AND ENDANGERED SPECIES

This section summarizes the 10 federal and state listed animal species that have been documented on Fort Custer, including the federally protected bald eagle. As shown in **Table H-1**, three animal species are considered state endangered and six animal species are considered state threatened.

Table H-1. Threatened and Endangered Animals Documented at Fort Custer Training Center			
Species	Status	CCVI (Confidence)	Comments/Habitat
Mammals			
Prairie vole <i>Microtus ochrogaster</i>	SE, S3	PS (Very High)	Dry to mesic grassland habitat and prefer thick groundcover of herbaceous vegetation. Occur in prairies, pastures, rights-of-way, and agricultural fields. Breeding season February through November.
Birds			
Henslow's sparrow ^{1,2} <i>Ammodramus henslowii</i>	SE, S3	PS ^a (Very High)	Weedy and grassy fields and meadows are utilized, usually in old field and pasture habitats. Damp areas with widely scattered shrubs are common.
Trumpeter swan <i>Cygnus buccinator</i>	ST, S3	MV ^b (High)	Use a variety of wetland types such as marshes, ponds, and lakes with nests frequently placed on muskrat houses.
Merlin ² <i>Falco columbarius</i>	ST, S3	PS ^b (Very High)	Nests are near lakeshores or other partially open areas.
Bald eagle ^{1,2} <i>Haliaeetus leucocephalus</i>	BGEPA SC, S4	IL (Moderate)	Wide variety of habitats that provide suitable nest sites close to open water. Nests may be placed in snags or large live trees as well as on constructed platforms or utility poles. They are resident (stay year round) as long as there is open water where they can forage.
King rail <i>Rallus elegans</i>	ST, S1	PS ^a (Very High)	Occur in coastal wetlands in the Great Lakes region in permanent marsh habitats along upland-wetland edges.

Table H-1. Threatened and Endangered Animals Documented at Fort Custer Training Center			
Species	Status	CCVI (Confidence)	Comments/Habitat
Cerulean warbler ^{1,2,3} <i>Setophaga cerulea</i>	ST, S3	MV ^a (Very High)	Most commonly found in the canopy of large tracts of mature deciduous forest. Prefer mesic sites over more xeric sites.
Common tern <i>Sterna hirundo</i>	ST, S2	MV ^b (Moderate)	Often nest on islands to avoid predators.
Reptiles and Amphibians			
Blanchard's cricket frog ^{1,2} <i>Acris blanchardi</i>	ST, S2S3	HV ^a (Low)	This frog is considered the most aquatic species of all treefrogs in North America and utilize open edges of permanent ponds, lakes, floodings, bogs, seeps and slow-moving streams and rivers, as well as temporary water. Prefer open or partially vegetated mud flats, deeper water, muddy or sandy shorelines, and mats of emergent aquatic vegetation.
Fish			
Pugnose shiner ^{1,2} <i>Notropis anogenus</i>	SE, S1S2	HV (Moderate)	Inhabit clear lakes and pools with vegetation and non-turbulent streams and rivers.
<p><i>Sources:</i> *USFWS Calhoun County and Kalamazoo County lists; USFWS Official Species List for Fort Custer (IPaC); Michigan County Elements Data for Calhoun¹ and Kalamazoo² Counties; MNFI Rare Species Explorer for Calhoun and Kalamazoo Counties.</p> <p>FE=federally endangered, FT=federally threatened, BGEPA=Bald and Golden Eagle Protection Act SE=state endangered, ST=state threatened S RANK: The priority assigned by MNFI based upon the element's status within the state S1 = critically imperiled in state due to extreme rarity (< 5 occurrences, very few individuals or acres) or a factor(s) making it especially vulnerable to extirpation in the state S2 = imperiled in state due to rarity (6 to 20 occurrences, few remaining individuals or acres) or a factor(s) making it very vulnerable to extirpation from the state S3 = rare or uncommon in state (21 to 100 occurrences) S4 = apparently secure in state, with many occurrences CCVI RANK: NatureServe CCVI scores for climate vulnerable Michigan species by 2050 (Hoving et al. 2013). Populations of these species may decrease globally but increase in Michigan if their populations shift northward. EV = Extremely Vulnerable (Abundance and/or range extent extremely likely to substantially decrease or disappear by 2050.) HV = Highly Vulnerable (Abundance and/or range extent likely to decrease significantly by 2050.) MV = Moderately Vulnerable (Abundance and/or range extent likely to decrease by 2050.) PS = Presumed Stable/Not Vulnerable (Available evidence does not suggest that abundance and/or range extent will change (increase/decrease) substantially by 2050. Actual range boundaries may change. IL = Increase Likely ^a The CCVI output included the caveat that "Species may expand range in assessment area." ^b The CCVI output included the caveat that "Species range may shift and perhaps leave the assessment area."</p>			

Prairie vole (*Microtus ochrogaster*): <https://mnfi.anr.msu.edu/species/description/11451/Microtus-ochrogaster>

The prairie vole was first recorded on FCTC in 1994 (Legge et al. 1995a) in a degraded field used for military training (Area 7 PVA). Given that it was the only known population of the state-threatened species in Michigan, a monitoring study was initiated. A total of thirteen reports summarizing

monitoring efforts over the last 25 years have been generated (Legge 2012, 2014, 2017, 1995, 1996, 2002, 2003, 2004, 2005, 2006, 2007; Cooper 1997, 2000). The prairie vole has been documented on FCTC in the following surveys:

- Four monitoring reports were generated in the 1990s, following training restrictions in the known area containing the prairie vole population on FCTC (Legge 1995, 1996; Cooper 1997, 2000). The first outlined the location of the prairie vole population south of Territory Road on a portion of a degraded field. The population of prairie voles fluctuated over the years. Continued vehicular restrictions on the southern portion of the field and maintenance of dense herbaceous cover were recommended, along with continued monitoring.
- In the next decade (2000-2010), the first report was generated in 2002, three years after the previous survey in 1999 (Legge 2002). The 2002, 2003, and 2004 reports indicated that management efforts had been successful in maintaining and increasing prairie vole habitat, but the 2005 survey indicated a decline in the population (Legge 2002, 2003, 2004, 2005). The 2006 and 2007 surveys showed that the population had rebounded and that the limits to vehicular traffic on the south side of the study area did not necessarily align with greater success of prairie voles (i.e. the northern site, where military vehicle use was continuing, saw the greatest increase in prairie vole numbers) (Legge 2006, 2007b).
- From 2010-2017, three reports indicated that the population was similar to the previous decade, with fluctuations occurring as in years past (Legge 2012, 2014). In 2017, the prairie vole was not documented during surveys – this also occurred in 1996 – though the species is assumed to be present, just in lower numbers (Legge 2017). Encroachment of woody species and less abundance of brome grass (*Bromus inermis*) in 2017 were noted as possible cause for the lack of captures.

Henslow's sparrow (*Ammodramus henslowii*):

<https://mnfi.anr.msu.edu/species/description/11221/Ammodramus%20henslowii/>

A single Henslow's sparrow nest with two birds in it was found in the 2006 field season on FCTC property (Miller et al. 2006). Further studies are needed to determine the status of this state threatened species on FCTC. Henslow's sparrow has been documented in the following surveys:

- Documented in MNFI survey in 2006 (Miller et al. 2006).

Trumpeter swan (*Cygnus buccinator*):

<https://mnfi.anr.msu.edu/species/description/10893/Cygnus%20buccinator/>

This species is potentially vulnerable to the projected changes in climate. Trumpeter swans have been seen in likely nesting locations. These include the Whitman Lake system in the northeast part of TA 8, Lawler Pond in the northwest corner of TA 4, and the large unnamed wetland system spanning from the northeast corner of TA 4, down-gradient, to the northwest corner of TA 7.

The trumpeter swan was recently reintroduced in Michigan and has been documented on FCTC in the following surveys:

- Juveniles were documented in a small pond near Augusta-Climax Road (Legge et al. 1995b).
- Documented in 2010 survey (Baldy et al. 2011)

Merlin (*Falco columbarius*):

<https://mnfi.anr.msu.edu/species/description/10951/Falco%20columbarius/>

The merlin has been documented on FCTC in the following surveys:

- Documented in surveys in 1994 (Legge et al. 1995b).
- 1 animal was documented in 2005, and the individual was determined to be a migrant, not a resident (Roloff 2005).

Bald eagle (*Haliaeetus leucocephalus*): This bird is protected by the Bald and Golden Eagle Protection Act (BGEPA) and is a Michigan state species of special concern. The bald eagle has a wingspan of 6 – 7.5 feet, with adults having a white head and neck and brown body and wings (MNFI 2019a). Bald eagles are typically a summer resident in Michigan and usually seen along lakes and streams or where waterfowl congregate. Typical bald eagle habitat includes land within one-quarter mile of a major river or prey-supporting lakes larger than 40 acres, with mature or super-canopy trees located at the edge of a forest stand with clear flight paths (USFWS 2007). Nesting begins in February and young fledge in summer. Nests for bald eagles are added to each year and can be as large as 20 feet wide.

<https://mnfi.anr.msu.edu/species/description/10937/Haliaeetus%20leucocephalus/>

Bald eagles have been documented on FCTC in the following surveys:

- Documented nesting in 2010 during avian surveys (1 fledgling) (Baldy et al. 2011).
- Documented nesting during nesting in 2016 (2 fledglings) (Brenneman et al. 2017b). (It was also noted in this report that the nest became dislodge in 2012 and was rebuilt in the same tree and used to fledge young in 2013 and 2016; the nest fell again in 2017 and was not used to rear young in 2018.)

King rail (*Rallus elegans*): <https://mnfi.anr.msu.edu/species/description/10967/Rallus%20elegans/>

This species was documented only once at Fort Custer, in the 2014 avian survey (Brenneman et al. 2015).

Cerulean warbler (*Setophaga cerulea*):

<https://mnfi.anr.msu.edu/species/description/11182/Setophaga%20cerulea/>

This species is potentially vulnerable to the projected changes in climate. Cerulean warblers were first documented in 1994 (Legge et al. 1995a). Since 1997, population trends, distribution, and estimated survival rates of the cerulean warblers on FCTC have been monitored annually. The cerulean warbler has been documented on FCTC consistently since then, with the most recent results below:

- Breeding bird survey estimated the population size to be 46 males (Miller et al. 2002b)
- The most recent surveys documented 30 singing males in 2017 and 36 singing males in 2018 (Brenneman et al. 2017a, 2018).

Common tern (*Sterna hirundo*):

<https://mnfi.anr.msu.edu/species/description/11039/Sterna%20hirundo/>

This species is potentially vulnerable to the projected changes in climate. The common tern is known as occasional in Kalamazoo County, as it has been documented less than 50 times in the last half century

(John Brenneman, KNC, personal communication). The majority of documentation for common tern in the county has occurred in Gull Lake. It was documented on FCTC in 1994 and has not been noted since then (John Brenneman, KNC, personal communication).

Blanchard's cricket frog (*Acris blanchardi*): This state threatened amphibian is small (0.6-1.5 inches long) with a distinctive dark triangular mark between its eyes on top of its head (MNFI 2019b). The Blanchard's cricket frog is usually tan, brown, gray or olive green and warty skin. It occasionally has a broad light stripe down its back or has scattered green, reddish, or black. Its breeding call is unique and consists of a rapid series of metallic clicks (MNFI 2019b).

<https://mnfi.anr.msu.edu/species/description/10848/Acris%20blanchardi/>

This species is very vulnerable to the projected changes in climate. Blanchard's cricket frog is very sensitive to pollution and lower water levels. Water in TA 2 originates from an off-installation site (Hart's Lake), which is in close proximity to factories with potential to pollute source waters and impact habitat for this species (Tobin 2005). Blanchard's cricket frog has been documented in the following reports:

- Documented in several sites in 1994 and considered a potentially important population in the state of Michigan (Legge et al. 1995b).
- Documented in 2005 in TA 4 at Lawler and Overlook pond; TA 7 at Mitchell's pond; and in TA 2 in the Denso Road Wetland (Tobin 2005).

Pugnose shiner (*Notropis anogenus*):

<https://mnfi.anr.msu.edu/species/description/11316/Notropis%20anogenus/>

This species is very vulnerable to the projected changes in climate. The pugnose shiner has been documented in the following surveys:

- One individual was found in the small lake in the northern Impact Area that is connected via a small channel to Harts Lake outside of FCTC boundaries (Legge et al. 1995b).

H.1.2 SPECIES OF SPECIAL CONCERN

This section summarizes the 15 animal species of special concern that have been documented on Fort Custer, with their rarity status and the CCVI rank.

Table H-2. State Animal Species of Concern Documented at Fort Custer Training Center			
Species	Status	CCVI (Confidence)	Comments/Habitat
Mammals			
Little brown bat <i>Myotis lucifugus</i>	SC, S1	-	Hibernates in caves and mines in the winter (early September – mid-May). Roosts in a variety of locations, generally forages over or near water, hibernates in caves and tunnels.
Tricolored bat¹ <i>Perimyotis subflavus</i>	SC, S1	PS ^a (Very High)	Hibernates in caves, mines, and deep crevices in winter (end October – April). Forages over the open water and forest edges and roosts within 30 miles of hibernacula in summer.
Birds			
Cooper's hawk <i>Accipiter cooperii</i>	SC, S3S4	PS ^a (Very High)	Uses a variety of forest types, utilizing edge habitats, and have an association with deciduous forests.
Grasshopper sparrow^{1,2} <i>Ammodramus savannarum</i>	SC, S4	PS ^a (Moderate)	Uses a variety of grasslands and fields if there is tall and dense grassy vegetation present.
Northern harrier hawk <i>Circus cyaneus</i>	SC, S4	MV (Moderate)	Large patches of open, herbaceous vegetation.
Osprey^{1,2} <i>Pandion haliaetus</i>	SC, S4	PS ^b (Low)	Nest in trees, snags, cliffs, and some man-made structures (e.g. utility poles and windmills). Preferred nest sites are above or near water.
Prothonotary warbler <i>Protonotaria citrea</i>	SC, S3	IL ^a (Low)	Nests in holes and will also nest in bird houses. Occurs in bottomland forests bordered by red maple and associated trees.
Hooded warbler^{1,2} <i>Setophaga citrina</i>	SC, S3	PS ^a (Very High)	Beech-maple and floodplain forest understory in mesic and wet broad-leaved forests. Nesting occurs in small saplings of beech, maple and basswood trees, though nesting can sometimes also takes place in shrubs and herbaceous plants.
Dickcissel^{1,2} <i>Spiza americana</i>	SC, S3	IL ^a (Very High)	Uses a wide variety of natural grassland communities as well as agricultural areas.
Golden-winged warbler <i>Vermivora chrysoptera</i>	SC, S5	IL ^a (Very High)	Uses a variety of shrubby and early successional habitats (e.g., overgrown farmland and open swampy forests). Only known as migrant on FCTC.
Reptiles and Amphibians			
Eastern box turtle^{1,2} <i>Terrapene carolina carolina</i>	SC, S2S3	HV ^a (Moderate)	Typically occurs in forested habitats with sandy soils near water (e.g. pond, stream, or marsh). May also be found in adjacent thickets, old fields, pastures, or vegetated dunes. Reproduction requires access to unshaded nesting sites in sandy, open areas.

Table H-2. State Animal Species of Concern Documented at Fort Custer Training Center			
Species	Status	CCVI (Confidence)	Comments/Habitat
Blanding's turtle ^{1,2} <i>Emydoidea blandingii</i>	SC, S2S3	HV ^a (Very High)	These turtles need high quality, shallow waters with abundant aquatic vegetation and soft muddy bottoms over firm substrates. This species is found in ponds, marshes, swamps, bogs, wet prairies, river backwaters, embayments, sloughs, slow-moving rivers, and lake shallows and inlets. Blanding's Turtles also occupy terrestrial habitats in the spring and summer during the mating and nesting seasons and in the fall to a lesser extent. Females nest in open uplands adjacent to wetland habitats, preferring sunny areas with moist but well-drained sandy or loamy soil. Their primary diet is crayfish.
Insects			
Monarch butterfly <i>Danaus plexippus</i>	Under Review	N/A	This butterfly requires milkweed for its caterpillars to survive and forages in open areas (e.g., gardens, prairies) with nectar sources.
Sprague's pygarctia or Tiger moth ² <i>Pygarctia spraguei</i>	SC, S2S3	MV ^a (Low)	This moth inhabits open spots in oak barrens and oak-pine barrens. It is also associated with herbaceous habitats where the larval host plant, flowering spurge (<i>Euphorbia corollate</i>) is found (e.g. prairie, right-of-way, savanna).
Tiger spiketail dragonfly <i>Cordulegaster erronea</i>	SC	PS ^a (Very High)	Adults appear in river/floodplain areas. Burrow in headwater streams too small for fish. Larvae found in stream seepage.
Leafhopper <i>Flexamia reflexa</i>	SC, S1	HV (Very High)	Found in hay pastures, rights-of-way, and savanna that support its host plant, indiagrass (<i>Sorghastrum nutans</i>).
Mollusks			
Watercress snail ^{1,2} <i>Fontigens nickliniana</i>	SC, S2S3	EV (Very High)	Found on watercress (<i>Naturtium officianale</i> or <i>Rorippa naturtium-aquaticum</i>) in small lakes and ponds, springs, and spring-fed streams.
Sources: *USFWS Calhoun County and Kalamazoo County lists; Michigan County Elements Data for Calhoun ¹ and Kalamazoo ² Counties; MNFI Rare Species Explorer for Calhoun and Kalamazoo Counties. SC = state species of special concern (see S RANK). S RANK: See Table H-1 for explanation. S1, S2, S3 all indicate state Species of Conservation Concern CCVI RANK: See Table H-1 for explanation.			

Little brown bat (*Myotis lucifugus*): The little brown bat weighs between 0.2 and 0.5 ounces, with a body length between 2.3 and 4 inches and is dark to olive brown in color. Females are larger than males, especially in the winter. They occupy day and night roosts in the spring, summer, and fall. Day roosts are dark and provide shelter, while night roosts are in confined spaces where several bats can cluster

together. Day and night roosts can be in buildings, trees, under rocks, and in wood piles. This species occupies hibernation roosts in the winter (early September – mid-May). They feed primarily on aquatic insects in wooded areas, fields, and over water. (Havens 2017)

Suitable summer roosting habitat may be present on Fort Custer. This bat has been documented foraging on FCTC in the following surveys:

- Acoustic surveys in 2005 documented little brown bats on Fort Custer (Kurta and Foster 2005).

Tricolored bat (*Perimyotis subflavus*): <https://mnfi.anr.msu.edu/species/description/11429>

The eastern pipistrelle (also known as tricolored bat) was documented in the summer maternity season in 2005, a first for Michigan and also the first inland record (Cohen et al. 2009). Continued surveys were organized based on the rare 2005 finding, but 2006 did not document any specimens (Kurta et al. 2006a). The tricolored bat has been documented in the following surveys:

- Confirmed presence during the mist netting and acoustic survey in 2005 via acoustic analysis (Kurta and Foster 2005).

Cooper's hawk (*Accipiter cooperii*): http://mnfi.anr.msu.edu/abstracts/zoology/accipiter_cooperii.pdf

Cooper's hawks have been documented during migration and foraging, although they have the potential to nest on site as well (Legge et al. 1995b; Roloff 2005).

Grasshopper sparrow (*Ammodramus savannarum*): <https://mnfi.anr.msu.edu/species/description/11220/Ammodramus-savannarum>

- Documented during breeding bird surveys (Miller et al. 2002b).

Northern harrier hawk (*Circus cyaneus*): <https://mnfi.anr.msu.edu/species/description/10938/Circus-cyaneus>

This species is potentially vulnerable to projected changes in climate. Although northern harrier hawks are not known to nest on FCTC, they have been documented during migration and foraging.

- Migrating individuals documented in the southern Impact Area (Legge et al. 1995b).
- Documented in 2004 (Roloff 2005).

Osprey (*Pandion haliaetus*): <https://mnfi.anr.msu.edu/species/description/10934/Pandion-haliaetus>

Although ospreys do not nest on FCTC, the birds use habitats on FCTC during the summer months (Roloff 2005). Osprey have been documented on FCTC in the following surveys:

- Observed in 2005 (Roloff 2005).

Prothonotary warbler (*Protonotaria citrea*): <https://mnfi.anr.msu.edu/species/description/11185/Protonotaria-citrea>

- One individual was documented in 1998 (Miller et al. 2002b)

Hooded warbler (*Setophaga citrina*): <https://mnfi.anr.msu.edu/species/description/11195/Hooded-warbler>

Hooded warbler has been documented on FCTC in the following surveys:

- Observed in mature mesic and dry mesic forest in TAs 3, 4, 5, and 6, and in the southern Impact Area in 1994 (Legge et al. 1995b).
- Documented breeding bird surveys with an estimated population size of 78 males (Miller et al. 2002b)
- Multiple individuals documented regularly in avian surveys with several recent records (Brenneman et al. 2015, 2016, 2017a, 2018).

Dickcissel (*Spiza americana*): <https://mnfi.anr.msu.edu/species/description/11208/Spiza-americana>

This grassland bird has been documented on Fort Custer in the following surveys:

- [Documented during point counts in 2004 but was not detected the next year \(Miller et al. 2005\).](#)
- [Documented during surveys in 2006 \(Miller et al. 2006\).](#)

Golden winged warbler (*Vermivora chrysoptera*):

<https://mnfi.anr.msu.edu/species/description/11160/Golden-winged-warbler>

This bird is only found as a migrant on FCTC, typically using early successional habitat, and has been documented on Fort Custer in the following survey:

- [Documented during migration \(KNC 2012\).](#)

Eastern box turtle (*Terrapene carolina carolina*): <https://mnfi.anr.msu.edu/species/description/11493>

This species is very vulnerable to the projected changes in climate. This species occurs broadly across the installation and has been documented in the following reports.

- One individual in 1972 (Legge et al. 1995b).
- 26 individuals were found in 1994 surveys in all locations in the installation except for Area 2 (Legge et al. 1995b).
- Radio telemetry studies began in 2006 by The Center for Reptile and Amphibian Conservation and Management of Purdue University to examine patterns of movement and habitat use by the eastern box turtles, focusing on two areas of FCTC (Training Areas 3 and 7) (Gibson 2007).
- 247 confirmed individuals in 2004 (Tobin 2005).
- Presence confirmed in 2009 (Gibson 2009).

Blanding's turtle (*Emydoidea blandingii*): <https://mnfi.anr.msu.edu/species/description/11490>

The Blanding's turtle is a medium-sized turtle with an elongated, dome-like carapace and a long neck. This turtle has a dark brown head with yellow or brown spots and has a jaw and snout that make it look like it has a permanent grin. The Blanding's turtle has a very long neck and a bright yellow chin and throat (MNFI 2019c). This turtle is fairly common in parts of the Lower Peninsula, but it is rare and local in the Upper Peninsula. Blanding's turtles inhabit shallow bodies of water with some aquatic plant growth and a muddy bottom, such as marshes, ponds, and river backwaters. Mating occurs in water in the spring. This species is very vulnerable to the projected changes in climate.

These turtles are almost always found in or near a pond or wetland. The survey in 2000 indicated that the Sherriff's Marsh Blanding's turtle population is a self-sustaining one. The adjacent low marsh habitat, contiguous to the main marsh and to high-ground nesting areas, is where juvenile Blanding's turtles spend their first several years (Gibbons et al. 2000). They have been found in TAs 2, 4, 5, and 7 and in Impact Areas in TA 8 and 9 (Tobin 2005). Blanding's turtle was documented in the following surveys:

- First documented in 1994, with 1 individual near the northern impact area and four others in wetlands in TA 6 and the southern impact area (Legge et al. 1995a).
- Multiple individuals were captured in 2000, with several in Sherriff's Marsh, including three recaptured from the 1960s. Juveniles documented using the adjacent low marsh habitat (Gibbons et al. 2000)
- Several individuals were documented in 2004 (Tobin 2005).

Monarch butterfly (*Danaus plexippus*): https://www.michigan.gov/dnr/0,4570,7-350-79135_79218_79617-61323--,00.html

This butterfly requires milkweed and flowering plants, usually found along roadsides, in gardens, and native grasslands. Many species of milkweed are found in North America, and the monarch utilizes several with the genus *Asclepias* as well as *Calotropis procera*. This insect has been documented on Camp Gruber in the following surveys.

- Monarchs were likely present on FCTC for the last century and were noted as present in the 2008 FCTC INRMP.
- Incidental sightings of monarchs were documented in KBB surveys in 2018 in the Impact Area and TA 7 north of Mott Road. In addition to butterflies, six species of milkweed were also identified (Cole-Wick 2018).

Sprague's pygarcia or Tiger moth (*Pygarctia spraguei*): <https://mnfi.anr.msu.edu/species/description/11848/Pygarctia-spraguei>

This species is potentially vulnerable to the projected changes in climate. Flowering spurge (*Euphorbia corollata*) is its host plant, and openings containing this plant were present where it has been documented on the installation previously.

- One individual was collected in a degraded oak opening in Area 4 in 1994 (Legge et al. 1995b).

Tiger spiketail dragonfly (*Corduleqaster erronea*): <https://mnfi.anr.msu.edu/species/description/12063>

This dragonfly was thought to be extirpated in the state of Michigan. In 2016, researchers conducting surveys on FCTC near seepages documented the occurrence of the tiger spiketail dragonfly near dirt roadways (O'Brien et al. 2017).

Leafhopper (*Flexamia reflexa*): <https://mnfi.anr.msu.edu/species/description/11563>

This species is very vulnerable to the projected changes in climate. The leafhopper was documented in 1994 (MNFI 1994).

Watercress snail (*Fontigens nickliniana*): <https://mnfi.anr.msu.edu/species/description/12529/Fontigens-nickliniana>

This species is very vulnerable to the projected changes in climate. The watercress snail has been documented on FCTC in the following surveys:

- Four colonies were identified in TAs 4 and 7 and Whitman Lake Fen in the southern impact area where large amount of watercress were present (Legge et al. 1995b).

H.2 DOCUMENTED PLANTS

This section summarizes the 18 plants that have been documented at FCTC that are either state listed or state species of special concern (there are no federally listed plants present on the installation). In **Section H.2.1** and **Section H.2.2**, a summary of documented plant species is presented in **Tables H-3 and H-4**. Following the tables is text discussing habitat preferences and history of documentation on Fort Custer. For all species, the MNFI link providing species summaries, habitat preferences, and county records is contained in a hyperlink embedded in the common name.

H.2.1 THREATENED AND ENDANGERED SPECIES

This section summarizes the 14 state listed plant species that have been documented on Fort Custer (no federally listed plants have been documented). Climate change vulnerability indices have not been completed for plant species in Michigan at this time.

Species	Status	Comments/Habitat
Beaked agrimony ^{1,2} <i>Agrimonia rostellata</i>	ST, S2	Found in openings within oak-hickory forest, or, less commonly, beech-maple forest.
Cut-leaved water parsnip ² <i>Berula erecta</i>	ST, S2	Occurs in cold headwater streams and seeps within a variety of non-forested and forested wetlands, including prairie fens, southern wet meadow, southern shrub-carr, rich tamarack swamp, hardwood-conifer swamp, and rich conifer swamp.
American chestnut <i>Castanea dentata</i>	ST, S1S2	Documented historically in 1994 but not currently found on site. Intermittent wetlands of various types, including wet prairies, moist sandy barrens and open marshy flats or swales.
Yellow fumewort or Pale fumewort ^{1,2} <i>Corydalis flavula</i>	ST, S2	Occurs in floodplain forests and mesic hardwood forests in southwestern Lower Michigan. The majority of occurrences are known from degraded, successional dry-mesic southern forest in south-central Lower Michigan, where the species is typically associated with the non-native black locust.
Upland boneset ^{1,2} <i>Eupatorium sessilifolium</i>	ST, S1	Found in remnant oak forests and oak savannas in southern Lower Michigan, often on wooded slopes and in steep topography.

Table H-3. Threatened and Endangered Plants Documented on Fort Custer Training Center		
Species	Status	Comments/Habitat
Queen-of-the-prairie ^{1,2} <i>Filipendula rubra</i>	ST, S2	Known primarily within the state distribution from prairie fens in southwest Lower Michigan, principally in glacial interlobate areas where these alkaline, groundwater fed systems usually occur, especially in association with lake and river complexes and other large drainages.
Showy orchis ^{1,2} <i>Galearis spectabilis</i>	ST, S2	Found in rich deciduous woods, often near temporary spring ponds in sandy clay or rich loam soils, or in shady, rich microhabitats alongside common spring ephemerals. Vigorous colonies can spread into more open habitat.
Stiff gentian ² <i>Gentianella quinquefolia</i>	ST, S2	Known from alkaline soils in marshy meadows, in mucky areas along river and stream banks, and wooded edges and hillsides.
Downy sunflower <i>Helianthus mollis</i>	ST, S2	Found in prairie remnants in open sandy ground, and in dry, sandy disturbed areas along railroads, as well as in savannas.
Goldenseal ^{1,2} <i>Hydrastis canadensis</i>	ST, S2	Goldenseal is found in southern hardwood forests, as well as moist ravines and portions of riparian forests.
Virginia flax ² <i>Linum virginianum</i>	ST, S2	Found in open oak forests, upland woods, dry and mesic lakeside and riparian forests in the southern Lower Peninsula.
Red mulberry ² <i>Morus rubra</i>	ST, S2	Red mulberry occurs locally in rich forests in southern Lower Michigan, including forested floodplains, wet-mesic swamps, and bluffs, including wooded dunes.
Ginseng ^{1,2} <i>Panax quinquefolius</i>	ST, S2S3	Ginseng is found in rich shaded forests with loamy soils and heavy canopies. This species is highly threatened from collection of the root, commonly used in herbal remedies.
Lesser ladies-tresses ² <i>Spiranthes ovalis</i>	ST, S1	Occurs in open, sandy soil, old roads and open fields.
<p>Sources: *USFWS County Lists for Kalamazoo and Calhoun Counties; USFWS Official Species List Report for Fort Custer; Michigan County Elements Data for Calhoun¹ and Kalamazoo² Counties; MNFI Rare Species Explorer for Calhoun and Kalamazoo Counties; Species surveys including (Legge et al. 1995b; Cohen et al. 2009). FE=federally endangered, FT=federally threatened SE=state endangered, ST=state threatened, SC = state species of special concern (see S RANK). S RANK: See Table H-1 for explanation. S1, S2, S3 all indicate state Species of Conservation Concern</p>		

Beaked agrimony (*Agrimonia rostellata*): <https://mnfi.anr.msu.edu/species/description/14664>

This species has been documented on FCTC in mature and rich dry-mesic woods. Beaked agrimony has been documented on FCTC in the following surveys:

- Documented in 1994 near TA 2 (Legge et al. 1995a).
- Two occurrences were reconfirmed, one on the west side of Little Hart's Lake, the other in the south portion of Area 5 scattered in the Whitman Lake Woods (Cohen et al. 2009).
- Documented in 2007 in Harts Lake Dry-mesic Forest and Whitman Woods (Bassett 2007)

Cut-leaf water parsnip (*Berula erecta*):

<https://mnfi.anr.msu.edu/species/description/13319/Berula%20erecta/>

Cut-leaf water parsnip has been documented on FCTC in the following surveys:

- Identified in 1994 and in previous surveys (Legge et al. 1995b).
- Documented in 2007 in 5 locations near springs, including Cemetery Complex Seeps, Mott Road Fen South, Territorial Road Complex (North and South, including "Lunchtime Pond"); Whitman Lake Fen Complex, and Whitman Creek Fen (Bassett 2007).
- Four occurrences in streams or small seeps associated with southern wet meadow and prairie fen, with a significant metapopulation in Cemetery Complex Seeps (Cohen et al. 2009).

American chestnut (*Castanea dentata*):

<https://mnfi.anr.msu.edu/species/description/14214/Castanea%20dentata/>

American chestnut has been documented on FCTC in the following surveys:

- Identified in the flora survey in 1994 (Legge et al. 1995b).
- Verified the individual from the 1994 survey, but the tree was dead (Cohen et al. 2009).

Yellow fumewort or Pale fumewort (*Corydalis flavula*):

<https://mnfi.anr.msu.edu/species/description/14232/Corydalis%20flavula/>

The pale fumewort has been monitored annually for seventeen years with one or several methods employed each year and a pilot project for the control of garlic mustard has been underway since 1998 (Higman 1997; Nuzzo 1998; Native Connections 2007a; Bassett 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016). MDMVA also has completed studies to determine specific habitat requirements of the plant, in order to improve the success of conservation efforts for the species, range-wide (Higman 1997; Nuzzo 1998). These two management measures came as requirements of the MDNR's Endangered Species permit issued to MDMVA in 1994. MDMVA sought this permit in order to take a sizable portion of a colony of yellow fumewort on a site where the Augusta Armory at FCTC was built.

In 2009 an additional MDNR Endangered Species permit was issued to MDMVA to account for populations being impacted by several new building developments on and at the edge of the already-developed areas of the cantonment area. More recent studies have surveyed known areas, located potential new populations, determined garlic mustard's impact on the plant, and studied other portions of the plant's phenology (Native Connections 2007a; Bassett 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016). As a result, more meta-populations of the plant were found and more information about this disturbance-based species is emerging.

FCTC may contain nearly half of the occurrences of yellow fumewort in the state of Michigan, with a high potential for more occurrences (Cohen et al. 2009). Yellow fumewort has been documented in the following surveys:

- Identified in 1994 (Legge et al. 1995b).
- Four occurrences were documented in 2007, including Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta - Climax Rd., and Training Compartment #2 (Native Connections 2007a).
- Five occurrences were documented in 2008, including Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta - Climax Rd., Training Compartment #2, and Reese Rd. (Bassett 2008).
- Six occurrences were documented at Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, and Reese Rd. (Bassett 2009).
- Six occurrences were documented in 2008, including TAs 1, 2, 4 and 7, near impact areas, and near the border with Fort Custer Recreation Area (Cohen et al. 2009).
- Six occurrences were documented in 2010, including Training Area #1, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, Reese Rd., Territorial Rd./Armstrong Rd. (Bassett 2010).
- Six occurrences were documented in 2012 at the following locations: Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, Reese Rd., Territorial Rd./Armstrong Rd. (Bassett 2012).
- Six occurrences were documented in 2014 at the following locations: Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, Reese Rd., Territorial Rd./Armstrong Rd. (Bassett 2013).
- Six occurrences were documented in 2014 at the following locations: Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, Reese Rd., Territorial Rd./Armstrong Rd. (Bassett 2014).
- Six occurrences were documented in 2015 at the following locations: Armory Site, Longman Rd./Territorial Rd., Territorial Rd./Augusta-Climax Rd., Training Compartment #2, Reese Rd., Territorial Rd./Armstrong Rd; A population made up of several thousand individuals at the armory site was documented in 2015 (Bassett 2015, 2016).

Upland boneset (*Eupatorium sessilifolium*):

<https://mnfi.anr.msu.edu/species/description/13517/Eupatorium%20sessilifolium/>

Upland boneset is associated with dry-mesic forests with a partially open canopy. Prescribed burning and invasive plant species control seem to be beneficial (Cohen et al. 2009). When it was documented in 2008, it was only the second occurrence of this plant in the county (Cohen et al. 2009). Upland boneset has been documented on FCTC in the following surveys:

- Documented in 2007 at Lost Lake Savanna (Dry-mesic Forest) and Longman Dry-mesic Forest (Bassett 2007).
- A new occurrence (not documented since 1947) of two colonies containing hundreds of plants was located on the fringe of the impact area and on the west side of Whitman Lake Fen (Cohen et al. 2009).

Queen-of-the-prairie (*Filipendula rubra*):

<https://mnfi.anr.msu.edu/species/description/14724/Filipendula%20rubra/>

Queen-of-the-prairie has been documented on FCTC in the following surveys:

- Identified in 1994 in a wetland south of Territorial Road in TA 7 and in Whitman Lake Fen in the impact area, and in a previous survey in prairie fens (Legge et al. 1995b).
- Documented in 2007 in Whitman Lake Fen (Bassett 2007).
- One population was relocated from the populations documented in 1994 – it was at Whitman Lake Fen near the dam in the impact area (Cohen et al. 2009).

Showy orchis (*Galearis spectabilis*):

<https://mnfi.anr.msu.edu/species/description/15511/Galearis%20spectabilis/>

Showy orchis has been documented on FCTC in the following surveys:

- Identified in 1994 in two locations (Legge et al. 1995b).
- Documented in 2007 at Cemetery Complex Ridge (Bassett 2007).
- One occurrence from 1994 was relocated in the Cemetery Complex Ridge dry-mesic southern forest in TA 4 (Cohen et al. 2009).

Stiff gentian (*Gentianella quinquefolia*):

<https://mnfi.anr.msu.edu/species/description/14248/Gentianella%20quinquefolia/>

Stiff gentian has been documented on FCTC in the following surveys:

- Identified in the flora survey in 1994 in disturbed mesic uplands (Legge et al. 1995b).
- Documented in 2007 in 4 locations at Mott Road Fen South, Mott Road Prairie, Mott Road Mesic Woods, and Cemetery Complex Seeps (Bassett 2007).
- Two populations were reconfirmed from the 1994 study in TA 7 in the Mott Road mesic sand prairie, and in TA 4 in the Cemetery Complex Seeps (Cohen et al. 2009).

Downy sunflower (*Helianthus mollis*):

<https://mnfi.anr.msu.edu/species/description/13540/Helianthus%20mollis/>

Downy sunflower has been documented on Fort Custer in the following surveys:

- Identified in 1994 (Legge et al. 1995b).

Goldenseal (*Hydrastis canadensis*):

<https://mnfi.anr.msu.edu/species/description/14625/Hydrastis%20canadensis/>

Goldenseal has been documented on Fort Custer in the following surveys:

- Identified in 1994 (Legge et al. 1995b).
- Documented in 2007 in 3 locations at Cemetery Complex Ridge, Cemetery Complex Seeps, and Mott Road Fen South (Bassett 2007).
- One large occurrence was reconfirmed (TA 4 in the Cemetery Complex Seep and Cemetery Complex Ridge), and two new smaller occurrences were also documented (TA 3, TA 5) (Cohen et al. 2009).

Virginia flax (*Linum virginianum*):

<https://mnfi.anr.msu.edu/species/description/14382/Linum%20virginianum/>

Virginia flax was first documented in 2008 after last being documented in the state in 1938. Virginia flax has been documented on FCTC in the following surveys:

- 19 plants were found on a slope above the Territorial Road Fen in the impact area (Cohen et al. 2009).

Red mulberry (*Morus rubra*): <https://mnfi.anr.msu.edu/species/description/14431/Morus%20rubra/>

A specimen from 2008 was relatively young and the 2nd record for Kalamazoo county, indicating that more specimens may be nearby (Cohen et al. 2009). Red mulberry has been documented on FCTC in the following surveys:

- A new occurrence in the Cemetery Complex Seeps in TA 4 (Cohen et al. 2009).

American ginseng (*Panax quinquefolius*):

<https://mnfi.anr.msu.edu/species/description/13373/Panax%20quinquefolius/>

Ginseng has been documented on FCTC in the following surveys:

- Documented in 2007 in the Cemetery Complex Ridge (Bassett 2007).
- One occurrence in the Cemetery Complex Ridge in TA 4 (Cohen et al. 2009).

Lesser ladies-tresses (*Spiranthes ovalis*):

<https://mnfi.anr.msu.edu/species/description/15545/Spiranthes%20ovalis/>

Lesser ladies-tresses does not necessarily occur every year. It has been documented at FCTC in the following surveys:

- One occurrence in September of 1993 in TA 4 but was not relocated in 1994 or 2008 (Cohen et al. 2009).

H.2.2 SPECIES OF SPECIAL CONCERN

The following eight rare plants are designated by the state of Michigan as species of special concern.

Species	Status	Comments/Habitat
Leadplant ^{1,2} <i>Amorpha canescens</i>	SC, S3	Found in dry to mesic prairies and savannas, dry bluffs and hills, sandy roadsides and clearings. Most records consist of small colonies in degraded, marginal habitat.
White false indigo <i>Baptista alba</i> var. <i>macrophylla</i>	SC, S3	Occurs in dry to mesic prairies and savannas, dry open roadsides, along railroads, and in fencerows.
False boneset <i>Brickellia eupatorioides</i>	SC, S2	Occurs in sandy fields and prairies in former oak savanna areas.
Sedge <i>Carex amphibola</i>	SC, SNR	Found in floodplains and forests.
Field dodder ² <i>Cuscuta campestris</i>	SC, S1	Reported to be a pest on field crops as well as herbaceous species in open areas.

Species	Status	Comments/Habitat
Wahoo ² <i>Euonymus atropurpurea</i>	SC, S3	Found in moist soil of floodplain forests in southern Lower Michigan.
Purple twayblade or brown widelip orchid <i>Liparis lilifolia</i>	SC, S3	Known to occur in the region in deciduous forests, brushy thickets, and occasionally floodplain forests. At FCTC it was found in openings in dry-mesic southern forest to openings in moist woods.
Prairie dropseed ² <i>Sporobolus heterolepis</i>	SC, S3	Known from a variety of habitats, including prairies and fens in the southern Lower Peninsula.

Sources: * USFWS County Lists for Kalamazoo and Calhoun Counties; USFWS Official Species List Report for Fort Custer; Michigan County Elements Data for Calhoun¹ and Kalamazoo² Counties; MNFI Rare Species Explorer for Calhoun and Kalamazoo Counties; Species surveys including (Legge et al. 1995b; Cohen et al. 2009).
SC = state species of special concern (see S RANK).
S RANK: See Table H-1 for explanation. S1, S2, S3 all indicate state Species of Conservation Concern

Leadplant (*Amorpha canescens*): <https://mnfi.anr.msu.edu/species/description/14108/Amorpha-canescens>

Prescribed burning seems benefit this species (Cohen et al. 2009). Leadplant has been documented on the installation:

- One population found in 1994 in the restricted northern impact area (Legge et al. 1995b).
- Documented in 2007 in Impact Area Barrens East and West (Bassett 2007).
- Two populations were found in the northern impact area among oak barrens where it was documented in 1994 (Cohen et al. 2009). The previously recorded occurrence had many new colonies.

White false indigo (*Baptista alba* var. *macrophylla*):
<https://mnfi.anr.msu.edu/species/description/14118/Baptisia-lactea>

White false indigo has been documented in the following reports:

- Flora survey in 1994 (Legge et al. 1995b)

False boneset (*Brickellia eupatorioides*): <https://mnfi.anr.msu.edu/species/description/13463>

False boneset has been documented on the installation in the following reports.

- Flora survey in 1994 (Legge et al. 1995b).

Sedge (*Carex amphibola*): <https://mnfi.anr.msu.edu/species/description/15116/Carex-amphibola>

Sedge has been documented on the installation in the following reports.

- Flora survey in 1994 (Legge et al. 1995b).

Field dodder (*Cuscuta campestris*): <https://mnfi.anr.msu.edu/species/description/14048/Cuscuta-campestris>

This species was documented in the northern portion of the impact area in 2007 but not relocated in 2008 (Cohen et al. 2009). As an annual, this species may not occur every year (Cohen et al. 2009). As of 2009, the FCTC population was the only known extant population in the state and is highly significant. Field dodder has been documented on the installation in the following reports.

- Flora survey in 1994 (Legge et al. 1995b).
- Documented in 2007 in the Impact Area Barrens (Bassett 2007).
- Collected in 2007 in the northern portion of the impact area (Cohen et al. 2009).

Wahoo (*Euonymus atropurpurea*): <https://mnfi.anr.msu.edu/species/description/13917/Euonymus-atropurpureus>

This species was identified in 1994 and added to the state species of concern list in 1999. It was not relocated during the 2008-2009 surveys (Cohen et al. 2009). It has high potential to occur on the installation, and future surveys should continue to target it. Wahoo was documented on the installation in the following report:

- Flora survey in 1994 in Cemetery Complex Seeps in TA 4 (Legge et al. 1995b).

Purple twayblade or brown widelip orchid (*Liparis lilifolia*): https://mnfi.anr.msu.edu/abstracts/botany/Liparis_liliifolia.pdf

Purple twayblade has been documented on the installation in the following reports.

- Flora survey in 1994 (Legge et al. 1995b).
- Documented in 2007 in the Cemetery Seeps and Mott Road Mesic Woods (Bassett 2007).
- Scattered throughout the installation in small numbers (Cohen et al. 2009).

Prairie dropseed (*Sporobolus heterolepis*): <https://mnfi.anr.msu.edu/species/description/15780/Sporobolus-heterolepis>

Prairie dropseed has been found in the following surveys:

- Identified in 1994 and also in a previous survey (Legge et al. 1995b).
- Documented in 2007 at Whitman Lake Fen (Bassett 2007).
- One occurrence reconfirmed in Whitman Lake Fen in the impact area and new colonies were found in the Territorial Road Fen (Cohen et al. 2009).

H.3 POTENTIAL THREATENED AND ENDANGERED SPECIES

An additional eight listed species potentially could occur on the installation, although they have not been found in surveys. All of these are animals and are federally listed, with five also state listed. Rarity and climate vulnerability rankings for these species are presented in Table H-5, along with a description of potential habitat. Chapter 3 of the INRMP further discusses the factors that make these species more climate vulnerable and management recommendations to reduce stressors. **Table H-5** summarizes those federally and state listed species with potential to occur on Fort Custer, but which have not yet

been documented. Following the table is a discussion of habitat preferences and survey history on Fort Custer. For all species, the MNFI link providing species summaries, habitat preferences, and county records is contained in the hyperlink embedded in the common name.

Table H-5. Threatened and Endangered Animal Species with Potential to Occur on Fort Custer			
Species	Status	CCVI (Confidence)	Comments/Habitat
Mammals			
Northern long-eared bat <i>Myotis septentrionalis</i>	FT, SC, S1	PS (Very High)	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Indiana bat ^{4+*o} <i>Myotis sodalis</i>	FE, CH SE, S1	MV ^a (Moderate)	Maternity colonies under loose bark or in hollows and cavities of mature trees in floodplain forest. Winter hibernation primarily occurs in caves in Kentucky, Indiana, and Missouri.
Reptiles			
Eastern massasauga ^{+*o} <i>Sistrurus catenatus</i>	FT SC, S3	HV (High)	Generally, appear to be characterized by open, sunny areas intermixed with shaded areas, presumably for thermoregulation; presence of the water table near the surface for hibernation; and variable elevations between adjoining lowland and upland habitats.
Copperbelly water snake * <i>Nerodia erythrogaster neglecta</i>	FT SE, S1	EV ^a (Very High)	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods. Hibernation, often in crayfish burrows, in forested wetlands from October to April.
Insects			
Rusty-patched bumblebee <i>Bombus affinis</i>	FE, SC, SNR	PS ^a (Very High)	Nests underground, in old rodent burrows, utilizes many habitats for foraging and queens overwinter in rotten wood or underground.
Karner blue butterfly <i>Lycaeides melissa samuelis</i>	FE, ST, S2	HV (Very High)	Larvae feed exclusively on wild lupine (<i>Lupinus perennis</i>) and adults feed on a variety of flowers. Oak or oak-pine savanna or barrens prior to European settlement. Openings, old fields, and right-of-ways surrounded by oak forest.
Mitchell's satyr butterfly ^{+o} <i>Neonympha mitchelli mitchelli</i>	FE SE, S1	EV ^a (Very High)	Found exclusively in prairie fens and open parts of rich tamarack swamps in Michigan.
Poweshiek skipperling <i>Oarisma poweshiek</i>	FE ST, S1	EV (Very High)	Found in prairie fens; adults associated with abundant nectar and mat muhly (<i>Muhlenbergia richardsonis</i>) in Michigan.

⁴ Based on our survey results in 2015 and in previous studies, the forests of the FCTC are not likely inhabited by endangered Indiana bats. No positive identification of acoustic calls of Indiana bat could be made during two previous bat studies (Kurta et al. 2006b; CEC 2015)

Table H-5. Threatened and Endangered Animal Species with Potential to Occur on Fort Custer			
Species	Status	CCVI (Confidence)	Comments/Habitat
<p><i>Sources:</i> USFWS Kalamazoo* and Calhoun* County lists; USFWS IPaC Report for Fort Custer^o; Michigan County Elements Data for Kalamazoo and Calhoun Counties; MNFI Rare Species Explorer for Kalamazoo and Calhoun Counties.</p> <p>FE=federally endangered, FT=federally threatened</p> <p>SE=state endangered, ST=state threatened, SC = state species of special concern (see S RANK).</p> <p>S RANK: See Table H-1 for explanation. S1, S2, S3 all indicate state Species of Conservation Concern</p> <p>CCVI RANK: See Table H-1 for explanation.</p>			

Northern long-eared bat (*Myotis septentrionalis*): The northern long-eared bat is a medium-sized bat 3 to 3.7 inches in length with a wingspan of 9 to 10 inches (USFWS 2015). It is named for its long ears (longer than others in its genus). This species has declined dramatically in the northeastern US due white-nose syndrome, a fungal disease (USFWS 2018b). The northern long-eared bat hibernates in caves and mines and roosts and forages in upland forests during spring and summer. FCTC provides suitable summary foraging and roosting habitat.

- Surveys conducted in 2005 did not confirm NLEB (Kurta et al. 2006b)
- Presence/absence surveys were conducted in 2015 but were unable to make a positive identification of NLEB from acoustic calls (CEC 2015)

Indiana bat (*Myotis sodalis*): Indiana bats are small and lightweight, with a wingspan of 9 to 11 inches with dark-brown to black fur. They hibernate in caves or sometimes in abandoned mines during the winter, and summer roosts include peeling bark of dead and dying trees (USFWS 2019b). Indiana bats eat a variety of flying insects found along rivers or lakes and in uplands. White nose syndrome (WNS) is an illness that has killed over a million bats since 2006 and is a major threat to Indiana bat populations (USFWS 2019b).

Fort Custer does not contain any known potential winter roosting areas, but summer foraging and roosting habitat is present on the installation. There have been Indiana bats documented in nearby areas. Although Indiana bats have not been documented on Fort Custer, the following surveys have been carried out on FCTC.

- 1993 was the first year that Indiana bat was surveyed for on Fort Custer (Kurta 1993)
- Presence/absence surveys were conducted for the Indiana bat in 2004 using mist nets and acoustic methods (Kurta and Foster 2005)
- Presence/absence surveys were conducted in 2015 (CEC 2015)

Eastern massasauga (EMR, *Sistrurus catenatus*): This federally threatened snake is Michigan's only venomous snake. Adults can range in size from 1.5 to 3 feet in length and have a segmented rattle. Massasaugas body markings are black splotches edged in white; below the head these markings may resemble video game controllers or bowties (MDNR 2017c). It was listed as federally threatened on October 31, 2016 (USFWS 2016) and is a Michigan species of Special Concern. Michigan's only venomous snake has declined in numbers throughout its range. The primary causes of decline are habitat loss and persecution (MDNR et al. 2016). This snake requires wetland fringes for overwintering. During the active

season, individuals will utilize open and forested wetlands and adjacent open and forested upland habitat.

Two populations confirmed by MNFI lie just outside the fenceline of FCTC: one at Hart's Lake and one on the Fort Custer Recreation Area. The home range of this species is large enough that it could easily cross the fence line into FCTC. While survey efforts have not yet confirmed their presence on FCTC lands, the proximity of these populations assumes presence and requires proactive management. USFWS entered into a programmatic candidate conservation agreement with assurances (CCAA) between the MDNR, MDMVA and other stakeholders, with a term of 25 years before the species was officially listed (MDNR et al. 2016). MDMVA staff participated in the fourteen-year process to craft the document to ensure that natural resources management could be performed on Michigan installations in line with the requirements of the CCAA. Survey efforts will continue in accordance with USFWS requirements. Habitat management at FCTC will follow as closely as possible the parameters outlined in the CCAA, although it is not required on FCTC.

Because of excellent habitats on FCTC, EMR may be considered for reintroduction, pending the successful reintroduction of other species, such as the Mitchell's satyr butterfly. Portions of Training Areas 1, 5, 7, 8, and 9 all contain potentially habitat for EMR that may be targeted for reintroduction in the future. The presence of EMR would not radically alter current management techniques. Although EMR has not been documented on Fort Custer, the following surveys have been carried out on FCTC.

- Surveys in 2014-2016 focused on good snake habitat in three wetland complex areas: TA 7 Wetland Complexes, Impact Area Survey Zone, and TA 4 Wetland Complex (Tobin 2016).

Copperbelly water snake (*Nerodia erythrogaster neglecta*): This is a federally threatened non-venomous snake that is 2 to 4 feet long with a solid, dark back with a bright orange-red belly (USFWS 2013). Mosaic of shallow wetlands or floodplain wetlands surrounded by forested uplands. Seasonally flooded wetlands without fish are favored foraging areas, and copperbellies frequently move from one wetland to another. Copperbellies hibernate, often in crayfish burrows, in forested wetlands and immediately adjacent forested uplands. They remain underground from late October until late April.

This snake has not been documented either in the numerous multi-species surveys that have been conducted on the installation or the reptile-specific surveys on Fort Custer. However, this species can be easily overlooked if not targeted during a survey. The only known population in Michigan is in Hillsdale County and is not likely to occur at FCTC.

Rusty-patched bumblebee (*Bombus affinis*): This endangered bee varies in appearance slightly from queen to worker to males, but all rusty-patched bumble bees have entirely black heads (only workers and males have a rusty reddish patch centrally located on the back) (USFWS 2019c). They are actively collecting pollen from spring through the fall, when they go into hibernation. Bumble bees need areas that provide nectar and pollen from flowers, nesting sites (underground and abandoned rodent cavities or clumps of grasses), and overwintering sites for hibernating queens (undisturbed soil) (USFWS 2019c). Their habitat includes tallgrass prairie, but this habitat type has been altered and fragmented. Additional threats to this species include pesticide use and climate change.

The rusty-patched bumblebee has not been documented on Fort Custer, but as with other tallgrass prairie-reliant species, there is potential habitat on the installation to support this species.

Karner blue butterfly (*Lycaeides melissa samuelis*): This small, endangered butterfly lives in oak savannas and pine barren ecosystems and relies on the wild blue lupine (*Lupinus perennis*) exclusively as a host plant (USFWS 2019d). Males and females have different topside appearances, with the males being silver or dark blue with narrow black margins and the females being grayish brown (especially on the outer portions of the wings) to blue with irregular bands of orange crescents inside the narrow black border (USFWS 2019d). Both males and females have the same underside - gray with a continuous band of orange crescents along the edges of both wings and with scattered black spots circled with white (USFWS 2019d). Habitat loss is the major factor in the decline of this butterfly, and the state of Michigan along with the USFWS has a Habitat Conservation Plan to address this issue (MDNR 2009).

Six surveys have been completed on FCTC for KBB in particular (Fettinger 2005; Native Connections 2007b, 2008, 2009; Wick and Bhullar 2015; Cole-Wick 2018) and several comprehensive surveys have included this butterfly in their searches over the years (see Appendix D). Suitable habitat types for KBB are similar to the Mitchell's satyr butterfly, and several surveys cover both of these species. While the host plant is present on the installation, it is limited in terms of quantity and quality of habitat. To date, the Karner blue butterfly has not been documented on FCTC.

Further surveys will be done on an intermittent basis for the Karner blue butterfly. While the habitat is limited, it is present, and undocumented sightings have occurred (M. Richards, pers. comm). In 2018, surveys were completed in two locations with lupine populations: one in the impact area north of the Territorial Road Fen but south of Range Road, and the second located north of Mott Road in TA 7 between the mesic prairie and Mott Road Fen. No KBB were documented (Cole-Wick 2018).

Mitchell's satyr butterfly (*Neonympha mitchelli mitchelli*; MSB): This endangered butterfly is only found in Michigan and Indiana. It is dark brown with a wing span that ranges from 1.5 to 1.75 inches, with the undersides of the wings having a row of four to five black, yellow-ringed eyespots encircled by two orange rings (MDNR 2019). Mitchell's satyr butterfly is reliant on prairie fens for habitat.

As with KBB, multiple surveys for this species have been conducted at FCTC with no butterflies found to date (SWMLC 2005; Wick and Kornoelje 2014; KNC 2015), and it is not known whether the species is present on adjacent lands (see **Appendix D**).

In 2003, ten wetland complexes were surveyed, covering over 140 acres throughout FCTC, for the presence of fen habitat and evaluating the potential for supporting Mitchell's satyrs. If a wetland was found to contain fen habitat, it was surveyed multiple times within the Mitchell's satyr flight period, typically the first three weeks of July. Potential habitats were mapped using a combination of aerial image interpretation and field data.

Four high-quality fen sites of sufficient size to support populations of Mitchell's satyrs have been identified (KNC 2015). Surveys will continue, as required by USFWS. Potential habitat lies in the fens occurring in TAs 5, 6, 7, 8 and 9.

MIARNG is in the process of working with ARNG-IEN, USFWS and FCTC staff to reintroduce the Mitchell's satyr butterfly onto FCTC with proper legal protections to protect training from any impacts of the presence of the species. This will likely occur through a Section 7 consultation with permit to take the whole population if training requires this. However, the site identified for reintroduction is a duded impact area (from 1940s era) and will likely never experience total destruction. It contains a large,

contiguous area of the preferred habitat with required host plant species. Additional information is included in the reintroduction plan currently being reviewed and approved by the various parties.

Poweshiek skipperling (*Oarisma poweshiek*): The Poweshiek skipperling is a small endangered butterfly with a wingspan of less than 1 inch and dark brown coloring above with light orange along the wing margins and a lighter orange head. The underside of the wings are dark to light brown with very prominent white veins that make the wing look striped (USFS 2014). Its habitat includes a variety of tallgrass prairie, mostly fens in Michigan (USFS 2014). Its range has declined over the last several decades due to habitat fragmentation and destruction.

Multiple surveys for this species have been conducted at FCTC with no butterflies found to date, and it is not known whether the species is present on adjacent lands. Surveys will continue, as required by USFWS. Potential habitat lies in TAs 5, 6, 7, 8 and 9. The Poweshiek skipperling butterfly has been surveyed for on FCTC as described in the following reports.

- In 2014 and 2015, the butterfly was surveyed for on roughly 175 acres of prairie fen (Wick and Kornoelje 2014; KNC 2015).

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APPENDIX I
CLIMATE HISTORY AND PROJECTIONS

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I.1 HISTORICAL SUMMARY

I.1.1 RECENT CLIMATE DATA (2009-2019)

Fort Custer is located in Kalamazoo and Calhoun Counties in the southwest portion of Michigan's Lower Peninsula. **Table I-1** presents the average monthly and yearly precipitation over the last decade in the area near FCTC. The average total precipitation in the last 10 years (2009-2018) has been approximately 30 inches (NOAA 2019). The majority of the annual precipitation falls between April and September. During the relatively long growing season (140-150 days), most of the precipitation is associated with passing cold fronts and showers caused by airmass instability (Legge et al. 1995). The average snowfall is 71.4 inches. **Table I-2** presents average monthly temperatures for the area near FCTC. The average mean temperature in the region is 26.0 °F during the winter and is 70.8 °F during the summer months (NOAA 2019). At mid-afternoon, the average relative humidity is 62 percent. The prevailing wind in the area is from the southwest.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2009	0.48	1.22	3.82	3.92	1.57	3.57	0.18	5.58	1.29	4.58	0.68	1.19	28.08
2010	0.41	0.52	0.52	2.93	5.05	M	10.36	0.71	2.41	0.99	2.18	0.68	26.76
2011	0.27	M	M	4.98	6.97	3.20	4.66	3.51	3.41	2.20	3.15	1.58	33.93
2012	1.17	1.25	2.55	3.41	0.96	0.81	1.28	3.37	2.75	4.73	0.37	1.66	24.31
2013	-	1.12	0.54	5.87	1.64	3.74	4.90	4.75	1.68	4.05	1.90	1.11	31.3
2014	-	0.78	0.96	2.33	3.14	5.57	4.21	2.20	M	M	2.37	0.85	22.41
2015	0.80	0.21	0.27	1.80	5.17	8.57	4.21	M	2.71	2.42	2.05	3.12	31.33
2016	0.94	0.66	2.94	2.50	M	1.40	4.14	8.08	-	3.16	-	1.04	24.86
2017	3.22	2.25	3.73	3.40	2.88	1.38	2.68	2.06	M	11.13	3.57	M	36.3
2018	1.26	5.09	1.58	2.56	7.45	2.58	-	4.45	1.79	3.92	1.87	2.13	28.08
Mean	23.1	25.6	36.3	47.9	61.1	69	72.7	70.8	64.1	52.3	39.7	29.2	

Source: NOAA 2019 – data from Calhoun County, primarily Battle Creek; M= missing¹

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	16	26.5	38.7	48.3	58.9	67.8	68.1	69.4	63.8	47.7	44.7	27.5
2010	23.6	25.7	40.7	54.7	62.3	68.6	74.9	73.7	62.9	53.7	41.4	24.5
2011	19.7	23.4	34.2	46.3	59.9	68.7	76.2	70.6	60.7	51.9	43.1	33.2
2012	28.2	30.8	50	47.7	63.1	70.2	79.1	70.4	62.1	49.8	38.7	34.1
2013	26.5	24.6	31	45	62.4	68.2	71.6	69	62.6	52.5	37	25.5
2014	16.3	17	27	47.6	59.4	70	67.8	70.9	61.9	50.5	35	33.2
2015	22.9	13.9	33.9	48.7	62.4	68.6	71.1	70.4	67.5	52.5	45.1	-
2016	25.9	28.4	41.3	47	58.6	68.2	71.6	71.4	66.3	55.9	M	27.1
2017	29.6	36	35.6	53	57.8	69.6	72.6	68.6	66.3	55.5	38.6	25.3
2018	24.4	29.3	34.3	40.7	65.7	70.2	73.5	73.6	66.9	52.5	34.1	32.4
Mean	23.1	25.6	36.3	47.9	61.1	69	72.7	70.8	64.1	52.3	39.7	29.2

Source: NOAA 2019 – data from Calhoun County, primarily Battle Creek; M=missingⁱ

I.1.2 RECENT CLIMATOLOGICAL PERIOD (1981-2010)

To provide historical context for the most recent weather, as summarized above, the latest climatological period (1981-2010) is summarized below. **Table I-3** presents the monthly averages for maximum, minimum, and average temperature as well as total precipitation for the 1981-2010 period.

Month	Temperature (°F)			Precipitation (Inches)
	Maximum	Minimum	Average	
January	31.6	15.6	23.6	1.66
February	35.4	17.3	26.4	1.34
March	46.4	24.9	35.6	1.91
April	60.1	36.1	48.1	2.80
May	70.5	45.7	58.1	3.77
June	79.4	55.2	67.3	3.23
July	82.6	59.2	70.9	3.36
August	80.7	57.8	69.2	3.47
September	73.4	49.9	61.6	3.65
October	61.0	39.3	50.2	3.14
November	47.9	30.4	39.1	2.83
December	35.2	19.8	27.5	1.99
Annual	58.8	37.7	48.2	33.15 (total)

Source: 1981-2010, Battle Creek Kellogg Airportⁱ, from NCDC: <https://www.ncdc.noaa.gov/cdo-web/datatools/normals> (NCDC 2019).

I.1.3 HISTORICAL TRENDS

1981-2010 Normals Compared to 1961-1990 Normalsⁱⁱ at Battle Creek Kellogg Airport

Overall, there was not much change between the 1961-1990 and the 1981-2010 climatological averages for temperature. The average annual temperature has remained the same between the two periods, at 48.2 °F. However, the average annual maximum temperature increased slightly between the two periods. The largest increases (about 1°F) occurred during winter (December-March). Average annual minimum temperature decreased slightly (less than 0.5°F) between the two periods. While the average minimum temperature increased in January and February, all other months had the same average minimum temperature or an observed decrease. The months January through April experienced an increase in the average annual temperature, while May through November experienced a decrease. Finally, annual precipitation decreased slightly (less than 1 inch) between the two periods. Winter precipitation decreased, while summer and fall precipitation increased slightly or stayed about the same.

Battle Creek 1949-1998 Trends

Some of the climate trends observed at the Battle Creek Kellogg Airport align with changes that have been experienced regionally, but some of the trends, like no change in annual mean temperatures, are different from the regional pattern. Additionally, while climatological averages may not have shifted drastically for temperature or precipitation, some of the more extreme weather patterns have changed. **Table I-4** summarizes various changes in these patterns in the region and locally for the Battle Creek station.

Table I-4. Summary of Regional and Battle Creek Climate Trends		
Regional Trend	Battle Creek Trend 1949 to 1998^a	Battle Creek Trend 1949 to 2017^b
Temperature (Annual and By Season)		
Overall, annual average temperature has been increasing in the continental U.S., with a magnitude between 1.2-1.8 °F of warming. In the Midwest, the average annual temperature increased by 1.26 °F, with the average annual maximum temperature increasing by 0.77 °F and the average annual minimum temperature increasing by 1.75 °F. The magnitude of change in these metrics is similar for western Michigan. Seasonally, southwestern Michigan has seen an increase in the average winter temperature of more than 1.5 °F, and a 0-0.5 °F increase in summer temperature. The annual change in temperature is best seen by looking at trends in average minimum temperature and average winter temperature.	<ul style="list-style-type: none"> • Annual change: +.0098 °F • Spring change: +1.51 °F • Summer change: -1.29 °F • Fall change: -1.46 °F • Winter change: -0.04 °F 	<ul style="list-style-type: none"> • Annual change: +.99 °F • Spring change: +3.71 °F • Summer change: -0.95 °F • Fall change: +0.53 °F • Winter change: +1.44 °F
Extreme Temperatures		
In the Midwest, the coldest temperature of the year has increased by 2.93 °F between the 1986-2016 average and the 1901-1960 average. The warmest temperature of the year has decreased in the Midwest, with a magnitude of 2.22 °F. However, this decrease is often clouded by data from the Dust Bowl in the 1930s, where extreme heat was common	<ul style="list-style-type: none"> • Days above 90 °F: -6.37 days • Days above 95 °F: -2.84 days • Days above 100 °F: 	<ul style="list-style-type: none"> • Days above 90 °F: -3.82 days • Days above 95 °F: -1.65 days • Days above 100 °F:

Table I-4. Summary of Regional and Battle Creek Climate Trends

Regional Trend	Battle Creek Trend 1949 to 1998 ^a	Battle Creek Trend 1949 to 2017 ^b
<p>throughout much of the summertime and is also impacted by agricultural changes in the Midwest. For the continental U.S., cold waves (6 day periods with a low temperature below the 10th percentile for 1961-1990) have decreased in frequency since the 1900s, while heat waves (6 day periods with a high temperature above the 90th percentile for 1961-1990) have increased in frequency since the 1970s. Additionally, the number of record setting low temperatures has decreased, and record setting highs have increased, with a 2:1 ratio in record highs (i.e. 2 times more record highs than record lows).</p>	<p>-0.14 days</p> <ul style="list-style-type: none"> • Days below 32 °F: -5.34 days • Days below 0 °F: +2.71 days 	<p>+0.19 days</p> <ul style="list-style-type: none"> • Days below 32 °F: -16.62 days • Days below 0 °F: +2.22 days
Precipitation (Annual and By Season)		
<p>Over southwestern Michigan, the average annual precipitation has been increasing. Compared to the 1901-1960 average, the 1986-2015 average annual precipitation increased by 10 to 15% in southwestern Michigan. Seasonally, every season has an observed increase in precipitation, with the exception of spring, where there has been little to no change. The largest magnitude of change occurred during summer, where the seasonal average precipitation increased by greater than 15%. In winter and fall, seasonal averages increased by 10 to 15%.</p>	<ul style="list-style-type: none"> • Annual: +1.22 inches • Spring: -0.19 inches • Summer: +0.27 inches • Fall: +3.13 inches • Winter: -1.66 inches 	<ul style="list-style-type: none"> • Annual: -1.31 inches • Spring: -0.52 inches • Summer: +0.84 inches • Fall: +1.52 inches • Winter: -1.54 inches
Heavy Precipitation Events		
<p>As temperature increases, the air's capacity to hold water vapor increases as well. Therefore, with warmer temperatures, the intensity and frequency of precipitation events has started to increase due to greater moisture availability. For daily events with a 20-year return period (i.e. a 5% chance of occurring), the intensity of the precipitation (or amount of precipitation accumulated during the event) has increased in every season in the Midwest from 1948 to 2016. The largest increase has been in fall, with the average change in intensity being 0.27 more inches of rain during these events. Furthermore, days with precipitation amounts being in top 1% of daily accumulation have increased in the Midwest by 42% from 1958 to 2016. Finally, there has been a 53% increase in events with a 2-day duration and a 5-year return period (i.e. a 20% chance of occurring) from 1958 to 2016. Collectively, these metrics suggest that both the frequency and intensity of precipitation has been increasing in the Midwest.</p>	<ul style="list-style-type: none"> • Days with precipitation > 1": -0.35 days • Days with precipitation > 2": -0.59 days 	<ul style="list-style-type: none"> • Days with precipitation > 1": -0.73 days • Days with precipitation > 2": +0.23 days
Drought		
<p>From the Intergovernmental Panel on Climate Change (IPCC) AR5: "There is low confidence in detection and attribution of</p>	Data not available	Data not available

Table I-4. Summary of Regional and Battle Creek Climate Trends		
Regional Trend	Battle Creek Trend 1949 to 1998^a	Battle Creek Trend 1949 to 2017^b
changes in (meteorological) drought over global land areas since the mid-20th century, owing to observational uncertainties and difficulties in distinguishing decadal-scale variability in drought from long-term trends.”		
Date of First Fall Freeze		
The date of the first fall freeze has been occurring later.	<ul style="list-style-type: none"> Freezes at 32 °F: 6.35 days later Freezes at 28 °F: 11.87 days later 	<ul style="list-style-type: none"> Freezes at 32 °F: 2.04 days earlier Freezes at 28 °F: 1.71 days later
Date of Last Spring Freeze		
The date of the last spring freeze has been occurring earlier. This shift contributes more to the increase in the frost-free season than the shift in date of the first fall freeze.	<ul style="list-style-type: none"> Freezes at 32 °F: 17.56 days earlier Freezes at 28 °F: 3.95 days earlier 	<ul style="list-style-type: none"> Freezes at 32 °F: 7.8 days earlier Freezes at 28 °F: 7.01 days earlier
Frost-Free/Growing Season		
In the Midwest, the average frost-free season length has increased by 9 days between the 1986-2015 average and the 1901-1960 average. The growing season has increased by almost 2 weeks since 1950 in the Midwest. While the growing season and frost-free season are not exactly the same, they are often used interchangeably.	<ul style="list-style-type: none"> Growing season days above 32 °F: 23.9 days longer Growing season days above 28 °F: 15.82 days longer 	<ul style="list-style-type: none"> Growing season days above 32 °F: 5.77 days longer Growing season days above 28 °F: 8.72 days longer
Evapotranspiration Soil Moisture		
Potential evapotranspiration is the demand/maximum amount of water that would be evaporated/transpired if enough water was available. As temperature increases, the potential increases. This increase results in a greater demand for water. If precipitation doesn't change, that water comes from soil. Therefore, as temperature increases, water demand increases, and soil moisture decreases.	Data not available	Data not available
Snowfall		
For snowfall, it is important to look as locally as possible, especially given the proximity to Lake Michigan. Although Calhoun County is a bit far to receive substantial lake effect snow, Kalamazoo County, just one county west, has seen an increase in snowfall because of increased lake effect snow. In Calhoun County, the average annual snowfall from 1981-2010 was a few inches less than the average annual snowfall from 1961 to 1990. Additionally, warmer temperatures have led to a decrease in days with snow cover, as snow melt has begun earlier in the year.	<ul style="list-style-type: none"> Average annual snowfall has decreased a few inches Number of days with snow cover has decreased 	Data not available
Arctic Oscillation/Polar Vortex		
Over the last 37 years, the polar vortex has shifted towards a weaker pattern. When the polar vortex is weak, a pressure	Data not available, due to lack of standard metric and lack of	Data not available, due to lack of standard metric and

Regional Trend	Battle Creek Trend 1949 to 1998^a	Battle Creek Trend 1949 to 2017^b
pattern that resembles the negative phase of the Arctic Oscillation is often present. During this phase, cold air that is typically confined to the Arctic progresses south, oftentimes leading to colder temperatures over the mid-latitudes.	stable pattern to evaluate trends	lack of stable pattern to evaluate trends
^a There is approximately 0-2% of data missing for this time period. ^b There is approximately 16-18% of data missing ⁱ for this time period Sources: Regional Trends from Climate Science Special Report (USGCRP 2017), Climate Change Impacts in the United States: The Third National Climate Assessment (Melillo et al. 2014).		

Summary of Climate Trends from Table I-4

- Locally (Battle Creek), temperatures increased during spring but decreased during other seasons with surrounding counties experiencing more warming.
- Locally, precipitation increased on average, especially during fall, while winter precipitation decreased; notable increase in days with top 1% daily precipitation accumulation.
- Regionally, frequency and intensity of heavy precipitation increased regionally, although the local trends are varied within the region.
- First fall freeze later, last spring freeze earlier, so frost free season longer.
- Potential evapotranspiration increased.
- Snowfall decreased slightly.

I.2 REGIONAL PROJECTIONS

Under effects from current and future greenhouse gases concentrations in the atmosphere, the Midwest United States is projected to experience an overall warming trend into the next century (Chapter 6, Table 6.4 in USGCRP 2017). For the lower peninsula, estimates for the years 2041-2070 include a 4.5 to 5°F increase in average annual temperatures and 30 to 40 more days per year above 90°F (MIARNG 2016). Additionally, the growing season (frost-free season) could include an additional 40 to 50 days each year by 2100 (MIARNG 2016).

To support natural resources planning at Fort Custer, dynamically downscaled climate projections for the Great Lakes region were used in the development of four future scenarios (**Figure I-1**). The climate model simulations⁵ were produced by the Nelson Institute Center for Climatic Research at the University of Wisconsin-Madison, where a regional climate model coupled to a 1-D lake model was run six times with boundary information from a set of global climate models. Six Coupled Model Intercomparison Project (CMIP) version 5 global climate models (GCMs) downscaled to a 25-km spatial resolution according to the RCP8.5 scenario using the International Centre for Theoretical Physics (ICTP) Regional Climate Model Version Four (Reg- CM4) coupled to a 1-dimensional lake model to represent the Great Lakes. Altogether, this dataset offers one of the most credible representations of climate in the Great Lakes region, especially when accounting for the representation of lake-effect precipitation. The historic

⁵ More information can be found at <https://nelson.wisc.edu/ccr/resources/dynamical-downscaling/index.php>

data generally show trends that are aligned with future projections. Though the Battle Creek vicinity is roughly the size of one grid cell, the climate projections presented here provide a general description of future climate at Fort Custer, supplying relevant information for the late-century period (2080-2099).

The following changesⁱⁱⁱ are predicted by **all six** downscaled models for the Battle Creek vicinity:

- Temperature increases during all seasons.
- Longer growing season.
- Later first fall freeze and earlier last spring freeze.
- Winter and spring precipitation increases.
- Reduction in number of days with precipitation.
- Increase in number of extreme precipitation events.
- Reduction in number of days with snowfall.
- Lake-effect snowfall increases in the near-term and then decreases by late century.
- Reduction in annual snowfall depths.
- Reduction in upper soil moisture.

I.3 CLIMATE SCENARIO PLANNING

In its most simple form, a climate scenario is a description of future climate conditions. Climate scenarios may be qualitative and/or quantitative in nature, and they vary in the amount of detail that is included based on the needs of the practitioner. Typically, greater amounts of detail (i.e., descriptions beyond how annual temperatures and precipitation may change) make the scenarios more tangible for practitioners to incorporate into their planning, but those details do not necessarily need to be quantitative.

As part of understanding how potential future climate conditions could impact natural resources and their management on Fort Custer, the MIARNG hosted a climate scenario planning workshop with stakeholders in October 2018.

A basic set of climate scenarios was developed in advance of this workshop to use as a starting point to further refine based on the management area. These scenarios were created using a set of six future climate projections designed specifically for use in the Great Lakes region and resulted in four detailed climate scenarios (see Regional Projections section). **Figure I-1** illustrates the components of the four scenarios, along with the historic conditions.

Prior to this workshop, four management areas were identified as focus areas that the climate scenarios would address. Those management areas included:

- Fire (Prescribed Burn)
- Invasive Species Control
- High Quality Natural Areas/Forestry/Habitat Conservation
- Water/Soil Resources



Figure I-1. Visual Summary of the Climate Scenarios and Conditions Used in the Workshop.

The workshop attendees were broken into four groups based on the management areas and then used the following steps to develop their planning outcomes:

- Step 1: Define and describe your management goals
- Step 2: Describe the local weather and/or climate connections and drivers
- Step 3: Get familiar with a basic set of pre-built climate scenarios
- Step 4: Build in specifics to each climate scenario

The workshop produced preliminary results in each of the management areas above. As part of the workshop, the participants identified climate and weather events that would have an impact on the ability to manage resources within the four management areas. These results are summarized in **Table I-5**. Further work will need to go into those management areas to fully explore and plan for climate resiliency within each of these areas. In addition to these management areas, additional scenarios will be evaluated for birds, mammals, aquatic species, novel ecosystems, and insects using the climate scenarios created by Great Lakes Integrated Sciences + Assessments Center (GLISA) within the Northern Institute of Applied Climate Sciences (NIACS) Climate Adaptation Toolkit framework.

Table I-5. Summary of Management Impact Rankings for Specific Weather/Climate Events (IN=Invasive Species, FI=Fire, HQ=HQNAs/Forestry, WA=Water/Soil)			
Weather Events	Low Impact	Medium Impact	High Impact
Very hot days		WA	IN FI HQ
Very cold days	IN	HQ WA	
Heavy precipitation/storm events	FI	HQ	IN WA
High wind storms	WA	HQ	IN FI
Heavy snowstorms	IN	HQ	WA
Ice Storms	IN FI	HQ WA	
Multiple consecutive days with rain		FI	IN HQ WA
Multiple consecutive days without rain		IN	FI HQ WA
Rain on snow			WA
Short thaw period			WA
Long thaw period	WA		
More drying of relative humidity			FI
Climate Trends	Low Impact	Medium Impact	High Impact
Warmer annual and seasonal temperatures		HQ WA	IN FI
Fewer days with extreme cold	FI HQ WA		IN
Increased annual precipitation		IN FI	WA
Altered timing of seasonal precipitation patterns		HQ	IN FI WA
Prolonged periods of drought			IN FI HQ WA
Prolonged periods of moist conditions		IN FI	HQ WA
Less snow/shorter winters	FI	IN HQ	WA
Longer growing season	FI	HQ	IN WA

Table I-5. Summary of Management Impact Rankings for Specific Weather/Climate Events (IN=Invasive Species, FI=Fire, HQ=HQNAs/Forestry, WA=Water/Soil)			
Combined Climate & Weather Events	Low Impact	Medium Impact	High Impact
Extreme precipitation event during an extended dry period (any time of year)		IN	FI WA
Several consecutive dry summers interrupted by a particularly wet summer	IN	WA	FI
Several consecutive wet summers interrupted by a particularly dry summer or multiple dry summers	IN		
Extreme cold event (e.g. frost/freeze) after spring warm up	FI		IN
Fuel moisture/duff moisture			FI
Low precipitation followed by extreme storm			FI

While there are number of potential impacts from the project changes in climate patterns, the overall hotter temperatures and the suite of changes in precipitation patterns are likely to have the greatest impacts on managing natural resources on FCTC.

FCTC expects to be managing for both rare, high quality natural communities as well as novel ecosystems that are already forming from the influences of land use change and invasive species, as well as climate change. With limited resources we cannot hope to restore all of our lands to high quality natural states. However, we CAN increase the adaptive capacity of all species by carefully considering and managing HQNAs while seeing the matrix of novel ecosystems as less of a threat and more of an adaptive tool in the toolbox.

I.4 LIKELY MANAGEMENT NEEDS

Given the information in the chart of climate trends (**Table I-4**), the dynamically downscaled global climate change data for FCTC, obtained through GLISA, and the summary of the likely changed climatic conditions at FCTC, the following issues will need to be accounted for as natural resource planning and military training carry forward into the future.

Increasing temperatures in all seasons, with decreasing precipitation in the middle of the growing season and decreased upper soil moisture points to incorporating drought-tolerant plantings when restoration occurs.

Reduction in annual snowfall and warmer winters will present challenges for animal species whose disease vectors do not experience the freeze needed to keep their populations limited. Overall vegetation community structure may change.

Migrating animals not seen in our region before may begin to appear. Patterns in birds have already provided evidence of this change – many species are shifting gradually northward. Invasive species currently present may thrive, new species may make it into our region, and novel vegetative communities are likely to form over time. Invasive species management will need to be handled with precision and weighted prioritization.

We do not yet know the **impacts of the lengthening growing seasons on plant species**. There is merit in saving high quality natural communities if the climate does not change too drastically, as they can provide seed bank and refugia for species who need these specialized requirements. We also only know a handful of answers about our native species and their reaction to an atmosphere with increased carbon in it; however, carbon is often a limiting factor for plant growth.

Increased extreme precipitation events will require better planning by facility management, range operations and environmental offices to ensure that flooding and sedimentation are managed with an eye toward more extreme conditions to avoid violating policies and laws and protect infrastructure.

Those are but a few of the questions we face as we work to help our natural resources adapt to a changing climate. Working in concert with experts from various fields that touch upon these issues, adaptation planning will occur in an adaptive management framework that will influence how we implement our INRMP. Specific issues will be addressed with small group work. New projects will be appended to the INRMP as they are created.

Afforestation, wind and solar energy, and forest protection are all solidly within the means of FCTC and MIARNG to continue and which would help reduce the carbon footprint of FCTC. These all fall into the top ways to reduce carbon in our atmosphere (Hawken 2017). Reducing carbon provides us with the quickest means of slowing or stopping climate change. Other possibilities for MIARNG include reducing food waste in our systems and, while outside the scope of this document, it is worth mentioning as an action for MIARNG that would produce tangible benefits in many ways. These things plus planning for natural resources management with a full integration of expected changes in climate parameters will provide the species that reside at FCTC the best possible chance of succeeding in the future.

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I.6 NOTES

ⁱ Notes on Battle Creek station data quality: No changes in the observation location have occurred since 1960. Before February 12th, 1998, observations were taken through the volunteer-based Cooperative Observer Program (COOP) under the National Weather Service. After this date, observations came from an Automated Surface Observing System (ASOS). Shortly after the ASOS began recording observations, 15-20% of daily observations were missing per year. Specifically, the years 1999-2005, and 2008-2011 had considerable data missing. Many things can lead to missing data, such as mechanical failure or weather-related damage to the equipment.

ⁱⁱ While local climate data typically provides the most site-specific information for adaptation planning, it comes with many challenges. Oftentimes, this data comes from an automated weather observing station. These stations rely on multiple sensors and instruments to record atmospheric variables, like temperature and precipitation. Occasionally, these sensors or instruments break, leading to a break in the data record. These breaks can be short or long lived. Additionally, observing stations can be moved from time to time. Since local conditions can change abruptly over short distances (especially in the case

of precipitation and lake-effect snow), it is important to take into account any station movement when evaluating historical climate data. Also, with system automation, there are limitations to what variables can be measured. Not all automated stations are equipped to measure snow, for example. Therefore, such data must come from other sources (i.e., unofficial observing stations, peoples' recollection of past events, etc) if it is required, and it may not be as accurate. Finally, official station data sites are fairly sparse at the local scale, therefore, there are typically not other nearby stations to verify observations against. All of these factors must be taken into account to gain a sense of data reliability at the local scale.

Because of the challenges that come with obtaining high-quality local climate data, regional climate data are often used to evaluate historical trends for an area. Regional climate data rely on multiple stations to develop historical trends for the region. Greater station density in a region makes the trend more representative, because it uses more stations in the averaging. Some variables, such as local temperatures, typically follow the regional pattern closely, with only slight differences in magnitude occurring - in other words, if a region has a significant warming trend reported, most of the stations in that region also report warming to various degrees. However, with variables such as precipitation and soil moisture, trends are more likely to be highly localized, therefore, the local trend may not follow the regional trend. Finally, with more stations per region, locations that don't have an observing station may be able to use interpolated (estimated) data based on proximity to nearby stations. Essentially, when the data at multiple nearby locations is known, the data in between can be inferred with some confidence.

ⁱⁱⁱ The level of confidence for future precipitation is less certain than temperature. Most models suggest precipitation increases, but most models do not account for drought conditions. Lake-effect snowfall is projected to decline during early winter (November-December) but potentially increase during mid-to-late winter up until mid-century (2040-2059). Most heavy lake-effect snow storms will be confined to January-March. By late-century, more winter precipitation will be in the form of rain opposed to snow.

APPENDIX J
LAWS, REGULATIONS, POLICIES AND EXECUTIVE ORDERS

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APPENDIX J: LAWS, REGULATIONS, POLICIES AND EXECUTIVE ORDERS

Federal Laws**American Indian Religious Freedom Act of 1978 (Public Law 95-341; 42 United States Code [USC] §1196)**

– requires the US, where appropriate, to protect and preserve religious rights of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

Animal Damage Control Act of 1931 (7 USC §426 *et seq.*) – provides broad authority for investigation, demonstrations and control of mammalian predators, rodents and birds.

Anti-Deficiency Act of 1982 (31 USC §1341 *et seq.*) - provides that no federal official or employee may obligate the government for the expenditure of funds before funds have been authorized and appropriated by Congress for that purpose.

American Antiquities Act of 1906 (Public Law 59-209; 16 USC §431-433) – authorizes the President to designate historic and natural resources of national significance, located on federal lands, as National Monuments for the purpose of protecting items of archeological significance.

Archeological and Historical Preservation Act of 1974 (Public Law 95-96; 16 USC §469 *et seq.*) – provides for the preservation of historical and archeological data, including relics and specimens, threatened by federally funded or assisted construction projects.

Archeological Resources Protection Act of 1979 (16 USC §470 *et seq.*) – prohibits the excavation or removal from federal or Indian lands any archeological resources without a permit.

Bald Eagle Protection Act of 1940 (Public Law 87-884; 16 USC §668a-d) – prohibits the taking or harming (i.e. harassment, sale, or transportation) of bald eagles or golden eagles, including their eggs, nests, or young, without appropriate permit.

Clean Air Act of 1970 (42 USC §7401 *et seq.*) – regulates air emissions from stationary, area, and mobile sources. This law authorizes the US Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.

Clean Water Act of 1972 (Public Law 92-500; 33 USC §1251 *et seq.*) – aims to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters. Under Section 401, states have authority to review federal permits that may result in a discharge to wetlands or water bodies under state jurisdiction. Under section 404, a program is established to regulate the discharge of dredged or fill material into the Nation’s waters, including wetlands.

Coastal Zone Management Act of 1972 (Public Law 92-583; 16 USC §1451 *et seq.*) – provides incentives for coastal states to develop coastal zone management programs. Federal actions that impact the coastal zone must be consistent to the maximum extent practicable with the state program.

Conservation and Rehabilitation Program on Military and Public Lands (Public Law 93-452; 16 USC §670 *et seq.*) – provides for fish and wildlife habitat improvements, range rehabilitation, and control of off-road vehicles on federal lands.

Conservation Programs on Military Reservations (Public Law 90-465; 16 USC §670 *et seq.*) – Requires each military department to manage natural resources and to ensure that services are provided which are necessary for management of fish and wildlife resources on each installation; to provide their personnel with professional training in fish and wildlife management; and to give priority to contracting work with federal and state agencies that have responsibility for conservation or management of fish and wildlife.

In addition, it authorizes cooperative agreements (with states, local governments, non-governmental organizations, and individuals) which call for each party to provide matching funds or services to carry out natural resources projects or initiatives.

Defense Appropriations Act of 1991 (Legacy Program) – establishes the “Legacy Resource Management Program” for natural and cultural resources with emphasis is on inventory and stewardship responsibilities.

Emergency Wetlands Resources Act of 1986 (16 USC §3901-3932) – requires reporting of wetland loss by the Secretary to Congress; authorizes the purchase of wetlands; requires the Secretary to establish a National Wetlands Priority Conservation Plan; and requires states to include wetlands in their Comprehensive Outdoor Recreation Plans, among others.

Endangered Species Act of 1973, as amended (16 USC §1531 *et seq.*) – provides for the identification and protection of threatened and endangered plants and animals, including their critical habitats. Requires federal agencies to conserve threatened and endangered species and cooperate with state and local authorities to resolve water resources issues in concert with the conservation of threatened and endangered species. This law establishes a consultation process involving federal agencies to facilitate avoidance of agency action that would adversely affect species or habitat. Further, it prohibits all persons subject to US jurisdiction from taking, including any harm or harassment, endangered species.

Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (Public Law 92-516; 7 USC §136 *et seq.*) – governs the use and application of pesticides in natural resource management programs. This law provides the principal means for preventing environmental pollution from pesticides through product registration and applicator certification.

Federal Land Policy and Management Act of 1976 (43 USC §1701) – establishes public land policy and guidelines for its administration and provides for the management, protection, development, and enhancement of the public lands.

Fish and Wildlife Conservation Act of 1980 (Public Law 96-366; 16 USC §2901 *et seq.*) – encourages management of non-game species and provides for conservation, protection, restoration, and propagation of certain species, including migratory birds threatened with extinction.

Fish and Wildlife Coordination Act of 1934 (16 USC §661 *et seq.*) – provides a mechanism for wildlife conservation to receive equal consideration and coordinate with water-resource development programs.

Military Reservations and Facilities: Hunting, Fishing and Trapping (an update to the Military Construction Authorization Act; 10 USC §2671) – dictates that the Secretary of Defense require that all hunting, fishing, and trapping on military installations be in accordance with the fish and game laws of the State in which it is located, that license be obtained (except with respect to members of the armed forces), and that safety protocols be enacted.

Land and Water Conservation Act of 1965 (16 USC §4601 *et seq.*) – assists in preserving, developing, and assuring accessibility to outdoor recreation resources.

Migratory Bird Conservation Act of 1929 (16 USC §715 *et seq.*) – establishes a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds.

Migratory Bird Treaty Act of 1918 (Public Law 65-186; 16 USC §703 *et seq.*) – provides for regulations to control taking of migratory birds, their nests, eggs, parts, or products without the appropriate permit and provides enforcement authority and penalties for violations.

National Environmental Policy Act of 1969 (Public Law 91-190; 42 USC §4321 *et seq.*) – mandates federal agencies to consider and document environmental impacts of proposed actions and legislation. In addition, it mandates preparation of comprehensive environmental impact statements where proposed action is “major” and significantly affects the quality of the human environment.

National Historic Preservation Act of 1966, as amended (PL 89-665; 16 USC §470 *et seq.*) – directs federal agencies to take into account the effect of any undertaking (a federally funded or assisted project) on historic properties.

Native American Graves Protection and Repatriation Act of 1990 (Public Law 101-601; 25 USC §3001-3013) – addresses the recovery, treatment, and repatriation of Native American and Native Hawaiian cultural items by federal agencies and museums. It includes provisions for data gathering, reporting, consultation, and issuance of permits.

Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 – created the Aquatic Nuisance Species Task Force which is committed to preventing and controlling aquatic nuisance species and implementing the act.

Noxious Plant Control Act (PL 90-583) – provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.

Plant Protection Act of 2000⁶ (7 USC §7701 *et seq.*) (replaces Federal Noxious Weed Act of 1973 [PL 93-629]) – authorizes the USDA to prohibit or restrict the importation or interstate movement of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary of Agriculture determines it is necessary to prevent introduction or spread of plant pests or noxious weeds.

Plant Quarantine Act (7 USC §151-167) – regulates the importation and interstate movement of nursery stock and other plants that may carry pests and diseases that are harmful to agriculture.

Readiness and Environmental Protection Initiative (within Section 2811, FY 2003 National Defense Authorization Act) (10 USC §2684a) – outlines agreements to limit encroachments and other constraints on military training, testing, and operations.

Resource Conservation and Recovery Act of 1976 (42 USC §6901 *et seq.*) – establishes a comprehensive program which manages solid and hazardous waste. Subtitle C, Hazardous Waste Management, sets up a framework for managing hazardous waste from its initial generation to its final disposal. Waste pesticides and equipment/containers contaminated by pesticides are included under hazardous waste management requirements.

Sikes Act Improvement Act of 1997 (Public Law 105-85; 16 USC §670a *et seq.*) – amends the Sikes Act of 1960 to mandate the development of an integrated natural resources management plan through cooperation with the Department of the Interior (through the US Fish and Wildlife Service [USFWS]),

⁶ Replaces Federal Noxious Weed Act of 1974 (Public Law 93-629; 7 USC §2801).

Department of Defense, and each state fish and wildlife agency for each military installation supporting natural resources.

Soil Conservation Act of 1935 (16 USC §590a *et seq.*) – provides for soil conservation practices on federal lands.

Watershed Protection and Flood Prevention Act (PL 84-566; 16 USC §1001-1009) – the Soil Conservation Service at the Department of Agriculture provides planning assistance and construction funding for projects constructed by local sponsors, often in the form of flood control districts.

Federal Regulations

15 Code of Federal Regulations [CFR] 930 – Federal Consistency with Approved Coastal Management Programs

32 CFR 190 – Natural Resources Management Program

40 CFR 6 – USEPA Regulations on Implementation of NEPA Procedures

40 CFR 162 – USEPA Regulations on Insecticide, Fungicide, and Rodenticide Use

40 CFR 1500-1508 – Council on Environmental Quality (CEQ) Regulations on Implementing National Environmental Policy Act (NEPA) Procedures

50 CFR 17 – USFWS list of Endangered and Threatened Wildlife

50 CFR 10.13 – List of Migratory Birds

32 CFR 651 – Environmental Effects of Army Actions

Federal Executive Orders (EOs)

Environmental Safeguard for Activities for Animal Damage Control on Federal Lands (EO 11870) - restricts the use of chemical toxicants for mammal and bird control.

Exotic Organisms (EO 11987) – restricts federal agencies in the use of exotic plant species in any landscape and erosion control measures.

Floodplain Management (EO 11988) – specifies that agencies shall encourage and provide appropriate guidance to applicant to evaluate the effects of their proposals in floodplains prior to submitting applications. This includes wetlands that are within the 100-year floodplain and especially discourages filling.

Off-Road Vehicles on Public Lands (EO 11989⁷) – establishes criteria for designating public lands as open, limited or closed to the use of off-road vehicles (ORVs) and establishes rules for use and operation of ORVs in order to protect the resources of the public lands, to promote safety, and to minimize conflicts among various users.

Protection of Wetlands: Amends Executive Order 11990 (EO 12608) – directs all federal agencies to take action to minimize the destruction loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. This applies to the acquisition, management, and disposal of federal lands and facilities; to construction or improvements undertaken, financed, or assisted by the federal government; and to the conduct of federal activities and programs which affect land use.

⁷ Amends Executive Order 11644.

Protection and Enhancement of Environmental Quality: Amends Executive Order 11514 (EO 11991) – provides for environmental protection of federal lands and enforces requirements of NEPA.

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898) – requires environmental protection for all communities by focusing federal attention on the environmental and human health effects of federal actions on minority and low-income populations.

Energy Efficiencies and Water Conservation at Federal Facilities (EO 12902) – federal agency use of energy and water resources is directed towards the goals of increased conservation and efficiency.

Indian Sacred Sites (EO 13007) – provides for the protection of and access to Indian sacred sites.

Protection of Children from Environmental Health Risks and Safety Risks (EO 13045) – requires that the USEPA evaluate the effects of a planned regulation on children and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives.

Invasive Species (EO 13112) – directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

Greening the Government through Leadership in Environmental Management (EO 13148) – requires the head of each federal agency to be responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision making and long-term planning processes across all agency missions, activities, and functions.

Consultation and Coordination with Indian Tribal Governments (EO 13175) – ensures that all federal departments and agencies consult with Indian tribes and respect tribal sovereignty as they develop policy on issues that impact Indian communities.

Responsibilities of Federal Entities to Protect Migratory Birds (EO 13186) – directs all federal agencies taking actions that have a potential to negatively affect migratory bird populations to develop and implement a Memorandum of Understanding with the USFWS by January 2003 that shall promote the conservation of migratory bird populations.

Strengthening Federal Environmental, Energy, and Transportation Management (EO 13423) – requires federal agencies to lead by example in advancing the nation’s energy security and environmental performance by establishing new and updated goals, practices, and reporting requirements for environmental, energy, and transportation performance and accountability.

Facilitation of Hunting Heritage and Wildlife Conservation (EO 13443) – directs the Department of the Interior and its component agencies, bureaus and offices facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Executive Order 13148: Greening the Government Through Leadership in Environmental Management (2000). – requires federal laboratories, testing facilities, maintenance facilities, hospitals, and others with operations that interact with the environment across all federal departments and agencies to implement an Environmental Management System (EMS) by December 31, 2005.

Presidential Memorandum, Government-to-Government Relations with Native American Tribal Governments (1994)– outlines principles that federal executive departments and agencies must follow in their interactions with Native American tribal governments such that the federal government operates within a government-to-government relationship with federally-recognized Native American Tribes.

Department of Defense Directive (DODD), Department of Defense Instruction (DoDI), Army Regulation (AR), & Army National Guard Regulation (ARNG)

DoDD 4150.7, DoD Pest Management Program

DoDD 4700.4, Natural Resources Management Program⁸

DoDD 4710.1, Archaeological and Historic Resources Management

DoDD 4715.1E, Environment, Safety, and Occupational Health

DoDD 6050.1, Environmental Effects in the US of DoD Actions

DoDD 6050.2, Use of Off-Road Vehicles on DID Lands

DoDI 4150.07, Pest Management Program

DoDI 4165.57, Air Installations Compatible Use Zones

DoDI 4715.03, Natural Resources Conservation Program

DoDI 4715.1, Environmental Security

DoDI 4715.9, Environmental Planning and Analysis

DoDI 6055.06, Fire and Emergency Services Program

Department of Defense, American Indian and Alaska Native Policy

AR 200-1 Environmental Protection and Enhancement dated 13 December 2007

AR 210-9 – Use of Off-Road Vehicles on Army Lands

AR 215-1 – Morale, Welfare, and Recreation Activities and Non-Appropriated Fund Instrumentalities

AR 315-19 – The Army Sustainable Range Program

AR 405-80 – Management of Title and Granting Use of Real Estate

AR 420-40 – Historic Preservation

AR 420-90 – Fire and Emergency Services

ARNG Guidance for the Creation, Implementation, Review, and Revision and Update of INRMPs dated 9 April 2012

Department of Defense Memoranda

Memorandum, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), 20 Sept 11, Subject: *Interim Policy on Management of White Nose Syndrome in Bats.*

Memorandum, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), 3 Apr 07, Subject: *Guidance to Implement the Memorandum of Understanding to Promote the Conservation of Migratory Birds.*

⁸ Cancels DoD Directive 4700.1. Replaced by 32 CFR 190 – Natural Resources Management Program.

Memorandum, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), 14 Aug 06, Subject: *Integrated Natural Resource Management Plan (INRMP) Template*

Memorandum, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), 17 May 05, Subject: *Implementation of Sikes Act Improvement Amendments: Supplemental Guidance concerning Leased Lands*

Memorandum, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), 1 Nov 04, Subject: *Implementation of Sikes Act Improvement Amendments: Supplemental Guidance concerning INRMP Reviews*

Memorandum, Deputy Under Secretary of Defense (Installations and Environment), 10 Oct 02, Subject: *Implementation of Sikes Act Improvement Act: Updated Guidance*

Memorandum, Assistant Deputy Under Secretary of Defense (Environment), 5 Aug 02, Subject: *Access to Outdoor Recreation Programs on Military Installations for Persons with Disabilities.*

Memorandum, Assistant Secretary of Army (Environment, Safety and Occupational Health), Deputy Assistant Secretary of the Navy (Environment), Deputy Assistant Secretary of the Air Force (Environment, Safety and Occupational Health), 20 Sep 11, Subject: *Interim Policy on Management of White Nose Syndrome in Bats.*

Memorandum, DAIM-ED Guidance for Implementation of the Sikes Act Improvement Act (SAIA) (Updated), 25 May 2006. Subject: *USFWS and State involvement in developing INRMPs; defining “mutual agreement” with the USFWS and the appropriate State agency; and coordinating INRMPs with other planning statutes.*

Memorandum, DAIM-ZA (200-3) Army Wildland Fire Policy Guidance, 04 September 2002

Memorandum, United States Army policy entitled Army Goals and Implementing Guidance for Natural Resources Planning Level Surveys (PLS) and INRMP (“Army INRMP Policy”); 21 March 1997

Memorandum, Army National Guard (ARNG) Installations and Environmental (I&E) Directorate Policy for Integrated Natural Resources Management Plans (INRMP); 20 March 2019

US Fish and Wildlife Service (USFWS) Guidance

USFWS Guidelines for Coordination on Integrated Natural Resource Management Plans (June 2015).

Provides updated guidance to USFWS personnel for implementing the requirements of the Sikes Act. It replaces the following memorandum: *Guidance for Coordination of Department of Defense Sikes Act Integrated Natural Resource Management Plans (June 8, 2001).*

Michigan State Laws

Public Act 172 Crawford County Land dated 13 May 1913: Authorizes the military board to accept certain lands for state, authorizes fishing in Lake Margarethe, authorizes lease of facilities for training, and allows examination of documents to Grayling Recreation Authority.

Public Act 321 Recreational Authorities Act dated 1 December 2000: Provides for the establishment of recreational authorities; powers and duties of an authority; authorizes the assessment of a fee, the levy of a property tax, and the issuance of bonds and notes by an authority; and provides for the powers and duties of certain government officials.

Act 451 Natural Resources and Environmental Protection Act (NREPA), 1994 as amended: Michigan's environmental laws have been consolidated into the Natural Resources and Environmental Protection Act of 1994 (as amended).

The Natural Resource and Environmental Protection Act serves to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, assessments, and donations; to provide certain appropriations; to prescribe penalties and provide remedies; and to repeal acts and parts of acts.

The Natural Resources and Environmental Protection Act is organized into Parts, which include Habitat Protection, Management of Renewable Resources, Management of Nonrenewable Resources, and Recreation. Details regarding the provisions within each Part can be found at: <http://legislature.mi.gov/doc.aspx?mcl-act-451-of-1994>. Other parts of NREPA may be applicable occasionally at Camp Grayling, but those listed below are the most applicable to the INRMP and its implementation.

Article II Pollution Control

Part 31 – Water Resources Protection: new or upgraded stream crossing or stream bank stabilization activities and any other alterations of water courses. Requires MDEQ/USACE Joint Permit Application (JPA). Other sections of Part 31 apply to wastewater and other water quality discharges and rules.

Part 91 – Soil Erosion and Sedimentation Control: specifies requirements related to soil erosion and sediment control, changes in land use, and enforcement by county and municipal entities.

Article III Natural Resources Management

Part 301 - Inland Lakes and Stream: most activities that occur within or along the shoreline of inland lakes and streams (e.g. dredging, installation of rip rap, interfering with the natural flow of water, etc.) require a permit (MDEQ/USACE JPA).

Part 303 - Wetlands Protection: most activities that alter a wetland require a permit (MDEQ/USACE JPA).

Part 305 - Natural Rivers: legal authority for managing river systems and regulating all land management or construction activities occurring on these river systems; Rules for Utilities and Publicly Provided Facilities (include standards related to road/stream crossings, erosion control, management of vegetation in utility corridors and others)

Part 309 - Inland Lake Improvements: provides for lake boards and establishes rules related to improvements and regulations on inland lakes.

Part 311 - Local River Management: provides for watershed councils, river management districts, and minimum stream flows, along with specifies duties and rules associated with them.

Part 355 - Biological Diversity Conservation: directs state agencies to recommend strategies for conserving biological diversity; has no regulatory requirements.

Part 365 - Endangered Species: protects and prohibits take of federally and state listed species and allows for certain exceptions.

Part 401 - Wildlife Conservation: generally relates to regulation of game species.

Part 411 - Protection and Preservation of Fish, Game, and Birds: generally relates to regulation of game species.

Part 831 – State Forest Recreation: defines recreation with state forests and establishes rules associated with recreation on state forest lands.

MDNR Wildland Fire Policy

- DNR Policy and Procedure 33.42-08, Prescribed Burning, revised September 20, 2013.
- DNR Policy and Procedure 33.42-09, Wildfires in State Natural Areas, issued July 11, 2005.

Forest, Mineral and Fire Management and Wildlife Division (FMFMD) Policy and Procedures

- DNR FMFMD Policy and Procedure 141, Wildfire Training for Fire Departments, dated October 22, 1999
- DNR FMFMD Policy and Procedure 161, Physical Fitness Standards, dated February 17, 2000
- DNR FMFMD Policy and Procedure 511, Five-Year Unit Management Planning, undated
- DNR FMFMD Policy and Procedure 512, Annual Fire Plan, dated December 13, 1999
- DNR FMFMD Policy and Procedure 514, Incident Command System
- DNR FMFMD Policy and Procedure 521, Forest Fire Law, dated June 16, 1981
- DNR FMFMD Policy and Procedure 522, Control of Open Burning, dated June 16, 1981
- DNR FMFMD Policy and Procedure 542, Fire Operations Involving Structures, dated March 24, 1988
- DNR FMFMD Policy and Procedure 572, Wildfires in State Natural Areas, dated March 15, 2001

- DNR FMFMD Policy and Procedure 581, Prescribed Burning, undated.

MDNR Director's Order No. FO-224.13 - It shall be unlawful to kill, take, trap, possess, buy, sell, offer to buy or sell, barter, or attempt to take, trap, possess or barter any reptile or amphibian from the wild, or the eggs of any reptile or amphibian from the wild, except as provided within this Order. Available at: https://www.michigan.gov/documents/dnr/FO-224-02_182417_7.pdf

Michigan Department of Agriculture

Regulation No. 637, Pesticide Use, amended 2008, section 8325 of 1994, PA 451, MCL 324.8325 - The statute that regulates pesticide products including their use, the people that apply them, licensing requirements, and penalties.

Regulation No. 636, Pesticide Applicators, amended 1991, section 8325 of 1994, PA 451, MCL 324.8325 - Rules that regulate pesticide applicators including categories of certification and registration, and licensing of firms that apply pesticides and record keeping.

APPENDIX K
STANDARD OPERATING PROCEDURES

Mowing SOP (draft)

Firewood SOP

Mushroom/Berry Harvesting SOP (in development)

Fishing SOP (in development)

Hunting SOP (in development)

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16-Jan-20

1. PURPOSE

Mowing as necessary maintains sight distance for safety. If done improperly, mowing can cause additional maintenance problems and adverse effects to soils, roadside habitat, and nesting birds. Improper mowing height and too frequent or poorly timed mowing can reduce root mass, plant vigor, and overall plant production potential. Operating heavy equipment on roadside slopes can destroy vegetation, weakening the plant community and making roadsides more susceptible to weeds and erosion. If done at the wrong time, mowing can also help to rapidly spread undesirable weed species.

A primary purpose of roadsides is to provide drainage away from the roadway, and to store snow. Roadsides can provide relatively unique and permanent strips of critical habitat, particularly in agricultural and forested landscapes, valuable as wildlife cover for reproduction, feeding, and predator avoidance, and as connections between isolated habitat patches.

Properly maintaining roadsides, prairies, and to some extent ranges can increase biological diversity and wildlife abundance, providing critical but rare habitats used for feeding, reproduction, and cover by wildlife (invertebrates and vertebrates, game and non-game) including a variety of pollinating insects and predators of crop pests.

Additionally, Presidential Memorandum, Pollinator-Friendly Best Management Practices for Federal Lands, DRAFT May 11, 2015 was written to reduce the impacts to pollinators from mowing. "Fixing America's Surface Transportation Act (FAST Act-Public Law 114-94)" became law on December 4, 2015. Employees of Federal land management agencies are encouraged to become knowledgeable about pollinators and pollination ecology and to make commitments to healthy, resilient pollinator habitats. The following is an excerpt from the Memorandum:

"Sec. 3. Increasing and Improving Pollinator Habitat. Unless otherwise specified, within 180 days of the date of this memorandum:

(j) The Department of Defense shall, consistent with law and the availability of appropriations, support habitat restoration projects for pollinators, and shall direct military service installations to use, when possible, pollinator-friendly native landscaping and minimize use of pesticides harmful to pollinators through integrated vegetation and pest management practices."

DOD mowing activities are described in the Departments of the Army, the Navy, and the Air Force, ***Natural Resources Land Management; ARMY TM 5-630***, NAVY NAVFAC MO-100.1, AIR FORCE AFM 126-2, JULY 1982 document, Part II. Land Management and Grounds Maintenance, Chapter 15 Establishment and Maintenance of Grounds, **Section 15-13 Mowing**.

The purpose of this standard operating procedure (SOP) is to provide a procedure for Fort Custer Training Center (FCTC) mowing activities based on ARMY TM-5-630 and standard practices to support training as well as, protect wildlife and habitat.

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2. RESPONSIBILITY AND SCOPE

2.1 Responsibility

It is the responsibility of FCTC Environmental (ENV) and Department of Public Works (DPW) to implement this SOP.

2.2 Scope

The scope of this SOP is to provide guidance on mower blade height, optimum times, and restricted/limited times for conducting roadside, range, and prairie mowing activities throughout the year.

3. PERSONNEL AND EQUIPMENT REQUIREMENTS

3.1 Personnel Requirements

In compliance with any and all State of Michigan (SOM), FCTC DPW, and manufactures rules, regulations, and instructions for the safe operation of the applicable mower.

3.2 Equipment Requirements

Applicable mower capable of meeting the requirements of this SOP based on the type of area being mowed. For early season and along unpaved roadsides, a sickle bar type mower is suggested.

4. PROCEDURE

The differences between an ultimately beneficial mowing regime and a detrimental one are timing, technique, and scale. Although mowing is not a frequent management activity in natural areas, it is used by many agencies to maintain roadside safety, road shoulders, ranges, bivouac areas, and as a fuels management practice for fire prevention. Mowing can shorten the lifespan and health of plants depending on the timing, frequency and height at which plants are cut. Mowing causes grasses and broad-leaf plants to deplete energy stored in their root systems. If plants are mowed too often, too short (under six inches), or during the growing season before they transfer energy to the roots, they may not live to regrow the next year. Mowing grasses during the active growing season can cause the next growth to be shorter and spread out more. The shorter the grass is mowed, the closer to the ground it will start branching off to grow, creating more spreading growth.

Mowing should be used selectively and only where needed, such as in targeted areas to prevent snow drift, to control invasive species, or to maintain sightlines, and sign visibility. **Late May through June is a critical time period for wildlife at Fort Custer. Animals are emerging from hibernation, mating and nesting during this period and are vulnerable to mowing actions. If possible mowing during this timeframe should be avoided.**

FCTC is designated as having Eastern Massasauga Rattlesnake (EMR) habitat. The EMR is an endangered species. FCTC additionally, has several other species of reptiles and amphibians which are active during the warm months. The best time to mow is during the hottest time of year, which in Michigan is generally July, when animals can flee or in late fall to early winter when animals are inactive. However, it is also beneficial

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for less frequent mowing as it results in fewer mower-related mortalities of herpetofauna and other wildlife. Mowing less frequently also costs less and reduces carbon emissions.

To avoid hitting turtles with mowers, mow prior to or preferably after turtle nesting season (i.e., after early June). Mowing should be timed to avoid the turtle nesting season and the peak foraging and migration seasons of other amphibians and reptiles (late spring and fall). **Refer to Table 1.**

4.1 Roadside Mowing

Mowing should occur during non-blooming seasons and avoid mowing when plants are coming out of dormancy (typically September to end of March) in pollinator areas and roadsides. Wait until fall (preferable after first freeze) in areas with desirable plants and grasses or during the winter (when vegetation is going into dormancy). Mowing later in the season allows seeds to fall, leading to more new plants the next year, controls invasion of woody vegetation and rejuvenates herbaceous growth. This timing allows birds and other wildlife to complete the reproductive season. Vegetation should be 10 to 12" high by the end of the growing season which protects plants from damage over winter and provides winter cover and spring nesting cover for birds.

For **paved roadsides** confine close mowing (under 8 inches) to road shoulders. Encourage flowering plants indigenous to the geographic location of the installation. Encourage trees and shrubs to take over back slopes completely or in irregular bed type arrangements where compatible with safety visibility. Mowing of paved roadsides is performed to preserve erosion resisting turf; provide marginal strips for emergency use; maintain sight distances for markers, signs, and traffic safety structures; reduce snow accumulations on adjacent pavements; accelerate drainage; reduce fire hazards; and provide an attractive appearance. For paved roadways, mow strips 20 feet in width from the pavement edges along the principal traffic arteries and 15 feet along other paved roadways. Where embankments or ditch slopes steeper than 3 to 1 impinge upon these 20- or 15-foot strips, mow a single cutter bar width up or down the embankment where feasible.

For **unpaved roadsides** requirements are determined by evaluation of local conditions and road use. Prevention of drainage failures and soil erosion, and use of rights-of-way for firebreaks are of principal interest. Unpaved roadsides the minimum mowing height should be **eight (8) inches** to reduce likelihood of injury to snakes, turtles, and other wildlife. Higher deck height will reduce the risk of death or injury to wildlife in the area. Unmaintained/longer grass may be used by snakes and make them vulnerable to mortality during the next mowing event. Small saplings and brush (stems up to 2 inches in diameter) within the mowing cut swath should be mowed to the same height as grasses and broadleaf plants. Restrict mowing to one (1) mower width or "swath" (typically 10-12 feet wide) located immediately next to the roadside edge. Increase mowing width to meet the requirements of specific conditions, including: sight line areas at intersections and cross-overs. Mowing should be done after first freeze and before the end of March.

4.2 Range, Bivouac, and Landing Zones Mowing

Mowing of Ranges, Landing Zones, field training areas, Bivouac, and similar areas is required at intervals depending on intensity of use. On airfields, grass height management is a tool in reducing airfield bird population, thus reducing bird/aircraft strike hazards. In general, airfield grass height should be maintained at a height of 6 to 12 inches. Although this recommended height will vary with

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grasses involved, geographic location, and location climate, 6 to 12 inches is a good standard to work from for the following reasons: This height is tall enough to discourage those birds which prefer short grass areas because of the easily accessible invertebrate food supplies and good visibility. It is short enough to discourage the presence of small mammals which are food for hawks and owls. Ground-nesting birds are similarly discouraged. Cutting the grass prior to maturity also reduces the attractiveness by eliminating the seeds, an important food source for many birds. It is an ecologically sound practice. Close frequent mowing should not be permitted since it weakens many turf grass species and encourages weeds.

During the active season (July and August), follow daytime mowing restrictions and mow during times of day when snakes are less likely to be active (~11:00 to 15:00 and after 18:00). During March through June, and September through November mow after 18:00 and before 10:00).

For Ranges, Landing Zones, or in areas with turf grass or areas where trying to discourage herpetofauna (e.g., in areas around ranges and bivouacs), mow regularly and keep grass relatively short (4 inches) to reduce its suitability for snakes. If starting with longer grass (greater than 6 inches), mow during the inactive season initially, and then maintenance mowing can occur during the active season (as long as it is regularly maintained and kept shorter than 4-6 inches, so that snakes are unlikely to use those areas). Mowing is unrestricted during the inactive season.

For all other bivouacs and training areas the minimum mowing height should be **six to eight (8) inches** to reduce likelihood of injury to snakes, turtles, and other wildlife. Higher deck height will reduce the risk of death or injury to wildlife in the area. Unmaintained/longer grass may be used by snakes and make them vulnerable to mortality during the next mowing event. Mowing height may be reduced to a minimum of four (4) inches for winter snowstorm preparation.

4.3 Pollinator & Prairie Mowing

For areas planted as **pollinator habitat, mowing needs to be coordinated with ENV**. Mow only when vegetation height is 17 inches or more. Allow pollinators to escape mower blades by using a flushing bar on the mower and by mowing at reduced speeds (less than 8 miles per hour). Cut high (a minimum of 12-16 inches) and/or mow in patches to ensure that some pollinator habitat is left intact. For 2 to 3 years following seeding, do not mow unless absolutely necessary and do not mow shorter than 6 inches.

Prairie should not be mowed, unless part of a bivouac or training area which needs to be coordinated with ENV when it is deemed needed. Follow procedures in Section 4.2 Range, Bivouac, and Landing Zones Mowing "For all other Bivouacs and Training Areas" paragraph.

5. TRAINING, INSPECTIONS & RECORD KEEPING

This SOP has been developed to support training as well as, protect wildlife and habitat. Secondly, this SOP will help protect FCTC from possible Notices of Violation (NOVs) from State and Federal Agencies who manage the threatened and endangered species. NOVs can be issued by governmental agencies for damaging or destroying habitat, and potentially harming or killing wildlife.

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5.1 Training

- ENV will arrange a SOP meeting with applicable DPW and Range staff to discuss and highlight important sections of the SOP. A condensed two page Summary version of the SOP will be developed and provided.

5.2 Inspections

- FCTC ENV staff routinely inspects/observes the FCTC grounds. Infractions to the SOP requiring action, at the discretion of ENV, and based on severity will be documented and provided to DPW.

5.3 Hardcopy Record Keeping

- SOP meeting sign-in sheet
- A copy of the SOP, and SOP Summary will be kept at the DPW Building (2590), ENV Building (2510), and Range Control (RC).
- SOP infractions that are severe enough to be documented.

5.4 Electronic Record Keeping

- An electronic copy of the SOP, SOP Summary, SOP meeting sign-in sheet, the Army TM 5-630, and any documented infractions will be filed at: O:\FCTC\FCTC_Share\FCTC Environmental\Mowing.

6. ACRONYMS

DPW	Department of Public Works
EMR	Eastern Massasauga Rattlesnake
ENV	Environmental Department
FCTC	Fort Custer Training Center
RC	Range Control
SOM	State of Michigan
SOP	Standard Operating Procedure

7. REFERENCES

- Arizona Department of Transportation *Vegetation Management Guidelines – Mowing*, undated
- Departments of the Army, the Navy, and the Air Force, *Natural Resources Land Management*; ARMY TM 5-630, NAVY NAVFAC MO-100.1, AIR FORCE AFM 126-2, JULY 1982
- Michigan Amphibian and Reptile Best Management Practices. Herpetological Resource and Management Technical Publication 2014.
- Minnesota Department of Transportation Office of Research Services *Best Practices Handbook for Roadside Vegetation Management* July 2008
- Presidential Memorandum, Pollinator-Friendly Best Management Practices for Federal Lands, DRAFT May 11, 2015

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- Pollinator Partnership Technical Manual for Maintaining Roadsides for Pollinators Establishment, Restoration, Management and Maintenance *A Guide for State DOT Managers and Staff* 2016
- U.S. Fish and Wildlife Service, Michigan Ecological Services Field Office *Environmental Screening for Eastern Massasauga Rattlesnake in Michigan*, March 14, 2017
- U.S. Forest Service Pollinator-Friendly Best Management Practices for Federal Lands, DRAFT May 11, 2015

8. AUTHORSHIP AND POINTS OF CONTACT

This document was drafted by Curtis G. Roebuck, Environmental Manager, Fort Custer Training Center. To report errors, request clarification, suggest updates, or any other matters regarding the contents of this SOP contact:

Curtis G. Roebuck
curtis.g.roebuck.nfg@mail.mil
269-282-7611

9. IMPLEMENTATION AUTHORITY AND ENDORSEMENT

This SOP is specific to FCTC, and is the official policy of the MIARNG Environmental Office as of the date included in the below signature and by the authority of Jonathan Edgerly, Environmental Program Manager for the Michigan Army National Guard (MIARNG).



MICHIGAN ARMY NATIONAL GUARD
FORT CUSTER TRAINING SITE COMMAND
2501 26th Street
Augusta, Michigan 49012-9205

MIAR-FC-ENV

The individual listed below is authorized per AR 420-74 and DOD Directive 4160-21-M to collect and remove firewood from Fort Custer Training Center (FCTC) on the date (s) stated below. This permit to cut firewood must be carried by the cutter while he/she is collecting and hauling wood on FCTC.

Name: _____

Telephone Number: _____

Firewood collection/removal date: _____

Requirements are as follows:

- 1) All equipment and labor will be supplied by the permit holder. Extraction of disabled or mired privately owned equipment is the responsibility of the wood collector. State or Federally owned property is not available for such purposes.
- 2) NO FIREWOOD CUTTING IN AREA 6 or ADJACENT ROADS. Firewood harvest should be restricted to areas immediately adjacent to the following roads; Longman (North of Mott Rd), Augusta/Climax, Territorial, 40th, and 42nd St. (See attached MAP to this SOP)
- 3) Only naturally felled wood may be collected without being marked. Wood lying on the ground as debris from other timber sales may not be collected, except when declared available by the FCTC-ENV office. Standing trees (living or dead) will not be cut unless declared available by the FCTC-ENV office.
- 4) Permit holders must check in with FCTC-OPS each day to ensure no conflicts with training. Wood collectors must sign-in before entering training areas and check out when leaving.
- 5) All wood collectors will vacate the wood collecting areas before dusk, or earlier if determined by FCTC-OPS.
- 6) Trash and refuse will not be deposited on FCTC.
- 7) The US Government and the State of Michigan are not responsible for any damage or injury to persons or property incurred as a result of the removal of firewood from the FCTC.
- 8) Persons not complying with the above requirements will not receive additional firewood permits and will be subject to possible administrative and/or legal action.

AUTHORIZING OFFICIAL: _____

I agree to abide by the requirements stated above. I agree to hold harmless the US Government and the State of Michigan for any damage or injury to person or property incurred as a result of use of this permit to remove firewood from FCTC.

SIGNATURE OF PERMIT HOLDER: _____

APPENDIX L

INRMP REVIEWS AND CORRESPONDENCE

Review for Operation and Effect (March 2019)

Agency Correspondence on Updated INRMP (April 2020, June 2020)

NEPA Documentation for Updated INRMP (2020)

Annual Reviews



19 March 2019

To: USFWS, MDNR

Re: Review for Operation and Effect, Michigan Army National Guard (MIARNG), Integrated Natural Resources Management Plans (INRMP) for Fort Custer Training Center, Michigan

Hello!

The MIARNG would like to complete the required Review for Operation and Effect (ROE) for the INRMP for Fort Custer Training Center in Kalamazoo and Calhoun Counties, Michigan. There is a current INRMP as required by the Sikes Act and you have been involved in annual reviews and various stakeholder meetings. The INRMP was originally approved by the U.S. Fish and Wildlife Service (USFWS) and the Michigan Department of Natural Resources (MDNR) in 2001 and updated in 2012. The previous ROE was completed in association with the update in 2012, although annual meetings to discuss INRMP implementation with multiple stakeholders have been held every year.

The current ROE will ensure that all cooperating partners have an opportunity to review INRMP implementation, provide input on that implementation, and affirm whether they consider the INRMPs are effective. The MIARNG is intending to at least update the INRMP to reflect new data, new policies, and new requirements since 2012.

As part of this ROE and the INRMP update, the MIARNG hosted an INRMP scenario planning workshop on October 4, 2018. The meeting minutes from this workshop are attached, which includes a list of stakeholders who participated in the workshop. This included a representative from MDNR (Mark Mills) although a USFWS representative was unable to attend. Also, as part of completing this ROE, we have attached a summary of project completion status since the last update.

At this time, we are seeking any additional input from your agency regarding areas of the INRMP that could use improvement or are working well. Please also provide any new or additional information, new natural resources topics or issues of concern, updates on policies or regulations, updates on rare flora and fauna listings and nearby observations, identification of issues of regional concern, or other new information that your agency thinks should be considered during this review and subsequent updating of the INRMPs.

In order to complete this ROE, please provide written concurrence of our initial determination that the INRMP is being implemented, is effective, and that an updated INRMP is acceptable to you. We look forward to and welcome your participation in this INRMP review process. Please send correspondence or questions to me at (517) 243-0788 or michele.m.richards2.nfg@mail.mil.

Sincerely,

Michele Richards

Natural Resources Manager
Fort Custer Training Center

<i>Project</i>	<i>Project Number</i>	<i>Start Date</i>	<i>Completion/End Date</i>	<i>Interval</i>	<i>Principal Responsible Party</i>	<i>Funding Source</i>	<i>Notes</i>	<i>Project Status</i>	<i>Next INRMP?</i>
Butterfly and moth monitoring	1.1.1a	FY94	Ongoing	Every 5 years (next FY20)	IEM	ARNG-ILE	Emphasis on listed species, also see 1.1.2 and 1.1.3	Ongoing	Yes
	1.1.1b	FY15	Ongoing	Annual	IEM	Volunteers	Done through KNC's citizen science program	Ongoing	Yes
Karner blue butterfly survey	1.1.2	FY05	Ongoing	Every 3 years (next FY21)	IEM	ARNG-ILE		Ongoing	Yes
		FY05	FY06				Delineated habitat and initial presence survey		
		FY08	FY10				Presence survey		
		FY11	FY13				Presence survey		
		FY14	FY16				Presence survey		
	FY18	Ongoing				Presence survey and possible introduction			
Mitchell's satyr butterfly survey	1.1.3	FY00	Ongoing	Every 3 years (next FY21)	IEM	ARNG-ILE	With 1.1.2	Ongoing, pending funding	Yes
		FY05	FY08				Survey for 3 years, with SWMLC		
		FY11	FY12				Presence survey		
		FY13	FY15				Presence survey		
	FY18	Ongoing				Presence survey and possible introduction			
Cerulean warbler survey	1.1.4	FY05	Ongoing	Annual	IEM	ARNG-ILE	Point count and area searches	Ongoing	Yes
Prairie vole surveys	1.1.5	FY02	Ongoing	Every 3 years (next FY20)	IEM	ARNG-ILE	Assess impacts of training on species and habitat	Ongoing	Yes
Listed Indiana bat survey	1.1.6	FY 05	Ongoing	Every 5 years (next FY20)	IEM	ARNG-ILE	Per USFWS requirements	Ongoing	Yes, change to Listed Bats
		FY00	FY03						
		FY14	FY16				Acoustic monitoring in 2014 thru MDA contract. No evidence of Indiana Bat found.		
		FY15	FY17			Associated with EIS	EIS survey indicated NLEB		
Eastern box turtle monitoring	1.1.7a	FY07			IEM	Self	Monitor health of population	Combined with Herp Surveys, 1.1.12	Yes
	1.1.7b	FY15			IEM	Legacy or SERDP?	Head-starting	Ongoing	Yes
		FY17	FY19					Ongoing	
Eastern massasauga rattlesnake survey	1.1.8	FY02	Ongoing	Every 2 Years (next FY22?)	IEM	ARNG-ILE	Presence survey	Ongoing	
		FY02	FY05				Presence survey (3 years, none found)		
							Multiple years between 2000 and 2014		
		FY14	FY15				Presence survey (2 years, none found)		
		FY16	FY20				Presence survey (3 years)	Ongoing	
Bald eagle survey	1.1.9	FY13	Ongoing	Annual	IEM	USFWS	Conduct surveys for presence and potential nests	Ongoing	Yes
Trumpeter swan monitoring	1.1.10	FY03	FY16	Annual	IEM	Self	Survey 2x during breeding season	Completed, removing mute swans, also see 1.1.12	No
Henslow sparrow survey	1.1.11	FY14	Ongoing	Every 3 years (next FY19)	IEM	ARNG-ILE	Presence survey	Ongoing	Yes

<i>Project</i>	<i>Project Number</i>	<i>Start Date</i>	<i>Completion/End Date</i>	<i>Interval</i>	<i>Principal Responsible Party</i>	<i>Funding Source</i>	<i>Notes</i>	<i>Project Status</i>	<i>Next INRMP?</i>
Other sensitive animal species surveys	1.1.12a	FY93	Ongoing	Annual	IEM	ARNG-ILE	Bird surveys	Ongoing	Yes
	1.1.12b	FY94	Ongoing	Every 10 years (FY21)	IEM	ARNG-ILE	Mammal surveys	Ongoing	Yes
	1.1.12c	FY02	Ongoing	Every 5 years (FY21)	IEM	ARNG-ILE	Herptile surveys	Ongoing	Yes
	1.1.12d	FY94	Ongoing	Every 10 years (FY21)	IEM	ARNG-ILE	Fish surveys	Ongoing	Yes
Pale fumewort survey	1.1.13	FY97	Ongoing	Annual	IEM	ARNG-ILE	Annual survey for frequency and quality as required by ITP	Ongoing	Yes
Other listed plant surveys	1.1.14	FY94	Ongoing	Every 10 years (next FY28)	IEM	ARNG-ILE	Surveys of 28 listed Michigan sensitive plant species	Ongoing	Yes
Eastern pipistrelle survey	1.1.15	FY05	FY06	Completed	IEM	ARNG-ILE		Complete, but see 1.1.6	No
Special species range shift monitoring	1.1.16	FY15?	Ongoing	Annual	In-house	N/a	Coordinate with state/regional entities during shifts of listed species ranges	Ongoing	Yes, move to activity
Surveys for white nose syndrome in bats	1.1.17	FY24	Ongoing	As Needed	IEM	ARNG-ILE or Grants	Surveys for white nose syndrome, based on USFWS and MDNR policy	As needed	Yes
Deer population study and analysis	2.1.1a	FY05	FY07	Completed	IEM	Self	Study on deer survival using radio telemetry	Completed	
	2.1.1b	FY07	Ongoing	Annual	IEM	Self	Analysis of deer harvest for sex and age	Ongoing	Yes
MAPS bird study	2.1.2a	FY05	FY10	Completed	IEM	ARNG-ILE	Five year survey for nest success	Completed	
	2.1.2b	FY11	Ongoing	Annual	IEM	ARNG-ILE	Breeding bird census and nesting success	Ongoing	Yes
Control strategy for raccoon populations	2.1.3a	FY05	Ongoing	As Needed	IEM	Self-supporting	Conducted a two week raccoon hunt to reduce populations	Ongoing	Yes
	2.1.3b	FY05	Ongoing	Every 10 years (FY19)	IEM	Self-supporting	Control strategy	Ongoing	Yes
		FY05	FY05				Developed control strategy		
Beaver population surveys	2.1.4	FY02	Ongoing	Annual	IEM	Self-supporting	Population surveys	Ongoing, with mammal surveys in 1.1.12	Yes
Frog and toad surveys	2.1.5	FY05	FY16	Annual	IEM	Self-supporting	Perform presence/absence surveys in early/late spring and summer	Complete, also combined with Herp Surveys 1.1.12	Yes
Prescribed fire habitat restoration	2.1.6	FY03	Ongoing	Annual	IEM	ARNG-ILE/grants	Annual burns (on rotation)	Ongoing, also see 3.2.1 (Monitoring in 3.2.2)	Yes
IPM implementation	2.1.7a	FY03	Ongoing	Annual	IEM	ARNG-ILE	Implement PM program	Ongoing	Yes
	2.1.7b	FY03	Ongoing	Annual	IEM	ARNG-ILE	Control invasive species	Ongoing	Yes
Erosion control in aquatic habitats	2.1.8	FY03	Ongoing	Annual	IEM	ARNG-ILE	Preserve aquatic habitats by decreasing erosion runoff	Ongoing	
							Describe activities/locations - if it isn't just implementing BMPs/SWPPPs		
Deer hunt	2.2.1	FY??	Ongoing	Annual	IEM/MIL	Self-supporting	2-3 week deer hunt to reduce herd size	Ongoing	Yes
Turkey hunt	2.2.2	FY??	Ongoing	Annual	IEM/MDNR	Self-supporting	8-day hunt. Assess flock size afterwards	Ongoing	Yes

<i>Project</i>	<i>Project Number</i>	<i>Start Date</i>	<i>Completion/End Date</i>	<i>Interval</i>	<i>Principal Responsible Party</i>	<i>Funding Source</i>	<i>Notes</i>	<i>Project Status</i>	<i>Next INRMP?</i>
Public access activities	2.2.3	FY??	Ongoing	Annual	IEM	Self-supporting		Ongoing	Yes
Develop invasive species and pest management program	3.1.1	FY04	Ongoing	As Needed	IEM	ARNG-ILE		Ongoing	Yes
		FY04	FY06				Invasive species inventory	Completed	
		FY09	Ongoing				Develop program for invasive species control	Ongoing	Yes
		FY04	Ongoing				Implement control measures	Ongoing, also see 2.1.7b	Yes
		FY00	Ongoing				Garlic mustard biocontrol Purple loosestrife biocontrol (releases)		
Monitoring of invasive and problematic plants	3.1.2	FY94	Ongoing	Annual	IEM	ARNG-ILE /self-supporting	Monitor invasive plants identified in previous inventory	Ongoing	Yes
Implementation of invasive species and pest management program	3.1.3	FY94	Ongoing	As Needed	MIL	MIL	Implement the control elements proposed in management plan	Ongoing, also see 2.1.7b	Yes
Garlic mustard management		FY04	FY06	Completed	IEM	ARNG-ILE	Monitoring conducted, managed with use of herbicides and cutting	Completed	
Purple loosestrife control	3.1.4	FY01	FY08	Completed	IEM	ARNG-ILE	Use of herbicides and bio agents for control	Completed	
Seed genotype harvesting	3.1.5	FY10	Ongoing	Annual	IEM	ARNG-ILE	Harvesting native genotype seeds from FCTC	Ongoing	Yes
Regional invasive species response coordination	3.1.6	FY03	Ongoing	As Needed	IEM	Self-supporting	Early detection/rapid response coordination and regional coordination.	Ongoing	Yes
Conduct prescribed burns	3.2.1	FY04	Ongoing	Annual	IEM	ARNG-ILE	Between 500-1000 acres were burned in a two year period	Ongoing, also see 2.1.6	Yes
		FY04	FY05				Between 500-1000 acres were burned in a two year	Completed	
		FY05-FY18							
Conduct post burn monitoring	3.2.2	FY15	Ongoing	Annual	IEM	ARNG-ILE	Monitoring after prescribed burns	Ongoing	Yes
Fire management training	3.2.3	FY03	Ongoing	As Needed	IEM	ARNG-ILE	Prescribed burn training	Ongoing	Yes
		FY03					Training in fire prevention, suppression, communications and conducting prescribed burns	Completed	
		FY04	Ongoing						
Fire weather monitoring/communications		FY03		Completed			Established protocol for alerting FCTC users to potential fire hazard weather conditions	Completed	
Watershed protection		FY02		Completed			Watershed management plan was completed	Completed	
Monitoring activities affecting wetlands	4.1.1	FY05	Ongoing	As Needed	IEM	ARNG-ILE	Wetlands will be monitored and restoration when needed	Ongoing	Yes
Wetland inventory		FY05	Ongoing	Every 10 years (FY20?)	IEM	ARNG-ILE		Ongoing	Yes
		FY05					Field surveys and ground-truthing completed	Completed	
		FY15					New surveys for CIS EIS		
							Plan with vegetation community		Tie in with project

<i>Project</i>	<i>Project Number</i>	<i>Start Date</i>	<i>Completion/End Date</i>	<i>Interval</i>	<i>Principal Responsible Party</i>	<i>Funding Source</i>	<i>Notes</i>	<i>Project Status</i>	<i>Next INRMP?</i>
Wetland/Section 404 permitting	4.1.2	FY07	Ongoing	As Needed	IEM	ARNG-ILE/proponent	Section 404 permitting support	Ongoing	Yes
Groundwater characterization	4.1.??	FY02	Ongoing	As Needed	IEM	ARNG-ILE	Characterize groundwater flow direction, quantity and quality	Ongoing	Yes
		FY02					Characterized groundwater flow direction, quantity, quality, determined location of wellheads/cisterns to close		
		FY15?					some done through CIS EIS		
		FY18	Ongoing				New project just started		
Surface water monitoring	4.1.3	FY00	Ongoing	Annual	IEM	ARNG-ILE	Conduct surface water testing to assess water quality	Ongoing	Yes
		FY05-FY17					Long-term related to ranges		
		FY18					New project just started		
Implement erosion and sediment controls on trails	4.2.1	FY07	Ongoing	As Needed	NRS	ITAM/SRM	Erosion and sediment control measures related to maneuver trails	Ongoing (also see 2.1.8 and 4.2.2)	Yes
Implement erosion and sediment controls related to training	4.2.2	FY07	Ongoing	As Needed	NRS	ITAM/SRM	Erosion and sediment control measures related to training (other than trails)	Ongoing (also see 2.1.8 and 4.2.1)	Yes
	5.1.1	FY04	Ongoing	Every 5 Years	IEM	Forestry	Delineation and management prescriptions for high quality natural communities	Ongoing	Yes
Develop prescriptions for forest and vegetation management		FY04						Completed	
		FY13	FY18				Finalize prescriptions for vegetation/timber management		
Implement forest and vegetation management program		FY17	Ongoing				Ongoing, with MiVeg protocol (particularly identify No/Limited Harvest areas)		
	5.1.2	FY13			IEM	Forestry		Duplicate of 5.1.4	No
Planning actions and environmental documentation	5.1.3	FY00	Ongoing	Annual	IEM	Self/Forestry	Complete planning actions and environmental documentation for vegetation management and timber harvests	Discontinue, included with overall adaptive management	No
Vegetation management and timber harvests	5.1.4	FY05	Ongoing	Every 2 years	IEM	Self/Forestry	Conduct vegetation management and timber harvests	Ongoing, timber harvesting split from general vegetation mgt	Yes
		FY05-FY15					TSI and biannual timber harvest ongoing		
Inspections for forest insects and diseases	5.2.1	FY05	Ongoing	Annual	IEM	Self-supporting	Conduct walking/driving inspections to assess changes in forest insects and diseases	Ongoing	Yes

<i>Project</i>	<i>Project Number</i>	<i>Start Date</i>	<i>Completion/End Date</i>	<i>Interval</i>	<i>Principal Responsible Party</i>	<i>Funding Source</i>	<i>Notes</i>	<i>Project Status</i>	<i>Next INRMP?</i>
Gypsy moth surveys	5.2.2	FY02	Ongoing	As Needed	IEM	Self-supporting	If moths recover, reinstate surveys	Ongoing	Yes
		FY05					Complete gypsy moth egg mass surveys	Completed	
		FY02	FY07				Annual egg surveys, defoliation assessments with MDNR aerial surveys	Complete	
Forest pest assessments	5.2.3	FY05	Ongoing	Annual	IEM	USDA	Forest pest assessments with USDA (EAB and Asian longhorned beetle)	Ongoing	Yes
Training site inspections for environmental impact	6.1.1	FY05	Ongoing	Annual	IEM	Self-supporting	Inspections of high use and potential problem areas	Ongoing	Yes
Training land soil erosion control	6.1.2	FY05	Ongoing	Annual	IEM	ITAM/SRM	Control major erosion on roads, trails and training sites	Discontinue (Duplicate of 4.2.1, 4.2.2)	No
Unit Environmental Compliance Officer training	6.1.3	FY05	Ongoing	Annual	MIL	MIARNG	Training for UECO	Ongoing	Yes
GIS file updates	6.1.4	FY05	Ongoing	Annual	MDMVA	GIS/ITAM	Update GIS files with new data	Ongoing	Yes
Training area and Environmental awareness materials	6.1.5	FY04	Ongoing	As Needed	IEM	EA	EA materials for soldiers and community about natural resources	Ongoing	Yes
Operation, facilities, and range control coordination	6.1.6	FY00	Ongoing	As Needed	IEM	Self-supporting	Coordinate with operations, facilities and range control	Ongoing	Yes

Johnson, Dawn

From: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>
Sent: Friday, March 22, 2019 8:52 AM
To: Edgerly, Jonathan W NFG (US); Rubinoff, Jay M CIV NG NGB ARNG (US); Beckley, Eric R CIV NG NGB ARNG (USA); Roebuck, Curtis G NFG NG MIARNG (USA)
Cc: Johnson, Dawn
Subject: FW: [Non-DoD Source] ROE files

Follow Up Flag: Follow up
Flag Status: Flagged

Here's our state regulator's concurrence.

M

(If you sent an attachment from a non-.mil email address I will likely not receive the email or the attachment, and never know I didn't get it. Please send attachments to earthviva@yahoo.com)

Michele Richards
FCTC-ENV
2501 26th St, Bldg 2510
Augusta, MI 49012
(517) 243-0788

-----Original Message-----

From: Sargent, Mark (DNR) [mailto:SARGENTM@michigan.gov]
Sent: Thursday, March 21, 2019 6:08 PM
To: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>
Subject: RE: [Non-DoD Source] ROE files

Michele,

Thank you for the opportunity to be involved in the discussion and planning process. The SW Region concurs with the proposed direction. Let us know if we can help in anyway in the implementation.

Thanks, Mark

Mark Sargent
Regional Supervisor
SW Region, Wildlife Division
Michigan DNR

(269) 512-1218

The spring turkey hunting application period is now open! What are you waiting for?

-----Original Message-----

From: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>

Sent: Tuesday, March 19, 2019 11:05 AM

To: Chris Mensing <chris_mensing@fws.gov>; Sargent, Mark (DNR) <SARGENTM@michigan.gov>

Cc: Beckley, Eric R CIV NG NGB ARNG (USA) <eric.r.beckley.civ@mail.mil>; Edgerly, Jonathan (DMVA)

<JONATHAN.W.EDGERLY.NFG@MAIL.MIL>; Roebuck, Curtis G NFG NG MIARNG (USA) <curtis.g.roebuck.nfg@mail.mil>

Subject: FW: [Non-DoD Source] ROE files

Alcon:

Good morning! Attached you will find a letter and documentation requesting agency concurrence on our INRMP implementation. Chris and Mark (or Mark, if it's not you, please forward to the appropriate MDNR staffer). You can reply via email for simplicity's sake if all is good. If you have any issues, please let me know and I will do all in my power to quickly address them.

We had that meeting last fall which neither agency was able to attend, which stood in for our annual review meeting. We are currently re-writing the INRMP, as documented in the letter, but for now we are working from our 2012 INRMP until we have the new one completed.

Thanks in advance!

Michele

(If you sent an attachment from a non-.mil email address I will likely not receive the email or the attachment, and never know I didn't get it. Please send attachments to earthviva@yahoo.com)

Michele Richards

FCTC-ENV

2501 26th St, Bldg 2510

Augusta, MI 49012

(517) 243-0788

-----Original Message-----

From: Johnson, Dawn [mailto:dawn.johnson@woodplc.com]

Sent: Friday, March 15, 2019 12:50 PM

To: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>

Cc: earthviva@yahoo.com

Subject: [Non-DoD Source] ROE files

All active links contained in this email were disabled. Please verify the identity of the sender, and confirm the authenticity of all links contained within the message prior to copying and pasting the address to a Web browser.

Here they are - just clone the letter for both agencies and add the address/contact info and put on letterhead and pdf.

You can provide everything over email and an email concurrence from the agency is fine too. Just needs to be in writing if at all possible.

Sincerely,

Dawn L Johnson, PhD

Senior Biologist

Direct/Mobile: +1 (805)252 4370

Caution-www.woodplc.com < Caution-www.woodplc.com >

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Please click [Caution-https://urldefense.proofpoint.com/v2/url?u=http-3A_www.woodplc.com_email-2Ddisclaimer&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeCKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNiDyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=zEY6GANPhPPg_OOn5diBObFHkl8wg-593PIgu7LQ7kA&e=](https://urldefense.proofpoint.com/v2/url?u=http-3A_www.woodplc.com_email-2Ddisclaimer&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeCKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNiDyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=zEY6GANPhPPg_OOn5diBObFHkl8wg-593PIgu7LQ7kA&e=) < [Caution-https://urldefense.proofpoint.com/v2/url?u=http-3A_www.woodplc.com_email-2Ddisclaimer&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeCKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNiDyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=zEY6GANPhPPg_OOn5diBObFHkl8wg-593PIgu7LQ7kA&e=](https://urldefense.proofpoint.com/v2/url?u=http-3A_www.woodplc.com_email-2Ddisclaimer&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeCKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNiDyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=zEY6GANPhPPg_OOn5diBObFHkl8wg-593PIgu7LQ7kA&e=) > for notices and company information in relation to emails originating in the UK, Italy or France.

As a recipient of an email from a John Wood Group Plc company, your contact information will be on our systems and we may hold other personal data about you such as identification information, CVs, financial information and information contained in correspondence. For more information on our privacy practices and your data protection rights, please see our privacy notice at [Caution-https://urldefense.proofpoint.com/v2/url?u=https-3A__www.woodplc.com_policies_privacy-2Dnotice&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNI5DyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=yDKDU1bKF9yQPk4A7ZQ_tcA5FsKTRfhiM9Ev1HZCjE&e=](https://urldefense.proofpoint.com/v2/url?u=https-3A__www.woodplc.com_policies_privacy-2Dnotice&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNI5DyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=yDKDU1bKF9yQPk4A7ZQ_tcA5FsKTRfhiM9Ev1HZCjE&e=) < Caution-https://urldefense.proofpoint.com/v2/url?u=https-3A__www.woodplc.com_policies_privacy-2Dnotice&d=DwIFAg&c=ZWY66qCYUTYUcOev9C2GIDeKuYKzoWDVNR_L93Z9mQ&r=JYV-YFDWQb10o25t_SAMLIDYuhtI5RNI5DyeogUk8x1E&m=xKWaKYrduiGYBR7Hr_Dj9B76QvogZuDX6qnk6sFKxnE&s=yDKDU1bKF9yQPk4A7ZQ_tcA5FsKTRfhiM9Ev1HZCjE&e= >



21 April 2020

MEMORANDUM FOR SCOTT HICKS, FIELD SUPERVISOR
U.S. FISH AND WILDLIFE SERVICE
2651 COOLIDGE ROAD SUITE 101
EAST LANSING, MI 31905
ATTENTION: 48823-6360

SUBJECT: Integrated Natural Resources Management Plan Update for Fort Custer Training Center, Michigan

1. In accordance with regulations, standards, and procedures of the Department of Defense, the U.S. Air Force, and the Sikes Act Improvement Act of 1997 (16 U.S.C. §670a), the Michigan Army National Guard (MIARNG) at has completed an updated Integrated Natural Resources Management Plan (INRMP) for Fort Custer Training Center (FCTC) located in Kalamazoo and Calhoun Counties, Michigan
2. An INRMP meeting was held at FCTC on 4 October 2018. At this meeting, we completed some INRMP scenario planning and requesting input from various stakeholders on INRMP implementation. Unfortunately, neither USFWS nor Michigan Department of Natural Resources (MDNR) representatives were able to attend. As a result, we sent an email to USFWS and MDNR on 19 March 2019 to complete the Review for Operation and Effect. This email included a summary of the October meeting as well as a summary of the projects originally planned in the 2012 INRMP and whether they had been completed, were being carried forward into the updated INRMP, or being discontinued and why. USFWS and MDNR concurred on this review and continued implementation of the INRMP with updates.
4. As part of the mutual cooperation required under the Sikes Act, we are seeking input from your agency and MDNR with respect to the updated draft INRMP. Comments may be provided in the comment matrix on the CD, using track changes in Word, or provided through other means. The complete updated implementation tables and goals/objectives/criteria table are provided in Appendix C and found in a separate Excel spreadsheet. Those tables will be the core of annual reviews going forward, so your review of those items is essential. Thank you for your time reviewing and providing comments.
5. At this time, we have determined No Effect on species listed under the Endangered Species Act. For FCTC, this is partially because none of the potential species have been documented on FCTC, but also because we limit tree removals during bat and bird breeding seasons. In addition, we manage the potential habitat for federally listed species for their benefit, when it does not conflict with military training. A summary of potential habitat and known information regarding federally listed species on FCTC is provided in Appendix H. Our proposed management is described in Section 3.8.
6. Files are being provided via email and/or file transfer website. Files include both Word/Excel versions and a complete pdf version, along with a comment matrix. If you would like a CD with the files or a hard copy of either updated INRMP, please let us know. We look forward to receipt of your comments by 22 June 2020.
7. If you have any questions concerning this request, please do not hesitate to contact Michele Richards, Natural Resources Manager (517-243-0788 or michele.m.richards2.nfg@mail.mil).

A handwritten signature in black ink that reads "Michele Richards".

MICHELE RICHARDS
NATURAL RESOURCES MANAGER

Attachments:

1. Draft FCTC Integrated Natural Resources Management Plan (Word, Excel and pdf)

Cc: USFWS Regional Sikes Act Coordinator (Bob Krska, robert_krska@fws.gov)



21 April 2020

MEMORANDUM FOR MICHIGAN DEPARTMENT OF NATURAL RESOURCES
BARRY STATE GAME AREA
1805 SOUTH YANKEE SPRINGS RD
MIDDLEVILLE, MI 49333
ATTENTION: RANDY HEINZE

SUBJECT: Integrated Natural Resources Management Plan for Fort Custer Training Center, Michigan

1. In accordance with regulations, standards, and procedures of the Department of Defense, the U.S. Air Force, and the Sikes Act Improvement Act of 1997 (16 U.S.C. §670a), the Michigan Army National Guard (MIARNG) at has completed an updated Integrated Natural Resources Management Plan (INRMP) for Fort Custer Training Center (FCTC) located in Kalamazoo and Calhoun Counties, Michigan.
2. An INRMP meeting was held at FCTC on 4 October 2018. At this meeting, we completed some INRMP scenario planning and requesting input from various stakeholders on INRMP implementation. Unfortunately, neither US Fish and Wildlife Service (USFWS) nor Michigan Department of Natural Resources (MDNR) representatives were able to attend. As a result, we sent an email to USFWS and MDNR on 19 March 2019 to complete the Review for Operation and Effect. This email included a summary of the October meeting as well as a summary of the projects originally planned in the 2012 INRMP and whether they had been completed, were being carried forward into the updated INRMP, or being discontinued and why. USFWS and MDNR concurred on this review and continued implementation of the INRMP with updates.
3. As part of the mutual cooperation required under the Sikes Act, we are seeking input from your agency and MDNR with respect to the updated draft INRMP. Comments may be provided in the comment matrix, using track changes in Word, or provided through other means. Appendix C contains the updated implementation tables and goals/objectives/criteria table. Those tables will be the core of annual reviews going forward, so your review of those items is essential. Thank you for your time reviewing and providing comments.
4. Files are being provided via email and/or file transfer website. Files include both Word/Excel versions and a complete pdf version, along with a comment matrix. If you would like a CD with the files or a hard copy of either updated INRMP, please let us know. Let us know if we need to provide a copy to any other MDNR reviewers.
5. We are sending the Camp Grayling Maneuver Training Center INRMP for review at the same time to their regional MDNR reviewer(s). We look forward to receipt of your comments by 22 June 2020.
6. If you have any questions concerning this request, please do not hesitate to contact Michele Richards, Natural Resources Manager, at (517) 243-0788 or michele.m.richards2.nfg@mail.mil.

MICHELE RICHARDS
NATURAL RESOURCES MANAGER

Attachments:

1. Draft FCTC Integrated Natural Resources Management Plan (Word, Excel, pdf)

Johnson, Dawn

From: Heinze, Randal (DNR) <HEINZER@michigan.gov>
Sent: Tuesday, June 30, 2020 11:53 AM
To: Richards, Michele (DMVA); Johnson, Dawn
Subject: RE: [Non-DoD Source] RE: Ft Custer INRMP review Part 1 of 2

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

No I have no comments for this plan.

Randy Heinze
Wildlife Biologist
Barry State Game Area
1805 Yankee Springs Rd
Middleville, MI 49333
Office 269-795-3280 | Fax 269-795-6085

From: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>
Sent: Monday, June 29, 2020 10:44 AM
To: Johnson, Dawn <dawn.johnson@woodplc.com>; Heinze, Randal (DNR) <HEINZER@michigan.gov>
Subject: RE: [Non-DoD Source] RE: Ft Custer INRMP review Part 1 of 2

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Hey, Randy,

We are past our 60 day deadline for receiving comments. Do any of your folks have any comments to offer that we can incorporate into our plan?

Thanks,
Michele

From: Johnson, Dawn <dawn.johnson@woodplc.com>
Sent: Wednesday, June 17, 2020 3:02 PM
To: Heinze, Randal (DNR) <HEINZER@michigan.gov>
Cc: Richards, Michele M NFG NG MIARNG (USA) <michele.m.richards2.nfg@mail.mil>
Subject: [Non-DoD Source] RE: Ft Custer INRMP review Part 1 of 2

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Randy-



United States Department of the Interior

FISH AND WILDLIFE SERVICE

East Lansing Field Office (ES)
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823-6316

June 23, 2020

Michelle Richards
Michigan Department of Military and Veterans Affairs
Construction and Facilities Management Office
Environmental Division
3423 North Martin Luther King Jr Boulevard
Lansing, Michigan 48906

RE: Review of the Draft Fort Custer Training Center Updated Integrated Natural Resources Management Plan

Dear Ms. Richards:

Thank you for your request for comments on the Draft Fort Custer Training Center (FCTC) Updated Integrated Natural Resources Management Plan (Draft INRMP). We provide these comments under the authority of the Sikes Act Improvement Act of 1997, the Migratory Bird Treaty Act (MTBA), the Bald and Gold Eagle Protection Act (BGEPA), and section 7 of the Endangered Species Act of 1973, as amended (Act). We have reviewed the Draft INRMP and have captured our comments in the attached comment matrix provided by FCTC.

Sikes Improvement Act Comments

The Sikes Act states that military installations shall conserve and rehabilitate natural resources, sustain multipurpose use of the resources, and provide public access. We find that the Draft INRMP adequately addresses the management of natural resources at FCTC.

Endangered Species Act Comments

Surveys have been conducted at FCTC for Indiana bat (*Myotis sodalis*), northern long eared bat (*Myotis septentrionalis*), eastern massasauga rattlesnake (*Sistrurus catenatus*), copperbelly watersnake (*Nerodia erythrogaster neglecta*), Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*), Karner blue butterfly (*Lycaeides melissa samuelis*), and Poweshiek skipperling (*Oarisma poweshiek*). No listed species have been documented on the installation, although suitable habitat is present. We appreciate the great efforts that FCTC has made to create and manage suitable habitat for these federally listed species even though they have not been documented on the installation.

Section 7(a)2 of the Act states that "Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical." FCTC has made a "no

effect” determination for the Draft INRMP on the aforementioned federally listed species on the basis that these species have not been documented on the installation. As such, your obligations pursuant to section 7 of the Act have been met.

Throughout implementation of the INRMP, we would encourage you to coordinate with our office if: 1) new information reveals effects of the project that may affect listed species or critical habitat in a manner or to an extent not previously considered; (2) the project is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (3) a new species is listed or critical habitat designated that may be affected by the project.

Migratory Bird and Bald Eagle Comments

We appreciate your commitment to managing and protecting migratory birds and bald eagles. As stated in the Draft INRMP regular monitoring of migratory breeding birds has been conducted at FCTC since 2001. Current point counts and area searches for breeding birds are conducted every 3-5 years to assess population trends over time, with the original baseline of four consecutive years of data. This has been augmented with the Monitoring Avian Productivity and Survivorship (MAPS) Program, which is a continent-wide network of hundreds of constant-effort mist netting stations. FCTC anticipates continuing with migratory bird surveys in some form on an annual basis and to use the results to continue adaptive management on the installation.

A bald eagle nest has been present on the installation most years over the last decade. This nest has been monitored during the annual bird surveys. FCTC implements the Service recommendations for bald eagles during the nesting season in the Midwest (USFWS 2018) to avoid impacts to nesting eagles.

General Comments

We have provided comments on the Draft INRMP in the comment matrix provided by FCTC. We appreciate the opportunity to provide these comments and look forward to continued coordination with your office. Should you have any questions regarding our comments, please contact Jessica Pruden, of this office, at 517-351-8245 or jessica_pruden@fws.gov.

Sincerely,

JOHN

DINGLEDINE

Acting for, Scott Hicks
Field Supervisor

Digitally signed by JOHN
DINGLEDINE
Date: 2020.06.24 10:36:38
-04'00'

Enclosures

cc: Jonathan Edgerly, MDMVA, Lansing, MI
Daniel Eichinger, MDNR, Lansing, MI
Bob Krksa, USFWS, Bloomington, MN

Comment #	Chapter	Section	Page	Paragraph	Line	Comment (FORT CUSTER INRMP)	Reviewer	Office of Reviewer	Name of Responder	Action Taken to Address the Comment:
1	3	3.8.1.2	68	2	15	We recommend incorporating EMR BMPs into the INRMP and implement them where applicable	J. Pruden	USFWS	Johnson, Richards	Added language to EMR description in Section 3.8.1.2
2	3	3.8.1.3	68	6	40	The only extant population of copperbelly watersnake in Michigan occurs in Hillsdale County, therefore surveys on Ft Custer Training Center are not required. However, it is great that Ft. Custer is implementing wetland protection measures that are very beneficial for other wetland species regardless of the presence of copperbelly watersnake.	J. Pruden	USFWS	Johnson, Richards	Added sentence to Appendix species summary. Removed survey requirement from text in Section 3.8, although they would still be a target species for any general herp surveys.
3	3	3.8.1.3	69		31-34	We would suggest considering removal of the following text in the event that a different mechanism under ESA is deemed more appropriate to authorize a Mitchell's satyr butterfly reintroduction program: <i>"If authorized by NGB and Army Deputy Chief of Staff for Installations, the reintroduction will occur through a Section 7 consultation resulting with a biological opinion and incidental take statement authorizing 'take' of the whole population of MSB to ensure there are no impacts to installation missions. However,"</i>	J. Pruden	USFWS	Johnson, Richards	Deleted
4	3	3.8	63		38	Consider pulling out discussion on bald eagle under separate section on Bald and Golden Eagle Protection Act as well as separate discussion on USFWS regulatory authority for migratory birds through the Migratory Bird Treaty Act.	J. Pruden	USFWS	Johnson, Richards	Pulled bald eagle into new section 3.8.1.3 and renumbered subsequent sections. Migratory birds are discussed in Section 3.7.3.
5	3	3.7.7 and 3.8.1.2	63, 66	2	15-17; and 37	Consider timing activities to avoid adverse impacts to species of concern. For example conducting activities outside of nesting season for migratory birds (April 15 - Aug 15), and outside of pupping season for bats (June 1 - July 31). Could also look to provide consideration of timing during the bat's active season April 1 - Sept 30)	J. Pruden	USFWS	Johnson, Richards	As described in Section 2.6 and listed under Policies in Section 3.7.7, there is no tree removal between 1 April – 1 October, without prior FCTC Environmental approval. This restriction includes the windows requested here. There are also mowing restrictions which benefit migratory birds.
6	3	3.8.1.2 and 3.2	25		39	Encourage use of Wildlife Friendly Erosion Control (WiFEC) throughout Ft. Custer Training Center.	J. Pruden	USFWS	Johnson, Richards	Added to Section 3.2.1 "Use wildlife-friendly erosion control (i.e., products that do not contain plastic netting) in sensitive wildlife habitats or near known wildlife populations, and elsewhere when feasible." Added under Policy to the disturbances greater than 5 acres... "while maximizing use of native plants during revegetation and wildlife-friendly erosion control measures"
7		Implementation Table				Clarify what is meant by maintain permits for T&E species ? 10a1a permits for recovery actions, or section 7 authorization / section 10a1b permits for incidental take?	J. Pruden	USFWS	Johnson, Richards	Activity PM2.3. Maintain any permits required is vague to account for a number of possibilities. Most likely it would be Section 7 and 10a1b incidental take permits, but given they are considering reintroduction it could be a 10a1a permit. Added "(recovery or incidental take)" to project