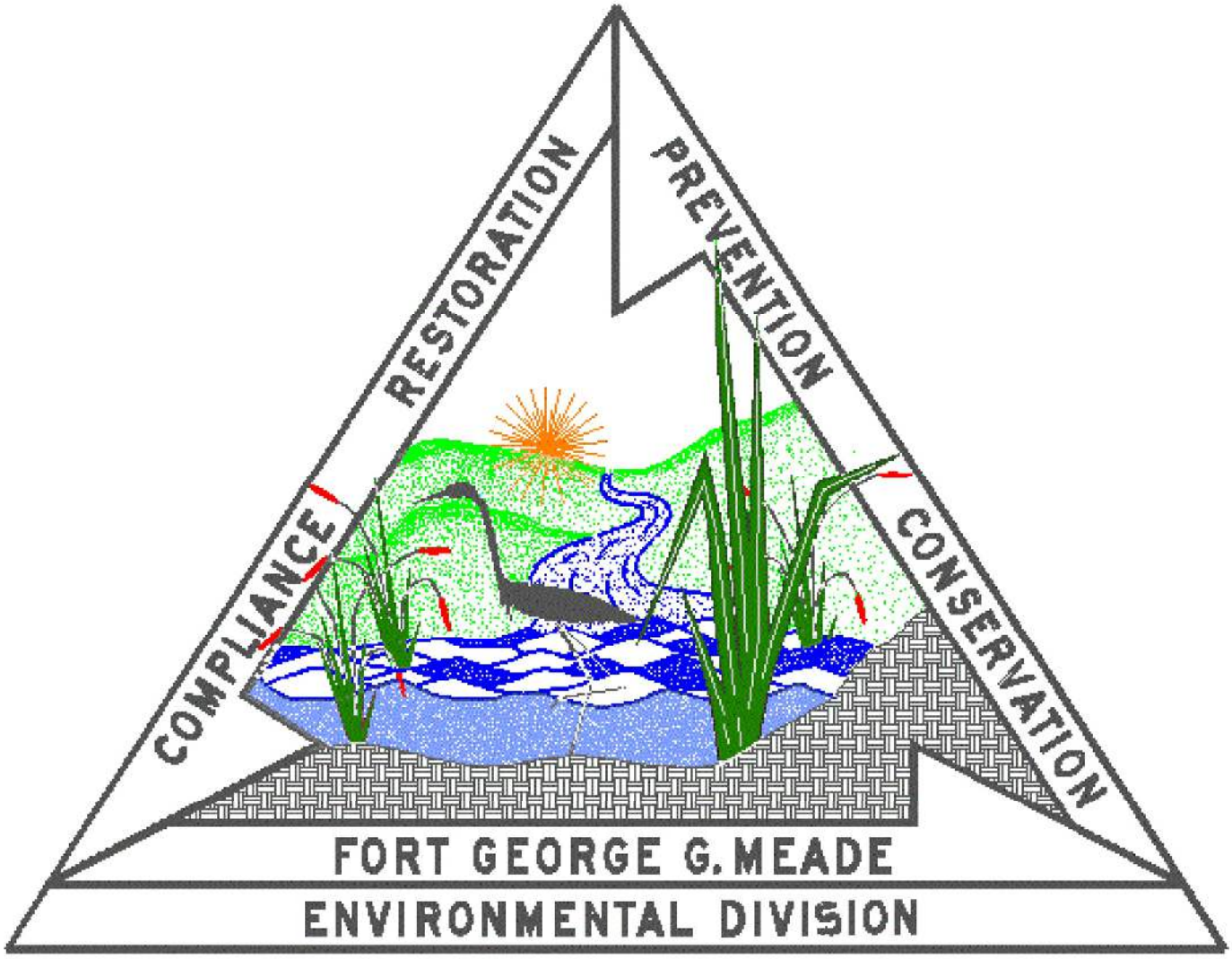

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Integrated Natural Resources Management Plan Update

2023-2027

U.S. Army Garrison Fort George G. Meade

Prepared by:

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FORT GEORGE G. MEADE, MARYLAND

This Integrated Natural Resources Management Plan has been developed by Fort Meade in cooperation with the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Maryland Department of Natural Resources and Maryland Department of the Environment. The signatures below indicate the mutual agreement of the parties concerning the conservation, protection, and management of fish and wildlife resources as presented in the Plan.

PLAN APPROVAL

Date

Colonel, Commanding Fort George G. Meade

AGENCY AGREEMENT

Date

Field Supervisor, U.S. Fish and Wildlife Services Chesapeake Bay Field Office

Date

Director Environmental Review Unit Maryland Department of Natural Resources

FORT MEADE REVIEW

Date

Chief, Environmental Division, Directorate of Public Works Fort George G. Meade

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PURPOSE

This Integrated Natural Resources Management Plan (INRMP) guides the implementation of the U.S. Army Fort George G. Meade's (FMMD) natural resources program for the years 2023 through 2027, in accordance with the Sikes Act, as ammended. INRMPs are prepared in cooperation with the US Fish and Wildlife Service (FWS) and state fish and wildlife agencies and reflects the mutual agreement of the parties concerning conservation, protection, and management of natural resources. The Sikes Act (1997) promotes effectual planning, development, maintenance, and coordination of fish and wildlife conservation on military installations. In addition, The Sikes Act (1997) authorizes the Secretary of Defense to carry out a program to provide for the conservation and rehabilitation of natural resources (lands, waters, airspace, and coastal resources) on military installations while allowing the military lands to continue to meet the needs of military operations.

SCOPE OF THE INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

The scope of this INRMP includes all lands owned, controlled or leased by FMMD. The main installation occupies approximately 5,253 contiguous acres in northwest Anne Arundel County, Maryland and includes the U.S. Army Garrison (USAG) offices, offices for approximately 85 tenants, and military housing and associated family support facilities. These resources include:

- Fish and wildlife management, land management, forest management, and fish- and wildlife-oriented recreation,
- Fish and wildlife habitat enhancement or modifications,
- Wetland protection, enhancement, and restoration, where necessary for support of fish, wildlife, or plants,
- Integration of, and consistency among the various activities conducted under the plan,
- Establishment of specific natural resources management objectives and time frames for proposed actions,
- Sustained use by the public of natural resources to the extent such use is consistent with the needs of fish and wildlife management and subject to installation safety and security requirements,
- Enforcement of natural resources laws and regulations,
- No net loss in the capability of military lands to support the military mission of the installation, and

RELATIONSHIP TO THE MILITARY MISSION

The underlying principle of DOD natural resource management is to support military mission and training through the application of ecosystem management principles. A key concept underpinning these principles is resilience. Ecosystem resilience is the ability of an ecosystem to maintain and provide ecosystem services (i.e., biodiversity, clean water, nutrient cycling, outdoor recreation) in a changing environment.

Unlike other larger installations-where field level, tactical maneuver training occurs- FMMD's mission is frequently indoor, though FMMD does have limited field training areas. Thus, the primary focus of the FMMD INRMP is to assist with site development in the context of planning and construction in a sustainable and resilient manner. FMMD uses a dynamic, ecosystem-based management approach to natural resources-related practices and decisions, using scientifically sound conservation procedures, techniques, and data.

Fulfilling FMMD missions and vision involves providing a wide range of services to its 117 partner organizations including the Army, Navy, Air Force, Marines, and Coast Guard, National Security Agency, Defense Media Activity, Defense Information Systems Agency, the Defense Courier Service and the U.S. Cyber Command. As the mission of FMMD has evolved since 1990, the landscape has correspondingly altered to support the mission. FMMD primary mission activities no longer are focused on military maneuvers and other field exercises thus land areas previously devoted to these training missions have been re-purposed and/or transferred to other agencies (e.g., Patuxent Wildlife Refuge). As result the "mission scape" of FMMD has evolved into an exurban, campus landscape.

1.0 MANAGEMENT OVERVIEW

1.1 AUTHORITY

In accordance with the United States Code (USC) §670a et seq. – Sikes Act, as amended and Department of Defense Instruction (DoD) 4715.03 (2011)– Natural Resources Conservation Program, Fort George G. Meade (FMMD) is required to implement and maintain a balanced and integrated program for the management of natural resources. Thus, the natural resources program at FMMD is required to develop and implement an Integrated Natural Resources Management Plan (INRMP). INRMPs are prepared in cooperation with the US Fish and Wildlife Service (FWS) and state fish and wildlife agencies and reflects the mutual agreement of the parties concerning conservation, protection, and management of natural resources. The Sikes Act (1997) promotes effectual planning, development, maintenance, and coordination of fish and wildlife conservation on military installations. In addition, The Sikes Act (1997) authorizes the Secretary of Defense to carry out a program to provide for the conservation and rehabilitation of natural resources (lands, waters, airspace, and coastal resources) on military installations while allowing the military lands to continue to meet the needs of military operations.

The Sikes Act Improvement Act (SAIA) states that "the Secretary of each military department shall prepare and implement an integrated natural resources management plan for each military installation in the United States under the jurisdiction of the Secretary, unless the Secretary determines that the absence of significant natural resources on a particular installation makes preparation of such a plan inappropriate." DoDI 4715.03 (U.S. Department of Defense 2011) proscribes procedures for integrated management of natural and cultural resources, including preparing an INRMP as required by the SAIA. DoDI 4715.03 (U.S. Department of Defense 2011) also states that "INRMPs shall be prepared, maintained and implemented for all lands and waters under DoD control that have suitable habitat for conserving and managing natural resources." AR 200–1 (U.S. Army 1997) requires the preparation of INRMPs and proscribes Army policies, procedures, and standards for the "conservation, management, and restoration of land and the renewable natural resources on it, consistent with and in support of the military mission."

The Sikes Act further requires, to the extent appropriate and applicable, the INRMP provide for:

- Fish and wildlife management, land management, forest management, and fish- and wildlife-oriented recreation,
- Fish and wildlife habitat enhancement or modifications,
- Wetland protection, enhancement, and restoration, where necessary for support of fish, wildlife, or plants,
- Integration of, and consistency among the various activities conducted under the plan,

- Establishment of specific natural resources management objectives and time frames for proposed actions,
- Sustained use by the public of natural resources to the extent such use is consistent with the needs of fish and wildlife management and subject to installation safety and security requirements,
- Enforcement of natural resources laws and regulations,
- No net loss in the capability of military lands to support the military mission of the installation, and
- Such other activities as the Secretary of the military department determines appropriate.

The FMMD INRMP is primarily focused on the integration of natural resources management within the undeveloped, natural areas with the natural resource issues in developed areas such as the medical support, base support, research and training, airfield operations, supply and storage, and recreational areas.

1.1.1 BACKGROUND AND PURPOSE

The Sikes Act (SAIA 1997) is the driver behind the FMMD natural resources management program and INRMP. According to the SAIA, the primary purposes of a military conservation program are conservation and rehabilitation of natural resources, sustainable multipurpose use of those resources, and public access to military lands, subject to safety requirements and military security. Moreover, the conservation program must be consistent with the mission-essential use of the installation and its lands. The SAIA (1997) requires the preparation of an INRMP to facilitate the conservation program. The FMMD INRMP must be cooperatively developed with the USFWS and the State fish and wildlife agency, which for FMMD is the MD DNR. The resulting plan reflects the mutual agreement of all three parties concerning conservation, protection, and management of natural resources on the installation.

The overall purpose of FMMD INRMP is to ensure that natural resources conservation activities will work to guarantee continued access to FMMD natural resources for military training and testing, while sustaining the long-term ecological integrity of the resource base and the ecosystem services FMMD provides (DoD Instruction 4715.03 2011). The scope of this INRMP includes all lands owned, controlled or leased by FMMD. The main installation occupies approximately 5,253 contiguous acres in northwest Anne Arundel County, Maryland and includes the U.S. Army Garrison (USAG) offices, offices for approximately 85 tenants, and military housing and associated family support facilities.

The 2022-2026 FMMD INRMP was developed after a thorough review of the previous FMMD INRMPs, Planning Level Surveys (PLS), other installation plans, and discussions with FMMD environmental staff. The FMMD INRMP uses an adaptive approach that integrates natural resource management with other installation plans and the military mission of the garrison and tenant organizations. The INRMP identifies explicit goals and objectives for natural resource management activities that will support the military mission through applies ecosystem management. The projects and initiatives contained in this plan include a combination of ongoing natural resources management activities and new projects and activities identified as priorities during the review process.

All requirements set forth in this INRMP requiring the expenditure of FMMD funds are expressly subject to the availability of appropriations and requirements of the Anti-Deficiency Act (31 USC section 1341). No obligation undertaken by [installation] under the terms of this INRMP will require or be interpreted to require a commitment to expend funds not obligated for a particular purpose.

1.1.2 FMMD MANAGEMENT PHILOSOPHY

The underlying principle of DOD natural resource management is to support military mission and training through the application of ecosystem management principles. A key concept underpinning these principles is resilience. Ecosystem resilience is the ability of an ecosystem to maintain and provide ecosystem services (i.e. biodiversity, clean water, nutrient cycling, outdoor recreation) in a changing environment. Maintaining and improving the resilience of the overall FMMD ecosystem to accommodate future mission requirements is the basis of the FMMD INRMP.

Unlike other larger installations-where field level, tactical maneuver training occurs- FMMD's mission is frequently indoor, though FMMD does have limited field training areas. Thus, the primary focus of the FMMD INRMP is to assist with site development in the context of planning and construction in a sustainable and resilient manner. FMMD uses a dynamic, ecosystem-based management approach to natural resources-related practices and decisions, using scientifically sound conservation procedures, techniques, and data. Natural resources are and will be managed for multiple uses when appropriate, including sustainable yield of all renewable resources, scientific research, education, and recreation. The FMMD 2022-2026 INRMP will:

1. Incorporate the principles of ecosystem-based management and resiliency.

2. Contain information needed to make appropriate decisions about natural resources management.

3. Maintain a relevant and updated baseline list of plant and animal species located on FMMD for all pertinent taxonomic and regionally important taxa groups.

4. Ensure that biologically or geographically significant or sensitive natural resources, are monitored and managed for their protection and long-term sustainability and resiliency.

5. Ensure no net loss to the training and testing capability and capacity of the installation and range and enhance those capabilities to the maximum extent practicable (DoD Instruction 4715.03 2011).

1.2 FORT GEORGE. G. MEADE MISSION & VISION

FMMD's mission is to provide required services, infrastructure, safe and secure community, and a quality of life that supports mission readiness and the Fort Meade community. FMMD's vision is to:

- Provide world-class support to mission commanders and the joint base community,
- Serve as an enabler to our warfighters as they project America's combat power,
- Make Fort Meade the station of choice for our nation's cyber warfighter.

Fulfilling FMMD missions and vision involves providing a wide range of services to its 117 partner organizations including the Army, Navy, Air Force, Marines, and Coast Guard, National Security Agency, Defense Media Activity, Defense Information Systems Agency, the Defense Courier Service and the U.S. Cyber Command. As the mission of FMMD has evolved since 1990, the landscape has correspondingly altered to support the mission. FMMD primary mission activities no longer are focused on military maneuvers and other field exercises thus land areas previously devoted to these training missions have been re-purposed and/or transferred to other agencies (e.g. Patuxent Wildlife Refuge). As result the "mission scape" of FMMD has evolved into an exurban, campus landscape.

1.3 GOALS AND OBJECTIVES

The INRMP is a long-term planning document that guides implementation of the natural resources program at FMMD to ensure support for the installation mission, while protecting and enhancing natural resources, meeting legal requirements, and providing for a variety of outdoor recreational opportunities for DoD personnel. The guiding principle for the FMMD INRMP is to, "Professionally manage natural resources on FMMD by using a sustainable, ecosystem management approach to conserve and enhance resources for current and future mission support, biodiversity conservation, and to maintain the production of ecosystem services." To support and implement the guiding natural resource management principle, FMMD in concert with stakeholders, developed goals, objectives, and indicators of success (Table 1-1).

Table 1-1: Goals, objectives, and indicators for the FMMD 2023-2027 INRMP.

Management Goal (s)	Objectives	Indicators
1. Vegetation and Forest Resource Management: *Vegetation and forest resources are to be managed in a sustainable manner to enhance healthy, forest and other terrestrial habitats on FMMD that provide ecosystem services that contribute to the resilience of FMMD's ex-urban ecosystem.*	**Objective 1.1:** Comply to the extent possible with the Maryland Forest Conservation Act. **Objective 1.2:** Maintain the total area of riparian forest buffers at a minimum width of 75' along all FMMD perennial stream riparian zones. **Objective 1.3:** Maintain individual trees and groups of historic trees (15-inch dbh or greater) in landscaped and urban areas. Ensure there is no net loss of urban trees. **Objective 1.4:** Ensure that new landscape areas incorporate pollinator friendly and/or native trees, shrubs, and herbaceous plants where appropriate. **Objective 1.5:** Identify specific areas with invasive plant species for eradication and subsequent restoration.	**Indicator 1.1:** Insure to the extent feasible that total tree canopy remains consistent with levels measured in 2018. **Indicator 1.2:** Mean width of riparian corridors is equal to or exceed 75 feet among all perennial streams. **Indicator 1.3:** Total number of trees > 15 inches dbh does not significantly decline.[1] **Indicator 1.4:** A list of native plants suitable for pollinators have been provided to all internal stakeholders that may have responsibility for landscaping or other plantings. **Indicator 1.5:** Invasive species have been removed/controlled and restoration efforts have been instituted on at least 3 sites.

[1] Note: This excludes instances where disease, weather or other unforeseen events cause loss of trees > 15 inches dbh.

2. Fish and Wildlife and Habitat Management: *Fish and wildlife populations and habitats are assessed, managed, and enhanced as necessary to support natural resource resilience and sustainability.*	**Objective 2.1:** Determine the status of non-game and game species populations that have the potential to affect natural resource sustainability. **Objective 2.2:** Evaluate and manage white-tailed deer population on FMMD to reduce over-browsing and to enhance the health of terrestrial habitats. **Objective 2.3:** Conduct regular surveys of migratory and breeding bird populations on FMMD. **Objective 2.4:** Conduct a pollinator survey that identifies locations and opportunities to create and/or enhance pollinator habitat. **Objective 2.5:** Create an updated habitat protection area GIS coverage.	**Indicator 2.1:** Species planning level surveys are conducted as needed to inform management actions to maintain populations at acceptable levels for the available habitat and military mission. **Indicator 2.2:** White-tailed deer populations and their effect on terrestrial habitats are monitored. **Indicator 2.3:** A database of migratory and/or breeding birds is developed and maintained. **Indicator 2.4:** Pollinator habitat is created/and or enhanced minimum of one site. **Indicator 2.5:** Updated habitat protection area GIS was created and maintained.
3. Rare, Threatened and Endangered Species: *Designation of critical habitat for federally endangered species is limited.*	**Objective 3.1:** Conduct periodic surveys for rare, threatened, and endangered (RTE) species. **Objective 3.2:** If new RTE species are identified, quantify and assess habitat quality and distribution on FMMD.	**Indicator 3.1:** All surveys are up to date and consistent with USFWS and Maryland DNR guidelines. **Indicator 3.2:** The distribution and habitat of newly listed RTE species and/or newly identified RTE species has been assessed.
4. Water Resource Management: *The health of aquatic ecosystems are maintained and enhanced to support overall natural resource sustainability.* *Wetlands are protected, enhanced, and restored wetlands to maintain ecosystem services and ensure no net loss of wetland acreage on FMMD.*	**Objective 4.1:** Assess ecological conditions of aquatic ecosystems on FMMD. **Objective 4.2:** Reduce the sediment and nutrient input to FMMD aquatic ecosystems to help meet Chesapeake Bay Total Maximum Daily Load requirements. **Objective 4.3:** Restore stream reaches that have been channelized to natural channels. **Objective 4.4:** Insure GIS database accurately reflects FMMD wetland location and acreage.	**Indicator 4.1:** Periodic surveys are conducted to assess conditions of aquatic ecosystems **Indicator 4.2:** Floodplain and wetland buffers are maintained and improved. **Indicator 4.3:** Stream restoration projects are identified and implemented. **Indicator 4.5:** Wetland location and acreage has been assessed and GIS updated.

	Objective 4.5: Maintain the ecosystem function(s) of FMMD wetlands and floodplains through protection of critical vegetative cover surrounding and within designated wetlands and floodplains.	**Indicator 4.6:** Vegetative cover in designated wetlands has not significantly decreased.
5. Climate Change Adaptation and Resiliency: *FMMD will implement measures to improve resiliency and adapt to Climate Change.*	**Objective 5.1:** Identify adaptive practices and processes to improve FMMD resiliency to climate change. **Objective 5.2:** Incorporate these practices and processes into the FMMD INRMP.	**Indicator 5.1:** Installation natural resource managers have applied the climate assessment tool. **Indicator 5.2:** Installation natural resource managers have updated the INRMP based upon the climate change adaptation process.
6. Outdoor Recreation and Education: *Support and promote a high quality of life for the Fort George G. Meade community by managing natural resources for recreation, education, and scientific research.*	**Objective 6.1:** Assess usage and preferences of recreational anglers on FMMD. **Objective 6.2**: Assess the composition and populations of fish species and implement a comprehensive fish management program for Burba lake. **Objective 6.3**: Develop educational materials for FMMD employees, tenants, housing residents, contractors, and schoolchildren about FMMD's location within the Chesapeake Bay watershed and the natural resource actions on FMMD that affect the Chesapeake Bay. **Objective 6.4**: Educate FMMD employees, tenants, housing residents, contractors, and schoolchildren about the role of native pollinators and how to protect and enhance local habitat.	**Indicator 6.1:** At minimum qualitative angler usage and preferences are determined for Burba lake. **Indicator 6.2:** Conduct a fish survey and implement management actions recommended **Indicator 6.3:** Appropriate educational materials about the Chesapeake Bay have been made available to FMMD's population through a variety of sources. **Indicator 6.4**: Appropriate educational materials about pollinators have been made available to FMMD's population through a variety of sources.
7. Integrated Pest Management:	**Objective 7.1:** Conduct surveys of pests that pose a potential health risk to humans or natural resources as necessary.	

Minimize pest-related habitat damage and health risks to natural resources and people.	**Objective 7.2:** Implement pest management controls from the Integrated Pest Management Plan and other pest-related guidance and plans.	
8. Wildland Fire Management: *Develop a management strategy for wildland fire.*	**Objective 8.1:** Obtain Wildland Fire Management Waiver in accordance with DCS G-9 Wildland Fire Guidance.	**Indicator 8.1:** Wildland fire management waiver is granted.

1.4 REVIEW, REVISION AND REPORTING

A review, involving internal and external stakeholders, of the FMMD 2023-2027 INRMP will occur at minimum every 5 years and will assess the implementation progress. The FMMD INRMP will be reviewed and updated as appropriate in concert with installation needs to obtain mutual agreement in coordination with and signed by the United States Fish and Wildlife Service (USFWS), Maryland Department of Natural Resources, and other internal and external stakeholders. This review will ascertain whether the FMMD INRMP is meeting Sikes Act requirements and contributing to the conservation and rehabilitation of natural resources on FMMD. At a minimum, reviews shall assess conservation goals and objectives from Table 1-1.

To ensure that the FMMD is making satisfactory progress in accomplishing the goals and objective of the INRMP, yearly internal and –as warranted-external assessments will be performed. At minimum FMMD natural resource personnel will document accomplishments over the preceding year and compare to the INRMP objectives outlined in Table 1-1. Each objective will be assessed according to the indicators in table 1-1.

1.5 STEWARDSHIP AND COMPLIANCE

Environmental compliance requirements are management actions that are driven by federal, Executive Orders (EOs); and Memoranda of Agreements or Understanding (MOAs or MOUs). The primary federal environmental laws that are legal drivers for natural resources management at FMMD include, but are not limited to:

- Sikes Act
- ESA
- MBTA
- NEPA
- CWA
- CAA
- Federal Noxious Weed Act.

Environmental mandates also include several executive orders such as:

- EO 13508 - Chesapeake Bay Protection and Restoration
- EO 13514 - Federal Leadership in Environmental - Federal Leadership in Environmental, Energy, and Economic Performance
- EO 13112 - Invasive Species
- EO 11990 - Protection of Wetlands
- EO 11988 - Floodplain Management.

A comprehensive list of environmental laws, regulations, policies, guidelines, instructions and EOs that are relevant to natural resources management at FMMD is located in Appendix A. The FMMD INRMP must identify critical management requirements and projects necessary for maintaining ecosystem health and integrity to ensure the sustainability of the land for current and future military missions and to ensure effective stewardship of public land. Therefore, this INRMP identifies both stewardship and compliance projects that help meet natural resources management goals at FMMD. However, priority will be given to projects that are required to meet compliance criteria. Stewardship efforts that rely on volunteer labor and enjoy the support of the military community or have available alternate funding sources are also likely to be implemented.

1.6 LITERATURE CITE AND REFERENCES REVIEWED

Sikes Act Improvement Act of 1997, Public Law 105-85, Div. B Title XXIX, November 18, 1997; and codified at 10 USC §§670a et seq. (1998) (amending the Sikes Act of 1960, 10 USC §§670a et seq. (1996)).

U.S. Army Corps of Engineers. 2014. Fort George G. Meade, Maryland Integrated Natural Resources Management Plan Update 2011-2015. US Army Corps of Engineers Baltimore District. 122 pages.

U.S. Army. 1997. Army Regulation 200-1, Environmental Protection and Enhancement. February 1997.

U.S. Department of Defense. 2011. Department of Defense Instruction 4715.3, Natural Resources Conservation Program.

U.S. Department of Defense Memorandum, Deputy Under Secretary of Defense. 1994. Memorandum on Implementation of Ecosystem Management in the DoD.

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2.0 INSTALLATION OVERVIEW

FMMD occupies approximately 5,253 contiguous acres in northwest Anne Arundel County, Maryland (Figure 2-1). The main installation includes the U.S. Army Garrison (USAG) offices, approximately 85 tenants, and family housing and support facilities. The majority of FMMD has been intensively developed over many years for military use, and few areas of relatively undisturbed habitat remain. Prominent tenant organizations at FMMD include, the National Security Agency (NSA), the U.S. Environmental Protection Agency (USEPA), Defense Information Systems Agency (DISA) and the Defense Information School (DINFOS). Approximately 520 acres of the installation are currently used exclusively by the NSA through an Inter-Service Support Agreement and approximately 98 acres are currently occupied by the Architect of the Capitol (AOC).

In addition to the main post, FMMD is also responsible for two former NIKE missile sites that were deactivated in 1973. Project NIKE was a United States Army project proposed in 1945 to develop a line-of-sight anti-aircraft missile system. These relatively small, noncontiguous sites are located in Baltimore County, and include the Granite NIKE Control Site (16.5 acres) and the Phoenix Military Reservation (17 acres). Both sites are undeveloped and contain no ecologically significant natural habitats or species. FMMD intends to release both sites once hazardous waste contamination concerns associated with previously removed buildings and underlying soils and groundwater have been remediated.

2.1 LOCATION

FMMD is a Military District of Washington installation located in Anne Arundel County, Maryland midway between Washington, D.C. and Baltimore, Maryland immediately adjacent to the town of Odenton and to the USFWS Patuxent Research Refuge (Figure 2-2). FMMD lies along the busy transportation corridor between Baltimore, Maryland and Washington, D.C. Major highways neighboring the installation include: the Baltimore-Washington Parkway (MD 295) to the northwest, MD 32 to the southwest and MD 175 to the east.

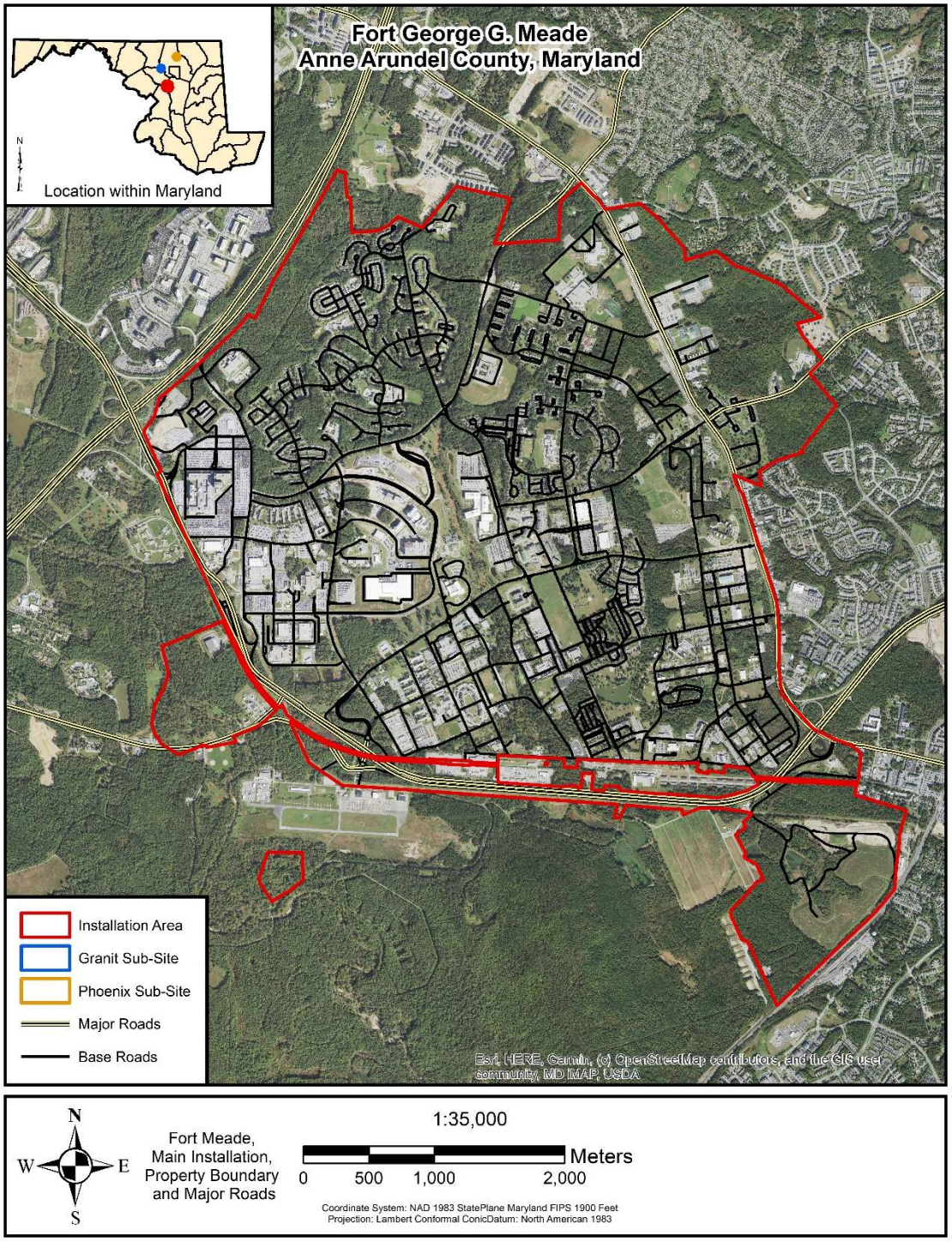

Figure 2-1. Fort George G. Meade, Maryland installation boundary.

Figure 2-2. Fort George G. Meade regional map location in Maryland.

Figure 2-3 Constraints map

Constraints Map: impact and surface danger zone areas, off-limit areas, critical habitat or special management areas, and major wetlands/waters that are (or are likely) "waters of the U.S".

2.2 GENERAL INSTALLATION INFORMATION

Over 56,000 military and civilian personnel work for the DoD and various tenants on the installation making it Maryland's largest employer and the second largest workforce of any United States Army installation (FMMD 2020). FMMD is dedicated to supporting its service members, Department of Defense civilian employees, family members, and military retirees. FMMD currently consists of 5,067 acres with approximately 1,670 buildings on the installation (US Army Garrisons, 2021). Every day, approximately 140,000 military personnel, civilian employees, family members, local military retirees, and residential family members utilize the services provided by FMMD. Within FMMD there are six neighborhoods containing over 2,600 homes available to military personnel. General land use at FMMD includes amenities for the residential community, industrial infrastructure, professional and institutional facilities, ranges and troop training facilities.

FMMD's primary mission is to provide a diversity of services to its 95 partner organizations including the Army, Navy, Air Force, Marines, and Coast Guard as well as to federal agencies such as the National Security Agency, Defense Media Activity, Defense Information Systems Agency, Defense Courier Service and U.S. Cyber Command (FMMD 2021). Professional and institutional land use include non-tactical organizations like military schools, headquarters, major commands, and non-industrial research, development, test, and evaluation facilities. In 2011, FMMD gained the Defense Information Systems Agency (DISA) which is a combat support agency that plans, engineers, acquires, fields, and supports global net-centric solutions that serve the President, Vice President, Security of Defense and other DoD components in peace and war (U.S. Army Corps of Engineers 2014). Additionally, the Defense Media Activity (DMA) was acquired. To support these and operations, a variety of new facilities have been constructed and completed since 2011.

2.3 INSTALLATION HISTORY

The installation is named for General George G. Meade who commanded the union Army of the Potomac from July 1863 through the conclusion of the Civil War. General Meade is best known for being victorious at the Battle of Gettysburg where his army repelled repeated assaults by General Robert E. Lee's Confederate forces.

The first known military use of the area where FMMD is located was an iron foundry-Patuxent Forge-located on a branch of the Patuxent River. The Patuxent Forge made gun carriages for

George Washington's Continental Army. During the Civil War, union troops occupied the area to protecting the vital supply line of the Annapolis & Elk Ridge Railroad.

The location chosen for the establishment of Fort Meade in 1917 was considered ideal by military planners due to its' proximity to the railroad, Baltimore port, and Washington D.C (FMMD 2020). In May 1917, congress authorized Camp George G. Meade, which brought a wave of civilian and military personnel to the area. During World War I, Camp Meade and 15 other cantonments were built for troops drafted for World War I and approximately 100,000 soldiers received training at Camp Meade. In 1928 following the war, Camp Meade was purchased by the Army and designated a permanent facility. A year later it was renamed Fort George G. Meade and in the 1920's it became one of the major training schools for armored warfare. The first permanent buildings on FMMD housed armored units but in 1932, the Army transferred the Tank School to Fort Benning.

Approximately 2,200 troops were assigned to FMMD in the 1930's and by 1940, 251 permanent brick buildings and 218 temporary wooden buildings had been constructed. In 1941, FMMD became the fourth largest community in Maryland because of the ongoing construction related to expansion for WWII. During this period FMMD grew from 9,349 acres to 13,691 acres as more training lands were acquired. Over 200 organizations and 3.5 million troops were trained in FMMD throughout World War II with wartime missions including infantry training, serving as a troop replacement depot, a prisoner of war camp, and troop separation center. During this time, housing and commercial developments around FMMD were established as the installation had become one of the largest employers in Anne Arundel County.

At the conclusion of World War II, FMMD reverted to peacetime activities and in 1947, the Second U.S. Army Headquarters was transferred from Baltimore to FMMD. With the outbreak of the Korean War in 1950, FMMD reverted to its wartime operations. Post-war construction included the 250 Wherry housing units in Meade Heights and the 1,400 Capehart housing units in Argonne Hills. In 1952, an Executive Order established the NSA which underwent construction on FMMD from 1954-1957. During the Cold War, FMMD was instrumental in providing air defense and intelligence to the US. Through this period FMMD became host to radar installations to aid in the detection of possible aerial attacks from the USSR and from 1957-1973, Nike missile sites were active. The 1988 BRAC Commission instituted major changes when it realigned FMMD from its reserve training mission which resulted in 8,100 acres of training and range lands to be transferred to the USFWS in 1991. That land became what is now two-thirds of the 12,750-acre USFWS National Patuxent Research Refuge. The BRAC also resulted in the transfer of the 366-acre Tipton Army Airfield from FMMD to Anne Arundel County in 1999. The property transfers of the 1990's reduced FMMD from its peak size of 13,691 acres to its current size of 5,253 acres. Currently, FMMD is the nation's center for information, intelligence and cyber operations.

2.4 INSTALLATION LAND USE

FMMD is home to approximately 100 partner organizations from the Army, Navy, Air Force, Marines and Coast Guard, as well as several federal agencies such as the NSA, DINFOS, the USEPA, the Defense Courier Service, and the Office of Personnel Management. With the wide variety of tenants and associated mission requirements land use is diverse (Table 2-1). The installation has administrative buildings, industrial areas, motor pools, warehouses, and a substantial number of family housing units. FMMD also has unaccompanied personnel housing, recreational areas and a shopping complex with a main Post Exchange, Commissary, bank, gas station, Post Office, and a bowling alley.

FMMD's natural resources provide high quality settings for housing and administration facilities. It also contributes to the installation's Morale, Welfare, and Recreation Program, which is aimed at increasing the quality of life for military and civilian personnel, who work and reside on post. The natural resources on FMMD provide numerous opportunities for outdoor recreation activities for active-duty personnel, Army civilian employees, residents, and contractors. In addition, natural resources, particularly forests, are important to ensure that NSA can maintain necessary security in order to perform their mission effectively.

Table 2-1: Summary of FMMD land uses **and users**

Category	Description
Community	The community land use encompasses a mix of facilities including religious, family support, personnel services, professional services, medical, community, housing, commercial and recreational services. This zone can be divided into two general areas. The first area is a mix of community buildings and services south of Mapes road, roughly between Zimborski and Griffin Avenue down to Rock Avenue. This includes facilities such as the DINFOS, the Department of Emergency Services, Club Meade, ITR/ Arts and Crafts Center, and the Gaffney Fitness Center. The second area includes the main commercial hub, located centrally within the Installation, and several other community facilities spread out north and south along Ernie Pyle Street. The majority of commercial-base activities are concentrated between Mapes and Reece Road. This includes the PX, Commissary, PNC Bank, Child Care Center, Burger King, Service Station and Shoppette, Post Office, and Bowling Center.

Industrial	This land use is designated for production, maintenance, depot and other storage, as well as activities that generate significant amounts of heavy traffic and pollution. Industrial land uses are located in the southern half of the Installation. Recently, a trend has evolved to consolidate the industrial functions along Rock Avenue corridor in the southernmost part of the Installation. Although this idea of consolidation was ideal, the location along Rock Avenue is highly visible due to the lack of buffering along Highway 32, which traverses the southern boundary of the Installation. The Architect of the Capitol possesses a significant parcel along Rock Avenue.
Professional/Institutional	This land use provides for non-tactical organizations including military schools, headquarters, major commands, and non-industrial RDT&E. Currently, FMMD's administrative facilities are spread throughout a large part of the Installation. These facilities can be grouped and analyzed in three separate zones. The first zone encompasses the troop barracks within the NSA. The second zone, south of Mapes Road along Highway 32, consists of several high-profile administrative facilities. The third and final zone is located on the eastern edge of the Installation along highway 175.
Ranges and Training	Currently, there are 126 acres of land designated for training on the southern-most tip of the Installation across Route 32. This site, commonly referred to as Site S, serves as an area for detonation of suspicious packages and functions as a mission training area for bivouac operations and physical training for loaded backpacks. Also located on this parcel of land is the DINFOS Field Training Exercise Facility (FTX) on approximately 1.2 acres.
Residential	This land use designates family housing and senior unaccompanied personnel housing. It may also include family services and other neighborhood services. FMMD Family Housing is privatized through the Army's Residential Communities Initiative (RCI) office and its partner, Picerne Military Housing. FMMD has seven neighborhoods, with the primary residential area occupying most of the northern half of the Installation. In this main residential zone, there are currently five neighborhoods: Midway Common, Meuse Forest, Normandy Bluff, Patriot Ridge, and Potomac Place. To the south of this large zone, are the two neighborhoods of Heritage Park.
Troop	This land use is designated for operational facilities for Table of Organization and Equipment (TOE) units, Basic Combat Training (BCT) and One Station Unit Training (OSUT) complexes and for selected Initial Entry Training (IET) complexes. The primary area for troop land use is the southwestern section of the cantonment area located south of Mapes Road, roughly between Grant Road and

	York Avenue. This area is relatively small in size and consists of barracks, administrative facilities, recreation facilities, and AAFES and dining facilities.

2.5 REGIONAL LAND USE AND SETTING

FMMD is located between Washington D.C. and Baltimore in the state of Maryland near Odenton, Laurel, Columbia, and Jessup (FMMD 2020). FMMD is located in an expanding exurban setting, surrounded by a mix of residential, commercial areas and light industry, particularly to the east, west and north of the installation boundaries. Tipton Airport and the Patuxent Research Refuge are south of FMMD. The Tipton airport is a 366-acre facility and was formerly a U.S. Army airfield (Tipton 2018). In 1999, it became a public airport and is currently working on extending its runway. Adjacent to the airport is the Patuxent Research Refuge. The refuge is approximately 12,841 acres and is part of the U.S. Fish and Wildlife Service's National Wildlife Refuge System. Established in 1936, it is the only national wildlife refuge established in support of wildlife research (USFWS 2018). About 12 miles outside of the urbanized area to the East of FMMD is the Severn Run Natural Environment Area (Anne Arundel County 2016b). This natural area is protected by the state of Maryland and holds 1,700 acres of the 24 square mile watershed of Severn Run, which is a 9-mile headwater stream originating from the Severn River. Outside of the urbanized areas surrounding FMMD to the West is the T. Howard Duckett reservoir. The reservoir is surrounded by 6,000 acres of wooded property and it collects water that drains off 132 square mile watershed (WSSC 2018).

Anne Arundel County, Maryland has an estimated population of approximately 586,000 people (U. S. Census Bureau 2020). Generally, the FMMD community uses the areas surrounding FMMD for religious purposes, family support, and housing (FMMD 2020). These areas provide the FMMD community with personnel, professional, medical, community, commercial, and recreational services.

2.6 NATURAL ENVIRONMENT

FMMD is located in a rapidly urbanizing area of Anne Arundel County and itself is a largely suburban installation with housing, shopping, recreation areas, parks, and military campuses to

support the military mission. Nevertheless, FMMD does provide important ecosystem and conservation services to the local and regional communities.

2.6.1 CLIMATE

FMMD and Anne Arundel County as a whole, lies in the humid, temperate, semi-continental climatic zone of the eastern United States with a mean annual temperature of 55.2 F (Climate-Data 2015). FMMD experiences a wide range of temperatures from season to season with summer temperatures averaging 85^0 F and winter temperatures averaging 30^0F (FMMD 2020). Mean annual precipitation is 50 inches and is fairly evenly distributed throughout the year with snowfall in the winter ranging from 4-10 inches per month. (Climate-Data 2015). The Chesapeake Bay exerts a modifying effect on temperature extremes in the region with an average growing season of 194 days beginning around mid-April and ending around mid-October. Humidity is moderate to high throughout the year, and prevailing winds are light to moderate and primarily from the west (Climate-Data 2015).

2.6.2 HYDROLOGY

2.6.2.1 SURFACE WATER

Regionally, FMMD is located in the Chesapeake Bay watershed and locally within the Little Patuxent River and Severn River watersheds. The Patuxent watershed is approximately 66,000 acres and encompasses portions of Howard and Anne Arundel County, while the Severn watershed is approximately 44,248 acres (Anne Arundel County 2016a).

The Patuxent River drains an area of 932 square miles in Maryland before emptying into the Chesapeake Bay's western shore and is designated a "scenic river" under the Maryland Scenic and Wild Rivers Act (1968). The act mandates the preservation and protection of natural values associated with each designated river, and state and local governments are required to take whatever actions necessary to protect and enhance the qualities of the designated rivers.

There are three primary tributaries within FMMD, Midway Branch, Franklin Branch, and a southernmost tributary that arises from two small unnamed streams (figure 2-4). All of the tributaries drain to the Little Patuxent River and flow into the waters of the Patuxent research refuge (Figure 2-5) (U.S. Army Corps of Engineers 2013). Midway Branch originates north of FMMD and flows southward through the western half of the installation, draining approximately 1,461 acres on-post. Franklin Branch originates as an intermittent stream near Meade Senior High School and flows southward draining 1,176 acres of the eastern half of the post. The Franklin Branch merges with Midway Branch at FMMD's southern boundary forming the Rogue Harbor Branch flows off-post into Allen Lake (formerly Soldier's Lake) south of Route 32. The third and southernmost tributary is comprised of two small, unnamed branches that join on-post before emptying into the Little Patuxent River. The Little Patuxent River lies along the southwest edge of FMMD and is also designated a "scenic river" under the Maryland Scenic and Wild Rivers Act of 1968 (U.S. Army Corps of Engineers 2013).

In addition to stormwater retention ponds, there are four standing bodies of water within the boundaries of FMMD, three of which are unnamed. A small pond is located near the eastern boundary of 20th Street and a second small pond is adjacent to Range Road near the border with the Patuxent research refuge. The third unnamed pond is located north of the closed landfill and is part of a wetland restoration project. The largest body of water on FMMD is Burba Lake, which is located in the near the post theater in the south-central portion of post. Originally constructed as a stormwater retention pond, the 8-acre lake is now the focal point of a recreational area named Burba Park.

2.6.2.2 GROUND WATER

Several aquifers underlay Anne Arundel County that supply ground water for the area (Mach and Achmad 1986). The main aquifer that provides water to FMMD is the Patuxent aquifer (Staley et al. 2009). This aquifer is comprised of lenticular deposits of sand, silt, and clay underlain by bedrock and is 1,500 ft deep in eastern Anne Arundel County (Mach and Achmad 1986). The upper and lower Patapsco aquifers also underlie FMMD and are separated from the Patuxent aquifer by Arundel clay formations (Mach and Achmad 1986). The Arundel clay acts as a confining layer due to its low vertical hydraulic conductivity.

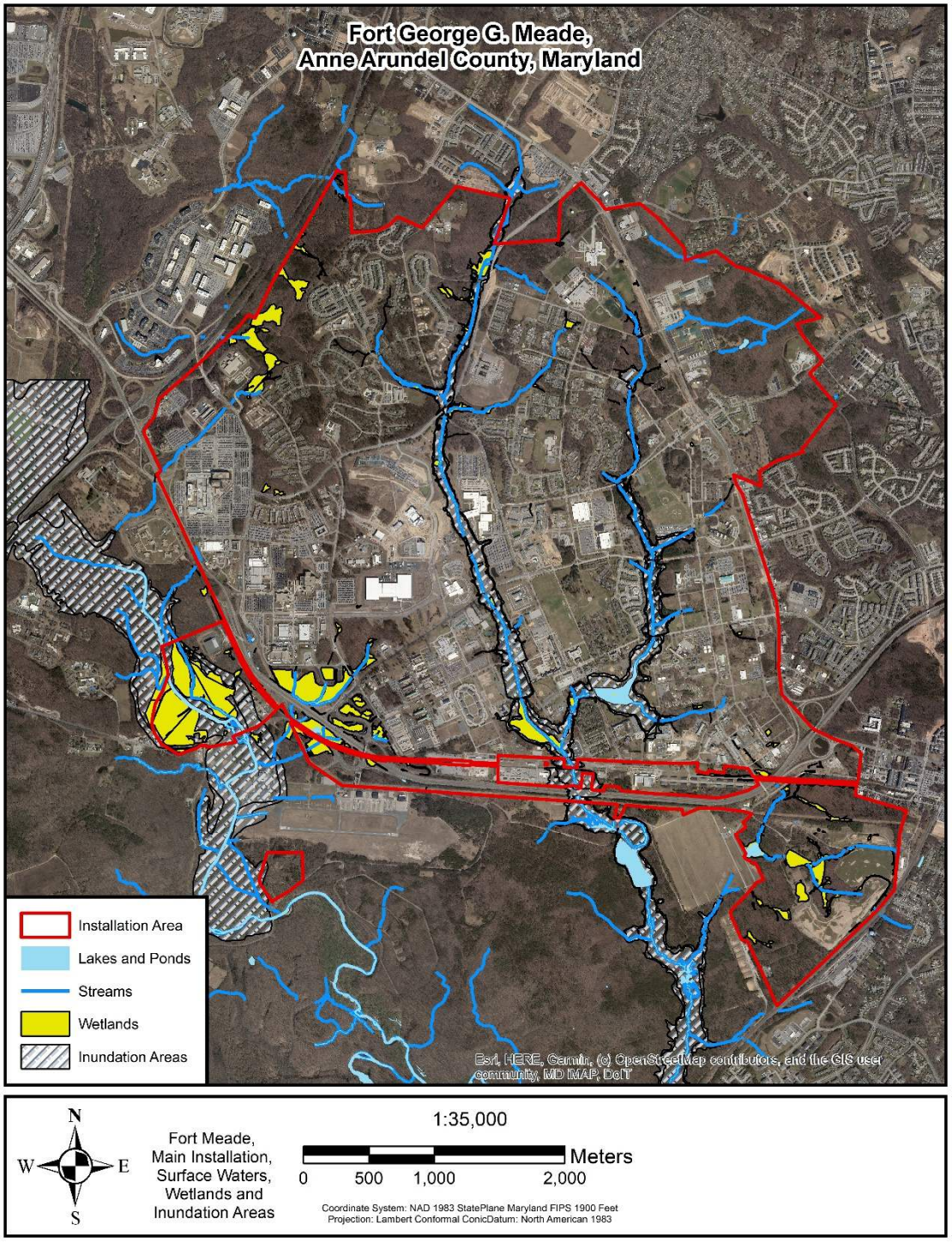

Figure 2-4. Distribution of Fort George G. Meade surface water and wetlands.

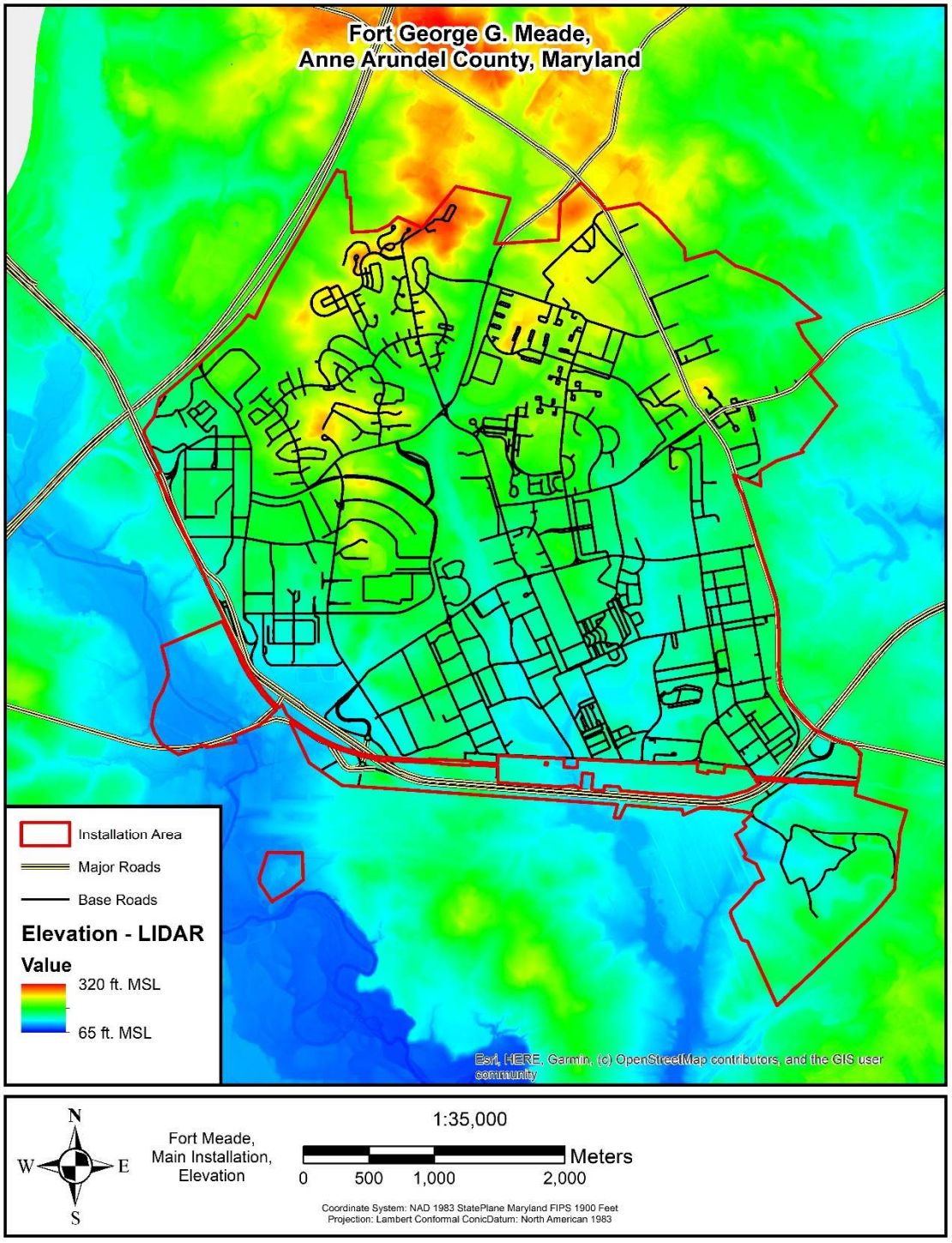

Figure 2-5. Fort George G. Meade elevation gradient.

2.6.2.3 STORMWATER

The FMMD Stormwater Program is responsible for maintaining compliance under its Municipal Separate Storm Sewer System (MS4) permit and the Chesapeake Bay Total Maximum Daily Load (TMDL). Utilizing a watershed-based approach, the stormwater programs' goal is to restore degraded drainage ways to improve stream and wetland function, water quality, and aquatic and riparian habitat leading to improved health of the local waterways and overall resilience of FMMD's environment (FMMD 2018). Stormwater runoff is drained within FMMD by the three tributaries discussed in "section 2.5.2.1 Surface Water", but primarily by the Midway and Franklin branches into the Little Patuxent River. FMMD utilizes drainpipes, retention ponds, swales, and ditches to prevent flooding and overflows (R&K Engineering, Inc. 2005b). The majority of FMMDs stormwater infra-structure was designed to store quantities of water but not directly improve water quality. To improve water quality of stormwater runoff FMMD has implemented other initiatives such as installing rain gardens, riparian forest buffers, stormwater ponds, grass swales instead of concrete storm drains (U.S. Army Corp of Engineers 2013).

2.6.2.4 WETLANDS

Wetlands are defined by the EPA as "areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season" (EPA 2018). There are approximately 257 acres of wetland located within FMMD with the majority occurring along the Little Patuxent River floodplain. Some wetland areas are also found along Midway and Franklin Branch as well as their associated tributaries. Most wetlands found on FMMD are considered palustrine forested meaning they are "nontidal wetlands dominated by trees, shrubs, persistent emergent, and emergent moss or lichen (USFWS n.d.) (fig. 2-4).

2.6.3 GEOLOGY, SOILS, AND TOPOGRAPHY

Located within the Atlantic Coastal Plain Physiographic Province, FMMD is underlain by unconsolidated sediments that lie over a crystalline substrate consisting of gabbro, diorite, and other igneous and metamorphic rocks (Mach and Achmad, 1986, Maryland Geological Survey 2014). The

series of thick, unconsolidated sediments are subdivided-from youngest to oldest-into the Potomac group, Magothy formation, and Patuxent River terraces and associated alluvium. Within the Potomac group, the Arundel Clay, Patuxent aquifer, and lower Patapsco aquifer geological units underlie FMMD. The Arundel Clay has low vertical hydraulic conductivity and is the confining layer between the two aquifers under FMMD. Above the lower Potomac aquifer is an unnamed confining layer composed of tough variegated clay that also exhibits low vertical hydraulic conductivity, although some layers are permeable. Alluvium underlies all of FMMD's streams and wetlands, and consists of interbedded sand, silt, and clay with small gravel inclusions (Mach and Achmad, 1986). The topography of FMMD is mostly level to gently rolling, and generally slopes from north to south. Elevations range between 97 feet above mean sea level (MSL) in the southwestern corner of the installation at the Little Patuxent River, to 307 feet MSL near the 1st Army Radio Station (Building 2844) (R&K Engineering, 2005a) (fig. 2-5).

The predominant soils on FMMD are part of the Evesboro and Galestown complexes, covering approximately 42 percent of the area (NRCS 2012). Evesboro soils are a very deep, excessively drained sandy loam soil found on uplands. Galestown soils are very deep, somewhat excessively drained sandy soils generally occurring on terrain with little slope. Other soil series occurring on FMMD include the Bibb-Iuka, Downer, Hambrook, Hammonton, Ingleside, Keyport, Muirkirk, Patapsco, Runclint, Sassafras, Udorthents, and Woodstown (fig. 2-6). Bibb and Evesboro soils are Entisols, which are recent mineral soils that have been only slightly modified from the geologic material in which they formed. All the other soil series are Ultisols, which are excessively weathered soils with well-developed horizons and argillic B horizons.

"Urban land" and "Cut and fill land" were also identified as map units in the soil survey (NRCS, 2012). Urban land includes areas in the vicinity of pavements and buildings. Cut and fill land includes miscellaneous soil types in severely disturbed areas to the extent that identification by soil series cannot be determined. Both urban and cut and fill lands are common in developed sites that have been severely modified by earth-moving equipment (NSA 2010).

Of the 39 distinct soil mapping units on FMMD, the Muirkirk Loamy Sand, Keyport Sandy Loam, and Evesboro and Galestown Loamy Sand units are classified as highly erodible lands (HEL), as defined by The Anne Arundel County Code, § 2-101 (22E). Several soil mapping units have severe limitations to development due to slope and/or wetness, including the Bibb-Iuka Silt Loams, Downer Loamy Sand, Downer Sandy Loam, Evesboro and Galestown Loamy Sands, Evesboro-Urban Complex, Fallsington Sandy Loam, Ingleside Sandy Loam, Muirkirk Loamy Sand, Muirkirk-Urban Complex, Sassafras Sandy Loam, Sassafras-Urban Complex, and Udorthents (U.S. Army Corp of Engineers 2007).

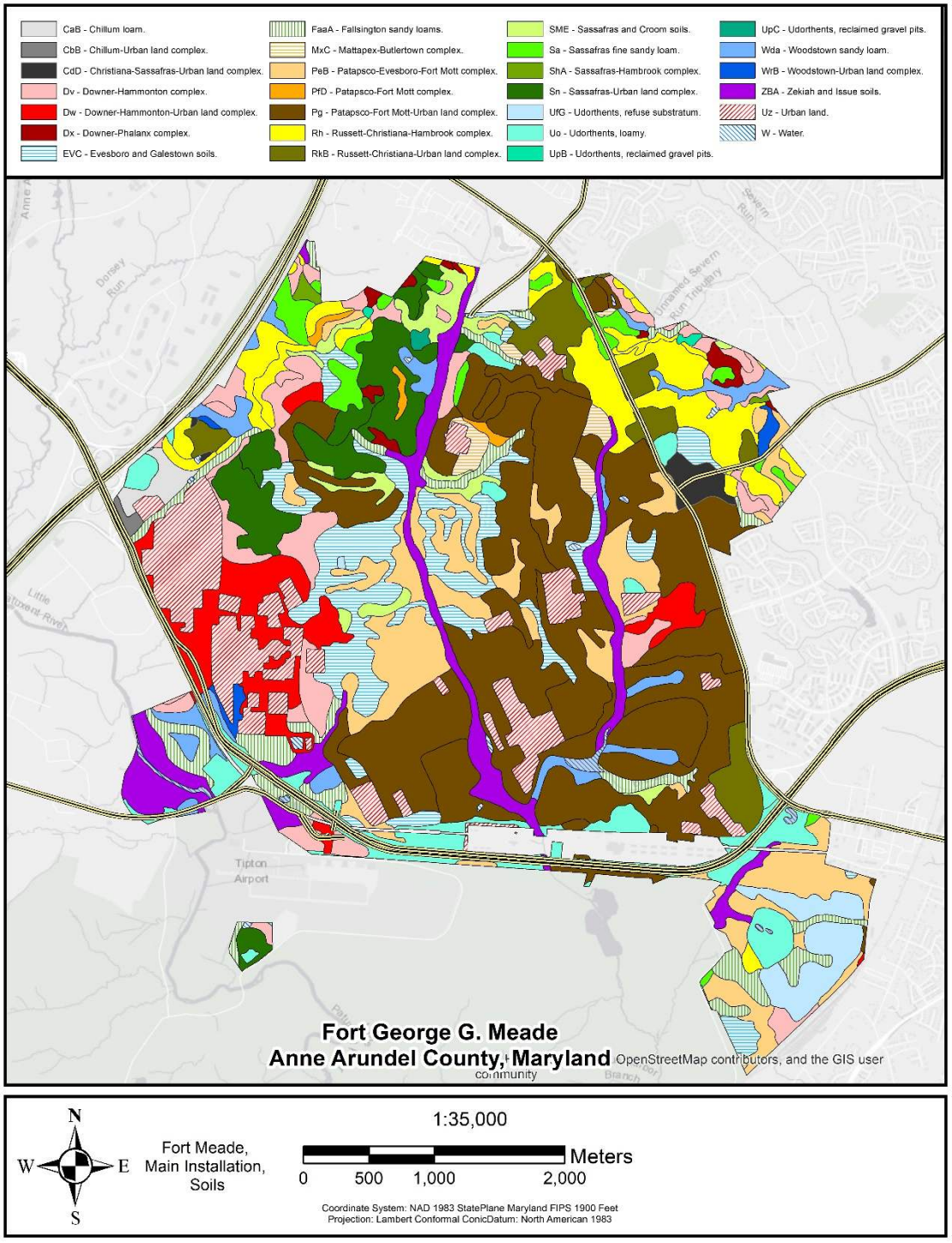

Figure 2-6. Soil type distribution on Fort George G. Meade.

2.6.4 FMMD VEGETATION

FMMD is located in the **Temperate Deciduous Forest Biome** which encompasses the majority of the eastern United States into southern Ontario. Because the biome covers an extensive and diverse area, both geographically and topographically, this biome is broken into eight major forest regions identified by the dominant species or species groups. These are: mixed mesophytic, Appalachian oak, hemlock-white pine-northern hardwoods, oak-hickory, maple-basswood, beech-maple, oak-pine, and southern pine. FMMD is located within the oak-pine forest region.

2.6.4.1 LAND COVER TYPES

Of the 5,233 contiguous acres comprising FMMD, a little less than half (approx. 46%) is covered in natural (i.e., forests, wetlands) or semi-natural (successional, unimproved) vegetation (Emrick et al. 2018). The remainder is a combination of suburban neighborhoods, recreation areas and developed areas.

The forest vegetation at FMMD has been a high priority for management for much of the installations' history. As such, the distribution and composition of the forest cover types have been well documented. As of 2020 FMMD had approximately 1,600 acres of forestland of which 1500 acres were divided into 44 compartments or forest management units (fig. 2-7). The most recent vegetation planning level survey further refined these compartments into 157 stands for the purposes of classifying and mapping their distribution (EEE consulting 2014). These stands were classified, based upon their dominant species, using the Classification of Vegetation Communities of Maryland (Harrison 2004). Fifteen different forest alliances were identified with the most common, in terms of acreage, being: *Pinus virginiana* forest alliance, *Quercus falcata* forest alliance, *Liriodendron tulipifera* forest alliance, *Quercus prinus* - (*Quercus coccinea, Quercus velutina*) forest alliance, *Quercus alba* - (*Quercus Rubra, Carya spp.*) forest alliance, and the *Quercus alba* - *Quercus* (*falcata, stellata*) forest alliance (Table 2-2) (EEE consulting 2014).

In addition to forest cover, FMMD monitors total tree canopy, which incorporates not only forest canopy but tree canopy in the suburban setting (i.e., neighborhoods, parks, campuses etc.). The most recent analysis using 2018 imagery indicates total tree canopy ranges between 2,012 and 2,466 acres (Klopfer et al. 2020). These estimates indicate that total tree canopy has been relatively stable since 2013, though Klopfer et al. (2020) did detect locations where canopy has increased and others where it has decreased.

Unlike the forest vegetation, successional and suburban/urban land cover types have not undergone as thorough of study and evaluation at FMMD. Nevertheless, these cover types can and do provide important conservation and ecosystem services.

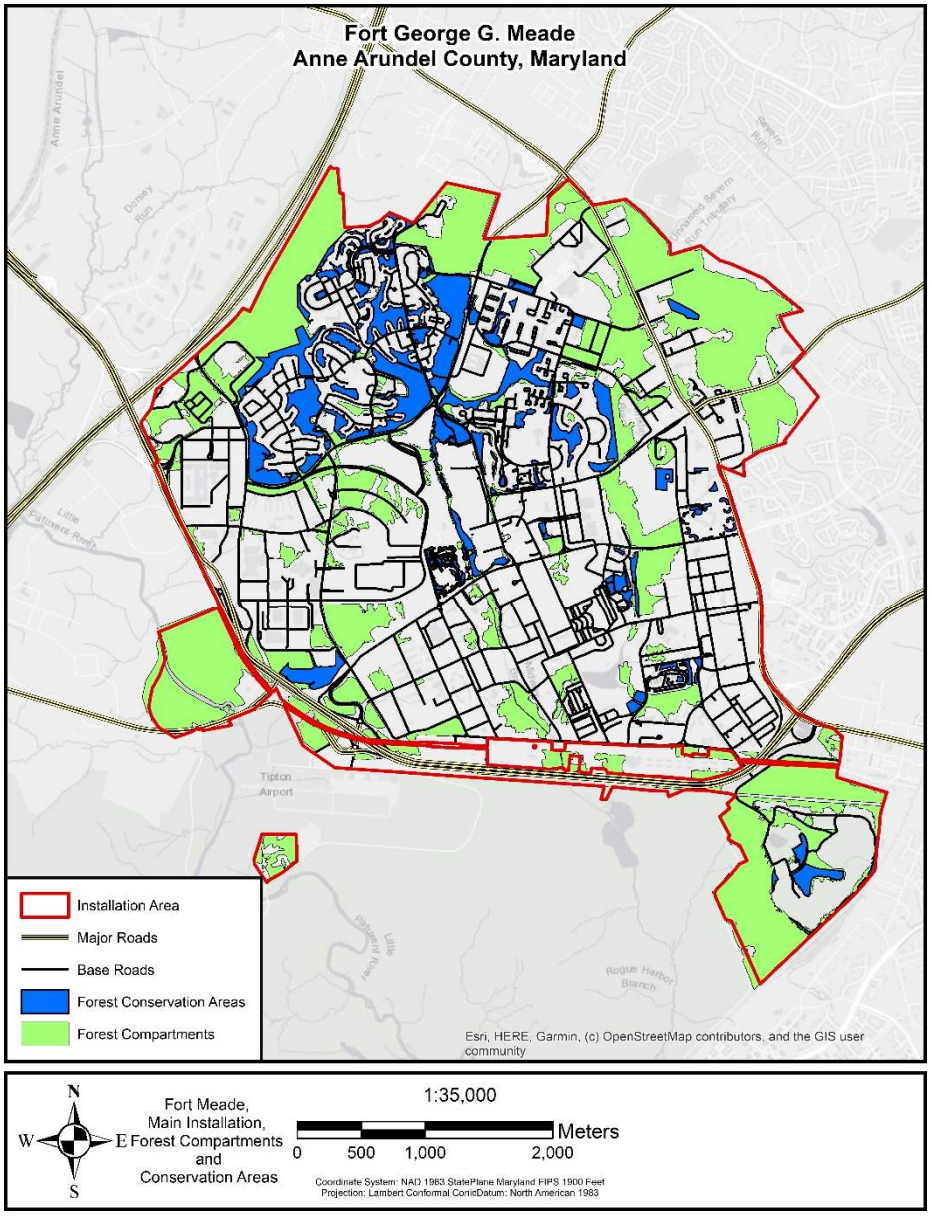

Figure 2-7. Forest compartments and conservation units on FMMD.

Table 2-2: Forest Alliances and their acreage mapped on FMMD in 2014.

Forest Alliance	Acreage
Pinus virginiana Forest Alliance	502
Quercus falcata Forest Alliance	388
Liriodendron tulipifera Forest Alliance	93
Quercus prinus - (*Quercus coccinea, Quercus velutina*) Forest Alliance	93
Quercus alba - (*Quercus alba, Carya spp.*) Forest Alliance	89
Quercus alba - *Quercus (falcata, stellata*) Forest Alliance	84
Juniperis virginiana Woodland Alliance	51
Quercus velutina - *Quercus alba* - (*Quercus Coccinea*) Forest Alliance	50
Quercus phellos Seasonally flooded Forest Alliance	46
Plantanus occidenatalis - *(Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum*) Temporarily flodded Forest Alliance	37
Pinus taeda Forest Alliance	29
Liquidambar styraciflua - *(Liriodendron tulipifera, Acer rubrum*) Temporarily Flooded Forest Alliance	15
Quercus palustris - *Acer rubrum* Temporarily Flooded Forest Alliance	8
Acer rubrum - *Fraxinus pennsylvanica* Seasonally Flooded Forest Alliance	4
Pinus taeda - *Quercus (alba, falcata, stellata*) Forest Alliance	4
total	1493

2.6.4.2 FLORAL SPECIES

The most recent floral planning level survey was conducted in 2013 (EEE consulting 2014). A total of 413 plant species were detected during the 2013 survey. None of the plant species observed during the survey were federally listed and the majority of them were common to Anne Arundel County and Central Maryland. However, there are 22 plant species occurring on FMMD that are considered by the state of Maryland species of greatest conservation need (Maryland Department of Natural Resources 2016). Of these 22 species, 3, blunt-lobe grapefern, partridge pea, and Torrey's rush are considered endangered in the state of Maryland including (see section 4.5.3).

Common trees detected during the 2013 survey were Virginia pine (Pinus virginiana), pitch pine (*Pinus rigida*), oak (*Quercus spp.*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*) and black gum (*Nyssa sylvatica*). Successional habitats included herbaceous and shrub species, such as greenbrier (*Smilax rotundifolia*), deertongue (*Dichanthelium clandestinum*), white edge sedge (*Carex debilis var. debilis*), black huckleberry (*Gaylussacia baccata)* and Virginia creeper (*Parthenocissus quinquefolia*) (EEE consulting 2014). A complete list of all plant species detected, survey year, state and global rarity ranking, and invasive status is provided in Appendix B.

Because of the exurban nature of FMMD there are numerous non-native ornamental plants in the developed areas and in the immediate vicinity on the installation. As a result, FMMD has a moderate number of invasive plant species. The abundance of invasive plant species varies with site and species, with some sites exhibiting high densities and others just scattered occurrences. The highest density of invasive species occurs in edge and disturbed habitat, as would be expected, and lowest in mature forests. Thirty-four invasive plant species have been identified at FMMD (Appendix B). The most common invasive plant species encountered at FMMD are Asiatic bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*) and mile-a-minute (*Polygonum perfoliatum*) (U.S. Army Corps of Engineers 2012).

2.6.5 FMMD FAUNA

FMMD, though located in a rapidly developing suburban region, possesses a diverse assemblage of faunal species. These species are likely taking advantage of the habitats provided by FMMD forest cover and stream corridors and those provided by the adjacent Patuxent Research Refuge. To date, 34 herpetofaunal species, 102 bird species, 33 fish species, 22 mammal species have been identified on FMMD (Appendix C). Of these species, 11 are listed as either Endangered, Threatened or a candidate species under the auspices of the ESA (see section 4.5.1). In addition to the federally listed and/or candidate species, there are two species (glassy darter, American brook lamprey) that are considered state threatened, two (northern waterthrush, coastal plain swamp sparrow) considered imperiled (see section 4.5.2) and 28 species that are of greatest conservation need that have been detected on FMMD (Appendix D) (Maryland Department of Natural Resources 2016).

2.7 CURRENT MILITARY MISSION

FMMD's primary mission is to provide required services, infrastructure, safe and secure community, and a quality of life that supports mission readiness and the Fort Meade community This mission includes supporting a wide range of services to 117 partner organizations from the Army, Navy, Air Force, Marines and Coast Guard, as well as to several federal agencies including the NSA, the U.S. Army Recruiting Command, the Defense Information School, the Defense Courier Service, the U.S. Army Field Band and most recently the U.S. Cyber Command (Table 2-3). FMMD enables critical national security missions by providing their tenants and community the facilities and infrastructure, the quality of life they deserve, and a safe, secure environment in which to work and live. FMMD also provides base operations support for facilities and infrastructure, quality of life, and protective services in support of DoD activities and federal agencies (FMMD 2020).

Table 2-3: Major installation users and missions.

Installation Users	Primary Mission	Garrison Resources Utilized
Defense Information Systems Agency (DISA)	Planning, engineering, acquiring, fielding, and supporting global net-centric solutions to serve the needs to the President, Vice President, Secretary of Defense, and other DoD components under conditions of peace and war	One million square foot DISA facility constructed
Adjudication Activities Co-location Offices		250,000 square foot office
Defense Media Activity (DMA)		186,000 square foot facility
Community	Religious, family support, personnel services, professional services, medical, community, housing, commercial and recreational services	Mix of facilities including community buildings and commercial hub, , conference center
Industrial	Production, maintenance, depot and storage	Motor pools and industrial facilities

Professional/Institutional	Non-tactical organizations like military schools, headquarters, major commands, non-industrial RDT&E	Facilities including high profile administrative facilities
Ranges and Training	Training lands	126 acres of land on southern-most tip of installation for detonation, bivouac operations, and physical training for loaded backpacks
Residential	Family housing and senior unaccompanied personnel housing, family and neighborhood services	Neighborhoods
Troop	Designated for operational facilities for Table of Organization and Equipment, Basic Combat Training and One Station Unit Training complexes, and Initial Entry Training Complexes	Barracks, administrative facilities, recreation facilities, AAFES, and dining facilities
Installation Commander	Overall management of facilities and carrying out FMMD's mission	Funding, staff and resources to manage installation's natural resources
Directorate of Public Works	Manages real property, natural resources, environmental protection, and pollution abatement programs, coordinates master planning, engineering, construction, operation, and maintenance of buildings, structures, grounds, and utilities.	
Public Affairs Office	Formulates, implements, and disseminates command information to the public	
Staff Judge Advocate	Provides legal advice to the Command in all areas of law	

	including compliance with applicable environmental and natural resource management laws.	
Directorate of Information Management	Responsible for information technology and information management to the garrison and tenant organizations on FMMD	
Directorate of Morale, Welfare, and Recreation	Manages installation morale, welfare, and recreation activities for FMMD community.	Manages installation resources at Burba Lake, RV travel camp, athletic courts and fields, playgrounds, and walking trails
Directorate of Plans, Training, Mobilization and Security	Manages installation contingency planning, mobilization activities, force modernization, parades and ceremonies, military support requests, DoD service school requirements, on-post Reserve Component activities, aviation, and supervision and control of FMMD museum	
Directorate of Contracting	Provide contract support to Army installations, information technology users, and to those deployed	Three regional service-contracting centers and one Electronic Commerce/Commercial Contracting Center

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3.0 INTEGRATION OVERVIEW

The successful implementation of the FMMD INRMP requires the integration through active support of internal stakeholders including but not limited to, natural resource management personnel, other garrison staff, command personnel, and installation tenants. Effective communication among installation personnel is vital to proactively ensure that management activities are implemented as planned under the FMMD INRMP in order to sustain mission critical natural resources FMMD's natural resources collectively provide ecosystem services that contribute to FMMD's efforts to sustainably manage water resources, conserve soil, conserve native biodiversity, maintain and enhance air and water quality, moderate climate, and maintain an aesthetic value for military and civilian personnel. Natural resources also contribute to the installation's Morale, Welfare and Recreation (MWR) program, which seeks to enhance the quality of life for military, military retirees, their family members, and authorized civilian personnel.

The FMMD INRMP is based upon an ecosystem approach to natural resources management that seeks to improve the installation resiliency in a changing environment. This approach will also contribute to regional natural resource sustainability and resiliency thus necessitating the involvement of various external non-DoD partners and stakeholders. In addition to required external stakeholders, such as the USFWS and Maryland Department of Natural Resources MDNR, other local and regional stakeholders can provide critical input and assist in the implementation of the FMMD INRMP.

External constraints caused by regional growth and development have increased encroachment on FMMD requiring more efficient land use with the boundaries to meet mission requirements. This regional growth in employment, population, and development are expected to continue in the surrounding area in the coming decades. Consequently, the impacts of planning and future development in Odenton, Anne Arundel County, and FMMD are inextricably linked. These changes in land use coupled with increases in human population density have reduced the resiliency of natural processes and ecosystems throughout much of the Chesapeake Bay watershed.

The recognition of these internal and external factors requires that natural resources management on FMMD be integrated with other disciplines, programs, and planning beyond the scope of traditional fish and wildlife management on Army installations. On a day-to-day basis, INRMP goals, objectives and projects are integrated with master planning and other installation plans primarily through DPW Environmental Division representation and participation on the Environmental Quality Control Committee (EQCC) and Real Property Planning Board (RPPB).

3.1 INSTALLATION PLANS

3.1.1 REAL PROPERTY MANAGEMENT PLAN

FMMD has undergone rapid changes in land use and development over the last 30 years. The Real Property Master Plan (RPMP) establishes the future direction for on-post development and describes many approved and proposed projects. A RPMP provides a means for sustainable installation development that supports mission and environmental requirements and establishes and planning philosophies and strategies applicable across the Army (FMMD 2016).

"The FMMD RPMP provides the Garrison Commander's strategy for meeting the challenges of operating under changing conditions. These conditions include anti-terrorism and force protection (AT/FP); Defense Critical Infrastructure Program (DCIP); reduced manpower and resources; natural and cultural resources management and constraints; executing base realignments and closures (BRAC); and shifting appropriate base operations (BASOPS) functions from the government to the private sector…" (FMMD 2016).

The FMMD RPMP identifies objectives, and policies to ensure that natural resources are protected and compatibly managed with the installation's evolving mission. A key objective of the RPMP states that all environmentally sensitive areas, including waters of the U.S., wetlands and habitat will be protected from development as required by Federal and State laws; and that selected forested areas will be preserved as "No-Build" zones, as determined by FMMD.

The Installation Design Guide provides design standards for site planning, buildings, vehicular and pedestrian circulation, site elements (i.e., signage, utilities), force protection, landscaping, and Sustainable Design. The standards were developed to improve the quality of the total installation environment, including reducing the impacts of projects on the natural environment. Standards, particularly related to the INRMP, include those related to landscaping, sustainable design, and ensuring that site designs do not have adverse impacts to FMMD land, water, or air quality. Some or all of the IDG standards and guidance are relevant to the USAG, tenant organizations, planning and design personnel, facility maintenance personnel, and associated consultants.

In addition to the RPMP, the following installation plans were reviewed to incorporate key interrelationships, and recommendation contained within these plans were utilized to develop this INRMP. Note that the following summaries are not intended to provide detailed information on each plan and its contents, but to identify those that contribute to the development, integration and implementation of the FMMD INRMP.

3.1.2 INTEGRATED PEST MANAGEMENT PLAN

The Integrated Pest Management Plan (IPMP) was completed in 2018 and provides guidance for implementing the FMMD pest management programs. The IPMP encourages non-chemical controls for managing pests on FMMD and includes management recommendations for a wide variety of pests found in an urban system. This INRMP will be reviewed by the FMMD Installation Pest Management Coordinator to ensure that goals, objectives and management initiatives contained within this plan do not contradict those contained within the IPMP (FMMD 2018). In addition, FMMD natural resources staff will continue to provide input during updates of the IPMP to ensure it is consistent with the goals and objectives of this INRMP.

3.1.3 NUTRIENT MANAGEMENT PLAN

The Nutrient Management Plan (NMP) FMMD addresses reduction of nutrient loadings into the Chesapeake Bay per State of Maryland regulations. Maryland regulations state that the plan shall be updated at a minimum of every 3 years from the preparation date.

3.1.4 POLLUTION PREVENTION PLAN

The Stormwater Pollution Prevention Plan is currently being updated (FMMD 2018) and addresses stormwater management on FMMD. This INRMP will be reviewed by the FMMD DPW Environmental Management Division to ensure that goals, objectives and management initiatives contained within this plan do not contradict those contained within the Stormwater Pollution Prevention Plan.

3.1.5 INTEGRATED CULTURAL RESOURCES MANAGEMENT PLAN

The Integrated Cultural Resources Management Plan (ICRMP) will be finalized in FY23 and provide the guidelines and procedures to manage cultural resources on FMMD. This INRMP will be reviewed by the FMMD cultural resource manager to ensure that goals, objectives and management initiatives contained within this plan do not contradict those contained within the ICRMP. In addition, the FMMD natural resources staff will coordinate with the cultural resources manager to ensure INRP-related activities will not impact cultural resources.

3.1.6 ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTATION PLAN

The Environmental Management System Implementation Plan was completed in September 2007 and provides a systematic tool for environmental management personnel on FMMD. This INRMP will be reviewed by the FMMD Emergency Services (EMS) Coordinator to ensure that goals, objectives and management initiatives contained within this plan do not contradict those contained within the EMS Implementation Plan. Likewise, the FMMD natural resources staff will coordinate with the installation EMS Coordinator to ensure that the goals and objectives of this INRMP are integrated with the FMMD EMS.

3.2 INTERNAL INRMP STAKEHOLDERS

The responsibility for the development, review, revision, and implementation of INRMPs is shared by several command elements and other internal FMMD stakeholders.

3.2.1 INSTALLATION COMMANDER

The Installation Commander (IC) is responsible for the overall management of the facilities and for successfully implementing FMMD's overall mission. The IC is also responsible for the implementation and enforcement of the FMMD INRMP, managing installation operations, including the facilities and security directorates, and contingency operations. To fulfill the environmental stewardship component of FMMD's mission, the IC is responsible for ensuring that FMMD has the funding, staff, and other resources necessary to effectively manage the installation's natural resources.

3.2.2 DIRECTORATE OF PUBLIC WORKS

The Directorate of Public Works (DPW) manages real property, natural resources, environmental protection, and pollution abatement programs; coordinates master planning, engineering, construction, operation, and maintenance of buildings, structures, grounds, and utilities (including unaccompanied personnel housing), and provides asset management to privatized housing. Its divisions include Business Operations and Integration, Engineering, Housing, Master Planning, and Environmental. In addition, Residential Communities Initiative (RCI) family housing operations fall under the DPW.

The DPW Environmental Division is responsible for advising the installation on environmental compliance, planning, and decision-making consistent with the Department of the Army (DA) regulations and policies. The DPW Environmental Division includes professionals, technicians, and the Environmental Chief. Personnel within the division have responsibilities for natural resources management, cultural resources stewardship, pest management, hazardous waste and hazardous materials management, solid waste, stormwater, air, noise, pollution prevention, contingency planning, environmental management systems, National Environmental Policy Act (NEPA), and environmental permitting. The DPW also maintains the installation Geographic Information Systems (GIS), and consequently, is an important internal stakeholder in natural resources information and management.

3.2.3 PUBLIC AFFAIRS OFFICE

The Public Affairs Office (PAO) is responsible for formulating, implementing, and disseminating all command information to the public, including information about natural resources management. The PAO, through the DPW Environmental Division, is responsible for providing timely and accurate information about this INRMP and related activities to the public, as the mission will allow.

3.2.4 STAFF JUDGE ADVOCATE

The Staff Judge Advocate (SJA) provides legal advice to the IC in all areas of law, including compliance with applicable environmental and natural resource management laws and regulations. The SJA provides advice about the statutory and policy framework in which this INRMP is implemented. It is the SJA's responsibility to ensure that all violations of federal, Maryland, and local fish and wildlife regulations are investigated and prosecuted as appropriate. The SJA is also involved in enforcement actions, legal interpretation, development of Memoranda of Understanding (MOUs) and cooperative agreements (CAs), and review and approval authority on actions.

3.2.5 DIRECTORATE OF INFORMATION MANAGEMENT

NEC Global is responsible for information technology (IT) and information management (IM) support to the garrison and tenant organizations located on FMMD. NEC Global will be responsible for managing the web-based version of the FMMD INRMP and other natural resource information maintained on the FMMD webpage and intranet. Day-to-day maintenance of the web-based version of the FMMD INRMP, as well as other natural resource information on the FMMD webpage and intranet will be performed by a contractor or DPW.

3.2.6 DIRECTORATE OF MORALE, WELFARE AND RECREATION

The Directorate of Morale, Welfare & Recreation (DMWR) manages installation morale, welfare, and recreation (MWR) activities for the FMMD community. The DMWR has a primary role in managing the Installation's recreational resources at Burba Lake, the RV travel camp, athletic courts and fields, playgrounds, and walking trails. In addition, the DMWR is responsible for hosting outdoor recreational activities on the Istallation. The FMMD natural resource manager coordinates with DMWR to organize volunteers to perform various natural resource projects on the installation including invasive species management, stream cleanup, and stenciling storm drains.

3.2.7 DIRECTORATE OF PLANS, TRAINING, MOBILIZATION AND SECURITY

The Directorate of Plans, Training, Mobilization and Security (DPTMS) manages installation contingency planning, mobilization activities, force modernization, parades and ceremonies, military

support requests, DoD service school requirements, on-post Reserve Component activities, aviation, and supervision and control of the Fort George G. Meade Museum.

3.2.8 DIRECTORATE OF CONTRACTING

The Directorate of Contracting (DOC) performs contracting functions in accordance with the Federal Acquisition Regulation, Defense Federal Acquisition Regulation, Army Federal Acquisition Regulation, and Installation Management Command (IMCOM) regulations. The Army Contracting Agency (ACA) reports to the Assistant Secretary of the Army concerning activities relating to acquisition, logistics and technology. The mission of the ACA is to provide contract support to Army installations, information technology users, and to those deployed. To accomplish this mission, the ACA established three regional service-contracting centers (ACA Northern Region, ACA Southern Region and ACA Pacific Region) and one Electronic Commerce/Commercial Contracting Center (E-commerce Center) for non-tactical/strategic information technology (IT) and commercial items (ITEC4).

3.2.9 OTHER INSTALLATION AND TENANT ORGANIZATIONS AND PARTNERS

In addition to the USAG directorates and offices mentioned above, INRMP implementation requires assistance from or coordination with a variety of other installation organizations, tenants, and contract personnel. Among the many tenants, the NSA, USEPA, and the DINFOS are a few of the major mission partners. Other installation partners consulted for natural resources activities on FMMD include Corvias Group LLC (responsible for developing family housing under RCI), Enhanced Use Lease (EUL) proponents and partners, the Baltimore Gas and Electric Company and Anne Arundel County Schools.

The two formal mechanisms by which the INRMP and natural resources program are integrated with facility-wide activities are through DPW Environmental Division representation and participation on the Environmental Quality Control Committee (EQCC) and the Real Property Planning Board (RPPB).

The EQCC is a communications forum for environmental planning and management of FMMD lands. The IC chairs the EQCC and the DPW Environmental Division chief, or an elected representative, facilitates the quarterly committee meetings. The EQCC responsibilities with respect to the INRMP include:

- Identifying and evaluating management issues and concerns
- Providing policy, guidance, and oversight for development of goals and objectives
- Identifying staffing and funding resources for implementing the INRMP
- Overseeing development, implementation, and revision of the INRMP
- Fostering environmental awareness and sound stewardship
- And providing input on siting facilities and installation planning

The installation also maintains a RPPB in accordance with AR 210-20 Real Property Master Planning for Army Installations (U.S. Army 2005). Board members include representatives from the command, operations (including the DPW Environmental, and Engineering, and Planning Divisions), as well as mission partners. The RPPB guides the development and implementation of the CEMP, the RPMP and its component plans, and advises the IC on changes to the RPMP.

3.3 EXTERNAL INRMP STAKEHOLDERS

External stakeholders are non-DoD entities that have a vested interest in FMMD natural resource management. These external stakeholders have been offered the opportunity to participate in the natural resources planning process through providing technical and/or regulatory input during the development of this INRMP and in its annual reviews. It is Army policy to encourage local and regional partnerships to implement an INRMP.

Under the Sikes Act, new INRMPs and significant changes to existing INRMPs are required to be developed in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the appropriate state fish and wildlife agencies and be made available to the public for review. The USFWS is the principal federal agency for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats and has responsibility for the enforcement of federal wildlife protection laws such as the Endangered Species Act (ESA) and Migratory Bird Treaty Act (MBTA).

Table 3-1 : External Stakeholders that contribute to the development, implementation or integration of the FMMD INMRP

External Stakeholder	Type	Document/Agreement	Brief Description
State DNR	**Required Partnership**	State Wildlife Action Plan (SWAP)	INRMP developed and updated in coordinated with State to address SWAP goals where mutually agreed.
USFWS local field office	**Required Partnership**	Any species Recovery Plans	INRMP developed and updated in coordinated with USFWS local office to address Recovery goals where mutually agreed.
Partners in Flight			
Baltimore-Washington Partners for Forest Stewardship			
Patuxent River Commission			
Chesapeake Bay Foundation			

3.3.1 U.S. FISH AND WILDLIFE SERVICE

The USFWS is a signatory agency of installation INRMPs in accordance with the Sikes Act Improvement Act (SAIA). In addition, the DoD and DA consult formally and informally with the USFWS on endangered species and wetland issues, pursuant to applicable legislation including the Endangered Species Act (ESA) and the Clean Water Act (CWA). The USFWS office with responsibility for FMMD is the Chesapeake Bay Field Office in Annapolis, Maryland. Additionally, the National Patuxent Research Refuge is a neighbor of FMMD, a partner with FMMD on numerous natural resources issues.

Per Sikes Act requirements, the USFWS agrees to cooperate in the development and review of the FMMD INRMP at minimum once every five years. No element of the Sikes Act is intended to either enlarge or diminish the existing responsibility and authority of the USFWS or state fish and wildlife agencies concerning natural resources management on military lands.

3.3.2 STATE OF MARYLAND AGENCIES

The Maryland Department of Natural Resources (MDDNR) is the lead fish and wildlife agency in Maryland and a signatory agency for this INRMP with similar responsibilities of review and development as the USFWS. The MDDNR oversees the management and use of the state's forests and parks, fisheries, and wildlife. It has statewide responsibilities for assessing and restoring water quality and habitat; managing and regulating recreational boating, fishing and hunting; and managing wetlands, wildlife, and rare, threatened, and endangered species.

The Maryland Department of the Environment (MDE) is the state agency largely responsible for administering Maryland's environmental laws, regulations, and environmental permits related to wetlands, water withdrawal, discharges, stormwater, and water and sewage treatment. The mission of the MDE is to protect the state's air, land, and water from pollution and to provide for the health and safety of its citizens through a cleaner environment.

FMMD is one of 20 DoD facilities in Maryland and one of five with its own wastewater treatment plant. On 19 July 2006, the DoD signed a memorandum of understanding (MOU) with the State of Maryland that committed DoD facilities in Maryland to help restore water quality and watershed health in the Maryland portion of the Chesapeake Bay and its tributaries by upgrading wastewater treatment plants and implementing nonpoint source pollution control measures, such as shoreline restoration, establishing riparian buffers, and creating or enhancing wetlands.

3.3.3 USEPA CHESAPEAKE BAY PROGRAM

The DA and DoD have signed several MOUs and cooperative agreements with the USEPA Chesapeake Bay Program (CBP). The various agreements commit FMMD and the other Bay federal facilities to coordinate and work cooperatively with the CBP and its members and partners on Chesapeake Bay restoration activities.

The USEPA administrator represents all federal agencies as a member of CBP's Executive Council and is the signatory for all federal agencies to special directives and certain agreements. The DoD and each of the services are signatory agencies to the 1994 and 1998 federal agencies agreements. The CBP can provide technical assistance and other resources needed to implement projects that contribute to the restoration and protection of natural resources that affect the health of the Chesapeake Bay watershed.

3.3.4 BALTIMORE-WASHINGTON PARTNERS FOR FOREST STEWARDSHIP

The Baltimore Washington Partners for Forest Stewardship (BWPFS) is a coalition of federal and local landowners, who have joined with the Maryland Department of Natural Resources and the Center for Chesapeake Communities to promote collaborative strategies for the restoration, conservation and stewardship of shared forested ecosystems and managed lands in the Baltimore Washington corridor. The MDDNR provides resource management and analysis support along with the Center for Chesapeake Communities. The USDA Forest Service provides technical assistance and coordination within the Chesapeake Bay Program.

The Partnership provides a landscape-level perspective to coordinate management and restoration activities on 26,000 contiguous acres and among four Federal landowners in the highly urbanized Baltimore-Washington corridor. Through these efforts, the Partnership seeks to improve the ecological services of their natural landscapes and reduce the environmental impacts of their land and facility management activities to a greater degree by working together, rather than on an individual basis.

3.3.5 PATUXENT RIVER COMMISSION

The Patuxent River Commission (PRC) serves as a steward for the Patuxent River and commits to lead and inspire actions to protect, enhance and restore river species as well as the natural, cultural, economic, and recreational values in the watershed. The PRC is a 34-member, inter-jurisdictional group created by State legislation in 1980 to address Patuxent watershed issues. Membership is comprised of a cross-section of businesses, developers, state and local governments, federal facilities, and the local community. The PRC is charged with the implementation of the Patuxent Policy Plan and the Patuxent River Tributary Strategy. The focus of the Patuxent Policy Plan is to address programmatic and land management issues while the Patuxent Tributary Strategy seeks to reduce nutrient and sediment pollution. FMMD's natural resources manager is an official member of the PRC.

3.3.6 PARTNERS IN FLIGHT

Partners in Flight (PIF) focuses on land bird conservation throughout the Americas and brings scientific land bird expertise to the North American Bird Conservation Initiative, which addresses shared bird conservation challenges and priorities for land birds, shorebirds, water birds, and waterfowl. DoD PIF facilitates the development of cooperative agreements for implementing bird conservation programs and projects on military lands, facilitates communication and information sharing across geographic and political boundaries, participates and provides leadership in PIF committees and working groups, and provides military natural resources professionals with the most up-to-date information on bird conservation.

3.4 OTHER DOD AND DA ORGANIZATIONS AND PROGRAMS

3.4.1 ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT

The U.S. Army Office of the Assistant Chief of Staff for Installation Management (ACSIM) provides policy, guidance, and program management on all matters relating to overall management and resourcing of Army installations worldwide. The ACSIM ensures the availability of efficient, effective base services and facilities. The ACSIM functions include organizational alignments, manpower, doctrine, equipment, and functional responsibilities in support of the Transformation of Installation Management. The ACSIM manages installations and installation support services through Installation Management Command.

3.4.2 U.S. ARMY INSTALLATION MANAGEMENT COMMAND

The U.S. Army Installation Management Command (IMCOM) is directly accountable to the Chief of Staff of the Army for effective garrison support of mission activities and serves as the Army's single authority and primary provider of base support services (U.S. Army, 2006). The IMCOM implements DA policies and standards for installations worldwide to support mission readiness and execution, promote the well-being of soldiers, civilians and family members, improve infrastructure, and preserve the environment.

3.4.3 U.S. ARMY ENVIRONMENTAL COMMAND

The U.S. Army Environmental Command (USAEC) implements the Army environmental program by providing innovative and cost-effective products and services in support of Army training, operations, and sound environmental stewardship. The USAEC also has centralized support contracts with other federal agencies (i.e., USFWS, Natural Resource Conservation Service, and U.S. Forest Service) that installations can use to assist in resources management.

3.4.4 U.S. ARMY CORPS OF ENGINEERS

The USACE provides contract management, construction management, and technical support. USACE Baltimore District also provides environmental and cultural resources support, and has

supported the development of the FMMD ICRMP, EMS Implementation plans, wetland delineations, species surveys and multiple NEPA documentation reports.

3.5 OTHER FEDERAL AGENCIES AND PROGRAMS

3.5.1 NATIONAL SECURITY AGENCY

The NSA is the largest tenant organization on FMMD in terms of personnel and land/support needs. The National Security Agency/Central Security Service (NSA/CSS) leads the U.S. Government in cryptology that encompasses both signals intelligence (SIGINT) and information assurance (now referred to as cybersecurity) products and services and enables computer network operations (CNO) in order to gain a decision advantage for the Nation and our allies under all circumstances. The NSA developed an INRMP in 2003 to guide implementation on the natural resources program for NSA on FMMD. The NSA developed their INRMP to be consistent with DoD and DA objectives of land sustainability for mission use, protection of natural resources, and multiple use accommodations for resources. This plan was also consistent with FMMD goals including:

- Preserving FMMD as a premier Army administrative facility
- Using a long-term ecosystem management approach
- Promoting land management flexibility by using adaptive management strategies
- Developing management strategies to mitigate military-related impacts
- Integrating resources management goals within and among watersheds

The goals and objectives listed above have been integrated into the FMMD INRMP and therefore, the NSA INRMP does not require updating.

3.5.2 U.S. ENVIRONMENTAL PROTECTION AGENCY

The United States Environmental Protection Agency (USEPA) leads the nation's environmental science, research, education and assessment efforts. Its activities include developing and enforcing environmental regulations, providing financial assistance to state environmental programs, non-profits and educational institutions, performing environmental research at laboratories located nationwide, sponsoring voluntary partnerships and programs, and providing environmental education. As a tenant organization on FMMD, the USEPA is a vital partner in ensuring that the natural resources goals and objectives outlined in this INRMP are met.

3.5.3 U.S. GEOLOGICAL SURVEY

The United States Geological Survey (USGS) is a multi-disciplinary organization that provides scientific information on biology, geography, geology, geospatial information, and water, to minimize damage from natural disasters; and manage the nation's water, biological, energy, and mineral resources. The USGS could assist FMMD by helping design biological, water quality, and hydrologic surveys, and facilitating the integration of FMMD data into national or regional databases.

3.5.4 U.S. DEPARTMENT OF AGRICULTURE

The United States Department of Agriculture (USDA) Agricultural Research Service Foreign Plant Disease and Weed Science Research Unit is a mission partner on FMMD. Additionally, the USDA Beltsville Agricultural Research Center is located a few miles to the south of FMMD and is a partner with FMMD on the Baltimore-Washington Forest Partnership.

3.5.5 REGIONAL AND LOCAL AGENCIES

Local governments and agencies can also have an important role in implementing this INRMP, particularly with respect to helping FMMD accomplish ecosystem and watershed management objectives, such as through activities of the PRC and the BWPFS partnership. Some of these local entities include the town of Odenton and the Anne Arundel County Planning and Zoning Office and Environmental and Cultural Resources Office.

3.6 COLLEGES AND UNIVERSITIES

Universities may be contracted to provide technical support in natural resources management and technical expertise on specific resource issues. Twenty-one university/research institutions and nine Federal agencies comprise the Chesapeake Watershed Cooperative Ecosystems Studies Unit (CWCESU). The host institution for the CWCESU is the University System of Maryland represented by the University of Maryland Center for Environmental Science. The mission of the CWCESU is to foster stewardship of the watershed through collaborative research, technical assistance, and education that support integrated ecosystem management. The CWCESU was established in August 2001 through a cooperative agreement. Therefore, FMMD has access to any of the partners in the CESU and can acquire their technical assistance through a task agreement.

3.7 LITERATURE CITED AND REFERENCES REVIEWED

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4.0 PROGRAM ELEMENTS

The Army acknowledges that simply complying with environmental regulations does not necessarily sustain the Army mission (U.S. Department of the Army 2004). The **Army Strategy for the Environment** moves the Army's environmental program beyond compliance to a long-range vision of sustainability that recognizes the interdependency of mission, community, and environment. The strategy calls for collaboration with stakeholders in an ecosystem-based approach to manage natural resources to ensure that the environment is sustained, and waterways and ecological resources are preserved as natural and economic assets (U.S. Department of the Army 2004).

The DoD adopted ecosystem management as the basis for future management of DoD lands and waters in 1994 (U.S. Department of Defense 1994). DoD instructions and guidance promote the principles of ecosystem management, adaptive management, and collaboration with parties both inside and outside the fence (U.S. Department of Defense 1994, U.S. Department of Defense 1996). The FMMD INRMP will strive to integrate each of these strategies to move towards a resilient, landscape-based approach to managing its ex-urban ecosystem. The INRMP must assess and identify management actions that promote the resiliency of the FMMD ecosystem to support the conservation and sustainability goals of the Army and the military mission.

In the following sections, program elements are arranged by broad topic areas. However, each element is not independent and management actions identified within each will either directly or indirectly affect other elements. For each element, the objectives from table 1-1, pertinent to that element, are presented and management actions included that are intended to address these objectives.

4.1 VEGETATION AND FOREST RESOURCE MANAGEMENT

The manipulation and management of vegetation is often the most significant activity in which natural resource managers directly or indirectly affect multiple levels of an ecosystem. At FMMD vegetation management activities are integrated among Forest Management, Non-forest Plant Community and Habitat Management, Invasive Plant Species Management, and Grounds Maintenance and Management to accomplish multiple objectives. Vegetation and Forest Resource management on FMMD is addressed through the following INRMP goals and objectives:

INRMP Vegetation and Forest Resources Management Goal. Vegetation and forest resources are to be managed in a sustainable manner to enhance healthy forest and other terrestrial habitats on FMMD that provide ecosystem services that contribute to the resilience of FMMD's ex-urban ecosystem.

To fulfill the overall goal for this element, five specific objectives for were identified. These are:

Objective 1.1: *Comply to the extent possible with the Maryland Forest Conservation Act.*

Objective 1.2: *Maintain the total area of riparian forest buffers at a minimum width of 75' along all FMMD perennial stream riparian zones.*

Objective 1.3: *Maintain individual trees and groups of historic trees (15-inch dbh or greater), "specimen trees", in landscaped and urban areas. Ensure there is no net loss of urban trees. (Specimen tree determinations vary by health and dbh varies by species.)*

Objective 1.4: *Maintain and expand, where practicable, street trees and the buffer they provide to the urban environment.*

Objective 1.5: *Ensure that new landscape areas incorporate pollinator friendly and/or native trees, shrubs, and herbaceous plants where appropriate.*

Objective 1.6: *Identify specific areas with invasive plant species for eradication and subsequent restoration of natives.*

4.1.1 FOREST MANAGEMENT

The forested regions of FMMD are recognized as mission-critical because they provide important ecosystem services including but not limited to, wildlife habitat, soil and water protection, nutrient cycling, climate amelioration, and carbon sequestration. In addition, FMMD forests provide recreational opportunities and cultural benefits to personnel and their families.

Due to significant and increasing forest loss, the state of Maryland developed the Forest Conservation Act (FCA). Adopted in 1991, the FCA (1991) explicitly recognized that forests play an important role by providing a variety of ecosystem services including protecting air and water quality, habitat, climate moderation, aesthetics, and recreation among others. The FCA establishes **minimum** forest conservation requirements for land development in the state of Maryland. The FCA was amended in 2013 to facilitate no net loss of forest and it is administered by the Maryland

Department of Natural Resource (DNR) Forest Service but is primarily operated at a local level. In addition to the FCA, Maryland has implemented incentives and programs for preserving forest acreage. Under the FCA, local governments with zoning and planning authority must develop and adopt forest conservation programs that meet or exceed the minimum forest conservation requirements and standards established.

4.1.1.1 FOREST CONSERVATION ACT AND FMMD

As a federal installation, FMMD is not required to by law comply with the FCA. However, FMMD's policy for managing forests is to comply with the spirit of the FCA to the extent possible through coordination with the Maryland DNR. The basis of this compliance is a Department of the Army (DA) Memo (FMMD Forest Conservation Act and Tree Management Policy 2009) and a memorandum of understanding (MOU) between the State of Maryland and US DOD (MOU 2013). The 2013 memorandum specifically states that…. "An installation's INRMP may be sufficient for this purpose." For land-disturbing activities of 40,000 square feet or greater occurring on an installation, the Department of Defense will submit to Maryland either a negative determination with a finding of no effect to coastal uses or resources, or a consistency determination.

The FMMD policy states that to comply with FCA standards and in lieu of performing a Forest Stand Delineation and Conservation Plan for individual development projects, FMMD requires that the equivalent of 20% of the project area be forested, regardless of whether or not forest was present on site before development. To the extent possible, this shall occur within the project area by enhancing forest corridors and preserving existing tree cover. Preservation of dominant trees and woodland areas may be credited towards the total FCA requirement. Forestation that cannot feasibly be performed within the project area shall be performed on other land areas within FMMD. The planting plan and specifications shall be a component of the projects planning documents. All forestation planting shall be with native tree species that reflect the local forest composition.

The DPW Environmental Division developed a *Tree Management Policy* that formalizes tree management and replacement on post for activities that could cause the death, destruction or lead to removal of existing trees. The policy states that any project that adversely affects desirable trees would be responsible for replacing trees at their own cost. If a project cannot meet the 20% threshold, a mitigation plan will be proposed by the project proponent. The mitigation plan will, in general, follow the requirements in the FCA. Mitigation plans will contain at minimum the following information:

- List of species removed. This information will be used to identify tree species to use in the mitigation that are similar to ones removed, presuming the removed trees are native species. In all instances using the exact species removed in a ratio reflecting the removed trees is preferable.

- Preservation of existing dominant and specimen trees shall receive the highest consideration in planning the development of proposed projects.

- Mitigation tree planting should occur within the project area; where this is not practical, other planting locations will be provided by the Environmental Division. Silvicultural improvements to existing stands such as invasive removal and disease control can be used as mitigation and will be assessed on a case by case basis by the FMMD Environmental Division.

- For small scale projects (< 40,000 square feet) trees to be planted shall be at least 1.0-inch dbh, or as otherwise directed in writing by the Environmental Division. All planted trees shall be protected from potential injury with tree guards and mulching.

- Existing trees shall be protected during construction activity to the greatest extent possible. Grading, cutting, filling and compaction of soil beneath the trees drip line shall be avoided.

All aspects of forest management at FMMD either directly or indirectly support compliance with the FCA.

INRMP Implementation and Management Actions:

1. Assess total tree cover throughout FMMD every three years.

2. Update forest cover type map every 5 years.

3. Identify and update stands of invasive species data for management and removal.

4.1.1.2 GENERAL SILVICULTURE MANAGEMENT

FMMD does not engage in an active silvicultural program for the purpose of producing forest products for market. Nevertheless, FMMD does implement silvicultural methods and processes to

promote and maintain healthy and sustainable forest cover. These activities range from removal of hazardous and/or diseased trees, to stand level management to provide a diversity of habitat and forest types. FMMD does issue no cost firewood collection permits of dead and down trees in appropriate locations and situations where the trees are not providing necessary habitat for wildlife.

INRMP Implementation and Management Actions:

None

4.1.1.3 URBAN FOREST AND TREE MANAGEMENT

Urban forests are defined as systems comprising all woodlands, groups of trees, and individual trees located in urban and exurban areas, including street trees, trees in parks and gardens, and trees in vacant lots. At FMMD there is not a strict line demarcating urban forests and wildland forests. In fact, all forests and trees on FMMD could be considered as part of the urban forest. However, for the purposes of the INRMP urban forests are those individual trees and forest stands < than 5 acres that occur within and adjacent to the various campuses, neighborhoods and parks throughout FMMD.

Trees in urban forests must often deal with less-than-ideal growing environments due to their proximity to pavement, buildings, vehicles, and people. Trees in the urban forest must tolerate a variety on conditions ranging from poor soils and climate extremes to heavy pruning. In the urban forests of FMMD, there are a variety of habitats ranging from the relatively good growing condition in the parks (e.g. Burba lake park), to stressful locations such as street sides and parking lots. Identifying native trees that will perform well in each of these urban habitats will improve the success of plantings.

Some issues facing FMMD urban forests is the invasive Emerald ash borer (EAB), Ambrosia Beetles, Spotted Lantern Fly, and Asian Longhorn Beetle. EAB is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles feed on ash (*Fraxinus* spp.) foliage but cause little damage to the overall tree health. However, the larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients and eventually killing the tree. Infestation at FMMD has led to near 100% die-off of ash trees in the urban and natural forest environments.

INRMP Implementation and Management Actions:

1. Map and inventory trees > 1-inch dbh in FMMD urban forest habitats.

2. Identify native trees suitable to the different growing environments in the urban forest at FMMD.

3. Ensure street trees are maintained or expanded as applicable

4.1.2 NON-FOREST VEGETATION MANAGEMENT

Landscaped areas on FMMD are primarily managed through implementation of the 2011 *Installation Design Guide* (IDG). The purpose of the IDG is to provide design guidance for standardizing and improving the quality of the total environment of the installation. This guidance includes not only the visual impact of features on the installation, but also the impact of projects on the total built and natural environment. The improvement of the quality of visual design and development and use of sustainable design and development practices have a direct and future impact on the quality of life for those who live, work, or visit the installation. The IDG includes standards and general guidelines for the design issues of site planning, architectural, vehicular and pedestrian circulation, and landscape elements (Atkins 2011). The IDG contains landscape design standards for the selection, placement, and maintenance of vegetation with an overall goal of improving the physical and psychological well-being of the people who live and work on the installation. To accomplish this goal, the IDG contains the following objectives (Atkins 2011):

- Contributing to the preservation and restoration of the natural resources.
- Incorporating sustainability, energy conservation, climate modification, erosion control, air purification, noise abatement and environmental restoration.
- Blend built elements with the natural environment.
- Provide scale and comfort to pedestrian environments.
- Reinforce the hierarchy of the circulation system.
- Screen unsightly views or elements and incompatible land uses.
- Minimize maintenance through the use of native plant materials.
- Enhance Anti-Terrorism/Force Protection (AT/FP) capabilities.
- Match the correct plant with the given environmental conditions.
- Install plants with consideration to their mature size.

In addition to the IDG objectives above, the incorporation of pollinator friendly and/or native trees, shrubs, and herbaceous plants where appropriate and suitable for the Chesapeake Bay region would increase overall sustainability and resilience of the FMMD ecosystem[2]. Known as "bayscaping" it is a style of low maintenance landscaping that serves to protect the streams, rivers, and waters of the Chesapeake Bay. While it is not necessary to have all plantings be native, increasing the use of native species in landscaping will facilitate the objectives of the IDG and INRMP, particularly the blending of built elements with the natural environment. While every landscaping project will have site specific requirements, developing recommendations for the inclusion of native species in landscaping will assist in meeting IDG and INRMP objectives.

INRMP Implementation and Management Actions:

1. Develop a guide to using native plants in landscaping at FMMD as a supplement to the IDG.

2. Implement pollinator gardens and "bayscaping" where possible

4.1.3 INVASIVE SPECIES MANAGEMENT-PLANTS

Executive Order 13112 (1999), defined invasive species as non-native species that "cause economic or environmental harm or harm to human health." Invasive species occur throughout the United States on military lands, negatively affecting training, ecosystem services, native biodiversity, and overall resilience and sustainability of military lands.

The overall goal of DoD's Invasive Species Management Program is prevention, control of invasive species on military installations, and restoration using native plants. FMMD is required to comply with all Federal, DoD and Army laws, regulations and guidance regarding invasive species control including Executive Order 13112 (1999) and Army Policy Guidance for Management and Control of Invasive Species (DoD Instruction 4150.7 2019).

The ACOE developed an Invasive Species Management Plan (U.S. Army Corps of Engineers 2012) for FMMD. The management plan included a survey for 45 likely invasive plant sites throughout FMMD and found that invasive plant cover at FMMD is generally highest along woodland margins, road edges, old field successional areas, riparian buffers and other disturbed areas. Species

[2] See Appendix F for links to online resources for sourcing native plants suitable to FMMD.

abundance varied with some scattered throughout the sites in high density patches. At other locations, invasives were limited to scattered occurrences along edge habitat. During the survey thirty-two invasive plant species were detected, with Asiatic bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*) and mile-a-minute (*Polygonum perfoliatum*) having the highest number of occurrences. General pathways for species to spread on FMMD included streams, wind, "residential escapees" and faunal defecation (U.S. Army Corps of Engineers 2012).

INRMP Implementation and Management Actions:

1. Identify sites within habitat protection areas (see section 4.2) where invasive species removal is feasible and would benefit Species of Greatest Conservation Need (SGCN) plant and/or faunal species.

2. Select 5 of these sites to implement ACOE recommended control methods.

3. Identify sites for timberstand improvement

4.1.4 SPECIES OF GREATEST CONSERVATION NEED (SGCN)-FLORA

During the most recent vegetation planning level survey EEE consulting (2014) confirmed 22 SGCN from FMMD (not counting RTE species section 4.3) out of Maryland's list of 786 SGCN (Appendix D). While these plant species have no legal protection, FMMD will conserve these plants and their habitat when possible given mission requirements.

INRMP Implementation and Management Actions:

1. Spatially identify the locations for each of the SGCN species from the 2014 vegetation planning level survey by EEE consulting (2014) as input to create an updated habitat protection area GIS.

4.2 FISH, WILDLIFE, AND HABITAT MANAGEMENT

Management of wildlife in an ex-urban setting present challenges and opportunities. This element is primarily concerned with the management of game and non-game wildlife and their habitat. Terrestrial Maryland SGCN management, including migratory birds, are included in this section.

Aquatic wildlife is addressed in the water resources management element and recreational fisheries in the outdoor recreation and environmental education element.

INRMP Wildlife and Habitat Management Goal. Wildlife populations and habitats are assessed, managed, and enhanced as necessary to support natural resource resilience and sustainability.

To fulfill the overall goal for this element, six specific objectives were identified. These are:

Objective 2.1: *Determine the status of non-game and game species populations that have the potential to affect natural resource sustainability.*

Objective 2.2: *Evaluate and manage white-tailed deer population on FMMD to reduce over-browsing and to enhance the health of terrestrial habitats.*

Objective 2.3: *Evaluate and manage Canada Geese population on FMMD to reduce nutrient load in Burba Lake and subsequent waters.*

Objective 2.4: *Conduct regular surveys of migratory and breeding bird populations on FMMD.*

Objective 2.5: *Conduct a pollinator survey that identifies locations and opportunities to create and/or enhance pollinator habitat.*

Objective 2.6*: Create an updated habitat protection area GIS coverage.*

4.2.1 WILDLIFE

Because of security and safety concerns, FMMD does not currently operate an active hunting program. Thus, management of all wildlife species on FMMD is primarily accomplished by managing habitats. FMMD natural resources personnel coordinate with MDDNR and other natural resource habitat management professionals to identify, prioritize, and implement habitat enhancement projects targeted for particular species or groups of species.

As a result of FMMD becoming more urbanized, and through projected increases in the development of administrative buildings, housing, and roads, staff from the DPW Environmental Division consider deer as a growing problem on FMMD. FMMD is in the process of evaluating management measures to reduce the herd.

INRMP Implementation and Management Actions:

1. Conduct a population survey for deer across FMMD to determine if control measures are required.

4.2.2 SPECIES OF GREATEST CONSERVATION NEED-FAUNA

An analysis performed in support of this INRMP, using the Maryland State Wildlife Action Plan (SWAP) (Maryland Department of Natural Resources 2016), identified 385 SGCN species confirmed from Anne Arundel County. Currently, 25 of those species have been detected on FMMD including three mammals, one fish, two reptiles, one amphibian, one butterfly, and 21 bird species. A full list of the SGCN that have been detected on FMMD is located in Appendix D. Further analysis revealed that there are 220 SGCN species confirmed from Ann Arundel County that are associated with habitat found on FMMD but have not been detected during previous surveys (Appendix E).

INRMP Implementation and Management Actions:

1. *Spatially identify the locations for each of the SGCN species from all planning level surveys as input to create an updated habitat protection area GIS*.

4.2.3 MIGRATORY BIRDS

The Migratory Bird Treaty Act (MBTA) of 1918 established protections for migratory birds in the United States due largely to many species' populations being decimated by feather hunters in the early 19th century (Migratory Bird Treaty Act 1918). The MBTA prohibits the take by capture, killing or possession of any migratory bird, as well as the sale, purchase, shipment and transportation of any migratory bird, their associated parts or nests, unless allowed by permitting. The MBTA was updated in 2004 with the Migratory Bird Treaty Reform Act (MBTRA) to only include species native or established in the United States and its territories prior to 1918 (Migratory Bird Treaty Reform Act 2004). In order to clarify the responsibilities and requirements of the DoD and its installations for upholding these regulations, the USFWS and the DoD produced a MOU (2014). Two sections of the MOU directly apply to FMMD management: **The Responsibilities of both Parties**, and **The DoD Responsibilities**. These responsibilities are to integrate migratory bird conservation into installation activities and planning and identify collaborative projects that inventory and monitor bird species status.

The MOU between the USFWS and the DoD also encompasses the Bald and Golden Eagle Protection Act (BGEPA). This Act is very similar to the MBTA in its restrictions and prohibitions. No person or entity can take, transport, sell, buy or disturb any eagle in the United States or its territories. This includes any part of the animals or their nests and eggs (Bald Eagle Protection Act 1940). There are some exceptions by permit, specifically when the presence of Golden Eagles is detrimental to conservation efforts of other species. In addition, the BGEPA also forbids the disturbance of nesting Bald Eagles.

The FMMD INRMP integrates migratory bird conservation by identifying and managing habitat important to migratory bird conservation, preventing and abating detrimental alteration of migratory bird habitats, and preventing the introduction and spread of invasive species that would negatively impact bird populations. The FMMD INRMP also identifies projects that will assess and monitor birds utilizing the installation to determine potential negative impact from development, construction, or land management activities that could impact habitat. In particular, FMMD will assess and monitor SGCN species that have been previously detected (Table 4-1).

Table 4-1. Migratory SGCN bird species actively monitored and managed at FMMD.

Common name	Scientific name	Residency Status[#]	Breeding Status*
Northern parula	*Setophaga americana*	**SR**	**LB**
Sharp-shinned hawk	*Accipiter striatus*	**WR**	**NB**
Spotted sandpiper	*Actitus macularius*	**SR/M**	**U**
Worm-eating warbler	*Helmitheros verminorum*	**SR**	**LB**
Chimney swift	*Chaetura pelagica*	**SR**	**PB**
Golden-crowned kinglet	*Regulus satrapa*	**WR**	**NB**
American kestrel	*Falco sparverius*	**PR**	**PB**
Wood thrush	*Hylocichla mustelina*	**SR**	**LB**
Ovenbird	*Seiurus aurocapillus*	**SR**	**LB**
Acadian flycatcher	*Empidonax virescens*	**SR**	**LB**
American redstart	*Setophaga ruticilla*	**SR**	**LB**

American woodcock	*Scolopax minor*	**PR**	**LB**
Bald eagle	*Haliaeetus leucocephalus*	**PR**	**PB**
Black-and-White Warbler	*Mniotilta varia*	**SR**	**LB**
Broad-winged hawk	*Buteo platypterus*	**SR**	**LB**
Brown creeper	*Certhia americana*	**WR**	**NB**
Eastern meadowlark	*Sturnella magna*	**PR**	**LB**
Great blue heron	*Ardea herodias*	**PR**	**LB**
Kentucky warbler	*Geothlypis formosa*	**SR/M**	**LB**

Permanent Resident= PR, Passage Migrant=M, Winter resident=WR, Summer Resident=SR. Permanent resident is a bird that utilizes the base year-round. Passage migrants are birds that only pass through in the Fall or Spring. Winter residents are northern birds that only use the base in the fall/winter. Summer residents are birds that are only present from late spring to late summer/early fall. * **Likely Breeder= LB, Possible Breeder=PB, Non-breeder= NB, Status Unknown: U.** Likely breeders are generalist birds whose presence is nearly a confirmation of breeding. Possible Breeders are birds that may breed on base but due to some constraint (usually proper nesting location) may just breed in the general area and utilize the base for foraging. Non-breeders do not breed on the base.

INRMP Implementation and Management Actions:

1. *Identify habitat used by SGCN avian species and incorporate into the overall habitat protection area GIS.*

2. Identify bald eagle nesting sites on FMMD (if any).

3. Conduct a planning level survey to identify bird species utilizing FMMD.

4.2.4 POLLINATORS

Globally, insect populations have declined dramatically over the last 30 years, with many populations experiencing > 75% reduction in biomass (Conrad et al. 2006). Insect pollinators, primarily species in the orders Hymenoptera (bees) and Lepidoptera (butterflies), have not been immune to this decline. Populations of butterflies, native bees, and honeybees have been steadily declining across the United States for the last 30 years, with estimates of a 23% decline in wild bee populations just since 2008 (Insu et. al 2016). While systematic research investigating the decline in butterfly populations is less common, Wepprich et al. (2019) found a 33% decrease in butterfly populations in Ohio since 1999. One species that has been studied extensively is the monarch butterfly (*Danaus*

plexippus), where intensive research over the last 25 years have documented precipitous declines in their populations across their range (Agrawal and Inamine 2018, Boyle et al. 2019).

Pollinators play a key role in sustaining native ecosystems, with > 75% of known flowering plants relying on insect pollinators to reproduce (Cameron et al. 2011, NRCS 2007). Economically, pollinators are critical to agricultural productivity. For example, honeybee hives are necessary contributors in the production of $29 billion worth of produce every year in the United States (Calderone 2012).

Because of the precipitous decline in pollinator populations, the federal government was directed to create a strategy to "…promote the health of honeybees and other pollinators" (White House 2015). To facilitate the implementation of this strategy, a broad spectrum of federal agencies were included in a 'Pollinator Health Taskforce,' including the Department of Defense (DoD). The DoD issued guidance and policies to implement the federal strategy including reduced pesticide and herbicide use in sensitive habitat, coordination with governmental and non-governmental agencies, and the implementation of pollinator friendly management and conservation practices on military installations (Department of Defense 2014). To implement the DoD strategy at the installation level, a comprehensive assessment of the diversity and abundance of pollinators coupled with a landscape level evaluation of the distribution and occurrence of habitat is required.

INRMP Implementation and Management Actions:

1. Conduct installation wide pollinator survey to identify abundance and diversity of pollinators and available habitat on FMMD.

2. Identify locations where pollinator habitat can be improved or developed.

3. Develop a list of plant species that benefit pollinators that are suitable for landscaping in the built environment.

4.2.5 HABITAT PROTECTION AREAS

Previous rare, threatened, and endangered species (Eco-Science Professionals 1994, 2001) and vegetation planning level surveys (EEE 2014) identified five **Habitat Protection Areas (HPA)** based on the presence of rare, threatened, or endangered species. The five HPAs were, Rock Avenue Shrub Swamp, Range Road Obstacle Course, Range Road Corridor, NSA Antenna Site, and Little Patuxent River. The presence of an HPA does not imply that activities (training, development etc.) are restricted, but that there are significant natural resources associated with that location and

their presence should be accounted for in land use planning for the site. These sites are, in some cases, over 30 years old and may not be relevant to current conditions based upon the SGCN analysis performed in support of this INRMP (See sections 4.1.4 and 4.2.2). As a result, a new analysis is recommended as part of the INRMP implementation process.

INRMP Implementation and Management Actions:

1. *Spatially identify the locations for each of the floral and faunal SGCN species from all planning level surveys as input to create an updated habitat protection area GIS.*

4.3 RARE, THREATENED, AND ENDANGERED SPECIES MANAGEMENT

FMMD manages Rare, Threatened, and Endangered (RTE) through consultation with USFWS and implementation of the INRMP. The FMMD INRMP identifies specific management actions required to minimize the impact to listed species while ensuring military mission requirements are met.

RTE species management at FMMD encompasses the following species:

- Federally endangered, threatened and candidate species
- Maryland threatened and endangered species
- Maryland species of greatest conservation concern

FMMD is not bound by state laws to protect state of Maryland designated RTE species. However, to the extent possible, FMMD will undertake management actions that conserve these species and their associated habitat in order to limit the potential for federal listing.

INRMP Rare, Threatened, and Endangered Species Management Goal: Limiting the designation of critical habitat for federally threatened and endangered species.

To fulfill the overall goal for this element, two specific objectives were identified. These are:

Objective 3.1: *Conduct periodic surveys for rare, threatened, and endangered (RTE) species.*

Objective 3.2: *If new RTE species are identified, quantify and assess habitat quality and distribution on FMMD.*

4.3.1 FEDERAL THREATENED AND ENDANGERED SPECIES

Plant and animal species that are federally listed as threatened or endangered are protected by the Endangered Species Act (ESA) of 1973 (16 USC 1531-1544). The ESA is managed by the USFWS and NOAA Fisheries, depending on the species. The ESA requires all federal agencies, in consultation with USFWS or NOAA Fisheries, to ensure actions do not jeopardize the continued existence of listed species or result in loss of critical habitat. In order to comply with the ESA, planned federal actions with the potential to impact a federally endangered, threatened, or candidate species, and/or designated critical habitat, must undergo a biological assessment to determine the likelihood of the action to adversely affect that species and/or critical habitat.

On FMMD there are 11 species listed as either endangered, threatened or a candidate species under the auspices of the ESA (Table 4-1). Currently, there are no critical habitat designations on FMMD. Projects that may impact federally listed rare, threatened, or endangered resources shall be coordinated with the Natural Resources Program Manager well in advance. The Natural Resources Program Manager will coordinate with USFWS on behalf of project proponents to determine if a biological assessment or other coordination is required. Projects may only proceed after any required consultation is performed and coordination with USFWS is completed.

Table 4-2: Federally Listed Species that occur or may occur on FMMD.

Common Name	Scientific Name	Federal listing	Maryland State listing	Installation Presence	Existing USFWS Consultation
Northern long-eared bat	*Myotis septentrionalis*	*Threatened*	Threatened S1	Present, but Transient (Acoustic only)	Yes
Indiana bat	*Myotis sodalis*	*Endangered*	Endangered S1	Present, but Transient (Acoustic only)	Yes
Tricolored Bat	*Perimyotis subflavus*	*Under Review (Candidate)*	Endangered S1	Present, but Transient (Acoustic only)	Yes
Wood Turtle	*Glyptemys insculpta*	*Under Review (Candidate)*	Vulnerable S3	Known[3] presence	
Spotted Turtle	*Clemmys guttata*	*Under Review (Candidate)*	Vulnerable S3	None known, Occurs on a	

[3] A single individual was found near Burba Lake that may have been a pet release. Surveys are ongoing to determine if a population exists at FMMD.

				neighboring parcel	
Rusty Patch Bumble Bee	*Bombus affinis*	*Endangered*	SH	Historic-locally extirpated	Informal
Eastern Small-footed Bat	*Myotis leibii*	*Watch List*	Critically imperiled S1	Present, but Transient (Acoustic only)	
Little Brown Bat	*Myotis lucifugus*	*Under Review (Candidate*	Critically imperiled S1	Known presence	
Monarch	*Danaus plexippus*	*Under Review (Candidate)*	Secure S5B	Present	
Northern Red Bellied Cooter	*Pseudemys rubriventris*		Secure S5B	Present	

4.3.1.1 NORTHERN LONG-EARED BAT

The Northern long-eared Bat (NLEB) (*Myotis septentrionalis*) was listed as a federally threatened species under the ESA in 2015 primarily due to the impacts of white-nose syndrome (Table 4-1). This species has a wide range that covers the eastern and north central United States. NLEB typically hibernate in caves during the winter and are forest dwellers during summer months, roosting in the crevices of live or dead trees or under their bark and may occasionally roost in structures. FMMD lies within the eastern range of the NLEB and contains suitable habitat, mixed hardwood forests over three inches diameter at breast height, for summer roost trees. The presence of the NLEB was detected acoustically on FMMD during a 2016 field survey, but it was not netted using USFWS protocols (Deeley 2017). No active summer roost trees or hibernacula have been confirmed in Anne Arundel County. Due to the lack of known hibernacula and maternity roost trees, NLEB detected at FMMD are likely transient (Deeley an Emrick 2018)

FMMD submitted the results of the 2016 survey to the USFWS Chesapeake Bay Field Office-Ecological Services office for review. The USFWS requested that FMMD informally coordinate projects with their office using the USFWS Information for Planning and Consultation (IPAC) tool and the streamlined section 7 consultation form developed as part of a Programmatic Biological Opinion (BO) 5 January 2016 on the Final 4(d) Rule. FMMD is using the Installation Management

Command (IMCOM) Programmatic Agreement (PA) signed with the USFWS Region 3 on 4 May 2015 to avoid impacts to NLEB during pest control inside structures. USFWS has not designated critical habitat for NLEB on FMMD.

INRMP Implementation and Management Actions:

1. *Evaluate NLEB survey data and USFWS regulations to determine if conservation measures, such as a time restriction on tree harvesting during pup season is warranted.*

2. Use the USFWS IPAC system (https://ecos.fws.gov/ipac/) to informally consult on projects where potential NLEB habitat may be adversely affected.

4.3.1.2 INDIANA BAT

Indiana bats (*Myotis sodalis*) were listed for protection under the ESA in 1967 and are currently listed as endangered. Indiana bats live in the forests and caves of the Northeast and Southeast, but primarily in the Midwest. The Chesapeake Bay Field Office of the USFWS does not consider Ann Arundel County within the range of the Indiana bat (USFWS 2017). The bats congregate in winter and summer colonies, migrating between the two sites in the spring and fall. These bats live in wooded or semi-wooded areas during the summer and form maternity colonies and roosts in dead standing trees. Indiana bats eat flying insects, and their diet reflects the available prey. Bats forage along river and lake shorelines, in the crowns of trees in floodplains, and in upland forests.

The presence of the Indiana bat was detected on FMMD during a 2016 field survey for the northern long-eared bat (Deeley 2017). The species was detected acoustically but not netted using USFWS protocols. FMMD is currently performing a second year of bat surveys, but preliminary results indicate the acoustic presence of Indiana bat. No active summer roost trees or hibernacula have been confirmed in Anne Arundel County. FMMD has submitted the results of the 2016 survey to the local USFWS Ecological Services office for review and they have determined not to regulate the Indiana bat on FMMD since we are out of range. Due to the lack of known hibernacula and maternity roost trees, these species may be transitory.

INRMP Implementation and Management Actions:

None

4.3.1.3 TRICOLORED BAT

The tricolored bat (*Perimyotis subflavus*) is currently under review for candidate status. Following the finding in December of 2017 that the petition to list the tricolored bat presents 'substantial' scientific information and may be warranted for listing (80 FR 60362), the tricolored bat was proposed for listing on the Endangered Species list on September 13, 2022. They identified habitat destruction or modification, disease or predation, and other factors as potential threats to the species. The presence of the tricolored bat (Perimyotis subflavus) was detected acoustically on FMMD during a 2016 field survey, but it was not netted (Deeley 2017). FMMD submitted the results of the 2016 survey to the local USFWS Ecological Services office for review.

INRMP Implementation and Management Actions:

None

4.3.1.4 WOOD TURTLE

The wood turtle (*Glyptemys insculpta*) is also currently under review for candidate status. USFWS announced in 90 day finding in September of 2015 that the petition to list the spotted turtle presents 'substantial' scientific information and may be warranted for listing (80 FR 56423). They identified habitat destruction, overutilization, disease or predation, inadequate regulatory mechanisms, and other factors as potential threats to the species. USFWS has initiated a 12-month status review and should issue findings in the near future. A potential specimen was located during the winter of 2018 but whether it is a member of a population, or a pet release is unknown at this time (Emrick et al 2018). The species was known to occur in the watershed of the Little Patuxent but thought to occur at the fall line and further west in Maryland.

INRMP Implementation and Management Actions:

1. Conduct a comprehensive survey of all potential habitat to ascertain whether a wild population exists on FMMD.

4.3.1.5 SPOTTED TURTLE

The spotted turtle (*Clemmys guttata*) is currently under review for candidate status. USFWS announced in 90 day finding in July of 2015 that the petition to list the spotted turtle presents 'substantial' scientific information and may be warranted for listing (80 FR 37568). They identified pet trade, habitat destruction and fragmentation, predation, road mortality and inadequate protections as potential threats to the species.

INRMP Implementation and Management Actions:

None

4.3.1.6 RUSTY-PATCHED BUMBLE BEE

USFWS listed the rusty-patched bumble bee (*Bombus affinis*) as threatened effective March 21, 2017. The USFWS identified the primary causes of decline of the species as, "habitat loss and degradation, pathogens, pesticides, and small population dynamics (82 FR 3186). FMMD is proximate to extant and historical counties identified in the listing. However, based upon local 'negative occurrence' data and informal consultation, the USFWS Chesapeake Bay Field Office considers the occurrence of this species historic in nature, not current. USFWS has not required surveys for the rusty-patched bumble bee on FMMD or satellite parcels.

INRMP Implementation and Management Actions:

None

4.3.1.7 EASTERN SMALL-FOOTED BAT

USFWS (2011) found that a petition presented substantial scientific or commercial information indicating that listing of the eastern small-footed bat (*Myotis leibii*) may be warranted. A status review was initiated. In a 12-month petition finding, USFWS (2013) found that listing the eastern small-footed bat is not warranted. The presence of the eastern small-footed bat was detected acoustically on FMMD during a 2016 and 2017 field surveys for the northern long-eared bat (Deeley 2017, Deeley and Emrick 2018). The most serious threat to bats in eastern North America is white-nose syndrome (WNS). Since its initial discovery, WNS has spread rapidly and now has been documented

throughout the range of eastern small-footed bat. Human disturbance is a potential threat at approximately half of the known hibernacula in Kentucky, Maryland, North Carolina, Vermont, and West Virginia (USFWS 2013). Isolated colonies of eastern small-footed bat are particularly vulnerable to extirpation by chance events, especially when concentrated during winter months. USFWS (2013) determined that several activities, such as construction of physical barriers at cave accesses, mining, flooding, vandalism, development, and timber harvest may modify or destroy eastern small-footed bat habitat. However, these activities do not appear to have significant, population-level effects on the species. Conversion of forested habitats to agricultural and residential uses has also decreased the amount of ideal habitat in some areas, but the bats do make use of bridges and various other non-natural roost sites. Reliance on loose shale, talus, or karst formations often found in oil-, gas-, and mineral-rich lands makes eastern small-footed bat vulnerable to habitat loss associated with natural resource exploitation (USFWS 2011).

INRMP Implementation and Management Actions:

None

4.3.1.8 LITTLE BROWN BAT

The primary threat to the little brown bat (*M. lucifugus*) is a white-nose syndrome (WNS), which attacks hibernating bats and killed at least 1 million M. lucifugus in the four years following detection of WNS in 2006 (Frick et al. 2010). The presence of the little brown bat was detected acoustically on FMMD during a 2016 and 2017 field surveys for the northern long-eared bat (Deeley 2017, Deeley and Emrick 2018). This species commonly incurs significant mortality by turbines at wind energy facilities, though these fatalities are much less frequent than those of hoary, eastern red, and silver-haired bats (Arnett et al. 2008). Pesticides and other contaminants are also a potential threat (Agosta 2002). Other threats include deforestation (Parker et al. 1996) and destruction of caves and shafts associated with karst topography (Agosta 2002).

INRMP Implementation and Management Actions:

None

4.3.1.9 MONARCH BUTTERFLY

A petition for listing the Monarch (*Danaus plexippus plexippus*) as threatened under the U.S. Endangered Species Act was submitted in September 2014. During the 90-day petition finding, USFWS determined that action may be warranted and initiated a status review. On December 15, 2020, the U.S. Fish and Wildlife Service announced that listing the monarch as endangered or threatened under the Endangered Species Act is warranted, but precluded by higher priority listing actions. While the species as whole is not seriously threatened, the migratory populations in North America seem to be declining significantly. Overwintering habitats in Mexico are undertreat from logging, agriculture, urban development, and climate change. More recent analysis has determined that the recent large-scale decline of North American monarchs is primarily the result of changes in the core breeding habitat, not the wintering habitat, apparently largely the recent loss of milkweed as a result of changes in agricultural practices (Pleasants and Oberhauser 2013, Flockhart et al. 2013, 2014, Center for Biological Diversity et al. 2014). Loss of genetic diversity is a real concern for the species as a whole (Zhan et al., 2014)

INRMP Implementation and Management Actions:

1. Informally consult with the Chesapeake Bay Field Office-Ecological Services.

2. Complete a pollinator survey that emphasizes the identification of suitable habitat (i.e. presence of Milkweeds) to determine if there is a summer resident population.

4.3.1.10 NORTHERN RED BELLIED COOTER

The Northern Red-bellied Cooter has been petitioned for listing under the Endangered Species Act (ESA). Throughout most of the species' range, the Northern Red-bellied Cooter does not receive protection under the ESA. However, isolated populations in Massachusetts were previously recognized as a separate subspecies ("Plymouth" Red-bellied Cooter; *Pseudemys rubriventris bangsi*) and that subspecies, which exists only in Massachusetts, was listed under the ESA as endangered in 1980. The separate listing of the sub-species has caused confusion in management at numerous levels. The species occurring at FMMD is not currently protected under the ESA and is considered to have a stable population in the state of Maryland. A ruling on the status for the species range wide is due in 2023.

INRMP Implementation and Management Actions:

None

4.3.2 STATE LISTED SPECIES/SPECIES OF CONCERN

4.3.2.1 FAUNA

The Maryland Department of Natural Resources (DNR), Wildlife and Heritage Service lists several species that occur on FMMD as state rare, threatened, endangered, or watch list species. DNR protects these species in Title 8, Chapter 8 of the Code of Maryland Regulations (COMAR). These state protections do not extend to Army land and the Army does not obligate funds to explicitly manage state listed species but attempts to conserve these species where possible. When impacts to state listed or sensitive species cannot be avoided or are likely, the Natural Resources Program Manager coordinates with DNR in advance. The state listed species include the glassy darter (*Etheostoma vitreum*), American brook lamprey (*Lethenteron appendix*), coastal plain swamp sparrow (*Melospiza georgiana nigrescens*) and Northern waterthrush (*Parkesia noveboracensis*).

Table 4-3: State listed species that are known to occur on FMMD

Common Name	*Scientific Name*	Maryland state listing	Maryland State Conservation Status
Glassy darter	*Etheostoma vitreum*	T	A
American brook lamprey	*Lethenteron appendix*	T	A
Northern waterthrush	*Parkesia noveboracensis*	I	B
Coastal plain swamp sparrow	*Melospiza georgiana nigrescens*	I	A

INRMP Implementation and Management Actions:

None

4.3.2.2 FLORA

Populations of three state listed species have been identified on FMMD including blunt-lobe grapefern (*Sceptridium oneidense*), Torrey's rush (*Juncus torreyi*) and Partridge Pea (*Chamaecrista fasciculate*

var. macrosperma),(Table 4-4). These state protections do not extend to Army land and the Army does not obligate funds to explicitly manage state listed species, but attempts to conserve these species where possible. When impacts to state listed or sensitive species cannot be avoided or are likely, the Natural Resources Program Manager coordinates with DNR in advance.

Table 4-4. State Listed Plant Species Known to Occur on FMMD

Common Name	Scientific Name	Maryland State listing	Maryland State Conservation Status
Blunt-lobe grapefern	*Sceptridium oneidense*	E	A
Partridge pea	*Chamaecrista fasciculata var. macrosperma*	E	A
Torrey's Rush	*Juncus torreyi*	E	A

INRMP Implementation and Management Actions:

None

4.4 WATER RESOURCE MANAGEMENT

FMMDs location within the Chesapeake Bay-one of our nations' greatest natural and economic resources-watershed provides a unique opportunity to positively affect water resources far beyond its boundaries. FMMD shares the overall DoD vision for the Chesapeake which is… "to protect the Chesapeake Bay for military readiness, for our community, and for future generations".

Water resource management on FMMD includes strategies to mitigate existing and minimize future degradation to water bodies within both the Patuxent and Severn watersheds. Water resources are managed on FMMD using a multi-scale management approach. For this approach, actions are based on size (post-wide, stream corridor, and sub-watershed), and are analyzed to determine priorities for management. Post-wide includes activities and management practices that can be applied across the post. Stream corridor management includes evaluation of management practices at individual

streams within FMMD. Finally, sub-watershed management addresses management of specific reaches or sites along individual streams.

INRMP Water and Aquatic Resources Management Goal: The health of aquatic ecosystems are maintained and enhanced to support overall natural resource sustainability. Wetlands are protected, enhanced, and restored wetlands to maintain ecosystem services and ensure no net loss of wetland acreage on FMMD.

Objective 4.1: *Assess ecological conditions of aquatic ecosystems on FMMD.*

Objective 4.2: *Reduce the sediment and nutrient input to FMMD aquatic ecosystems to help meet Chesapeake Bay Total Maximum Daily Load (TMDL) requirements.*

Objective 4.3: *Restore stream reaches that have been channelized to natural channels.*

Objective 4.4: *Ensure GIS database accurately reflects FMMD wetland location and acreage.*

Objective 4.5: *Maintain the ecosystem function(s) of FMMD wetlands and floodplains through protection of critical vegetative cover surrounding and within designated wetlands and floodplains.*

4.4.1 STREAMS

Stream assessments of Franklin Branch and Midway Branch, the two major stream systems on FMMD, and Burba lake were conducted in 2009 (U. S. Army Corp of Engineers 2009). The objective of the stream assessments was to implement a sampling program that documents baseline water quality conditions and health of the aquatic waterways of the FMMD. These assessments included benthic macroinvertebrate and fish community sampling, aquatic habitat evaluations, and water sampling and analysis at 14 locations. In addition, *in situ* water quality measurements, including temperature, pH, dissolved oxygen, conductivity, and turbidity, were collected at each location. Water samples were collected and analyzed for metals, hardness, total petroleum, hydrocarbons, ammonia, nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus, total fecal coliform, and total suspended solids (U. S. Army Corp of Engineers 2009). The results indicated the health of the biological communities inhabiting these streams is generally poor due to degraded habitat conditions.

Since 2009 BMPs and other management actions were undertaken to improve water resource quality on FMMD. These actions included physical and water quality stream assessments along Franklin

Branch, Midway Branch and their main tributaries conducted to identify sources of stream impairment at FMMD streams (U.S. Army Corps of Engineers 2013). The stream assessments indicated that degraded stream habitat conditions have led to an impaired biological community at most stream locations in Midway Branch and Franklin Branch. The likely cause at a majority of the problem sites was a result of altered stream hydrology associated with the predominately urban land use in the watershed. The most severe problems sites were generally the result of inadequate buffer systems, channel alteration, and erosion.

A 2019 assessment (U.S. Army Corps of Engineers 2019) identified 6 high priority sites on FMMD (Midway Branch, Franklin Branch and Severn Run) where restoration would generate TMDL credits. An Environmental Assessment (EA) was prepared to analyze the potential environmental, cultural, and socioeconomic effects associated with implementing the proposed restoration activities at eight impaired stream reaches in Midway Branch, Franklin Branch, Rogue Harbor, and Severn Run watersheds at FMMD (U.S. Department of the Army 2020). The EA found no significant impact would be caused by the proposed stream restoration.

One taxa group that can play key ecological role in aquatic environments are the unionid mussels. Several rare mussel species, including the federally listed yellow lance mussel (*Elliptio lanceolata),* have been detected in the Patuxent River basin in Anne-Arundel county (https://www.fws.gov/southeast/wildlife/mussels/yellow-lance/).

INRMP Implementation and Management Actions:

1. Establishing a water quality and resource monitoring program to identify short-term problems and long-term trends based upon the ACOE 2009 approach.

2. Institute the use of Bayscaping in association with all new construction and redevelopment to the extent possible.

3. Support the implementation of stream restoration activities described in the EA (FMMD 2020).

4. Conduct a planning level survey to determine mussel fauna in the Little Patuxent River and other water bodies with suitable habitat.

4.4.2 COASTAL / MARINE MANAGEMENT

Section 307 of the federal Coastal Zone Management Act requires that proposed federal activities in a state's coastal zone be consistent with a state's Coastal Zone Management Program (CZMP). The Maryland CZMP is overseen by the MDDNR and consists of a network of state laws and policies designed to protect coastal and marine resources and achieve a balance between development and protection in the coastal zone. Maryland's coastal zone includes the Chesapeake Bay, coastal bays, and Atlantic Ocean, as well as the towns, cities and counties that contain and help govern the coastline.

Compliance with Maryland Coastal Zone Management Act (CZM) is required for FMMD because the installation is in Anne Arundel County. To comply with the Act, Anne Arundel County requires a 100-foot buffer be placed around designated critical areas, and that buffers be placed around wetlands outside the critical area. FMMD does not have Critical Areas but does have wetlands to be protected. A buffer's extent is from the top of the slope adjacent to the wetland boundary, and an additional 25-foot buffer for slopes of 25% or greater adjacent to wetland boundary.

INRMP Implementation and Management Actions:

None.

4.4.3 WETLANDS

FMMD manages wetlands using an approach that focuses on maintaining and restoring riparian habitat surrounding wetlands. The Maryland CZMP has specific objectives related to wetlands: protection of significant resource value (such as endangered species habitat, significant wildlife habitat, and wintering and resting areas of migratory birds) and maintenance of natural buffers along coastal waters to minimize development impacts. Federal actions and permits (including Corps Section 404 permits) must comply with Coastal Zone Consistency requirements. For activities impacting wetlands, the Coastal Zone Consistency determination is issued as part of the State's wetlands permit. For federal activities that do not require a state permit, the decision is made through MDE's Wetlands and Waterways Program, with input from other State and local agencies.

INRMP Implementation and Management Actions:

1. *Ensure wetland buffer habitats on FMMD are not disturbed.*

2. *Assess current status of wetland buffers to ensure compliance with Maryland CZMP objectives for wetlands.*

3. *Ensure wetland locations are properly mapped on GIS and updated as needed.*

4.4.4 FLOODPLAINS

Management of floodplains on FMMD follows a no disturbance policy in floodplain areas. Floodplains are important to minimize the impact of floods on human safety, health, and welfare, and also provide biological benefits. Floodplains are protected under the Clean Water Act (CWA) and Executive Order (EO) 11988. Federal agencies must consider flood hazards and floodplain management and federal construction in floodplains is discouraged. If the only practicable alternative is construction in a floodplain, then the FMMD proponent must explain why the proposed action is to be located in a floodplain and implement mitigation strategies to minimize potential harm to the floodplain

INRMP Implementation and Management Actions:

1. Ensure floodplain buffer habitats on FMMD are not disturbed without consultation with FMMD Environmental office.

2. Assess current status of floodplain buffers to ensure compliance with Maryland CZMP objectives for floodplains.

4.5 CLIMATE CHANGE ADAPTATION AND RESILIENCY

Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. The magnitude and rate of climate change depends upon the rate of increase of greenhouse gases in the atmosphere, how strongly climate features like temperature, precipitation, and sea level respond to atmospheric greenhouse gas concentrations, and other the natural influences on climate from sources such as volcanic activity, changes in the sun's intensity, and changes in ocean circulation patterns.

Per DoD Directive 4715.21- Climate Change Adaptation and Resilience (U.S. Department of Defense 2018), the DoD must "be able to adapt current and future operations to address the

impacts of climate change in order to maintain an effective and efficient U.S. military." The directive continues to state that the effects of climate change must be identified and assessed and considered when developing future plans and procedures with the goal of anticipating and managing any risks that may develop as a result of climate change.

INRMP Climate Change and adaptation and resiliency Goal: FMMD will implement measures to improve resiliency and adapt to climate change.

Objective 5.1: *Identify adaptive practices and processes to improve FMMD resiliency to climate change.*

Objective 5.2: *Incorporate these practices and processes into the FMMD INRMP.*

In January 2019, the **Report on Effects of a Changing Climate to the Department of Defense** (U.S. Department of Defense 2019) re-stated that the effects of a changing climate remain a national security issue and attempted to analyze the potential for climate related events on 79 mission assurance priority installations including FMMD. To increase resiliency to the changing climate, the DoD is updating built and natural infrastructure to better adapt to climate impacts and updating Unified Facilities Criteria to require climatic variables be considered in planning and development activities in order to address risks to the infrastructure and the military mission.

In order to address risks associated with climate change, installations need to address climate considerations when updating and/or revising their INRMPs. To facility climate change incorporation into INRMP updates, Stein et.al (2019) developed a guide—*Climate Adaptation for DoD Natural Resource Managers*— to assist installation managers with implementing policy guidance (see appendix G for climate change adaptation tool). This guide is designed to help military natural resource managers prepare for and reduce climate-related risks, to ensure that DoD installations can continue to meet the evolving needs of the U.S. military. The guide and tool are specifically designed to be used by installation natural resource managers and internal stakeholders to explore options and best practices that can be adopted, as appropriate, by installations to meet their specific needs (Stein et al. 2019). The management actions and practices identified through this process are not a one-time occurrence and should be revisited and updated periodically.

Management Actions

1. Convene installation natural resources managers and stakeholders to work through the climate adaptation tool (Appendix G).

2. Incorporate results into the yearly updates to the FMMD INRMP.

4.6 OUTDOOR RECREATION AND ENVIRONMENTAL AWARENESS

There is wide recognition that outdoor recreation provides many physical and mental benefits and is an integral part of a healthy and resilient community. Outdoor recreation is the most common activity where the FMMD community will actively interact with natural resources and their management. FMMD views outdoor recreation as a key goal that helps develop a sense of community and healthy active lifestyles. A goal of the Real Property Vision Plan (FMMD 2016) is the development of "…pleasant community areas connected by well-developed trail systems that enhance opportunities throughout FMMD for running, walking and bicycling while establishing areas for troop movement, PT and recreational activities." Natural resources and their management are key to reach the overall vison plan goal.

INRMP Outdoor Recreation and Education Goal. Support and promote a high quality of life for the Fort George G. Meade community by managing natural resources for recreation, education, and scientific research.

Objective 6.1: *Assess usage and preferences of recreational anglers on FMMD.*

Objective 6.2: *Assess the composition and populations of fish species for Burba lake.*

Objective 6.3: *Develop educational materials for FMMD employees, tenants, housing residents, contractors, and schoolchildren about FMMD's location within the Chesapeake Bay watershed and the natural resource actions on FMMD that affect the Chesapeake Bay.*

Objective 6.4: *Educate FMMD employees, tenants, housing residents, contractors, and schoolchildren about the role of native pollinators and avians, and how to protect and enhance local habitat.*

Security concerns in the aftermath of September 11, 2001, have greatly restricted public access on DoD facilities. Access to FMMD outdoor recreation facilities is restricted to military personnel, families, and civilian personnel including:

- Active-duty military and their family members
- Retired military and their family members
- National Guard & Reserve
- Civilian Employees (CPO/NAF) and family members
- Retired Civilian Employees and family members
- Contractors: One-year contract with FMMD Personnel that live or work on the installation (must provide letter of employment or ID from on post school etc.)

Access to FMMD is granted through obtaining proper identification and documentation as accepted by FMMD. To enter the installation, Department of Defense ID card holders are only required to show a Common Access Card (CAC), military identification card, or other approved access credential issued by the Fort Meade Visitor Center. Visitors who do not have a CAC, military ID or approved access credential must access the installation using the main gate at Reece Road and Maryland State Route 175. Reece Road is the only visitor access gate to Fort Meade; follow signs to the vehicle inspection station. All other gates are designated for Department of Defense identification card holders or other approved access credentials.

Active outdoor recreational pursuits and facilities are managed by the U.S. Army Family and Morale, Welfare and Recreation (MWR) Command. Active outdoor recreation facilities include RV campgrounds, Burba Park, athletic fields.

Burba Park and Lake is a key outdoor recreation area used for walking, jogging, fishing, picnics, and unit affairs where natural resources are the centerpiece. The park has a trail system with benches, several fishing piers and educational signs. The lake supports populations of several warm-water fish species and is periodically re-stocked by the FMMD Environmental Division. Waterfowl, reptiles, amphibians, and dragonflies are relatively common in and around the lake, and beaver and muskrat are sometimes seen in the streams that feed it.

Recreational fishing at Burba Lake is a primary outdoor recreational activity under the purview of the INRMP. In addition, trails at Burba Park and throughout FMMD provide opportunities for engaged natural resource-related recreation and education through watchable wildlife activities and education.

Some outdoor recreation facilities and activities have the potential for causing natural resources impacts. For example, turf management operations for recreational facilities such as baseball and soccer fields can result in the release of fertilizers and pesticides. Protection of turf may necessitate measures to deter or remove nuisance wildlife. The use of groundwater for irrigation represents an additional demand on local aquifers. Potential impacts can be minimized or even eliminated through careful planning and through the NEPA process.

INRMP Implementation and Management Actions:

1. Conduct a creel survey of anglers using Burba Lake to gain insight about recreational angling perceptions, efforts, and harvests in order to inform future decision making.

2. Assess the composition of the fish species in Burba Lake and implement management actions as needed.

3. Develop educational materials for the public that describe the importance of the Chesapeake Bay and its watershed and everyday activities that individuals can do to help sustain the bay.

4. Develop educational materials for the public that describe the importance native pollinators and how to protect and enhance local habitat.

5. Promote education regarding bird strike incidents and how to protect bird species from injury or death.

4.7 INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Pest management at FMMD is managed through implementation of the Integrated Pest management plan (IPMP). The purpose of the IPMP is to describe pest management requirements for the installation, outline the resources necessary for surveillance and control, and describe the administrative, safety and environmental requirements of the program. Pests included in the plan, but not limited to are invasive vegetation and weeds, medically important pests, mice, nuisance wildlife, and other vertebrate pests

INRMP Integrated Pest Management Goal: Minimize pest-related habitat damage and health risks to natural resources and people.

Objective 7.1: *Conduct surveys of pests that pose a potential health risk to humans or natural resources as necessary.*

Objective 7.2: *Implement pest management controls from the Integrated Pest Management Plan and other pest-related guidance and plans.*

INRMP Implementation and Management Actions:

None

4.8 WILDLAND FIRE MANAGEMENT

Wildland fire by definition is a non-structure fire that occurs in natural fuels (i.e., forests, grasslands, and shrublands) and includes both wildfires and prescribed fires. Wildfires are wildland fires that result from unplanned ignition sources (e.g., lightning, munitions, accidental human caused among others), while prescribed fires are intentionally ignited and controlled by qualified personnel to accomplish natural resources and/or management objectives.

As described previously, FMMD is primarily an ex-urban installation embedded within a largely urbanized corridor between Washington DC and Baltimore, Maryland. As a result, wildland fire management at FMMD has largely been the responsibility of the fire department and not part of the overall natural resources management program. Nevertheless, there are substantial areas of natural fuels within FMMD and immediately adjacent on USFWS owned lands bordering the southeastern boundary. The wildfire risk on FMMD has been evaluated using DCS G-9 Wildland Fire Guidance. The result determined that FMMD would apply for a wildfire management waiver, indicating a wildland fire management plan is not needed for FMMD. The wildfire management waiver is pending, and a decision was not yet made at the time of completion of this draft. An approved waiver would later be added to document appendices. Equally, a denial of the waiver would require and amendment to the guidance laid out here.

INRMP Wildland Fire Management Goal: Develop a management strategy for wildland fire.

Objective 8.1: *Seek and maintain waiver and update as needed.*

The Army considers wildland fire management is a "…. critical mission element to minimize the risk of installation and training and testing lands, as well as personal safety. Managing lands through prescribed burning has significant benefits for fuel reduction, mission and training support, meeting ecosystem management principles, managing for optimal atmospheric conditions and significantly reducing the potential for an uncontrolled wildfire emergency…" (https://denix.osd.mil/army-nr/army-wildland-fire/).

INRMP Implementation and Management Actions:

1. Obtain a wildland fire management waiver and update as needed.

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5.0 IMPLEMENTATION

The most recent policy on INRMP implementation is contained in DoD 4715.3 (2011), Natural Resources Conservation Program. According to the memorandum, an INRMP is considered implemented if an installation:

- Actively requests, receives, and uses funds for "must fund" projects and activities.
- Ensures that sufficient numbers of professionally trained natural resources management personnel are available to perform the tasks required by the INRMP.
- Coordinates annually with all cooperating offices; and
- Documents specific INRMP action accomplishments undertaken each year.

5.1 FUNDING

The budget process employed by the DoD is an ongoing, continuously reviewed process called the Planning, Programming, and Budgeting System (PPBS). The process can be summarized as follows (U.S. DoD 2005):

- The PPBS process consists of long-range planning to anticipate and secure requirements to meet security threats and accomplish program goals.
- Resources to meet these requirements are estimated and programmed by program managers in the Future Year Defense Plan (FYDP). The FYDP is a list of resource requirements for the next 6 years. Specifically, the FYDP comprises the subsequent FY budget and funding requirements projected out 5 years.
- The FYDP resources next are analyzed via the Programming Process. In the Programming Process, program managers reassess their requirements, reprioritize planned activity, reevaluate existing funding guidance, and estimate their funding needs for the next budget year, plus the subsequent 5 FYs (referred to as POMs 1–5).
- The Program Objectives Memorandum (POM) process takes place within Defense Components beginning in the fall of each year. Then each DoD Component submits the POM in the spring to OSD. The OSD reviews the budget submissions and develops the President's budget that will be submitted to Congress. At the installation level, data submissions to support this are made to the Major Commands twice annually, in fall and spring.
- Based on POM decisions of each Component, budget controls are issued to the field commands for budget preparation.

The time scale of an INRMP fits well into the DoD PPBS forecasting process. One full cycle of the DoD budget process includes the next budgeted FY and projections for the following 5 FYs. One full cycle of the

INRMP, with upper command re-approval, covers a 5-year period. This means that by relying on an INRMP that is updated regularly, installations should be able to project relatively accurate funding requirements for natural resources management for 5-year periods, at a minimum. (U.S. DoD, 2005)

The IC is responsible for ensuring that FMMD has sufficient staff to implement the INRMP, and the DPW Environmental Division is responsible for annual coordination with USFWS and MD DNR, as well as documenting INRMP actions. The DPW Environmental Division is also responsible for requesting funds for INRMP projects. However, the DPW Environmental Division is not responsible for whether or not it receives the funds it requests for various projects. Consequently, the projects and schedules proposed in this INRMP are targets to facilitate natural resources program planning. When requested funds are not received, the DPW Environmental Division will re-examine its natural resource programming schedule, and adapt plans, budgets, and project scheduling subject to availability of funding.

Conservation projects are currently funded through Environmental Program Requirements (EPR) system by the IMCOM. Once projects are prioritized and the EPR generated, the DPW Environmental Division submits the EPR report through the IMCOM – NERO to IMCOM Headquarters for final funding allocations. Clean-up or restoration project are funded by the USAEC. Headquarters DA is in the process of restructuring how Army installations projects are funded, and these changes will be addressed in the next update of this INRMP.

5.2 FIVE YEAR IMPLMENTATION

Project priority within this INRMP is initially determined by funding classification, as defined in DoDI 4715.03 (*Programming and Budgeting Priorities for Natural Resources Programs*) as follows (DA, 2011):

Class 0: Recurring Natural Resources Conservation Management Requirements. Includes activities needed to cover the recurring administration, personnel, and other costs associated with managing DoD's conservation program 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.

Class I: Current Compliance. Includes projects and activities needed because an installation is currently out of compliance (has received an enforcement action from a duly authorized Federal or state agency, or local authority); has a signed compliance agreement or has received a consent order; has not met requirements based on applicable Federal or state laws, regulations, standards, Presidential EOs, or DoD policies; and/ or are immediate and essential to maintain operational integrity or sustain readiness of the military mission. "Class I" also includes projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations, standard, DoD policies, or Presidential EOs, but deadlines have not passed or requirements are not in force) but shall be if projects or activities are not implemented in the current program year.

Class II: Maintenance Requirements. Includes those projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations, standards, Presidential EOs, or DoD policies) but deadlines have not passed, or requirements are not in force, but shall be out of compliance if projects or activities are not implemented in time to meet an established deadline beyond the current program year.

Class III: Enhancement Actions, Beyond Compliance. Includes those projects and activities that enhance conservation resources or the integrity of the installation mission or are needed to address overall environmental goals and objectives but are not specifically required under regulation or EO and are not of an immediate nature.

Table 5-1: Summary of major program elements and the priority of the implementation and management actions required to address INRMP objectives.

Project Element	INRMP Implementation and Management Action	Priority Class	INRMP Objective (s) Addressed
Vegetation and Forest Resources Management	Assess total tree cover throughout FMMD every three years.	0	1.1; 1.2
	Update forest cover type map every 5 years.	3	1.1; 1.2; 4.4; 4.5
	Map and inventory the trees in FMMD urban forest habitats.	3	1.3
	Identify native trees suitable to the different growing environments in the urban forest at FMMD.	0	1.4
	Develop a guide to using native plants in landscaping at FMMD as a supplement to the IDG.	3	1.4

	Identify sites within habitat protection areas (see section 4.2) where invasive species removal is feasible and would benefit SGCN plant and/or faunal species.	3	1.5
	Select 5 sites to implement ACOE recommended control methods.	3	1.5
	Spatially identify the locations for each of the SGCN species from the 2014 vegetation planning level survey by EEE consulting (2014) as input to create an updated habitat protection area GIS.	3	2.5
Fish, Wildlife and Habitat Management	Conduct a population survey for deer across FMMD to determine if control measures are required.	3	2.1; 2.2
	Identify habitat used by SGCN avian species and incorporate into the overall habitat protection area GIS.	2	2.5
	Identify bald eagle nesting sites on FMMD (if any).	2	2.3
	Conduct a planning level survey to identify bird species using FMMD.	2	2.3
	Conduct installation wide pollinator survey to identify abundance and diversity of pollinators and available habitat on FMMD.	2	2.4
	Identify locations where pollinator habitat can be improved or developed.	3	2.4
	Develop a list of plant species that benefit pollinators that are suitable for landscaping in the built environment.	0	1.4; 2.4
	Spatially identify the locations for each of the floral and faunal SGCN species from all planning level surveys as input to create an updated habitat protection area GIS.	0	2.5
Rare Threatened and Endangered Species Management	Evaluate NLEB survey data and USFWS regulations to determine if conservation measures, such as a time restriction on tree harvesting during pup season is warranted.	2	3.1; 3.2
	Use the USFWS IPAC system (https://ecos.fws.gov/ipac/) to informally consult on projects where potential NLEB habitat may be adversely affected.	2	3.2

	Conduct a comprehensive survey of all potential habitat to ascertain whether a wild population of wood turtles exists on FMMD.	1	3.1
	Informally consult with the Chesapeake Bay Field Office-Ecological Services	1	3.2
	Complete a pollinator survey that emphasizes the identification of suitable habitat (i.e. presence of Milkweeds) to determine if there is a summer resident population.	1	1.4; 2.4; 3.1; 3.2
Water Resource Management	Establishing a water quality and resource monitoring program to identify short-term problems and long-term trends based upon the ACOE 2009 approach.	3	4.1
	Institute the use of Bayscaping in association with all new construction and redevelopment to the extent possible.	0	1.4; 2.4; 4.2
	Support the implementation of stream restoration activities described in the EA (FMMD 2020).	2	4.2; 4.3
	Conduct a planning level survey to determine mussel fauna in the Little Patuxent River and other water bodies with suitable habitat.	2	3.1; 4.1
	Ensure wetland buffer habitats on FMMD are not disturbed.	0	4.4; 4.5
	Assess current status of wetland buffers to ensure compliance with Maryland CZMP objectives for wetlands.	0	1.1; 1.2; 4.5
	Ensure floodplain buffer habitats on FMMD are not disturbed without consultation with FMMD Environmental office.	0	4.4;4.5
	Assess current status of floodplain buffers to ensure compliance with Maryland CZMP objectives for floodplains.	0	1.1; 1.2; 4.5
Climate Change Adaptation and Resiliency	Convene installation natural resources managers and stakeholders to work through the climate adaptation tool (Appendix G).	2	5.1;5.2
	Incorporate results into the yearly updates to the FMMD INRMP.	2	5.1;5.2

Outdoor Recreation and Environmental awareness	Conduct a creel survey of anglers using Burba lake to gain insight about recreational angling perceptions, efforts, and harvests in order to inform future decision making.	3	6.1;6.2
	Assess the composition of the fish species in Burba lake and implement management actions as needed.	3	6.2
	Develop educational materials for the public that describe the importance of the Chesapeake Bay and its watershed and everyday activities that individuals can do to help sustain the bay.	0	6.3
	Develop educational materials for the public that describe the importance native pollinators and how to protect and enhance local habitat.	3	6.4
Wildland Fire Management	Obtain a Wildland Fire Management Plan Waiver	2	8.1

5.3 LITERATURE CITED AND REFERENCES REVIEWED

U.S. Department of Defense. 2011. Department of Defense Instruction 4715.3, Environmental Conservation Program.

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APPENDIX A: LAWS AND REGULATIONS

Table A-6-1. Laws and regulations potentially affecting FMMD INRMP.

Law/Reg/MOU #	Law/Reg/MOU Title	Responsible/ Administering Agency(s)
DoD Financial Management Regulation 7000.14-R, Vol. 11A, Ch.16	Accounting for Production and Sale of Forest Products, August 2002.	Department of Defense
7 U.S.C.§ 426-426b	Animal Damage Control Act	U.S. Department of Agriculture
16 U.S.C. 4701–4751	Aquatic Nuisance Prevention and Control	Department of Defense, State DNR, & International Partners (As Applicable)
16 U.S.C. §§668-668d	Bald & Golden Eagle Protection Act	U.S. Fish & Wildlife Service
42 U.S.C. § 7401-7642	Clean Air Act	Environmental Protection Agency
33 U.S.C. §1251 *et. seq.*	Clean Water Act	Environmental Protection Agency
16 U.S.C. §1451 *et. seq.*	Coastal Zone Management Act, as amended	National Oceanic & Atmospheric Administration
40 C.F.R. Parts 1500-1508	CEQ Regulations - Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA	All Federal Agencies (As Applicable)
42 U.S.C. §9601-9675	Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	Environmental Protection Agency
DoDI 4715.03	Conservation Program for Natural Resources, March 18, 2011	Department of Defense
DoDI 5525.17	Conservation Law Enforcement Program (CLEP), October 17, 2013	Department of Defense
DoD & USFWS MOU	Conservation of Migratory Birds MOU (Partners in Flight)	Department of Defense & U.S. Fish & Wildlife Service

DoD & the Pollinator Partnership MOU	Conservation of Pollinators MOU	Department of Defense & The Pollinator Partnership
DoDI 6055.06	DoD Fire and Emergency Services Program, December 21, 2006	Department of Defense
DoD 5400.7-R	DoD Freedom of Information Act Program, September 4, 1998	Department of Defense
16 U.S.C. §1531-1543	Endangered Species Act of 1973, as amended	U.S. Fish & Wildlife Service
32 C.F.R. § 989	Environmental Impact Analysis	Department of Defense
16 U.S.C. §1221-1226	Estuary Protection Act	Department of Interior, All other Federal Agencies, & States DNR (As Applicable)
16 U.S.C § 3901-3932	Emergency Wetlands Resources Act of 1986	Secretary of the Interior
DoDI 4715.17	Environmental Management Systems	Department of Defense
40 C.F.R. 149	EPA Sole Source Aquifers	Environmental Protection Agency
7 U.S.C. §136 *et. seq.*	Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended	Environmental Protection Agency
43 U.S.C. §1701	Federal Land Policy and Management Act of 1976	Department of Defense
Executive Order 13514	Federal Leadership in Environmental, Energy, and Economic Performance, October 5, 2009	Department of Defense
7 U.S.C. § 2801	Federal Noxious Weed Act of 1974	Secretary of Agriculture
33 U.S.C. § 1251-1376	Federal Water Pollution Control Act of 1977 (Clean Water Act), as amended	Environmental Protection Agency
16 U.S.C. §2901 – 2911	Fish and Wildlife Conservation Act of 1980	U.S. Fish & Wildlife Service
Executive Order 11988	Floodplain Management, May 24, 1977	Department of Defense
16 U.S.C. §1601 *et. seq.*	Forest and Rangeland Renewable Resources Planning Act of 1974	Secretary of Agriculture
Executive Order 13148	Greening the Government through Leadership in Environmental Management, April 21, 2000	Department of Defense
10 U.S.C. §2671	Hunting, Fishing and Trapping on Military Lands	Department of Defense

Executive Order 13112	Invasive Species, February 3, 1999	Department of Defense, State DNR, & other Federal Agencies (As Applicable)
16 U.S.C. §701, 702	Lacey Act of 1900	Secretary of the Interior
U.F.C. 3-210-10	Low Impact Development	Department of Defense
16 U.S.C. §703 *et. seq.*	Migratory Bird Treaty Act, as amended	U.S. Fish & Wildlife Service
P.L. 107-314	National Defense Authorization Act for Fiscal Year 2003	Department of Defense
P.L. 108-136	National Defense Authorization Act for Fiscal Year 2004	Department of Defense
Public Law 91-190, 42 U.S.C. §4321-4347	National Environmental Policy Act (NEPA) of 1969, as amended	Department of Defense
16 U.S.C. §§1241-1249	National Trails Systems Act of 1986	Department of Defense
32 C.F.R. 190	Natural Resource Management Program for the Department of Defense	Department of Defense
16 U.S.C. §4601	Outdoor Recreation on Federal Lands	Department of Defense
50 C.F.R. 13 para 12-4	Permit Procedures of the USFWS	U.S. Fish & Wildlife Service
Public Law 106-224, 7 U.S.C. §7702	Plant Protection Act	U.S. Department of Agriculture
43 U.S.C. § 1701 et. Seq., 18 U.S.C. §641, and 18 U.S.C. §1361	Protection of Fossils on Federal Lands	Department of Defense
DoD & USFWS MOU	Promote the Conservation of Migratory Birds	Department of Defense
Executive Order 11990	Protection of Wetlands, May 24, 1977	Department of Defense,U.S. Fish & Wildlife Service, & U.S. Army Corps of Engineers
Executive Order 12962	Recreational Fisheries, June 7, 1995	Department of Defense & State DNR
42 U.S.C. 6901-6992 k	Resource Conservation and Recovery Act	Environmental Protection Agency
Executive Order 13186	Responsibilities of Federal Agencies to Protect Migratory Birds, January 10, 2001	U.S. Fish & Wildlife Service
33 U.S.C. §401 *et. seq.*	Rivers and Harbors Act of 1899	U.S. Army Corps of Engineers
16 U.S.C. §670a-f	Sikes Act	U.S. Fish & Wildlife Service, State DNR

Sikes Act Tripartite MOU	Cooperative Integrated Natural Resource Management Program on Military Lands	Department of Defense, U.S. Fish & Wildlife Service, & Association of Fish & Wildlife Agencies
16 U.S.C. §2001	Soil and Water Conservation Act	Secretary of Agriculture
Executive Order 13423	Strengthening Federal Environmental, Energy, and Transportation Management, January 24, 2007	Department of Defense
10 U.S.C. §2665	Timber Sales on Military Lands	Department of Defense
50 C.F.R. 10-16	Taking, Possession, Transportation, Sale, Purchase, & Barter, Exportation & Importation of Wildlife & Plants	U.S. Fish & Wildlife Service
Title I of P.L. 102-440, signed October 23, 1992 (106 Stat. 2224)	Wild Bird Conservation Act	U.S. Fish & Wildlife Service
AR 200-1	*Environmental Protection and Enhancement*	*Department of Army*

APPENDIX B: FLORAL SPECIES LIST

Table B-1: Floral species detected on FMMD since 1994 and their global and state status.

Scientific Name	Common Name	Global Rank	State Status	Invasive Species	1994	2001	2009	2013
Acalypha rhomboidea								X
Acer negundo	Boxelder				X	X	X	X
Acer platanoides	Norway maple			YES	X	X		X
Acer rubrum	Red maple				X	X	X	X
Acer saccharinum	Silver maple				X	X	X	X
Achillea millefolium	Common yarrow				X	X	X	X
Agrimonia parviflora	Small-flowered agrimony				X	X	X	
Agrostis hyemalis	Winter bentgrass				X	X		
Agrostis perennans	Upland bentgrass				X	X		
Agrostis sp.	Bentgrass							X
Agrostis stolonifera	Creeping bentgrass							X
Ailanthus altissima	Tree of heaven			YES	X	X	X	X
Aira caryophyllea	Silver hairgrass				X	X		X
Albizia julibrissin	Mimosa						X	X
Alisma plantago-aquatica	European water plantain				X	X		X
Alisma subcordatum	American water plantain							X
Alliaria petiolata	Garlic mustard			YES	X	X	X	X
Allium cernuum	Wild nodding onion						X	
Allium vineale	Crow garlic			YES	X	X	X	X
Alnus serrulata	Smooth alder				X	X	X	X
Alnus sp.	Alder species						X	

Ambrosia artemisiifolia	Common ragweed				X	X	X	X
Ambrosia trifida	Great ragweed				X	X		
Amelanchier canadensis	Canadian serviceberry				X	X		X
Amorpha fruticosa	False indigo bush							X
Ampelopsis brevipedunculata	Porcelainberry						X	
Amphicarpaea bracteata	Hog-peanut				X	X		X
Anagallis arvensis	Red pimpernel				X	X		
Anaphalis margaritacea	Western pearly everlasting	G5					X	X
Andropogon gerardii	Big bluestem						X	X
Andropogon virginicus	Broomsedge				X	X	X	X
Antennaria neglecta	Field pussytoes				X	X	X	
Antennaria sp.	Pussytoes							X
Anthoxanthum odoratum	Sweet vernal grass							X
Apios americana	Potato bean							X
Apocynum androsaemifolium	Spreading dogbane						X	
Apocynum cannabinum	Dogbane				X	X		X
Arabidopsis thaliana	Mouseear cress				X	X		
Aralia nudicaulis	Wild sarsaparilla				X	X		
Aralia spinosa	Devil's walkingstick				X	X	X	X
Arenaria serpyllifolia	Thymeleaf sandwort				X	X		
Arisaema triphyllum	Jack-in-the-pulpit				X	X		X
Arnoglossum atriplicifolium	Pale Indian plantain					X		
Artemisia annua	Sweet Annie						X	
Artemisia vulgaris	Common mugwort			YES			X	X
Arthraxon hispidus	Small carpgrass						X	X
Aruncus dioicus	Goatsbeard						X	

Arundinaria gigantea	Giant cane	G5						X
Asarum canadense	Canada wild ginger				X	X		X
Asclepias amplexicaulis	Clasping milkweed				X	X		X
Asclepias incarnata	Swamp milkweed				X	X	X	X
Asclepias syriaca	Common milkweed				X	X		X
Asclepias tuberosa	Butterfly milkweed				X	X		X
Asimina triloba	Paw-paw				X	X	X	X
Asplenium platyneuron	Ebony spleenwort				X	X	X	X
Athyrium filix-femina	Lady fern				X	X		X
Baccharis halimifolia	Eastern baccharis						X	
Baptisia tinctoria	Horseflyweed				X	X		X
Barbarea verna	American cress				X	X		
Barbarea vulgaris	Bittercress				X	X		
Berberis thunbergii	Japanese barberry			YES		X	X	X
Betula nigra	River birch				X	X	X	X
Bidens aristosa	Bearded beggarticks					X		
Bidens bipinnata	Spanish needles					X		X
Bidens coronata	Crowned beggarticks	G5					X	X
Bidens frondosa	Devil's beggarticks				X	X		
Boehmeria cylindrica	False nettle				X	X	X	X
Botrychium dissectum	Cut-leaved grape fern				X	X	X	
Botrychium virginianum	Rattlesnake fern				X	X		
Brassica rapa	Field mustard				X	X		
Bromus sterilis	Poverty brome				X	X		
Buglossoides arvensis	Corn gromwell				X	X		
Bulbostylis capillaris	Densetuft hairsedge				X	X		

Buxus sempervirens	Common boxwood						X	
Calamagrostis coarctata	Arctic reedgrass				X	X		X
Callitriche heterophylla	Large water-starwort				X	X		
Caltha palustris	Yellow marsh marigold				X	X		
Calystegia sepium	Hedge false bindweed							X
Campsis radicans	Trumpet creeper					X	X	X
Capsella bursa-pastoris	Shepherds purse						X	X
Cardamine bulbosa	Spring cress				X	X	X	
Cardamine hirsuta	Hairy bittercress				X	X		X
Cardamine sp.	Cress species						X	
Carex alata	Broadwing sedge							X
Carex albolutescens	Greenwhite sedge				X	X		
Carex amphibola	Eastern narrowleaf sedge				X	X		
Carex annectens	Yellowfruit sedge				X	X		
Carex atlantica	Prickly bog sedge				X	X		
Carex atlantica ssp.	Prickly bog sedge							X
Carex billingsii	Billings' sedge				X	X		
Carex blanda	Common woodland sedge							X
Carex bullata	Button sedge	G5					X	
Carex canescens	Silvery sedge				X	X		
Carex castnea	Chestnut sedge						X	
Carex crinita	Fringed sedge				X	X		X
Carex debilis var. *debilis*	White edge sedge				X	X		X
Carex echinata	Star sedge	G5					X	
Carex festucacea	Fescue sedge							X

Carex folliculata	Northern long sedge				X	X		X
Carex frankii	Frank's sedge				X	X		X
Carex glaucodea	Blue sedge							X
Carex granularis	Limestone meadow sedge							X
Carex hirsutella (syn. *Carex complanata* var. *hirsuta*)	Fuzzy wuzzy sedge				X	X		
Carex intumescens	Greater bladder sedge							X
Carex laevivaginata	Smoothsheath sedge				X	X		X
Carex leavenworthii	Leavenworth's sedge				X			
Carex lupulina	Common hop sedge				X	X		
Carex lurida	Shallow sedge				X	X		X
Carex nigromarginata	Black edge sedge				X	X		
Carex pensylvanica	Oak sedge				X	X		
Carex radiata	Stellate sedge					X		X
Carex rosea	Rosy sedge				X	X		
Carex seorsa	Weak stellate sedge				X	X		X
Carex sp.	Sedge species						X	
Carex squarrosa	Squarrose sedge							X
Carex stipata	Awlfruit sedge				X	X		X
Carex stricta	Upright sedge				X	X		
Carex swanii	Swan's sedge				X	X		X
Carex tenuiflora	Shaved sedge				X	X		
Carex tonsa	Shaved sedge				X	X	X	
Carex tribuloides	Blunt broom sedge				X	X		X
Carex trisperma	Threeseeded sedge				X	X		
Carex typhina	Cattail sedge							X

Carex umbellata	Parasol sedge				X	X		X
Carex vulpinoidea	Fox sedge				X	X		X
Carex albicans	Emmon's sedge				X	X		
Carpinus caroliniana	American hornbeam				X	X	X	X
Carya cordiformis	Bitternut hickory				X	X	X	X
Carya glabra	Pignut hickory					X	X	X
Carya ovata	Shagbark hickory						X	
Carya pallida	Sand hickory							X
Carya tomentosa	Mockernut hickory				X	X	X	X
Castanea dentata	American chestnut	G4			X	X		X
Castanea pumila	American chinquapin				X	X		X
Catalpa sp.	Catalpa species						X	
Catalpa speciosa	Northern catalpa					X		X
Celastrus orbiculatus	Oriental bittersweet			YES			X	X
Celastrus scandens	American bittersweet				X	X		
Celtis occidentalis	Common hackberry							X
Cenchrus tribuloides	Sanddune sandbur							X
Centaurea cyanus	Cornflower						X	
Centaurea maculosa)	Spotted knapweed			YES	X	X	X	X
Cephalanthus occidentalis	Buttonbush				X	X	X	X
Cerastium arvense	Field chickweed				X	X		X
Cerastium fontanum ssp. v*ulgare*	Big chickweed							X
Cerastium glomeratum	Sticky chickweed				X	X		
Cerastium semidecandrum	Little mouseear				X	X		
Cercis canadensis	Redbud				X	X	X	X
Chaenomeles speciosa	Flowering quince						X	

Chamaecrista fasciculata	Partridge pea						X	X
Chasmanthium laxum	Slender woodoats				X	X		X
Chimaphila maculata	Spotted wintergreen				X	X	X	X
Chionanthus virginicus	White fringetree				X	X		
Cichorium intybus	Chicory				X	X	X	X
Cicuta maculata	Spotted water hemlock				X	X		
Cinna arundinacea	Sweet woodreed							X
Circaea lutetiana	Enchanter's nightshade							X
Cirsium arvense	Canada thistle			YES	X	X	X	
Cirsium vulgare	Spear thistle			YES	X	X	X	X
Claytonia virginica	Eastern spring beauty							X
Clematis sp.	Leather flower species				X	X		
Clematis virginiana	Virgin's bowers					X	X	
Clethra alnifolia	Coastal sweet pepperbush				X	X	X	X
Collinsonia canadensis	Richweed						X	
Comandra umbellata	Bastard toadflax				X	X		
Commelina communis	Asiatic dayflower				X	X	X	X
Commelina virginica	Virginia dayflower				X	X	X	
Conoclinium coelestinum	Hardy ageratum						X	
Convallaria majalis	European Lily of the Valley							X
Convolvulus sp.	Bindweed species						X	
Conyza canadensis	Canadian horseweed				X	X		
Conyza canadensis	Canadian horseweed						X	X

Coreopsis verticillata	Whorled coreopsis	G5					X	
Cornus amomum	Silky dogwood				X	X		
Cornus florida	Flowering dogwood				X	X	X	X
Cornus racemosa	Gray dogwood						X	
Cornus sericea	Red twig dogwood						X	
Cornus sericea	Redosier dogwood						X	
Cornus sp.	Dogwood species						X	
Corydalis flavula	Yellow fumewort				X	X		X
Corylus americana	American hazelnut				X	X		
Cotoneaster sp.	Cotoneaster species				X	X		
Cuscuta gronovii	Scaldweed				X	X		X
Cynanchum laeve	Honeyvine							X
Cynodon dactylon	Bermuda grass					X	X	X
Cyperus echinatus	Globe flatsedge				X	X		X
Cyperus esculentus	Chufa sedge				X	X		
Cyperus grayi	Gray's flatsedge				X	X		
Cyperus lupulinus	Great Plains flatsedge							X
Cyperus polystachyos	Many-spiked flatsedge							X
Cyperus retrorsus	Pine barren flatsedge				X	X		
Cyperus strigosus	Strawcolored flatsedge				X	X		X
Cypripedium acaule	Moccasin flower				X	X		X
Dactylis glomerata	Orchard grass				X	X		X
Danthonia sericea	Downy danthonia				X	X		
Danthonia spicata	Poverty grass							X
Daucus carota	Queen Anne's lace				X	X	X	X

Dennstaedtia punctilobula	Hay-scented fern				X	X	X	X
Desmodium nudiflorum	Naked flowered tick trefoil				X	X		
Desmodium paniculatum	Panicled tick-trefoil				X	X		X
Dianthus armeria	Grass Pink				X	X	X	X
Dianthus barbatus	Sweet William				X	X		
Dichanthelium acuminatum	Western panicgrass							X
Dichanthelium clandestinum	Deertounge				X	X	X	X
Dichanthelium commutatum	Variable panicgrass							X
Dichanthelium depauperatum	Starved panic grass				X	X		
Dichanthelium dichotomum	Forked rosette-panicgrass				X	X		X
Dichanthelium leucothrix	Rough panicgrass	G4Q			X	X		
Dichanthelium sabulorum	Hemlock rosette grass				X	X		
Dichanthelium scoparium	Velvet panicum				X	X		X
Diervilla lonicera	Bush honeysuckle						X	
Digitaria ischaemum	Smooth crabgrass							X
Digitaria sanguinalis	Hairy crabgrass						X	X
Diodia teres	Poorjoe				X	X		X
Dioscorea villosa	Wild yam				X	X		X
Diospyros virginiana	Common persimon				X	X	X	X
Dipsacus fullonum	Wild teasel				X	X		X
Draba verna	Shadflower				X	X		
Dryopteris cristata	Crested woodfern							X
Dryopteris expansa	Spreading woodfern							X
Dryopteris marginalis	Marginal woodfern							X
Dryopteris sp.	Wood fern species						X	X

Duchesnea indica	Indian strawberry				X	X		X
Echinochloa crus-galli	Barnyardgrass						X	X
Echinochloa muricata	Rough barnyardgrass							X
Echinochloa sp.	Cockspur grass species				X	X		
Echinochloa walteri	Coast cockspur grass				X	X		
Echinocystis lobata	Wild cucumber				X	X		
Eclipta alba	False daisy				X	X		
Elaeagnus angustifolia	Silver berry						X	X
Elaeagnus umbellata	Japanese silverberry			YES			X	X
Eleocharis obtusa	Blunt Spike Rush					X		X
Eleocharis ovata	Ovate spikerush				X	X		X
Eleocharis quadrangulata	Squarestem spikerush				X	X		
Eleocharis sp.	Spikerush							X
Eleocharis tenuis	Slender spikerush				X	X		
Elodea canadensis	Pondweed				X	X		
Elymus hystrix	Eastern bottlebrush grass							X
Elymus riparius	Riverbank wildrye							X
Elymus virginicus	Virginia wild-rye				X	X		X
Epifagus virginiana	Beechdrops				X	X		X
Epigaea repens	Trailing arbutus						X	
Epilobium sp.	Fireweed species				X	X		
Equisetum arvense	Field horsetail				X	X		X
Equisetum pratense	Meadow horsetail				X	X		
Eragrostis capillaris	Lace grass				X	X		
Eragrostis pectinacea	Tufted lovegrass							X

Eragrostis sp.	Lovegrass species				X	X		
Eragrostis spectabilis	Purple lovegrass						X	X
Erechtites hieracifolia	Fireweed							X
Erigeron annuus	Daisy fleabane				X	X	X	
Erigeron strigosus	Prairie fleabane							X
Erythronium americanum	Yellow trout lily						X	
Eubotrys racemosa	Swamp doghobble				X	X		X
Euonymus alatus	Winged euonymus						X	
Euonymus americanus	Strawberry bush				X	X		X
Euonymus sp.	Euonymus species						X	
Eupatorium album	White boneset				X	X	X	
Eupatorium altissimum	Tall thoroughwort	G5			X	X		
Eupatorium dubium	Eastern Joe-pye weed						X	
Eupatorium hyssopifolium	Hyssopifolium				X	X	X	X
Eupatorium perfoliatum	Common boneset						X	X
Eupatorium purpureum	Kidney-root				X	X		
Eupatorium rotundifolium	Roundleaf thoroughwort				X	X		
Eupatorium serotinum	Late boneset				X	X		X
Euphorbia corollata	Flowering spurge				X	X		X
Euphorbia ipecacuanhae	American ipecac				X	X		X
Eurybia divaricata	White wood aster				X	X		
Euthamia graminifolia	Flat-top goldentop				X	X		X
Fagus grandifolia	American beech				X	X	X	X
Festuca myuros	Rat's tail fescue				X	X		
Festuca rubra	Red fescue				X	X		
Festuca subverticillata	Nodding fescue				X	X		X
Filipendula ulmaria	Meadowsweet						X	
Floerkea proserpinacoides	False mermaid				X	X		

Fragaria virginiana	Virginia strawberry				X	X		
Fraxinus americana	White ash						X	
Fraxinus pennsylvanica	Green ash				X	X	X	X
Froelichia floridana	Plains snakecotton							X
Gaillardia aristata	Common gallardia						X	
Galium aparine	Stickywilly				X	X		X
Galium sp.	Bedstraw							X
Galium tinctorium	Stiff marsh bedstraw							X
Galium triflorum	Fragrant bedstraw				X	X		
Gaultheria procumbens	Eastern teaberry					X		X
Gaylussacia baccata	Black huckleberry				X	X		X
Gaylussacia frondosa	Dangleberry				X	X		X
Geranium carolinianum	Carolina geranium				X	X		X
Geranium dissectum	Cutleaf geranium				X	X		
Geum canadense	White avens				X	X		
Geum virginianum	Cream avens				X	X		
Glechoma hederacea	Ground ivy				X	X	X	X
Gleditsia triacanthos	Honey locust				X	X	X	
Glyceria obtusa	Atlantic mannagrass				X	X		
Glyceria sp.	Mannagrass species						X	
Glyceria striata	Fowl mannagrass				X	X		X
Goodyera pubescens	Downy rattlesnake plantain					X	X	
Hamamelis virginiana	Common witch hazel				X	X		
Hedera helix	English ivy			YES			X	X
Helianthemum canadense	Longbranch frostweed				X	X		X

Helianthemum propinquum	Low frostweed				X	X		
Helianthus divaricatus	Woodland sunflower				X	X		
Helianthus salicifolius	Willowleaf sunflower						X	
Helianthus tuberosus	Jerusalem artichoke						X	
Hemerocallis fulva	Orange daylilly			YES				X
Hesperis matronalis	Dames rocket				X	X		
Hibiscus moscheutos	Rose mallow						X	X
Hieracium caespitosum	Meadow hawkweed						X	
Hieracium gronovii	Queendevil				X	X		X
Hieracium sp.	Hawkweed species						X	
Holcus lanatus	Common velvetgrass				X	X	X	X
Hordeum pusillum	Little barley				X	X		X
Hordeum vulgare	Common barley				X	X		
Humulus japonicus	Japanese hops			YES	X	X		X
Hydrophyllum virginianum	Virginia waterleaf				X	X		X
Hypericum canadense	Lesser St. John's-wort							X
Hypericum gentianoides	Orangegrass				X	X		X
Hypericum hypericoides	St. Andrew's cross							X
Hypericum mutilum	Dwarf St. Johnswort				X	X		X
Hypericum perforatum	Common St. Johnswort					X	X	
Hypochaeris radicata	Catsear				X	X		X
Hypoxis hirsuta	Common goldstar				X	X		
Ilex laevigata	Smooth winterberry				X	X		X

Ilex opaca	American holly				X	X	X	X
Ilex verticillata	Winterberry				X	X	X	X
Impatiens capensis	Common jewelweed				X	X	X	X
Impatiens pallida	Yellow jewelweed				X	X		
Ipomoea pandurata	Man of the earth							X
Iris versicolor	Blue flag				X	X		
Isotria verticillata	Large whorled pogonia				X	X		
Itea virginica	Henry's garnet				X	X		
Juglans cinerea	White walnut	G4					X	
Juglans nigra	Black walnut				X	X	X	X
Juncus acuminatus	Tapertip rush				X	X		X
Juncus biflorus	Bog rush							X
Juncus canadensis	Canadian rush				X	X		X
Juncus debilis	Weak rush						X	
Juncus dichotomus	Forked rush							X
Juncus effusus	Common rush				X	X	X	X
Juncus marginatus	Grassleaf rush							X
Juncus scirpoides	Needlepod rush				X	X		
Juncus secundus	Lopsided rush				X	X		
Juncus sp.	Rush species				X	X		
Juncus tenuis	Poverty rush				X	X		X
Juncus torreyi	Torrey's rush	G5	E					X
Juncus validus	Roundhead rush							X
Juniperus virginiana	Eastern red-cedar				X	X	X	X
Kalmia angustifolia	Sheep laurel	G5			X	X		
Kalmia latifolia	Mountain laurel				X	X	X	X
Krigia virginica	Virginia dwarf dandelion				X	X		

Kummerowia striata	Japanese clover							X
Lactuca canadensis	Wild lettuce				X	X	X	X
Lamium amplexicaule	Henbit deadnettle				X	X		X
Lamium purpureum	Purple dead nettle				*X*	*X*	X	*X*
Lechea minor	Thymeleaf pinweed				X	X		
Lechea racemulosa	Illinois pinweed				X	X		
Lechea sp.	Pinweed							X
Leersia oryzoides	Rice cutgrass				X	X		X
Leersia virginica	Whitegrass				X	X		X
Lemna minor	Duckweed						X	
Lepidium campestre	Field pepperweed				X	X	X	X
Lepidium virginicum	Wild peppergrass				X	X	X	
Lespedeza cuneata	Sericea lespedeza							X
Lespedeza procumbens	Trailing lespedeza				X	X		X
Lespedeza repens	Creeping lespedeza				X	X		X
Lespedeza sp.	Lespedeza species						X	X
Lespedeza stuevei	Tall lespedeza	G4?			X	X		
Lespedeza virginica	Slender lespedeza				X	X		X
Leucanthemum vulgare	Ox-eye daisy				X	X	X	X
Ligustrum sp.	Privet							X
Ligustrum vulgare	European privet					X	X	X
Lilium superbum	Turk's-cap lily							X
Lindera benzoin	Spicebush				X	X	X	X
Lindernia dubia	Yellowseed false pimpernel				X	X		X
Linum medium	Stiff yellow flax				X	X		
Liquidambar styraciflua	Sweet gum				X	X	X	X
Liriodendron tulipifera	Tuliptree				X	X	X	X
Lobelia cardinalis	Cardinal flower				X	X		

Lobelia inflata	Indian tobacco					X		
Lobelia siphilitica	Great blue lobelia				X	X		
Lonicera japonica	Japanese honeysuckle			YES	X	X	X	X
Lonicera maackii	Bush honeysuckle			YES				X
Lonicera tatarica	Tatarian honeysuckle			YES		X		
Ludwigia alternifolia	Seedbox				X	X		
Ludwigia palustris	Marsh seedbox				X	X	X	X
Luzula bulbosa	Bulbous woodrush				X	X		
Luzula multiflora	Common woodrush				X	X		X
Lycopodium clavatum	Wolf's-foot clubmoss				X	X		
Lycopodium digitatum	Ground pine						X	X
Lycopodium obscurum	Ground pine				X	X		X
Lycopus americanus	Water horehound				X	X		X
Lycopus virginicus	Bugle-weed				X	X		X
Lyonia ligustrina	Maleberry				X	X		
Lyonia mariana	Piedmont staggerbush				X	X		
Lysimachia ciliata	Fringed loosestrife				X	X		
Lysimachia nummularia	Creeping Jenny				X	X		X
Lysimachia quadrifolia	Whorled loosestrife				X	X		X
Lythrum salicaria	Purple loosestrife			YES	X	X		
Magnolia virginiana	Sweet-bay magnolia				X	X	X	X
Maianthemum racemosum	False Soloman's seal							X
Smilacina racemosa					X	X	X	X

Malus angustifolia	Southern crab apple	G5?					X	
Matteuccia struthiopteris	Ostrich fern	G5					X	
Medeola virginiana	Indian cucumber				X	X		X
Medicago lupulina	Black medic				X	X	X	X
Melampyrum lineare	Narrowleaf cowwheat				X	X		X
Melilotus albus	Sweet clover				X	X	X	X
Menispermum canadense	Common moonseed							X
Mentha aquatica	Water mint						X	
Mentha arvensis	Field mint						X	X
Mentha spicata	Spearmint				X	X	X	
Mertensia virginica	Virginia bluebell							X
Microstegium vimineum	Japanese stiltgrass			YES	X	X	X	X
Mikania scandens	Climbing hempvine							X
Mimulus alatus	Sharpwing monkeyflower				X	X		
Mimulus ringens	Allegheny monkeyflower				X	X		X
Miscanthus sinensis	Chinese silvergrass			YES			X	X
Mitchella repens	Partridgeberry				X	X	X	X
Monarda punctata	Spotted horsemint							X
Monotropa uniflora	Indian pipe				X	X	X	X
Morella pensylvanica	Northern bayberry				X	X		
Morus alba	White mulberry					X		X
Morus rubra	Red mulberry				X	X	X	
Muhlenbergia frondosa	Wirestem muhly				X	X		
Muhlenbergia schreberi	Nimbelwill muhly							X
Muhlenbergia sp.	Muhly							X

Myosotis arvensis	Field forget-me-not				X	X		X
Myosotis stricta	Strict forget-me-not				X	X		
Myriophyllum aquaticum	Parrot feather			YES	X	X	X	X
Narcissus sp.	Daffodil							X
Nuphar lutea	Yellow pond-lily						X	X
Nuttallanthus canadensis	Canada toadflax				X	X		X
Nymphaea odorata	American white water lily				X	X		
Nyssa sylvatica	Black gum				X	X	X	X
Oenothera biennis	Common evening primrose						X	
Oenothera laciniata	Cutleaf evening primrose							X
Oenothera perennis	Little evening primrose				X	X		
Onoclea sensibilis	Sensitive fern				X	X	X	X
Oplismenus hirtellus	Basketgrass							X
Opuntia humifusa	Devil's tongue							X
Ornithogalum umbellatum	Star-of-Bethlehem				X	X		X
Osmunda cinnamomea	Cinnamon fern				X	X	X	X
Osmunda regalis	Royal fern				X	X		X
Oxalis stricta	Common yellow oxalis				X	X	X	X
Packera aurea	Golden ragwort							X
Panicum anceps	Beaked panicgrass							X
Panicum boscii	Bosc's panicgrass							X
Panicum dichotomiflorum	Fall panic grass				X	X	X	X
Panicum rigidulum	Redtop panicgrass							X
Panicum sp.	Panicum species						X	
Panicum virgatum	Switchgrass						X	X

Parckera anonyma	Small's ragwort				X	X		
Parthenocissus quinquefolia	Virginia creeper				X	X	X	X
Paspalum laeve	Field paspalum							X
Paulownia tomentosa	Princess tree					X	X	X
Peltandra virginica	Green arrow arum				X	X		X
Penstemon grandiflorus	Large beardtongue						X	
Perilla frutescens	Beefsteakplant			YES	X	X	X	X
Phalaris arundinacea	Reed canarygrass						X	X
Photinia floribunda	Purple chokeberry	G4G5Q			X	X		
Photinia pyrifolia	Red Chokeberry				X	X		X
Phragmites australis	Common reed			YES	X	X	X	X
Physalis heterophylla	Clammy ground cherry						X	
Physalis pubescens	Husk tomato							X
Phytolacca americana	American pokeweed				X	X	X	X
Picea pungens	Blue spruce						X	
Pilea pumila	Clearweed				X	X	X	X
Pinus echinata	Shortleaf pine				X	X		
Pinus resinosa	Red pine					X		
Pinus rigida	Pitch pine					X	X	X
Pinus strobus	Eastern white pine				X	X	X	X
Pinus taeda	Loblolly pine				X	X	X	X
Pinus virginiana	Virginia pine				X	X	X	X
Plantago aristata	Largebracted plantain							X
Plantago lanceolata	Narrowleaf plantain				X	X	X	X
Plantago major	Common plantain						X	X
Plantago virginica	Virginia plantain							X

Platanus occidentalis	American sycamore				X	X	X	X
Poa annua	Annual meadow grass							X
Poa autumnalis	Autumn bluegrass						X	
Poa bulbosa	Bulbous bluegrass				X	X		
Poa compressa	Canada bluegrass				X	X		
Poa pratensis	Kentucky bluegrass				X	X		
Poa trivialis	Rough bluegrass							X
Podophyllum peltatum	Mayapple				X	X		X
Polygonatum biflorum	Smooth Soloman's seal							X
Polygonum arifolium	Halberd-leaved tearthumb				X	X		X
Polygonum cespitosum	Tufted knotweed				X	X		X
var. *longisetum*	Oriential lady's thumb							X
Polygonum cuspidatum	Mile-a-minute			YES		X	X	X
Polygonum erectum	Erect knotweed							X
Polygonum pensylvanicum	Pennsylvania smartweed				X	X	X	
Polygonum perfoliatum	Asiatic tearthumb			YES	X	X	X	X
Polygonum persicaria	Spootted ladysthumb						X	X
Polygonum punctatum	Ditted smartweed							X
Polygonum sagittatum	Arrowleaf tearthumb				X	X		X
Polygonum sp.	Smartweed species						X	
Polygonum virginianum	Jumpseed				X	X		X
Polygonum hydropiperoides	Swamp smartweed				X	X		
Polystichum acrostichoides	Christmas fern						X	X

Pontederia cordata	Pickerelweed				X	X	X	X
Populus alba	Silver poplar							X
Populus deltoides	Eastern cottonwood						X	X
Populus grandidentata	American aspen				X	X		X
Potamogeton crispus	Curly pondweed			YES	X	X		
Potentilla argentea	Silver cinquefoil				X	X		
Potentilla arguta	Prairie cinquefoil	G5			X	X		
Potentilla recta	Sulphur cinquefoil				X	X		
Potentilla simplex	Common cinquefoil						X	X
Prenanthes sp.	Rattlesnakeroot							X
Primula sp.	Primrose species						X	
Prunella vulgaris	Common selfheal						X	X
Prunus avium	Sweet cherry						X	X
Prunus serotina	Black cherry				X	X	X	X
Pseudoghaphalium obtusifolium	Rabbit-tobacco				X	X		
Pteridium aquilinum	Bracken fern				X	X		X
Ptilimnium capillaceum	Herbwilliam							X
Pycnanthemum tenuifolium	Mountain mint							X
Pyrus calleryana	Callery pear			YES			X	X
Pyrus communis	Pear tree				X	X	X	
Quercus acutissima	Sawtooth oak							X
Quercus alba	White oak				X	X	X	X
Quercus bicolor	Swamp white oak				X	X	X	X
Quercus coccinea	Scarlet oak				X	X		X
Quercus falcata	Southern red oak				X	X	X	X
Quercus laevis	Turkey oak						X	
Quercus lyrata	Swamp post oak							X
Quercus marilandica	Black-jack oak				X	X	X	

Quercus michauxii	Swamp chestnut oak							X
Quercus montana	Chestnut oak						X	X
Quercus palustris	Pin oak				X	X	X	X
Quercus phellos	Willow oak				X	X	X	X
Quercus rubra	Northern red oak				X	X	X	X
Quercus stellata	Post oak						X	X
Quercus velutina	Black oak				X	X	X	X
Ranunculus abortivus	Litterleaf buttercup				X	X		X
Ranunculus bulbosus	St. Anthony's turnip							X
Ranunculus ficaria	Fig buttercup							X
Ranunculus hispidus	Bristly buttercup					X		
Ranunculus sceleratus	Cursed buttercup				X	X		X
Ranunculus sp.	Buttercup species						X	
Rhexia mariana	Maryland meadowbeauty							X
Rhexia virginica	Handsome Harry				X	X		X
Rhododendron atlanticum	Dwarf azalea				X	X		X
Rhododendron periclymenoides	Pink azalea				X	X		X
Rhododendron viscosum	Swamp azalea				X	X		X
Rhus copallinum	Winged sumac				X	X	X	X
Rhus glabra	Smooth sumac				X	X		
Rhus typhina	Staghorn sumac				X	X	X	
Rhynchospora chalarocephala	Loosehead beaksedge							X
Rhynchospora microcephala	Smallhead beaksedge	G5						X
Robinia pseudoacacia	Black locust				X	X	X	X
Rosa carolina	Carolina rose							X
Rosa multiflora	Multiflora rose			YES	X	X	X	X

Rosa palustris	Swamp Rose						X	
Rosa virginiana	Virginia rose							X
Rubus allegheniensis	Allegheny blackberry						X	X
Rubus argutus	Sawtooth blackberry				X	X		X
Rubus cuneifolius	Sand blackberry							X
Rubus flagellaris	Common dewberry							X
Rubus hispidus	Swamp dewberry				X	X		X
Rubus idaeus	Red raspberry						X	
Rubus occidentalis	Black raspberry						X	
Rubus phoenicolasius	Japanese wineberry							X
Rudbeckia hirta	Black-eyed Susan				X	X	X	X
Rudbeckia nitida	Shiny coneflower						X	
Rumex acetosella	Sheep's sorrel				X	X		X
Rumex crispus	Curly dock				X	X	X	X
Rumex obtusifolius	Broadleafed dock				X	X		
Sagittaria graminea	Grassy arrowhead	G5			X	X		
Sagittaria latifolia	Broadleaf arrowhead				X	X	X	X
Salix babylonica	Weeping willow							X
Salix discolor	Pussy willow	G5			X	X		
Salix humilis	Prairie willow	G5T4T5			X	X		
Salix nigra	Black willow				X	X	X	X
Salix x sepulcralis	Weeping willow							X
Sambucus canadensis	Common elder				X	X	X	X
Sanguisorba minor	Salad burnet				X	X		
Sassafras albidum	Sassafras				X	X	X	X
Saururus cernuus	Lizard's tail				X	X	X	X
Schedonorus arundinaceus	Tall fescue				X	X	X	X

Schizachyrium scoparium	Little bluestem							X
Scirpus validus	Softstem bulrush				X	X		X
Scirpus atrovirens	Green bulrush				X	X		X
Scirpus cyperinus	Woolgrass				X	X	X	X
Scirpus polyphyllus	Leafy bulrush							X
Scleranthus annuus	German knotgrass				X	X		X
Scrophularia marilandica	Late figwort				X	X		
Scutellaria integrifolia	Helmet flower				X	X		X
Securigera varia	Crownvetch						X	
Senecio sp.	Ragwort							X
Senna hebecarpa	American senna							X
Setaria faberi	Japanese bristlegrass				X	X	X	X
Setaria parviflora	Marsh bristlegrass							X
Setaria pumila	Yellow foxtail							X
Silene stellata	Widowsfrill				X	X		
Sisyrinchium angustifolium	Blue-eyed grass				X	X		X
Smilax glauca	Cat greenbriar				X	X	X	X
Smilax rotundifolia	Common greenbriar				X	X	X	X
Solanum carolinense	Carolina horsenettle				X	X	X	X
Solidago altissima	Late goldenrod				X			X
Solidago odora	Anisesecented goldenrod				X	X		X
Solidago puberula	Downy goldenrod							X
Solidago rugosa	Wrinkleleaf goldenrod				X	X		X
Sparganium americanum	American bur-reed				X	X		X
Sparganium sp.	Bur reed species						X	
Spergula arvensis	Corn spurry				X	X		X

Sphagnum sp.	Sphagnum							X
Spiraea prunifolia	Bridalwreath spiraea							X
Stellaria graminea	Grass-like starwort				X	X		
Stellaria longifolia	Longleaf starwort				X	X		
Stellaria media	Common chickweed				X	X	X	X
Strophostyles umbellata	Pink fuzzybean				X	X		
Symphoricarpos orbiculatus	Coralberry						X	X
Symphyotrichum novae-angliae	New England aster				X	X		
Symphyotrichum cordifolium	Heart-leaved aster				X	X		
Symphyotrichum ericoides	Heath aster				X	X		
Symphyotrichum pilosum	Hairy white oldfield aster				X	X		X
Symphyotrichum patens	Late purple aster				X	X		
Symphyotrichum puniceum	Purple stem aster				X	X		
Symphyotrichum racemosum	Smooth white oldfield aster							X
Symphyotrichum sp.	Aster species							X
Symplocarpus foetidus	Skunk cabbage				X	X	X	X
Taraxacum officinale	Common dandelion				X	X	X	X
Taxodium distichum	Bald cypress							X
Teesdalia nudicaulis	Barestem teesdalia				X	X		X
Teucrium canadense	Canada germander							X
Thalictrum polygamum	Tall meadow rue					X		
Thalictrum thalictroides	Rue anemone						X	
Thelypteris noveboracensis	New York fern				X	X		X
Tipularia discolor	Crippled cranefly					X		
Toxicodendron radicans	Poison ivy				X	X	X	X
Toxicodendron vernix	Poison sumac							X

Triadenum virginicum	Virginia marsh St. Johnswort				X	X		
Trichostema dichotomum	Forked bluecurls				X	X		X
Tridens flavus	Greasegrass				X	X		X
Trifolium arvense	Rabbitfoot clover				X	X		X
Trifolium pratense	Red clover				X	X	X	
Trifolium repens	White clover						X	X
Trifolium sp.	Clover species						X	
Triodanis perfoliata (syn.	Clasping Venus' looking- glass				X	X		X
Tussilago farfara	Coltsfoot				X	X		X
Typha angustifolia	Lesser bulrush				X	X		X
Typha latifolia	Common cattail				X	X	X	X
Ulmus americana	American elm					X		X
Ulmus rubra	Slippery elm				X	X	X	
Urtica dioica	Stinging nettle				X	X		
Urticularia sp.	Bladderwort species				X	X		
Uvularia perfoliata	Perfoliate bellwort							X
Uvularia sessilifolia	Wild oats							X
Vaccinium angustifolium	Lowbush blueberry				X	X		
Vaccinium corymbosum	Highbush blueberry				X	X	X	X
Vaccinium pallidum	Lowbush blueberry						X	X
Vaccinium sp.	Blueberry							X
Vaccinium stamineum	Deerberry							X
Valerianella radiata	Beaked cornsalad							X
Verbascum blattaria	Moth mullein				X	X		X
Verbascum thapsus	Great mullein				X	X	X	X
Verbena hastata	Swamp verbena				X	X		X
Verbena simplex	Narrowleaf vervain				X	X		X

Verbena stricta	Hoary verbena				X	X		
Verbena urticifolia	White vervain				X	X		X
Verbensia sp.	Crownbeard species						X	
Verbesina alternifolia	Wingstem						X	X
Vernonia noveboracensis	New York ironweed				X	X		X
Veronica arvensis	Corn speedwell							X
Veronica hederacea	Ground ivy							X
Veronica officinalis	Common speedwell				X	X		
Veronica persica	Bird's eye speedwell						X	
Veronica sp.	Speedwell species				X	X		X
Viburnum dentatum	Southern arrowwood				X	X	X	X
Viburnum nudum	Possumhaw viburnum				X	X		X
Viburnum prunifolium	Blackhaw				X	X	X	X
Vicia cracca	Tufted vetch							X
Vicia sativa	Common vetch							X
Vicia sativa ssp. *nigra*	Garden vetch							X
Vicia villosa	Winter vetch				X	X		
Vinca minor	Lesser periwinkle						X	X
Viola arvensis	European field pansy				X	X		
Viola bicolor	Field pansy				X	X		
Viola blanda	Sweet white violet				X	X		
Viola cucullata	Marsh blue violet				X	X		
Viola macloskeyi	Small white violet							X
Viola sororia	Common blue violet				X	X		

Viola sp.	Violet species						X	
Viola striata	Striped cream violet							X
Viola x *primulifolia*	Primrose-leaved violet				X	X		X
Vitis aestivalis	Summer grape				X	X		X
Vitis aestivalis	Summer grape							X
Vitis labrusca	Fox grape						X	
Vitis riparia	Riverbank grape							X
Vitis rotundifolia	Muscadine							X
Vitis sp.	Grape species						X	
Vitis vulpina	Frost grape				X	X		X
Vulpia octoflora	Sixweeks fescue				X	X		
Woodwardia areolata	Netted chainfern				X	X		X
Woodwardia virginica	Virginia chain fern				X	X		
Xanthium strumarium	Rough cocklebur							X
Xyris caroliniana	Carolina yelloweyed grass				X	X		X
Yucca filamentosa	Adam's needle yucca						X	

APPENDIX C: FAUNAL SPECIES DETECTED ON FMMD

Table C-1: Faunal Species detected on FMMD and their state and federal status**.**

Taxa	Common Name	Species	Federally listed	State listed
Amphibian	American Bullfrog	*Lithobates catesbeianus*		
Amphibian	Eastern American Toad	*Anaxyrus americanus americanus*		
Amphibian	Eastern Cricket Frog	*Acris crepitan crepitans*		
Amphibian	Eastern mud salamander	*Pseudotriton montanus*		
Amphibian	Eastern Red-backed Salamander	*Plethodon cinereus*		
Amphibian	Four-toed Salamander	*Hemidactylium scutatum*		
Amphibian	Fowler's Toad	*Anaxyrus fowleri*		
Amphibian	Gray Tree Frog	*Hyla versicolor*		
Amphibian	Marbled Salamander	*Ambystoma opacum*		
Amphibian	Northern Dusky Salamander	*Desmognathus fuscus*		
Amphibian	Northern Green Frog	*Lithobates clamitans melanota*		
Amphibian	Northern Red Salamander	*Pseudotriton ruber*		
Amphibian	Southern Leopard Frog	*Lithobated sphenocephalus*		

Amphibian	Spotted Salamander	*Ambystoma maculatum*		
Amphibian	Spring Peeper	*Pseudacris crucifer*		
Amphibian	Wood frog	*Rana sylvatica*		
Reptile	Common Five-lined Skink	*Plestiodon fasciatus*		
Reptile	Eastern Box Turtle	*Terrapine carolina carolina*		
Reptile	Eastern Gartersnake	*Thamnophis sirtalis sirtalis*		
Reptile	Eastern Hog-nosed Snake	*Heterodon platirhinos*		
Reptile	Eastern Painted Turtle	*Chrysemys picta picta*		
Reptile	Eastern Ratsnake	*Pantherophis alleghaniensis*		
Reptile	Eastern Smooth Snake	*Virginia valeriae valeriae*		
Reptile	Eastern Snapping Turtle	*Chelydra serpentina serpentina*		
Reptile	Eastern Wormsnake	*Carphophis amoenus amoenus*		
Reptile	Little Brown Skink	*Scincella lateralis*		
Reptile	Northern Brownsnake	*Storeria dekayi dekayi*		
Reptile	Northern Red-bellied Cooter	*Pseudemys rubriventris*		
Reptile	Northern Ring-necked Snake	*Diadophis punctatus edwardsii*		
Reptile	Northern Rough Greensnake	*Opheodrys aestivus*		

Reptile	Northern Watersnake	*Nerodia Sipedon*		
Reptile	Pickeral Frog	*Lithobates palustris*		
Reptile	Red-eared Slider	*Trachemys scripta elegans*		
Bird	Acadian flycatcher	*Empidonax virescens*		
Bird	American Crow	*Corvus brachyrhynchos*		
Bird	American Goldfinch	*Spinus tristis*		
Bird	American kestrel	*Falco sparverius*		
Bird	American redstart	*Setophaga ruticilla*		
Bird	American Robin	*Turdus migratorius*		
Bird	American Woodcock	*Scolopax minor*		
Bird	Bald Eagle	*Haliaeetus leucocephalus*		
Bird	Baltimore Oriole	*Icterus galbula*		
Bird	Barn swallow	*Hirundo rustica*		
Bird	Barred owl	*Strix varia*		
Bird	Belted kingfisher	*Megaceryle alcyon*		
Bird	Black and white warbler	*Mniotilta varia*		
Bird	Black Vulture	*Coragyps atratus*		
Bird	Blue Jay	*Cyanocitta cristata*		
Bird	Blue-gray gnatcatcher	*Polioptila caerulea*		
Bird	Broad-winged hawk	*Buteo platypterus*		

Bird	Brown creeper	*Certhia americana*		
Bird	Brown thrasher	*Toxostoma rufum*		
Bird	Brown-headed Cowbird	*Molothrus ater*		
Bird	Canada Goose	*Branta canadensis*		
Bird	Canada warbler	*Wilsonia canadensis*		
Bird	Carolina Chickadee	*Poecile carolinensis*		
Bird	Carolina Wren	*Thryothorus ludovicianus*		
Bird	Cedar waxwing	*Bombycilla cedrorum*		
Bird	Chimney swift	*Cheatura pelagica*		
Bird	Chipping sparrow	*Spizella passerina*		
Bird	Common flicker	*Colaptes auratus*		
Bird	Common Grackle	*Quiscalus quiscula*		
Bird	Common snipe	*Gallinago gallinago*		
Bird	Common yellowthroat	*Geothlypis trichas*		
Bird	Cooper's Hawk	*Accipiter cooperii*		
Bird	Dark-eyed Junco	*Junco hyemalis*		
Bird	Downy woodpecker	*Picoides pubescens*		
Bird	Eastern Bluebird	*Sialia sialis*		
Bird	Eastern kingbird	*Tyrannus tyrannus*		
Bird	Eastern meadowlark	*Sturnella magna*		

Bird	Eastern pewee	*Contopus virens*		
Bird	Eastern Phoebe	*Sayornis phoebe*		
Bird	Eastern Towhee	*Pipilo erythrophthalmus*		
Bird	European Starling	*Sturnus vulgaris*		
Bird	Fish Crow	*Corvus ossifragus*		
Bird	Golden-crowned Kinglet	*Regulus satrapa*		
Bird	Gray Catbird	*Dumetella carolinensis*		
Bird	Great Blue Heron	*Ardea herodias*		
Bird	Great crested flycatcher	*Myiarchus crinitus*		
Bird	Great horned owl	*Bubo virginianus*		
Bird	Green heron	*Butorides virescens*		
Bird	Hairy Woodpecker	*Picoides villosus*		
Bird	Hermit Thrush	*Catharus guttatus*		
Bird	Hooded Merganser	*Lophodytes cucullatus*		
Bird	House Finch	*Haemorhous mexicanus*		
Bird	House Sparrow	*Passer domesticus*		
Bird	House wren	*Troglodytes aedon*		
Bird	Indigo bunting	*Passerina cyanea*		
Bird	Kentucky warbler	*Geothlypis formosa*		

Bird	Killdeer	*Charadrius vociferus*		
Bird	Mallard	*Anas platyrhynchos*		
Bird	Mourning Dove	*Zenaida macroura*		
Bird	Northern Cardinal	*Cardinalis cardinalis*		
Bird	Northern junco	*Junco hyemalis*		
Bird	Northern mockingbird	*Mimus polyglottos*		
Bird	Northern parula warbler	*Setophaga americana*		
Bird	Northern rough-winged swallow	*Stelgidopteryx serripennis*		
Bird	Northern waterthrush	*Parkesia noveboracensis*		
Bird	Orchard oriole	*Icterus spurius*		
Bird	Osprey	*Pandion haliaetus*		
Bird	Ovenbird	*Seiurus aurocapilla*		
Bird	Palm Warbler	*Setophaga palmarum*		
Bird	Pileated woodpecker	*Hylatomus pileatus*		
Bird	Pine Warbler	*Setophaga pinus*		
Bird	Red-bellied Woodpecker	*Melanerpes carolinus*		
Bird	Red-eyed vireo	*Vireo olivaceus*		
Bird	Red-shouldered Hawk	*Buteo lineatus*		
Bird	Red-tailed Hawk	*Buteo jamaicensis*		

Bird	Red-winged blackbird	*Agelaius pheoniceus*		
Bird	Ring-billed Gull	*Larus delawarensis*		
Bird	Ring-necked Duck	*Aythya collaris*		
Bird	Rock dove	*Columba livia*		
Bird	Ruby-crowed kinglet	*Regulus calendula*		
Bird	Ruby-throated hummingbird	*Archilochus colubris*		
Bird	Rufus-sided towhee	*Pipilo erythrophthalmus*		
Bird	Scarlet tanager	*Piranga olivacea*		
Bird	Sharp-shinned hawk	*Accipiter striatus*		
Bird	Song Sparrow	*Melospiza melodia*		
Bird	Spotted sandpiper	*Actitis macularius*		
Bird	Swainson's thrush	*Catharus ustulatus*		
Bird	Swamp sparrow	*Melospiza georgiana*		
Bird	Tree swallow	*Tachycineta bicolor*		
Bird	Tufted Titmouse	*Baeolophus bicolor*		
Bird	Turkey vulture	*Cathartes aura*		
Bird	White-breasted Nuthatch	*Sitta carolinensis*		
Bird	White-eyed vireo	*Vireo griseus*		
Bird	White-throated Sparrow	*Zonotrichia albicollis*		

Bird	Wilson's snipe	*Gallinago delicata*		
Bird	Wood Duck	*Aix sponsa*		
Bird	Wood thrush	*Hylocichla mustelina*		
Bird	Worm eating warbler	*Helmitheros vermivorum*		
Bird	Yellow warbler	*Setophaga petechia*		
Bird	Yellow-billed cuckoo	*Coccyzus americanus*		
Bird	Yellow-breasted chat	*Icteria virens*		
Bird	Yellow-rumped Warbler	*Setophaga coronata*		
Fish	American brook lamprey	*Lampetra appendix*		
Fish	American eel	*Anguilla rostrata*		
Fish	Black crappie	*Poxomis nigromaculatus*		
Fish	Blacknose dace	*Rhinichthys atratulus*		
Fish	Blueback herring	*Alosa aestivalis*		
Fish	Bluegill	*Lepomis machrochirus*		
Fish	Bluespotted sunfish	*Enneacanthus gloriosus*		
Fish	Comely shiner	*Notropis amoenus*		
Fish	Creek chubsucker	*Erimyzon oblongus*		
Fish	Cutlips minnow	*Exoglossum maxillingua*		
Fish	Eastern mudminnow	*Umbra pygmaea*		

Fish	Fallfish	*Semotilus corporalis*		
Fish	Gizzard Shad	*Dorosoma sp.*		
Fish	Glassy darter	*Etheostoma vitreum*		
Fish	Golden shiner	*Notemigonus crysoleucas*		
Fish	Green sunfish	*Lepomis cyanells*		
Fish	Largemouth bass	*Macropterus salmoides*		
Fish	Least Brook Lamprey	*Lampetra aepyptera*		
Fish	Longnose dace	*Rhinichthys cataractae*		
Fish	Mosquito fish	*Gambusia afinis*		
Fish	Mummichog	*Fundulus heteroclitus*		
Fish	Northern hogsucker	*Hypentelium nigricans*		
Fish	Northern Redhorse	*Gambusia afinis*		
Fish	Pumpkinseed	*Lepomis gibbosus*		
Fish	Redbreast sunfish	*Lepomis auritus*		
Fish	Redear sunfish	*Lepomis microlophus*		
Fish	Satinfin shiner	*Cyprinella analostana*		
Fish	Shield darter	*Percina peltata*		
Fish	Smallmouth bass	*Micropterus dolomieu*		
Fish	Swallowtail shiner	*Notropis procne*		
Fish	Tessellated darter	*Etheostoma olmstedi*		

Fish	Topminnow	*Fundulus sp.*		
Fish	White sucker	*Catostomus commersonii*		
Mammal	Big Brown Bat	*Eptisicus fuscus*		
Mammal	Eastern chipmunk	*Tamias striatus*		
Mammal	Eastern Gray squirrel	*Sciurus carolinensis*		
Mammal	Eastern Red Bat	*Lasiurus borealis*	Watch List	Vulnerable
Mammal	Eastern Small-footed Bat	*Myotis leibii*	Watch List	Critically imperiled
Mammal	Evening Bat	*Nycticenius humeralis*		
Mammal	Gray fox	*Urocyon cinereoargenteus*		
Mammal	Groundhog	*Marmota monax*		
Mammal	Hoary Bat	*Lasiurus cinereus*	Watch List	Vulnerable
Mammal	Indiana bat	*Myotis sodalis*	Endangered	Endangered
Mammal	Little Brown Bat	*Myotis lucifugus*	Under Review (Candidate)	Critically imperiled
Mammal	Mouse	*species unknown**		
Mammal	Northern long-eared bat	*Myotis septentrionalis*	Threatened	Threatened
Mammal	Northern Raccoon	*Procyon lotor*		
Mammal	Opossum	*Didelphimorphia*		
Mammal	Rabbit	*Lepus curpaeums*		
Mammal	Red fox	*Vulpes vulpes*		

Mammal	Silver-Haired Bat	*Lasionycteris noctivagans*		
Mammal	Tricolored Bat	*Perimyotis subflavus*	Under Review (Candidate)	Endangered
Mammal	White-tailed deer	*Odocoileus virginianus*		
Mammal	Woodchuck	*Marmota monax*		

APPENDIX D: SPECIES OF GREATEST CONSERVATION NEED CONFIRMED ON FMMD

Table D 2. Faunal Species of Greatest Conservation Need from Anne Arundel County confirmed on FMMD.

Taxa	Common Name	Scientific Name	State Rank	Conservation Status
Mammal	Eastern red bat	*Lasiurus borealis*	SUB**SUN**	D
Mammal	Big brown bat	*Eptesicus fuscus*	S5	C
Mammal	Silver-haired bat	*Lasionycteris noctivagans*	SUB**SUN**	D
Fish	Comely shiner	*Notropis amoenus*	S3	C
Reptile	Wood turtle	*Glyptemys insculpta*	S2S3**	A
Reptile	Eastern box turtle	*Terrapene carolina*	S5	C
Amphibian	Eastern mud salamander	*Pseudotriton montanus*	S2	B
Bird	Northern parula	*Setophaga americana*	S5B	C
Bird	Sharp-shinned hawk	*Accipiter striatus*	S2S3B, S4N	B
Bird	Spotted sandpiper	*Actitus macularius*	S3S4B	C
Bird	Worm-eating warbler	*Helmitheros verminorum*	S4B	C
Bird	Veery	*Catharus fuscescens*	S4B	C
Bird	Chimney swift	*Chaetura pelagica*	S5B	C
Bird	Black-throated green warbler	*Setophaga virens*	S2B, S3N	C

Bird	Golden-crowned kinglet	*Regulus satrapa*	S3B, S4N	C
Bird	American kestrel	*Falco sparverius*	S3B, S2N	C
Bird	Wood thrush	*Hylocichla mustelina*	S5B	C
Bird	Ovenbird	*Seiurus aurocapillus*	S5B	C
Bird	Acadian flycatcher	*Empidonax virescens*	S5B	C
Bird	American redstart	*Setophaga ruticilla*	S4B	C
Bird	American woodcock	*Scolopax minor*	S4B, S4N	C
Bird	Bald eagle	*Haliaeetus leucocephalus*	S4	C
Bird	Black-and-White Warbler	*Mniotilta varia*	S4B	C
Bird	Broad-winged hawk	*Buteo platypterus*	S3S4B	C
Bird	Brown creeper	*Certhia americana*	S3B, S4N	C
Bird	Eastern meadowlark	*Sturnella magna*	S5B, S3N	C
Bird	Great blue heron	*Ardea herodias*	S5B, S3S4N	C
Bird	Kentucky warbler	*Geothlypis formosa*	S4B	C

Table D-3. Floral Species of Greatest Conservation Need for Maryland identified on FMMD

Common Name	Species	Global Rank	State Rank	Conservation Status	Habitat
Giant Cane	*Arundinaria gigantea*	G5	S2	B	Flood plains and Riparian edges. Soil Type: sandy to highly acidic
Crowned beggarticks	*Bidens coronata*	G5	S2S3	B	Wet meadows and swamps. Soil type: Moist, Rich soil
Button sedge	*Carex bullata*	G5	S3	C	Occurs in wetlands-bogs, fens, meadows and fields, shores of rivers/lakes. Soil type: acidic soil of bogs, or peaty/sandy soil of ponds and lakeshores
Star sedge	*Carex echinata*	G5	S3	C	Occurs in wetlands-bogs, fens, meadows and fields, shores of rivers/lakes. Soil type: acidic soil of bogs, or peaty/sandy soil of ponds and lakeshores
American chestnut	*Castanea dentata*	G4	S2S3	B	Rocky, well drained slopes of mountains & piedmont regions. Soil Type: well drained, slightly acidic soil
Whorled Coreopsis	*Coreopsis verticillata*	G5	S3	C	Dry woods and clearings. Soil type:

Rough Panicgrass	*Dichanthelium leucothrix*	G4?Q	SU	D	Low, Damp pine barrens and savannahs. Soil type: Wet sandy soils
Tall Boneset	*Eupatorium altissimum*	G5	S3	C	Open woods and Prairies. Soil Type: well drained soils
Butternut	*Juglans cinerea*	G4	S2S3	B	Moist, rich, sunny habitats in forests or river terraces. Soil Type: Fertile, moist, well-drained soils. Especially on soils of limestone origin.
Sheep laurel	*Kalmia angustifolia*	G5	S3S4	C	Pastures, woods, and swamps. Soil Type: well drained acidic soils
Tall lespedeza	*Lespedeza stuevei*	G4?Q	S3	C	Upland, non-aquatic habitats- woodlands, clearings, barrens and roadsides. Soil Type: sandy soils
Southern crab apple	*Malus angustifolia*	G5?	S3	C	Along streams and slopes, fencerows, old fields. Soil type: well-drained, moist and acidic soils
Ostrich fern	*Matteuccia struthiopteris*	G5	S2	B	Forest river bottoms, moist thickets, swamps, and stream banks. Soil type: Moist loamy soils

Purple Chokeberry	*Photinia floribunda*	G4G5Q	S3	C	Found near swamps, wetland margins, shorelines, and fields. Soil type: peaty soils
Tall cinquefoil	*Potentilla arguta*	G5	SH	E	Dry fields and rocky slopes. Soil type: deep mesic, rocky, or alluvial soils
Smallhead beaksedge	*Rhynchospora microcephala*	G5T5	S2	B	Sands and sandy peats of savanna swales, pineland seeps, bogs, ditches, pond shores, and banks.
Pussy willow	*Salix discolor*	G5	SU	D	Marshy, low ground, stream banks, diches. Soil Type: Medium-wet, well-drained soils.
Prairie willow	*Salix humilis*	G5T4T5	S1	A	Found on dry, sunny habitats. Soil type: dry, sandy soils
Pubescent sedge	*Carex hirtifolia*	G5	S3	C	Deciduous woods, thickets, wooded slopes, and trail edges. Soil Type: average to dry, often disturbed soil
Eastern straw sedge	*Carex straminea*	G5	S1S2	A	Open freshwater swamps, grassy marshes, and wet field. Soil Type: Sandy, peaty, or acidic soils

Grass-leaved arrowhead	*Sagittaria graminea*	G5	SU	D	Shallow water and marshes. Soil Type: Wet, hardy soils
Pearly everlasting	*Anaphalis margaritacea*	G5	S3	C	Dry habitats: dry prairies, open woods, roadsides, waste places. Soil Type: Sandy or Gravely soils.

Conservation Status Groups- SGCN Categorization Matrix

Global Status \ State Status	S1	S2	S3	S4	S5	SNR/SU	SH
G1	A					D	E
G2	A	A				D	E
G3	A	A	B			D	E
G4	A	B	C	C		D	E
G5	A	B	C	C	C	D	E
GNR/GU	A	B				D	E

*1To apply the matrix, "range" status ranks were rounded upward in priority (e.g., S2S3 = S2); "range" ranks spanning 3 ranks were considered as the middle rank (e.g., S1S3 = S2); global status ranks for subspecies with T-ranks are treated as the "T" status (e.g., G5T3 = G3). Most "non-numeric" state status ranks are classified in Group D, the "Data Deficient" group (e.g., SU, SNR, SP, SR), except for SH.

Definitions of the five conservation status categories from figure 3.1 based on global and state conservation status ranks

Group	Definition
A	Highest conservation status
B	High conservation status
C	Moderate conservation status
D	Conservation status in uncertain, insufficient data to assign a state conservation status rank
E	Historical statusl; ranked as "SH" and may no longer occur in Maryland, but with some potential for rediscovery in the foreseeable future

APPENDIX F: LINKS TO ONLINE RESOURCES

F.1 NATIVE PLANT RESOURCES

https://www.fws.gov/Chesapeakebay/pdf/NativePlantsforWildlifeHabitatandConservationLandscaping.pdf

https://www.wildflower.org/collections/collection.php?collection=usfws_ches

http://www.nativeplantcenter.net/

https://mdflora.org/publications/nurseries.html

https://vnps.org/view/native-plant-nurseries/

https://www.cbf.org/join-us/more-things-you-can-do/in-your-yard/native-plants.html

F.2 AGENCY LINKS

https://www.fws.gov/chesapeakebay/

https://www.chesapeakebay.net/

https://www.epa.gov/aboutepa/about-chesapeake-bay-program-office

http://www.bwpfs.org/

https://dnr.maryland.gov/Pages/default.aspx

https://mde.maryland.gov/Pages/index.aspx

https://planning.maryland.gov/Pages/OurWork/PaxRiverComm/PatuxentRiverCommInfo.aspx

MP Adaptation Planning Worksheets

The following worksheets support installation-level application of the INRMP adaptation planning process and are drawn from Climate Adaptation for DoD Natural Resource Managers (Stein et al. 2019). They provide a structured means for managers to gather, evaluate, and analyze adaptation-relevant information, and the worksheets are designed to build on and draw from one another with earlier steps in the process informing subsequent worksheets. Because adaptation planning is an iterative process, the worksheets also provide an opportunity to "show your work" to document decisions and facilitate future assessments or refinements.

The following worksheets support installation-level application of the INRMP adaptation planning process. They provide a structured means for managers to gather, evaluate, and analyze adaptation-relevant information, and the worksheets are designed to build on and draw from one another with earlier steps in the process informing subsequent worksheets. Because adaptation planning is an iterative process, the worksheets also provide an opportunity to "show your work" to document decisions and facilitate future assessments or refinements.

The worksheets are intended to serve as an aid in carrying out adaptation planning; they are not intended to be prescriptive. Although the worksheets are designed to be used sequentially, users should not feel compelled to fill out all of the worksheets or each cell in a given worksheet. Additionally, the level of detail entered into the worksheets may vary, depending on the availability of relevant information, and on whether the worksheets are being used to inform a preliminary screening of adaptation needs and options, or to support in-depth decision-making and allocation of resources. Just as the overall INRMP adaptation planning process is designed to be flexible, these worksheets may be adapted or modified (for instance, adding additional rows or columns) to most effectively support the adaptation planning needs of particular installations.

Managers may also find it useful to initially focus on a limited number of resources, risks, or strategies and keep a "parking lot" of items to address in subsequent passes through the adaptation planning process. If you get stuck at any point in filling out the worksheets—for instance, due to incomplete information or knowledge—make an informed conjecture (documenting your assumptions) to keep moving through the planning process. Should additional information become available, you can then revisit and refine the relevant worksheet and outcomes.

Supporting Worksheets by INRMP Adaptation Planning Process Step

Step 1. Set Context for Adaptation Planning

- **Worksheet 1.1. Installation Mission and Requirements**
- **Worksheet 1.2. Target Resources and Existing Goals**
- **Worksheet 1.3. Planning Scope and Background Information**

Step 2. Assess Climate Vulnerabilities and Risks

- **Worksheet 2.1. Climate Concerns and Projections**
- **Worksheet 2.2. Climate Vulnerabilities of Target Natural Resources**
- **Worksheet 2.3. Military Mission Risks from Natural Resource Vulnerabilities**

Step 3. Evaluate Implications for INRMP Goals and Objectives

- **Worksheet 3. Climate Implications for INRMP Goals and Objectives**

Step 4. Develop Strategies and Actions to Reduce Climate Risks

- **Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions**
- **Worksheet 4.2. Evaluation and Selection of Adaptation Strategies and Actions**

Step 5. Implement Adaptation Strategies and Actions

- **Worksheet 5. Implementation of Adaptation Strategies/Actions**

Step 6. Monitor and Adjust Adaptation Actions

- **Worksheet 6. Climate-Informed Monitoring and Evaluation**

Step 1. Set Context for Adaptation Planning

The purpose of Step 1 is to set the context for adaptation planning and incorporating climate change considerations into the installation's INRMP. Step 1 worksheets are intended to help identify: installation mission and mission support requirements; relevant INRMP goals and objectives; the natural resource features that will be the focus for assessment; relevant geographic scope; and available information resources and expertise.

Step 1 is supported by three worksheets:

- **Worksheet 1.1. Installation Mission and Requirements**
- **Worksheet 1.2. Target Resources and Existing Goals**
- **Worksheet 1.3. Planning Scope and Background Information**

Worksheet 1.1 Installation Mission and Requirements provides a structure for the identification of core mission and tenant mission requirements for the installation. Because of the importance for sustaining the installation mission into the future, this worksheet serves as a foundation for identifying risks and opportunities, and as a reference point for decision-making throughout the adaptation planning process. Engagement of all relevant internal stakeholders (e.g., operations and training, public works, security, safety, tenant commands, environmental, etc.) in the process of identifying mission components and requirements will greatly affect the overall success of the INRMP and the adaptation planning process.

Instructions for Worksheet 1.1

1) **Mission and Mission Support Components:** ***Articulate the core mission and mission support components for the installation.*** Mission and tenant mission support components are generally reflected by the organizations and processes on the installation that directly or indirectly compose the military mission. Such components can involve ground-based or aerial training, weapons testing, munitions storage and transport, security, explosives safety, fire management, etc. List each distinct mission component on a separate row. It may be necessary to consolidate an exhaustive list into core components.

2) **Critical Mission Requirements:** ***Identify the built and natural features/conditions critical to carrying out and sustaining the installation mission area.*** Critical mission requirements can include the availability of certain built infrastructure and assets (e.g., firing ranges, training maneuver areas, airfields, impact areas, clear zones, firebreaks, access roads/bridges, buildings, utilities), working landscapes (e.g., agricultural fields, grazing pastures), and natural habitats (e.g., beach habitat for amphibious training, wetlands and floodplains for flood attenuation).

Worksheet 1.1. Installation Mission and Requirements	
Mission and Mission Support Components *What are the core mission and mission support components for the installation?*	**Critical Mission Requirements** *What are the built and natural features/conditions critical to carrying out and sustaining this installation mission component?*

Worksheet 1.2 Target Resources and Existing Goals is intended to focus the INRMP adaptation planning process on specific target resources and to clarify existing INRMP goals and objectives for those resources. Target natural resources selected in this step will serve as the basis for evaluation in subsequent steps and worksheets.

Instructions for Worksheet 1.2

1) **Target Natural Resources:** ***Identify the natural resource features that will be the focus of adaptation planning.*** These are the natural resources that are the subject of management efforts in the INRMP, and which will serve as the focus of the adaptation planning. Target natural resource may be species, habitat types, ecological processes, or other natural features. The resources identified here will likely be a subset of the full range of natural resources on the installation, and should reflect resources that are of particular management interest and concern. In the context of this adaptation planning process, target natural resources are generally those resources that are the intended beneficiaries of INRMP strategies and actions. As an example, for program elements focused on particular "threats" (e.g., Invasive Species Management) or "practices" (e.g., Agricultural Outleasing), relevant "target natural resources" would be the resources that are the focus of conservation efforts. In this instance, the species or habitats that might be adversely affected by the invasive species would be the target natural resource, not the invasive species themselves.

2) **Goals/Objectives:** ***List the existing INRMP goals/objectives for selected target natural resources.*** Describe with as much specificity as possible the conservation goals or management objectives that the installation has for these resources. This will serve as the basis later in the adaptation planning process (Step 3) for evaluating the implications of climate change for the feasibility of meeting those goals and objectives.

3) **Associated Program Element(s):** ***Identify the INRMP program element(s) relevant to the target natural resource.*** A given natural resource feature may be associated with one or more program elements. For instance, a target habitat type may be relevant to the following program elements: Threatened and Endangered Species, Fish and Wildlife Management, Vegetation Management, and Migratory Birds Management. Identifying the program elements that are associated with the target resource highlights which INRMP programs may be affected in the adaptation planning cycle.

Worksheet 1.2. Target Resources and Existing Goals		
Target Natural Resources *What are the natural resource features (species, habitats, ecosystem processes, etc.) that are the focus of this adaptation planning effort?*	**Goals/Objectives** *What are the existing INRMP goals and objectives for the target natural resources?*	**Associated Program Element(s)** *What INRMP program elements are associated with each of the target natural resources?*
Notes: "Target natural resources" are the intended beneficiaries of INRMP conservation efforts. Only a subset of target resources that are of particular management interest or concern typically are evaluated in a given adaptation planning cycle. List each target resource on a separate row below.	*Notes:* Describe in as much specificity as possible existing conservation goals or management objectives that apply to the individual target natural resources.	*Notes:* Target natural resources may fall under the purview of one or more INRMP program elements.

Worksheet 1.3 Planning Scope and Background Information offers a framework for identifying the scope and context for the adaptation planning process, along with key stakeholders and available information and expertise. Taking climate into consideration often necessitates planning at larger geographic scales and longer time frames than are typically represented in INRMPs.

Instructions for Worksheet 1.3

1) **Geographic Scope:** ***Identify the spatial context for addressing climate change in the INRMP.*** Although installations already take into account areas outside installation boundaries to address ecosystem management and encroachment factors, shifting climatic conditions may require that adaptation planning consider an even larger geographic area, or areas that might not otherwise have been considered relevant.

2) **Stakeholders/Partners:** ***Identify key stakeholders/participants to engage in the adaptation planning process.*** Relevant participants are expected to come from within and outside of the installation. To the extent feasible, identify individuals or specify organizations to engage. Involving knowledgeable climate scientists and other relevant experts early on can help installations navigate the process more effectively.

3) **Available Information/Expertise:** ***Compile existing background information and identify available expertise.*** Identify and compile any existing studies or resources for understanding regional or local climate projections and natural resource responses. Existing information can include regional climate summaries, such as included in the National Climate Assessment, state-level assessments, and other adaptation plans. Many state and federal agencies and universities have climate science and adaptation experts available. Information may also include "local knowledge," such as information on species invasiveness gleaned through garden clubs and weed management areas.

Worksheet 1.3. Planning Scope and Background Information		
Geographic Scope *What is the spatial context for addressing climate change in the installation's INRMP planning?*	**Stakeholders/Partners** *Who are the key stakeholders and participants to engage in the adaptation planning process, both within DoD and externally?*	**Available Information/Expertise** *What existing studies or resources are available for understanding regional or local climate projections and natural resource responses?*
Notes: Shifting climatic conditions may require that adaptation planning considers an even larger geographic area, or areas that might not otherwise have been considered relevant.	*Notes:* To the extent feasible, identify specific individuals or organizations. Involving climate scientists and other relevant experts early on may help installations navigate the process more effectively.	*Notes:* Existing information can include regional climate summaries, such as included in the National Climate Assessment, state-level assessments, and other adaptation plans.

Step 2. Assess Climate Vulnerabilities and Risks

The purpose of Step 2 is to identify key climate concerns for the installation; understand how relevant climatic factors are projected to change over time; assess the impacts of those changes on target natural resources and the resulting climate vulnerabilities of those resources; and finally, determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Step 2 is supported by three worksheets:

- **Worksheet 2.1. Climate Concerns and Projections**
- **Worksheet 2.2. Climate Vulnerabilities of Target Natural Resources**
- **Worksheet 2.3. Military Mission Risks from Natural Resource Vulnerabilities**

Worksheet 2.1. Climate Concerns and Projections walks managers through the higher-level elements of climate concerns and projections, drawing from existing information and engagement with climate scientists and other experts (from Worksheet 1.3). The amount of detail installations are able to complete will likely vary—be as thorough as possible based on available information, but do not get too bogged down where information may be unavailable. For all factors, be sure to document the source for the specific projections, whether literature, data sets, organizations, DoD offices or analyses, individual experts, in sufficient detail to allow future validation and updates.

Instructions for Worksheet 2.1

1) **Key Climate Concerns:** ***Identify climate-related changes and impacts of particular concern for the installation.*** These will typically be articulated as the specific threats or impacts of concern (e.g., increased droughts, increased flooding and/or erosion from sea-level rise, or expansion of invasive species). Existing regional or local climate assessments may help in identifying climate-related impacts that should be of concern to the installation in the context of natural resource management.

2) **Climatic Factors:** ***Identify the specific climatic factors associated with those impacts.*** These factors should be as specific as possible to your installation and resources. They can include physical variables (e.g., air and water temperature, precipitation, sea levels, flood levels and frequency). Depending on the variable it may be appropriate to consider both averages and extremes. NOTE: Some of these will overlap with the identified "climate concerns" (e.g., sea-level rise), whereas others may reflect underlying physical drivers of those impacts (e.g., both changes in precipitation patterns and rising temperatures may contribute to drought; rising average winter temperatures may be a driver of expansion of invasive species). The purpose of identifying the specific climatic factors is to help determine what climate-related variables may be relevant for future projections. To the degree possible, focus on those variables that are ecologically relevant to the natural resources of interest (e.g., for a

given species, timing of spring ice-breakup may be more significant than measures of winter temperature).

3) **Describe current and future climatic conditions:** ***Based on existing information and/or work with experts, document historical or current climatic conditions, trends, and future projections for the climatic factors identified in column 2.***

    a. **Historical/Current Conditions.** Historical and current climatic conditions provide an important context for developing future climate scenarios, and are the basis for most existing resource management efforts. Historical and current climate data is widely available, although values for ecologically relevant variables, including extremes (rather than averages), may require special processing.

    b. **Trend.** Knowing the directionality or trend of a climate factor can be informative, even without detailed projections of rate or magnitude. If possible, indicate the trend or directionality (e.g., hotter/cooler, drier/wetter, more variable, shift in seasonality, etc.).

    c. **Projections.** To the degree possible, note how these climatic factors are projected to change in the future. Such projections usually will be derived from existing sources, although installations may also work with climate scientists to identify or develop projections at resolutions considered most useful for the decisions at hand. Multiple scenarios of future conditions are often appropriate (e.g., low vs. high), as are projections for different timescales (e.g., 30–50 years vs. 70–100 years).

4) **Confidence/Uncertainty:** ***Highlight any notable uncertainties in climate projections.*** Some climatic changes have higher certainty than others (e.g., air temperature vs. precipitation). There also may be high certainty in the trend for particular factors (e.g., sea-level rise) but lower certainty in rate and magnitude. Uncertainty is not a reason in decisions—rather, it may indicate the need for application of tools such as adaptive management and scenario planning. In addition, monitoring key climate variables may help reduce uncertainties over time.

Worksheet 2.1. Climate Concerns and Projections					
Key Climate Concerns *What are the key climate change–related impacts or threats to the installation, and more specifically for the target natural resources?*	**Climatic Factors** *What are the climatic factors or variables related to those concerns, and which are ecologically relevant for your installation and the resources you are managing?*	**Historical/Current Conditions** *What are the historical/current values for this climate factor?*	**Trend** *What is the trend or directionality for this factor, if known?*	**Projections** *What are available projections for this variable?*	**Confidence/Uncertainty** *What is the level of confidence or certainty in the trend or magnitude of change for this variable (i.e., High, Medium, or Low)?*
Notes: Such concerns could include increased drought, change in fire frequency and severity, changes in flood frequency and severity, sea-level rise and associated shoreline or beach loss.	*Notes:* These include physical variables (e.g., air and water temperature, precipitation, sea levels, flood levels and frequency), and they should specify averages and extremes (where relevant).	*Notes:* Identifying current values may show where conditions have already changed.	*Notes:* Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude.	*Notes:* Multiple scenarios of future conditions are often appropriate (e.g., low vs. high) as are projections for different timescales (e.g., 30–50 years vs. 70–100 years).	*Notes:* Some climatic changes have higher certainty than others. Uncertainties may exist for directional changes, rates of change, etc.

Information Sources *List sources of information used to fill in this table*					

Worksheet 2.2 Climate Vulnerabilities of Target Natural Resources delves more deeply into the specific implications of climatic changes highlighted in Worksheet 2.1 for target natural resources (i.e., the climate vulnerabilities).

Instructions for Worksheet 2.2

1) **Target Natural Resource(s):** ***List the target natural resources to be assessed for climate vulnerability.*** These may include those features (species, habitats, ecological processes, etc.) that underpin the INRMP goal/objective under consideration (identified in Worksheet 1.2). These may fall within one or more program elements, and they may represent all or a subset of relevant resources, depending on the scope of the assessment and the time, resources, and information available.

2) **Climate-Related Threats:** ***For each target resource, identify factors that may contribute to its climate vulnerability.*** This information may derive from existing vulnerability assessments or other scientific literature, as well as through input from resource experts both within and outside of the installation. The worksheet draws on the components of vulnerability (i.e., sensitivity, exposure, and adaptive capacity), although installations should not feel overly constrained by that frame. The ultimate goal is to help managers understand and articulate key vulnerabilities (or viabilities) of target resources, and the reasons for that vulnerability, to carry through into the subsequent steps of the process.

    a. **Sensitivity.** Estimate how and to what degree the resource would be affected by and respond to expected climate-related changes.

    b. **Exposure.** Estimate or document the degree to which the target resource is likely to be subjected to the change to which it is sensitive. What is the overlap between the threat and the actual distribution of the resource? For example, a species may be highly sensitive to flooding, but if it is found outside current and projected flood zones on the installation, it would not be considered vulnerable to that threat.

    c. **Adaptive Capacity.** Estimate the degree to which the target resource may have the innate capacity to accommodate or cope with projected changes, or if there are external factors that may allow the resource to adjust to and cope with those changes.

3) **Other Threats:** ***Consider whether and how other threats may amplify the climate threats to the resource.*** Some non-climate threats (e.g., land-use changes, invasive species) can render resources more sensitive to climate-related threats, while other threats (e.g., polluted runoff) may become more severe or potent due to climatic changes. Here, it is important to be clear about the specific linkages between the climatic factors and non-climate threats, rather than assume that addressing *any* non-climate stressor is relevant from an adaptation perspective.

4) **Degree/Reason for Vulnerability:** ***Estimate the relative degree of vulnerability for individual target resources and describe why they are considered vulnerable.*** Being specific about the

reasons a resource is vulnerable will be useful in for identifying possible risk reduction approaches and developing management responses. It is also useful to identify key areas of uncertainty, such as in how species, habitats, or ecological systems may respond to changing climatic conditions. Such uncertainties can inform the direction of further research and monitoring efforts.

Worksheet 2.2. Climate Vulnerabilities of Target Natural Resources					
Target Natural Resource(s) *What are the target natural resources to be evaluated (from Worksheet 1.2)?*	**Climate-Related Threats**			**Other Threats** *What existing or "non-climate" threats to the resource may be exacerbated by or amplified due to projected changes in in climatic factors?*	**Degree/Reason for Vulnerability** *Rate the relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating.*
	Sensitivity *How and to what degree might this resource respond (negatively or positively) to expected climate-related changes?*	**Exposure** *To what degree is the resource likely to overlap with and be exposed to conditions to which it is sensitive?*	**Adaptive Capacity** *Does the target resource have the ability to accommodate, cope with, or adjust to projected changes in climatic conditions? If so, how?*		
Notes: Select all or a subset of the target resources listed in Worksheet 1.2. These may fall within one or more program elements.	*Notes:* Understanding innate sensitivities of the resource help identify which climate-related changes should be considered under the exposure component of vulnerability.	*Notes:* Drawing on Worksheet 2.1, determine which climate-related changes will most affect the target resource.	*Notes:* If possible, identify both intrinsic and extrinsic/external factors that might affect the ability of the species to adjust to/accommodate changes.	*Notes:* Be as clear as possible clear about the specific linkages between the climatic factors and non-climate threats.	*Notes:* In addition to assessing the relative vulnerability, documenting the reasons for that vulnerability helps in development of risk reduction strategies. It also may be useful to highlight any uncertainties in the assessment.

Worksheet 2.3 Military Mission Risks from Natural Resource Vulnerabilities provides a framework for linking the vulnerability of target natural resources with risks to the sustainability of military mission and its requirements. Based on the natural resource vulnerabilities identified in Worksheet 2.2, consider what effect these vulnerabilities may have on the mission requirements identified in Worksheet 1.1. Although there may be direct climate impacts affecting the installation's ability to meet its mission (e.g., temperatures too hot for training, wind damage to structures), the focus here is how climate-vulnerable natural resources may pose risks to mission.

Instructions for Worksheet 2.3

1) **Vulnerabilities of Target Natural Resources:** Based on Worksheet 2.2, identify the target natural resource vulnerabilities that may have implications for mission sustainability.

2) **Risks to Installation Mission Requirements:** Describe how climate impacts on key natural resources may compromise the ability of the installation to deliver on its military mission. This could take the form, for instance, of deterioration of the protective function that coastal habitats may provide to installation facilities or assets, or the possibility that climate-related species declines may impose new regulatory requirements on training activities. These represent the impacts or risks to the mission if not effectively addressed through adaptation efforts.

3) **Degree of Risk:** Evaluate how significant a risk this vulnerability might pose to the installation's ability to meet mission requirements. This should be expressed generally in terms of Very High, High, Medium, or Low risks. Natural resource vulnerabilities that pose significant risks to military mission would, in turn, be prime candidates for identifying risk reduction strategies in Step 4.

Worksheet 2.3. Military Mission Risks from Natural Resource Vulnerabilities		
Vulnerabilities of Target Natural Resources *List the most consequential natural resource vulnerabilities identified in the last column of Worksheet 2.2.*	**Risks to Installation Mission Requirements** *How might this natural resource vulnerability affect the ability of the installation to deliver its military mission (e.g., training, testing, etc.) and long-term sustainment?*	**Degree of Risk** *Rate the relative risk this vulnerability poses to the installation's ability to meet its military mission requirements (e.g., Very High, High, Medium, Low).*

Step 3: Evaluate Implications for INRMP Goals and Objectives

The purpose of Step 3 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key INRMP goals and objectives, based on the information gleaned from assessing the vulnerabilities of target natural resources and the associated risks to the military mission.

Step 3 is supported by a single worksheet:

- **Worksheet 3. Climate Implications for INRMP Goals and Objectives**

Worksheet 3 Climate Implications for INRMP Goals and Objectives is intended for managers determine if their existing goals and objectives may be compromised and need revision based on projected climatic changes and resulting vulnerabilities. Such a review may indicate that the goal remains viable into the future. In other instances, it may indicate that certain aspects of the goals may be unfeasible, or even physically impossible, based on projected changes. This worksheet provides a means for evaluating and updating the goal based on a structured process that distinguishes among four primary components of the goal: *what* (the target resources that are the focus of the goal); *why* (the intended outcome or rationale for the goal); *where* (the geographic area across which achieving the goal is relevant or feasible; and *when* (the time frame during which the goal is applicable). If necessary, this step can be repeated following Step 4 to determine if modified or new management practices might change the outcome.

Instructions for Worksheet 3

1) **INRMP Goals to Evaluate:** List the existing INRMP goals for the relevant target natural resources as listed in Worksheet 1.2.

2) **Climate Implications for Existing Goals/Objectives:** Consider the potential implications of the climate impacts (Worksheet 2.1) and vulnerabilities (Worksheet 2.2) on the identified goal. At this stage in the analysis, assume continuation of existing management practices. A reassessment of climate implications on goals can also be carried out following Step 4 if new or modified management approaches offer the prospect for addressing those issues. A useful framework for assessing the climate implications for existing goals involves a review of the following:

    a. **What: the target resources.** Based on the climate vulnerabilities, are there changes in what features or resources should be the focus of the goal/objective? Is there a need to shift from one species to another, or from a species focus to a habitat focus?

    b. **Why: the intended outcome of the goal.** Do projected climatic changes affect whether intended outcomes (whether ecological, social, or economic) of the goal remain achievable? Are there differences in how climate change may affect different goal outcomes, or a possible need to shift the emphasis among them?

c. **Where: the spatial scope and scale of the goal.** Is the current geographical area still relevant, or should new or different areas be considered to achieve the goal? If so, what changes should be made? Projected shifts in the range of a target species, for example, may necessitate coordination with neighbors to expand habitat protection.

d. When: the time frame relevant to the goal. Do the potential impacts/vulnerabilities affect the feasibility of achieving the goal during the currently identified time frame? With climate change, many goals will no longer be appropriate "in perpetuity" and may instead have an "expiration date." Are there shorter-term goals that emphasize a "buying time" strategy?

3) **Climate-Informed Goals/Objectives:** Based on the evaluation of climate implications for the goal under consideration, are there any updates or revisions that may be needed in the "what, why, where, or when" in order to make the goal more climate-informed? At this stage, some goals and objectives will remain unchanged, whereas others may be updated (either in part or wholly) after taking the impacts and vulnerabilities into consideration. These climate-informed goals may be carried forward to Step 4.

Worksheet 3. Climate Implications for INRMP Goals and Objectives		
INRMP Goals to Evaluate *What are the existing goals for the target natural resources under consideration (from Worksheet 1.2)?*	**Climate Implications for Existing Goals/Objectives** *Based on climate concerns (Worksheet 2.1), vulnerabilities (Worksheet 2.2), and mission risks (Worksheet 2.3), how might your ability to achieve existing goals be compromised?*	**Climate-Informed Goals/Objectives** *Are there any refinements or updates that may be needed to craft a more climate-informed version of the goal or objective?*
	Notes: Consider climate implications to the "what," "why," "where," and "when" of the goal (see Section 9.1 for description). At this stage, assume continuation of existing management practices. If necessary, this review can be repeated following Step 4 to determine if modified or new management practices might change the outcome.	*Notes:* Consider needed updates or refinements to program element goals to take future climate into account. Craft possible modifications based on the "what," "why," "where," "when" framework for goal evaluation.

Step 4. Develop Strategies and Actions to Reduce Climate Risks

The purpose of Step 4 is to help installations identify, evaluate, and select appropriate adaptation strategies and actions. Such strategies and actions ultimately should be designed to reduce climate risks to target natural resources and mission assets, and enable managers to meet INRMP goals and objectives.

Step 4 is supported by two worksheets:

- **Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions**
- **Worksheet 4.2. Evaluation and Selection of Adaptation Strategies and Actions**

Worksheet 4.1 Identification of Possible Adaptation Strategies and Actions is designed to help managers articulate a range of potential management strategies/actions to address climate-related vulnerabilities to target resources or risks to mission requirements. The idea here is to be as inclusive as possible and not be constrained by factors such as cost (that comes in Worksheet 4.2). Here, *strategies* are the broadest level management efforts (e.g., increase habitat connectivity; enhance key ecosystem features), and *actions* are specific activities/projects in support of the strategy (e.g., replant depleted riparian vegetation; reintroduce beavers). Managers may identify current management actions, potential modifications to those actions, and/or new actions that may enable the installation to meet climate-informed goals for those resources and then articulate the specific assumptions and rationale for why proposed strategies and actions will reduce relevant risks and vulnerabilities.

As possible adaptation strategies and actions to reduce climate risks are being identified and evaluated, a "no action" alternative could also be considered. Depending on the magnitude of risk and level of uncertainty, passive (hands-off) or status quo management may be the most cost-effective or prudent approach.

Instructions for Worksheet 4.1

1) **Vulnerability/Risk:** ***Identify the specific climate-related vulnerability or risks to be addressed.*** Describe the specific vulnerability (to target natural resource) or risk (to military mission) for which risk reduction strategies and actions are being designed.

2) **Risk Reduction Strategies:** ***Identify potential strategies to reduce the climate risks and vulnerabilities identified in Worksheets 2.2 and 2.3.*** Strategies constitute general approaches for addressing a problem, and are supported by specific actions and projects, which are identified in the next column. At this stage in the planning process, teams should think creatively and not be overly constrained by feasibility factors such as cost, which are taken into account in Worksheet 4.2.

3) **Supporting Actions/Projects:** ***Identify specific actions and/or projects that would help to achieve the strategies identified under Column 1***. Again, the strategies and actions identified in these columns may include existing efforts, modifications of those efforts, and/or new strategies/actions that might be capable of reducing the relevant risks and enabling the installation to

meet its climate-informed goals. There may be one or more actions or projects available to support a given strategy. List all the actions/projects that are appropriate.

4) **Rationale and Assumptions:** ***Describe why you think a given strategy or actions would be effective in addressing the risk or vulnerability.*** Laying out your hypothesis for how the strategy/action is designed to reduce a specific risk, along with the assumptions behind that hypothesis, are key for evaluating the likely effectiveness of the strategy in Worksheet 4.2. Additionally, being able to "connect the dots" by linking actions to climate impacts is an overarching principle for effective climate adaptation.

Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions			
Vulnerability/Risk *What specific natural resource vulnerability (from Worksheet 2.2) or mission risk (from Worksheet 2.3) is being addressed?*	**Risk Reduction Strategies** *What strategies could reduce these vulnerabilities and risks?*	**Supporting Actions/Projects** *What actions or projects could be carried out to realize a given strategy?*	**Rationale and Assumptions** *How is this strategy or set of actions likely to reduce these vulnerabilities or risks?*
Notes: Describe the specific vulnerability (to target natural resource) or risk (to military mission) to be addressed by the strategy and their associated actions/projects.	*Notes:* List possible strategies for reducing the vulnerability or risk. Strategies can be general in nature, since more detailed supporting actions/projects are listed at right.	*Notes:* For each strategy identified at left, list the actions or projects—or suite of actions—that could help to achieve its intended risk reduction benefits. Be as specific as possible. These can be existing, modified, or new actions/projects.	*Notes:* Describe why you think this strategy (and its associated actions/projects) may be capable of reducing the stated vulnerabilities and risks. Note any assumptions or uncertainties.

Worksheet 4.2 Evaluation and Selection of Adaptation Strategies and Actions is intended to help installations winnow down from a broad list of possible actions to those that are most likely to be successful at reducing climate risks, achieving INRMP goals, and supporting broader military mission requirements. The intent of this "consequence table" is to identify those strategies or actions that should be considered as priorities for incorporation into the INRMP and subsequent implementation (the focus of Worksheet 5). A separate worksheet or consequence table can be filled out to evaluate strategies that address different risks/vulnerabilities. Similarly, separate consequence table can be filled out to evaluate different actions that may support a given strategy.

Instructions for Worksheet 4.2

1) ***Focus of worksheet.*** Note on the worksheet what the consequence table is being used to evaluate. The worksheet can be used to focus on a particular *risk/vulnerability*, comparing potential strategies for ameliorating that risk. The worksheet can also be used to carry out a more in-depth exploration of a particular *strategy*, comparing potential actions or projects that might support implementation of that strategy. As noted above, multiple versions of this worksheet, focusing on different risks or strategies, may be filled out depending on specific installation planning needs.

2) ***List a set of management strategies/actions for evaluation*** (derived from Worksheet 4.1). These strategies or actions should be inserted at the head the columns (i.e., "Strategy/Action 1"). Modify the worksheet to include as many columns as needed to accommodate all strategies or actions to be evaluated, including the no-action alternative if appropriate. These strategies/actions can reflect alternatives where the intent is to select the best among them, or they may reflect a suite of strategies or actions where the intent is to include multiple actions that meet certain criteria.

3) ***Create criteria for evaluating the strategies/actions.*** Criteria for evaluating the strategies/actions should be inserted in the left-hand rows. Modify the worksheet to include as many rows as needed to accommodate all criteria to be used in the evaluation. Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Defining explicit criteria for use in evaluation and comparison of alternatives helps clarify what really matters, not just with respect to desired ecological outcomes, but also in terms of other important values or benefits. In particular, it is important to make sure you address risk, tradeoffs, and uncertainties. Illustrative evaluation categories are indicated on Worksheet 4.2.

4) ***Evaluate and score the strategies/actions based on agreed-upon criteria.*** Worksheet 4.2 is based on a structured decision-making "consequence table" approach and is designed to help managers evaluate options or alternatives identified in Worksheet 4.1. There are many ways in which to conduct scoring under this approach. For example, you can rank options on a relative scale (e.g., low, medium, high) for how they meet the criteria, or you can rank them numerically and tally scores (e.g., low = 1, medium = 2, high = 3). In these instances, it is important to be clear about whether higher scores are "better" or "worse." For transparency, it may also be useful to qualify your choice with a reason for

choosing the particular rank. This type of "consequence table" is just one approach for evaluation and comparison of options; installations should feel free to use other approaches based on their existing capacities and planning procedures.

5) ***Determine which strategies/actions merit incorporation into the INRMP.*** Based on evaluation against the agreed-upon criteria, managers are in a position to select the strategies/actions that best meet their needs and are feasible to implement. Selecting which alternatives to include in the INRMP can be based on a number of techniques, which can range from quantitative techniques (i.e., highest total values) to selecting alternatives that optimize one or more particular criteria. There is no right or wrong way, but use of a consequence table such as this allows managers to be transparent and explicit about their selection process.

Worksheet 4.2. Evaluation and Selection of Adaptation Strategies and Actions				
Focus of Worksheet:				
Strategies/Actions to Evaluate List strategies or actions to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.		**Strategy/Action 1**	**Strategy/Action 2**	**Strategy/Action 3**
Criteria for Evaluation *Identify and list below relevant criteria for evaluating/comparing proposed strategies/actions. Add rows for additional criteria as needed.*				
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.				
Effectiveness at meeting				
Effectiveness in meeting				
Feasibility				

RECOMMEND FOR INCLUSION IN INRMP?			

Step 5. Implement Adaptation Strategies and Actions

Step 5 focuses on steps needed to effectively carry out recommended adaptation strategies, actions, and projects, leading to incorporation of actions and projects into the INRMP implementation table.

This step is supported by a single worksheet:

- **Worksheet 5. Implementation of Adaptation Strategies/Actions**

Worksheet 5 Implementation of Adaptation Strategies/Actions provides a general framework to help installations identify: who will carry out the implementation of the adaptation strategies and actions/projects; whether and how the relevant strategies and actions fit within existing DoD program implementation; what decisions are especially relevant to get the strategies and actions ready to implement; and when various element of the strategies and actions should be implemented. Go from strategy to action to projects.

Instructions for Worksheet 5

1) **Recommended Strategies/Actions:** ***List the strategies, actions, or projects identified in Worksheet 4.2 for incorporation into the INRMP.***

2) **Responsible Parties:** ***Identify who has responsibility or needs to be involved in carrying out this action or project.*** For example, can it be done in-house or will it be done via contract or through a partnering effort?

3) **Relationship to Existing INRMP Strategies:** ***Determine whether and how the action or project fits into existing efforts.*** Is the action within the installation's authority or fit within an approved project? It may: (1) fit under a project approved through the Military Service's Environmental POM process; (2) be part of the installation's forestry or agricultural outleasing program; or (3) be an opportunity for third party partnership (internal or external to the military), such as partnering with neighboring landowners to coordinate weed management, upsizing culverts to handle larger storm events, etc.).

4) **Project Planning Needs:** ***Identify what needs to be done to get this project ready to implement.*** Note here what would be necessary to put in place prior to projection implementation, such as regulatory permits, funding mechanisms, engineering work, detailed project design, or scientific research to validate the approach or solve technical issues. Are there any unique adaptation barriers (legal, social, etc.)?

5) **Timing and Sequencing:** ***Identify when the project is needed or should be carried out.*** Identify when the project should be started, including any interim steps over time. Are there any dependencies that would influence the timing or sequencing of implementation? In some cases, specific dates may be relevant (e.g., start "phase 1" in FY19). In others, it may be necessary to identify specific management trigger points (e.g., actions to be implemented in response to a specific ecological or climate threshold, such as percentage declines in a species population, or a certain extent of sea-level rise). These may carry over to Step 6.

6) ***Incorporate into INRMP Implementation Table.*** Once a project has been adequately defined, incorporate it into the INRMP's implementation table.

Worksheet 5. Implementation of Adaptation Strategies/Actions				
Recommended Strategies/Actions *List strategies/actions recommended for incorporation into the INRMP (from Worksheet 4.2).*	**Responsible Parties** *Who would have responsibility for or be involved in implementing the strategy/action?*	**Relationship to Existing INRMP Strategies** *Does this fit within a current INRMP effort, or is it a new activity/project?*	**Project Planning Needs** *What preparations or requirements would be necessary before carrying out the recommended strategies/actions?*	**Timing and Sequencing** *When should the action/project be implemented (immediately or at some future time)?*
	Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes:* List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical, etc.)?	*Notes:* Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.

Step 6. Monitor and Adjust Adaptation Actions

Step 6 involves monitoring changing climatic and ecological conditions and tracking effectiveness of adaptation actions. Ideally, this should be integrated with and build on existing monitoring and evaluation protocols. It is important to recognize, however, that successfully implementing climate adaptation strategies and actions may require a shift in what to monitor, and possibly how, where, or when to monitor. In addition, the long-term nature of climate change adaptation underscores the need for consistency and commitment of sufficient monitoring resources over time.

Step 6 is supported by a single worksheet:

- **Worksheet 6. Climate-Informed Monitoring and Evaluation**

Instructions for Worksheet 6

1) **Adaptation Strategies/Actions:** ***Identify management strategies or actions to be evaluated.*** Depending on need, these could be strategies, actions, or projects, and should carry over from Worksheets 4.2 and 5.

2) **Expected Outcomes:** ***Articulate monitoring objectives for near-term and long-term outcomes.*** This should draw from the climate-informed INRMP goals and objectives highlighted in Worksheets 1.2 and 3, the key climate-related risks and uncertainties identified in Worksheets 2.1 and 2.2, and the assumptions and rationale for the adaptation strategies and actions from Worksheet 4.1. Given the long-term nature of managing for climate change, near-term evaluation may need to focus on "interim" outcomes, such as success of planning efforts or initial implementation. Detection of statistically significant changes in relevant climatic conditions and ecological responses is likely to require commitment to monitoring over the mid- to long term. In addition, expected outcomes over the long term may need to be revised as conditions change.

3) **Indicators:** ***Develop an appropriate set of indicators.*** Indicators represent a subset of monitoring attributes that track changes in conditions to assess progress toward achieving and maintaining desired management outcomes. Ultimately, the choice of indicators depends on the purpose of the monitoring and evaluation effort. In many cases, standard INRMP monitoring indicators (e.g., key ecological attributes) will remain viable for climate adaptation. However, informing climate adaptation decisions also may necessitate adjustments in traditional indicators or development of new ones (e.g., changes in physical climate variables and associated impacts). In addition, identification of process- and output-based indicators will help installations gauge progress in the near term.

4) **Management Triggers:** ***Identify any ecological thresholds that would trigger an adjustment in management.*** As part of an adaptive management approach, identify any specific thresholds or triggers for making modifications to management practices. These triggers could also indicate a need to

conduct another cycle of adaptation planning to determine whether more fundamental changes may be needed in goals or strategies.

Worksheet 6. Climate-Informed Monitoring and Evaluation			
Adaptation Strategies/Actions *List the strategies, actions, or projects being implemented that will be the subject of monitoring and evaluation.*	**Expected Outcomes** *Include both near- and long-term outcomes expected for the action or project.*	**Indicators**	**Management Triggers** *What thresholds (based on your indicators) might cause you to adjust management practices or rethink strategies?*
Notes: These should carry over from Worksheets 4.2 and 5.	*Notes:* Near-term monitoring and evaluation may need to focus on expected outcomes of interim activities, such as success of planning efforts.	*Notes:* These may include process- and output-based indicators.	

APPENDIX H: ACRONYMS AND ABBREVIATIONS

ACA

Army Contracting Agency

ACBP
Army Chesapeake Bay Program

ACSIM
Assistant Chief of Staff of Installation Management

AR
Army Regulation

BRAC
Base Realignment and Closure

BWPFS

Baltimore-Washington Partners for Forest Stewardship

CA
Cooperative Agreement

CBP
Chesapeake Bay Program

CBPO

Chesapeake Bay Program Office

CEMP
Comprehensive Expansion Master Plan

CFR
Code of Federal Regulations

COMAR
Code of Maryland Regulations

CWA
Clean Water Act

CW CESU

Chesapeake Watershed Cooperative Ecosystem Studies Unit

CWMP
Comprehensive Watershed Management Plan

CZM

Coastal Zone Management Act

CZMP

Coastal Zone Management Plan

DA
Department of the Army

DEP

Department of Environmental Protection

DMWR
Directorate of Morale, Welfare & Recreation

DOC
Directorate of Contracting

DoD
Department of Defense

DoDI
Department of Defense Instruction

DOIM

Directorate of Information Management

DOL
Directorate of Logistics

DMA

Defense Media Activity

DPTMS
Directorate of Plans, Training, Mobilization and Security

DPW
Directorate of Public Works

DRM
Directorate of Resource Management

DUSD(I&E)
Deputy Under Secretary of Defense for Installations and Environment

EA
Environmental Assessment

EIS
Environmental Impact Statement

EMS
Environmental Management System

EO
Executive Order

ESA
Endangered Species Act

Fº
Fahrenheit

FCA

Forest Conservation Act

FMMD
Fort George G. Meade

FYDP

Future Year Defense Plan

GCN
Greatest Conservation Need

GIS
Geographical Information System

HEL
Highly Erodible Land

IC
Installation Commander

ICRMP
Integrated Cultural Resources Management Plan

IDG
Installation Design Guide

IMCOM -- NERO
Installation Management Command – Northeast Region Office

IMP
Installation Master Plan

INRMP
Integrated Natural Resources Management Plan

IPMP
Integrated Pest Management Plan

LRC
Long Range Component

LARF
Large Animal Research Facility

MD DNR
Maryland Department of Natural Resources

MDE
Maryland Department of Environment

MOU
Memorandum of Understanding

MSL
Mean Sea Level

MWR
Morale, Welfare, and Recreation

NCR
National Capitol Region

NEPA
National Environmental Policy Act

NGO

Non-Governmental Organization

NMP
Nutrient Management Plan

NPDES
National Pollution Discharge Elimination System

NRCS
Natural Resources Conservation Service

NSA
National Security Agency

OSD

Office of the Secretary of Defense

PAO
Public Affairs Office

PIF
Partners in Flight

RFB
Riparian Forest Buffer

RPMP
Real Property Management Plan

RTE

Rare, Threatened or Endangered Species

SAIA
Sikes Act Improvement Act

SAV
Submerged Aquatic Vegetation

SJA
Staff Judge Advocate

USACE
U.S. Army Corps of Engineers

USAG
United States Army Garrison

USAR
United States Army Reserve

USDA
U.S. Department of Agriculture

USDA APHIS

USDA Animal and Plant Health Inspection Service

USEPA
U.S. Environmental Protection Agency

USFWS
U.S. Fish and Wildlife Service

USGS
U.S. Geological Survey