Integrated Natural Resources Management Plan Update

Maine Army National Guard Training Facility, Auburn, Maine

Plan Period FY 2022 Through FY 2027

Maine Army National Guard
Directorate of Facilities Engineering
Camp Keyes, Augusta, Maine 04333–0033

Maine Army National Guard Review and Coordination Signature Page

2022-2027 Integrated Natural Resources Management Plan

Auburn Training Facility, Auburn, Maine

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US Fish & Wildlife Service Review and Coordination Signature Page

2022-2027 Integrated Natural Resources Management Plan

Auburn Training Facility, Auburn, Maine

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Review and Coordination Signature Page

2022-2027 Integrated Natural Resources Management Plan

Auburn Training Facility, Auburn, Maine

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Integrated Natural Resources Management Plan Auburn Training Facility, Auburn, Maine

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Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

List of Appendices

List of Tables (In Appendix A)

List of Figures (In Appendix B)

List of Tables (In Appendix D)

1.0 Executive Summary

This Integrated Natural Resources Management Plan (INRMP or Plan) provides guidance and procedures to enable the Maine Army National Guard (MEARNG) to meet its legal responsibilities for managing the natural resources at the 176-acre Auburn Training Facility (Facility or Site) located in the City of Auburn, Androscoggin County, Maine (Appendix B, Figure 1). This INRMP Review for Operation and Effect has been prepared for this Facility and is considered the implementing document for the natural resources management program of MEARNG at the Facility for the period 2022–2027. The INRMP is intended to support and complement the military mission of MEARNG while also promoting sound natural resource stewardship principles.

The primary mission of MEARNG is to provide the best military training environment possible to National Guard units in Maine and to enhance MEARNG's readiness for its Federal, state and community missions. In accordance with this mission, this INRMP helps ensure the maintenance of quality training lands to accomplish the MEARNG's critical military mission on a sustained basis and to ensure that natural resources conservation measures and Army activities on mission land are integrated and consistent with Federal stewardship requirements.

Natural resources management will be driven by the land's primary use, which is military training. This INRMP incorporates the goals and objectives of MEARNG's Integrated Training Area Management (ITAM) program, and various other MEARNG conservation programs, to manage the natural resources at the Facility and subsequently implement the INRMP. The goals and objectives of the following programs are integrated in this Plan (and summarized in Appendix A, Table 4) to ensure the sustainability of training lands and management of natural resources to support the military mission.

1) Training Area Management.
2) Training Site Resource Information Management.
3) Natural Resources Management, which includes (but is not limited to):

- Terrestrial Community Management
- Wildlife Management
- Threatened and Endangered Species Management
- Surface Water and Wetlands Management
- Pest and Invasive Species Management

The planning process used in developing and reviewing this INRMP focused on involving key stakeholders from MEARNG, Maine's Department of Agriculture, Conservation and Forestry's Natural Areas Program (MNAP), the U.S. Fish and Wildlife Service (USFWS), Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Historic Preservation Commission (MHPC), and other interested parties including Native American Tribes.

The changes required in this INRMP are not expected to result in consequences materially different from the existing INRMP, therefore an INRMP Update is the appropriate path forward. An INRMP Update does not require conducting an Environmental Assessment (EA) but instead will be documented with a Record of Environmental Consideration (REC) per ARNG G9 Memorandum "Army National Guard (ARNG) Installations and Environment (I&E) Directorate Policy for Integrated Natural Resource Management Plans (INRMP)" dated 20 March 2019. In accordance with this memorandum and the Sikes Act, this INRMP will be reviewed again for operation and effect no later than 5 years from the approval date.

2.0 General Information

2.1 Purpose

The purpose of this INRMP is to guide the implementation of the natural resources management program at the Facility between 2022 and 2027. Cultural resources also are discussed, however specific management of these resources are directed under MEARNG's Integrated Cultural Resources Management Plan (ICRMP). The INRMP program will conserve land and natural resources and will help ensure compatibility with military activities and compliance with environmental laws and regulations. Further, the INRMP will help ensure the maintenance of quality training lands, to accomplish MEARNG's critical military mission on the Facility on a sustained basis, and to ensure that natural resources conservation measures and military activities on mission land are integrated and consistent with Federal stewardship requirements. This INRMP is designed to protect and enhance the training lands upon which the military mission is dependent. It uses an integrated approach to natural resources management and demonstrates that MEARNG is a committed steward of the land.

This Plan is not designed to evaluate MEARNG's military mission, nor is it intended to replace any requirements for environmental documentation of the military mission.

In accordance with U.S. Army Policy, this INRMP includes narratives that address the following:

- Wildlife, land, and forest management, and wildlife-oriented recreation;
- Wildlife habitat enhancement or modifications;

- Wetland protection, enhancement, and restoration where necessary for support of wildlife or plants;
- Integration of, and consistency among, the various activities conducted under the INRMP;
- Establishment of specific natural resources management goals and objectives, and time frames for proposed action;
- Sustainable use by the public of natural resources to the extent that the use is not inconsistent with the needs of wildlife resources;
- Public access to the military installation to the extent that the use is not inconsistent with the needs of wildlife resources, subject to requirements necessary to ensure safety and military security;
- Enforcement of applicable natural resource laws;
- No net loss in the capability of military installation lands to support the military mission of the installation;
- Regular review of this INRMP and its effects, not less often than every 5 years;
- Exemption from procurement of services under Office of Management and Budget Circular A-76 and any of its successor circulars; and,
- Priority for contracts involving implementation of this INRMP to state and Federal agencies having responsibility for conservation of wildlife.

2.2 Authority

Preparation and implementation of this INRMP is required by the Sikes Act (16 USC §670 et seq.). MEARNG staff and contractors prepared this INRMP using Guidelines to Prepare Integrated Natural Resources Management Plans for Army Installations and Activities, as modified by Forces Command. This Plan describes how MEARNG will implement provisions of AR 200–1 and local regulations. This INRMP will help to ensure MEARNG compliance with other Federal and state laws, most notably laws associated with environmental documentation of wetlands, endangered species, and wildlife management including the following:

- American Indian Religious Freedom Act (42 United States Code (USC)
- Archaeological Resources Protection Act of 1979 (PL 96–95:16 USC 470aa-11)
- Bald and Golden Eagle Protection Act (Public Law (PL) 86–70, as amended; and 16 USC 668a-d)
- Clean Air Act (as amended through 1990)
- Clean Water Act of 1977, including Federal Water Pollution Control Act Amendments of 1972 (PL 92–522)

- Department of Defense Instruction 4715.3, Environmental Conservation Program, 1996
- Department of Defense Instruction 4715.03 Natural Resource Conservation Program, 2011
- Deputy Under Secretary of Defense Sikes Act Policy Memorandum, 10 October 2002 (updated 1 November 2004)
- Endangered Species Act of 1973 (PL 95–632, as amended)
- Executive Order 11514, Protection and Enhancement of Environmental Quality, 1970
- Executive Order 11991, Protection and Enhancement of Environmental Quality, 1977 Amendments
- Executive Order 11990, Protection of Wetlands, 1977
- Executive Order 12962, Recreational Fisheries, 1995
- Executive Order 13007, Indian Sacred Sites, 1996
- Executive Order 13112, Invasive Species, 1999
- Executive Order 13751, Invasive Species, 2016
- Federal Insecticide, Fungicide and Rodenticide Act (7 USC 136 *et seq*.)
- Federal Noxious Weed Act of 1974 (PL 93–629)
- Fish and Wildlife Coordination Act (19 USC 661–667e)
- Fish and Wildlife Conservation Act of 1980 (16 USC 2901–2911, as amended; PL 96–366)
- Fish and Wildlife Conservation and Natural Resource Management Programs on Military Reservation [Amends PL 86–797 (Sikes Act PL 96–561)]
- Migratory Bird Treaty Act (PL 65–186; 16 USC 703 *et seq*.)
- Maine Natural Resources Protection Act [NRPA, Title 38 Maine Revised Statutes Annotated (MRSA) §480]
- Maine Shoreline Zoning Act (Title 38 MRSA §438-A)
- Maine Standards for Classification of Fresh Surface Waters (Title 38 MRSA §465)
- Maine Department of Human Services, Subsurface Wastewater Disposal Systems (Title 22 MRSA §42)
- Native American Graves Protection and Repatriation Act (25 USC, Section 3001 *et seq*.; PL 101–601)
- National Environmental Policy Act of 1969, as amended (42 USC 4321 *et seq*.; PL 91–190)
- National Historic Preservation Act of 1966, as amended (16 USC 470 *et seq*.; PL 89–665)
- Noxious Plant Control Act or “Carlson-Foley Act” (43 USC 1241 *et seq*.; PL 90–583)

- Sale of Certain Interests in Land; Logs (10 USC 2665)
- Sikes Act (16 USC 670 *et. seq.*) including Conservation and Rehabilitation Program on Military and Public Lands (PL 93–452) and Conservation Programs on Military Reservations (PL 90–465)
- Water Quality Act of 1987
- Watershed Protection and Flood Prevention Act (16 USC 1001–1009, Chapter 18, PL 566; 68 Stat 666, as amended)

In addition, the National Environmental Policy Act (NEPA) established a mandate for Federal agencies to consider the potential environmental consequences of proposed activities, document the analysis, and make this information available to the public for comment prior to implementation of a project. NEPA requires, to the fullest extent possible, that the policies, regulations, and laws of the Federal government be interpreted and administered in accordance with its environmental protection goals. NEPA also requires Federal agencies to use an interdisciplinary approach in planning and decision making for any action that adversely impacts the environment.

In accordance with NEPA regulation 32 CFR 651 Environmental Effects of Army Actions and the Council on Environmental Quality (Implementing Guidelines for NEPA, 40 CFR Parts 1500¬1508), an EA must be completed for natural resources management plans. 32 CFR 651 outlines NEPA compliance requirements of proposed Army actions and an environmental assessment is used to evaluate the environmental consequences of an INRMP

This INRMP, upon signature, has the approval of the USFWS and MDIFW. Approval from these agencies includes agreement that the INRMP complies with both the Federal and Maine Endangered Species Acts and other applicable laws. Review of the INRMP is informal consultation with regard to the Endangered Species Act. Within the spirit and intent of the Sikes Act Amendments of 1997 and the Endangered Species Act, this INRMP serves to provide adequate management or protection for endangered species and their habitats. Agency correspondence is provided in Appendix C.

All actions contemplated in this INRMP are subject to the availability of funds properly authorized and appropriated under federal law. Nothing in this INRMP is intended to be nor shall be construed to be a violation of the Anti-Deficiency Act, 31 USC § 1341.

2.3 Responsibilities

The successful management of natural resources and implementation of this INRMP requires cooperation among all responsible parties. The level of success can be enhanced by developing partnerships among other parties that have a vested interest in natural resources management at Auburn.

The Adjutant General of MEARNG is directly responsible for operating and maintaining Auburn, including implementing and enforcing this INRMP. The Adjutant General may be held personally liable for noncompliance with environmental laws. Thus, the Adjutant General has a vested interest in assuring that this INRMP is properly implemented.

The Construction and Facilities Management Officer (CFMO) of MEARNG is responsible for the management of all services supporting the installation mission including grounds, roads, training lands, and facilities at Auburn.

The MEARNG Environmental Branch Chief is responsible for assuring that all regulations and legislation applicable to natural resources management on the site are adhered to, including all environmental programs encompassing fish and wildlife management, endangered species management, land management, woodcutting, water quality protection, NEPA compliance, cultural resources conservation, hazardous waste management and site cleanup. The Branch Chief's responsibilities also include assurance that all appropriate environmental documentation is prepared and reviewed for all Federal actions (e.g., military training, new technology/equipment testing, construction projects, and real property actions).

The Natural Resources Manager reports directly to the Environmental Branch Chief and is responsible for implementation of the INRMP including wildlife management, hunting and fishing programs, endangered species management, land management, forestry, water quality and wetlands protection and wildland fire.

The Deputy Chief of Staff Operations (DCSOPS) serve as the interface between the Environmental Division and troops training in the field. The DCSOPS is responsible for managing range complexes, coordinating military training, implementing ITAM, and releasing training areas for land restoration and recreational use. The DCSOPS provides control of military activities needed to conserve and protect natural resources. The DCSOPS's responsibilities also include providing access to facilities to accomplish natural resources management, providing opportunities for wildlife-related recreation, and enforcing environmental requirements involving training area use.

The MEARNG Training Site Manager has the responsibility of specific day-to-day operations during annual training, weekend drills and maintenance at the site. Specific responsibilities include control and work assignments of all personnel, issuance of directives, overall supervision of Site safety and orders pertaining to military operation at Auburn.

Per 10 USC sec. 10501, NGB is a joint activity of the Department of Defense. NGB is the higher headquarters for the MEARNG. Two Directorates are involved in the management of natural resources: ARNG G9 and the Director of Operations, Training, and Readiness (ARNG-TRS).

The Natural Resources Manager at ARNG-G9 is responsible for reviewing the INRMP and advising the Environmental Office before formally submitting the Plan to the USFWS and the MEDIFW. ARNG-G9 ensures operational readiness by sustaining environmental quality and promoting the environmental ethic and is also responsible for tracking projects, providing technical assistance, quality assurance and execution of funds.

ARNG-G9 provides policy guidance and resources to create, sustain, and operate facilities that support the Army National Guard. ARNG-G9 coordinates proposed construction projects with ARNG-TRS and provides design and construction support, as well as environmental management that are directly related to property maintenance (e.g., grounds maintenance, pest control).

ARNG-TRS is responsible for training and training site support to include sustainable range management.

Cooperative efforts with the USFWS, MNAP, and MDIFW address threatened and endangered species and communities. Personnel from these agencies have identified rare, threatened, and endangered (RTE) species and communities of concern at Auburn as summarized in this report. Furthermore, the Maine Department of Agriculture, Conservation and Forestry, under MNAP, manages and maintains a database in which sensitive species location information is stored and made available to the public and research entities. The MDIFW is also the primary state agency regarding wildlife management for Auburn. Agency correspondence is provided in Appendix C.

2.4 Management Philosophy

MEARNG strives to manage the natural resources at its training facilities in a manner that ensures the sustainable uses of facilities for the training needs of the military as well as to restore, protect, and conserve the natural biodiversity within these areas. INRMP's and other planning documents serve to support this philosophy by facilitating long-range planning efforts and development, as well as ensuring the long-term sustainable use of training lands. To facilitate this, the INRMP for the Auburn site was developed in an interdisciplinary manner in coordination with relevant agencies and interested parties. Resources from various disciplines were provided by staff from MEARNG, USFWS, MNAP, MDIFW, MHPC, and environmental consultants.

Key to MEARNG's management philosophy is an ecosystem management approach whereby management of natural resources (e.g., soils, wetlands, and wildlife) takes place on a community level, rather than a species specific or resource specific level, to help ensure that regional biodiversity enhancement occurs, rather than enhancement of a single resource or species. In addition, the following are integral components of MEARNG's management philosophy:

- Develop an understanding of the Site and its relationship to local and regional natural and cultural resources;
- Understand the military mission, potential effects of the mission on natural and cultural resources, and provide solutions to conflicts between the military mission and natural and cultural resources management;
- Ensure no net loss in the capability of military installation lands to support the mission of the Site;
- Document the presence of natural resources on the Site;
- Identify methods that will increase environmental awareness of MEARNG and its training facilities;
- Develop management guidelines that will be effective in maintaining and improving the sustainability and biological diversity of terrestrial and wetland ecosystems on the Site, support the military mission, and emphasize public involvement and partnerships; and,
- Avoid and/or limit impacts to natural and cultural resources, and provide recommendations that may better protect and/or restore natural and cultural resources.

2.5 Conditions for Implementation and Review

Personnel in the Environmental Section of MEARNG are closely involved in the planning and design phase of many projects. Involvement early in the planning process allows personnel to suggest and promote alternative actions and to make recommendations for avoidance of impacts and possible mitigation scenarios. Through this process, MEARNG will ensure that INRMP activities are properly assessed and planned to avoid and minimize impacts. Environmental reviews are conducted by an interdisciplinary team that investigate the proposed action for potential impacts to land, water, vegetation, air, quality-of-life, cultural resources, etc. Interagency agreement and recommendations for avoidance, minimization, and mitigation of environmental impacts also are made through this process.

The INRMP balances the installations' requirements to meet the training mission and applicable natural resources legal mandates. This document is a cooperative agreement between MEARNG, MDIFW, and USFWS that outlines issues and strategies, and goals, objectives, and actions required to meet the installations mission and legal mandates. An on-site trained natural resources staff is recommended to adequately balance the mission with legal requirements and to oversee INRMP development, implementation, annual evaluation, 5-year review for operation and effect and interagency coordination. Effective Plan implementation must include, but is not limited to, the following regular oversight by on-site trained professionals:

- Coordinate resource management and military training actions between installation directorates and between the installation, regulatory agencies, and the public to ensure that the mission and legal requirements are met;
- Develop and implement conservation and mitigation strategies for endangered species and for all wildlife and habitats, and for ecologically critical, sensitive, and rare habitats;
- Provide a key role in the environmental review process to evaluate the environmental effects of proposed actions by the installation and its tenants, and achieve, monitor, and maintain compliance with all applicable legal requirements; and,
- Evaluate recreation use impacts to natural resources, installation security, human safety, and fiscal soundness, and weekly training schedules, to allow limited public recreation use of the Facility.

The INRMP goals and actions provide a basis for evaluating plan implementation. An annual report will be prepared and may include funds requested and received, future funds requested, a list of projects implemented with a brief summary of results and recommendations for changes, projects not implemented and why, a review of Auburn activities including a brief summary of training activities and a description of changes proposed or incorporated into the INRMP.

3.0 Installation Overview

3.1 Location and Area

The approximately 160-acre (64.7 hectares), Federally-owned military training site, is located in Androscoggin County, in the City of Auburn, Maine (Appendix B, Figure 1). The site is bordered by Garfield Road along the northeast side of the site, and is situated south of Taylor Pond. Route 11/121 is located south of the site. To the northwest is Mt. Apatite; the eastern and southeastern slopes of Mt. Apatite extend onto the Site. Mt. Apatite Conservation Area, located directly adjacent to the site, is owned and managed by the City of Auburn, and is a popular hiking, biking, and cross-country skiing location. Access to the Conservation Area is provided by Stevens Mill Road, which runs east-west through the lower half of the Site (Appendix B, Figure 2). In addition to the Federally-owned land, MEARNG also manages two adjacent State owned parcels and leases one parcel totaling approximately 16 acre, located west of the primary training land. The north and south parcels are State owned, and the central parcel is leased from the Auburn Gun Club. This INRMP covers both the Federally owned, State owned land and the leased parcel.

The main access road to the site is via Stevens Mill Road in west Auburn, at the intersection with Garfield Road, north of Route 11/121 (Appendix B, Figure 2). The other road (unnamed) on the site is located north of Stevens Mill Road, and extends into the northern area of the Site. Two minor roads extend northeast from this unnamed road, providing site access from Garfield Road.

A large portion of the site is forested, with the most common tree species being oak-pine and hardwood species. The main features of the site are the Field Maintenance Shop (FMS) #2, located within the center of the Site, four controlled humidity storage buildings, a large open area used for engineer equipment training and an inactive 25m small arms range (Appendix B, Figure 2). FMS #2 includes buildings, compound and a parking area encompassing several acres. Three streams and wetland areas are associated with the site: 1) the largest stream and wetland complex is located northwest and west of the training and engineering equipment area; 2) a smaller stream and wetland area is located in the northern most section of the site, that extends from the base of Mt. Apatite northeast to Garfield Road; and, 3) the third stream and wetland area is located along the southern boundary of the Site, and extends from the developed area south of the Site and into the Powerline Right-of-Way located in that area (Appendix B, Figure 5). A large complex of created wetlands is associated with the recreational area located southeast of FMS #2, and several small vernal pools (Appendix B, Figure 5.) are located throughout the site. The main geological feature of the site is the eastern and southern slopes of Mt. Apatite, which has an approximate elevation of 500 feet (ft.) above mean sea level (MSL). The mountain contains very steep slopes and associated seepage areas from runoff (Auger 2006).

Within the FMS #2 area of the site are administrative offices, maintenance areas, storage buildings, and parking facilities, including areas that can accommodate heavy military construction equipment and trucks (Appendix B, Figure 2). A public recreational area, the Garfield Road recreational complex, is located south of FMS #2 within the southeast corner of the site, and is bordered by Stevens Mills Road and Garfield Road. The recreation area includes several athletic fields and is operated and maintained by the City of Auburn Recreation Department. Within the forested area located adjacent to FMS #2 are an existing inactive 25 meter baffled firing range, a compass course, a historic 800–1000 known distance (KD) firing range (not currently in use) that was utilized from the 1920's to the early 1960's. Portions of the three-target structures that were part of the historic ranges remain within the forested area (Vitale 2003). In the area north of the access road that extends into the northern section of the site is an area that is periodically used by off-road recreational vehicles, such as all-terrain vehicles (ATVs).

3.2 Installation History

The Auburn site was purchased in 1926 by the Federal Government and licensed to MEARNG by the United States Army Corps of Engineers (USACE). Its primary use, both historically and presently, is for training military personnel. Prior to the Sites development as a MEARNG training facility it was used for farming and pastureland for many years, including sections located along Garfield Road. This is evidenced by remnants of several stonewalls and wire fencing that can be observed throughout the southern half of the Site. The size and condition of the timber on the site indicates that very little timber harvesting has occurred on the site during the last 75 years or more (Vitale 2003).

Significant mining exploration associated with Mt. Apatite has been conducted in the western portion of the Site, and on land directly adjacent to and west of the Site. Two quarries, Greenlaw and Maine Feldspar, were in use on Mt. Apatite beginning in the 1850's, and active up until the early 20th century (Weber and Rooney 2002). Both quarries, located within the boundaries of the Mt. Apatite Conservation Area, were primarily used to extract feldspar for use in the manufacture of ceramics and china; however, other rare minerals were also extracted, including tourmaline, quartz, garnet and apatite. Much of the area within close proximity to the quarries was cleared to conduct the mining operations, and several old quarry roads remain with the Mt. Apatite Conservation Area.

As a result of the loss of recreational facilities within the City of Auburn, the City initiated negotiations with MEARNG officials in 1988 for a land swap between the two parties at a ratio of 1:3 acres in order for the City to construct a recreation facility on the site (MEARNG 2002a). The Garfield Road recreational complex was built by the City of Auburn in 1990 in the southeast corner of the Site. A lease agreement for the use of the recreational area on Federal lands was also approved by both parties in 1990 for a 5 year period. To date, a new lease agreement has not been signed, and the U.S. Army Corps of Engineers (USACE) has not received land compensation from the City as part of the original land swap negotiations; however, negotiations between the two parties is expected to continue until a mutual agreement can be reached.

3.3 Military Mission

The primary mission of MEARNG is to provide training facilities and services to U.S. Armed Forces and National Guard units within the State of Maine. Operations include engineering training requiring the use large heavy construction equipment on a year-round basis. Additional operations include orienteering activities, bivouacs, dismounted maneuvers, and tactical driving. Vehicles used in training and engineering equipment activities are restricted to existing cleared areas and sandy roads and trails.

In recent years, a National Directive has expanded the role of the site in order to broaden the capabilities and training opportunities of large equipment training centers throughout the nation, particularly in the northeast.

3.4 Surrounding Communities

Private and commercial property border the site to the south and east. The City of Auburn is the primary city surrounding the site. According to the U.S. Census Bureau (2010), the City of Auburn had a population of 23,055. The City of Lewiston, located adjacent to and east of Auburn, is often called the "sister city" to the City of Auburn, due to its' close proximity. The Androscoggin River runs north to south, and separates the two cities along the eastern side of Route 4 and Route 136. In 2010, the City of Lewiston had a population of 36,592. Two other small towns located within the surrounding area are the Town of Minot, and the Town of Sabattus. Minot is located approximately 1 mile west of the site, and as of 2010, had an estimated population of 2,607 residents. The Town of Sabattus is also a small community of approximately 4,876 residents, and is located about 9 miles east-northeast of the Facility near the eastern boundary of the Lewiston city limits.

North of the City of Auburn is Lake Auburn, a large lake owned and maintained by the Auburn Water District. The lake is used for public drinking water, serving the communities of Lewiston and Auburn, and although limited activities are permitted in some areas of the lake, boating, swimming, fishing, and other recreational activities are prohibited in a majority of the lake's waters.

3.5 Regional Land Use

Historically, regional land use was likely agricultural and undisturbed forests. Lewiston was settled in 1770 and officially incorporated in 1795 (Androscoggin County 2007). Auburn was settled in 1786, incorporated as a town in 1842, and incorporated as a city in 1868. Development of the Lewiston-Auburn area centers around the development of power driven by the flow of the Androscoggin River, the river that divides the two cities. The Great Androscoggin Falls Dam, Locks and Canal Company was formed in 1839, and was reorganized into the Lewiston Water Power Company in 1845. Power generated by the waterfalls was used in the general manufacturing business, mainly the production of textiles, cotton, and wool. Local families with ties to development of the riverfront for power generation and industrial use include the Littles, the Fryes, and the Garcelons.

The development of shoe factories began in the Auburn area in 1835. By the 1850's a large wave of Irish immigrants had arrived in the Lewiston-Auburn area, seeking to escape the potato famine of Ireland. By the late 1860's however, the largest group of immigrants consisted of families of French-Canadian descent (Androscoggin County 2007). By the turn of the century the area was also home to many other immigrant groups, including Italian, Greek, Lithuanian, Russian, English, and Scottish families. During the early 1900's the Lewiston area became known as a textile manufacturing center, and along with the power being generated by the Androscoggin River, this development was supported by the arrival of the railroad and development of the cities canal system (Androscoggin County 2007).

Beginning in the late 1950s, many of the area textile mills began to close due to lower production costs available in other parts of the country. This significantly affected the economic base of the community, which at one time produced one quarter of America's textiles (Wikipedia 2007). Today the Androscoggin River is not a significant source of power generation, and the health care industry represents the largest industry in Lewiston-Auburn. Currently Central Maine Medical Center is the largest employer for the area, with paper and shoe manufacturing, and tourism, representing other large employers operating within the community (Wikipedia 2007).

Current land use surrounding the installation to the north, west, and south is primarily rural, and forested open space. A small pocket of industrial development is located south of Route 11/121, and large commercial and residential areas are associated with the communities of Lewiston-Auburn within 1 mile to the east.

3.6 Local and Regional Natural Areas

The Auburn site is located within the southwestern portion of the Central Interior Region vegetative community, which is defined as a zone of transition from predominance of species suited to a temperate climate, to one where boreal species are more common (Weber and Rooney 2002). The Central Interior Region extends from the foothills of the White Mountains near Buckfield to the west, to the Penobscot River to the northeast, near Alton, extending to within 20 miles of the coast to the east, and south to the area of the site. The terrain of the Central Interior Region is comprised mostly of gently rolling hills, with an average elevation of between 200 and 400 feet above MSL.

Approximately 60 woody species and at least 250 herbaceous species reach their northern limit within the Central Interior Region vegetation zone (McMahon 1990 *as cited in* Weber and Rooney 2002). Some of the woody species reaching their northern limit within this zone include scarlet oak (*Quercus coccinea*), bear oak (*Quercus ilicifolia*), smooth winterberry (*Ilex laevigata*), and sassafras (*Sassafras albidum*). Other woody species at their southern limits within this zone, but occurring in zones located farther north, include mountain paper birch (*Betula papyrifera* var. *cordifolia*), white spruce (*Picea glauca*), jack pine (*Pinus banksiana*), and balsam poplar (*Populus balsamifera*). Another prominent transition in forest types that occurs in the region of the site includes the replacement of oak-pine forests, which is the dominant forest type in regions south of the site, by northern spruce-fir-northern hardwoods typical of northern forests.

Specifically six plant communities have been identified on the site. The two most dominant plant communities are Open Sandplain/Old Field and Oak-Pine Forest (Appendix B, Figure 3). Other minor plant communities documented on the Site include Maple-Basswood-Ash Forest, Beech-Birch-Maple Forest, Mixed Graminoid-Shrub Marsh, and a Powerline Right-of-Way. These plant communities are described in more detail in Section 5.2.2 Current Vegetative Cover.

Several wetlands, vernal pools, and stream channels are located throughout the Facility, totaling approximately 29.7 acres. The surface water features and wetlands located on the Facility are described in more detail in Section 4.5 Surface Water, and Section 5.5 Wetlands.

4.0 Physical Environment

4.1 Climate

The Facility is located in a region with a moderate climate, having approximately 140–160 frost-free days per year (Weber and Rooney 2002). July is normally the warmest month of the year with a mean maximum temperature of 80 degrees Fahrenheit (°F). January tends to be the coldest month of the year with a mean minimum temperature of 10°F. Average annual precipitation for the region is 42 inches of annual rainfall, and 80 inches of annual snowfall. This precipitation pattern is considered intermediate, falling in between precipitation patterns observed for the area located between Mid-Coast Maine and Penobscot Bay regions to the south, and the Western Foothills and Eastern Lowlands Regions to the north. Typically this area of the country does not contain a dry season, with precipitation distributed throughout the calendar year, although on average March tends to be the wettest month of the year with a mean monthly rainfall of 4.52 inches. According to data provided by the National Oceanic and Atmospheric Administration (NOAA) the warmest months are June, July, and August, with mean monthly maximum temperatures of 65.0, 70.7, and 68.8 °F, respectively (NOAA 2007). The extreme maximum temperature for a recent thirty year period (1961–1996) for which data is available, measured near the Portland weather station, was 103 °F on 2 August 1975 (NOAA 2007).

The mean annual temperature for Lewiston over the 30-year period of 1971–2000 is 46.7 °F. January is the coldest month, closely followed by February and December. The mean number of days per year with below-freezing temperatures for a 55-year period for which data is available for Portland is 157 days, with January (31) and December (30) containing the highest mean number of days per month with temperatures below 32 °F (NOAA 2007). Winter temperatures can present a severe hazard to personnel exposed to the outdoors. With a wind chill, the temperature may fall below the record low temperature of -39 °F, observed in Portland on 16 February 1943 (NOAA 2007), and flesh may freeze within 1 minute of exposure. Snow and ice cover generally thaws from late March to mid-May. The months of January and February tend to have the highest snowfall levels of the year, with approximately 20 inches and 17 inches observed for each of those months, respectively (58 years of data) on average (NOAA 2007). Snowfall is fairly heavy, with an annual average of 70.7 inches for Portland (NOAA 2007), although this average may be a bit higher for points north, such as Auburn. It should be noted that snowfall levels may be quite variable, not only from year to year, but also from place to place as a result of slope, elevation, and other factors, such as storm tracks and jet stream patterns.

Cloudiness and snow are characteristic features of winter weather in the Auburn area. Data for Portland for a recent 54 year period (1942–1995) shows that the amount of sunshine is low throughout the year with about 100 days on average of partly cloudy weather and 206 average days per year of cloudy weather. Wind velocities near Portland are moderate, averaging 8.7 miles per hour (mph) annually (NOAA 2007). The most violent winds are those that accompany storms, such as thunderstorms or the occasional tropical storm, with severe winds of 40–50 mph. In winter there are numerous days with sufficient wind to cause blowing and drifting snow.

Climate change is expected to impact Hollis Training Site. A summary of expected climate change impacts using the US Army Climate Assessment Tool can be found in Appendix G.

4.2 Landforms

The Auburn site is located in the Laurentian Plains and Hills ecoregion (U.S. Geological Survey 2006). The approximately 19,365-square mile Laurentian Plains and Hills ecoregion is located entirely within the State of Maine, and roughly defines the eastern half of the state. The western part of Maine is defined as the Northeastern Highlands region, and the southern tip of Maine is included in the Coastal Zone ecoregion. The Laurentian Plains and Hills ecoregion was formed by glacial processes, which created numerous lakes and wetland areas. Forest habitats dominate this ecoregion, covering nearly ¾ of the region. Spruce and fir trees are the most common types of trees found in this region, although maple, beech, and birch are also found here (USEPA 2002). The region as a whole is sparsely populated, much more so than the Coastal Zone region to the south; however, it has been affected somewhat by human activities. By far timber harvesting is the most significant activity in the region, with agriculture (most prevalent in the northern section of the region), and development activities that have also shaped the land. Topography is less rugged than the adjacent Northern Highlands ecoregion to the west, and soils of the Laurentian Plains and Hills regions are predominantly represented by Spodosols. Topography within the region is generally gently sloping with elevations of 500 feet above MSL or less.

Specifically, the Auburn site is located within the drainage area of Mt. Apatite to the west (Appendix B, Figure 1), with a majority of stormwater runoff draining to the east. In general, the eastern slopes of Mt. Apatite are the dominant feature of the Site, descending from approximately 500 feet above MSL onto the western portion of the Site. The east and south facing slope of Mt. Apatite descend to approximately 250 feet above MSL in elevation along the southeastern Site boundary. Here wet areas collect runoff from the slope forming a seep and seasonal stream. Overall, the elevation of the Site ranges from 250–350 feet above MSL, with approximately 25 percent (%) of the site having a southern aspect, and the remaining 75% of the site having fairly level terrain (Vitale 2003).

4.3 Geology and Soils

The underlying bedrock of the site is mainly a type of coarse-grained granite called pegmatite (Weber and Rooney 2002). The formation of the bedrock occurred when the molten form of igneous rock was subsequently enriched with water and rare minerals. This method of bedrock creation resulted in the formation of many types of rare minerals that are found on the Site and in the immediate area. Pink and green tourmaline, smoky quartz, garnet and apatite are some of the more common minerals associated with the areas geology and soils. It is estimated that these rocks and minerals formed and cooled approximately 300 million years ago.

Surface soil deposits on the higher elevations of the Site are primarily rocks and boulders of glacial origin. The weight associated with most recent glacial activities caused a depression in the ground, which allowed the inflow of seawater into previously ice-covered areas (Weber and Rooney 2002). This is evidenced by the presence of marine sediments that make up the large sandy deposit associated with FMS #2. This deposit of marine sediments is by itself a relatively rare occurrence in Maine.

A majority of the site soils, especially those found in the southern half of the Facility are associated with 0–8% slopes, and are relatively shallow (Appendix B, Figure 4). The presence of the slopes of Mt. Apatite that extend onto the site in the north and western sections of the Facility, results in soil types associated with 8–45% slopes with poor drainage qualities and high rates of runoff in this area. Six soil types have been identified on the site, including soils associated with the Adams, Ninigret, Sutton, Walpole and Hollis series (Appendix A, Table 2).

The primary soil type (approximately 36%) of the site is Adams loamy sand (0–8% slopes), which is derived from sandy glaciofluvial deposits derived from crystalline rock, and occurs on large sand plains (Natural Resources Conservation Service (NRCS) 2006). This soil type often has a water table located within 2 feet of the soil surface (Weber and Rooney 2002). Adams loamy sand is located throughout the Site (Appendix B, Figure 4), with large areas associated with the FMS #2 training area, and areas located near the western boundary. The next most common soil type, comprising approximately 32% of the soils on the Site is Ninigret fine sandy loam, with 0–8% slopes. Ninigret fine sandy loam is derived from coarse-loamy glaciofluvial deposits derived from slate (NRCS 2006), and is moderately well drained soil that occurs on outwash terraces. Ninigret fine sandy loam often has a water table located near the surface during spring and fall months, and tends to be very acidic in nature. This soil type may also contain pockets of poor to very poorly drained soils. Ninigret fine sandy loam is located in four large areas of the site as depicted in Figure 4 of Appendix B.

The next most common soil type, comprising approximately 17% of Site soils is Walpole fine sandy loam. Walpole fine sandy loam is poorly drained soil derived from sandy glaciofluvial deposits, and occurs in narrow bands of terraces and outwash plains. It is usually comprised of about 6 inches of dry sand that overlay poorly drained sand, and has a water table at or very near the surface. This soil type is limited to two large areas located on either side of the FMS #2 area, adjacent to areas of Adams loamy sand and/or Ninigret fine sandy loam.

Hollis very rocky fine sandy loam, with 15–45% slopes comprises approximately 11% of the Site soils, and is located in large areas located in the northern and western sections of the Facility where the eastern and southern slopes of Mt. Apatite extend onto the Site. This soil type has a composition made up of coarse, loamy supraglacial meltout till that is derived from mica schist (NRCS 2006), and tends to be well drained and shallow, with typical depths of 6–12 inches. Runoff is rapid due to the steep slopes, and this soil type is often located near areas that contain springs. Hollis very rocky fine sandy loam, 8–15% slopes, defines approximately 3% of the Site soils and was also formed from coarse, loamy supraglacial meltout till derived from mica schist (NRCS 2006). This soil type is well drained, having a typical depth of 6–12 inches, and may have outcrops of bedrock covering up to 25% of the surface and pockets of less well-drained soils (Weber and Rooney 2002). Hollis very rocky fine sandy loam, 8–15% slopes, is found in two small areas located along the western border of the Facility, where the more moderate slopes of Mt. Apatite extend onto the Site. The final soil type associated with the Facility is Sutton very stony loam, 0–8% slopes. This soil type defines less than 1% of the soils found on the Facility and is isolated to a small area located in the southwestern corner of the Site (Appendix B, Figure 4). This soil type is derived from coarse-loamy supraglacial meltout till derived from mica schist. It is moderately well drained, with moderately low water movement in the most restrictive layer.

The wetlands located on the Facility are primarily associated with areas of Adams loamy sand, 0–8% slopes, Ninigret fine sandy loam, 0–8% slopes, and Walpole fine sandy loam.

Soil Erosion Potential

The ability of a soil type to tolerate disturbances such as vehicular traffic, foot traffic, and other related training activities is an important characteristic for military facilities. Soil characteristics such as texture, organic content, moisture regime, structure, and depth, all contribute to a soil's ability to withstand disturbances, infiltrate water, and aid in determining a soil's erosion potential. Other factors such as precipitation and flooding, slope, wind, and vegetative cover also may affect soil erosion. The three primary types of erosion include:

- **Gully Erosion** – The erosion process whereby water accumulates and often recurs in narrow channels and, over short periods removes the soil to considerable depths; often defined for agricultural land in terms of channels too deep to easily ameliorate with ordinary farm tillage equipment, typically ranging from 0.5 m, to as much as 25–30 m deep.

- **Rill Erosion** – The removal of soil by concentrated water running through little streamlets, or headcuts. Detachment in a rill occurs if the amount of sediment in the flow is less than the amount the load can transport and if the flow exceeds the soil's resistance to detachment. As detachment continues or flow increases, rills will become wider and deeper.

- **Sheet Erosion** – Erosion of thin layers of earth-surface material, more or less evenly, from extended areas of gently sloping land by broad continuous sheets of running water, without the formation of rills, gullies, or other channelized flow.

Based on the NRCS Soil Information, several soil types located on the Site are particularly susceptible to erosion (NRCS 2006). These include the Hollis series soils and the Ninigret fine sandy loam, 0–8% slopes. Hollis very rocky fine sandy loam, 8–15% slopes, and the Ninigret fine sandy loam, 0–8% slopes are all classified as potentially highly erodible. The Hollis soils are located in the western section of the Site, and are associated with the slopes of Mt. Apatite (Appendix B, Figure 4). The Ninigret fine sandy loam is located in large sections located in and around the FMS #2 site.

Hollis very rocky fine sandy loam, 15–45% slopes is also classified as highly erodible. The Hollis soil type is associated with the steeper portions of the slopes of Mt. Apatite that extend onto the Facility. While sandy soils are generally relatively unstable and are susceptible to erosion in areas with high vehicular or human traffic, such as those associated with the FMS #2 site that are not vegetated, the FMS #2 area is relatively flat and erosion would not be as significant in this area.

4.3.1 Identified Soil Erosion

Erosion has not been identified as a significant issue at the site. However, the potential for erosion exists in sensitive areas should the soil in these areas be exposed. Those locations that are most susceptible to experience impacts are areas associated with heavy vehicle use, particularly in sandy areas and trails located near, or that cross streams or wetlands. The FMS #2 experiences heavy equipment usage on a regular basis; however, erosion is not expected to be a problem in this area due to its relatively flat topography.

The primary areas of concern in regards to soil erosion and sediments entering waterways are associated with streams and wetlands located within 75 ft. of existing roadways. The largest stream and wetland complex on the Site is crossed by the unnamed dirt road in the northern section of the Site, and Stevens Mill Road in the area where the roadway exits the Facility to the west and extends into the Mt. Apatite Conservation Area (Appendix B, Figure 5). The northern most stream and wetland complex is also intersected by the unnamed dirt road; several of the other small wetlands and vernal pools located on the Site are located within 75 ft. of roadways. Additionally, several unauthorized ATV trails are located in the northern and southern sections of the Site, some of which are located in or adjacent to wetland areas. Use of these trails for such purposes may allow sediment to enter these sensitive waters as a direct result of erosion and increase the potential for gasoline and oil to contaminate these wetland areas. In addition, ATV use can result in mud holes and/or deep ruts on heavily used trails, and if ATV riders steer around those spots, they create parallel tracks, which may impact vegetation and/or wetland areas. What can originate as a narrow lane through the woods or adjacent to water resources becomes a widening braid of trails. With adjacent brush and low lying vegetation destroyed and tree roots damaged, these trails can become susceptible to erosion.

MEARNG recognizes that the loss of soil and sedimentation of waters resulting from soil erosion negatively impacts the natural resources of the surrounding areas. The MEARNG does conduct annual erosion surveys and investigations to research and evaluate soil erosion at the site, and to identify any preventive measures that may be needed. These surveys will commence in 2012 once this INRMP has been adopted, and will focus on the identification of erosion located along the edges of waterbodies. While currently no barriers are in place to prevent unauthorized ATV use on the site, access barriers and signage may be erected in the future. Recently local police have increased patrols in and around the Site due to recent vandalism activities that have occurred at the site.

4.3.2 Prime Farmland

Prime farmland, as defined by the USDA, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is available for these uses (NRCS 2006). Because the supply of high quality farmland is in limited supply in the United States, prime farmland is identified to ensure that a long-term supply of food and fiber is available. Several soil properties are characteristic of prime farmland, including texture, organic matter content (i.e., nutrient levels), and moisture regime. In addition, several climatic and physiographic properties aid in identifying prime farmland including precipitation, temperature, and slope. Based on the aforementioned criteria, the Ninigret fine sandy loam, 0–8%, which is located in sections along Garfield Road and in several large sections adjacent to the sandy soils associated with the FMS #2 site (Appendix B, Figure 4), is classified as prime farmland. While not considered prime farmland, the Adams loamy sand, 0–8% slopes, Hollis fine sandy loam, 0–8% slopes, and Hollis fine sandy loam, 8–15% slopes that are located on the Site are considered farmland of statewide importance. None of the Site soils are currently being farmed, and based on their recent transition from open field to forested habitats, these areas are not considered to be available for farming in their current condition.

4.4 Hydrology

The Maine Geological Survey (MGS) has not identified or mapped any significant sand or gravel aquifers underlying the site (MGS 1999).

MGS has information related to one drilled well, located adjacent to the site boundary along Garfield Road (MGS 2007a, MGS 2007b, and MGS 2007c), which yielded 50–100 gallons per minute, at 400–500 feet below the surface. Bedrock was encountered approximately 75–100 feet below the soil surface. No other information on this well is available, and no other subsurface water information was included on the MGS maps available for the site.

4.5 Surface Water

Surface water associated with the site includes wetlands, vernal pools, and three stream channels. Eleven (11) wetlands and five vernal pools have been identified throughout the Site, totaling approximately 29.7 acres (Appendix B, Figure 5 and Appendix A Table 3). A large man-made wetland complex that includes four wetlands totaling approximately 9.2 acres is located in the southeast corner of the Site within the recreational area. The creation of wetlands was a mitigation requirement of the wetland permit received by the USACE, for development of that area as a recreational facility by the City of Auburn. The naturally occurring wetlands on the Site predominantly are associated with three stream channels located northwest and west of the FMS #2 site, and south of the FMS #2 site, near the southern boundary of the site, and are outside of the areas that would be impacted by training activities conducted within FMS #2.

Several of the wetlands are located adjacent to roads, and have the potential to be impacted by pollutants and sediments associated with stormwater runoff from the roadway. Along the northeastern border of the site, Garfield Road forms the boundary to the Site, and may impact several of the wetlands. Additionally, streams and wetlands are crossed by the unnamed road and Stevens Mill Road, which may result in an increased potential for erosion at the crossing area from vehicle use. However, traffic associated with both of these roads is limited, and Stevens Mill Road is primarily used by pedestrian and bicycle traffic to access the Mt. Apatite Conservation Area to the west. A vehicle barrier has been installed at the location where Stevens Mill Road exits the Site to provide access to the Mt. Apatite Conservation Area.

5.0 Ecosystems and the Biotic Environment

5.1 Ecosystem Classification

Regional Overview

The ecoregion of Auburn is classified by R.G. Bailey (1995) as Humid–Temperate Domain, specifically within the Warm Continental Division and in the Laurentian Mixed Forest Province. This low-lying province lies between the boreal forest and the broadleaf deciduous forest zones and is therefore considered transitional. Part of the Laurentian Mixed Forest Province consists of mixed stands of coniferous species (mainly pine, *Pinus* spp.) and a few deciduous species (mainly yellow birch [*Betula alleghaniensis*], sugar maple [*Acer saccharum*], and American beech [*Fagus grandifolia*]). The remainder of the province is a mosaic of deciduous forest occurring on favorable sites containing relatively fertile soils, and coniferous forest, occurring on sites with lower soil fertility. Pine trees are often the pioneer woody species in burned-over areas or on abandoned arable land. Because they grow more rapidly than deciduous species where soils are poor, they quickly form a forest canopy. However, where soils are less exposed and deciduous undergrowth is dense, pines often have difficulty regenerating, and remain successful only where fire or other disturbance recurs. Fires started by lightning are common in this province, and can spread quickly, particularly where soils are sandy and there is a layer of dry litter in summer.

Auburn site

Specific ecosystems within the boundaries of the site are generally similar to those described above for the larger region. Specific ecosystems, or community types occurring at the site, are described in detail in the following sections.

5.2 Vegetation

5.2.1 Historic Vegetative Cover

Prior to European settlement, the Auburn area likely consisted of various un-fragmented forest, grassland, and wetland cover types. The site is located within a vegetative transition zone, where the more common temperate climate species are gradually replaced by those suited for existing in a boreal environment. The oak-pine forests more common to temperate regions to the south become less common as they are replaced by spruce, fir, and northern hardwood species typical of northern climes. This vegetative transition zone likely existed historically, developing after the retreat of glaciers during the last glacial period. Forest types likely included a variety of species belonging to both oak-pine forest habitats and spruce-fir-northern hardwood habitats. Fires probably played a role historically, due to the lack of fire suppression and the presence of communities that depend on periodic fire occurrences to ensure maintenance and regeneration of the habitat.

During the late 1800's and into the early 1900's the mineral resources associated with Mt. Apatite were mined and quarried, which resulted in the physical disturbance of the vegetation and forest habitats since removal and clearing of vegetation was necessary to develop roads and facilities associated with the Greenlaw and Maine Feldspar quarries. The Forest Stewardship Management Plan developed for the Facility in 2003 indicates that significant timber harvesting has not been undertaken on the Site in at least the last 75 years; however, prior to that time period some tree removal may have occurred, but was not likely significant.

From the early to mid 1900's up until the Site was purchase by the Federal Government and licensed to MEARNG in 1926, some farming and agricultural activities were also associated with the Site. The MEARNG developed the Site as a training facility, and portions of the Site have been cleared and buildings and facilities constructed for this purpose; however, much of the Site north of FMS #2 remains in its natural state, with the exception of several dirt roads that provide access to the northern section of the Facility (Appendix B, Figure 2). The area located southeast of FMS #2 has been developed as a recreational area with several ball fields and associated facilities, and includes a large created wetland complex.

In recent history, the increase in population and development locally near the Cities of Auburn and Lewiston has also decreased the vegetative cover regionally. Forests have been cleared and converted to business districts and residential neighborhoods. Relative to the population growth of the surrounding towns, an increase in recreational use of natural areas also has significantly impacted the vegetation in the vicinity of the Facility. While a developed recreational facility is not located on the Site, other recreational uses common in the area include ATV use, hiking, biking, birdwatching, and snowmobiling and cross-country skiing during the winter. These activities degrade established vegetation and form trails through sensitive land leaving the area susceptible to erosion through alteration of the current vegetation. A minor portion of the Site is affected by ATV use, though in recent years efforts to curb illegal ATV use have been successful with very few incidents.

5.2.2 Current Vegetative Cover

A Flora and Fauna Survey conducted in 2002 by Weber and Rooney (2002) identified six vegetative communities on the Site, two of which are anthropogenic in nature. The largest vegetative community on the Site is Oak-Pine Forest, totaling approximately 75 acres, or 42% of the Facility acreage. Large oak and pine stands associated with this vegetative community are located in the northern and southern sections of the Site. Table 1 in Appendix A summarizes the acreages of all of the current vegetative communities at the site, and locations are depicted on Figure 3 of Appendix B. The second largest vegetative community totaling approximately 66 acres, or approximately 37% of the Site acreage, is Open Sandplain/Old Field. This represents the large sandy area used for large equipment training at the FMS #2 site, and includes old abandoned fields that were probably once utilized in farming activities.

Three distinct forest stand types were distinguished on the Site (Appendix A, Table 1) during the flora and fauna surveys conducted by Weber and Rooney (2002), resulting in approximately 60%, or 105 acres of the Site, representing forested habitat (Appendix B, Figure 3). In addition to the 75 acres of Oak-Pine Forest stands mentioned above, the other two vegetative communities of hardwood species comprise approximately 30 acres (18%) of the Facility, including stands of Beech-Birch-Maple (15 acres [9%]), and Maple-Basswood-Ash (15 acres [9%]) of the forested area at the Facility. Other habitats included on the Site are Mixed Graminoid-Shrub Marsh habitats associated with the wetland areas, totaling 4 acres (2%), and a small portion of a Powerline Right-of-Way located in the southwest corner of the Site totaling 2 acres (1%), (Appendix B, Figure 3 and Appendix A, Table 1).

A Forest Stewardship Management Plan (Wadsworth 2013) has been developed for the Facility in cooperation with and under the technical direction of the Maine Forest Service, which establishes guidelines and goals for managing the forest resources of the MEARNG Facility on a sustainable basis while maintaining the overall mission of MEARNG. This plan estimates that approximately 114 acres (65.9%) are forested, represented by softwood, mixed-wood, and hardwood species. The forest stands were characterized based on the stand density, species composition, and tree diameter. Forest types and associated volumes were determined by a systematic cruise using a basal area factor 15 prism and measured by 1 inch diameter classes using both a diameter tape and a Biltmore stick. Along with aerial photo interpretation, locations of each forest type were determined on the ground using Global Position System (GPS) locations and visual observations. The locations of different forest stands on the Auburn site can be seen in Appendix B, Figure 3.

A total of 452 tree, shrub, herb, moss, liverwort, and lichen species have been identified throughout the Facility during surveys conducted in 2002, 2003, 2014, 2015, and 2021 (Weber and Rooney 2002, Auger 2003, Vitale 2003, NewEarth 2014, 2015, and 2021). Of these, 14 are non-native, introduced species or are considered invasive, and one species, the small whorled pogonia (*Isotria medeoloides*), is listed as Federally-threatened and endangered in the State of Maine. A list of all plant species documented on the Site is provided in Appendix C, Table 1.

The following provides a detailed description of the various forested and non-forested upland habitats located on the Auburn site.

<u>Upland Communities</u>

Oak-Pine Forest

The Oak-Pine Forest habitat is the most common habitat type at the site, occupying approximately 75 acres of the Site, and is classified as upland forest (Appendix B, Figure 3). Stands are located in two distinct areas of the Site that have somewhat shallow, well-drained soil, and samples taken within these stands estimate their approximate age at 80 years (Wadsworth 2013). The locations of the stands include the entire area located south of FMS #2 (excluding the Powerline Right-of-Way), and a large area located in the north.

The closed canopy is dominated by northern red oak (*Quercus rubra*) and eastern white pine (*Pinus strobus*), with red maple (*Acer rubrum*) and paper birch (*Betula papyrifera*) also present. Species occupying the sub-canopy include striped maple (*Acer pensylvanicum*), serviceberry (*Amelanchier* sp.), American beech, and American witchhazel (*Hamamelis virginiana*). The shrub layer is patchy, varying from dense to sparse. Species found within the shrub layer include balsam fir (*Abies balsamea*), maple (*Acer* spp.), beaked hazelnut (*Corylus cornuta*) and withe-rod (*Viburnum nudum* v. *cassinoides*). The herb layer is well developed and diverse, with numerous species of club mosses, ferns, sedges, grasses, and broad-leaved herbaceous plants observed. Species observed that are diagnostic for this community type include bigleaf aster (*Eurybia macrophylla*), starflower (*Trientalis borealis*), western brackenfern (*Pteridium aquilinum*), and Canada mayflower (*Maianthemum canadense*). Dicranum mosses (*Dicranum* spp.), which are diagnostic of this community type, were also observed. Tree regeneration within this habitat is good, with most of the canopy species observed within the shrub layer.

Vernal pools represent special habitats required for the survival of certain species of amphibian, including spotted salamanders (*Ambystoma* spp.) and wood frogs (*Rana sylvatica*). These pools are ephemeral in nature, filling during the spring runoff and snowmelt, and often drying out by late June and early July. MNAP classifies vernal pools as part of the larger habitat type in which they are found, as opposed to including them in a separate habitat classification. A vernal pool survey conducted in 2015 revealed five vernal pools on the Auburn Training Site of which four met criteria as significant wildlife habitat (MEARNG 2015, Appendix F).

Open Sandplain/Old Field

The Open Sandplain/Old Field habitat is the second most common habitat type located on the Facility covering approximately 66 acres (Appendix B, Figure 3), and is classified as non-forested upland. On the Site this habitat type defines the FMS #2 training area and areas around the recreation area located in the southeast corner of the Facility, as well as a small area located along the Powerline Right-of-Way in the southwestern corner. The Open Sandplain habitat occurs on excessively well-drained soils of outwash deposits, and this type of habitat is considered rare in Maine. The significance of the Open Sandplain habitat on the Site however, is low due to its small size and high rate of disturbance. Prior to disturbance this area probably supported a sandplain grassland or inland sand barren community (Weber and Rooney 2002). Despite the high frequency of disturbance that occurs within the FMS #2 area and the athletic fields of the recreation area, fairly high species diversity exists within the Open Sandplain habitat. The dominant species documented within the Open Sandplain habitat includes little bluestem (*Schizachyrium scoparium*), lowbush blueberry (*Vaccinium angustifolium*), and several species of grasses and sedges. A number of invasive species were documented within the Open

Sandplain habitat, including Common wormwood (*Artemisia vulgaris*), Asiatic bittersweet (*Celastrus orbiculata*), Morrow's honeysuckle (*Lonicera morrowii*) and Multiflora rose (*Rosa multiflora*).

One notable occurrence documented within the Open Sandplain community was of non-native Cuman ragweed (*Ambrosia psilostachya*). Although this species is not listed as a rare plant in Maine, it is considered unusual. The documentation of Cuman ragweed on the Site represents a new county record for this species; previously it had been documented in only four other Maine counties (Campbell, et al. 1995 *cited in* Weber and Rooney 2002).

Old Field habitat represents areas in which agricultural activities previously took place, and where the activities that retained them in a treeless state have since been abandoned. Without further disturbances, these areas would eventually exhibit vegetation assemblages native to the immediate area. Old Field habitat on the Site contains several mature apple trees, which suggests its past use in farming operations. Dominant species that occur within the Old Field habitat include gray birch (*Betula populifolia*), and bigtooth aspen (*Populus grandidentata*), two species that commonly recolonize post-agricultural areas. Species common to Maple-Basswood-Ash forest communities that were also noted in the Old Field habitat include sugar maple, American basswood (*Tilia americana*), and American beech. The presence of these tree species within the immediate area suggests that these species would be the most likely to replace the Old Field habitat as it develops into native forested habitat that existed historically, prior to the period that farm-related activities were implemented on the Site.

Beech-Birch-Maple Forest

Beech-Birch-Maple Forest habitat represents approximately 15 acres (9%) of the Site, and is concentrated at the northern end of the Facility, with a small section associated with the leased parcels located along the western boundary adjacent to the Maple-Basswood-Ash Forest habitat (Appendix B, Figure 3). This habitat is classified as forested upland. Statewide, this common vegetation community occurs on low to mid-slopes of hills, and is associated with somewhat shallow, mesic, and often rocky soils. This association is true for the Site, where a mix of hardwood species, including American beech, white birch, and red and sugar maples define the canopy. Red oak and white pine are also components of this community, particularly in areas where the Beech-Birch-Maple Forest habitat transitions into Oak-Pine Forest habitat. These tree species were also observed within the shrub layer, where they occurred with beaked hazelnut, witch hazel, red spruce (*Picea rubens*), and withe-rod. Eastern leatherwood (*Dirca palustris*), another species associated with soil-enriched sites, was also observed within the Beech-Birch-Maple Forest habitat. Other species observed within the herbaceous layer that are typical of this forest type include wild sarsaparilla (*Aralia nudicaulis*), starflower, sedge and fern species, Canada mayflower, Indian cucumber (*Medeola virginiana*), and bluebead (*Clintonia borealis*) (Appendix C, Table 1).

Maple-Basswood-Ash Forest

The Maple-Basswood-Ash Forest habitat defines approximately 15 acres (9%) of the Site, and is associated with more mesic, nutrient-rich soils. This habitat covers a large portion of the large wetland area located north and west of the FMS #2 area, and is classified as forested wetland. Maple-Basswood-Ash Forest habitat is relatively uncommon within the state due to their restriction to deep, rich soils. They are most often located at the base of steep slopes, such as those associated with Mt. Apatite, where nutrients are carried and deposited from runoff. Forests associated with rich soil types tend to be composed of hardwood species that have a high market value, and as a result many historic stands have succumbed to intense harvesting. On the Facility the Maple-Basswood-Ash Forest habitat is dominated by red maple, with yellow birch, white ash (*Fraxinus americana*), and basswood representing other important species within the canopy. The shrub layer consists mainly of regenerating tree species, and in some areas the regeneration density of sugar maple is quite high. Canada yew (*Taxus canadensis*), another species associated with rich soils was also present in the shrub layers within this habitat type in some areas. Although at least 10 species of rare plants are associated with Maple-Basswood-Ash Forest communities in Maine, none were documented during the 2002 biological surveys.

The Maple-Basswood-Ash Forest habitat of the Facility is not considered exemplary for several reasons. First, it is only of medium age, approximately 80 years. Secondly, the soils are not greatly enriched, which is supported by the lack of rare species occurrences associated with this habitat type. The third reason for the exclusion of exemplary status is its relatively small size, approximately 15 acres. Although this forest type has been mapped as a separate habitat type, due to its small size and moderate soil enrichment, it could very well be included within the Beech-Birch-Maple Forest habitat associated with the Site.

Mixed Graminoid-Shrub Marsh

Mixed Graminoid-Shrub Marsh habitat represents approximately 4 acres of the Site within a low drainage area that is part of the larger Oak-Pine Forest habitat, and is largely associated with the wetlands and stream habitat that extend north of the FMS #2 area (Appendix B, Figure 3). Mixed Graminoid-Shrub Marsh habitat is a common, but variable habitat type that occurs throughout the state. Suites of species can occur as discrete patches, or may occur as a homogenous expanse (Weber and Rooney 2002).

At the Facility this habitat type is classified as non-forested wetland and is comprised of red maple, gray birch, leatherleaf (*Chamaedaphne calyculata*), white meadowsweet (*Spiraea alba*), speckled alder (*Alnus incana* ssp. *rugosa*), sweetgale (*Myrica gale*), and withe-rod within the shrub layer. The herbaceous layer is dominated by graminoid, or grass-like plants, with reed canarygrass (*Phalaris arundinacea*) being the most dominant. Other graminoid species that occur within the herbaceous layer are rattlesnake mannagrass (*Glyceria canadensis*), bluejoint (*Calamagrostis canadensis*), upright sedge (*Carex stricta*), and three-way sedge (*Dulichium arundinaceum*). The dominant non-graminoid species observed within the herbaceous layer is cinnamon fern (*Osmunda cinnamomea*), with crested woodfern (*Dryopteris cristata*), American marshpennywort (*Hydrocotyle americana*), and northern blueflag (*Iris versicolor*), also occurring. One species of peat moss (*Sphagnum girgensohnii*) was also observed within the herbaceous layer.

Powerline Right-of-Way

The Powerline Right-of-Way defines approximately 2 acres (1%) of the Sites habitat, and is confined to an area located in the southwestern corner of the Site. At the time of the biological surveys that have been conducted on the Site, this habitat was infested with ticks (Weber and Rooney 2002). A total of 89 different plant species were observed within this habitat type. Some of the species observed include red maple, eastern white pine, northern red oak, speckled alder, paper and gray birch, common yarrow (*Achillea millefolium*), common milkweed (*Asclepias syriaca*), bluejoint, several species of sedge, fescue (*Festuca* sp.), rattlesnake mannagrass, sensitive fern and several other fern species (*Osmunda* spp.), goldenrod (*Solidago* spp.), skunk cabbage (*Symplocarpus foetidus*), western poison ivy (*Toxicodendron rydbergii*), broadleaf cattail (*Typha latifolia*), and blueberry (*Vaccinium* spp.).

5.2.3 Turf and Landscaped Areas

Turf and landscaped areas are limited to the area of the Garfield Road recreational complex located in the southeastern section of the Site, and acreages have not been quantified. The facilities include athletic fields (baseball and soccer), which are maintained by the City of Auburn Parks and Recreation Department.

5.3 Fish and Wildlife

Several animal species are known to utilize the Site, and may move throughout the area as part of their home range, utilizing different areas for hunting/foraging, breeding, and cover. Frequent flora and fauna surveys have been conducted on the Auburn facility. A list of species that have been observed on the Auburn Training Facility during these surveys is available in Appendix C, Table 2. On the Facility, a total of 12 species were listed as being of special concern, while another 22 species were listed as being of greatest conservation need by the Maine State Wildlife Action Plan. The list in Appendix C, Table 2 is not meant to be comprehensive, as many more species than those documented are expected to occur, especially nocturnal or secretive animals, and those with low population levels.

5.3.1 Mammals

Fourteen (14) mammal species have been documented on the Site. These include red squirrel (*Tamiasciurus hudsonicus*), big brown bat (*Eptesiaus fuscus*), domestic dog (*Canus lupus familiaris*), eastern chipmunk (*Tamias striatus*), eastern coyote (*Canis latrans*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), Mole/vole/shrew (*Order rodentia*), red fox (*Vulpes vulpes*), silver-haired bat (*Lasionycteris noctivagans*), snowshoe hare (*Lepus americanus*), weasel family (*Family mustelidaes*), white-tail deer (*Odocoileus virginianus*), and woodchuck (*Marmota monax*). Of the fourteen mammal species documented on the site, three of them are listed as both a species of special concern and a species of greatest conservation need. Another species was listed just as a species of greatest conservation need. Ample signs of the presence of white-tail deer were observed; however, the population of this species of deer in the area is not expected to be so high as to observe these animals browsing. Common forest mammals such as raccoon (*Procyon lotor*), North American porcupine (*Erethizon dorsatum*), striped skunk (*Mephitis mephitis*), and gray fox (*Urocyon cinereoargenteus*) are also expected to be present on the Site and in the immediate area due to the presence of suitable habitat.

5.3.2 Birds

Sixty-one (61) common avian species were observed on the Site during biological surveys (Appendix C, Table 2). This number is based on observations, and since a specific bird and nest survey was not conducted, the actual number of bird species utilizing the Site is expected to be much higher, especially of predatory bird species that are nocturnal (i.e. owls and nighthawks). Common bird species documented on the Site include cedar waxwing (*Bombycilla cedrorum*), hermit thrush (*Catharus guttatus*), eastern wood peewee (*Contopus virens*), prairie warbler (*Dendroica discolor*), pine warbler (*Dendroica pinus*), black-throated green warbler (*Dendroica virens*), winter wren (*Troglodytes troglodytes*), red-eyed vireo (*Vireo olivaceus*), white-throated sparrow (*Zonotricha albicollis*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), blue jay (*Cyanocitta cristata*), black-capped chickadee (*Parus atricapillus*), white-breasted nuthatch (*Sitta carolinensis*), American robin (*Turdus migratorius*), and numerous other species.

Of the sixty-one bird species documented on the Auburn facility, nine species are listed as being of special concern. Eighteen of the bird species found on the Auburn facility are listed as species of greatest conservation needs. Some of these bird species include American redstart

(*Setophaga ruticlla*), black-and-white warbler (*Mniotilta varia*), and broad-winged hawk (*Buteo platypterus*).

With the exception of the ruffed grouse (*Bonasa unbellus*) and the wild turkey (*Meleargris gallopavo*) all of the bird species documented on the Site are protected by the Migratory Bird Treaty Act (USFWS 2013).

5.3.3 Fish

Lack of suitable fish habitat exists on the Site, and as such the Site was not surveyed for fish species.

5.3.4 Reptiles and Amphibians

Seven amphibian species (4 frogs, 1 toad and 2 salamanders) have been documented on the Site. One reptile has been documented on the Site, common garter snake (*Thamnophis sirtalis sirtalis*). Amphibians observed include eastern American toad (*Bufo a. americanus*), green frog (*Rana clamitans melanota*), wood frog, gray tree frog (*Hyla versicolor*), spring peeper (*Pseudacris crucifer*), northern red-backed salamander (*Plethodon cinereus*), and yellow spotted salamander (*Ambystoma maculatum*). The species diversity of amphibians and reptiles on the Site are undoubtedly higher than listed here. Intensive taxa-specific surveys, such as pit fall trapping, would likely result in the identification of additional species, including reptiles. Appendix C, Table 2 includes a list of amphibians and reptiles that have been documented on the site.

5.3.5 Invertebrates

During the biological surveys seven invertebrate species were documented (Weber and Rooney 2002). However, this most likely represents a small fraction of the number of invertebrate species that actually utilize the Facility. Additional invertebrate species inhabit the soil, water, wood and vegetation located on the Site, as these habitats were not specifically targeted for invertebrate presence. Numerous American dog ticks (*Dermacentor variabilis*) were documented within the Powerline Right-of-Way and the adjacent Old Field habitat. The biologists removed approximately 10 ticks from their clothing every few minutes while surveying these areas.

Other invertebrates documented on the Site include the butterfly species clouded sulphur (*Colias philodice*), viceroy (*Limenitis archippus*), and great spangled fritillary (*Speyeria cybele*). A species of cricket (*Gryllus* sp.) and a periodic cicada (*Magicicada septendecim*) were also observed on the site. Appendix C, Table 2 provides a list of invertebrates that have been confirmed on the Site.

5.4 Threatened and Endangered Species and Habitats

Army Regulation 200–1, Chapter 4 requires protection of listed species and designated critical habitat under the Endangered Species Act (ESA) of 1997, as amended; all activities conducted by installations and Army personnel are subject to ESA requirements. AR 200–1 also encourages cooperation and informal consultation with regulatory agencies at the earliest planning stages to determine the need for formal consultation. It is an Army goal to systematically conserve biological diversity on Army lands within the context of its mission.

The ESA imposes five primary requirements upon the Army:

- Conserve listed species;
- Not "jeopardize" listed species;
- "Consult" and "confer";
- Conduct a biological assessment; and,
- Not "take" listed fish and wildlife species, or remove or destroy listed plant species.

Endangered Species Act Section 7 consultation compliance was met in the development of this INRMP through direct written and verbal consultation with the USFWS Maine Field Office located in East Orland, ME, and was held concurrent with development and public review of this plan. In addition, other natural resource agencies and organizations were consulted, including the USFWS, MDIFW and MNAP regarding the presence of any know species or habitats of special concern at the Facility. Agency consultation letters are provided in Appendix C.

5.4.1 Federal or State-listed Species

Surveys and observations for Federal and state rare species have been conducted on the Site during 2002, 2006, 2013, 2014 and 2016 through 2022 (Weber and Rooney 2002, Auger 2006, NewEarth 2013 and 2014, MEARNG 2016-2018, MNAP 2019, MEARNG 2020-2021, and MNAP 2022). During these surveys conducted on the Site, the presence of one Federally-threatened and state-endangered plant species, the small whorled pogonia, was confirmed. This species is discussed in greater detail below.

No ecological communities or ecosystems of state significance are associated with the site.

Confirmed Listed Species

The biological survey conducted on the Site during July and August of 2002 (Weber and Rooney 2002) discovered a previously unknown population of the small whorled pogonia, a Federally-threatened and state-endangered species. This occurrence is located in the northern section of the Site; however, due to the sensitive nature of this protected orchid, its exact location is not disclosed. An endangered species botanical survey was conducted in August and September of 2005 (Auger 2006) to provide more extensive coverage of the Facility, and to determine if additional populations of the small whorled pogonia are located on the Site of the Facility. Results of the 2005 survey did not identify any additional populations of small whorled pogonia on the Site. A survey of the location in 2007 did not identify any stems of this species, and it was expected that the original plant identified in 2002 was a pioneer plant likely generated from a nearby, larger undiscovered population. A 2013 survey also failed to identify any stems however a survey in 2014 did identify seven individual stems in the same area as the original 2002 discovery. A 2016 survey revealed a larger population of 13 individuals covering a larger area than previously recorded. Since 2016, surveys have been conducted yearly by the MEARNG on the Facility. Since 2019, MNAP has been conducting a survey on the Facility every three years, with the latest survey being conducted in 2022.

The small whorled pogonia belongs to the Orchidaceae family and is one of two species belonging to the genus *Isotria*. The other species, the large whorled pogonia (*I. verticillata*), historically occurred in Maine, with documented historical occurrences in Androscoggin and Oxford counties, but is since thought to be extirpated, and was last seen in 1974 (see Section 5.4.2 Species of Special Concern).

The current distribution range of the small whorled pogonia is located within the Appalachian Mountain range of New England, coastal Massachusetts extending to the Coastal Plain of Delaware and New Jersey, extending south into Virginia and the southern portion of the Appalachian Mountains, and westward to scattered outlying areas in the Midwest and Canada (Auger 2006). Population sizes within this range tend to be quite small, with the total number of individuals within the entire range estimated at 3,000 stems or less. New York, Vermont, Maryland, Missouri, Ohio, the District of Columbia, and Ontario are home to historic locations only (NatureServe 2001 *in* Auger 2006). It is known that this species can remain dormant for several years before reoccurring, so continued efforts by volunteers to monitor historic sites is necessary to determine whether the species has actually been extirpated from these areas.

The USFWS listed the small whorled pogonia as Federally-endangered on 12 October 1982 (USFWS 2001), due to its scarcity throughout its range. A large effort was then undertaken to document additional populations, which lead to the species being downlisted to Federally-threatened on 6 October 1994 (USFWS 2001). Its current global rank is listed as G2 with protection of many of the extant sites that are considered viable, including site-specific protection and monitoring efforts established.

Small whorled pogonia has a State of Maine ranking of S2 (Imperiled Species), and Maine is considered one of the hotspots for this species within its range; as of 2022, 36 known sites have been documented within the state. (MNAP 2022) However, of these sites, 15 have documented five or less stems and 9 sites are historic or extirpated. Within the state, the species is generally restricted to southern areas, with 23 of the 36 sites occurring within York County. Other Maine counties with occurrences include Androscoggin, Cumberland, Kennebec, and Oxford. A fact sheet containing details for the small whorled pogonia is contained in Appendix E.

Potential Listed Species

The New England cottontail (*Sylvilagus transitionalis*) is considered an early successional forest species, that prefers areas of disturbance that have resulted from timber harvesting, hurricanes and other wind storms, or beaver activity (U.S. Department of the Interior 2004). Suitable habitat is unlikely to be found at the Auburn Training Site. The main threat to the species appears to be loss of habitat through forest succession, fragmentation, and conversion to other uses. This loss of habitat has contributed to a reduction in the range of the species and a reduction in numbers. Ongoing competition with eastern cottontails (*Sylvilagus floridanus*) that have been introduced into areas outside their native range also appears to be having a negative impact on the New England cottontail.

The drastic reduction in its historic range has caused the U.S. Fish and Wildlife to list the New England cottontail as a candidate species for Federal listing. Although the expected current range of this species in Maine is thought to be restricted to two southern coastal counties, based on the availability of suitable habitat on the Site there is a potential that the New England cottontail could occur (U.S. Department of the Interior 2004). No surveys specific to this species have been conducted on the Site and it is unknown if this species occurs. However, suitable habitat for this species on the Site includes Oak-Pine Forest with a dense understory, particularly those areas where shrub-dominated and early-successional habitats occur. Based on projected range maps for the New England cottontail, the Facility may be located beyond the expected northern limits of this species in Maine (New York State Department of Environmental Conservation 2007). In September 2015 the USFWS ruled that listing under the ESA was not warranted (Federal Register: Vol. 80, No. 178)

Additional state-listed plant species have been documented within a 4-mile radius of the Facility by MNAP (2007). Plants listed in the state as endangered include tiny love-grass (*Eragrostis capillaris*), scarlet oak (*Quercus coccinea*), and ram's head lady's slipper (*Cypripedium arietinum*). Plants listed as threatened in the state include low false bindweed (*Calystegia spithamaea*) and Vasey's pondweed (*Potamogeton vaseyi*). No surveys specific to these species have been conducted on the Site and it is unknown if these species occur on this Site; these species were not observed during the biological surveys.

5.4.2 Species of Special Concern

Confirmed Species of Special Concern

The USFWS has determined that no Federally threatened or endangered species under their jurisdiction are known to occur in the area of the Facility (USFWS 2007c). The bald eagle, (*Haliaeetus leucocephalus*), was removed from the Federal List of Threatened and Endangered Wildlife on 7 July 2007 (U.S. Department of the Interior 2007). However, this species is still listed as threatened in the State of Maine. The USFWS established National Bald Eagle Management Guidelines (USFWS 2007d) in 2007 that include protective measures outlined in the Bald and Golden Eagle Protection Act (16 USC 668–668c) and the Migratory Bird Treaty Act (16 USC 703–712). Although no known bald eagle nests have been documented on the Site, bald eagles are known to be transients in the area, and would be covered by the National Bald Eagle Management Guidelines.

Potential Species of Special Concern

Additional state-listed plant species of special concern have been documented within a 4-mile radius of the site by MNAP (MNAP 2007). These include broad beech fern (*Phegopteris hexagonoptera*), fernleaf yellow false foxglove (*Aureolaria pedicularia*) and the potentially extirpated species large whorled pogonia. The large whorled pogonia historically was documented in Androscoggin and Oxford counties; however, the last documented occurrence in the state was in 1974 (MNAP 2006 *in* Auger 2006). No Site-specific surveys for these species of special concern have been conducted and it is unknown if they occur within the Site boundaries; no occurrences were noted during the biological surveys.

5.4.3 Significant Habitats and Communities

No rare or unique natural communities have been identified within the boundary of the Facility.

5.5 Wetlands

The U.S. Congress enacted the Clean Water Act in 1972 to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Section 404 of the Clean Water Act delegates jurisdictional authority over wetlands to the U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA). Waters of the United States protected by the Clean Water Act include rivers, streams, estuaries, and most ponds, lakes, and wetlands. The USACE and the EPA jointly define wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (USACE 1987). Wetlands generally include swamps, marshes, fens, bogs, and similar areas.

The USFWS further defines wetlands to include a variety of areas that fall into one of five categories:

- Areas with hydrophytes and hydric soils, such as those commonly known as marshes, swamps, and bogs;
- Areas without hydrophytes but with hydric soils, such as flats where drastic fluctuation in water levels, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes;
- Areas with hydrophytes but nonhydric soils, such as margins of impoundments or excavations where hydrophytes have become established but hydric soils have not yet developed;
- Areas without soils but with hydrophytes, such as the seaweed-covered portion of rocky shores; and,
- Wetlands without soils and without hydrophytes, such as gravel beaches or rocky shores without vegetation.

5.5.1 Wetlands of Special Significance (WSS)

The stream channel and associated wetlands on the Site meet the WSS size criteria, however, the vegetation associated with this wetland is dominated by tree and shrub species, and is not dominated by emergent vegetation alone (Jones Associates Inc. 2009). There are several wetland areas that are located within 25 feet of a stream channel, and there is a very small area along Garfield Road at the northern end of the Site that has been mapped by the Federal Emergency Management Agency within the 100-year floodplain (Appendix B, Figure 6). These areas would fall under the WSS classification, and require greater setback requirements for protection.

5.5.2 Site Wetlands

A total of 14 wetlands and five vernal pools totaling approximately 29.7 acres are located on the Site. Appendix B, Figure 5, shows the wetland or vernal pool location and ID number, and Appendix A, Table 3, provides a summary of their acreages. Wetland and vernal pool data forms prepared as part of the 2009 wetland report for the Site are included in Appendix F as well as the vernal pool survey conducted in 2015. Natural wetlands located on Site are generally associated with stream channels, drainages, or isolated depression areas (Jones Associates, Inc. 2009). A majority of the wetland acreage of the Site is associated with three stream channels, and is classified as palustrine-forested wetlands (PFO). The complex of created wetlands, totaling approximately 7.1 acres, is associated with the recreational area located along both sides of Stevens Mill Road, near the Site entrance.

The stream channel and associated wetland complex located in the northwestern portion of the Facility traverses the Site from west to east, is approximately 3.2 acres in size, and is composed of PFO wetlands. This stream channel originates offsite to the west, near the base of Mt. Apatite, and continues northeasterly through the Facility, exiting the Site via a culvert that extends under Garfield Road. The stream traverses the dirt road that extends into the northwestern leg of the Facility, and is susceptible to erosion from vehicle traffic using this roadway.

A much larger stream and wetland area, totaling approximately 9.3 acres, is located west of the FMS #2 area, and discharges offsite via two culverts located underneath Garfield Road. The stream channel and wetland area located to the west of Stevens Mills Road, totaling approximately 1.1 acres, is hydrologically connected to the larger wetland; the larger wetland complex was bisected when the Stevens Mill Road was created. This wetland complex contains areas of PFO wetlands, as well as palustrine scrub-shrub wetlands (PSS), and palustrine emergent wetlands (PEM). The stream and wetland areas associated with these features may also be subjected to impacts from erosion and sedimentation associated with the two roadway crossings (Appendix B, Figure 3). However, traffic on both roadways is limited to primarily pedestrian and bicycle traffic, and therefore the impacts of erosion due to roadway use is likely to be low. A bollard has been installed along the western Site boundary where Stevens Mill Road exits the Facility, restricting vehicle access to the Mt. Apatite Conservation Area, and eliminating through traffic in this area.

The overstory of the PFO wetland areas are dominated by red maple, gray birch, balsam fir, and American elm. The understory includes shrubs such as speckled alder and common winterberry, and herbs such as sensitive fern and cinnamon fern. The PSS wetlands are dominated by shrubs such as speckled alder, common winterberry, arrowwood (*Viburnum* spp.), highbush blueberry (*Vaccinium corymbosum*), male berry (*Lyonia ligustrina*), and meadowsweet (*Spirea latifolia*). Smaller components of this wetland contain forested and herbaceous species. Common emergent vegetation found in the PEM includes broadleaf cattail, reed canarygrass, woolgrass (*Scirpus cyperinus*), and other grasses and sedges. A list of all plants observed on the Facility, including plants found in wetlands, is provided in Appendix C, Table 1.

The third stream and wetland area, totaling approximately 3.6 acres, is located along the southern boundary of the Site, and is associated with the power-line-right of way, continuing east into the forested area. There are also two small isolated wetlands located on the Facility, as shown in Figure 5 of Appendix B.

5.5.3 Site Vernal Pools

In accordance with the NRPA, the MDEP has designated special treatment and greater setbacks for significant wildlife habitat, including significant vernal pools (Chapter 335). MDEP defines a vernal pool as a natural, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Significance of a vernal pool is determined by counting vernal pool indicator species during the spring breeding period.

Jones Associates, Inc. identified four vernal pools during the wetland delineation conducted in the spring of 2009 (Appendix F). The MEARNG conducted a site wide vernal pool survey in 2015 (Appendix F) and identified five vernal pools on the Site with four pools meeting the criteria for significant wildlife habitat. One of the vernal pools is located in the northern area of the site (ATS-VP1) and is approximately 0.05 acres in size. Vernal pool ATS-VP2 is adjacent to Garfield Road along the eastern boundary of the site and is approximately 0.18 acres in size. The one non-significant vernal pool (ATS-VP3) is located in the southwest area of the Site and covers approximately 0.19 acres. The other two vernal pools are associated with the City of Auburn ballfields and mitigation wetland in the southeast corner of the Site. These vernal pools (ATS-VP4 and ATS-VP5) cover approximately 0.27 acres and 1.68 acres respectively (Appendix B, Figure 5). Significant vernal pools are protected by 750 foot buffer per USACE regulations.

6.0 Mission Impacts on Natural Resources

MEARNG command and staff are determined to complete the military training mission successfully, and an integral part of that mission is good environmental stewardship. Overall the effect of natural resources management on the military mission of MEARNG is positive. The ITAM program in particular has a positive effect on both military training and the environment.

Other programs, such as forestry and wildlife management have positive effects on military mission requirements. Many forestry projects open up areas to military use that otherwise would be difficult to utilize, and wildlife management provides resources for more realistic training while also providing another element to support soldiers' quality of life.

6.1 Land Use

Land within the Auburn site boundary is owned by the USACE and licensed to the State of Maine for the use of MEARNG, with the exception of three parcels located along the western boundary of the Site. Two of these parcels are State owned and one is leased. Land use over the past 10 years has included training for the MEARNG and limited authorized and unauthorized recreational uses by the public. Currently, the land is used by MEARNG primarily to train engineers in the operation of heavy construction equipment within the FMS #2 area. A wooded area of the Site contains a compass course, the remains of two unused firing ranges, an inactive 25 meter baffled range, and a historic 800–1000 yard KD rifle range that was used from 1926 until approximately 1960 (MEARNG 2002b). The Site is also used for small arms tactical firing (blanks), light dismounted activities such as orienteering activities, bivouac, and some tactical driving. In the future, MEARNG proposes to continue to conduct training outside of significant natural/cultural resources management zones, and will limit training inside of valuable natural/cultural resources management zones as noted in Section 7.1.2 in order to preserve and protect significant cultural and natural features, species, and habitats on the Site.

Public, residential and commercial property borders the Site. The Mt. Apatite Conservation Area located to the west of the Facility is owned and managed by the City of Auburn. This land is used for recreation and educational purposes, and it is not known if management goals for protecting and preserving significant species and habitat on adjacent lands are similar to the goals of the MEARNG lands, or if similar goals have been set in place that are consistent with MEARNG's use of the Site for training purposes, while promoting sound natural resource stewardship principles and land management practices. Due to the encouragement of rock hounding, hiking, biking, and snowmobiling within the Conservation Area, it is expected that some impacts to the natural vegetation and wildlife habitat occurs on a regular basis. However, these impacts are likely restricted to established trails and those areas of the quarry that have been approved for exploration by the public with hand tools. Vehicles are not allowed inside the Conservation Area, so vehicular and pedestrian traffic is limited to foot, bicycle, and cross country skiing traffic in the winter.

Several overlapping land uses occur on the Facility. A large portion of the training area includes forests that are open to timber harvesting and outdoor recreation activities. Because of overlapping uses, coordination of projects and land use between Command, Training Sites, Deputy Chief of Staff for Operations (DCSOPS), and the Directorate of Facilities Engineering–Environmental Program (DFE-ENV) is extremely important.

6.2 Current Major Impacts

Comprehensive studies that specifically evaluate the effects of military training and recreational uses on natural resources have not been conducted at the Auburn site. Current training activities on the site that are limited to the immediate area of the FMS #2 site are likely to cause minimal negative impacts to natural resources, due to the limited amount of natural resources associated with the sand plain that is used for heavy equipment training. Additionally, the flat topography of the FMS #1 training area results in a low potential for erosion of the sandy material associated with it. Use of forested areas for ground navigation training may impact natural resources, if specific areas have not been established for these purposes. The use of the forest habitat for navigational training will likely involve foot traffic impacts to low lying herbaceous vegetation; however, the level of impact to these resources would be dependent upon the density of individuals using this area during a training session and the frequency of use. Observations made during previous Site visits and surveys for wildlife and habitat have revealed some Site disturbance and potential sources of disturbance, past and current, which include the following:

- Unimproved sand roads and trails;
- Active bivouac sites and foot-traffic in forested areas;
- Field maintenance of vehicles and weapons during tactical maneuvers;
- Trash and other debris, primarily from unauthorized public use of the site; and
- Recreational uses of the Site that include unauthorized ATV and snowmobile use of the Site.

With the exception of unauthorized uses of the Site (i.e., dumping of trash and debris, irresponsible use of ATV's and snowmobiles), the disturbances resulting from authorized uses of the Site are very minor overall and have not resulted in significant negative impacts to the natural resources of the Site. Observed impacts include the following:

- Erosion, primarily associated with roads and unauthorized trail creation, and sedimentation of wetlands located adjacent to roads;
- Disturbance to wildlife due to noise/activity associated with training and recreational activities;
- Materials and litter associated with training activities;
- Long term vegetation loss in maintained roads, trails, open areas, and pad sites; and,

- Short-term impacts to vegetation in training areas and along road edges.

6.3 Potential Future Impacts

If the basic mission, land area, and intensity of missions remain unchanged as MEARNG anticipates, mission impacts on natural resources are expected to remain similar to those today. However, current and future training activities at Auburn could change over time as necessary to support the military mission.

Vehicular and heavy equipment traffic is and will be in the future restricted to the FMS #2 training area, existing roads, and existing cleared areas and trails. Thus, no additional future impacts are anticipated. Foot traffic may cause some trampling of vegetation and disturbance to soils, especially in the forest training areas, but overall impacts to the communities will be minor. Future activities proposed for the site involves potentially improvements to the network of old skid trails and logging roads to further enhance various training operations. Current activities include the continuation of military training exercises (i.e., orienteering, bivouacs, and dismounted maneuvers).

6.4 Natural Resource Needs to Support the Military Mission

Quality training opportunities necessitate quality natural resources. The mosaic of natural communities found on Auburn provides MEARNG with a variety of realistic training scenarios. Forested areas are used for infantry training and as bivouac sites. Forest clearings serve as small unit assembling points. Therefore, training areas are managed to support the military mission while sustaining their resource capabilities.

6.5 Natural Resource Constraints to Missions and Mission Planning

MEARNG command and staff are determined to complete the military training mission successfully, and an integral part of that mission is good environmental stewardship. However, special consideration and advanced planning is required to properly balance natural resources management with military training.

There may be time delays to coordinate with Natural/Cultural Resources staff or to obtain permits for proposed activities. Delays associated with these may affect military training schedules. Although prior to the implementation of this INRMP none of the Site was off-limits to training, the documentation of the Federally-threatened and state endangered small whorled pogonia on the Site will require additional protection measures. Training activities of any kind generally are not permitted within the vicinity of known locations of Federal or state-listed species. In addition, training activities are limited to foot traffic only in stream and wetland areas, and if possible, wetland areas will be avoided altogether by establishing a 75 ft. buffer around the ordinary high water mark of the waterbody.

7.0 Natural Resources Program Management

This section identifies management practices that directly affect soil, water, vegetation, and fauna. It includes forest management, habitat management, wetlands management, water quality programs, grounds maintenance, pest management, training land management, direct manipulation of wildlife, and threatened and endangered species management. This section also identifies all programs that will be used to manage installation natural resources during the next 5 years. Appendix A, Table 4, provides a summary of those management programs listed below that have specific management actions associated with them.

7.1 Natural Resources Program Management

Natural resources management can be accomplished through focused natural resources management projects, including forest management, wetlands management, and similar programs. The goals provided below ensure that MEARNG is able to continue to meet and improve military training objectives while ensuring impacts to natural resources are minimized and appropriate resources protected. The specific objectives are identified to achieve these goals. Goals and objectives follow established Best Management Practices (BMPs) where applicable.

7.1.1 Natural Resources Management Goals and Objectives

The Natural Resources Management Goals and Objectives for the Auburn Training site and the actions needed to achieve these goals and objectives are discussed in Sections 7.2 through 7.6, and are summarized in Appendix A, Table 4.

7.1.2 Natural Resource Management Zones

In order to accomplish many of the above goals and objectives, two natural resources management zones have been developed to consolidate activities in appropriate locations and to restrict certain activities in sensitive areas. The location and extent of the management zones are presented in Appendix B, Figure 6, and include the following:

Significant Natural Resource Management Zone (SMZ)

Training activities are generally restricted to foot traffic only in this zone due to the presence of significant natural resources. No vegetation removal, soil disturbance or vehicle traffic are allowed. Resources protected by this zone within the Facility boundaries include the confirmed presence of federally or state-listed species, specifically the Federally-threatened and state-endangered small whorled pogonia in 2002, 2014 and 2016 and the four vernal pool significant wildlife habitat buffers.

Valuable Natural Resource Management Zone (VMZ)

Training activities in this zone are generally limited to foot exercises only (provided that soil disturbance and the removal of vegetation will be minimal) due to the presence of valuable natural resources. Resources protected by this zone at the Site currently include the areas outside of the 25-ft SMZ buffer of all streams, extending out to 75-ft from the edge of the associated wetlands (Appendix B, Figure 6). Non-significant vernal pools are also located within the VMZ, and contain a 75-ft buffer. Training activities within the 75-ft buffer zone established around these features will be avoided if feasible.

Training Zones (TZ)

Training activities in this zone are generally not limited and vegetation disturbance is permitted in this zone for construction and training operations. However, where feasible, training activities throughout most of the designated TZ zone at the site that might impact soils should only be conducted on the established training area associated with the FMS #2 site, existing roads, trails, and other open sandy areas. No new permanent structures are proposed. TZs at the site include all of FMS #2, existing sandy roads, trails, and all open areas, with the exception of the established SMZ and VMZ areas.

7.2 Geographic Information Systems (GIS)

A Geographic Information System (GIS) database facilitates MEARNG's efforts to achieve the above goals and objectives and is an important training site management tool. MEARNG actively maintains a GIS and associated spatial data for all of its training facilities.

Data used in the production of figures and acreage estimates in this INRMP are based on the most recent available GIS data (MEARNG 2022). The database associated with the location of significant natural resources at the Auburn Facility is continually being updated by MNAP based on survey data collected by MNAP and MDIFW staff.

7.3 Wildlife Management

The purpose of wildlife management is to improve and maintain diverse vegetation/land cover types that support an array of native fauna. Wildlife management can also help maintain ecologically sound population levels of game and non-game species. The diverse vegetation/land cover types on the site are beneficial to various wildlife populations. Broad based habitat improvement is a major focus of wildlife management. However, more specific management programs are often necessary for individual species or a group of species.

Moreover, wildlife enhancements aimed at one or several species are often beneficial to many non-targeted species. Hunting is permitted within the site, as long as the persons involved have the appropriate state issued license(s). The wildlife habitat conservation at the site will include the following management prescriptions:

- Preserve sensitive communities that wildlife species depend upon by placing barriers across major access points to deter disturbance to critical habitats;
- Restrict activities in critical habitats for wildlife in accordance with designated management zones as shown in Appendix B, Figure 6; and,
- Preserve the habitat for sensitive species known to occur on the Site by restricting training and public access to those areas during established growing seasons.

Alterations of streams and drainages will be avoided and soil disturbances and vegetation removal will be restricted within, and up to 75 ft from, a stream, wetland, or vernal pool in order to maintain optimal water quality for invertebrate and plant production.

The EO also discusses requirements for conservation of migratory birds. The MOU guides management and conservation of migratory birds for military non-readiness activities such as land management, MILCON, maintenance, etc. It addresses means to avoid or minimize impacts on migratory birds, when practicable and reasonable.

Impacts to migratory birds will be considered during the NEPA process for all non-readiness activities IAW EO 13186 and the associated MOU between DoD and USFWS.

7.4 Management of Threatened and Endangered Species and Habitats

It is ESA and Army policy to protect federally and state-listed species, and to afford protection to special concern (not legally-protected) species and habitats whenever possible. To accomplish this, MEARNG training activities are conducted within appropriate resource zones (as shown in Appendix B, Figure 6, and described in Section 7.1), and every effort is made to follow specific guidelines in areas where there are populations of RTE species. These include:

- Conducting surveys as necessary to confirm presence of potential RTE species (i.e., Northern long-eared bat);

- Avoiding direct impacts to rare plant locations, such as the known location of the small whorled pogonia population on the Site;
- Avoiding direct impacts to rare species and nest sites;
- Reducing indirect impacts to rare species by minimizing traffic and activities in areas where birds or other rare animals are nesting or breeding; and
- Maintaining water levels surrounding rare aquatic plants and preventing alteration to water levels by avoiding watershed disturbances.

All natural and cultural resources management activities and military training will be conducted in a manner to minimize negative impacts to habitats and species. MEARNG environmental management practices avoid creating favorable conditions for exotic plant species, as any exotic species may impose threats to native flora, thereby affecting rare species and natural communities. Should planting be required on the Site, only native species will be planted in open areas to prevent soil erosion by wind or trampling. Although construction activities are not proposed at this time, any future activities will not begin until an examination of rare species habitats has been completed and recommendations on land use have been made. Recreational activities have been, and will continue to be managed so that species of concern and sensitive features are not disturbed.

7.4.1 Specific Management Requirements for the Small Whorled Pogonia

Several management requirements specifically designed to protect the population of the Federally-threatened and state-endangered small whorled pogonia, which was identified within the boundaries of the Facility in 2002, are to be implemented as part of this Plan. Management measures are being provided due to the potential for this species to remain dormant for several years before reoccurring. The following management actions are required:

- Ensure land managers are aware of the general location of the small whorled pogonia population on the Site, and know how to identify it;
- Conduct annual monitoring of the small whorled pogonia population located on the Site to determine frequency of recurrence, population size and viability;
- Conduct a search annually for new small whorled pogonia populations on the Site;
- Monitor forest health in the immediate vicinity of the small whorled pogonia population located on the Site;
- Establish a buffer of at least 164 feet (approximately 50 meters) around the known small whorled pogonia population located on the Site, where all training and recreational activities are prohibited. The location of the small whorled pogonia on the Site is located in the SMZ zone shown in Appendix B, Figure 6. The 164 foot buffer is not shown;

- Survey established buffer area for invasive species and remove as needed with hand tools to provide protection to the established population of small whorled pogonia on the Site; and
- Reassess the management requirements of the small whorled pogonia after 5 years, and make changes as necessary to provide long-term protection of this species based on the frequency of recurrence documented in annual monitoring surveys conducted.

7.4.2 Specific Management Requirements for Bald Eagle

Although the nearest mapped bald eagle nest is approximately three miles away along the Androscoggin River in Auburn, several management requirements specifically designed to protect the bald eagle, a possible transient of the Site, are to be implemented as part of this Plan. In accordance with the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act the following management actions are required:

- If bald eagles are documented on Site, ensure land managers are aware of the general location of the nests or eagles on the Site, and know how to identify this bird species;
- If bald eagle nests are confirmed on Site or within the immediate area, disturbance will be minimized as defined by USFWS:

"Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

- To avoid disturbing nesting bald eagles, the following recommendations will be implemented:
    - Establish a distance buffer between disturbance activity and the nest to minimize visual and auditory impacts associated with human activities;
    - Maintain preferably forested (or natural) areas between the disturbance activity and around nest trees (landscape buffers); and,
    - Avoiding certain disturbance activities, such as noise and construction-related disturbances, during the breeding season.

If additional guidance is needed in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, MEARNG will consult with the USFWS Field Office located in East Orland, ME.

7.5 Water Resource Protection

There are several surface waterbodies within the installation boundary (Appendix B, Figure 5). Surface waters at the Facility include several natural wetlands, streams, a created wetland complex, and five vernal pools (Weber and Rooney 2002, Jones Associates Inc. 2009 and MEARNG 2015). The Auburn Comprehensive Plan (City of Auburn 2008) provides protective measures for wetlands greater than 10 acres in size. The largest wetland located on the Facility is 9.27 acres, which defines the stream located west of the FMS #2 training area. Local, state, and Federal laws restrict certain activities within and adjacent to these surface waters. In order to maintain the integrity of the wetland resources at the Site, training activities within a 75-ft buffer of the normal high water mark of the aforementioned waterbodies will be avoided if at all feasible, and if training activities are necessary within the buffer zone, they will be restricted to foot traffic. The 75-ft buffer around wetland resources is shown as the VMZ zone in Appendix B, Figure 6. A 25-ft buffer has been established along the three stream channels located on the Site, and training activities are restricted within these zones, with the exception of where established road crossings are present. The 25-ft buffer along stream channels is shown as the SMZ zone in Appendix B, Figure 6. These buffer zones will also help to maintain water quality by filtering potential nutrients and sediments from surface water that drains into these waterbodies from surrounding areas. The MEARNG Environmental Office must approve any activities inconsistent with these guidelines.

In addition, MEARNG will conduct annual erosion surveys throughout the Site to document erosion issues that may impact water resources at the Facility and will implement measures to address erosion control as needed.

7.6 Wetlands Protection

Wetlands protection is required by Executive Order 11990, *Protection of Wetlands*. Protection and maintenance of habitat are the primary goals of wetlands management at the site. There are 14 wetlands and five vernal pools located within the installation boundary, including the created wetlands associated with the recreational area in the southeast corner of the Site, the natural wetlands located west and northwest of the FMS #2 training area (Appendix B, Figure 5). In order to maintain the integrity of these resources, training restrictions have been established for each wetland and vernal pool, avoiding the area within a 75-ft buffer zone (750 foot buffer zone for significant vernal pools) of these resources to the maximum extent possible, and if unavoidable, allowing training activities that are restricted to foot traffic only. The wetland and vernal pool resources, and the designated 75-ft buffer zone and 750 foot buffer zone around these resources, are shown in Appendix B, Figure 6. These buffer zones will help to maintain water quality by filtering potential nutrients and sediments from water that drains into these wetlands from surrounding areas.

The Record of Environmental Consideration and Checklist (REC) is the primary means of detecting threats to wetlands on the Site. The DFE-ENV reviews actions that may affect wetlands, and reviews may stem from several sources, including work orders, service orders, military mission plans, NEPA documentation, and major construction plans. If necessary, projects with potential impacts are referred to the MEDEP field determination to determine if jurisdictional wetlands are implicated, mitigation measures are required, and/or to obtain permits. Projects that affect wetlands also require NEPA documentation. In addition, compliance with NRPA will require contact with MDEP for:

> *Activities that involve dredging; bulldozing; removing or displacing soil, sand, vegetation or other materials; draining or dewatering; or construction, repair or alteration of any permanent structure located adjacent to a coastal wetland, great pond, river, stream or brook, or significant wildlife habitat contained within a freshwater wetland, or certain freshwater wetlands.*

Consultation with MDEP is not required for minor wetland impacts, such as projects that impact less than 4,300 square feet of freshwater wetland and do not occur within another type of protected natural resource; within 25 ft. of another protected natural resource and erosion controls are used; within a municipal shoreland zone; within a wetland normally containing at least 20,000 square feet of open water, aquatic or emergent marsh vegetation; or, within a peatland. Activities that meet the size and resource requirements do not require consultation with MDEP because they are exempt under NRPA, 38 Maine Revised Statutes Annotated Section 480-Q (17).

MEARNG has been conducting annual erosion surveys throughout the Site to document erosion issues that may impact wetland resources at the Facility, and will implement measures to address erosion control as needed (Appendix A, Table 4). The following recommendations will help to ensure that wetlands persist and are functionally valuable:

- Continue restricted use of all wetland areas to foot traffic, and if feasible restrict all activities within a minimum of 75 ft. of all wetlands, vernal pools and surface waters;
- Monitor wetland health and document negative impacts; and,
- Install signs and barriers as necessary to further restrict access where needed.

7.6.1 Specific Management Requirements for the Vernal Pools

Several management requirements specifically designed to protect vernal pool habitat and wildlife that utilize vernal pool habitats within the boundaries of the Facility are to be implemented as part of this INRMP (Appendix A, Table 4). The following management action is required:

- Survey and evaluate existing vernal pool habitat annually during the amphibian breeding period to document use of the vernal pool by wildlife species; and,
- If any Federally-listed species are documented during the survey period, contact the USFWS and MNAP to determine what additional protective measures are required, and update this INRMP to include the recommended management requirements to provide long-term protection to these species.

7.7 Grounds Maintenance

Site structures and grounds maintenance has the potential to affect training and natural resources management goals. There are several administrative, educational training, and maintenance buildings located on the Auburn site. Grounds maintenance associated with these buildings are limited to minor grading of existing unimproved roadways.

7.8 Terrestrial Vegetation Management

The general vegetation and forest management goal for the Auburn site is to use the forestlands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and potential to fulfill, now and in the future, relevant ecological, economic, and social functions at the local, state, and national levels, and that does not cause damage to the ecosystems within limits of overruling MEARNG military mission in accordance with the following objectives:

- Enhance military training facilities by providing accessible forestland cover (through proper silvicultural practices) that support year-round, intermittent, relatively low-impact military training;
- Maintain and optimize existing quality of wildlife habitat for overall species diversity, particularly in regard to deer winter cover, hard mast production, wetland and vernal pool protection, and riparian corridors for stream shoreline areas;
- Maintain critical habitat conditions for rare species;
- Maintain, and where possible enhance, the visual quality of areas surrounding recreational sites, trails, and travel corridors;
- Periodically evaluate the Site for opportunities to remove damaged vegetation (i.e., trees damaged by ice, storms, or infestations) in order to improve overall Site conditions;
- Inspect and mark Site boundaries every 10 years to protect against trespassing and unauthorized uses of the forest; and,

Currently, MEARNG conducts very limited timber harvesting on this site. However, should MEARNG decide to harvest timber, it would be in accordance with the forest management plan, which supports the following objectives:

- Conduct timber harvesting only if it supports INRMP goals and/or training requirements. If timber harvesting is conducted, adhere to the forest harvesting goals and policies outlined in the MEARNG Forest Stewardship Management Plan (Wadsworth 2013) that has been prepared for the Site, including:
    - Adhere to all harvesting laws when conducting commercial harvesting activities, including but not limited to, the Forest Practices Act, Shoreland Zoning, Notice of Intent to Harvest, Natural Resources Protection Act, and Erosion and Sedimentation Control Law;
    - Periodically update forest stand inventory data and stand maps;
    - Monitor the long-term effects of ice storm damage and take action as appropriate, such as harvesting damaged/dead trees as needed;
    - Regulate timber yield consistent with site productivity and stand-specific objectives;
    - Harvest marketable timber products and contribute forest products to the local and state economy;
    - Manage the forest ecosystem to support the military mission, maintain ecosystem integrity, and produce forest products on a sustainable basis, including monitoring impacts of harvesting and road/trail construction activities to streams, marshes and other wetland areas;
    - Clearly mark all boundary lines within 200 ft of cutting operation harvest areas greater than 10 acres (flagging should only be used as a temporary measure in boundary line demarcation);
    - Maintain a suitable number of wildlife trees (4–5 acres on average) and forest floor debris within harvested areas in order to maintain complex habitats for species that prefer such habitat (e.g., cavities, snags, and perches);
    - Monitor insect and disease damage regularly, especially in trees damaged by ice as follows:
        - Monitor for signs of impacts to hemlocks from hemlock wooly adelgid (*Adelges tsugae*), such as twig dieback and/or premature needle drop, white wooly masses at the base of needles of young twigs, and unhealthy grayish-green needles that normally would be dark green; and,

  - Monitor for signs of impacts to hemlocks from hemlock looper moth (*Lambdina fiscellaria*), in accordance with Maine Forest Service monitoring recommendations for this pest;

- Conduct plantings of wildlife shrubs suitable to the area, such as red oak, apple trees, and wild grape, to encourage various species of birds and mammals to visit the Site, as outlined in Section V of the Forest Stewardship Management Plan (Wadsworth 2013); and,

- Keep detailed records for all management activities and associated costs, including detailed records of all the timber harvested on the Site (including species, volume, and product information), information on road/trail and bridge building activities conducted, forest protection activities that were implemented, information on any pre-commercial thinning operations, tree plantings, boundary line work, and erosion control measures that were utilized.

In addition, the harvesting of the timber resources on the Site will be planned and conducted in accordance with Army Regulations 200–1. The State of Maine will administer any logging contracts. In addition, decisions regarding future timber harvests (e.g., stumpage sales) will be under the guidance of a licensed professional forester.

7.9 Agricultural Outleasing

No agricultural activities have been permitted on the site. Grazing of domestic animals is not allowed due to the determination that it is not in accordance with natural resources management for the installation. There are no plans to institute either agricultural or grazing leases since they are not compatible with the military mission or ecosystem management strategies.

7.10 Integrated Pest Management Program

The Integrated Pest Management (IPM) program goal is to control those plant and animal species that affect natural resources management (e.g., reduce ecosystem functionality, displace native species) or directly affect the military mission on Auburn.

Non-native and/or noxious weeds pose threats to native habitats, endangered species, and plant community composition and diversity. More specifically, they threaten wetland ecosystems, complicate land restoration projects, add to the cost of pest management, and in general, threaten ecosystem functionality. MEARNG is committed to the prevention of introduction of invasive species as well as their control, per Executive Order 13751, *Safeguarding the Nation From the Impacts of Invasive Species*.

In accordance with MEARNG's 2019 Integrated Pest Management Plan (IPMP), surveillance will be used to identify pests and invasive species at the Site and to monitor their status and the success of control measures. Typically, a combination of techniques may be required to resolve a problem on a sustained basis. Management may include optimum sanitation measures, good structural design and maintenance of facilities, mechanical control, cultural control, biological control, and regulatory control.

A total of 14 different invasive and/or non-native or introduced plant species were identified on the site during multiple biological surveys. The invasive species found during these biological survey include common wormwood (*Artemisia vulgaris*), Japanese barberry (B*erberis thunbergii*), asiatic bittersweet (*Celastrus orbiculate*), Japanese knotweed (*Fallopia japonica*), glossy buckthorn (*Frangula alnus*), morrow's honeysuckle (*Lonicera morrow*), purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), wood bluegrass (*Poa nemoralis*), black locust (*Robinia pseudoacacia*), multiflora rose (*Rosa multiflora*), rugosa rose (*Rosa rugosa*), field sorrel (*Rumex acetosella*), and climbing nightshade (*Solanum dulcamara*).

Insect and animal pests thought to occur, or that may potentially occur, at the Site include mosquito, black flies, gypsy moths, raccoon, woodchucks and skunks. The comprehensive approach identified in MEARNG's IPMP and used to control or prevent these pests ensures methods of pest control are used in a compatible manner and avoids/minimizes adverse side effects to non-target organisms and the environment and utilizes Integrated Pest Management principles (MEARNG 2019). The Facility IPMP discusses many aspects of pest management that are not directly within the scope of this INRMP, such as control of disease vectors and protection of facilities.

The Forest Stewardship Management Plan (Wadsworth 2013) identified several forest pests which could affect the vitality of the coniferous trees on the Site. These include the white pine weevil (*Pissodes strobi*), which can cause blister rust in affected spruce and pine trees, the hemlock looper, which can destroy stands of mature fir and hemlock trees causing defoliation, and the hemlock woolly adelgid, which also affects hemlocks by injecting toxins into needles as it feeds, causing needle drop and branch dieback. Although the white pine weevil and hemlock looper have become established in Maine, the hemlock wooly adelgid has not yet become a problem in the state. Although no major insect or disease infestations are known to occur within the forest habitat of the Facility, these pests should be included in the periodic review of forested habitats when conducting evaluations of their current condition.

Currently there are no plans for removal of invasive species known to occur on the Site, as funding has not been put in place for such removal. In the event invasive species or noxious weeds become a significant problem at the Facility or hinder training functions of the Facility, funding may be requested to address invasive species removal.

7.11 Outdoor Recreation

The most common public activities at the site are recreational activities associated with the Garfield Road recreational complex located on the Site. Several ball fields, including soccer and baseball fields are present, and are used by local citizens and Facility personnel and their families. Although activities are generally confined to the recreational area, some impact to significant vernal pools occurs in the form of trash and other debris being deposited in the pools. The upland habitat around ATS-VP4 is minimal due to the open fields, parking lots and road.

MEARNG currently allows the public to use the Site trails to access Mt. Apatite hiking, biking, birdwatching, snowshoeing and cross-country skiing in the winter. Additionally, MEARNG allows hunting activities to be conducted at the Facility, as long as persons conducting this activity are properly licensed. While minor unauthorized ATV and snowmobile use may occasionally occur within the forested area of the Site located near the northern boundary, to date it has not posed any significant impacts to vegetation, wetlands or wildlife habitat. MEARNG has made some effort to reduce unauthorized use of this area, such as through the placing of gates, barriers, or signage along access points to this area which have significantly reduced the unauthorized use. If damage to the vegetation, wetlands, and/or wildlife habitat in this area becomes an issue in the future, MEARNG may choose to implement additional measures to discourage unauthorized entry to the Site, and contact the local authorities to make them aware of the problem.

7.12 Coastal Zone Management

The Site is not located near coastal areas. Therefore, this section is not applicable.

7.13 Cultural Resources Protection

The MEARNG maintains a current Integrated Cultural Resource Management Plan which covers all MEARNG facilities and training sites including Auburn.

Management of the cultural resources on the Site is a mission of the DFE-ENV. A Cultural Resources Manager handles all aspects of cultural resources management including coordination with the Federally-recognized Native American tribal organizations, which include the Penobscot, Passamaquoddy, Maliseet, and Micmac tribes, and the public, as appropriate. The ICRMP is the guiding document for all cultural resources issues and should be referred to for specific resource management.

7.14 Enforcement

Many aspects of the MEARNG natural resources management require effective environmental law enforcement (e.g., protection of rare or unique species, protection of sensitive areas, and recreation). Several local, state, and Federal agencies are responsible for the enforcement of regulations protecting the natural resources at the Site. Enforcement agencies and their areas of focus include the following: the Maine Warden Service, which regulates and enforces Maine's hunting and fishing regulations; USFWS, which regulates and enforces Federal wildlife laws; MDEP, which regulates and enforces NRPA and the Shoreline Zoning Act; and, USACOE, which regulates and enforces Federal laws associated with wetlands, vernal pools and streams. Local and state police departments also provide surveillance and enforcement at the Site.

7.15 Public Outreach

Public awareness of conservation is instrumental in creating conditions needed to manage natural resources. The MEARNG approach to awareness stresses education via flyers and partnering with MIF&W, MNAP, and The Nature Conservancy who maintain web and outreach activities. Out internal outreach includes Unit Environmental Officer training and occasional newsletter articles. It provides military personnel and the public with insights into installation natural environments and conservation challenges. The more people know about the installation's unique and valuable natural resources, the more responsibly they act toward them. Education also promotes awareness of critical environmental projects and the rationale behind them. Activities, land rehabilitation, wildfire suppression, and other management activities can be accomplished with little conservation awareness effort because installation personnel, recreationists, and the general public naturally support these easily understood efforts. However, issues such as protection of sensitive areas for little known plant and wildlife species, permit fees and their uses, etc., require effective conservation communication to get positive support and, perhaps more importantly, to avoid adverse reactions from various users. A conservation awareness program must be directed to both installation and external interests to maximize effectiveness.

8.0 Training Area Management

The Training Area Management Goals and Objectives for the Auburn Training site and the actions needed to achieve these goals and objectives are summarized in Appendix A, Table 4.

9.0 Implementation

The success of this INRMP depends upon MEARNG's capability to implement it at Auburn. Appendix A, Table 4 presents the actions proposed to support this INRMP. Although this INRMP was prepared with a goal of 100% implementation, all activities, construction, design aspects, and other components of this INRMP are subject to the availability of annual funding, availability of manpower, environmental factors, and subject to mission requirements. MEARNG will make best efforts to request and procure funding through appropriate channels. Where projects identified in the Plan are not implemented due to lack of funding, availability of manpower, mission requirements or other compelling circumstances, MEARNG will review the INRMP goals and objectives annually to determine whether adjustments are necessary. Below are described the organization, personnel, and funding needed to implement INRMP programs.

9.1 Work Plans

The military must maintain the capability, through a total force effort, to put overwhelming combat power on the battlefield to defeat any potential enemies. Decisive victory depends on the ability to deploy rapidly, to fight, to self-sustain, and to win quickly with minimum casualties. Force readiness depends on high-quality realistic training. Such training, in turn, relies on the availability of training land on Army installations. The MEARNG will utilize the ITAM Program to integrate the military mission with the sustainable ecological management at the Auburn. According to Army Regulation 350–4, Integrated Training Area Management, "the U.S. Army recognizes that executing training to doctrinal standards to maintain the readiness of its units will impact the environment." The intent of ITAM is to support sound natural resources management practices to provide stewardship of land assets while sustaining those assets to support training and other installation missions.

ITAM establishes a systematic framework for decision-making regarding use of military training lands at or controlled by military installations. It integrates elements of operational, environmental, master planning, and other programs to identify and assess land use alternatives. The ITAM Program is built around four components, Range and Training Land Assessment (RTLA) is a management procedure that provides for collecting, inventorying, monitoring, managing, and analyzing tabular and spatial data concerning land conditions on an installation. Training Requirements Integration (TRI) is a decision support procedure that integrates training requirements with land management, training management, and natural and cultural resources management processes and data derived from RTLA and Army Conservation Program components. Land Rehabilitation and Maintenance (LRAM) is a preventive and corrective land rehabilitation and maintenance procedure that reduces the long-term impacts of training and testing on an installation. Environmental awareness is a means to develop and distribute educational materials to land users. Materials relate procedures for sound environmental stewardship of natural and cultural resources and reduce the potential for inflicting avoidable impacts.

ITAM projects that would support this INRMP are presented in Appendix A, Table 4. Projects will be completed based on availability of funds.

The DFE-ENV Section at MEARNG can implement most of this INRMP, fulfill general goals and policies established in Chapter 1 and more specific goals and objectives within Appendix A, Table 4. Other MEARNG organizations identified in Section 2.2 are also capable of implementing their portions of this INRMP with no organizational changes, although they may elect to make changes during the next INRMP update for improved operations efficiency.

9.2 Natural Resources Management Staffing

Professionally trained natural resources management personnel are required to implement this INRMP. This will likely require the following personnel within the Environmental Division and ITAM program, Environmental Branch Chief, Natural Resource Manager, Seasonal Field Crews, GIS Operator, Environmental Specialist, ITAM Coordinator, as well as outside contractors (part-time).

9.3 Annual Coordination Requirements

Although not required by the Sikes Act, an annual review will be initiated by the MEARNG and conducted by the USFWS at the Field Office level. Based on the findings of the INRMP annual review, there may be no changes, there may be minor editorial changes, or significant resource management changes required. Minor editorial changes requiring an update will not require concurrence from USFWS, MDIFW and MNAP, but a revision requiring significant resource management changes will require their concurrence. The annual review will consist of a scheduled correspondence with representatives from at least the USFWS, MDIFW and MNAP. The outcome of the review meeting should be documented in a memo to all parties involved in the development of the INRMP update for the site.

9.4 Monitoring INRMP Implementation

The natural resources management goals and objectives identified in Appendix A, Table 4, will be used to monitor the effectiveness of natural resources management at Auburn. TINRMP implementation will be evaluated by the NRM's periodic evaluation of the progress of management activities associated with the objectives and projects, management review, and periodic assessment to ensure those activities are in support of military training and natural resource management.

10.0 Summary of Auburn Training Facility

- Location: Auburn, Androscoggin County, Maine

- Terrain and elevation: Ranges from flat lying and gently rolling elevations to steep terrain associated with the slopes of Mt. Apatite that extend onto the Site. Elevations range from about 250 to 350 ft above MSL (approximately 76.2 m to 106.7 m).

- Acreage: 160.0 acres (64.7 hectares) of Federally-owned land and 16.3.acres (6.6 hectares) of state owned and leased parcels.

- Soil: Includes Adams loamy sand, 0–8% slopes, Hollis very rocky fine sandy loam, 8–15% slopes and 15–45% slopes, Ninigret fine sandy loam, 0–8% slopes, Walpole fine sandy loam, and Sutton very stony loam, 0–8% slopes. The water table is usually within 2 feet of the surface for Adams loamy sand and the Hollis soils are shallow to very shallow. Water table may be near the surface for Ninigret fine sandy loam during the spring and fall months, and Walpole fine sandy loam is described as deep, poorly drained soil, and also may have the water table at or near the surface.

- Habitats: Four upland and two wetland habitat types are associated with the Site. Non-forested upland habitats include Open Sandplain/Old Field (37%) and a Powerline Right-of-Way (1%), and forested upland habitats include Oak-Pine Forest (42%) and Beech-Birch-Maple Forest (9%). Mixed Graminoid-Shrub Marsh (2%) describes the non-forested wetland habitat on the Site, while Maple-Basswood-Ash Forest (9%) describes the forested wetland habitat of the Site.

- Access: Stevens Mill Road via Garfield Road located approximately 1 mile north of Route 11. Stevens Mill Road also provides access (through the Facility) to the Mt. Apatite Conservation Area, located west-northwest of the Site.

- Military facilities: FMS #2 training area consisting of educational buildings, maintenance buildings, and climate controlled storage buildings, in addition to the sandplain area used for heavy construction equipment training and maneuvering.

- Land use: Primarily heavy construction equipment education and training, forest orienteering and navigation and dismounted maneuvers. Recreational use is associated with the Garfield Road recreational complex located in the southeast corner of the Site, which is maintained and operated by the City of Auburn Parks and Recreation Department. Activities include light dismounted activities such as small unit operations, bivouac, orienteering and some tactical driving on existing road network. Recreational uses are primarily restricted to the Garfield Road recreational complex located in the southern section of the Site, although hiking, biking, birdwatching and cross-country skiing are also allowed on the dirt roads and trails of the Facility. Access to Mt. Apatite is also provided by the Facility.

- Hunting: The Facility allows hunting on the premises as long as the persons involved have the appropriate state issued license(s).
- Confirmed Federal or State-listed Species or Habitats**:** A single population of the Federally-threatened and state-endangered small whorled pogonia has been documented on the Site.
- Confirmed Sensitive Species or Habitats: None.
- Cultural Resources of Concern: SHPO has determined that the two potential archeological sensitive sites (Stevens Royal Site, ME-20.3 and Jacob-Stevens-S Stevens Site, ME-20.4), and the three WWII-era target complexes (ME-20.5, ME-20.6, and ME-20.7) identified in the Phase I survey are not eligible for inclusion in the NRHP.
- Other Special Concerns: There is potential for other state-listed species and species of concern to occur on the Site (i.e., eastern cottontail).
- Natural Resources Management Strategies: Adherences to Resource Protection Zones and conduct monitoring, maintenance, and surveys as recommended in Appendix A, Table 4, as funding becomes available.

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12.0 List of Acronyms

AaB - Adams loamy sand, 0–8% slopes

ATV - All Terrain Vehicles

BMPs - Best Management Practices

CFMO - Construction and Facilities Management Officer

DCSOPS - Deputy Chief of Staff for Operations

DFE-ENV - Directorate of Facilities Engineering-Environmental Programs

DoD - Department of Defense

EA - Environmental Assessment

EPA – Environmental Protection Act

ESA - Endangered Species Act

F - Fahrenheit degrees

Ft - Foot or feet

GIS - Geographic Information System

GPS - Global Positioning System

HsC - Hollis very rocky fine sandy loam, 8–15% slopes

HsD - Hollis very rocky fine sandy loam, 15–45% slopes

ICRMP - Integrated Cultural Resources Management Plan

INRMP - Integrated Natural Resources Management Plan

IPM - Integrated Pest Management

IPMP - Integrated Pest Management Plan

ITAM - Integrated Training Area Management

LRAM - Land Rehabilitation and Maintenance

MDEP - Maine Department of Environmental Protection

MDIFW - Maine Department of Inland Fisheries and Wildlife

MEARNG - Maine Army National Guard

MGS - Maine Geological Survey

MHPC - Maine Historic Preservation Commission

MNAP - Maine Natural Areas Program

Mph - Miles Per Hour

MSL - Mean Sea Level

NEPA - National Environmental Policy Act

NgB - Ninigret fine sandy loam, 0–8% slopes

NGB - National Guard Bureau

NOAA - National Oceanic and Atmospheric Administration

NRCS - Natural Resources Conservation Service

NRPA - Natural Resources Protection Act

REC - Record of Environmental Consideration and Checklist

RTE - Rare, Threatened, and Endangered

RTLA - Range and Training Land Assessment

SMZ - Significant Natural Resource Management Zone

SyB - Sutton very stony loam, 0–8% slopes

TRI - Training Requirements Integration

TZ - Training Zones

USACE - U.S. Army Corps of Engineers

USDA - U.S. Department of Agriculture

USEPA - United States Environmental Protection Agency

USFS - United States Forest Service

USFWS - U.S. Fish and Wildlife Service

USGS - U.S. Geological Survey

VMZ - Valuable Natural Resource Management Zone

Wa - Walpole fine sandy loam

Appendix A

Tables

Table 1. Summary of Habitat Types at the Auburn Training Facility for the Integrated Natural Resources Management Plan.

Cover Type	Classification	Acres	Percent Cover
Oak-Pine Forest	Forested Upland	74.5	42
Open Sandplain/Old Field	Non-Forested Upland	65.7	37
Beech-Birch-Maple Forest	Forested Upland	15.4	9
Maple-Basswood-Ash Forest	Forested Wetland	15.0	9
Mixed Graminoid-Shrub Marsh	Non-Forested Wetland	4.1	2
Powerline Right-of-Way	Non-Forested Upland	1.6	1
Total		**176.3**	**100**

Source: MEARNG.

Table 2. Summary of Soil Types at the Auburn Training Facility for the Integrated Natural Resources Management Plan.

Map Unit	Soil Series	Drainage Class	Acres	% of Total
AaB	Adams loamy sand 0–8% slopes	Somewhat excessively drained	64.1	36.4
NgB	Ninigret fine sandy loam 0–8% slopes	Moderately well drained	55.7	31.6
Wa	Walpole fine sandy loam	Poorly drained	30.1	17.0
HsD	Hollis very rocky fine sandy loam 15–45% slopes	Somewhat excessively drained	19.5	11.1
HsC	Hollis very rocky fine sandy loam 8–15% slopes	Somewhat excessively drained	5.1	2.9
SyB	Sutton very stony loam 0–8% slopes	Moderately well drained	1.8	1.0
Total			**176.4**	**100**

Source: NRCS 2016.

Table 3. Summary of Wetlands and Vernal Pools at the Auburn Training Facility for the Integrated Natural Resources Management Plan.

Wetland/Vernal Pool ID	Wetland Type	Acres
ATS-VP1	Significant Vernal Pool	0.05
ATS-VP2	Significant Vernal Pool	0.18
ATS-VP3	Vernal Pool	0.19
ATS-VP4	Significant Vernal Pool	0.27
ATS-VP5	Significant Vernal Pool	1.68
	Palustrine Forested Wetland (PFO)	7.96
	Palustrine Unconsolidated Bottom (PUB)	9.16
	Palustrine Scrub Shrub (PSS)	0.15
	Palustrine Emergent (PEM)/PFO/PSS	10.02
Vernal Pool Total		**3.24**
Wetland Total		**26.49**
Total		**29.73**

Source: MEARNG.

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.

Management Plan	Goal		Objective		Recommended Management Action	Implementation	Implementation date(s)
TRAINING AREA MANAGEMENT	Ensure sustained use of lands for military training and align land management priorities with training and readiness priorities.	1	Document and monitor training impacts on natural resources.	1	Define training area uses, and frequency and intensity of use.	Information has been collected. New information is added as need is identified.	Ongoing (2022–2027)
				2	Document existing natural resources, current impacts, and identify areas of heavy use.	Information has been collected. New information is added as acquired.	Ongoing (2022–2027)
				3	Incorporate pertinent data in the MEARNG GIS using GPS and digital aerial photography.	Information has been collected. New information is added as acquired.	Ongoing (2022–2027)
		2	Maintain Training Requirements Integration (TRI) program to ensure integration of training requirements and training land management.	1	Identify existing and projected training land resources and prioritized land use requirements.	Information has been collected.	Ongoing (2022–2027)
				2	Integrate training requirements with training land management into prioritized work plan, and execute requirements subject to availability of resources.	Project planning process has served to prioritize and fund projects.	Ongoing (2022–2027)
				3	Coordinate mission requirements and land maintenance activity with training land carrying capacity.	Cooperative partnering between MEARNG groups (environmental, facilities, and installation trainers) is having a positive impact on decision quality.	Ongoing (2022–2027)
				4	Generate prioritized requirements for land rehabilitation, repair, and/or reconfiguration.	Project planning process has served to prioritize and fund projects.	Ongoing (2022–2027)
		3	Maintain Land Rehabilitation and Management (LRAM) program to reduce long-term training impacts by using preventive and corrective land rehabilitation and maintenance procedures.	1	Identify and prioritize potential LRAM sites based on information acquired thorough ITAM Objectives 1 and 2.	Ongoing implementation. Restoration projects performed as needed based on inspection and training records. LRAM are prioritized through ITAM process and though on-site coordinators (TRI process).	Ongoing (2022–2027)
				2	Apply best management practices (BMPs) for design and execution of LRAM to ensure that the rehabilitation, repair, and maintenance results are commensurate with the applied resources.	Implemented and ongoing.	Ongoing (2022–2027)
				3	Identify SMZ's and ensure activity restrictions are adhered to.	Implemented and ongoing.	Ongoing (2022–2027)
				4	Coordinate long-term land maintenance plans with other real property management programs on the installation.	Project planning process has served to prioritize and fund projects.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.							
Management Plan	**Goal**		**Objective**		**Recommended Management Action**	**Implementation**	**Implementation date(s)**
TRAINING AREA MANAGEMENT (continued)	Ensure sustained use of lands for military training and align land management priorities with training and readiness priorities (continued).	4	Monitor training lands and rehabilitate when needed (i.e., implementation of ITAM program). Maintain the ITAM-EA program to educate users to ensure concurrent protection for both users and the training environment.	1	Inform MEARNG personnel that INRMP is approved and provide document access.	Notification dependant upon plan approval.	2022
				2	Create and distribute training maps illustrating environmentally sensitive and off-limits areas (SMZ's).	Information has been collected and combined in Management Zone Map.	Ongoing (2022–2027)
				3	Provide information on potential environmental dangers, such as Lyme disease and poisonous plants or animals that may occur at the installation and review prior to training activities.	Implemented and ongoing.	Ongoing (2022–2027)
		5	Provide quality natural resources as a critical training asset upon which to accomplish the military mission of the Facility. Improve the training conditions through natural resources management.	1	Document habitat conditions.	Conditions are documented in INRMP, and will be updated periodically as needed.	Update in 2023
				2	Document training needs and habitat conditions that may impede training efforts.	Implemented and updated periodically as needed.	Continually evaluated
				3	Identify opportunities for combined habitat management activities that also serve to improve training conditions.	Implemented and updated periodically as needed. Current strategies include a Forest Stewardship Management Plan to allow timber management through sustainable timber management practices, while improving line of sight and troop maneuverability within the forested training areas.	Plan completed, timber harvest in planning stages.
		6	Comply with local, state, Federal, and Army policies, laws, and regulations and manage natural resources within the spirit and letter of environmental laws.	1	Review of relevant Army documents.	Implemented and ongoing.	Ongoing (2022–2027)
				2	Review of relevant Local and State documents.	Implemented and ongoing.	Ongoing (2022–2027)
				3	Review of relevant Federal documents.	Implemented and ongoing.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.

Management Plan	Goal		Objective		Recommended Management Action	Implementation	Implementation date(s)
NATURAL RESOURCES MANAGEMENT	Manage and maintain diverse natural terrestrial habitats to promote native flora and fauna, ensure long-term training uses of these habitats, and provide recreational opportunities.	1	Maintain and protect upland forest habitats to maintain natural diversity and to ensure the long-term training use of upland habitats.	1	Identify SMZ's and ensure activity restrictions are adhered to.	Implemented and updated periodically as needed. Monitoring conducted as part of annual erosion surveys.	Annually (2022–2027)
				2	Conduct bivouacking operation in approved sites. Minimize off-road vehicle use to avoid damaging trees and understory species and to avoid soil compaction. Use portable toilets, remove garbage and debris, and avoid spills of gasoline, diesel fuel, and other vehicle-related lubricants.	Successfully implemented with training and SOPs.	Ongoing (2022–2027)
				3	Minimize vegetative disturbance in upland forests except within FMS #1 and areas targeted for timber management.	Successfully implemented with training and SOPs, and through practices outlined in the Forest Stewardship Management Plan.	Ongoing (2022–2027)
				4	Minimize use of heavy equipment and vehicles during wet weather, confine vehicle use to designated roads and trails to the extent possible, and park vehicles and equipment in old fields and existing openings when practicable to protect trees.	Implemented and ongoing.	Ongoing (2022–2027)
				5	Continue to provide limited public access to designated existing roads and restrict off-road vehicle usage in upland forest, wetlands, vernal pools and streams.	Implemented and ongoing. Additional measures may be implemented in the future to address unauthorized use of the Site by ATV and snowmobile users.	Ongoing (2022–2027)
				6	Suppress fires in upland forests from training activities, and take reasonable precautions when using pyrotechnics and other training devices to prevent forest fires. Use ammunition and other explosive and pyrotechnic devices in designated areas. Facility staff will contact the USFS to determine if weather conditions and the dangers of forest fires will limit or restrict training activities.	Successfully implemented through training and SOPs.	Ongoing (2022–2027)
				7	Concentrate any new developments around the existing road infrastructure and other suitable areas to avoid further habitat fragmentation and forest loss.	Continuing implementation.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.

Management Plan	Goal		Objective		Recommended Management Action	Implementation	Implementation date(s)
NATURAL RESOURCES MANAGEMENT (continued)	Manage and maintain diverse natural terrestrial habitats to promote native flora and fauna, ensure long-term training uses of these habitats, and provide recreational opportunities (continued).	2	Monitor upland habitats and mitigate for adverse affects to these habitats that threaten natural diversity and the long-term training use of these habitats.	1	Implement terrestrial habitat restoration measures as necessary. These measures include: seeding, reseeding, and mulching areas disturbed by training; installation of silt fences before training (if possible) and after training; reshaping eroded gullies giving the drainageway a broad flat or slightly concave bottom.	Implementation as needed. No specific areas have been identified at this time.	Completed after each training event as necessary.
				2	Maintain existing unimproved sand roadways, road-shoulders, and road-ditches, to minimize indirect affects to adjacent terrestrial communities. Provide v-shaped side ditches along roads. Routinely inspect roadways, road-ditches, intermittent drainageways, and permanent stream banks to document signs of erosion.	No new improvements are proposed. Surveys of road conditions will be completed as part of annual erosion surveys. Improvement activities will be conducted as needed.	Annually (2022–2027)
				3	Conduct brush removal as needed along existing roadways in the fall to control woody succession along the road shoulders and create small amount of herbaceous habitat, to add habitat diversity.	Continuing annual implementation.	Annually (2022–2027)
				4	Conduct surveys to document existing natural communities and evaluate potential impacts to communities.	Vegetation/terrestrial habitat surveys completed in 2002. No additional surveys are proposed; however surveys to update vegetation descriptions and GIS database may be performed as needed.	Update 2023
	Manage and maintain year-round wildlife habitat to ensure the long-term sustainability of populations of resident species and provide seasonal habitats for migratory species, ensure the long-term training uses of habitat.	1	Maintain, protect, and enhance wildlife habitat to promote regional biodiversity, provide a sustained yield for harvestable species, and ensure the long-term training use of the habitats wildlife are dependant upon.	1	Identify SMZ's and ensure activity restrictions are adhered to.	SMZ's have been identified. Continuing implementation to enforce, and assess during training activities and annual Site erosion surveys.	Annually (2022–2027)
				2	Utilize best management practices for timber harvesting in accordance with the Forest Stewardship Management Plan to maintain and enhance forested habitats and to promote use by forest-dwelling plant and animal species.	Continuing implementation in accordance with 2013 Forest Stewardship Management Plan.	Ongoing (2022–2027)
		2	Monitor wildlife populations and mitigate for adverse affects to wildlife species and their associated habitats and that threaten the long-term training use of these areas.	1	Conduct baseline surveys as needed to document wildlife communities.	Baseline surveys have been conducted for some species as described in the Auburn INRMP. No new surveys for non-listed species are proposed for the 2022–2027 period.	Update 2023
				2	Conduct monitoring as needed to evaluate potential affects to existing wildlife communities.	No species-specific surveys are proposed for 2022–2027 period. General observations for potential impacts are conducted during annual erosion surveys.	Annually (2022–2027)
		3	Provide for consumptive and non-consumptive uses of wildlife in accordance with Federal and state laws and regulations.	1	Continue to allow hunting on the Facility for persons having appropriate licenses.	Continuing implementation.	Annually (2022–2027)
				2	Continue to allow access to the Facility for authorized non-consumptive uses for such activities as hiking, biking, birdwatching and wildlife viewing.	Continuing implementation.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.

Management Plan	Goal		Objective		Recommended Management Action	Implementation	Implementation date(s)
NATURAL RESOURCES MANAGEMENT (Threatened and Endangered Species and Habitats)	Maintain and enhance existing habitats to support known populations of rare, threatened, and endangered species in compliance with the Endangered Species Act (ESA) and applicable state laws and regulations.	1	Maintain and protect rare species habitat to promote regional biodiversity, protect listed species, and ensure long-term training use of habitats used by rare species if applicable.	1	Identify SMZ's and ensure activity restrictions are adhered to.	SMZ's have been identified. Continuing implementation to enforce, and assess during training activities and annual Site erosion surveys.	Annually (2022–2027)
				2	Restrict timber management practices to areas located outside SMZ's to promote protection of rare plant species and wetlands known to occur on the Facility.	Continuing implementation in accordance with 2013 Forest Stewardship Management Plan.	Annually (2022–2027)
				3	Actively protect significant habitats and features by restricting access to these designated areas.	The general location of the special-status plant species and mapped wetlands are depicted on the management zone map, and will be updated as new information becomes available.	Ongoing annually
		2	Monitor rare species and critical habitats to insure compliance with State and Federal laws and regulations.	1	Conduct baseline surveys as needed to document rare species and habitats.	Baseline surveys have been conducted for species and habitats as described in the Auburn INRMP.	Update 2026
				2	Conduct monitoring as needed to evaluate potential affects to rare species and habitats.	Annual surveys for the small whorled pogonia are conducted in accordance with the Endangered Species Management Plan prepared for the Facility. General observations for potential impacts are conducted during annual erosion surveys. Continuing implementation to educate users of the Facility of SMZ's and to enforce SMZ restrictions.	Annually (2022–2027)
				3	Use GIS to monitor and assess species populations and their habitats.	Ongoing implementation. GIS and database updates are conducted as new information becomes available.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.							
Management Plan	**Goal**		**Objective**		**Recommended Management Action**	**Implementation**	**Implementation date(s)**
NATURAL RESOURCES MANAGEMENT (continued)	Manage and maintain diverse natural aquatic communities to protect associated watersheds and to promote native flora and fauna in compliance with laws and regulations.	1	Maintain and protect wetlands and surface waters to promote regional biodiversity, protect water quality and aquatic species, and ensure long-term training use.	1	Identify SMZ's and ensure activity restrictions are adhered to.	SMZ's have been identified. Continuing implementation to enforce.	Ongoing (2022–2027)
				2	Continue to restrict or prohibit vehicle traffic in streams, wetlands, and vernal pools.	Ongoing implementation. Training activities reviewed on a case-by-case basis by MEARNG personnel.	Ongoing (2022–2027)
				3	Actively protect streams, wetlands, and vernal pools by restricting access and restricting mowing/brush-hogging within 25 feet of the ordinary high water mark.	Ongoing implementation as needed. If the unauthorized use of ATVs on the Facility is determined to be negatively impacting Site wetlands, barriers and other measures may be put in place to restrict access to wetlands and waterbodies on the Facility.	Ongoing (2022–2027)
		2	Monitor wetland and aquatic habitats and mitigate for adverse affects to these habitats that threaten natural diversity and the long-term training use of the Facility.	1	Conduct surveys to document existing wetland and aquatic communities.	Wetland and aquatic habitat surveys were completed in 2002, 2009 and 2015 are presented in the Auburn INRMP. No additional wetland surveys are proposed for the 2022–2027 period. However, communities will be assessed and descriptions may be revised if needed, based on observations made during the annual erosion surveys.	Annually (2022–2027)
				2	Conduct monitoring as needed to evaluate potential affects to wetland and aquatic habitats.	Significant vernal pools will be monitored each year. General observations for potential impacts are conducted during annual erosion surveys. Continuing implementation to educate users of the Facility of SMZ's and to enforce SMZ restrictions.	Annually (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.							
Management Plan	**Goal**		**Objective**		**Recommended Management Action**	**Implementation**	**Implementation date(s)**
NATURAL RESOURCES MANAGEMENT (continued)	Minimize pesticide use in controlling pest and invasive species. Suppress or prevent pests from exceeding acceptable populations or damage thresholds with judicious use of mechanical, physical, cultural, and chemical control.	1	Maintain and protect native wildlife and vegetation communities to promote regional biodiversity, protect native species and ecosystems, and ensure long-term training use.	1	Prohibit use of invasive plants for landscaping or other purposes. Implement BMPs to minimize land disturbances that promote invasion, and re-vegetate disturbed areas with native species. Keep avoidance as the preferred control measure.	Ongoing implementation.	Ongoing (2022–2027)
				2	Monitor Site once per 5 year period for presence of invasive species.	Invasive species have been documented on Site during the flora and fauna surveys conducted in 2002. Known locations of invasive species will be revisited once during the INRMP period to determine their status and if removal is necessary.	Update 2026
		2	Monitor the Site for invasive species and mitigate for adverse affects from these species that threaten natural diversity and the long-term training use of the Facility.	1	Conduct surveys to document existing invasive species/communities.	Site has been surveyed for invasive species during the 2002, 2013, 2014, and 2021 flora and fauna and Small-whorled pogonia surveys.	Update 2026
				2	Conduct monitoring as needed to evaluate potential affects to wetland and aquatic habitats.	No species-specific monitoring is proposed for the 2022 - 2027 period. General observations for potential impacts are conducted during annual erosion surveys. Continuing implementation to educate users of the Facility of SMZ's and to enforce SMZ restrictions.	Annually (2022–2027)
		3	Train MEARNG personnel to recognize and avoid disease vectors and poisonous plants while participating in training activities.	1	Train personnel and troops to minimize tick exposure by wearing appropriate clothing, applying tick repellent, performing personal hygiene inspections daily, and avoiding tick habitat. Coordinate tick-borne disease awareness training.	Ongoing implementation.	Ongoing (2022–2027)

Table 4. Summary of Tasks Associated with Implementation of the Auburn Training Facility Integrated Natural Resources Management Plan.

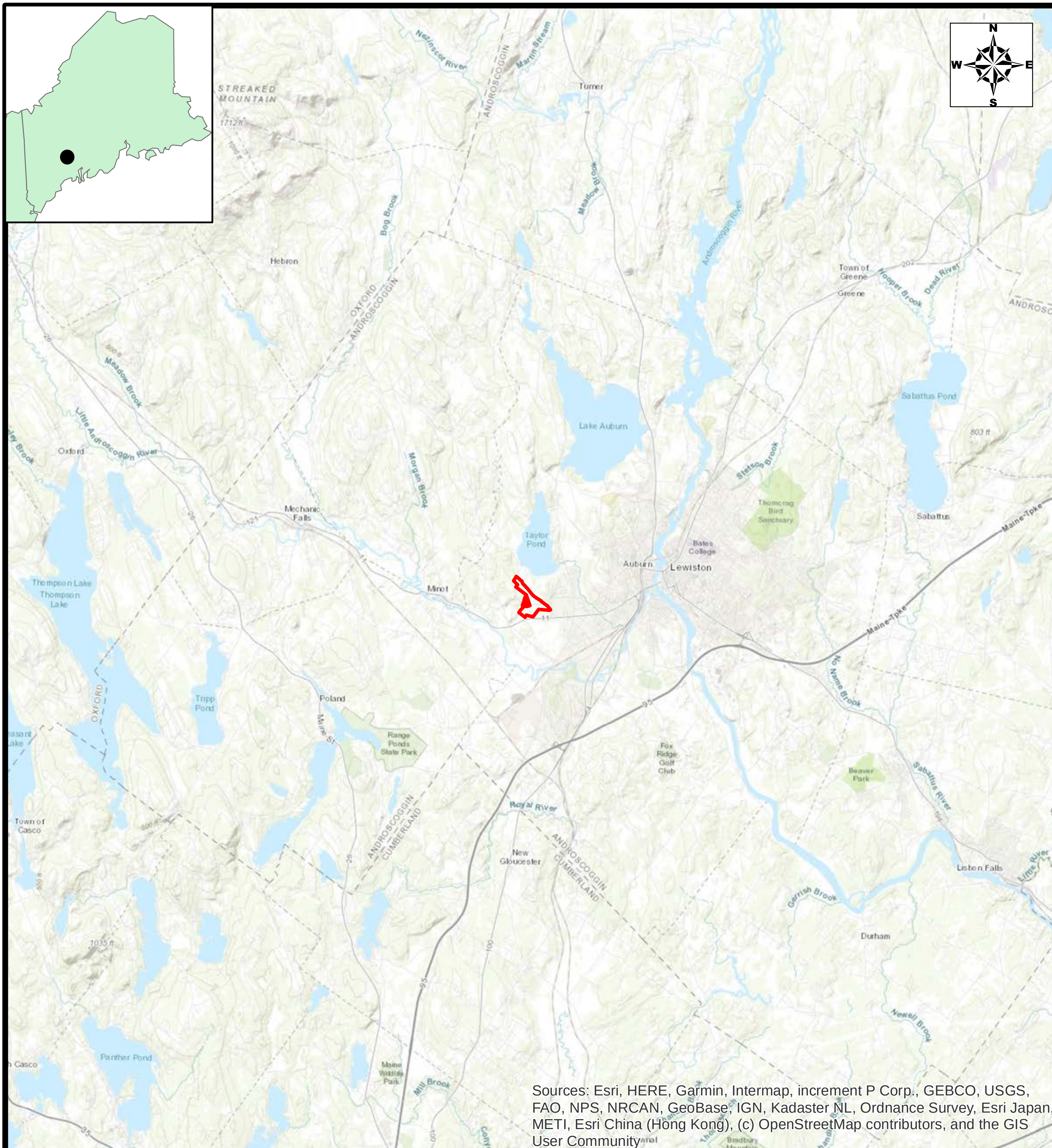
Management Plan	Goal		Objective		Recommended Management Action	Implementation	Implementation date(s)
CULTURAL RESOURCES MANAGEMENT	Maintain integrity of known locations of features of cultural significance in compliance with state laws and regulations.	1	Maintain and protect integrity of known locations of cultural resources and ensure the long-term training use of the Facility.	1	Identify SMZ's and ensure restrictions are adhered to.	SMZ's have been identified; however these are not applicable to any of the known cultural resources located on the Facility. If any new potential cultural resources are discovered the Cultural Resource program manager will be contacted to determine the appropriate action.	Ongoing (2022–2027)
		2	Monitor the Site for cultural resources and mitigate for adverse affects to cultural resources and threaten the long-term use of the Facility for training purposes.	1	Conduct surveys to document existing locations of cultural resources of significance.	Surveys for cultural resources have been conducted as presented in the Auburn INRMP and the ICRMP prepared for MEARNG facilities. No additional surveys are proposed.	Completed
				2	Conduct monitoring as needed to evaluate potential affects to known locations of cultural resources of significance.	No monitoring is proposed for the 2022 - 2027 period. General observations for potential impacts are conducted during annual erosion surveys. Continuing implementation to educate users of the Facility of SMZ's and to enforce SMZ restrictions. Existing SMZ's do not include restrictions for cultural resources.	Annually (2022–2027)
TRAINING SITE RESOURCE INFORMATION MANAGEMENT	Manage training site data to facilitate decision-making that integrates military training requirements with natural resources information.	1	Maintain natural resources information and GIS data to facilitate resource protection, protect resident and migratory species, identify rare ecosystems, and ensure the long-term use of the area for training purposes.	1	Use GIS to manage spatially referenced data related to the physical infrastructure and natural features of the installation. Use GIS as a tool for managing natural resources. Attach data to the mapped features and store in a database within the program.	Ongoing implementation. GIS database has been created, and will be updated as needed following annual erosion surveys.	Annually (2022-2027)
				2	Train GIS Analyst and other Environmental Management Office staff members through NGB-sponsored classes, specialized training and in-house training.	Ongoing implementation.	Ongoing (2022–2027)
		2	Disseminate natural resources information to the Auburn community, military personnel, and to other interested parties to educate users about natural resources at the Facility.	1	Facilitate access to current resource information, including GIS maps, to groups using the Facility for training or other activities that may potentially affect the resources found there.	Ongoing implementation. Site manager briefings cover these topics. Provide maps of area showing locations of SMZ's.	Ongoing (2022–2027)
				2	Provide complete and reliable sources of data for each natural resource topic discussed in the INRMP to facilitate sound management, training, planning, and construction.	Ongoing implementation. Databases are revised within 30 days of receipt of updates or new information from surveys.	Ongoing (2022–2027)
				3	Promote data sharing with partnering agencies, such as the USFS, and other MEARNG offices and installations.	Ongoing implementation.	Ongoing (2022–2027)
				4	Conduct resource awareness training for Site personnel and training units. Brief advance parties on wetland locations; rare, threatened and endangered species locations; cultural resources; restricted areas; pest management; information on dangerous or toxic plants and animals; and other information that helps reduce the risk of negative impacts to resources on the Site and dangers to personnel.	Ongoing implementation. Site manager briefings cover these topics. Provide maps of area showing locations of SMZ's.	Ongoing (2022–2027)

Implementation status pre- 2022

- Fully Implemented (green)
- Implemented but not complete or needs additional effort (yellow)
- Not Implemented (red)

Appendix B

Figures



Property Boundary

Figure 1. Location of Auburn Training Site

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

0 0.75 1.5 3 4.5 6

Miles

Source: ESRI

Author: Timothy Bickford

Filename: Auburn INRMP Figure 1 2022.mxd

Date: 2 Dec 2021

Legend

- Property Boundary
- Fence
- Landing Zone
- Building

Roads

- Asphalt
- Gravel
- Trail

0 55 110 220 330 440

Meters

Figure 2. Site Details

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

Source: MEARNG

Author: Timothy Bickford

Filename: Auburn INRMP Figure 2 2022.mxd

Date: 2 Dec 2021

Property Boundary

Stand Type

- Beech-Birch-Maple Forest
- Maple-Baswood-Ash Forest
- Mixed Graminoid-Shrub Marsh
- Oak-Pine Forest
- Power Line ROW
- Sand Plain/Old Field

Figure 3. Location of Forest Types

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

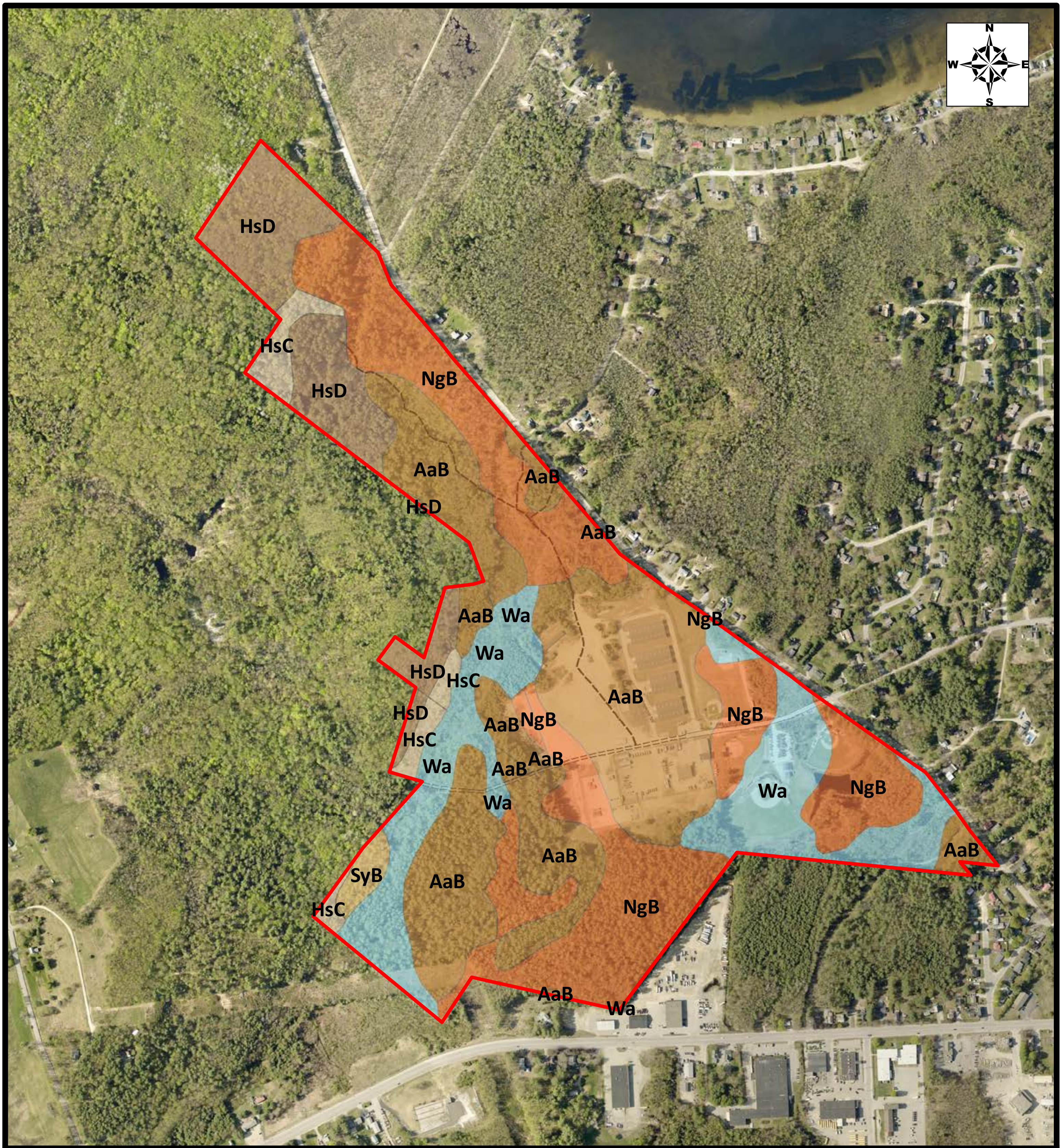
0 55 110 220 330 440

Meters

Source: MEARNG
Author: Timothy Bickford

Filename: Auburn INRMP Figure 3 2022.mxd

Date: 3 Dec 2021



Legend

Property Boundary

Soils

- Adams loamy sand, 0 to 8% slopes
- Lyman-Abram complex, 8 to 15% slopes, very rocky
- Lyman-Abram complex, 15 to 35% slopes, very rocky
- Ninigret fine sandy loam, 0 to 8% slopes
- Sutton very stony loam, 0 to 8% slopes
- Walpole fine sandy loam

Roads

- Asphalt
- Gravel
- Trail

Figure 4. Location of NRCS Soils Series

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

0 55 110 220 330 440

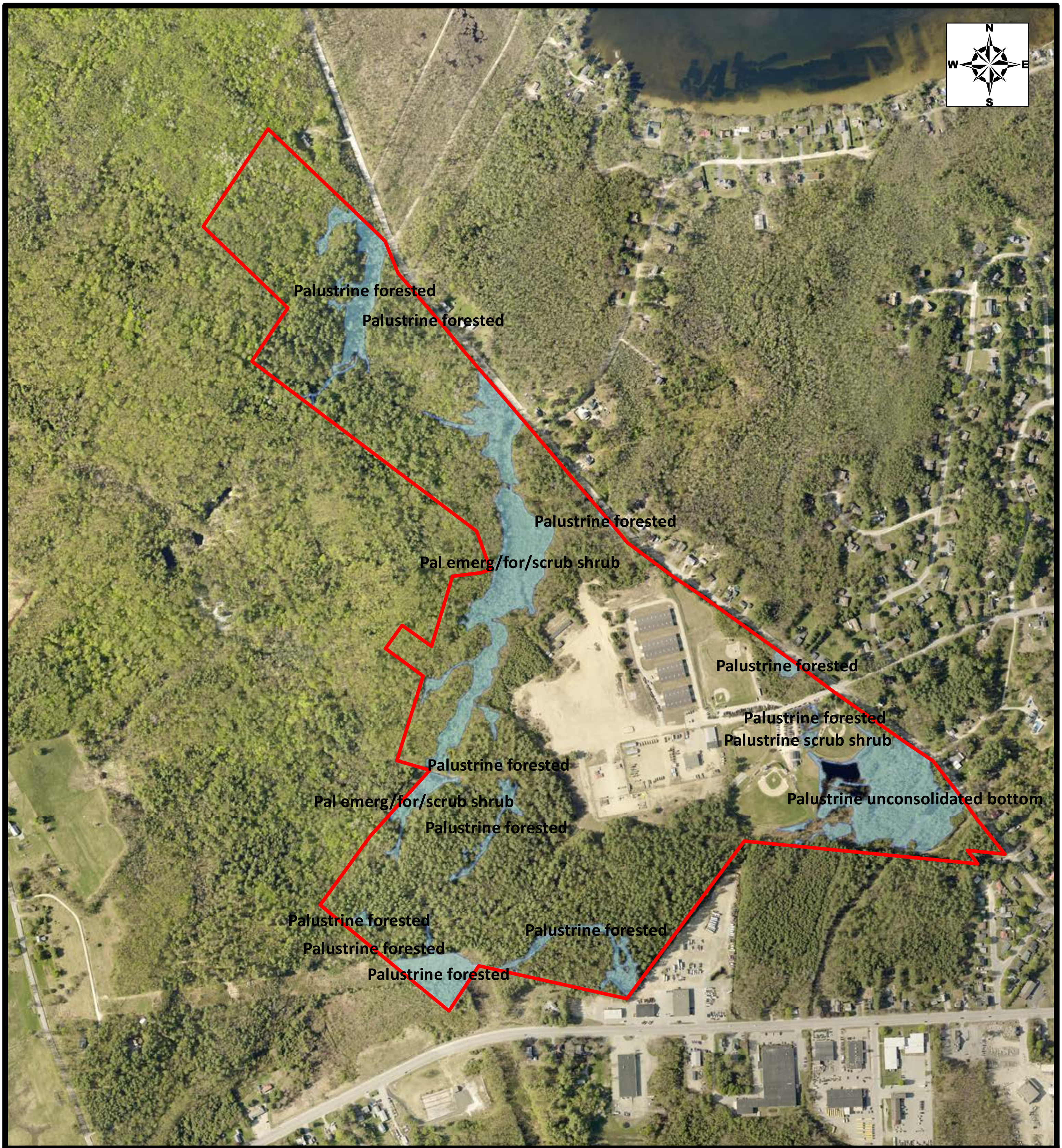
Meters

Source: NRCS

Author: Timothy Bickford

Filename: Auburn INRMP Figure 4 2022.mxd

Date: 3 Dec 2021



Property Boundary

Wetlands

Figure 5. Location and Type of Wetlands

Project Name:

Integrated Natural Resource Management Plan

0 55 110 220 330 440

Meters

Project Location:

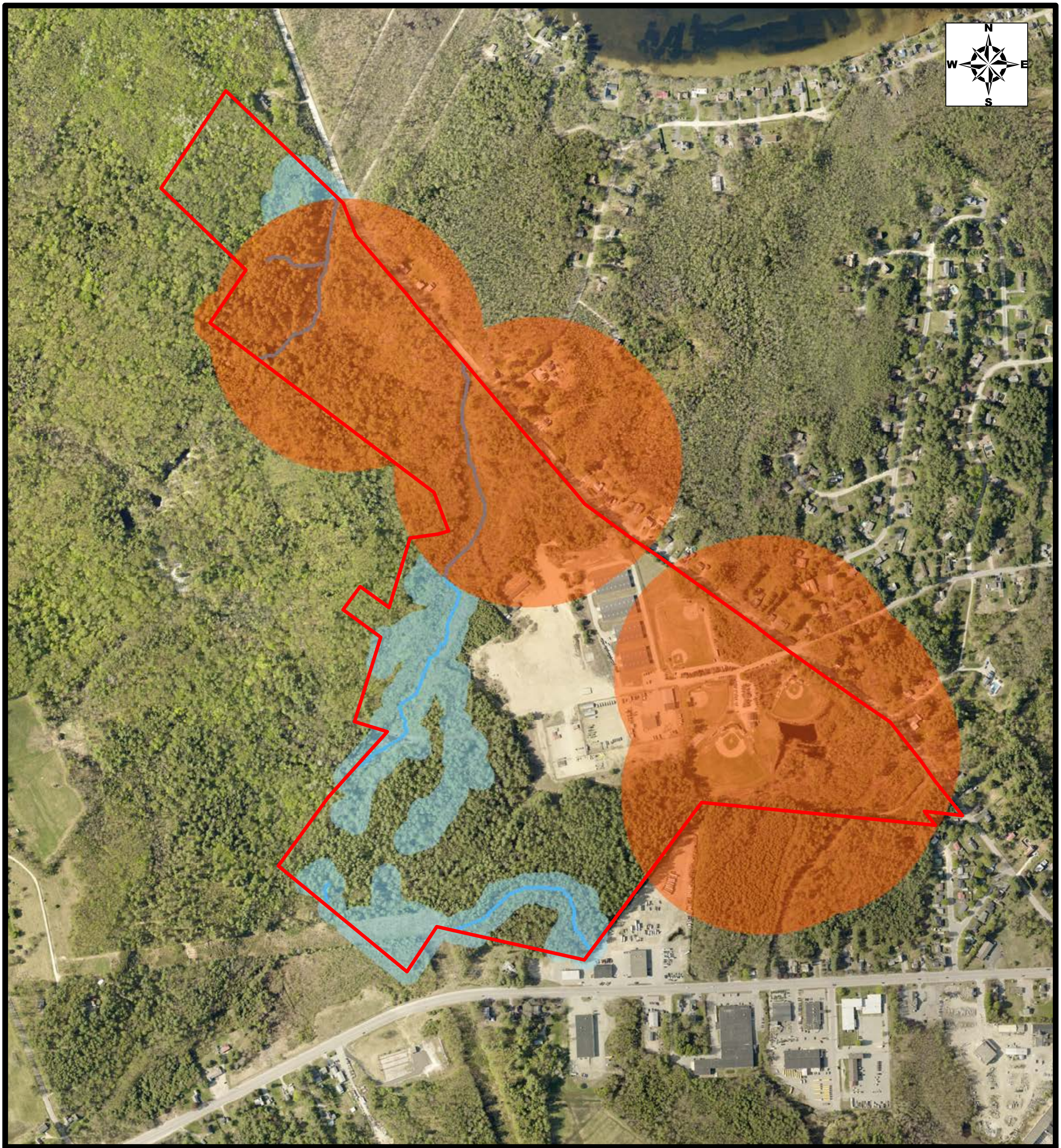
Auburn, Maine

Source: MEARNG

Author: Timothy Bickford

Filename: Auburn INRMP Figure 5 2022.mxd

Date: 3 Dec 2021



Legend

- Property Boundary
- Valuable Natural Resource Management Zone
- Significant Natural Resource Management Zone
- Streams

0 55 110 220 330 440

Meters

Figure 6. Location of Management Zones

Project Name:

Integrated Natural Resource Management Plan

Project Location:

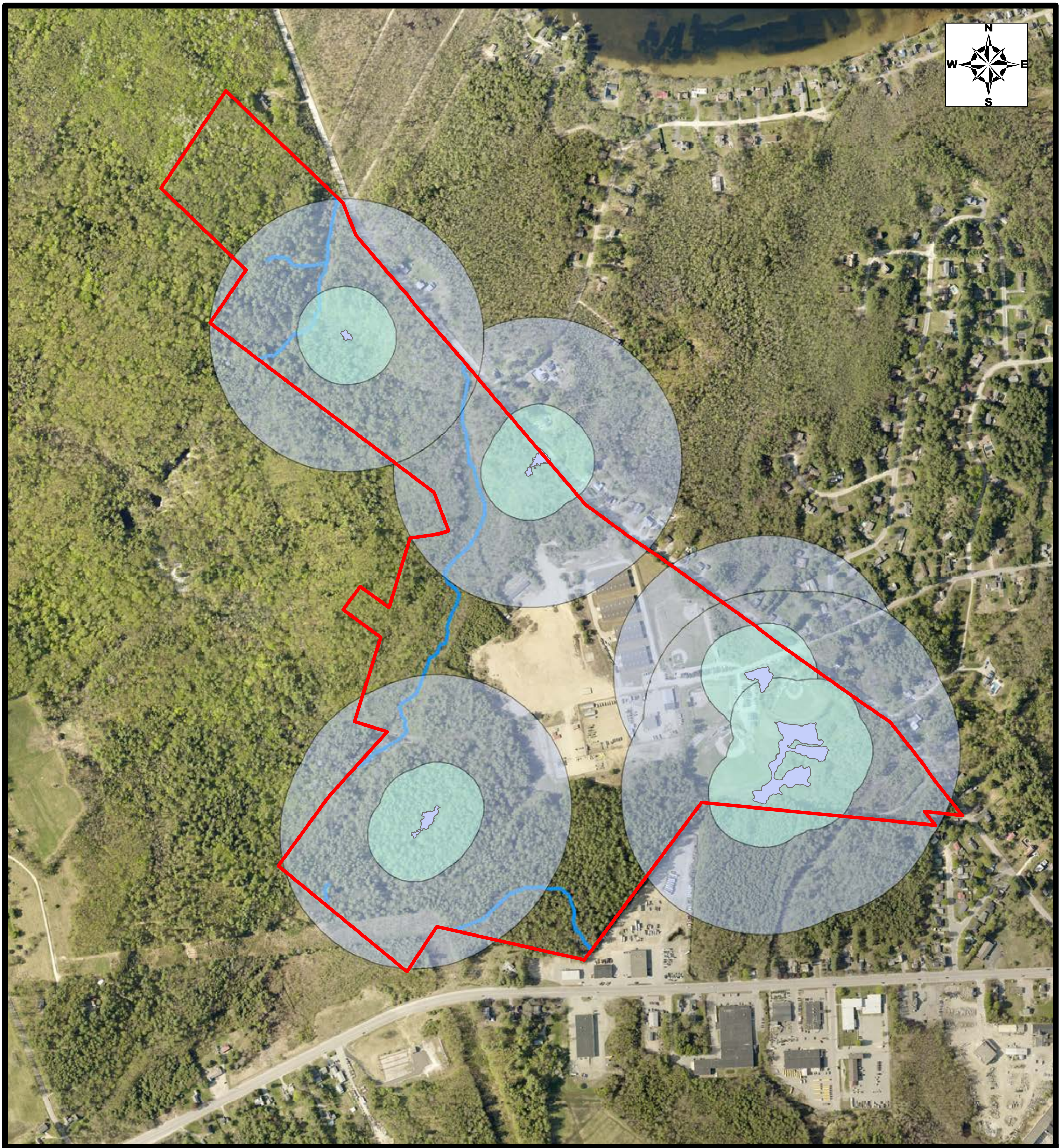
Auburn, Maine

Source: MEARNG

Author: Timothy Bickford

Filename: Auburn INRMP Figure 6 2022.mxd

Date: 6 Dec 2021



Property Boundary
Vernal Pools
Vernal Pool 250' Buffer
Vernal Pool 750' Buffer
Streams

Figure 7. Location of Vernal Pools

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

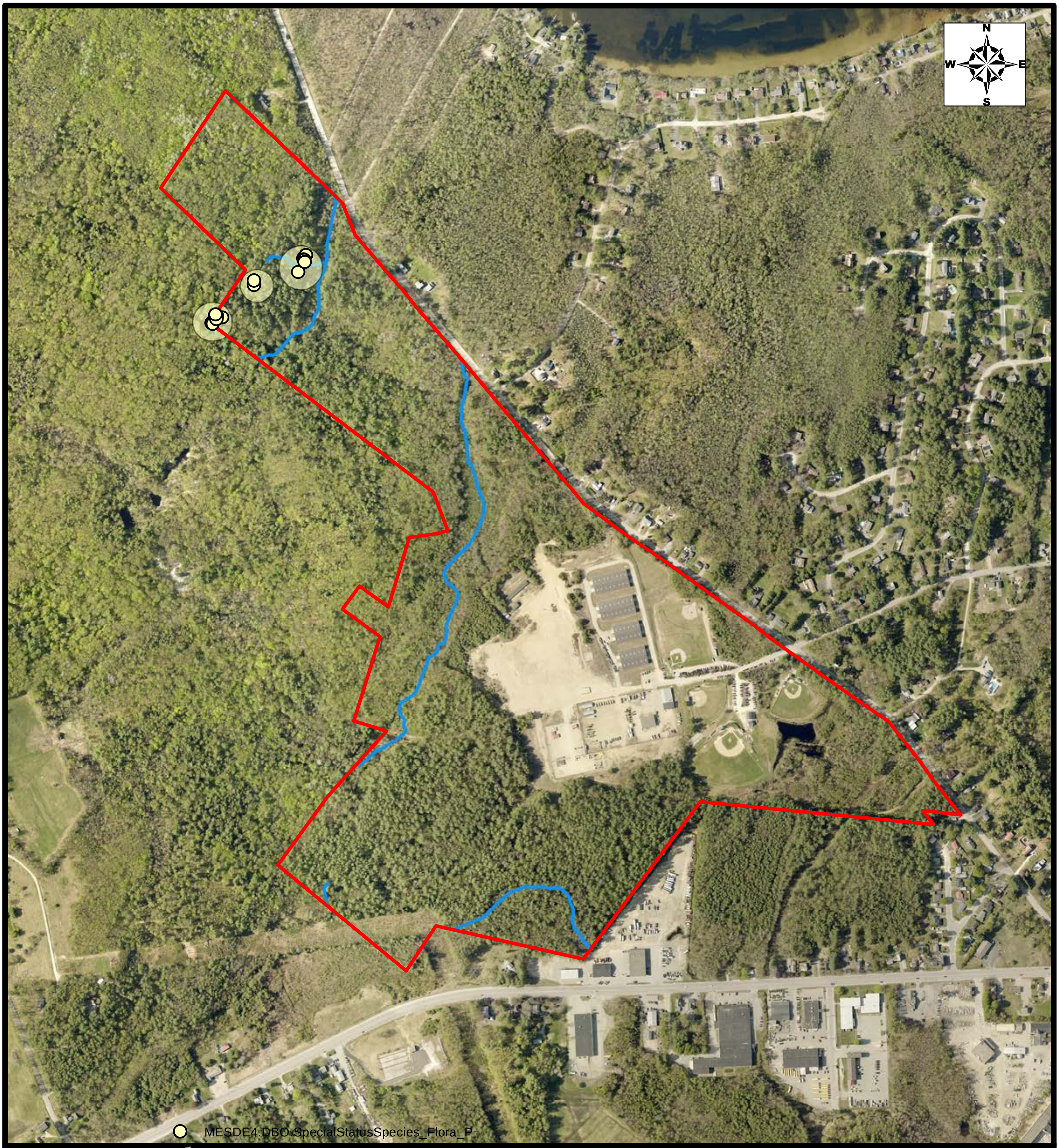
0 55 110 220 330 440

Meters

Source: MEARNG
Author: Timothy Bickford

Filename: Auburn INRMP Figure 7 2022.mxd

Date: 6 Dec 2021



MESDE4.DBO.SpecialStatusSpecies_Flora_P
MESDE4.DBO.EcologyCommunity_A
Property Boundary
Isotria
Streams

0 55 110 220 330 440
Meters

Figure 8. Location of Isotria

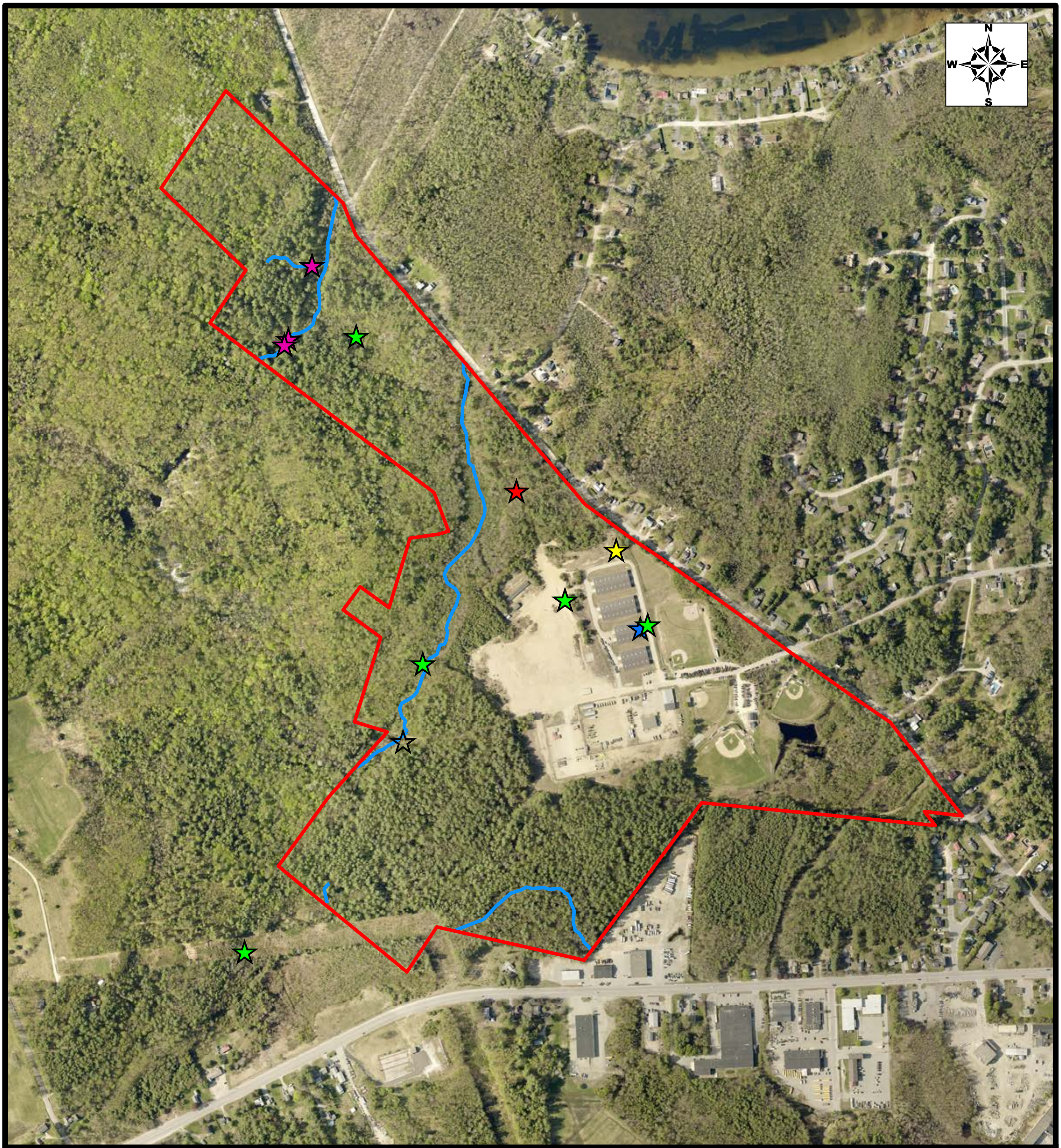
Project Name:
Integrated Natural Resource Management Plan

Project Location:
Auburn, Maine

Source: MEARNG
Author: Timothy Bickford

Filename: Auburn INRMP Figure 8 2022.mxd

Date: 6 Dec 2021



Property Boundary
Streams
Black locust
Cypress spurge
Japanese barberry
Morrow's honeysuckle
Multiflora rose
Reed canarygrass

Figure 9. Location of Invasive Species

Project Name:

Integrated Natural Resource Management Plan

Project Location:

Auburn, Maine

0 55 110 220 330 440

Meters

Source: MEARNG
Author: Timothy Bickford

Filename: Auburn INRMP Figure 9 2022.mxd

Date: 6 Dec 2021

Appendix C

Agency Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Maine Ecological Services Field Office
P. O. Box A
East Orland, ME 04431
Phone: (207) 469-7300 Fax: (207) 902-1588

In Reply Refer To: July 22, 2022
Project Code: 2022-0066486
Project Name: Auburn INRMP RFOE 2022

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Maine Ecological Services Field Office
P. O. Box A
East Orland, ME 04431
(207) 469-7300

Project Summary

Project Code: 2022-0066486
Event Code: None
Project Name: Auburn INRMP RFOE 2022
Project Type: Management Plans Land Management/Restoration
Project Description: Auburn INRMP 5 year review.
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@44.087722,-70.28221229592864,14z

Counties: Androscoggin County, Maine

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Fishes

NAME	STATUS
Atlantic Salmon *Salmo salar* Population: Gulf of Maine DPS There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2097	Endangered

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Small Whorled Pogonia *Isotria medeoloides* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1890	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPaC User Contact Information

Agency: Army National Guard
Name: Timothy Bickford
Address: 194 Winthrop St
City: Augusta
State: ME
Zip: 04330
Email timothy.a.bickford2.nfg@army.mil
Phone: 2074305923

MEMORANDUM

Maine Natural Areas Program

Department of Agriculture, Conservation and Forestry
State House Station #177, Augusta, Maine 04333

Date: December 1, 2021

To: Timothy Bickford, MEARNG

From: Don Cameron, Ecologist

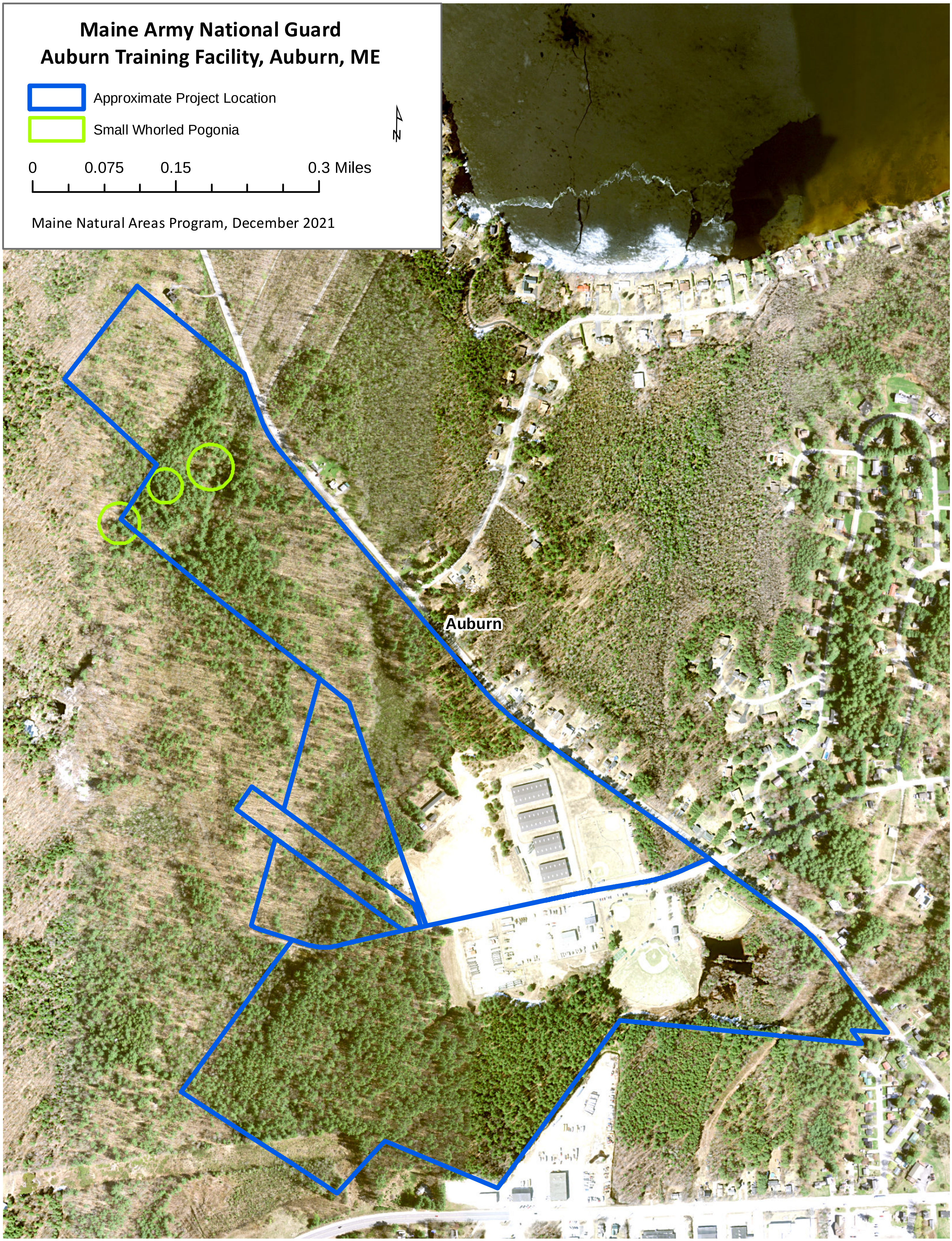
Re: Rare and exemplary botanical features, MEARNG Auburn Training Site, Integrated Natural Resource Management Plan (INRMP), Maine.

I have searched the Maine Natural Areas Program's Biological and Conservation Data System files for rare or unique botanical features in the vicinity of the proposed site in response to your request received November 16, 2021 for our agency's comments on the project.

According to our current information, the only feature we have mapped for at the MEARNG Auburn Training Site is the occurrence of Small Whorled Pogonia (*Isotria medeoloides*). This feature remains as previously mapped with three localized patches along an ephemeral drainage on an east facing slope – see attached map and shapefile.

The Maine Natural Areas Program is continuously working to achieve a more comprehensive database of exemplary natural features in Maine. We welcome the contribution of any information collected if a site survey is performed.

Thank you for using the Maine Natural Areas Program in the environmental review process. Please do not hesitate to contact our office if you have further questions about the Natural Areas Program or about rare or unique botanical features at this site.



Maine Army National Guard
Auburn Training Facility, Auburn, ME
Approximate Project Location
Small Whorled Pogonia
0
0.075
0.15
0.3 Miles
N
Maine Natural Areas Program, December 2021
Auburn

Maine Natural Areas Program

Isotria medeoloides (Pursh) Raf.

Small Whorled Pogonia

- State Rank: S2
- Global Rank: G2
- State Status: Endangered

Habitat: Mid-succession mixed forests. [Hardwood to mixed forest (forest, upland)]

Range: New England south to Georgia, west to Illinois, Missouri, and Michigan.

Aids to Identification: A member of the Orchid family, this low herb has elliptical leaves, 3-8 cm long, arranged in in whorls of five. There is one (occasionally two) greenish-yellow flower, about 2 cm long, on a short flowering stalk. The similar *Isotria verticillata* is distinguished by its longer flowering stalk (greater than 1 cm), taller stem (20-30 cm), and longer sepals (3-5 cm). It is vegetatively similar to the common Indian cucumber-root (*Medeola virginiana*), but can be distinguished by its pale, fleshy stem, unlike the firm, wiry stem of the common species.

Ecological characteristics: Small whorled pogonia typically occurs in mid-successional mixed woods with sparse shrub and herb layers and thick leaf litter. It often occurs near intermittent streamlets or where a hardpan impedes water percolation into the soil. Associated understory plants include Indian cucumber-root (*Medeola virginiana*), New York fern (*Thelypteris novaboracensis*), partridgeberry (*Mitchella repens*), and rattlesnake plantain (*Goodyera pubescens*).

Phenology: Flowers in June.

Family: Orchidaceae

Synonyms: *Arethusa medeoloides* Pursh; *Pogonia affinis* Austin *ex* Gray.

Known Distribution in Maine: This rare plant has been documented from a total of 19 town(s) in the following county(ies): Androscoggin, Cumberland, Kennebec, Oxford, York.

Reason(s) for rarity: Unknown; rare throughout its range. This is an extremely rare orchid, often called the rarest orchid in eastern North America.

Conservation considerations: Orchids attract some speciality

gardeners, and populations are vulnerable to unscrupulous or uneducated collectors. Plants usually do not survive transplanting, and removing them harms the natural population and may cause its eventual disappearance. This orchid has not been successfully propagated, and any plants offered for sale have been dug from the wild. Populations are vulnerable to conversion of their habitat to residential or commercial use, which is partly responsible for the species' rarity. Partial removal of the canopy may be beneficial, as long as subsequent undergrowth does not overgrow the plants.

For more information on *Isotria medeoloides*, see the MNAP Rare Plant Publications page for the following:

The Small Whorled Pogonia: A Recovering Endangered Species (Printer Friendly Version-pdf-1.6 MB)

Credits

Information

Maine.gov

Site Policies

Accessibility

Comments/Questions

Jobs @ DACF

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Donations & More

Contact

Department of Agriculture, Conservation and Forestry
22 State House Station
18 Elkins Lane
Augusta, ME 04333
More Locations

Phone: (207) 287-3200
Fax: (207) 287-2400
TTY: Maine Relay 711
DACF@Maine.gov

Conservation Status Ranks

State and Global Ranks: This ranking system facilitates a quick assessment of a species' or habitat type's rarity and is the primary tool used to develop conservation, protection, and restoration priorities for individual species and natural habitat types. Each species or habitat is assigned both a state (S) and global (G) rank on a scale of 1 to 5. Factors such as range extent, the number of occurrences, intensity of threats, etc., contribute to the assignment of state and global ranks. The definitions for state and global ranks are comparable but applied at different geographic scales; something that is state imperiled may be globally secure.

The information supporting these ranks is developed and maintained by the Maine Natural Areas Program (state ranks) and NatureServe (global ranks).

Rank	Definition
S1 **G1**	**Critically Imperiled** – At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
S2 **G2**	**Imperiled** – At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3 **G3**	**Vulnerable** – At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4 **G4**	**Apparently Secure** – At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
S5 **G5**	**Secure** – At very low risk or extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
SX **GX**	**Presumed Extinct** – Not located despite intensive searches and virtually no likelihood of rediscovery.
SH **GH**	**Possibly Extinct** – Known from only historical occurrences but still some hope of rediscovery.
S#S# **G#G#**	**Range Rank** – A numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the species or ecosystem.
SU **GU**	**Unrankable** – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
GNR **SNR**	**Unranked** – Global or subnational conservation status not yet assessed.
SNA **GNA**	**Not Applicable** – A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities (e.g., non-native species or ecosystems.
Qualifier	**Definition**
S#? **G#?**	**Inexact Numeric Rank** – Denotes inexact numeric rank.
Q	**Questionable taxonomy that may reduce conservation priority** – Distinctiveness of this entity as a taxon or ecosystem type at the current level is questionable. The "Q" modifier is only used at a global level.
T#	**Infraspecific Taxon (trinomial)** – The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.

State Status: Endangered and Threatened are legal status designations authorized by statute. Please refer to MRSA Title 12, §544 and §544-B.

Status	Definition
E	**Endangered** – Any native plant species in danger of extinction throughout all or a significant portion of its range within the State or Federally listed as Endangered.
T	**Threatened** – Any native plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range in the State or Federally listed as Threatened.
SC	**Special Concern** – A native plant species that is rare in the State, but not rare enough to be considered Threatened or Endangered.
PE	**Potentially Extirpated** – A native plant species that has not been documented in the State in over 20 years, or loss of the last known occurrence.

Element Occurrence (EO) Ranks: Quality assessments that designate viability of a population or integrity of habitat. These ranks are based on size, condition, and landscape context. Range ranks (e.g., AB, BC) and uncertainty ranks (e.g., B?) are allowed. The Maine Natural Areas Program tracks all occurrences of rare plants and natural communities/ecosystems (S1-S3) as well as exemplary common natural community types (S4-S5 with EO ranks A/B).

Rank	Definition
A	**Excellent** – Excellent estimated viability/ecological integrity.
B	**Good** – Good estimated viability/ecological integrity.
C	**Fair** – Fair estimated viability/ecological integrity.
D	**Poor** – Poor estimated viability/ecological integrity.
E	**Extant** – Verified extant, but viability/ecological integrity not assessed.
H	**Historical** – Lack of field information within past 20 years verifying continued existence of the occurrence, but not enough to document extirpation.
X	**Extirpated** – Documented loss of population/destruction of habitat.
U	**Unrankable** – Occurrence unable to be ranked due to lack of sufficient information (e.g., possible mistaken identification).
NR	**Not Ranked** – An occurrence rank has not been assigned.

Visit the Maine Natural Areas Program website for more information
http://www.maine.gov/dacf/mnap

Appendix D

Lists of Plants and Wildlife

Table 1. Flora Species List for Auburn Training Facility

Scientific Name	Common Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species
Abies balsamea	Balsam fir	1		
Acer negundo	Boxelder	1		
Acer pensylvanicum	Striped maple	1		
Acer rubrum	Red maple	1		
Acer saccharum	Sugar maple	1		
Acer spicatum	Mountain maple	1		
Achillea millefolium	Yarrow	1		
Actaea pachypoda	White baneberry	1		
Actaea rubra	Red baneberry	1		
Agrostis capillaris	Colonial bentgrass	1		
Agrostis gigantea	Redtop	1		
Agrostis hyemalis	Winter bentgrass	1		
Agrostis perennans	Ticklegrass	1		
Agrostis scabra	Rough bentgrass	1		
Agrostis stolonifera	Creeping bentgrass	1		
Alnus incana	Speckled alder	1		
Ambrosia artemesiifolia	Common ragweed	1		
Ambrosia psilostachya	Cuman ragweed	1		
Amelanchier spp.	Serviceberry	1		
Amphicarapaea bracteata	American hogpeanut	1		
Anemone americana	Blunt-lobed hepatica	1		
Anthoxanthum odoratum	Sweet vernalgrass	1		
Aquilegia canadensis	Red columbine	1		
Apios americana	Common groundnut	1		
Apocynum androsaemifolium	Spreading dogbane	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Aralia hispida	Bristly sarsaparilla	1		
Aralia nudicaulis	Wild sarsaparilla	1		
Aramanthus retroflexus	Redroot aramanth	1		
Arisaema triphyllum	Jack-in-the-pulpit	1		
Aronia melanocarpa	Black chokeberry	1		
Artemisia vulgaris	Common wormwood	1	1	
Asclepias syriaca	Common milkweed	1		
Athyrium angustum	Lady fern	1		
Atrichum undulatum	Undulate atrichum moss	1		
Berberis thunbergii	Japanese barberry	1	1	
Betula alleghaniensis	Yellow birch	1		
Betula papyrifera	White birch	1		
Betula populifolia	Grey birch	1		
Bidens frondosa	Devil's beggar-ticks	1		
Botrychium matricariifolium	Daisy-leaved moonwort	1		
Botrychium simplex	Little grapefern	1		
Brachyelytrum aristosum	Northern long-awned woodgrass	1		
Brachyelytrum septentrionale	Northern shorthusk	1		
Bulbostylis capillaris	Tufted hair-sedge	1		
Calamagrostis canadensis	Bluejoint	1		
Calla palustris	Water arum	1		
Calystegia sepium	Hedge false bindweed	1		
Cardamine pensylvanica	Pennsylvania bittercress	1		
Carex arctata	Drooping woodland sedge	1		
Carex atlantica ssp.capillacea	Prickly bog sedge	1		
Carex brunnescens	Brownish sedge	1		
Carex canescens	Hoary sedge	1		
Carex communis	Fibrousroot sedge	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Carex comosa	Longhair sedge	1		
Carex crinita	Drooping sedge	1		
Carex cumulata	Clustered sedge	1		
Carex debilis	White-edged sedge	1		
Carex echinata	Prickly sedge	1		
Carex folliculata	Northern long sedge	1		
Carex gracillima	Graceful sedge	1		
Carex gynandra	Nodding sedge	1		
Carex intumescens	Bladder sedge	1		
Carex lacustris	Lakeside sedge	1		
Carex leptalea	Bristlystalked sedge	1		
Carex lucorum	Blue ridge sedge	1		
Carex lupulina	Hop sedge	1		
Carex lurida	Sallow sedge	1		
Carex merritt-fernaldii	Fernald's sedge	1		
Carex novae-angliae	New England sedge	1		
Carex pallescens	Pale sedge	1		
Carex pedunculata	Longstalksedge	1		
Carex prasina	Drooping sedge	1		
Carex scabrata	Eastern rough sedge	1		
Carex scoparia	Pointed broom sedge	1		
Carex stipata	Awl-fruited sedge	1		
Carex stricta	Tussock sedge	1		
Carex swanii	Swan's sedge	1		
Carex tonsa	Shaved sedge	1		
Carex vesicaria	Blister sedge	1		
Carex vulpinoidea	Fox sedge	1		
Celastrus orbiculata	Asiatic bittersweet	1	1	

Table 1. Flora Species List for Auburn Training Facility (cont)

Cerastium arvense	Field chickweed	1		
Chamaedaphne calyculata	Leatherleaf	1		
Chamaepericlymenum canadense	Bunchberry	1		
Chamaesyce polygonifolia	Seaside sandmat	1		
Chamerion angustifolium	Narrow-leaved fireweed	1		
Chimaphila umbellata	Pipsissewa	1		
Chrysosplenium americanum	Golden saxifrage	1		
Cicuta bulbifera	Bulbet-bearing water hemlock	1		
Cinna latifolia	Slender wood-reed	1		
Circaea alpina	Dwarf enchanter's nightshade	1		
Circaea canadensis	Larger enchanter's nightshade	1		
Circaea lutetiana	Broadleaf enchanter's nighshade	1		
Cladina rangiferina	Graygreen reindeer lichen	1		
Clematis virginiana	Virgin's bower	1		
Clintonia borealis	Bluebead lily	1		
Coleataenia longifolia	Long-leaved redtop panicgrass	1		
Comptonia peregrina	Sweetfern	1		
Conyza canadensis	Canadian horseweed	1		
Coptis trifolia	Goldthread	1		
Corallorhiza maculata	Spotted coralroot	1		
Cornus canadensis	Bunchberry dogwood	1		
Cornus sericea	Redosier dogwood	1		
Corylus cornuta	Beaked hazel	1		
Crataegus sp.	Hawthorn	1		
Cyperus dentatus	Toothed flatsedge	1		
Cyperus esculentus	Nut flatsedge	1		
Cyperus lupulinus	Great Plains flatsedge	1		
Cypripedium acaule	Pink ladyslipper	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Dactylis glomerata	Orchardgrass	1		
Dalibarda sp.	Dalibarda	1		
Danthonia compressa	Flattened oatgrass	1		
Danthonia spicata	Poverty oatgrass	1		
Daucus carota	Queen Anne's lace	1		
Dendrolycopodium dendroideum	Prickly tree-clubmoss	1		
Dendrolycopodium hickeyii	Hickey's tree-clubmoss	1		
Dendrolycopodium obscurum	Flat-branched tree-clubmoss	1		
Dennstaedia punctilobula	Hay-scented fern	1		
Deschampsia flexuosa	Wavy hairgrass	1		
Desmodium glutinosum	Pointed ticktrefoil	1		
Dianthus armeria	Deptford pink	1		
Dichanthelium acuminatum	Hairy rosette panicgrass	1		
Dichanthelium clandestinum	Deer tongue rosette panicgrass	1		
Dichanthelium depauperatum	Starved rosette-panicgrass	1		
Dichanthelium linearifolium	Slimleaf panicgrass	1		
Dicranum spp.	Dicranum moss	1		
Diervilla lonicera	Bush honeysuckle	1		
Digitaria ischaemum	Smooth crabgrass	1		
Digitaria sanguinalis	Hairy crabgrass	1		
Diphasiastrum digitatum	Southern ground cedar	1		
Dirca palustris	Eastern leatherwood	1		
Doellingeria umbellata	Tall white aster	1		
Dryopteris camplyoptera	Mountain woodfern	1		
Dryopteris carthusiana	Spinulose woodfern	1		
Dryopteris cristata	Crested woodfern	1		
Dryopteris intermedia	Evergreen woodfern	1		
Dryopteris marginalis	Marginal woodfern	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Dulichium arundinaceaum	Three-way sedge	1		
Eleocharis acicularis	Needle spikesedge	1		
Eleocharis elliptica	Elliptic spikesedge	1		
Elymus repens	Quackgrass	1		
Epigaea repens	Trailing arbutus	1		
Epilobium palustre	Marsh willowherb	1		
Epipactis helleborine	Helleborine	1		
Equisetum arvense	Common horsetail	1		
Equisetum hyemale	Scouring rush	1		
Equisetum sylvaticum	Woodland horsetail	1		
Erigeron canadensis	Horseweed	1		
Erigeron strigosus	Daisy fleabane	1		
Euphorbia maculata	Spotted sandmat	1		
Eurybia macrophylla	Large-leaved aster	1		
Euthamia graminifolia	Flat-top goldenrod	1		
Fagus grandifolia	American beech	1		
Fallopia japonica	Japanese knotweed	1	1	
Festuca ovina	Sheep fescue	1		
Festuca filiformis	Fine-leaved sheep fescue	1		
Festuca rubra	Red fescue	1		
Festuca sp.	Fescue	1		
Fragaria virginiana	Wild strawberry	1		
Frangula alnus	Glossy buckthorn	1	1	
Fraxinus americana	White ash	1		
Fraxinus nigra	Black ash	1		
Fraxinus pennsylvanica	Green ash	1		
Galium aparine	Stickywilly	1		
Galium lanceolatum	Lance-leaved licorice bedstraw	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Galium mollugo	Whorled bedstraw	1		
Galium palustre	Marsh bedstraw	1		
Galium cf. triflorum	Fragrant bedstraw	1		
Gaultheria procumbens	Wintergreen	1		
Geum aleppicum	Yellow avens	1		
Glyceria canadensis	Rattlesnake mannagrass	1		
Glyceria grandis	American mannagrass	1		
Glyceria striata	Fowl mannagrass	1		
Gnaphalium uliginosum	Marsh cudweed	1		
Goodyera pubescens	Downy rattlesnake plantain	1		
Grass sp.	Grass	1		
Gymnocarpium dryopteris	Oak fern	1		
Hamamelis virginiana	Witch hazel	1		
Hepatica nobilis	Roundlobe hepatica	1		
Hieracium aurantiacum	Orange hawkweed	1		
Hieracium caespitosum	Yellow hawkweed	1		
Hieracium kalmii	Canada hawkweed	1		
Hieracium paniculatum	Panicled hawkweed	1		
Hieracium pilosella	Mouse-ear hawkweed	1		
Hieracium sp.	Hawkweed	1		
Houstonia caerulea	Azure bluet	1		
Huperzia lucidula	Shining clubmoss	1		
Hydrocotyle americana	American marsh-pennywort	1		
Hypercium canadense	Lesser Canadian St. Johnswort	1		
Hypericum gentianoides	Pineweed	1		
Hypericum mutilum	Dwarf St. Johnswort	1		
Hypericum perforatum	Common St. Johnswort	1		
Hypopitys monotropa	Pinesap	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Ilex mucronata	Mountain holly	1		
Ilex verticillata	Winterberry	1		
Impatiens capensis	Jewelweed	1		
Ionactis linariifolia	Stiff aster	1		
Iris versicolor	Harlequin blueflag	1		
Isotria medeoloides	Small-whorled pogonia	1		1
Juncus acuminatus	Sharp-fruited rush	1		
Junucs brevicaudatus	Short-tailed rush	1		
Juncus bufonius	Toad rush	1		
Juncus canadensis	Canada rush	1		
Juncus effusus	Common rush	1		
Juncus tenuis	Path rush	1		
Juniperus communis	Common juniper	1		
Kalmia angustifolia	Sheep laurel	1		
Lactuca canadensis	Wild lettuce	1		
Larix laricina	Tamarack	1		
Lechea intermedia	Largepod pineweed	1		
Leersia oryzoides	Rice cutgrass	1		
Lemna minor	Common duckweed	1		
Lepidium virginicum	Virginia pepperweed	1		
Lespedeza capitata	Round-headed bush clover	1		
Leucanthemum vulgare	Oxeye daisy	1		
Leucobryum glaucum	Leucobryum moss	1		
Lilium philadelphicum	Wood lily	1		
Lobelia inflata	Indian tobacco	1		
Lonicera canadensis	American honeysuckle	1		
Lonicera morrowi	Morrow's honeysuckle	1	1	
Lotus corniculatus	Bird's-foot trefoil	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Ludwigia palustris	Common water-primrose	1		
Luzula acuminata	Hairy woodrush	1		
Luzula multiflora	Common woodrush	1		
Luzula sp.	Woodrush sp.	1		
Lyonia ligustrina	Maleberry	1		
Lycopodium annotinum	Stiff clubmoss	1		
Lycopodium clavatum	Running clubmoss	1		
Lycopodium dendroideum	Tree groundpine	1		
Lycopodium digitatum	Fan clubmoss	1		
Lycopus uniflorus	Northern water-horehound	1		
Lycopus virginicus	Virginia water horehound	1		
Lysimachia borealis	Starflower	1		
Lysimachia quadrifolia	Whorled loosestrife	1		
Lysimachia terrestris	Swamp candles	1		
Lythrum salicaria	Purple loosestrife	1	1	
Maianthemum canadense	Canada mayflower	1		
Maianthemum racemosum	False solomon's seal	1		
Malus pumila	Apple	1		
Malus sylvestris	European crab apple	1		
Matricaria discoidea	Pineapple weed	1		
Matteuccia struthiopteris	Ostrich fern	1		
Medeola virginiana	Indian cucumber root	1		
Medicago lupulina	Black medick	1		
Melampyrum lineare	Cow wheat	1		
Melilotus albus	White sweet clover	1		
Melilotus officianalis	Yellow sweetclover	1		
Mitchella repens	Partridgeberry	1		
Mnium sp.	Mnium calcareous moss	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Monotropa uniflora	Indian pipe	1		
Muhlenbergia uniflora	Bog muhly	1		
Myrica gale	Sweetgale	1		
Nabalus altissimus	Tall white lettuce	1		
Nuttallanthus canadensis	Blue toadflax	1		
Oclemena acuminata	Whorled aster	1		
Oenothera biennis	Common evening primrose	1		
Onoclea sensibilis	Sensitive fern	1		
Orthilia secunda	One-sided shinleaf	1		
Oryzopsis asperifolia	Roughleaf ricegrass	1		
Osmunda claytoniana	Interrupted fern	1		
Osmunda regalis	Royal fern	1		
Osmundastrum cinnamomeum	Cinnamon fern	1		
Ostrya virginiana	Eastern hophornbeam	1		
Oxalis montana	Northern wood sorrel	1		
Oxalis stricta	Yellow wood sorrel	1		
Panicum capillare	Witch panicgrass	1		
Panicum sp.	Panicgrass	1		
Parathelypteris novaboriensis	New York fern	1		
Parthenocissus quinquefolia	Virginia creeper	1		
Parthenocissus vitacea	Woodbine	1		
Persicaria maculosa	Lady's thumb smartweed	1		
Persicaria sagittata	Arrow-leaved tearthumb	1		
Phalaris arundinacea	Reed canarygrass	1	1	
Phegopteris connectilis	Long beech fern	1		
Phleum pratense	Timothy	1		
Photina melanocarpa	Black chokeberry	1		
Picea rubens	Red spruce	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Pilea pumila	Canada clearweed	1		
Pinus resinosa	Red pine	1		
Pinus strobus	White pine	1		
Plantago aristata	Bracted plaintain	1		
Plantago lanceolata	English plantain	1		
Plantago major	Common plantain	1		
Plantago rugelii	Blackseed plantain	1		
Platanthera aquilonis	North wind bog orchid	1		
Platanthera lacera	Green fringed orchid	1		
Pleurozium schreberi	Schreber's big red stem moss	1		
Poa conpressa	Flat-stemmed bluegrass	1		
Poa nemoralis	Wood bluegrass	1	1	
Poa pratensis	Kentucky bluegrass	1		
Polygala paucifolia	Gaywings	1		
Polygonatum pubescens	Hairy solomon's seal	1		
Polygonella articulata	Coastal jointweed	1		
Polygonum amphibium L.var. stiplaceum	Longroot smartweed	1		
Polygonum arenastrum	Oval-leaf knotweed	1		
Polygonum articulatum	Coastal jointed knotweed	1		
Polygonum cilinodis	Fringed black bindweed	1		
Polygonum sp.	Knotweed	1		
Polypodium virginianum	Common polypody	1		
Polystichum acrostichoides	Christmas fern	1		
Polytrichum commune	Jensen's polytrichum moss	1		
Polytrichum piliferum	Polytrichum moss	1		
Polytrichum strictum	Polytrichum moss	1		
Populus grandidentata	Big-tooth aspen	1		
Populus tremuloides	Quaking aspen	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Potentilla argentea	Silver cinquefoil	1		
Potentilla norvegica	Rough cinquefoil	1		
Potentilla recta	Sulfur cinquefoil	1		
Potentilla simplex	Old field cinquefoil	1		
Prenanthes trifoliolata	Gall of the earth	1		
Prunella vulgaris	Heal-all	1		
Prunus pensylvanica	Pin cherry	1		
Prunus serotina	Black cherry	1		
Prunus virginiana	Chokecherry	1		
Pseudognaphalium macounii	Macoun's rabbit-tobacco	1		
Pteridium aquilinum	Bracken fern	1		
Pyrola americana	Shinleaf	1		
Pyrola elliptica	Waxflower shinleaf	1		
Quercus rubra	Red oak	1		
Ranunculus acris	Tall buttercup	1		
Ranunculus recurvatus	Hooked crowfoot	1		
Rhamnus alnifolia	Alder-leaved buckthorn	1		
Rhus hirta	Staghorn sumac	1		
Ribes glandulosum	Skunk currant	1		
Ribes lacustre	Spiny swamp currant	1		
Ribes sp.	Currant	1		
Robinia pseudoacacia	Black locust	1	1	
Rosa multiflora	Multiflora rose	1	1	
Rosa rugosa	Rugosa rose	1	1	
Rubus alleghaniensis	Common blackberry	1		
Rubus canadensis	Smooth blackberry	1		
Rubus dalibarda	Dewdrop	1		
Rubus flagellaris	Northern dewberry	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Rubus hispidus	Swamp dewberry	1		
Rubus ideaus	Red raspberry	1		
Rubus pubescens	Dwarf raspberry	1		
Rudbeckia hirta	Black-eyed susan	1		
Rumex acetosella	Field sorrel	1	1	
Rumex sp.	Dock	1		
Salix bebbiana	Bebb's willow	1		
Salix eriocephala	Heart-leaved willow	1		
Salix humilis	Prairie willow	1		
Salix lucida	Shining willow	1		
Salix sp.	Willow	1		
Sambucus nigra ssp. canadensis	American black elderberry	1		
Sambucus racemosa	Red-berried elder	1		
Schizachyrium scoparium	Little bluestem	1		
Schoenoplectus tabernaemontani	Soft-stemmed club bulrush	1		
Scirpus atrocinctus	Blackgirdle bulrush	1		
Scirpus atrovirens	Green bulrush	1		
Scirpus cyperinus	Common wool-sedge	1		
Scirpus hattorianus	Mosquito bulrush	1		
Scirpus pedicellatus	Stalked woolsedge	1		
Scorzoneroides autumnalis	Fall dandelion	1		
Scutellaria galericulata	Blue skullcap	1		
Scutellaria lateriflora	Mad dog skullcap	1		
Selaginella rupestris	Northern selaginella	1		
Setaria pumila	Yellow foxtail	1		
Setaria viridis	Green foxtail	1		
Silene latifolia	Bladder campion	1		
Sisyrinchium montanum	Strict blue-eyed grass	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Sium suave	Hemlock waterparsnip	1		
Smilax rotundifolia	Roundleaf greenbrier	1		
Solanum dulcamara	Climbing nightshade	1	1	
Solidago bicolor	Silverrod	1		
Solidago canadensis	Canada goldenrod	1		
Solidago flexicaulis	Zigzag goldenrod	1		
Solidago gigantea	Smooth goldenrod	1		
Solidago graminifolia	Grass-leaved goldenrod	1		
Solidago juncea	Early goldenrod	1		
Solidago macrophylla	Large-leaved goldenrod	1		
Solidago nemoralis	Gray goldenrod	1		
Solidago puberula	Downy goldenrod	1		
Solidago rugosa	Rough-stemmed goldenrod	1		
Solidago simplex v. randii	Rand's goldenrod	1		
Solidago sp.	Goldenrod	1		
Sorbus americana	American mountain ash	1		
Spergula arvensis	Corn spurry	1		
Spergularia rubra	Red sandspurry	1		
Sphagnum capilifolium v. capillifolium	Sphagnum	1		
Sphagnum girgensohnii	Girgensohn's sphagnum	1		
Sphagnum palustre	Prarie sphagnum	1		
Spinulum annotium	Common interrupted clubmoss	1		
Spirea alba	Meadowsweet	1		
Spirea tomentosa	Steeplebush	1		
Stellaria graminea	Grass-like starwort	1		
Stellaria media	Common stitchwort	1		
Streptopus amplexifolius	Clasping-leaved twisted stalk	1		
Streptopus lanceolatus	Lance-leaved twisted stalk	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Swida alterniflora	Alternate-leaved dogwood	1		
Swida sericea	Red osier dogwood	1		
Symphyotrichum cordifolium	Common blue wood aster	1		
Symphyotrichum lanceolatum	Lance-leaved American aster	1		
Symphyotrichum lateriflorum	Calico aster	1		
Symphyotrichum pilosum	Awl American-aster	1		
Symphyotrichum puniceum	Purplestem aster	1		
Symplocarpus foetidus	Skunk cabbage	1		
Syringa vulgaris	Lilac	1		
Tanacetum vulgare	Common tansy	1		
Taraxacum officinale	Common dandelion	1		
Taxus canadensis	Canada yew	1		
Thalictrum pubescens	Tall meadow rue	1		
Thelypteris noveboracensis	New York fern	1		
Thelypteris palustris	Marsh fern	1		
Thermopsis villosa	Blue ridge false lupine	1		
Thlaspi arvense	Field penny cress	1		
Thuidium delcatulum	Delicate thuidium moss	1		
Thuja occidentalis	Northern white cedar	1		
Tiarella cordifolia	Foamflower	1		
Tilia americana	American basswood	1		
Torreyochloa pallida	Pale flase mannagrass	1		
Toxicodendron radicans	Poison ivy	1		
Toxicodendron rydbergii	Western poison ivy	1		
Triadenum fraseri	Fraser's marsh-St. Johnswort	1		
Triadenum virginicum	Virgina St. Johnswort	1		
Trichostema dichotomum	Forked blue curls	1		
Trientalis borealis	Starflower	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Trifolium arvense	Rabbit-foot clover	1		
Trifolium dubium	Low hop clover	1		
Trifolium hybridum	Alsike clover	1		
Trifolium pratense	Red clover	1		
Trifolium repens	White clover	1		
Trillium erectum	Red trillium	1		
Trillium undulatum	Painted trillium	1		
Tsuga canadensis	Eastern hemlock	1		
Typha latifolia	Broad-leaved cattail	1		
Ulmus americana	American elm	1		
Uvularia sessifolia	Wild oats	1		
Vaccinium angustifolium	Early low blueberry	1		
Vaccinium corymbosum	Highbush blueberry	1		
Vaccinium macrocarpon	Large cranberry	1		
Vaccinium myrtilloides	Velvet-leaved blueberry	1		
Veratrum viride	American false hellebore	1		
Verbascum thapsus	Common mullein	1		
Verbena hastata	Blue vervain	1		
Veronica officinalis	Common speedwell	1		
Veronica serpyllifolia	Thyme-leaved speedwell	1		
Viburnum acerifolium	Maple-leaved viburnum	1		
Viburnum dentatum	Smooth arrowwood	1		
Viburnum lantanoides	Hobblebush	1		
Viburnum lentago	Nannyberry	1		
Viburnum nudum	Wild raisin	1		
Viburnum nudum v. cassinoides	White-rod	1		
Viburnum recognitum	Southern arrowwood	1		
Vicia cracca	Cow vetch	1		

Table 1. Flora Species List for Auburn Training Facility (cont)

Viola blanda	Sweet white violet	1		
Viola cucullata	Marsh blue violet	1		
Viola pubescens	Downy yellow violet	1		
Viola renifolia	Kidney-leaved violet	1		
Viola sororia	Common blue violet	1		
Viola sp.	Violet	1		
Virburnum nudum	Wild raisin	1		
	Total	**452**	**14**	**1**

Table 2. Fauna Species List for Auburn Training Facility

Invertebrates

Common Name	Scientific Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species	Species of Special Concern	SGCN
American dog tick	*Dermacentor variabilis*	1				
Clouded sulphur	*Colias philodice*	1				
Deer tick	*Ixodes scapularis*	1				
Field cricket	*Gryllus sp.*	1				
Great spangled fritillary	*Speyeria cybele*	1				
Periodic cicada	*Magicicada septendecim*	1				
Viceroy	*Limenitis archippus*	1				
	Summary	**7**	**0**	**0**	**0**	**0**

Reptiles

Common Name	Scientific Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species	Species of Special Concern	SGCN
Common garter snake	*Thamnophis sirtalis sirtalis*	1				
	Summary	**1**	**0**	**0**	**0**	**0**

Amphibians

Common Name	Scientific Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species	Species of Special Concern	SGCN
Eastern American toad	*Bufo americanus*	1				
Green frog	*Rana clamitans melanota*	1				
Gray tree frog	*Hyla versicolor*	1				
Northern red-backed salamander	*Plethodon cinereus*	1				
Spring peeper	*Pseudacris crucifer*	1				
Wood frog	*Rana sylvatica*	1				

Table 2. Fauna Species List for Auburn Training Facility (cont)

Yellow spotted salamander	*Ambystoma maculatum*	1				
	Summary	**7**	**0**	**0**	**0**	**0**

Birds

Common Name	Scientific Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species	Species of Special Concern	USFWS Birds of Conservation Concern	SGCN
Alder flycatcher	*Empidonax alnorum*	1					
American crow	*Corvus brachyrhynchos*	1					
American goldfinch	*Carduelis tristis*	1					
American redstart	*Setophaga ruticlla*	1			1		1
American robin	*Turdus migratorius*	1					
Baltimore oriole	*Icterus galbula*	1					1
Barred owl	*Strix varia*	1					
Black-and-white warbler	*Mniotilta varia*	1			1		1
Black-capped chickadee	*Parus atricapillus*	1					
Black-throated blue warbler	*Setophaga caerulescens*	1					1
Black-throated green warbler	*Setophaga virens*	1					1
Blue jay	*Cyanocitta cristata*	1					
Blue-headed vireo	*Vireo solitarius*	1					
Broad-winged hawk	*Buteo platypterus*	1					1
Brown creeper	*Certhia americana*	1					
Brown-headed cowbird	*Molothrus ater*	1					
Cedar waxwing	*Bombycilla cedrorum*	1					
Chipping sparrow	*Spizella passerina*	1					
Cliff swallow	*Petrochelidon pyrrhonota*	1					
Common Raven	*Corvus corax*	1					
Common yellowthroat	*Geothlypis trichas*	1					

Table 2. Fauna Species List for Auburn Training Facility (cont)

Eastern bluebird	*Sialia sialis*	1					
Eastern kingbird	*Tyrannus tyrannus*	1			1		1
Eastern phoebe	*Sayornis phoebe*	1					
Eastern wood pewee	*Contopus virens*	1			1		1
Gray catbird	*Dumetella carolinensis*	1					
Great crested flycatcher	*Mylarchus crinitus*	1					
Hairy woodpecker	*Picoides villosus*	1					
Hermit thrush	*Catharus guttatus*	1					
House finch	*Haemorhous mexicanus*	1					
Killdeer	*Charadrius vociferus*	1					
Louisiana waterthrush	*Parkesia motacilla*	1					1
Mourning dove	*Zenaida macroura*	1					
Northern cardinal	*Cardinalis cardinalis*	1					
Northern flicker	*Colaptes auratus*	1					1
Northern parula	*Setophaga americana*	1					1
Ovenbird	*Seiurus aurocapilla*	1					
Pine warbler	*Setophaga pinus*	1					
Prairie warbler	*Setophaga discolor*	1			1	1	1
Purple finch	*Haemorhous purpureus*	1					
Red-shouldered hawk	*Buteo lineatus*	1					
Red-breasted nuthatch	*Sitta canadensis*	1					
Red-eyed vireo	*Vireo olivaceus*	1					
Rose-breasted grosbeak	*Pheucticus ludovicianus*	1				1	1
Ruby-throated hummingbird	*Archilochus colubris*	1					
Ruffed grouse	*Bonasa umbellus*	1					
Scarlet tanager	*Piranga olivacea*	1					1
Song sparrow	*Melospiza melodia*	1					
Spotted sandpiper	*Actitis macularius*	1					

Table 2. Fauna Species List for Auburn Training Facility (cont)

Swamp sparrow	*Melospiza georgiana*	1					
Tree swallow	*Tachycineta bicolor*	1			1		1
Tufted titmouse	*Baeolophus bicolor*	1					
Turkey Vulture	*Cathartes aura*	1					
Veery	*Catharus fuscescens*	1			1	1	1
White-breasted nuthatch	*Sitta carolinensis*	1					
White-throated sparrow	*Zonotrichia albicollis*	1			1		1
Wild turkey	*Meleargris gallopavo*	1					
Winter wren	*Troglodytes hiemalis*	1					
Yellow warbler	*Setophaga petechia*	1			1	1	1
Yellow-bellied sapsucker	*Sphyrapicus varius*	1					
Yellow-rumped warbler	*Setophaga coronata*	1					
	Summary	**61**	**0**	**0**	**9**	**4**	**18**

Mammals

Common Name	Scientific Name	Total Species to Date	Invasive or Noxious Species	State or Federally-Listed Species	Species of Special Concern	SGCN
American red squirrel	*Tamiasciurus hudsonicus*	1				
Big brown bat	*Eptesiaus fuscus*	1				1
Domestic dog	*Canus lupus familiaris*	1				
Eastern chipmunk	*Tamias striatus*	1				
Eastern coyote	*Canis latrans*	1				
Eastern red bat	*Lasiurus borealis*	1			1	1
Hoary bat	*Lasiurus cinereus*	1			1	1
Mole/vole/shrew	*Order rodentia*	1				
Red fox	*Vulpes vulpes*	1				

Table 2. Fauna Species List for Auburn Training Facility (cont)

Sliver-haired bat	*Lasionycteris noctivagans*	1			1	1
Snowshoe hare	*Lepus americanus*	1				
Weasel family	*Family mustelidaes*	1				
White-tail deer	*Odocoileus virginianus*	1				
Woodchuck	*Marmota monax*	1				
	Summary	**14**	**0**	**0**	**3**	**4**

Appendix E

Threatened and Endangered Species Information

The revised recovery plan for the small whorled pogonia is available by contacting:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, MD 20814
Telephone: (301) 492-3421 or 1-800-582-3421

This brochure was written by Susan C. Gawler and Hank Tyler. We thank our several reviewers for helpful comments. Funding was provided by the U.S. Fish and Wildlife Service and the Maine Department of Economic and Community Development.

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DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
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the Small Whorled Pogonia

Susi von Oettingen

A Recovering Endangered Species

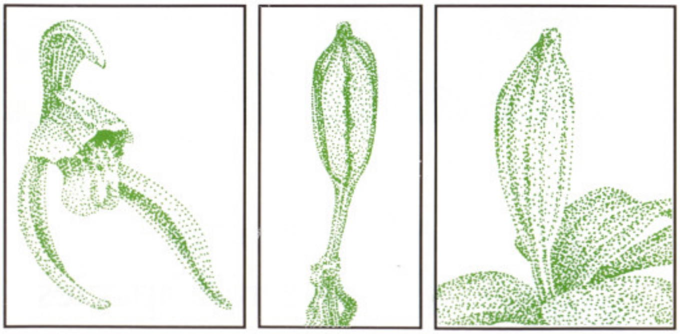
Introduction

The small whorled pogonia (*Isotria medeoloides*) is one of the rarest wild orchids in eastern North America and has been reclassified as federally threatened by the U.S. Fish and Wildlife Service. The largest populations of small whorled pogonia are found in central New Hampshire and southern Maine, although the species is widely distributed in the eastern United States and Ontario, Canada. Concerns about habitat loss led to the listing of this species as endangered in 1982. Since it was listed, botanists have located additional populations and sought to protect a number of sites. The success of finding more populations and protecting them led to the 1994 reclassification of this species.

However, being placed on the Federal Endangered Species List does not provide universal protection to the small whorled pogonia. Most population losses in the past occurred simply because landowners were unaware of the presence of small whorled pogonia on their property. Therefore, informed and concerned citizens continue to make a huge difference in the protection and recovery of this plant.

How to Recognize Small Whorled Pogonia

Careful inspection of a plant in the field can easily determine if it is the small whorled pogonia. Thus, collecting a specimen for identification is not necessary.



Diana Dee Tyler

The small whorled pogonia is a wildflower that reappears in the spring from a perennial underground rootstock. The stems usually occur singly (sometimes in groups of two or three), and are usually 3-6" (8-15 cm) tall. The elliptical leaves, usually numbering five, are 1-3" (2.5-8 cm) long and grow in a single whorl at the top of the stem. Flowering individuals have one (occasionally two) greenish-yellow flower, about 1" (2.5 cm) long, borne atop the whorl of leaves. The cylindrical fruit capsule which can develop after flowering is up to 1" (2.5 cm) long. It turns from green to brown as it dries. By late fall, it splits and releases thousands of dust-like seeds.

© June Henshaw

This rare orchid could be confused with similar forest plants such as the large whorled pogonia or the Indian cucumber-root. The large whorled pogonia *(Isotria verticillata)*, found occasionally from southern New England southward can grow in the same habitat as small whorled pogonia. The large whorled pogonia differs from the small whorled pogonia in several characteristics: its sepals are brownish, not green; and the flower is separated from the leaves by a longer stalk (more than 2 cm or 3/4" long).

Indian cucumber-root *(Medeola virginiana)* is a very common woodland plant with a strong resemblance to small whorled pogonia. Indian cucumber-root's leaves are deeper green than those of small whorled pogonia; the stem is thin and wiry, and has fine hairs, compared to that of small whorled pogonia which is thicker, pale green, and hairless. Small individuals of Indian cucumber-root have just one set of leaves, like small whorled pogonia, but reproducing individuals are easily distinguished by having two whorls of leaves.

Characteristic	Small Whorled Pogonia	Large Whorled Pogonia
stem color	usually grayish-green	purplish
leaf orientation*	pointed downward	pointed upward
leaf color	grayish-green	dark green
flower stalk	very short or absent	present
sepal length	less than 1 inch	1.25 to 2.5 inches
sepal color	grayish green	purplish
sepal position	arching over flower	widely spreading
fruit stalk length	equal to fruit	twice as long as fruit

**when plants begin flowering*

Habitat

The small whorled pogonia grows in a variety of wooded habitats. Most sites are mid-successional mixed woods with trees 40 to 75 years old and 8-18" in diameter. Maple and oak, beech, and white pine are common tree species. The shrub and herb layers where small whorled pogonia grows are usually sparse. Herbaceous plants often associated with small whorled pogonia in the northern part of its range include Indian cucumber-root *(Medeola virginiana)*, New York fern *(Thelypteris novaboracensis)*, partridge berry (*Mitchella repens*), and rattlesnake plantain *(Goodyera pubescens)*. Witch-hazel (*Hamamelis virginiana*) is a common shrub.

Most small whorled pogonia populations grow on gently sloping ground, often with thick leaf litter. Many sites are underlain by soils with a hardpan layer that impedes the downward flow of water and leads to the formation of shallow braided channels on the ground surface. Soils in which the small whorled pogonia grows are generally dry during most of the growing season.

Virtually all known small whorled pogonia sites in New England are on lands with signs of human use in the not-too-distant past. Many are in woods laced with old stone fences, indicating that they were once cleared. The forests often contain decaying stumps as well, evidence of timber harvest following regrowth of the forest. Several populations are in woods that have been selectively harvested in the last twenty-five years. Exactly how selective tree harvest affects this plant is still under study.

Most populations of small whorled pogonia contain fewer than twenty plants at any one time, though New Hampshire and Maine are home to several large populations with fifty to five hundred individuals. Virginia and North Carolina also have a few large populations.

Diana Dee Tyler

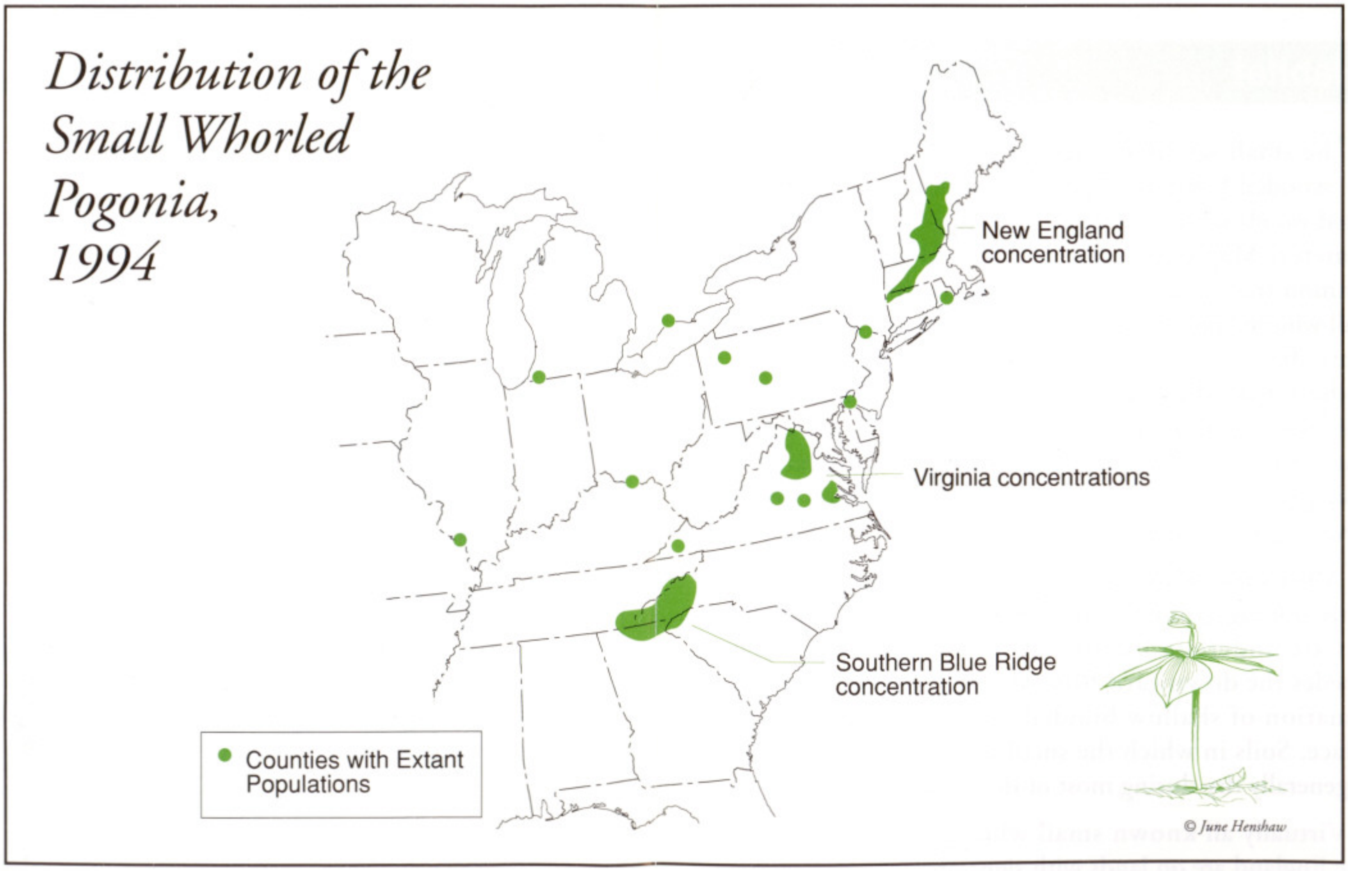
Conservation

During the last fifteen years federal and state governments, non-profit organizations and private citizens have worked hard to protect this species by conducting detailed biological studies, searching for new populations, and informing landowners. Several important populations are now protected through voluntary easement or acquisition. Most populations are on private land, and landowner awareness and involvement is critical. The primary impact continues to be the destruction of habitat by converting the forest to other uses. Numerous former small whorled pogonia sites are now housing developments, shopping centers, or golf courses. Digging up the plants is a very real threat as well. Small whorled pogonia plants need to be left in the wild; they do not survive long after being transplanted.

If You Find Small Whorled Pogonia

Private landowners with small whorled pogonia on their property can help by preventing people from picking or digging the orchid and by leaving the sites forested. Interested citizens can help by being alert for small whorled pogonia when walking through the woods, and by becoming involved in volunteer plant conservation activities.

If you find plants that appear to be the small whorled pogonia, carefully note their location and if possible photograph the plant. Please do not pick the plant! Notify your state's natural areas program or natural heritage program, or the nearest U.S. Fish and Wildlife Service office.



Appendix F

Wetland Report (2009) and Vernal Pool Report (2015)

TABLE OF CONTENTS

INTRODUCTION

Jones Associates, Inc. was contracted to provide wetland delineation services for the Maine Army National Guard, and other adjacent parcels located off Mount Apatite Road in Auburn, Maine The delineation area is approximately 140+/- acres comprised of Auburn Tax Map and Lots as follows: Portions of Map 216-Lots 1,2,3, and 4, and Map 215-Lot 004. The following report summarizes site conditions observed during site visits in April of 2008.

Wetland/upland boundaries were identified and delineated according to U.S. Army Corps of Engineers (ACOE) Wetlands Delineation Manual (Environmental Laboratory 1987). Wetlands were identified based on the presence of hydric soil (inundated or saturated soil conditions resulting from permanent or periodic inundation by ground water or surface water), hydrology (movement and distribution of water), and predominance of hydrophytic species (Hydrophytes: vegetation typically adapted for life in saturated soil conditions).

Wetland delineation consists of transecting the property, examining periodic soil samples, observing any evidence of hydrology and assessing each stratum of vegetation for its percentage of hydrophytic species. If all three factors were evident, the study plot was considered wetland habitat. Transitions between upland and wetland were clearly marked with blue sub-zero flagging every 30-40 feet, and labeled with alphanumeric codes to identify individual systems (A1, A2, A3….).

Wetland flags were located using Trimble Global Positioning System (GPS) technology with expected average accuracy of sub-meter. This method is recognized by both state and federal agencies. This being stated, Jones Associates, Inc. recommends that the wetland boundary be surveyed using a more precise method of location if any fill or regulated activities are to be performed within 20 feet of the GPS located wetland.

EXISTING CONDITIONS

The delineated area is adjacent to the U.S. Army Guard compound and Little League ball fields located off Mount Apatite Road and includes portions of 5 tax map parcels. The site extends from along Garfield Road (approximately 2900 feet of road frontage), southerly along the base of Mount Apatite to a power line right-of-way near Minot Avenue, then easterly along the back of the Morrison and Sylvester Inc. property.

All the site is wooded except developed areas adjacent to the Army Guard compound and ball fields. Terrain is relatively flat adjacent to the developed area, sloping south to wetland areas offsite and north and west to onsite wetland areas. The northerly portion of the site drains to two stream channels and associated wetlands that flow northerly to Garfield Road. The southerly portion of the site drains south to a stream channel which flows off the property near the Morrison and Sylvester Inc. property.

Wooded portions of the site are dominated by mature white pine (*Pinus strobus*) stands. Smaller sections contain a mixed-wood forest of tree species include eastern hemlock (*Tsuga canadensis*), red oak (*Quercus rubra*), paper birch (*betula papyrifera*), red maple (*Acer rubrum.*), and balsam fir (*Abies balsamea).* The upland understory contains bracken fern (*Pteridium aquilinum*), christmas fern (*Polystichum acrostichoides*), partridge berry (*Mitchella repens*), winter berry *(Ilex verticillata*) and various *lycopodium spp.*

SOILS

According to U.S. Department of Agriculture, Natural Resources Conservation Service, the soils series typed on the parcels include Ninigret, Walpole, Adams, Sutton and Hollis. The Hollis series is mapped along the slopes of Mount Apatite. Upland knolls are mapped for Adams. Lower areas including some wetlands are mapped as Ninigret and Walpole soils. One small unit the Sutton series was mapped in the southwesterly corner of the site. Characteristics of each series are described below according to: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture, Official Soil Series Descriptions[1].

The Ninigret series consists of very deep, moderately well drained soils formed in loamy sand over sandy and gravelly glacial outwash. They are nearly level to strongly sloping soils on glaciofluvial landforms, typically in slight depressions and broad drainage ways. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is moderately high or high in the solum and high or very high in the substratum.

The Walpole Series consists of very deep, poorly drained sandy soils formed in outwash and stratified drift. They are nearly level to gently sloping soils in low-lying positions on terraces and plains. Slope ranges from 0 to 8 percent. Permeability is moderately rapid in the surface layer and subsoil, and rapid or very rapid in the substratum.

The Adams series consists of very deep, excessively and somewhat excessively drained soils formed in glacial-fluvial or glacio-lacustrine sand. They are on outwash plains, deltas, lake plains, moraines, terraces, and eskers. Estimated saturated hydraulic conductivity is high or very high. Slope ranges from 0 to 70 percent.

The Sutton series consists of very deep, moderately well drained loamy soils formed in till. They are nearly level to strongly sloping soils on plains, low ridges, and hills, typically on lower slopes and in slight depressions. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is moderately high or high throughout.

The Hollis series consists of shallow, well drained and somewhat excessively drained soils formed in a thin mantle of till derived mainly from gneiss, schist, and granite. They are nearly level to very steep upland soils on bedrock-controlled hills and ridges. Slope ranges from 0 to 60 percent. Permeability is moderate or moderately rapid. Depth to hard bedrock ranges from 10 to 20 inches.

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[1] http://soils.usda.gov/technical/classification/osd/index.html

WETLAND CHARACTERISTICS

The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

--Corps of Engineers Wetlands Delineation Manual (U.S. Army Corps of Engineers 1987)

Onsite wetlands are associated with stream channels, drainage-ways, and isolated depressional areas. Three stream channels and associated wetlands make up the largest part of the onsite wetlands. The first channel is found in the northerly corner of the property. This channel begins off the property to the west near the base of Mount Apatite, continues northeasterly through the site, exiting through a culvert under Garfield Road. The second channel begins further south, also near the base of Mount Apatite, flowing northeasterly to Garfield Road through two culverts. The third channel begins near the southwesterly corner, flowing southeasterly off the site. In addition to the wetland associated with the stream channels, there are a number of isolated or semi-isolated wetlands.

Most of the delineated wetlands would be classified palustrine forested (PFO) wetlands. There are also areas of palustrine scrub-shrub (PSS), and palustrine emergent (PEM), mostly along the larger second stream channel described above. Forested wetlands are found throughout the site. Typically they are dominated by red maple (Acer rubrum), gray birch (Betula populifolia), balsam fir (Abies balsamea), and american elm (*Ulmus americana*) in the overstory. The understory contains shrubs such as speckled alder (*Alnus rugosa*), and winterberry (*Ilex verticillata*) and sensitive fern (*Onoclea sensibilis*) and cinnamon fern (*Osmunda cinnamomea*).

Scrub-shrub wetlands are dominated by shrubs such as speckled alder, winterberry, northern arrowwood (*Viburnum dentatum*), high-bush blueberry (*Vaccinium* *corymbosum*), male berry (Lyonia ligustrina), and meadowsweet (*Spirea latifolia*). Smaller components of this wetland contain forested and herbaceous species.

There are small areas that are dominated by emergent wetlands. These areas are found along the second stream channel in areas that contain standing water above the two old roads that the wetland crosses and along Garfield Road. Emergent vegetation common here includes cat-tail (*Typha latifolia*), reed-canary grass (*Phalaris arundinacea*), wool-grass (*Scirpus cyperinus*), and other grasses and sedges.

Maine's Department of Environmental Protection considers some types of wetlands to be of higher significance than others. These Wetlands of Special Significance (WSS) contain certain characteristics more fully described below and require greater setbacks. One Characteristic is areas of emergent vegetation greater than 20,000 square feet within a wetland. There are areas within the larger stream channel associated wetlands that contain emergent vegetation. However, these areas are dominated by tree and shrub species and not by emergent vegetation alone. Another characteristic that is found onsite is areas of freshwater wetland located within 25 feet of a stream. These areas would be considered WSS. Finally, wetland areas within the 100-year flood plain according to the Federal Emergency Rate Maps are considered WSS. There is a very small area along Garfield Road in the northeasterly corner of the property that is mapped within this flood zone.

In addition to WSS, vernal pools require special treatment and greater setbacks than other wetland types (See addition information below). MDEP defines a vernal pool as a <u>natural</u>, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Significance of the vernal pool is determined by counting vernal pool indicator species within the pool during a short breeding period in the spring.

Jones Associates, Inc. identified a number of potential vernal pools during the wetland delineation. These areas were either identified as potential vernal pools due to being isolated depressional wetland areas, or breeding vernal pool indicator species were spotted within the wetland during site visits. A total of four sites were identified during the delineation process. However, after visiting the pools and counting indicator species during the spring breeding season, none of the pools would be considered significant vernal pools per MDEP (See attached Significant Vernal Pool Data Collection Forms).

WETLANDS OF SPECIAL SIGNIFICANCE

Maine's Department of Environmental Protection considers some wetlands to be of higher significance than others. These wetlands are referred to as Wetlands of Special Significance (WSS). In order to be considered a WSS they must have one or more of the following characteristics:

(1) Critically imperiled or imperiled community. The freshwater wetland contains a natural community that is critically imperiled (S1) or imperiled (S2) as defined by the Natural Areas Program.

(2) Significant wildlife habitat. The freshwater wetland contains significant wildlife habitat as defined by 38 M.R.S.A. § 480-B (10).

(3) Location near coastal wetland. The freshwater wetland area is located within 250 feet of a coastal wetland.

(4) Location near GPA great pond. The freshwater wetland area is located within 250 feet of the normal high water line, and within the same watershed, of any lake or pond classified as GPA under 38 M.R.S.A. § 465-A.

(5) Aquatic vegetation, emergent marsh vegetation or open water. The freshwater wetland contains, under normal circumstances, at least 20,000 square feet of aquatic vegetation, emergent marsh vegetation or open water, unless the 20,000 or more square foot area is the result of an artificial pond or impoundment.

(6) Wetlands subject to flooding. The freshwater wetland area is inundated with floodwater during a 100-year flood event based on flood insurance maps produced by the Federal Emergency Management Agency or other site-specific information.

(7) Peatlands. The freshwater wetland is or contains peatlands, except that the department may determine that a previously mined peatland, or portion thereof, is not a wetland of special significance.

(8) River, stream or brook. The freshwater wetland area is located within 25 feet of a river, stream or brook.

STREAM CHANNELS

According to Maine's Natural Resource Protection Act, Title 38, Article 5-A, Protection of Natural Resources, §480-B Definitions:

> "River, stream or brook" means a channel between defined banks. A channel is created by the action of surface water and has two or more of the following characteristics:
>
> (1) It is depicted as a solid or broken blue line on the most recent edition of the U.S. Geological Survey 7.5-minute series topographic map or, if that is not available, a 15-minute series topographic map.
>
> (2) It contains or is known to contain flowing water continuously for a period of at least 6 months of the year in most years.
>
> (3) The channel bed is primarily composed of mineral material such as sand and gravel, parent material or bedrock that has been deposited or scoured by water.
>
> (4) The channel contains aquatic animals such as fish, aquatic insects or mollusks in the water or, if no surface water is present, within the stream bed.
>
> (5) The channel contains aquatic vegetation and is essentially devoid of upland vegetation.
>
> "River, stream or brook" does not mean a ditch or other drainage way constructed, or constructed and maintained, solely for the purpose of draining storm water or a grassy swale.

VERNAL POOLS

As defined by Maine's Department of Environmental Protection (MDEP): A vernal pool, also referred to as a seasonal forest pool, is a natural, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Vernal pools have no permanent inlet and no viable populations of predatory fish. A vernal pool may provide the primary breeding habitat for wood frogs (*Rana sylvatica*), spotted salamanders (*Ambystoma maculatum*), blue-spotted salamanders (*Ambystoma laterale*), and fairy shrimp (*Eubranchipus spp.*), as well as valuable habitat for other plants and wildlife, including several rare, threatened, and endangered species. A vernal pool intentionally created for the purposes of compensatory mitigation is included in this definition.

As of September 1, 2007, "Significant Vernal Pools" are defined by MDEP as "Significant Wildlife Habitat." As read in MDEP's Chapter 335 -- Significant Wildlife Habitat Rules, "Whether a vernal pool is a significant vernal pool is determined by the number and type of pool-breeding amphibian egg masses in a pool, or the presence of fairy shrimp, or use by threatened or endangered species as specified in Section 9(B). Significant vernal pool habitat consists of a vernal pool depression and a portion of the critical terrestrial habitat within a 250 foot radius of the spring or fall high water mark of the depression. An activity that takes place in, on, over, or adjacent to a significant vernal pool habitat must meet the standards of this chapter."

Species and abundance criteria required for Significant Vernal Pools.

Species	Abundance Criteria
Fairy shrimp	Presence in any life stage.
Blue spotted salamanders	Presence of 10 or more egg masses.
Spotted salamanders	Presence of 20 or more egg masses.
Wood frogs	Presence of 40 or more egg masses.

MDEP habitat management standards for significant vernal pools: To the greatest extent practicable, the following management practices must be followed within significant vernal pool habitat.

(1) No disturbance within the vernal pool depression;

(2) Maintain a minimum of 75% of the critical terrestrial habitat as unfragmented forest with at least a partly-closed canopy of overstory trees to provide shade, deep litter and woody debris.

(3) Maintain or restore forest corridors connecting wetlands and significant vernal pools;

(4) Minimize forest floor disturbance; and

(5) Maintain native understory vegetation and downed woody debris.

If more than 25% of the critical terrestrial habitat has been previously developed, restoring a portion of that area through supplemental planting or regrowth of native forest species may be considered toward meeting these standards, or towards standards for avoidance, minimization, or compensation. For purposes of Chapter 355, developed area includes disturbed areas excluding areas that are returned to a condition with the same drainage patterns and the same or improved cover type that existed prior to the disturbance;

Currently, Army Corps of Engineers (ACOE) regulate vernal pools but do not have specific characteristics that define a vernal pool, or a definition of which vernal pools require protection or buffering. They are looking at each site on a case by case basis. ACOE's jurisdiction does not begin until the waters of the United States are impacted.

NATURAL RESOURCES PROTECTION ACT

Jones Associates, Inc. has many years of experience working with and interpreting Maine's environmental laws, however MDEP has several unwritten policies that may change without public notice, therefore, certain project specific questions may need review by MDEP staff.

The Natural Resources Protection Act (NRPA) became effective on August 4, 1988. The law is focused on "protected natural resources". A permit is required when an "activity" will be:

(1) Located in, on or over any protected natural resource, or

(2) Located adjacent to (A) a coastal wetland, great pond, river, stream or brook or significant wildlife habitat contained within a freshwater wetland, or (B) certain freshwater wetlands.

An "activity" is (A) dredging, bulldozing, removing or displacing soil, sand, vegetation or other materials; (B) draining or otherwise dewatering; (C) filling, including adding sand or other material to a sand dune; or (D) any construction, repair or alteration of any permanent structure.

The Maine Department of Environmental Protection (MDEP) does not have to be contacted for projects involving minor wetland impacts. Single, complete activities that impact less than 4,300 square feet of freshwater wetland and do NOT occur within: another type of protected natural resource; 25 feet of another protected natural resource and erosion controls are used; a municipal shoreland zone; a wetland normally containing at least 20,000 sq. ft. of open water, aquatic or emergent marsh vegetation; or a peatland are exempt under the Natural Resources Protection Act, 38 M.R.S.A. Section 480-Q(17).

NRPA - PERMIT BY RULE

A "permit by rule" or "PBR", when approved by MDEP, is an approval for an activity that requires a permit under the Natural Resources Protection Act (NRPA). Only those activities described in Chapter 305 may proceed under the PBR process. A PBR activity will not significantly affect the environment if carried out in accordance with this chapter, and generally has less of an impact on the environment than an activity requiring an individual permit. A PBR satisfies the NRPA permit requirement and Water Quality Certification requirement. The following projects may be eligible as PBR activities:

(1) Activity Adjacent to Protected Natural Resource
(An activity adjacent to (any land area within 75 feet, measured horizontally, of the normal high water line), but not in: a coastal wetland, great pond, river, stream or brook or significant wildlife habitat contained within a freshwater wetland; or freshwater wetlands consisting of or containing: under normal circumstances, at least 20,000 square feet of aquatic vegetation, emergent marsh vegetation or open water, except for artificial ponds or impoundments; or peatlands dominated by shrubs, sedges and sphagnum moss.
(2) Placement of permanent intake pipes and water monitoring devices (including drilled wells)
(3) Replacement of Structures
(4) Movement of Rocks or Vegetation
(5) Placement of outfall pipes (including ditches and drain tiles)
(6) Shoreline stabilization using vegetation or riprap
(7) Construction of crossings (utility lines, pipes and cables)
(8) Construction of stream crossings (bridges, culverts and fords)
(9) State Transportation Facilities
(10) Restoration of natural areas (i.e., "undoing" human alteration)
(11) Fisheries & wildlife habitat creation or enhancement and water quality improvement projects
(12) Piers, wharves and pilings in coastal wetlands
(13) Public Boat Ramps
(14) Selected activities in coastal sand dunes

(15) Transfers and Permit Extensions

(16) One-time renewals of maintenance dredging permits

(17) Activities in/on/over significant vernal pool habitat

(18) Activities in existing dev. Areas located in/on/over high or moderate value inland waterfowl & wading bird habitat or shorebird nesting, feeding & staging areas

NRPA - TIER REVIEW PROCESS

NRPA's Tier Review process constitutes a joint application to both the Maine Department of Environmental Protection (MDEP) and the U.S. Army Corps of Engineers (USACOE) for a proposed alteration to a freshwater wetland that qualifies for Tier 1, 2 or 3 review. The square footage of impact is based on the alteration or impact of the whole activity in the wetland. If any part of the overall activity requires a higher tier review, then the whole activity will be reviewed under that higher tier.

The Tier Review process is required for impacts larger than 4,300 square feet, and for requesting a permit for activities in, on, or over a protected natural resource. It is also used for activities adjacent to certain protected natural resources (38 MRSA 480-C(1)). The Tier Review process is required when the activity is not eligible for a PBR.

According to 38 M.R.S.A. Section 480-X(2), an application for a permit to undertake activities altering freshwater wetlands must be reviewed in accordance with the following:

(1) A Tier 1 review process applies to any activity that involves a freshwater wetland alteration up to 15,000 square feet and does not involve the alteration of freshwater wetlands listed in 38 M.R.S.A. Section 480-X(4)
(2) A Tier 2 review process applies to any activity that involves a freshwater wetland alteration of 15,000 square feet up to one acre and does not involve the alteration of freshwater wetlands listed in 38 M.R.S.A. Section 480-X (4 or 5)
(3) A Tier 3 review process applies to any activity that does involve a freshwater wetland alteration greater than one acre, or an alteration of a freshwater wetland listed in 38 M.R.S.A. Section 480-X (4 or 5)

According to 38 M.R.S.A. Section 480-X(4), the following activities are not eligible for Tier 1 or Tier 2 review unless MDEP determines that the activity will not negatively affect the freshwater wetlands and other protected natural resources present.

(1) Activities located within 250 feet of a coastal wetland
(2) Activities located within 250 feet of the normal high-water line, and within the same watershed, of any lake or pond classified as GPA under section 465-A

(3) Activities occurring in freshwater wetlands, other than artificial ponds or impoundments, containing under normal circumstances at least 20,000 square feet of aquatic vegetation, emergent marsh vegetation or open water

(4) Activities occurring in freshwater wetlands that are inundated with floodwater during a 100-year flood event based on flood insurance maps produced by the Federal Emergency Management Agency or other site-specific information

(5) Activities occurring in freshwater wetlands containing significant wildlife habitat that has been mapped, identified or defined, as required pursuant to section 480-B(10), at the time of the filing by the applicant

(6) Activities occurring in peatlands dominated by shrubs, sedges and sphagnum moss, except that applications proposing work in previously mined peatlands may be considered by the department for Tier 1 or Tier 2 review, as applicable

(7) Activities occurring within 25 feet of a river, stream or brook

According to 38 M.R.S.A. Section 480-X(5), an activity in freshwater wetlands containing a natural community that is imperiled (S2) or critically imperiled (S1), as defined by the Natural Areas Program pursuant to Title 12, section 544 is not eligible for Tier 2 review unless the department determines that the activity will not negatively affect the freshwater wetlands and other protected natural resources present.

NRPA General Requirements for both the Tier 1 and Tier 2 review process require that the proposed freshwater wetland alteration must be avoided, if feasible, after considering cost, logistics, technology and the overall purpose of the project. However, if unavoidable, the alteration must be limited to the minimum amount necessary to complete the project. The project must utilize both temporary and permanent erosion control measures to prevent sedimentation of any protected natural resource. In addition, the alteration site must maintain an undisturbed 25 foot buffer strip between the activity and any river, stream or brook and must not violate any state water quality law, including those governing the classification of the State's waters.

RARE OR UNUSUAL FEATURES

During our investigations of the above site, Jones Associates, Inc. did not observe any rare or unusual plant or animal species within the mapped wetland area. Portions of the area described in this report had been previously altered through clearing and excavation activities. The wetlands on this property were dominated by plant communities typical of this region of Maine.

U.S. ACOE WETLAND DATASHEETS

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite	TRANSECT:	PLOT: K35-W
DELINEATOR(S): MAH		DATE: 4-20-09

VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Acer rubrum*	5/5	100	FAC
Liana				
Saplings	*Acer rubrum*	¾	75	FAC
	Betula .populifolia	¼	25	FAC
Shrubs	*Ilex verticillata*	60/60	100	FACW
Herbs	*Onoclea sensibilis*	30/50	60	FACW
	Osmunda regalis	20/50	40	OBL

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL
1	2	3				

Hydrophytes SUBTOTAL: 6 NON-hydrophytes SUBTOTAL: 0

100 x Subtotal Hydrophytes / Subtotal Hydrophytes + Subtotal Non-hydrophytes 6/6 PERCENT HYDROPHYTES = **100**

HYDROLOGY

1. Hydrology is often the most difficult feature to observe.
2. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
3. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA

Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:

☐ NO RECORDED DATA

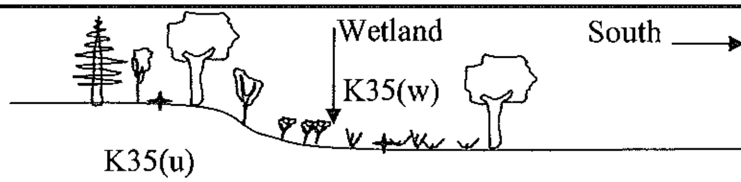
☒ OBSERVATIONS

Depth to Free Water: 0"
Depth to Saturation (including capillary fringe):0"
Describe Altered Hydrology:

☐ Inundated ☒ Saturated in upper 12 inches ☐ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☒ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL Sketch Landscape Position:



DEPT0-	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
0-4"	A	5Y4/1		Silty Loam
4-6"	B	5Y5/I	Mottles C/D	Sand
6-20"	C	5Y7I		Sand

HYDRIC SOIL INDICATOR(S): VI.

REFERENCE: *"Field Indicators for Identifying Hydric Soils in New England"*

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☒	☒	Is this datapoint with a wetland?	☒	☒
Hydric Soils Criterion Met?	☒	☒	Remarks: Disturbed site		
Wetland Hydrology Met?	☒	☒			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite Transect:: Plot: K35-W

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite DELINEATOR(S): MAH	TRANSECT:	PLOT: K35-U DATE: 4-20-09		
VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Acer rubrum*	3/5	60	FAC
	Tsuga canadensis	1/5	20	FACU
	Fagus grandifolia	1/5	20	FACU
Liana				
Saplings	*Fagus grandifolia*	2/2	100	FACU
Shrubs	*Hamamelis virginiana*	3/3	100	FAC-
Herbs	*Vaccinium angustifolium*	40	50	FACU
	Pteridium aquilinum	30	37.5	FACU
	Mitchella repens	10	12.5	FACU

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL
		1		1	6	

Hydrophytes SUBTOTAL: 1 NON-hydrophytes SUBTOTAL: 7

100 x Subtotal Hydrophytes / Subtotal Hydrophytes + Subtotal Non-hydrophytes 1/7 PERCENT HYDROPHYTES = **14%**

HYDROLOGY

4. Hydrology is often the most difficult feature to observe.
5. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
6. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA

Stream, lake or tidal gage Identification:

Stream, lake or tidal gage Identification:

Stream, lake or tidal gage Identification:

☐ NO RECORDED DATA

☒ OBSERVATIONS

Depth to Free Water: None Found

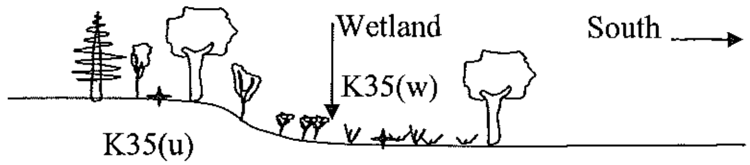
Depth to Saturation (including capillary fringe):

Describe Altered Hydrology:

☐ Inundated ☐ Saturated in upper 12 inches ☐ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL	Sketch Landscape Position:			



DEPTH	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
0-4"	A	2.5Y4/2		Fine Sandy Loam
4-20"	B	7.5YR5/6	C/D Mottles at 20"	Loamy Sand

HYDRIC SOIL INDICATOR(S):
HIS VII: Depleted below dark surface

REFERENCE:
"Field Indicators for Identifying Hydric Soils in New England"

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☐	☒	Is this datapoint with a wetland?	☐	☒
Hydric Soils Criterion Met?	☐	☒	Remarks:		
Wetland Hydrology Met?	☐	☒			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite Transect: Plot: K35-U

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite	TRANSECT:	PLOT: J32-W
DELINEATOR(S): MAH		DATE: 4-20-09

VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Betula alleghaniensis*	2/3	67	FAC
	Ulmus Americana	1/3	33	FACW
Liana				
Saplings	*Abies balsamea*	2/2	100	FAC
Shrubs	*Ilex verticillata*	60/60	100	FACW
Herbs	*Coptis trifolia*	20/20	100	FACW
	Sphagnum spp.	70		

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL
	3	2				

Hydrophytes SUBTOTAL: 5 NON-hydrophytes SUBTOTAL: 0

100 x Subtotal Hydrophytes / Subtotal Hydrophytes + Subtotal Non-hydrophytes 5/5 PERCENT HYDROPHYTES = **100**

HYDROLOGY

7. Hydrology is often the most difficult feature to observe.
8. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
9. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA

Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:

☐ NO RECORDED DATA

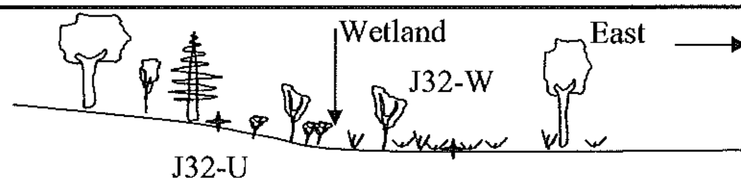
☐ OBSERVATIONS

Depth to Free Water: 0"
Depth to Saturation (including capillary fringe):
Describe Altered Hydrology:

☐ Inundated ☒ Saturated in upper 12 inches ☒ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL	Sketch Landscape Position:



DEPTH	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
-2-0"	O			Organic
0-1"	A	10YR3/1		Fine Sandy Loam
1-14"	B	10YR5/2	Mottles prominent	Fine Sandy Loam
14+"	C	5Y6/1		Fine Sand

HYDRIC SOIL INDICATOR(S):
VI. Depleted or gleyed Matrix

REFERENCE:
"Field Indicators for Identifying Hydric Soils in New England"

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☒	☐	Is this datapoint with a wetland?	☒	☐
Hydric Soils Criterion Met?	☒	☐	Remarks:		
Wetland Hydrology Met?	☒	☐			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite Transect: Plot: J32-W

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite TRANSECT: PLOT: J32-U
DELINEATOR(S): MAH DATE: 4-20-09

VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Pinus strobus*	5/7	71	FACU
	Fagus grandifolia	2/7	29	FACU
Liana				
Saplings	*Acer rubrum*	2/4	50	FAC
	Fagus grandifolia	2/4	50	FACU
Shrubs	*Abies balsamea*	3/3	100	FAC
Herbs				

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL
		2			3	

Hydrophytes SUBTOTAL: 5 NON-hydrophytes SUBTOTAL: 0

100 x Subtotal Hydrophytes / Subtotal Hydrophytes + Subtotal Non-hydrophytes 2/5 PERCENT HYDROPHYTES = 40

HYDROLOGY

10. Hydrology is often the most difficult feature to observe.
11. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
12. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA

Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:

☐ NO RECORDED DATA

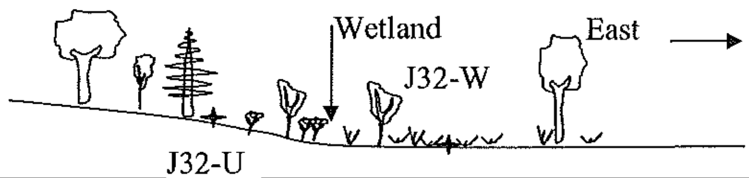
☐ OBSERVATIONS

Depth to Free Water: None Found
Depth to Saturation (including capillary fringe):
Describe Altered Hydrology:

☐ Inundated ☐ Saturated in upper 12 inches ☐ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL | Sketch Landscape Position:



DEPTH	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
0-10"	A	2.5Y3/2		Fine Sandy Loam
10-23"	B	2.5Y5/3	Mottles @18"	Fine Sandy Loam
23+"	C	10YR6/2		Fine Sand

HYDRIC SOIL INDICATOR(S):
HIS VII: Depleted below dark surface

REFERENCE:
"Field Indicators for Identifying Hydric Soils in New England"

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☐	☒	Is this datapoint with a wetland?	☐	☒
Hydric Soils Criterion Met?	☐	☒	Remarks:		
Wetland Hydrology Met?	☐	☒			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite | Transect: | Plot: J32-U

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite DELINEATOR(S): MAH	TRANSECT:		PLOT: B43-W DATE: 4-20-09	
VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Acer rubrum*	2/4	50	FAC
	Abies balsamea	2/4	50	FAC
Liana				
Saplings	*Betula populifolia*	3/3	100	FAC
Shrubs	*Ilex verticillata*	4/4	100	FACW
Herbs	*Symplocarpus feotidus*	30/70	43	OBL
	Osmunda cinnamomea	30/70	43	FACW
	Coptis trifolium	10		

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

1	2	3				
OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL

Hydrophytes SUBTOTAL: 6 NON-hydrophytes SUBTOTAL: 0

$$\frac{100 \times \text{Subtotal Hydrophytes}}{\text{Subtotal Hydrophytes + Subtotal Non-hydrophytes}} \quad 6/6 \quad \text{PERCENT HYDROPHYTES} = 100$$

HYDROLOGY

13. Hydrology is often the most difficult feature to observe.
14. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
15. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA

Stream, lake or tidal gage Identification:

Stream, lake or tidal gage Identification:

Stream, lake or tidal gage Identification:

☐ NO RECORDED DATA

☒ OBSERVATIONS

Depth to Free Water: 0"

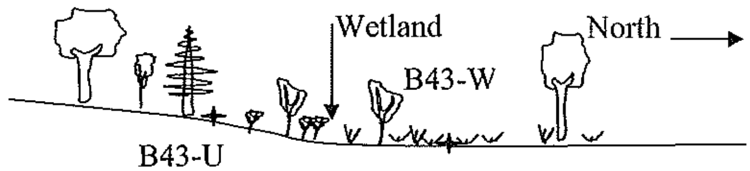
Depth to Saturation (including capillary fringe):

Describe Altered Hydrology:

☐ Inundated ☒ Saturated in upper 12 inches ☒ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☒ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL | Sketch Landscape Position:



DEPTH	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
0-4”	A	2.5Y3/1		Fine Sandy Loam
4-10”	B	Gley1 6/10Y	Many Distinct Mottles	Fine Sandy Loam
10-20”	C	5Y7/1		Loamy Sand

HYDRIC SOIL INDICATOR(S):
VI: Depleted or Gleyed Matrix

REFERENCE:
“Field Indicators for Identifying Hydric Soils in New England“

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☒	☐	Is this datapoint with a wetland?	☒	☐
Hydric Soils Criterion Met?	☒	☐	Remarks:		
Wetland Hydrology Met?	☒	☐			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite | Transect: | Plot: B43-W

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite TRANSECT: 1 PLOT: B43-U
DELINEATOR(S): MAH DATE: 4-20-09

VEGETATION	Stratum and Species (Dominants Only)	Dominance Ratio	Percent Dominance	NWI STATUS
Trees	*Acer Rubrum*	4/9	44	FAC
	Pinus strobus	3/9	33	FACU
	Tsuga canadensis	2/9	22	FACU
Liana				
Saplings	*Tsuga canadensis*	2/2	100	FACU
Shrubs				
Herbs	*Coptis trifolia*	20/30	67	FACW
	Mitchella repens	10/30	33	FACU

NOTE 1: Use asterisk * to indicate plants with observed adaptations to wetland hydrology. Plants recorded with asterisks should be considered as "other hydrophytes" in the tally below.

NOTE 2: Species with NA or NI status are report, but are not calculated in the tally below.

OBL	FACW	FAC	*OTHER HYDROPHYTES	FAC-	FACU	UPL
	1	1			4	

Hydrophytes SUBTOTAL: 2 NON-hydrophytes SUBTOTAL: 0

100 x Subtotal Hydrophytes / Subtotal Hydrophytes + Subtotal Non-hydrophytes 2/6 PERCENT HYDROPHYTES = 33

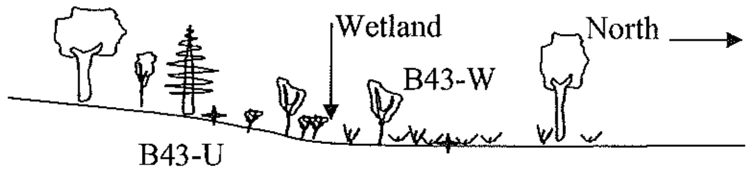
HYDROLOGY

16. Hydrology is often the most difficult feature to observe.
17. Interpretation must consider the validity of the observation in light of the season, recent weather conditions, watershed alterations, etc.
18. Interpretation of hydrology may require repeated observations over more than one season.

☐ RECORDED DATA
Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:
Stream, lake or tidal gage Identification:
☐ NO RECORDED DATA
☒ OBSERVATIONS
Depth to Free Water: none found
Depth to Saturation (including capillary fringe):
Describe Altered Hydrology:
☐ Inundated ☐ Saturated in upper 12 inches ☐ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns within Wetland

☐ Other (Explain):

SOIL	Sketch Landscape Position:			



DEPTH	HORIZON	MATRIX COLOR	REDOXIMORPHIC FEATURES Color, Abundance, Size & Contrast	USDA Texture; and nodules, concretions, masses, pore linings, restrictive layers, root distribution, soil water, etc.
2-0"	O			Organic, Duff
0-2"	A	5Y3/I		Fine Sandy Loam
2-3"	E	10YR6/I		Fine Loamy Sand
3-5"	Bhs	7.5YR4/4	Mottles C/D	Fine Loamy Sand
5-12"	B	I0YR6/4		Fine Loamy Sand
12-20+"	C	2.5Y6/1		Loamy Sand

HYDRIC SOIL INDICATOR(S):

REFERENCE: *"Field Indicators for Identifying Hydric Soils in New England"*

OPTIONAL SOIL DATA

TAXONOMIC SUBGROUP:

SOIL DRAINAGE CLASS:

DEPTH TO ACTIVE WATER TABLE:

NTCHS HYDRIC SOIL CRITERION:

CONCLUSIONS	Yes	No		Yes	No
Greater than 50% Hydrophytes?	☐	☒	Is this datapoint with a wetland?	☐	☒
Hydric Soils Criterion Met?	☐	☒	Remarks:		
Wetland Hydrology Met?	☐	☒			

PROJECT TITLE: 9004AU-MEARNG-Mt Apatite Transect: Plot: B43-U

JONES ASSOCIATES
Foresters And Environmental Consultants

WETLAND DELINEATION CHECKLIST

Job #:	9004AU	Map/Lot:	216/001, 216/002, 216/003, 216/004, 215/004	Acreage:	140+/-
Client:	Maine Army National Guard				
Site Address:	Mount Apatite Road, Auburn				
Site Description:					

Wetland Scientist:	Mike Hartman
Date of Office Review:	4/20/09
Date(s) of Field Delineation:	

Due Diligence: In office GIS review

Yes	No	
	X	Does the wetland system contain a mapped and numbered DWA?
	X	Does the wetland system contain an Inland Waterfowl Wading Bird Habitat?
	X	Does the wetland system contain a potential significant vernal pool?
X		Does the wetland system contain NWI wetlands?
	X	Does the recent aerial photos of the wetland system show open water or emergent wetlands with areas greater than 20,000 sq. ft.?
X		Does the wetland system contain a 100 year flood plain? (***Very small portion in the northeasterly corner of the property adjacent to Garfield Road***)
		Does the wetland system contain a S1 or S2 community?
	X	Does the wetland system contain a significant wildlife habitat?
	X	Is the wetland system within 250' of a coastal wetland?
	X	Is the wetland system within 250' of a great pond?

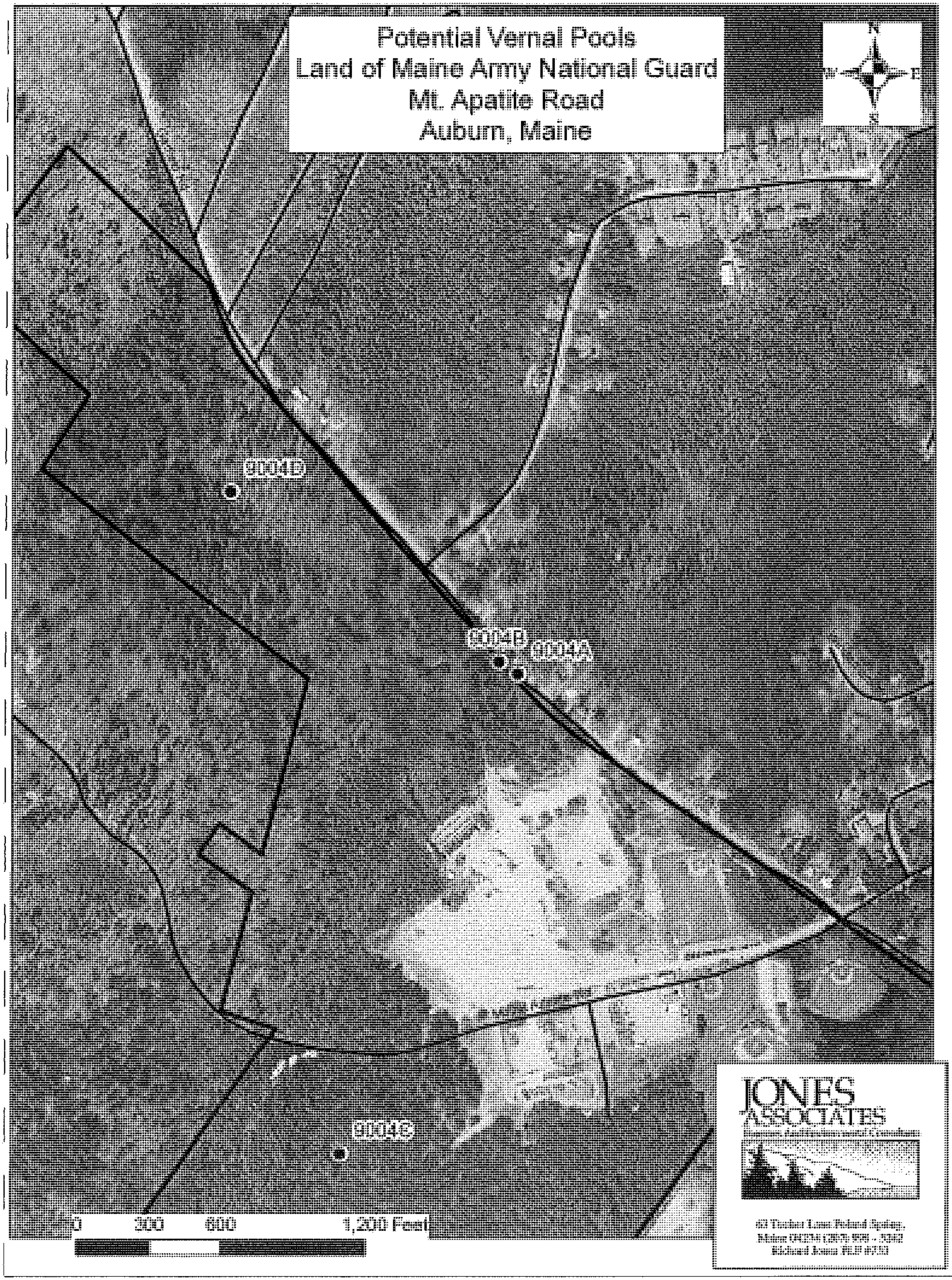
		Is the site in the watershed of a Great Pond or Impaired stream?
		Is the site in a lake watershed?
		Is the site in a watershed most at risk?

Due Diligence: In the field

Yes	No	
	X	Does the site contain peatlands?
	X	Does the site contain 20,000 sq. ft. of open water / emergent marsh vegetation?

Additional Comments:

There is a mapped inland waterfowl wading bird habitat and open water area located within the developed area on Map 216, Lot 001 that was not included within the limits of the wetland delineation area.


Potential Vernal Pools
Land of Maine Army National Guard
Mt. Apatite Road
Auburn, Maine
N
W
E
S
9004D
9004B
9004A
9004C
0
300
600
1,200 Feet
JONES
ASSOCIATES

Significant Vernal Pool Data Collection Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: 9004A

1. PRIMARY OBSERVER INFORMATION

Contact Information and credentials previously provided? ○ No (complete all of section 1) ◉ Yes (only name and phone number required)

a. Contact Information

Name: Mike Hartman
Company: Jones Associates Inc
Street: 63 Tucker Lane
City: Poland Spring State: ME Zip: 04274
Phone: 207-998-5242
Email: jones@fairpoint.net

b. Credentials

■ Please check all that apply; Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required by nonprofessional observers. Label all photographs with the Observer, Pool Location, and Date of Image.

- ☐ Professional Herpetologist and/or Ecologist
- ☒ Professional Wetland Scientist
- ☐ Professional Biologist (concentration: ________)
- ☐ Trained Citizen Scientist
- ☐ Self-informed Naturalist
- ☐ Other: ________

■ Please indicate your professional education, training, or certification that qualifies you to conduct biological surveys of vernal pools: BS degree in Environmental Science; Attended Vernal Pool Workshop with Maine Association of Wetland Scientists Oct. 19, 2006; Wetland Delineator - 10 years experience

2. VERNAL POOL LOCATION INFORMATION

a. Location

DeLorme page and grid (e.g. 04E2): 11E4 Township: Auburn

Brief site directions to the pool (using mapped landmarks): Travel approx. 0.76 miles on Garfield Road from Minot Avenue, Pool is on the left

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

- ☐ USGS Topographic Map or USGS NWI Map (1:24,000 scale) with pool clearly marked.
- ☐ Large Scale Aerial Photograph (1:12,000 scale or better) with pool clearly marked.
- ☒ GPS Coordinates (complete section below).

GPS location of vernal pool (UTM, NAD83 preferred.)

Longitude/Easting: 397390 Latitude/Northing: 4882525 Datum (e.g. NAD83): NAD83

Brand and model of GPS unit: Garmin Etrex Legend

Check one:
- ○ The pool perimeter is delineated by multiple GPS points. (best option)
  - Include map or spreadsheet with coordinates.
- ◉ The above GPS point is at the center of the pool. (good option)
- ○ The center of the pool is approximately ____ m○ /ft ○ in the compass direction of ____ degrees from the above GPS point. (acceptable option)

c. Landowner Contact Information

■ Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for this survey? ◉ Yes ○ No

■ Does SVP Habitat (pool + 250') extend across abutting landowner parcel? ○ Yes ○ No ○ Unknown

■ Landowner's contact information (if known) Name: Maine Army National Guard Phone: 626-4479

Street Address: Building 8, Camp Keyes City: Augusta State: ME Zip: 04333

3. VERNAL POOL SURVEY INFORMATION

a. Survey Date(s): 4/20/09;

b. Wetland Habitat Characterization

- Choose the best descriptor for the physical setting:
  - (•) Isolated upland depression
  - ( ) Pool associated with larger wetland complex
  - ( ) Floodplain depression
  - ( ) Other: ____

- Check all wetland types that best apply to this pool:
  - [X] Forested swamp
  - [X] Shrub swamp
  - [ ] Peatland (fen or bog)
  - [ ] Emergent marsh
  - [ ] Wet meadow
  - [ ] Shallow pond
  - [ ] Abandoned beaver flowage
  - [ ] Active beaver flowage
  - [ ] Slow stream
  - [ ] Floodplain overflow
  - [ ] Headwater seepage
  - [ ] Other: ____

c. Vernal Pool Status Under the Natural Resources Protection Act (NRPA)

i. Natural Origin

- Select the pool's origin: ( ) Natural (•) Natural-Modified ( ) Unnatural ( ) Unknown

  If modified, unnatural or unknown, describe any modern or historic human impacts to the wetland:
  The pool has been created by the road. Standing water lacking in wetland on opposite side of road.

ii. Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - ( ) Semi-permanent (drying partially in all years and completely in drought years)
  - (•) Ephemeral (drying out during the growing season in most years)
  - ( ) Unknown

  Depth of pool not sufficient for permanent water.

- Maximum depth at survey: (•) 0-12" (0-1 ft.) ( ) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: 20 ( ) m (•) ft Length: 100 ( ) m (•) ft
- Predominate substrate:
  - ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ( ) Mineral soil (sphagnum moss present)
  - (•) Organic matter (peat/muck/mud) shallow or restricted to deepest portion
  - ( ) Organic matter (peat/muck/mud) deep and widespread
- Nonwoody pool vegetation indicators (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Dry site ferns (e.g. spinulose wood ferns, lady fern, polypody fern)
  - [ ] Moist site ferns (e.g. sensitive fern, marsh fern, New York fern)
  - [X] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [ ] Sphagnum moss (anchored or suspended)
  - [X] Wet site ferns (e.g. royal fern, cinnamon fern, interrupted fern)
  - [X] Wet site graminoids (e.g. grasses, sedges, cattails)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Floating or submerged aquatics (e.g. water lilies, water shield, pond weeds, bladderwort)
- Faunal indicators (check all that apply):
  - [ ] Fish (list species if known: ____)
  - [ ] Bull frog or green frog tadpoles

iii. Inlet/Outlet Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ( ) No inlet or outlet
- ( ) Ephemeral inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- (•) Other or Unknown (explain): Ephemeral outlet - Culvert located at outlet of wetland

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION, continued from page 2

d. Significant Vernal Pool Status Under NRPA

i. Survey Date(s): 4/20/09;

ii. Abundance Criteria

- Was the entire pool comprehensively surveyed for egg masses? (•) Yes ( ) No
- For each indicator species, indicate the exact number of egg masses, method of verification, and confidence level for each life stage. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adults of Fairy Shrimp)									Tadpoles/Larvae					
	#			Method of Verification*			Confidence Level**			Method of Verification*			Confidence Level**		
Wood Frog	24			S			3								
Spotted Salamander															
Blue-spotted Salamander															
Fairy Shrimp															

*Method of verification: S = Seen, H = Handled, P = Photographed **Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

iii. Rarity Criteria

- Was a specific effort made to survey for rare species? ( ) Yes (•) No
- If yes above, indicate which species were targeted: ____
- Note any rare species associated with vernal pools. Check the method(s) of verification and fill in the confidence level (CL) for each species observation. Observations must be accompanied by a Rare Animal Form (available from MDIFW) and photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification*				CL**	SPECIES	Method of Verification*				CL**
	V	P	H	S			V	P	H	S	
Blanding's Turtle	☐	☐	☐	☐		Wood Turtle	☐	☐	☐	☐	
Spotted Turtle	☐	☐	☐	☐		Ribbon Snake	☐	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐	☐		Other:	☐	☐	☐	☐	

*Method of verification: V = Vouchered, P = Photographed, H = Handled, S = Seen
**CL - Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

e. General Comments and/or Observations of Other Wildlife Species:

4. OBSERVER SIGNATURE

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.

Signature [signature] Date 5/11/09

All submissions and supporting documents will be retained by the Maine Department of Inland Fisheries and Wildlife. Information submitted on this form and accompanying documents is part of the public record.

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401
Tara.King@maine.gov

For MDIFW use only Reviewed by MDIFW Date: ____ Initials: ____

This pool is: ☐ significant ☐ significant but no landowner permission ☐ not significant due to: ( ) insufficient data OR ( ) does not meet biological criteria and/or ( ) does not meet vernal pool definition criteria.

Significant Vernal Pool Data Collection Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: 9004B

1. PRIMARY OBSERVER INFORMATION

Contact Information and credentials previously provided?
○ No (complete all of section 1)
◉ Yes (only name and phone number required)

a. Contact Information

Name: Mike Hartman
Company: Jones Associates Inc
Street: 63 Tucker Lane
City: Poland Spring State: ME Zip: 04274
Phone: 207-998-5242
Email: jones@fairpoint.net

b. Credentials

- Please check all that apply; Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required by nonprofessional observers. Label all photographs with the Observer, Pool Location, and Date of Image.

☐ Professional Herpetologist and/or Ecologist
☒ Professional Wetland Scientist
☐ Professional Biologist (concentration: ________)
☐ Trained Citizen Scientist
☐ Self-informed Naturalist
☐ Other: ________

- Please indicate your professional education, training, or certification that qualifies you to conduct biological surveys of vernal pools: BS degree in Environmental Science; Attended Vernal Pool Workshop with Maine Association of Wetland Scientists Oct. 19, 2006; Wetland Delineator - 10 years experience

2. VERNAL POOL LOCATION INFORMATION

a. Location

DeLorme page and grid (e.g. 04E2): 11E4 Township: Auburn

Brief site directions to the pool (using mapped landmarks): Travel approx. 0.80 miles on Garfield Road from Minot Avenue. Pool is on the left.

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

☐ USGS Topographic Map or USGS NWI Map (1:24,000 scale) with pool clearly marked.
☐ Large Scale Aerial Photograph (1:12,000 scale or better) with pool clearly marked.
☒ GPS Coordinates (complete section below).

GPS location of vernal pool (UTM, NAD83 preferred.)

Longitude/Easting: 397365 Latitude/Northing: 4882541 Datum (e.g. NAD83): NAD83

Brand and model of GPS unit: Garmin Etrex Legend

Check one:
○ The pool perimeter is delineated by multiple GPS points. (best option)
- Include map or spreadsheet with coordinates.

◉ The above GPS point is at the center of the pool. (good option)

○ The center of the pool is approximately _____ m○ /ft○ in the compass direction of _____ degrees from the above GPS point. (acceptable option)

c. Landowner Contact Information

- Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for this survey? ◉ Yes ○ No
- Does SVP Habitat (pool + 250') extend across abutting landowner parcel? ○ Yes ○ No ○ Unknown
- Landowner's contact information (if known) Name: Maine Army National Guard Phone: 626-4479

Street Address: Building 8, Camp Keyes City: Augusta State: ME Zip: 04333

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION

a. Survey Date(s): 4/20/09;

b. Wetland Habitat Characterization

- Choose the best descriptor for the physical setting:
  - (●) Isolated upland depression
  - ( ) Pool associated with larger wetland complex
  - ( ) Floodplain depression
  - ( ) Other: ______
- Check all wetland types that best apply to this pool:
  - [X] Forested swamp
  - [ ] Wet meadow
  - [ ] Slow stream
  - [X] Shrub swamp
  - [ ] Shallow pond
  - [ ] Floodplain overflow
  - [ ] Peatland (fen or bog)
  - [ ] Abandoned beaver flowage
  - [ ] Headwater seepage
  - [ ] Emergent marsh
  - [ ] Active beaver flowage
  - [ ] Other: ______

c. Vernal Pool Status Under the Natural Resources Protection Act (NRPA)

i. Natural Origin

- Select the pool's origin: ( ) Natural (●) Natural-Modified ( ) Unnatural ( ) Unknown

  If modified, unnatural or unknown, describe any modern or historic human impacts to the wetland:

  The pool has been created by the road. Standing water lacking in wetland on opposite side of road.

ii. Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - (●) Semi-permanent (drying partially in all years and completely in drought years)
  - ( ) Ephemeral (drying out during the growing season in most years)
  - ( ) Unknown

  Pool sufficiently deep to have standing water through out the year in some years.

- Maximum depth at survey: ( ) 0-12" (0-1 ft.) (●) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: 40 ( ) m (●) ft Length: 100 ( ) m (●) ft
- Predominate substrate:
  - ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - (●) Organic matter (peat/muck/mud) shallow or restricted to deepest portion
  - ( ) Mineral soil (sphagnum moss present)
  - ( ) Organic matter (peat/muck/mud) deep and widespread
- Nonwoody pool vegetation indicators (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Sphagnum moss (anchored or suspended)
  - [ ] Dry site ferns (e.g. spinulose wood ferns, lady fern, polypody fern)
  - [X] Wet site ferns (e.g. royal fern, cinnamon fern, interrupted fern)
  - [ ] Moist site ferns (e.g. sensitive fern, marsh fern, New York fern)
  - [ ] Wet site graminoids (e.g. grasses, sedges, cattails)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [ ] Floating or submerged aquatics (e.g. water lilies, water shield, pond weeds, bladderwort)
- Faunal indicators (check all that apply):
  - [ ] Fish (list species if known: ______)
  - [ ] Bull frog or green frog tadpoles

iii. Inlet/Outlet Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- (●) No inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ( ) Ephemeral inlet or outlet
- ( ) Other or Unknown (explain): ______

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION, continued from page 2

d. Significant Vernal Pool Status Under NRPA

i. Survey Date(s): 4/20/09;

ii. Abundance Criteria

- Was the entire pool comprehensively surveyed for egg masses? (●) Yes ( ) No
- For each indicator species, indicate the exact number of egg masses, method of verification, and confidence level for each life stage. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adults of Fairy Shrimp) #	Egg Masses: Method of Verification*	Egg Masses: Confidence Level**	Tadpoles/Larvae: Method of Verification*	Tadpoles/Larvae: Confidence Level**
Wood Frog	59	S	3		
Spotted Salamander					
Blue-spotted Salamander					
Fairy Shrimp					

*Method of verification: S = Seen, H = Handled, P = Photographed **Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

iii. Rarity Criteria

- Was a specific effort made to survey for rare species? ( ) Yes (●) No
- If yes above, indicate which species were targeted: ____________________
- Note any rare species associated with vernal pools. Check the method(s) of verification and fill in the confidence level (CL) for each species observation. Observations must be accompanied by a Rare Animal Form (available from MDIFW) and photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification* V	P	H	S	CL**	SPECIES	Method of Verification* V	P	H	S	CL**
Blanding's Turtle	☐	☐	☐	☐		Wood Turtle	☐	☐	☐	☐	
Spotted Turtle	☐	☐	☐	☐		Ribbon Snake	☐	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐	☐		Other:	☐	☐	☐	☐	

*Method of verification: V = Vouchered, P = Photographed, H = Handled, S = Seen
**CL - Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

e. General Comments and/or Observations of Other Wildlife Species:

4. OBSERVER SIGNATURE

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.

Signature ____________________ Date 5/11/09

All submissions and supporting documents will be retained by the Maine Department of Inland Fisheries and Wildlife. Information submitted on this form and accompanying documents is part of the public record.

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401
Tara.King@maine.gov

For MDIFW use only Reviewed by MDIFW Date:________ Initials:________

This pool is: ☐ significant ☐ significant but no landowner permission ☐ not significant due to: ( ) insufficient data OR ( ) does not meet biological criteria and/or ( ) does not meet vernal pool definition criteria.

Significant Vernal Pool Data Collection Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: 9004C

1. PRIMARY OBSERVER INFORMATION

Contact Information and credentials previously provided? ○ No (complete all of section 1) ◉ Yes (only name and phone number required)

a. Contact Information

Name: Mike Hartman
Company: Jones Associates Inc
Street: 63 Tucker Lane
City: Poland Spring State: ME Zip: 04274
Phone: 207-998-5242
Email: jones@fairpoint.net

b. Credentials

- Please check all that apply; Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required by nonprofessional observers. Label all photographs with the Observer, Pool Location, and Date of Image.

☐ Professional Herpetologist and/or Ecologist
☐ Trained Citizen Scientist
☒ Professional Wetland Scientist
☐ Self-informed Naturalist
☐ Professional Biologist (concentration: ________)
☐ Other: ________

- Please indicate your professional education, training, or certification that qualifies you to conduct biological surveys of vernal pools: BS degree in Environmental Science; Attended Vernal Pool Workshop with Maine Association of Wetland Scientists Oct. 19, 2006; Wetland Delineator - 10 years experience

2. VERNAL POOL LOCATION INFORMATION

a. Location

DeLorme page and grid (e.g. 04E2): 11E4 Township: Auburn

Brief site directions to the pool (using mapped landmarks): Travel on Garfield Road approx. 0.5 miles from Minot Avenue. Turn left on Mount Apatite Road. Park at Gate. Walk to pool.

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

☐ USGS Topographic Map or USGS NWI Map (1:24,000 scale) with pool clearly marked.
☐ Large Scale Aerial Photograph (1:12,000 scale or better) with pool clearly marked.
☒ GPS Coordinates (complete section below).

GPS location of vernal pool (UTM, NAD83 preferred.)

Longitude/Easting: 397156 Latitude/Northing: 4881924 Datum (e.g. NAD83): NAD83

Brand and model of GPS unit: Garmin Etrex Legend

Check one: ○ The pool perimeter is delineated by multiple GPS points. (best option)
- Include map or spreadsheet with coordinates.

◉ The above GPS point is at the center of the pool. (good option)

○ The center of the pool is approximately _____ m○ /ft ○ in the compass direction of _____ degrees from the above GPS point. (acceptable option)

c. Landowner Contact Information

- Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for this survey? ◉ Yes ○ No
- Does SVP Habitat (pool + 250') extend across abutting landowner parcel? ○ Yes ○ No ○ Unknown
- Landowner's contact information (if known) Name: Maine Army National Guard Phone: 626-4479

Street Address: Building 8, Camp Keyes City: Augusta State: ME Zip: 04333

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION

a. Survey Date(s): 4/22/09; 4/27/09; 5/7/09

b. Wetland Habitat Characterization

- Choose the best descriptor for the physical setting:
  - (•) Isolated upland depression
  - ( ) Pool associated with larger wetland complex
  - ( ) Floodplain depression
  - ( ) Other: ______
- Check all wetland types that best apply to this pool:
  - [X] Forested swamp
  - [ ] Wet meadow
  - [ ] Slow stream
  - [ ] Shrub swamp
  - [ ] Shallow pond
  - [ ] Floodplain overflow
  - [ ] Peatland (fen or bog)
  - [ ] Abandoned beaver flowage
  - [ ] Headwater seepage
  - [ ] Emergent marsh
  - [ ] Active beaver flowage
  - [ ] Other: ______

c. Vernal Pool Status Under the Natural Resources Protection Act (NRPA)

i. Natural Origin

- Select the pool's origin: (•) Natural ( ) Natural-Modified ( ) Unnatural ( ) Unknown

  If modified, unnatural or unknown, describe any modern or historic human impacts to the wetland:

  ______

ii. Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - ( ) Semi-permanent (drying partially in all years and completely in drought years)
  - (•) Ephemeral (drying out during the growing season in most years)
  - ( ) Unknown

  Shallow water

- Maximum depth at survey: (•) 0-12" (0-1 ft.) ( ) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: ______ ( ) m (•) ft Length: ______ ( ) m (•) ft
- Predominate substrate:
  - ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - (•) Organic matter (peat/muck/mud) shallow or restricted to deepest portion
  - ( ) Mineral soil (sphagnum moss present)
  - ( ) Organic matter (peat/muck/mud) deep and widespread
- Nonwoody pool vegetation indicators (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Sphagnum moss (anchored or suspended)
  - [X] Wet site ferns (e.g. royal fern, cinnamon fern, interrupted fern)
  - [ ] Dry site ferns (e.g. spinulose wood ferns, lady fern, polypody fern)
  - [ ] Wet site graminoids (e.g. grasses, sedges, cattails)
  - [ ] Moist site ferns (e.g. sensitive fern, marsh fern, New York fern)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [ ] Floating or submerged aquatics (e.g. water lilies, water shield, pond weeds, bladderwort)
- Faunal indicators (check all that apply):
  - [ ] Fish (list species if known: ______)
  - [ ] Bull frog or green frog tadpoles

iii. Inlet/Outlet Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ( ) No inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- (•) Ephemeral inlet or outlet
- ( ) Other or Unknown (explain): Drainage way drains wetland at high water only

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION, continued from page 2

d. Significant Vernal Pool Status Under NRPA

i. Survey Date(s): 4/22/09; 4/27/09; 5/7/09

ii. Abundance Criteria

- Was the entire pool comprehensively surveyed for egg masses? (•) Yes ( ) No
- For each indicator species, indicate the exact number of egg masses, method of verification, and confidence level for each life stage. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adults of Fairy Shrimp) #			Method of Verification*			Confidence Level**			Tadpoles/Larvae Method of Verification*			Confidence Level**		
Wood Frog	15	9	2	S	S	S	3	3	3						
Spotted Salamander		7	5		H	H	3	3	3						
Blue-spotted Salamander															
Fairy Shrimp															

*Method of verification: S = Seen, H = Handled, P = Photographed **Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

iii. Rarity Criteria

- Was a specific effort made to survey for rare species? ( ) Yes (•) No
- If yes above, indicate which species were targeted: ______
- Note any rare species associated with vernal pools. Check the method(s) of verification and fill in the confidence level (CL) for each species observation. Observations must be accompanied by a Rare Animal Form (available from MDIFW) and photographs (labeled with observer name, pool location, and date).

SPECIES	V	P	H	S	CL**	SPECIES	V	P	H	S	CL**
Blanding's Turtle	☐	☐	☐	☐		Wood Turtle	☐	☐	☐	☐	
Spotted Turtle	☐	☐	☐	☐		Ribbon Snake	☐	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐	☐		Other:	☐	☐	☐	☐	

*Method of verification: V = Vouchered, P = Photographed, H = Handled, S = Seen
**CL - Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

e. General Comments and/or Observations of Other Wildlife Species:

______

4. OBSERVER SIGNATURE

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.

Signature [signature] Date 5/11/09

All submissions and supporting documents will be retained by the Maine Department of Inland Fisheries and Wildlife. Information submitted on this form and accompanying documents is part of the public record.

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401
Tara.King@maine.gov

For MDIFW use only Reviewed by MDIFW Date:______ Initials:______

This pool is: ☐ significant ☐ significant but no landowner permission ☐ not significant due to: ( ) insufficient data OR ( ) does not meet biological criteria and/or ( ) does not meet vernal pool definition criteria.

Significant Vernal Pool Data Collection Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: 9004D

1. PRIMARY OBSERVER INFORMATION

Contact information and credentials previously provided? ○ No (complete all of section 1) ◉ Yes (only name and phone number required)

a. Contact Information

Name: Mike Hartman   Company: Jones Associates Inc

Street: 63 Tucker Lane   City: Poland Spring   State: ME   Zip: 04274

Phone: 207-998-5242   Email: jones@fairpoint.net

b. Credentials

- Please check all that apply; Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required by nonprofessional observers. Label all photographs with the Observer, Pool Location, and Date of Image.

☐ Professional Herpetologist and/or Ecologist
☒ Professional Wetland Scientist
☐ Professional Biologist (concentration: ________)
☐ Trained Citizen Scientist
☐ Self-informed Naturalist
☐ Other: ________

- Please indicate your professional education, training, or certification that qualifies you to conduct biological surveys of vernal pools: BS degree in Environmental Science; Attended Vernal Pool Workshop with Maine Association of Wetland Scientists Oct. 19, 2006; Wetland Delineator - 10 years experience

2. VERNAL POOL LOCATION INFORMATION

a. Location

DeLorme page and grid (e.g. 04E2): 11E4   Township: Auburn

Brief site directions to the pool (using mapped landmarks): Travel approx. 0.7 miles on Garfield road from Minot Avenue. Park on left. Walk through woods to pool.

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

☐ USGS Topographic Map or USGS NWI Map (1:24,000 scale) with pool clearly marked.
☐ Large Scale Aerial Photograph (1:12,000 scale or better) with pool clearly marked.
☒ GPS Coordinates (complete section below).

GPS location of vernal pool (UTM, NAD83 preferred.)

Longitude/Easting: 397026   Latitude/Northing: 4882760   Datum (e.g. NAD83): NAD83

Brand and model of GPS unit: Garmin Etrex Legend

Check one: ○ The pool perimeter is delineated by multiple GPS points. (best option)
- Include map or spreadsheet with coordinates.

◉ The above GPS point is at the center of the pool. (good option)

○ The center of the pool is approximately _____ m ○ /ft ○ in the compass direction of _____ degrees from the above GPS point. (acceptable option)

c. Landowner Contact Information

- Are you the landowner? ○ Yes ◉ No   If no, was landowner permission obtained for this survey? ◉ Yes ○ No
- Does SVP Habitat (pool + 250') extend across abutting landowner parcel? ○ Yes ○ No ○ Unknown
- Landowner's contact information (if known) Name: Maine Army National Guard   Phone: 626-4479

Street Address: Building 8, Camp Keyes   City: Augusta   State: ME   Zip: 04333

3. VERNAL POOL SURVEY INFORMATION

a. Survey Date(s): 4/20/09;

b. Wetland Habitat Characterization

- Choose the best descriptor for the physical setting:
  - (•) Isolated upland depression
  - ( ) Pool associated with larger wetland complex
  - ( ) Floodplain depression
  - ( ) Other: ______
- Check all wetland types that best apply to this pool:
  - [ ] Forested swamp
  - [ ] Wet meadow
  - [ ] Slow stream
  - [ ] Shrub swamp
  - [ ] Shallow pond
  - [ ] Floodplain overflow
  - [ ] Peatland (fen or bog)
  - [ ] Abandoned beaver flowage
  - [ ] Headwater seepage
  - [ ] Emergent marsh
  - [ ] Active beaver flowage
  - [X] Other: Old borrow Pit

c. Vernal Pool Status Under the Natural Resources Protection Act (NRPA)

i. Natural Origin

- Select the pool's origin: ( ) Natural ( ) Natural-Modified (•) Unnatural ( ) Unknown

  If modified, unnatural or unknown, describe any modern or historic human impacts to the wetland:
  Old borrow pit

ii. Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - ( ) Semi-permanent (drying partially in all years and completely in drought years)
  - (•) Ephemeral (drying out during the growing season in most years)
  - ( ) Unknown

  Lack of vegetation suggests pool drys out most years.

- Maximum depth at survey: (•) 0-12" (0-1 ft.) ( ) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: 40 ( ) m (•) ft Length: 40 ( ) m (•) ft
- Predominate substrate:
  - (•) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ( ) Organic matter (peat/muck/mud) shallow or restricted to deepest portion
  - ( ) Mineral soil (sphagnum moss present)
  - ( ) Organic matter (peat/muck/mud) deep and widespread
- Nonwoody pool vegetation indicators (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Sphagnum moss (anchored or suspended)
  - [ ] Dry site ferns (e.g. spinulose wood ferns, lady fern, polypody fern)
  - [ ] Wet site ferns (e.g. royal fern, cinnamon fern, interrupted fern)
  - [X] Moist site ferns (e.g. sensitive fern, marsh fern, New York fern)
  - [ ] Wet site graminoids (e.g. grasses, sedges, cattails)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [ ] Floating or submerged aquatics (e.g. water lilies, water shield, pond weeds, bladderwort)
- Faunal indicators (check all that apply):
  - [ ] Fish (list species if known: ______)
  - [ ] Bull frog or green frog tadpoles

iii. Inlet/Outlet Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- (•) No inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ( ) Ephemeral inlet or outlet
- ( ) Other or Unknown (explain): ______

Significant Vernal Pool Data Collection Form

3. VERNAL POOL SURVEY INFORMATION, continued from page 2

d. Significant Vernal Pool Status Under NRPA

i. Survey Date(s): 4/20/09;

ii. Abundance Criteria

- Was the entire pool comprehensively surveyed for egg masses? ◯ Yes ◯ No
- For each indicator species, indicate the exact number of egg masses, method of verification, and confidence level for each life stage. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adults of Fairy Shrimp)									Tadpoles/Larvae					
	#			Method of Verification*			Confidence Level**			Method of Verification*			Confidence Level**		
Wood Frog	24			S			3								
Spotted Salamander															
Blue-spotted Salamander															
Fairy Shrimp															

*Method of verification: S = Seen, H = Handled, P = Photographed **Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

iii. Rarity Criteria

- Was a specific effort made to survey for rare species? ◯ Yes ◯ No
- If yes above, indicate which species were targeted:
- Note any rare species associated with vernal pools. Check the method(s) of verification and fill in the confidence level (CL) for each species observation. Observations must be accompanied by a Rare Animal Form (available from MDIFW) and photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification*				CL**	SPECIES	Method of Verification*				CL**
	V	P	H	S			V	P	H	S	
Blanding's Turtle	☐	☐	☐	☐		Wood Turtle	☐	☐	☐	☐	
Spotted Turtle	☐	☐	☐	☐		Ribbon Snake	☐	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐	☐		Other:	☐	☐	☐	☐	

*Method of verification: V = Vouchered, P = Photographed, H = Handled, S = Seen

**CL - Confidence level in observation: 1= <60%, 2= 60-95%, 3= >95%

e. General Comments and/or Observations of Other Wildlife Species:

4. OBSERVER SIGNATURE

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.

Signature [signature] Date 5/11/09

All submissions and supporting documents will be retained by the Maine Department of Inland Fisheries and Wildlife. Information submitted on this form and accompanying documents is part of the public record.

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401
Tara.King@maine.gov

For MDIFW use only Reviewed by MDIFW Date: Initials:

This pool is: ☐ significant ☐ significant but no landowner permission ☐ not significant due to: ◯ insufficient data OR ◯ does not meet biological criteria and/or ◯ does not meet vernal pool definition criteria.

Vernal Pool Survey

Maine Army National Guard

Auburn Training Site

2015

Prepared by

Timothy A. Bickford

Barry J. Turcotte

Maine Army National Guard

Directorate of Facilities Engineering

Table of Contents

Executive Summary

The Maine Army National Guard's Auburn Training Site located in Auburn, Maine was surveyed for the presence of vernal pools and assessed for significance on 30 May 2015. Document searches were conducted prior to the survey to identify any vernal pools that may have previously been located in the field. Eight potential pools were previously identified as vernal pools. Six of these vernal pools were found, two of which were combined and counted as one as they share surface hydrology. Four of the pools have been confirmed as significant wildlife habitat. This assessment will be used in planning of future development and natural resource management.

1.0 Introduction

This survey for vernal pools was conducted on the Maine Army National Guard's Auburn Training Site located in Auburn, Maine (figure 1.). This site consists of 154 acres owned by the US Army Corps of Engineers and 19 acres of leased property used for military training and contains a road and trail network, a formerly used small arms range, an equipment maintenance facility (FMS 2) as well as outdoor storage and controlled humidity storage buildings. The site contains approximately 1.25 miles of paved and gravel roads and trails.

The purpose of this survey is to identify vernal pools on the training site and determine their habitat significance in accordance with Maine Department of Environmental Protection Chapter 335 rules. The criteria used for significance determinations for vernal pools consist of the presence of the following:

1. Wood frog (*Rana sylvatica*) – 40 or more egg masses
2. Spotted salamander (*Ambystoma maculatum*) – 20 or more egg masses
3. Blue spotted salamander (*Ambystoma laterale*) – 10 or more egg masses
4. Fairy Shrimp (*Eubranchipus* sp.) – any presence
5. Utilization by any threatened or endangered species

Timing of vernal pool assessments was coordinated with the Maine Department of Inland Fisheries and Wildlife recommended periods.

Document searches conducted prior to the field assessment revealed that eight potential vernal pools had been identified during previous field visits.

2.0 Methods

This survey was conducted by an experienced biologist and an experienced environmental scientist gridding and walking over the entire site visually identifying vernal pools. When a pool was encountered, the location and boundary of the pool was recorded using a Trimble GeoXH 6000 global positioning system. Digital photographs were also taken of the pools. The presence, identification and count of amphibian egg masses was conducted as well as determining any noticeable utilization by threatened or endangered species. Identification guides and other resources developed by the University of Maine's Department of Wildlife and Ecology and Maine Audubon were used during the vernal pool, habitat and amphibian identification process. Observations were recorded on the Maine State Vernal Pool Assessment Form (DEPLW0897-82008 dated 05/09/2013).

3.0 Findings

During the survey, a total of five vernal pools were identified. The vernal pools were assigned identification numbers in a ATS-VP# format where ATS identifies which training site the vernal pool was found on (in this case Auburn Training Site). Each of these vernal pools are described below:

Vernal pools

ATS-VP1 - Vernal pool 1 was identified during previous work at the Auburn Training Site. This vernal pool is located in the northern end of the property just west of the trail that leads north from the range. This pool is located within a closed canopy (90% cover) with an over story of Green Ash (*Fraxinus pennsylvanica*), Red Maple (*Acer rubrum*) and Eastern White Pine (*Pinus strobus*) (Figure 3).

ATS-VP1 met all criteria for a vernal pool and contained 52 wood frog egg masses and 51 spotted salamander egg masses. No known threatened or endangered species were observed utilizing this pool. Given this information, this pool is considered **Significant Wildlife Habitat**. More data should be collected in the future to document ecological and pool hydrology changes.

ATS-VP2 - Vernal pool 2 was identified during previous work at the Auburn Training Site. This vernal pool is located along the eastern border and adjacent to Garfield Road (Figure 4). This pool has a mostly closed canopy (80% cover) with a mixed hardwood, Red Maple (*Acer rubrum*) and Eastern White Pine (*Pinus strobus*) over story.

ATS-VP2 meets all criteria for a vernal pool and contained 157 wood frog egg masses. No known threatened or endangered species were observed utilizing this pool. Given this information, this pool is considered **Significant Wildlife Habitat**. More data should be collected in the future to document ecological and pool hydrology changes.

ATS-VP3 - Vernal pool 3 was identified previously during field work. This vernal pool is located in the south western area of the training site just to the west of the outdoor equipment storage area and north of the power line. This pool is in a closed canopy (90% cover) consisting of Red

Maple (*Acer rubrum*), Balsam Fir (*Abies balsamea*) and Eastern White Pine (*Pinus strobus*) (Figure 5).

This vernal pool met all criteria to qualify as a vernal pool and contained 10 spotted salamander egg masses. No amphibian larva, fairy shrimp or other threatened or endangered species were observed utilizing this pool. Given the quantity of amphibian egg masses and the observed lack of use by threatened or endangered species, this pool is not considered significant wildlife habitat.

ATS-VP4 - Vernal pool 4 was identified previously during field work. This vernal pool is located in the south eastern area of the training site adjacent to Stevens Mills Road (entrance to the site), a gravel parking lot and a recreational field. This pool is in a somewhat closed canopy (70% cover) consisting of a re-generating stand of Red Maple (*Acer rubrum*) and Eastern White Pine (*Pinus strobus*) (Figure 6).

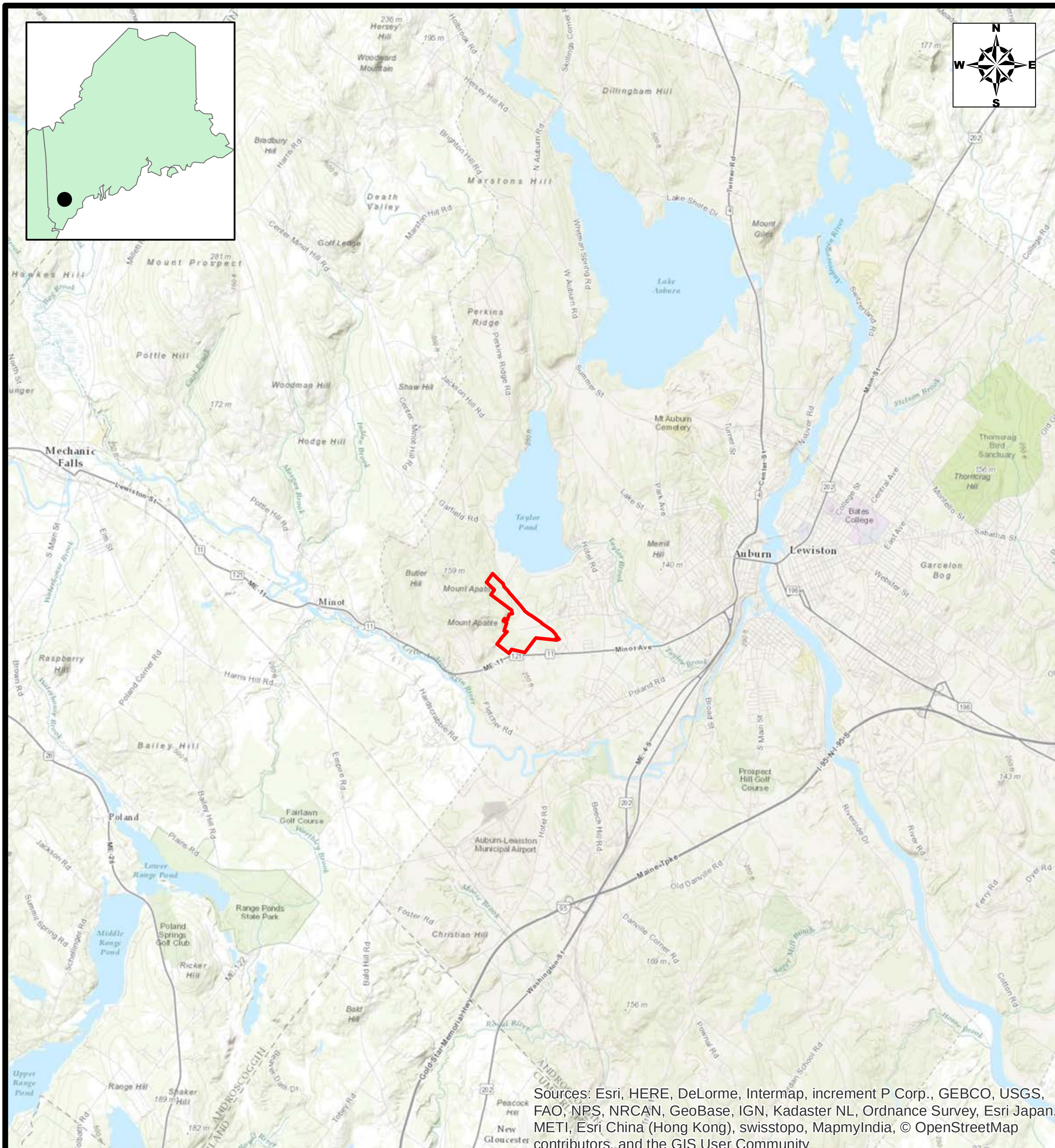
This vernal pool met all criteria to qualify as a vernal pool and contained 42 wood frog egg masses. No amphibian larva, fairy shrimp or other threatened or endangered species were observed utilizing this pool. Given the quantity of amphibian egg masses, this pool is considered **Significant Wildlife Habitat**.

ATS-VP5 - Vernal pool 5 was identified previously during field work as two separate pools. During the spring field work, it was determined that the two pools are hydraulically connected by surface water and are considered one pool within a larger wetland complex. This vernal pool is a large pool located to the south of ATS-VP4 within the forested wetland that was created by the MEARNG as a US Army Corps of Engineers required wetland mitigation. This pool is in a somewhat closed canopy consisting of wetland shrub species and Pitch Pine (*Pinus rigida*), Eastern White Pine (*Pinus strobus*), White Birch (*Betula papyrifera*), Grey Birch (*Betula populifolia*) and Red Maple (*Acer rubrum*) (Figure 6).

ATS-VP5 met all criteria to qualify as a vernal pool and contained in excess of 100 wood frog egg masses in the 80% of the pool that was surveyed. No amphibian larva, fairy shrimp or other threatened or endangered species were observed utilizing this pool. Given the quantity of amphibian egg masses, this pool is considered **Significant Wildlife Habitat**.

Appendix A

Figures



Property Boundary

Figure 1. Location of Auburn Training Site

Project Name: Vernal Pool Survey

Project Location: Auburn, Maine

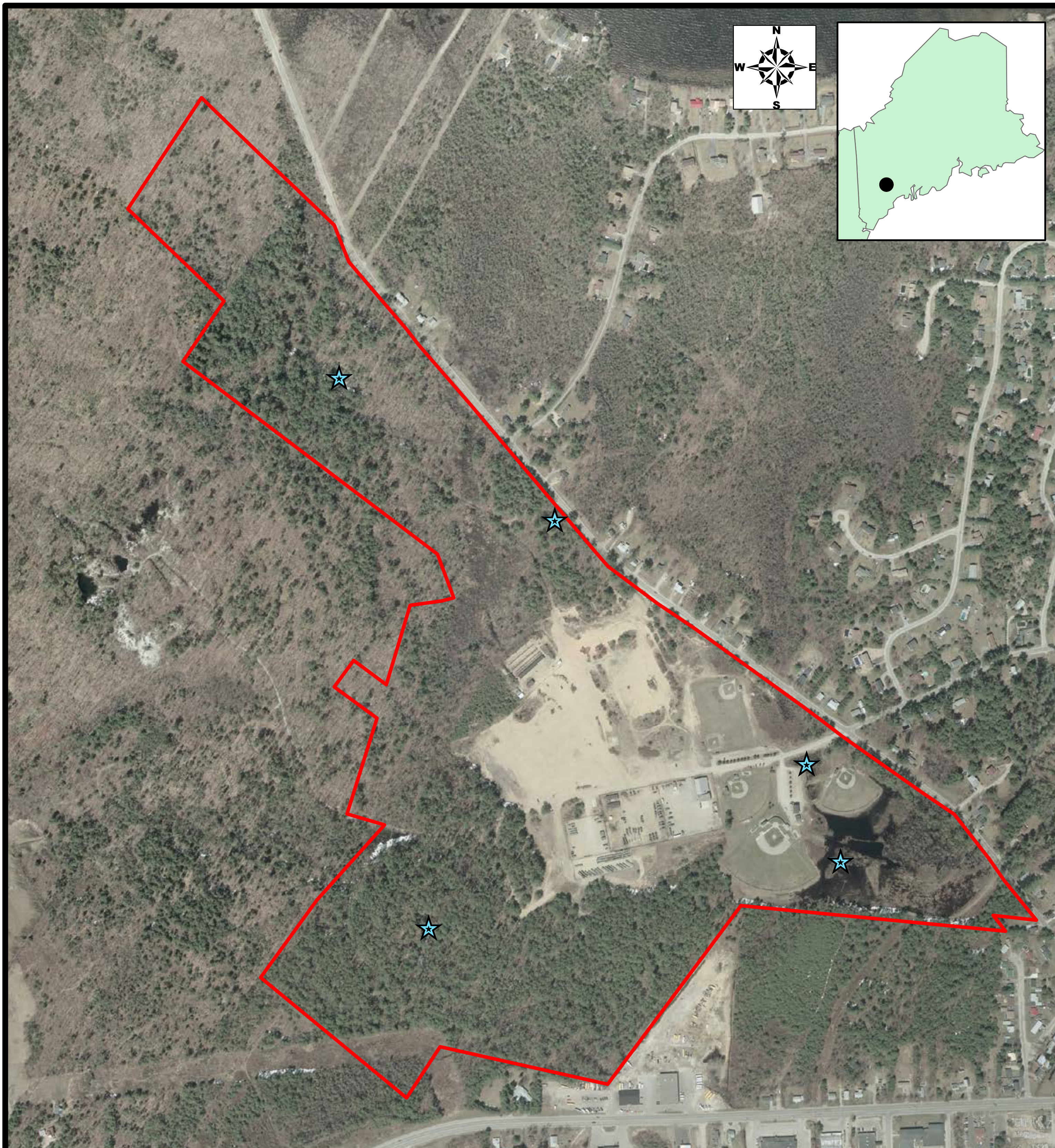
0 0.5 1 2 3 4

Miles

Source: ESRI

Filename: Auburn Vernal Pools Figure 1.mxd

Date: 29 May 2015



Property Boundary

Vernal Pools

Figure 2. Location of Vernal Pools

0 50 100 200 300 400

Meters

Project Name:

Vernal Pool Survey

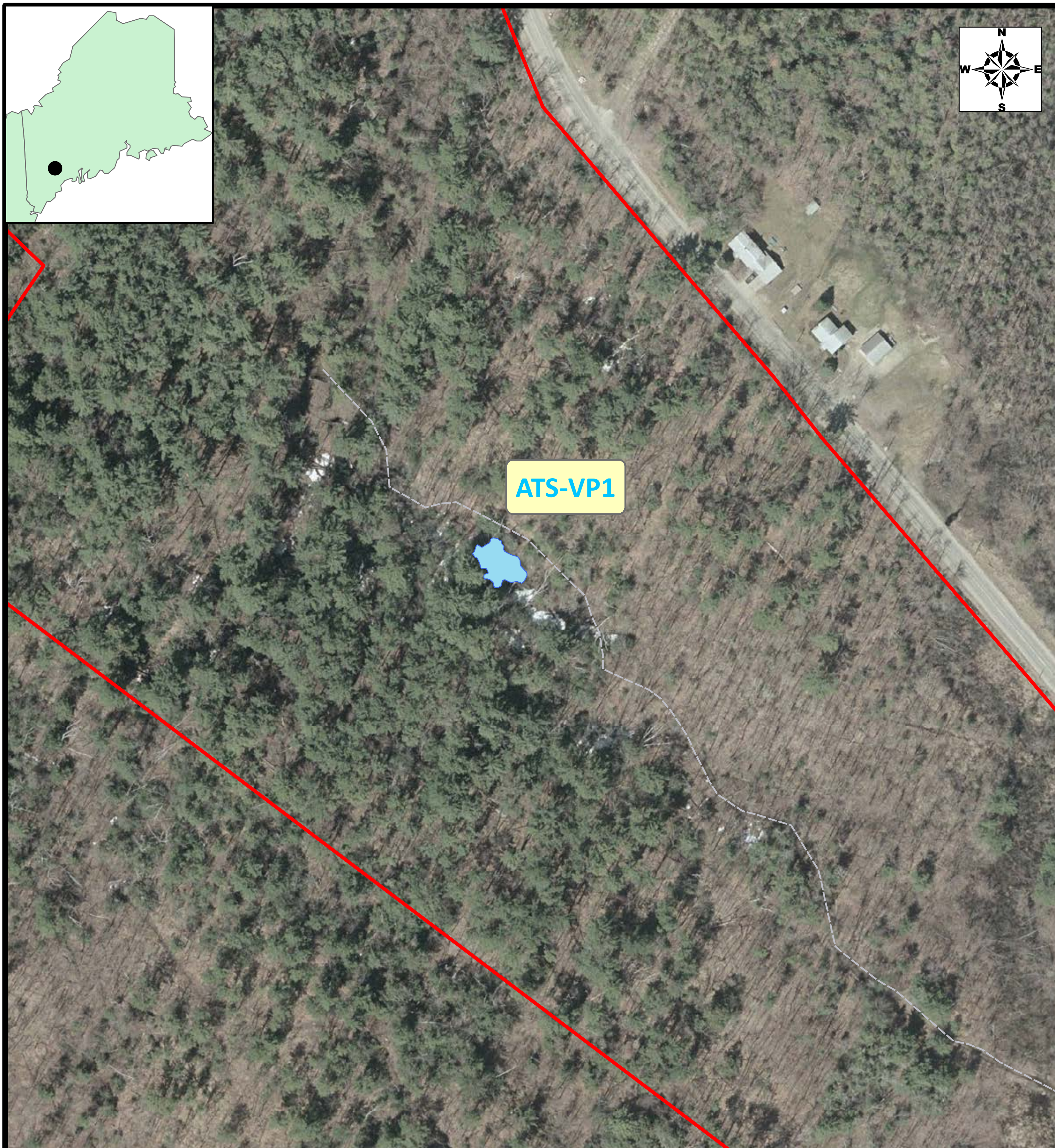
Project Location:

Auburn, Maine

Source: MEARNG

Filename: Auburn Vernal Pools Figure 2.mxd

Date: 27 May 2015



Property Boundary
Vernal Pools

Roads
Improved
Unimproved
Trail

0 12.5 25 50 75 100
Meters

Figure 3. Location of Vernal Pool ATS-VP1

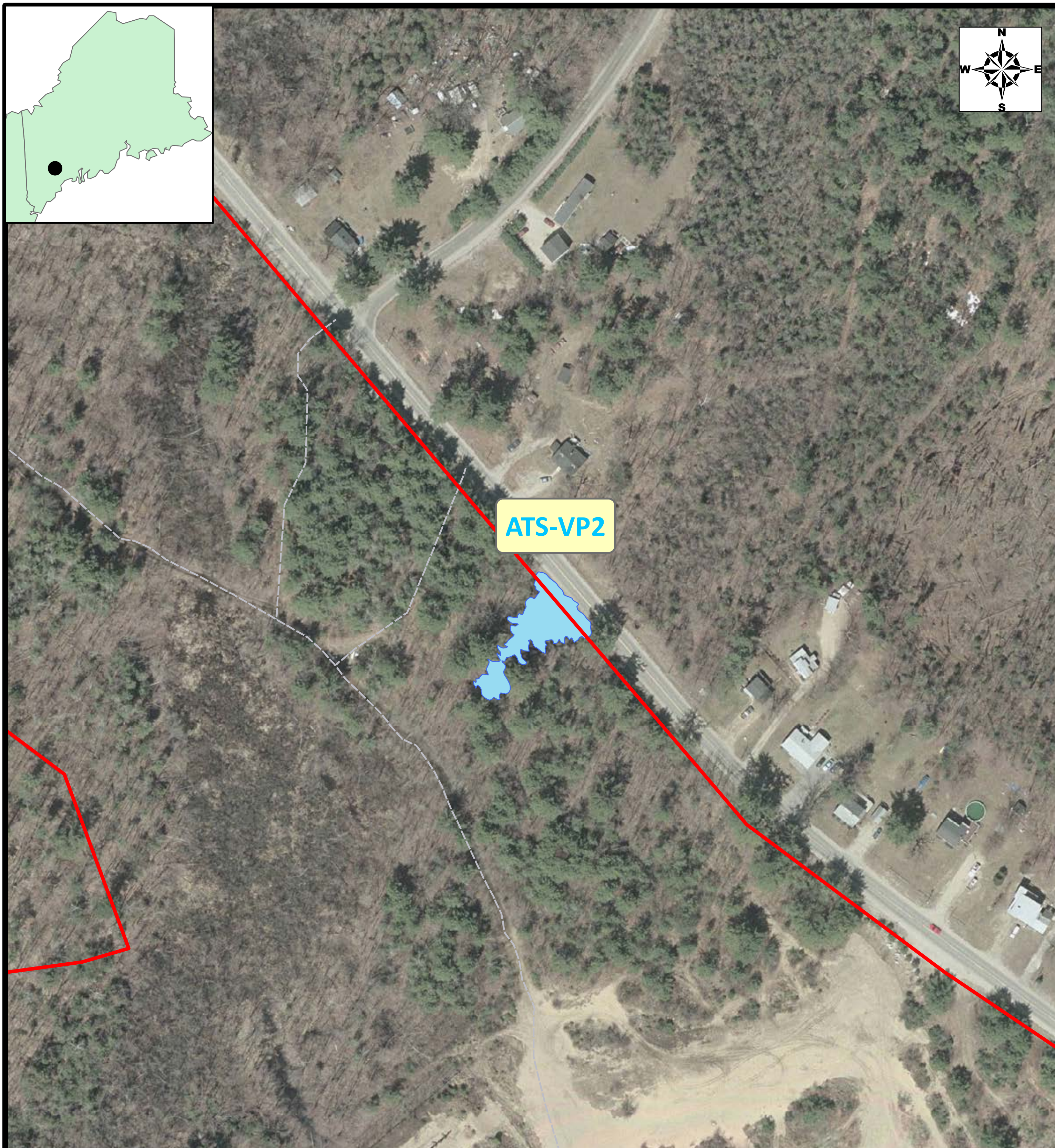
Project Name:
Vernal Pool Survey

Project Location:
Auburn, Maine

Source: MEARNG

Filename: Auburn Vernal Pools Figure 3.mxd

Date: 27 May 2015



Property Boundary
Vernal Pools

Roads

Improved
Unimproved
Trail

0 12.5 25 50 75 100

Meters

Figure 4. Location of Vernal Pool ATS-VP2

Project Name:

Vernal Pool Survey

Project Location:

Auburn, Maine

Source: MEARNG

Filename: Auburn Vernal Pools Figure 4.mxd

Date: 27 May 2015

Property Boundary

Vernal Pools

Roads

Improved

==== Unimproved

Trail

Figure 5. Location of Vernal Pool ATS-VP3

Project Name:

Vernal Pool Survey

0 12.5 25 50 75 100

Meters

Project Location:

Auburn, Maine

Source: MEARNG

Filename: Auburn Vernal Pools Figure 5.mxd

Date: 27 May 2015

Property Boundary
Vernal Pools

Roads
Improved
Unimproved
Trail

0 12.5 25 50 75 100
Meters

Figure 6. Location of Vernal Pools ATS-VP4 & ATS-VP5

Project Name:
Vernal Pool Survey

Project Location:
Auburn, Maine

Source: MEARNG

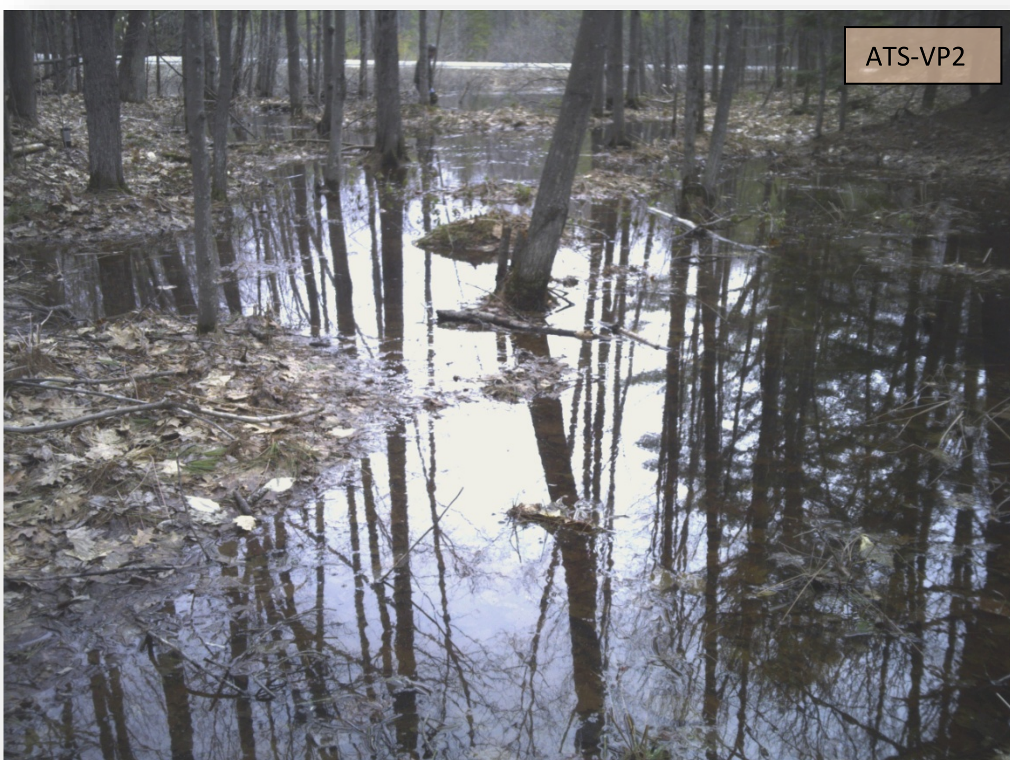
Filename: Auburn Vernal Pools Figure 6.mxd

Date: 27 May 2015

Appendix B

Photographs


ATS-VP1


ATS-VP2


ATS-VP3


ATS-VP4

Appendix C

Data Collection Forms

Maine State Vernal Pool Assessment Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: ATS - VP1 **MDIFW Pool ID:** ______

1. PRIMARY OBSERVER INFORMATION

a. Observer name: TIM BICKFORD, BARRY TURCOTTE

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ☒ same as observer ◯ other ______

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

c. Project Name: AUBURN TRAINING SITE VERNAL POOL ASSESSMENT

***NOTE:** Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required for nonprofessional observers and encouraged for all observers.*

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ◯ Yes ☒ No If no, was landowner permission obtained for survey? ☒ Yes ◯ No

b. Landowner's contact information (required)

Name: ARMY CORPS OF ENGINEERS Phone: ______

Street Address: ______ City: ______ State: ______ Zip: ______

c. ☐ Large Projects: check if separate project landowner data file submitted

4. VERNAL POOL LOCATION INFORMATION

a. **Location** Township: AUBURN

Brief site directions to the pool (using mapped landmarks):

WEST SIDE OF TRAIL NORTH OF FIRING RANGE

b. **Mapping Requirements:** At least 2 of the 3 must be submitted (check those submitted):

☐ USGS topographic map with pool clearly marked.

☐ Large scale aerial photograph with pool clearly marked.

☐ GPS data (complete section below).

GPS location of vernal pool

Longitude/Easting: 397027 Latitude/Northing: 4882767

Check Datum: ◯ NAD27 ☒ NAD83 / WGS84 Coordinate system: ______

Check one: ☒ GIS shapefile
- send to Jason.Czapiga@maine.gov; observer has reviewed shape accuracy (best)

◯ The pool perimeter is delineated by multiple GPS points. (excellent)
- Include map or spreadsheet with coordinates.

◯ The above GPS point is at the center of the pool. (good)

◯ The center of the pool is approximately ______ m◯ /ft ◯ in the compass direction of ______ degrees from the above GPS point. (acceptable)

Maine State Vernal Pool Assessment Form

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 4-30-15

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- (X) Isolated depression
- ( ) Floodplain depression
- ( ) Pool associated with larger wetland complex
- ( ) Other: ______

■ Check all wetland types that best apply to this pool:

- [X] Forested swamp
- [ ] Shrub swamp
- [ ] Peatland (fen or bog)
- [ ] Emergent marsh
- [ ] Wet meadow
- [ ] Lake or Pond Cove
- [ ] Abandoned beaver flowage
- [ ] Active beaver flowage
- [ ] Slow stream
- [ ] Floodplain
- [X] Isolated pool
- [ ] Other: ______

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: (X) Natural ( ) Natural-Modified ( ) Unnatural ( ) Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (required):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale for opinion.

- ( ) Permanent
- ( ) Semi-permanent (drying partially in all years and completely in drought years)
- ( ) Ephemeral (drying out completely in most years)
- (X) Unknown

Explain:

■ Maximum depth at survey: ( ) 0-12" (0-1 ft.) (X) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 50 ( ) m (X) ft Length: 75 ( ) m (X) ft

■ Predominate substrate in order of increasing hydroperiod:

- ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ( ) Mineral soil (sphagnum moss present)
- ( ) Organic matter (peat/muck) shallow or restricted to deepest portion
- (X) Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- [ ] Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- [X] Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- [ ] Sphagnum moss (anchored or suspended)
- [ ] Wet site ferns (e.g. royal fern, marsh fern)
- [ ] Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- [ ] Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- [ ] Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- [X] No vegetation in pool

■ Faunal indicators (check all that apply):

- [ ] Fish
- [ ] Bullfrog or Green Frog tadpoles
- [ ] Other: ______

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- (X) No inlet or outlet
- ( ) Intermittent inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ( ) Other or Unknown (explain): ______

Maine State Vernal Pool Assessment Form

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 4-30-15

b. Indicator abundance criteria

- Was the entire pool surveyed for egg masses? ☒ Yes ☐ No; what % of pool surveyed?________
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae					
	#			Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	52			3	[illegible]		M			/					
Spotted Salamander	51			3	[illegible]		M			/					
Blue-spotted Salamander	/									/					
Fairy Shrimp[3]	/														

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy Shrimp: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification* P	H	S	CL**	SPECIES	Method of Verification* P	H	S	CL**
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☒ SVP ☐ Potential SVP ☐ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

MIXED HARDWOOD (GREEN ASH, RED MAPLE) / WHITE PINE FOREST
~ 90% CANOPY COVER
CLUB MOSS, MOIST SITE FERNS AROUND EDGE

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401

NOTE: Digital submission (to Jason.Czapiga@maine.gov) of vernal pool field forms and photographs is only acceptable for projects with 3 or fewer assessed pools; larger projects must be mailed as hard copies.

For MDIFW use only Reviewed by MDIFW Date:________ Initials:________

This pool is: ☐ **Significant** ☐ **Potentially Significant but lacking critical data** ☐ **Not Significant due to:** ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Maine State Vernal Pool Assessment Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: ATS-VP2 **MDIFW Pool ID:** ____________

1. PRIMARY OBSERVER INFORMATION

a. Observer name: TIM BICKFORD, BARRY TURCOTTE

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ☒ same as observer ◯ other ____________

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

c. Project Name: AUBURN TRAINING SITE VERNAL POOL ASSESSMENT

NOTE: Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required for nonprofessional observers and encouraged for all observers.

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ☒ Yes ◯ No If no, was landowner permission obtained for survey? ◯ Yes ◯ No

b. Landowner's contact information (required)

Name: US Army Corps of Engineers Phone: 207-430-5923

Street Address: 194 Winthrop St City: Augusta State: ME Zip 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

4. VERNAL POOL LOCATION INFORMATION

a. **Location** Township: Auburn

Brief site directions to the pool (using mapped landmarks):

b. **Mapping Requirements:** At least 2 of the 3 must be submitted (check those submitted):

☐ USGS topographic map with pool clearly marked.

☐ Large scale aerial photograph with pool clearly marked.

☐ GPS data (complete section below).

GPS location of vernal pool

Longitude/Easting: 397340 Latitude/Northing: 4882535

Check Datum: ◯ NAD27 ☒ NAD83 / WGS84 Coordinate system: ____________

Check one: ◯ GIS shapefile
- send to Jason.Czapiga@maine.gov; observer has reviewed shape accuracy (best)

◯ The pool perimeter is delineated by multiple GPS points. (excellent)
- Include map or spreadsheet with coordinates.

◯ The above GPS point is at the center of the pool. (good)

◯ The center of the pool is approximately _____ m ◯ /ft ◯ in the compass direction of _____ degrees from the above GPS point. (acceptable)

Maine State Vernal Pool Assessment Form

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 4/30/15

b. Wetland habitat characterization

- Choose the best descriptor for the landscape setting:
  - [x] Isolated depression
  - [ ] Pool associated with larger wetland complex
  - [ ] Floodplain depression
  - [ ] Other: ______

- Check all wetland types that best apply to this pool:
  - [ ] Forested swamp
  - [ ] Wet meadow
  - [ ] Slow stream
  - [ ] Shrub swamp
  - [ ] Lake or Pond Cove
  - [ ] Floodplain
  - [ ] Peatland (fen or bog)
  - [ ] Abandoned beaver flowage
  - [x] Isolated pool
  - [ ] Emergent marsh
  - [ ] Active beaver flowage
  - [ ] Other: ______

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ( ) Natural ( ) Natural-Modified (x) Unnatural ( ) Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (required):

created by road

ii. Pool Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - ( ) Semi-permanent (drying partially in all years and completely in drought years)
  - ( ) Ephemeral (drying out completely in most years)
  - (x) Unknown

Explain:

- Maximum depth at survey: ( ) 0-12" (0-1 ft.) (x) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: 40 ( ) m (x) ft Length: 100 ( ) m (x) ft
- Predominate substrate in order of increasing hydroperiod:
  - ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ( ) Organic matter (peat/muck) shallow or restricted to deepest portion
  - ( ) Mineral soil (sphagnum moss present)
  - (x) Organic matter (peat/muck) deep and widespread
- Pool vegetation indicators in order of increasing hydroperiod (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
  - [ ] Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
  - [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [x] Sphagnum moss (anchored or suspended)
  - [ ] Wet site ferns (e.g. royal fern, marsh fern)
  - [ ] Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
  - [x] Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
  - [ ] No vegetation in pool
- Faunal indicators (check all that apply):
  - [ ] Fish
  - [ ] Bullfrog or Green Frog tadpoles
  - [ ] Other: ______

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- (x) No inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ( ) Intermittent inlet or outlet
- ( ) Other or Unknown (explain): ______

Maine State Vernal Pool Assessment Form

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 4/22/15

b. Indicator abundance criteria

- Was the entire pool surveyed for egg masses? (✓) Yes ( ) No; what % of pool surveyed?________
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae					
	#			Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	157			3			M								
Spotted Salamander															
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy Shrimp: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification* P	H	S	CL**	SPECIES	Method of Verification* P	H	S	CL**
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☑ SVP ☐ Potential SVP ☐ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Mixed Hardwood, red maple + Mature white pine. (80% cover)

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401

NOTE: Digital submission (to Jason.Czapiga@maine.gov) of vernal pool field forms and photographs is only acceptable for projects with 3 or fewer assessed pools; larger projects must be mailed as hard copies.

For MDIFW use only Reviewed by MDIFW Date:______ Initials:______

This pool is: ☐ **Significant** ☐ **Potentially Significant but lacking critical data** ☐ **Not Significant due to:** ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Maine State Vernal Pool Assessment Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: ATS-VP3 **MDIFW Pool ID:** ______

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Tim Bickford, Barry Turcotte

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ◯ other ______

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

c. Project Name: Auburn Vernal Pool Assessment

NOTE: ***Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required for nonprofessional observers and encouraged for all observers.***

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ◉ Yes ◯ No If no, was landowner permission obtained for survey? ◯ Yes ◯ No

b. Landowner's contact information (required)

Name: US Army Corps of Engineers Phone: 207-430-5923

Street Address: 194 Winthrop Street City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

4. VERNAL POOL LOCATION INFORMATION

a. **Location** Township: Auburn

Brief site directions to the pool (using mapped landmarks):

b. **Mapping Requirements:** At least 2 of the 3 must be submitted (check those submitted):

- ☐ USGS topographic map with pool clearly marked.
- ☒ Large scale aerial photograph with pool clearly marked.
- ☒ GPS data (complete section below).

GPS location of vernal pool

Longitude/Easting: 397151 Latitude/Northing: 4881913

Check Datum: ◯ NAD27 ◉ NAD83 / WGS84 Coordinate system: UTM

Check one:
- ◉ GIS shapefile
  - send to Jason.Czapiga@maine.gov; observer has reviewed shape accuracy (best)
- ◯ The pool perimeter is delineated by multiple GPS points. (excellent)
  - Include map or spreadsheet with coordinates.
- ◯ The above GPS point is at the center of the pool. (good)
- ◯ The center of the pool is approximately ____ m ◯ /ft ◯ in the compass direction of ____ degrees from the above GPS point. (acceptable)

Maine State Vernal Pool Assessment Form

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 4/30/15

b. Wetland habitat characterization

- Choose the best descriptor for the landscape setting:
  - (✓) Isolated depression
  - ( ) Pool associated with larger wetland complex
  - ( ) Floodplain depression
  - ( ) Other: ______
- Check all wetland types that best apply to this pool:
  - [x] Forested swamp
  - [ ] Wet meadow
  - [ ] Slow stream
  - [ ] Shrub swamp
  - [ ] Lake or Pond Cove
  - [ ] Floodplain
  - [ ] Peatland (fen or bog)
  - [ ] Abandoned beaver flowage
  - [ ] Isolated pool
  - [ ] Emergent marsh
  - [ ] Active beaver flowage
  - [ ] Other: ______

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: (✓) Natural ( ) Natural-Modified ( ) Unnatural ( ) Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (required):

ii. Pool Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ( ) Permanent
  - ( ) Semi-permanent (drying partially in all years and completely in drought years)
  - ( ) Ephemeral (drying out completely in most years)
  - (✓) Unknown

Explain:

- Maximum depth at survey: (✓) 0-12" (0-1 ft.) ( ) 12-36" (1-3 ft.) ( ) 36-60" (3-5 ft.) ( ) >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: 40 ( ) m (✓) ft Length: 150 ( ) m (✓) ft
- Predominate substrate in order of increasing hydroperiod:
  - ( ) Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ( ) Organic matter (peat/muck) shallow or restricted to deepest portion
  - ( ) Mineral soil (sphagnum moss present)
  - (✓) Organic matter (peat/muck) deep and widespread
- Pool vegetation indicators in order of increasing hydroperiod (check all that apply):
  - [ ] Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - [ ] Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
  - [ ] Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
  - [ ] Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - [ ] Sphagnum moss (anchored or suspended)
  - [ ] Wet site ferns (e.g. royal fern, marsh fern)
  - [ ] Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
  - [ ] Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
  - [ ] Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - [ ] Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
  - [x] No vegetation in pool
- Faunal indicators (check all that apply):
  - [ ] Fish
  - [ ] Bullfrog or Green Frog tadpoles
  - [ ] Other: ______

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- (✓) No inlet or outlet
- ( ) Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ( ) Intermittent inlet or outlet
- ( ) Other or Unknown (explain): ______

Maine State Vernal Pool Assessment Form

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 4|30|15

b. Indicator abundance criteria

- Was the entire pool surveyed for egg masses? ☑ Yes ☐ No; what % of pool surveyed?________
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae					
	#			Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog															
Spotted Salamander	10			3			M								
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy Shrimp: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification* P	H	S	CL**	SPECIES	Method of Verification* P	H	S	CL**
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Mixed wood Stand, Red Maple, Balsam Fir, white pine
90% cover

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401

NOTE: Digital submission (to Jason.Czapiga@maine.gov) of vernal pool field forms and photographs is only acceptable for projects with 3 or fewer assessed pools; larger projects must be mailed as hard copies.

For MDIFW use only Reviewed by MDIFW Date:______ Initials:______

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant due to:** ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Maine State Vernal Pool Assessment Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: ATS-VP4 **MDIFW Pool ID:** ______

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Tim Bickford, Barry Turcotte

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ○ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other ______

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ○ Yes

c. Project Name: Auburn Vernal Pool Assessment

***NOTE:** Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required for nonprofessional observers and encouraged for all observers.*

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ◉ Yes ○ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: US Army Corps of Engineers Phone: 207-430-5923

Street Address: 194 Winthrop Street City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Auburn

Brief site directions to the pool (using mapped landmarks):

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

☐ USGS topographic map with pool clearly marked.

☒ Large scale aerial photograph with pool clearly marked.

☒ GPS data (complete section below).

GPS location of vernal pool

Longitude/Easting: 397751 Latitude/Northing: 4882154

Check Datum: ○ NAD27 ◉ NAD83 / WGS84 Coordinate system: UTM

Check one: ◉ GIS shapefile
- send to Jason.Czapiga@maine.gov; observer has reviewed shape accuracy (best)

○ The pool perimeter is delineated by multiple GPS points. (excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (good)

○ The center of the pool is approximately ____ m○ /ft ○ in the compass direction of ____ degrees from the above GPS point. (acceptable)

Maine State Vernal Pool Assessment Form

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 4/30/15

b. Wetland habitat characterization

- Choose the best descriptor for the landscape setting:
  - ☑ Isolated depression
  - ☐ Pool associated with larger wetland complex
  - ☐ Floodplain depression
  - ☐ Other: ____________

- Check all wetland types that best apply to this pool:
  - ☐ Forested swamp
  - ☐ Wet meadow
  - ☐ Slow stream
  - ☐ Shrub swamp
  - ☐ Lake or Pond Cove
  - ☐ Floodplain
  - ☐ Peatland (fen or bog)
  - ☐ Abandoned beaver flowage
  - ☑ Isolated pool
  - ☐ Emergent marsh
  - ☐ Active beaver flowage
  - ☐ Other: ____________

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ☐ Natural ☐ Natural-Modified ☑ Unnatural ☐ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (required):

Development surrounds pool.

ii. Pool Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ☐ Permanent
  - ☐ Semi-permanent (drying partially in all years and completely in drought years)
  - ☐ Ephemeral (drying out completely in most years)
  - ☑ Unknown

Explain:

- Maximum depth at survey: ☑ 0-12" (0-1 ft.) ☐ 12-36" (1-3 ft.) ☐ 36-60" (3-5 ft.) ☐ >60" (>5 ft.)

- Approximate size of pool (at spring highwater): Width: _____ ☐ m ☐ ft Length: _____ ☐ m ☐ ft

- Predominate substrate in order of increasing hydroperiod:
  - ☐ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ☐ Organic matter (peat/muck) shallow or restricted to deepest portion
  - ☐ Mineral soil (sphagnum moss present)
  - ☑ Organic matter (peat/muck) deep and widespread

- Pool vegetation indicators in order of increasing hydroperiod (check all that apply):
  - ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
  - ☐ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
  - ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - ☐ Sphagnum moss (anchored or suspended)
  - ☐ Wet site ferns (e.g. royal fern, marsh fern)
  - ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
  - ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
  - ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
  - ☐ No vegetation in pool

- Faunal indicators (check all that apply):
  - ☐ Fish
  - ☐ Bullfrog or Green Frog tadpoles
  - ☐ Other: ____________

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ☐ No inlet or outlet
- ☐ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ☑ Intermittent inlet or outlet
- ☐ Other or Unknown (explain): ____________

Maine State Vernal Pool Assessment Form

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 4/30/15

b. Indicator abundance criteria

- Was the entire pool surveyed for egg masses? ◯ Yes ☑ No; what % of pool surveyed? 60%
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae					
	#			Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	42			3			M								
Spotted Salamander															
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy Shrimp: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. <u>Observations should be accompanied by photographs (labeled with observer name, pool location, and date)</u>.

SPECIES	Method of Verification* P	H	S	CL**	SPECIES	Method of Verification* P	H	S	CL**
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☑ Potential SVP ☐ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Red maple, white pine successional stand - 70% cover

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401

NOTE: Digital submission (to Jason.Czapiga@maine.gov) of vernal pool field forms and photographs is only acceptable for projects with 3 or fewer assessed pools; larger projects must be mailed as hard copies.

<u>For MDIFW use only</u> Reviewed by MDIFW Date:________ Initials:________

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant due to:** ◯ does not meet biological criteria. ◯ does not meet MDEP vernal pool criteria.

Comments:

Maine State Vernal Pool Assessment Form

INSTRUCTIONS: Complete all 3 pages of form as thoroughly as possible. Most fields are required for pool registration.

Observer's Pool ID: ATS-VPS **MDIFW Pool ID:** ______

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Tim Bickford, Barry Turcotte

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ✓ same as observer ◯ other ______

b. Contact and credentials previously provided? ◯ No (submit Addendum 1) ◯ Yes

c. Project Name: ______

***NOTE:** Clear photographs or digital images of a) the pool and b) the indicators (one example of each species egg mass) are required for nonprofessional observers and encouraged for all observers.*

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ✓ Yes ◯ No If no, was landowner permission obtained for survey? ◯ Yes ◯ No

b. Landowner's contact information (required)

Name: US Army Corps of Engineers Phone: 207-430-5923

Street Address: 194 Winthrop St. City: Augusta State: ME Zip: 04330

c. ☐ Large Projects: check if separate project landowner data file submitted

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Auburn

Brief site directions to the pool (using mapped landmarks):

b. Mapping Requirements: At least 2 of the 3 must be submitted (check those submitted):

☐ USGS topographic map with pool clearly marked.

☐ Large scale aerial photograph with pool clearly marked.

☐ GPS data (complete section below).

GPS location of vernal pool

Longitude/Easting: 397804 Latitude/Northing: 4881997

Check Datum: ◯ NAD27 ✓ NAD83 / WGS84 Coordinate system: ______

Check one:
- ◯ GIS shapefile
  - send to Jason.Czapiga@maine.gov; observer has reviewed shape accuracy (best)
- ◯ The pool perimeter is delineated by multiple GPS points. (excellent)
  - Include map or spreadsheet with coordinates.
- ◯ The above GPS point is at the center of the pool. (good)
- ◯ The center of the pool is approximately _____ m◯ /ft◯ in the compass direction of _____ degrees from the above GPS point. (acceptable)

Maine State Vernal Pool Assessment Form

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 4/30/15

b. Wetland habitat characterization

- Choose the best descriptor for the landscape setting:
  - ◯ Isolated depression
  - ✓ Pool associated with larger wetland complex
  - ◯ Floodplain depression
  - ◯ Other: ____

- Check all wetland types that best apply to this pool:
  - ☐ Forested swamp
  - ☐ Wet meadow
  - ☐ Slow stream
  - ☑ Shrub swamp
  - ☐ Lake or Pond Cove
  - ☐ Floodplain
  - ☐ Peatland (fen or bog)
  - ☐ Abandoned beaver flowage
  - ☐ Isolated pool
  - ☐ Emergent marsh
  - ☐ Active beaver flowage
  - ☐ Other: ____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◯ Natural ◯ Natural-Modified ✓ Unnatural ◯ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (required):

Created by MEARNG

ii. Pool Hydrology

- Select the pool's estimated hydroperiod AND provide rationale for opinion.
  - ◯ Permanent
  - ◯ Semi-permanent (drying partially in all years and completely in drought years)
  - ◯ Ephemeral (drying out completely in most years)
  - ✓ Unknown

Explain:

- Maximum depth at survey: ◯ 0-12" (0-1 ft.) ✓ 12-36" (1-3 ft.) ◯ 36-60" (3-5 ft.) ◯ >60" (>5 ft.)
- Approximate size of pool (at spring highwater): Width: ____ ◯ m ◯ ft Length: ____ ◯ m ◯ ft
- Predominate substrate in order of increasing hydroperiod:
  - ◯ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
  - ◯ Organic matter (peat/muck) shallow or restricted to deepest portion
  - ◯ Mineral soil (sphagnum moss present)
  - ✓ Organic matter (peat/muck) deep and widespread
- Pool vegetation indicators in order of increasing hydroperiod (check all that apply):
  - ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
  - ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
  - ☐ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
  - ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
  - ☑ Sphagnum moss (anchored or suspended)
  - ☐ Wet site ferns (e.g. royal fern, marsh fern)
  - ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
  - ☑ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
  - ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
  - ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
  - ☐ No vegetation in pool
- Faunal indicators (check all that apply):
  - ☐ Fish
  - ☐ Bullfrog or Green Frog tadpoles
  - ☐ Other: ____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ✓ No inlet or outlet
- ◯ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ◯ Intermittent inlet or outlet
- ◯ Other or Unknown (explain): ____

Maine State Vernal Pool Assessment Form

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 4/30/15

b. Indicator abundance criteria

- Was the entire pool surveyed for egg masses? ◯ Yes ◉ No; what % of pool surveyed? 80%
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae					
	#			Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	100+			3			H			Many			3		
Spotted Salamander															
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy Shrimp: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs (labeled with observer name, pool location, and date).

SPECIES	Method of Verification* P	H	S	CL**	SPECIES	Method of Verification* P	H	S	CL**
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☑ Potential SVP ☐ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Shrub wetland with pitch pine, WP, WB, GB, RM

Send completed form and supporting documentation to: Maine Dept. of Inland Fisheries and Wildlife
Attn: Vernal Pools
650 State Street, Bangor, ME 04401

NOTE: Digital submission (to Jason.Czapiga@maine.gov) of vernal pool field forms and photographs is only acceptable for projects with 3 or fewer assessed pools; larger projects must be mailed as hard copies.

For MDIFW use only Reviewed by MDIFW Date:________ Initials:________

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant due to:** ◯ does not meet biological criteria. ◯ does not meet MDEP vernal pool criteria.

Comments:

Appendix G

Climate Change

The following climate change information is taken from the Department of Defense's Climate Assessment Tool Regional Overview. The Regional Overview and Background and Context sections contain information consolidated from the 3rd and 4th National Climate Assessments (NCA3 and NCA4) produced by the U.S. Global Change Research Program (USGCRP) for Continental U.S., Alaska and Hawaii (CONUS/AK/HI) regions. Section 18 is included here which specifically addresses the Northeastern United States. Installation specific climate change assessments are not yet available for Maine locations. This section will be updated as further information becomes available

18 Northeast

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On the Web: https://nca2018.globalchange.gov/chapter/northeast

18 Northeast

Bartram Bridge in Pennsylvania

Key Message 1

Changing Seasons Affect Rural Ecosystems, Environments, and Economies

The seasonality of the Northeast is central to the region's sense of place and is an important driver of rural economies. Less distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and environments in ways that adversely impact tourism, farming, and forestry. The region's rural industries and livelihoods are at risk from further changes to forests, wildlife, snowpack, and streamflow.

Key Message 2

Changing Coastal and Ocean Habitats, Ecosystems Services, and Livelihoods

The Northeast's coast and ocean support commerce, tourism, and recreation that are important to the region's economy and way of life. Warmer ocean temperatures, sea level rise, and ocean acidification threaten these services. The adaptive capacity of marine ecosystems and coastal communities will influence ecological and socioeconomic outcomes as climate risks increase.

Key Message 3

Maintaining Urban Areas and Communities and Their Interconnectedness

The Northeast's urban centers and their interconnections are regional and national hubs for cultural and economic activity. Major negative impacts on critical infrastructure, urban economies, and nationally significant historic sites are already occurring and will become more common with a changing climate.

Key Message 4

Threats to Human Health

Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise. These environmental changes are expected to lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, and a lower quality of life. Health impacts are expected to vary by location, age, current health, and other characteristics of individuals and communities.

Key Message 5

Adaptation to Climate Change Is Underway

Communities in the Northeast are proactively planning and implementing actions to reduce risks posed by climate change. Using decision support tools to develop and apply adaptation strategies informs both the value of adopting solutions and the remaining challenges. Experience since the last assessment provides a foundation to advance future adaptation efforts.

Executive Summary

The distinct seasonality of the Northeast's climate supports a diverse natural landscape adapted to the extremes of cold, snowy winters and warm to hot, humid summers. This natural landscape provides the economic and cultural foundation for many rural communities, which are largely supported by a diverse range of agricultural, tourism, and natural resource-dependent industries (see Ch. 10: Ag & Rural, Key Message 4).[1] The recent dominant trend in precipitation throughout the Northeast has been towards increases in rainfall intensity,[2] with increases in intensity exceeding those in other regions of the contiguous United States. Further increases in rainfall intensity are expected,[3] with increases in total precipitation expected during the winter and spring but with little change in the summer.[4] Monthly precipitation in the Northeast is projected to be about 1 inch greater for December through April by end of century (2070–2100) under the higher scenario (RCP8.5).[4]

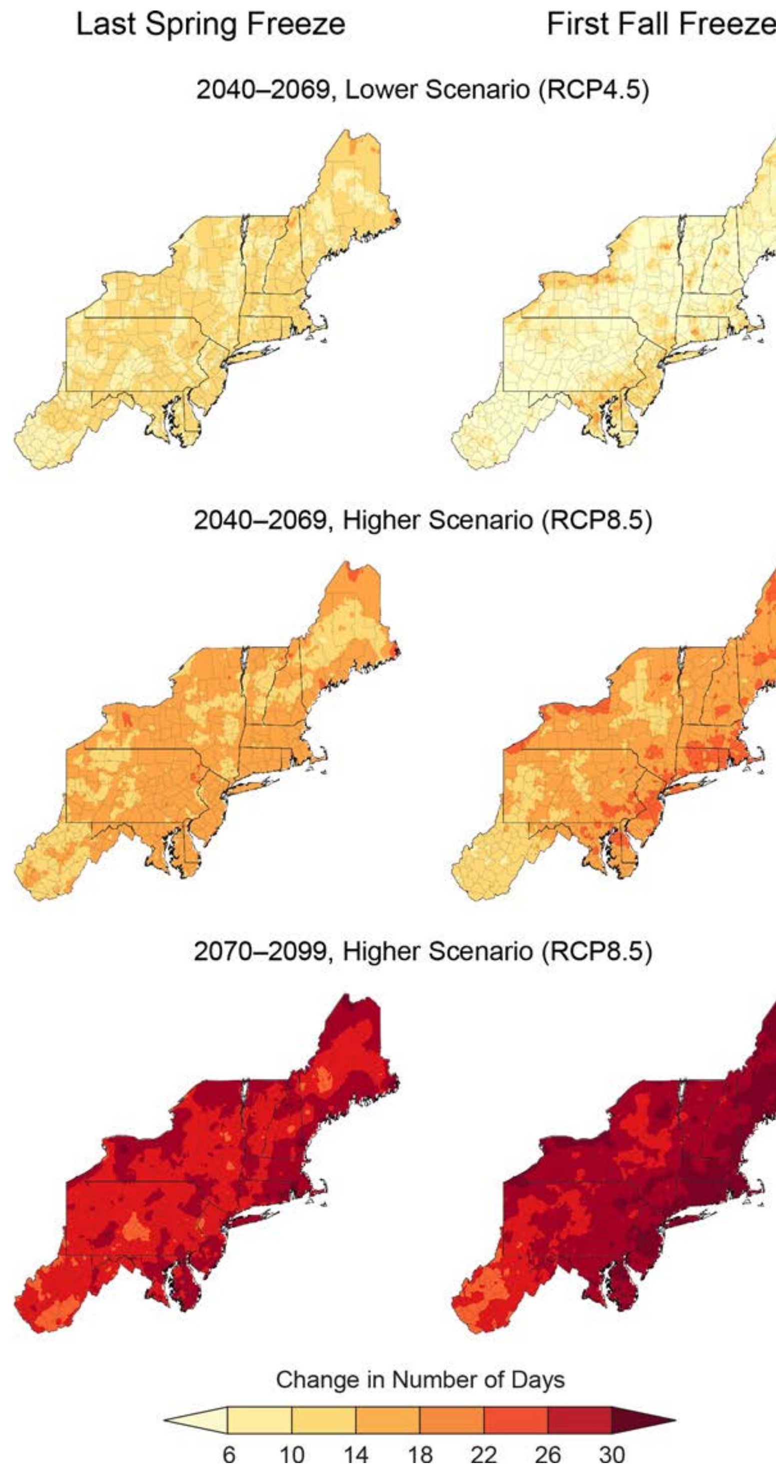
Ocean and coastal ecosystems are being affected by large changes in a variety of climate-related environmental conditions. These ecosystems support fishing and aquaculture,[5] tourism and recreation, and coastal communities.[6] Observed and projected increases in temperature, acidification, storm frequency and intensity, and sea levels are of particular concern for coastal and ocean ecosystems, as well as local communities and their interconnected social and economic systems. Increasing temperatures and changing seasonality on the Northeast Continental Shelf have affected marine organisms and the ecosystem in various ways. The warming trend experienced in the Northeast Continental Shelf has been associated with many fish and invertebrate species moving northward and to greater depths.[7,8,9,10,11] Because of the diversity of the Northeast's coastal landscape, the impacts from storms and sea level rise will vary at different locations along the coast.[12,13]

Northeastern cities, with their abundance of concrete and asphalt and relative lack of vegetation, tend to have higher temperatures than surrounding regions due to the urban heat island effect. During extreme heat events, nighttime temperatures in the region's big cities are generally several degrees higher than surrounding regions, leading to higher risk of heat-related death. Urban areas are at risk for large numbers of evacuated and displaced populations and damaged infrastructure due to both extreme precipitation events and recurrent flooding, potentially requiring significant emergency response efforts and consideration of a long-term commitment to rebuilding and adaptation, and/or support for relocation where needed. Much of the infrastructure in the Northeast, including drainage and sewer systems, flood and storm protection assets, transportation systems, and power supply, is nearing the end of its planned life expectancy. Climate-related disruptions will only exacerbate existing issues with aging infrastructure. Sea level rise has amplified storm impacts in the Northeast (Key Message 2), contributing to higher surges that extend farther inland, as demonstrated in New York City in the aftermath of Superstorm Sandy in 2012.[14,15,16] Service and resource supply infrastructure in the Northeast is at increasing risk of disruption, resulting in lower quality of life, economic declines, and increased social inequality.[17] Loss of public services affects the capacity of communities to function as administrative and economic centers and triggers disruptions of interconnected supply chains (Ch. 16: International, Key Message 1).

Increases in annual average temperatures across the Northeast range from less than 1°F (0.6°C) in West Virginia to about 3°F (1.7°C) or more in New England since 1901.[18,19] Although the relative risk of death on very hot days is lower today than it was a few decades ago, heat-related illness and death remain significant public health problems in the Northeast.[20,21,22,23] For example, a study in New York City estimated that in 2013 there were 133 excess deaths due to extreme heat.[24] These projected increases in temperature are expected to lead to substantially more premature deaths, hospital admissions, and emergency department visits across the Northeast.[23,25,26,27,28,29] For example, in the Northeast we can expect approximately 650 additional premature deaths per year from extreme heat by the year 2050 under either a lower (RCP4.5) or higher (RCP8.5) scenario and from 960 (under RCP4.5) to 2,300 (under RCP8.5) more premature deaths per year by 2090.[29]

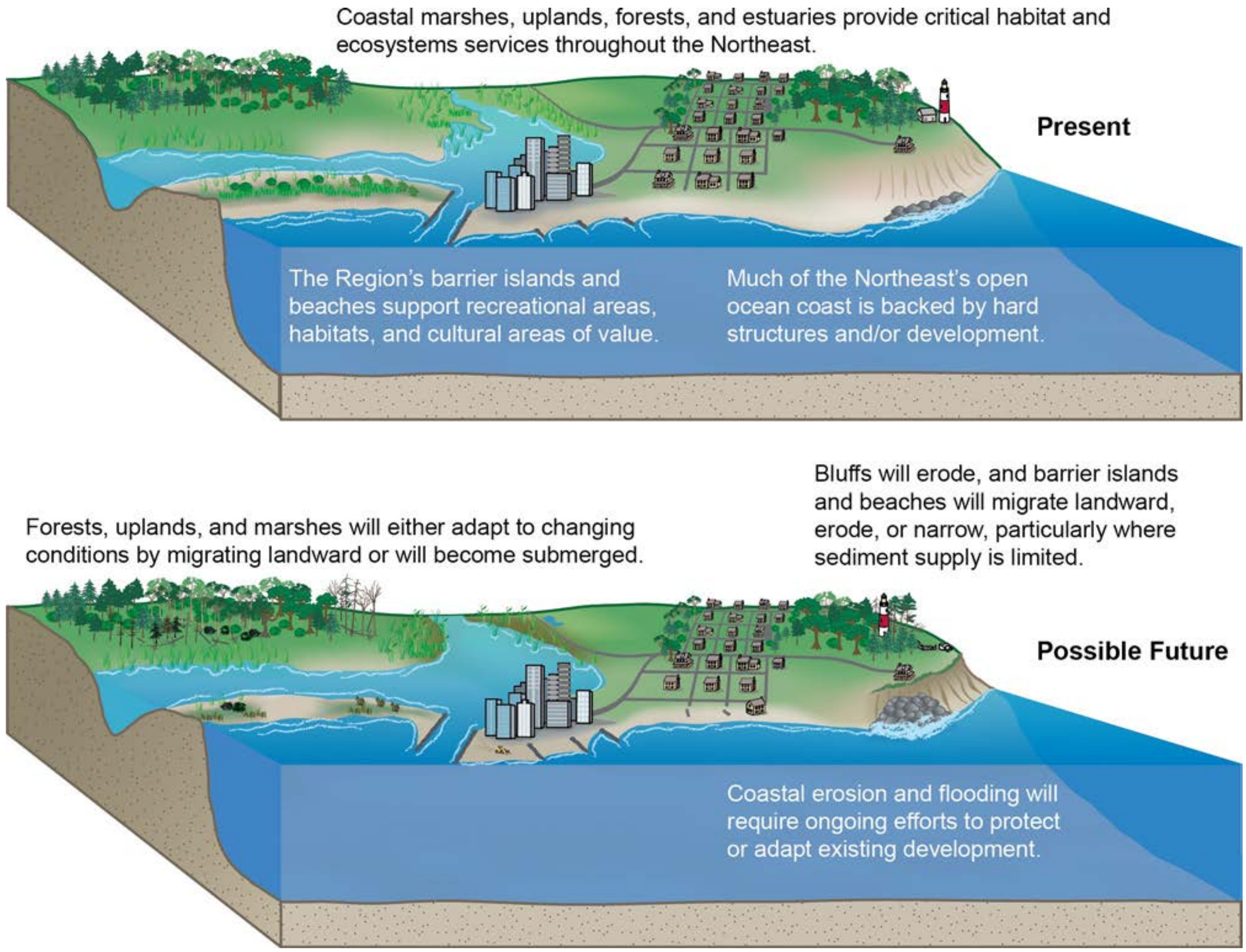
Communities, towns, cities, counties, states, and tribes across the Northeast are engaged in efforts to build resilience to environmental challenges and adapt to a changing climate. Developing and implementing climate adaptation strategies in daily practice often occur in collaboration with state and federal agencies (e.g., New Jersey Climate Adaptation Alliance 2017, New York Climate Clearinghouse 2017, Rhode Island STORMTOOLS 2017, EPA 2017, CDC 2015[30,31,32,33,34]). Advances in rural towns, cities, and suburban areas include low-cost adjustments of existing building codes and standards. In coastal areas, partnerships among local communities and federal and state agencies leverage federal adaptation tools and decision support frameworks (for example, NOAA's Digital Coast, USGS's Coastal Change Hazards Portal, and New Jersey's Getting to Resilience). Increasingly, cities and towns across the Northeast are developing or implementing plans for adaptation and resilience in the face of changing climate (e.g., EPA 2017[33]). The approaches are designed to maintain and enhance the everyday lives of residents and promote economic development. In some cities, adaptation planning has been used to respond to present and future challenges in the built environment. Regional efforts have recommended changes in design standards when building, replacing, or retrofitting infrastructure to account for a changing climate.

Lengthening of the Freeze-Free Period



These maps show projected shifts in the date of the last spring freeze (left column) and the date of the first fall freeze (right column) for the middle of the century (as compared to 1979–2008) under the lower scenario (RCP4.5; top row) and the higher scenario (RCP8.5; middle row). The bottom row shows the shift in these dates for the end of the century under the higher scenario. By the middle of the century, the freeze-free period across much of the Northeast is expected to lengthen by as much as two weeks under the lower scenario and by two to three weeks under the higher scenario. By the end of the century, the freeze-free period is expected to increase by at least three weeks over most of the region. *From Figure 18.3 (Source: adapted from Wolfe et al. 2018[35]).*

Coastal Impacts of Climate Change



(top) The northeastern coastal landscape is composed of uplands and forested areas, wetlands and estuarine systems, mainland and barrier beaches, bluffs, headlands, and rocky shores, as well as developed areas, all of which provide a variety of important services to people and species. (bottom) Future impacts from intense storm activity and sea level rise will vary across the landscape, requiring a variety of adaptation strategies if people, habitats, traditions, and livelihoods are to be protected. *From Figure 18.7 (Source: U.S. Geological Survey)*.

Background

The Northeast region is characterized by four distinct seasons and a diverse landscape that is central to the region's cultural identity, quality of life, and economic success. It is both the most heavily forested and most densely populated region in the country. Residents have ready access to beaches, forests, and other natural areas and use them heavily for recreation. Colorful autumn foliage, winter recreation, and summer vacations in the mountains or at the beach are all important parts of the Northeast's cultural identity, and this tourism contributes billions of dollars to the regional economy. The seasonal climate, natural systems, and accessibility of certain types of recreation are threatened by declining snow and ice, rising sea levels, and rising temperatures. By 2035, and under both lower and higher scenarios (RCP4.5 and RCP8.5), the Northeast is projected to be more than 3.6°F (2°C) warmer on average than during the preindustrial era. This would be the largest increase in the contiguous United States and would occur as much as two decades before global average temperatures reach a similar milestone.[36]

The region's oceans and coasts support a rich maritime heritage and provide an iconic landscape, as well as economic and ecological services. Highly productive marshes,[37,38] fisheries,[39,40] ecosystems,[41,42] and coastal infrastructure[43,44] are sensitive to changing environmental conditions, including shifts in temperature, ocean acidification, sea level, storm surge, flooding, and erosion. Many of these changes are already affecting coastal and marine ecosystems, posing increasing risks to people, traditions, infrastructure, and economies (e.g., Colburn et al. 2016[45]). These risks are exacerbated by increasing demands on these ecosystems to support human use and development. The Northeast has experienced some of the highest rates of sea level rise[46] and ocean warming[39] in the United States, and these exceptional increases relative to other regions are projected to continue through the end of the century.[47,48,49,50]

The Northeast is quite varied geographically, with a wide spectrum of communities including densely populated cities and metropolitan regions and relatively remote hamlets and villages (Figure 18.1). Rural and urban areas have distinct vulnerabilities, impacts, and adaptation responses to climate change.[51,52] The urbanized parts of the Northeast are dependent on the neighboring rural areas' natural and recreational services, while the rural communities are dependent on the economic vitality and wealth-generating capacity of the region's major cities. Rural and urban communities together are under increasing threat of climate change and the resulting impacts, and adaptation strategies reveal their interdependence and opportunities for successful climate resilience.[51] Rural–urban linkages[53,54,55] in the region could also be altered by climate change impacts.

In rural areas, community identity is often built around the prominence of small, multigenerational, owner-operated businesses and the natural resources of the local area. Climate variability can affect human migration patterns[56] and may change flows into or out of the Northeast as well as between rural and urban locations. Published research in this area, however, is limited. The Northeast has long been losing residents to other regions of the country.[57] Droughts and flooding can adversely affect ecosystem function, farm economic viability, and land use. Although future projections of major floods remain ambiguous, more intense precipitation events (Ch. 2: Climate, KM 6)[58] have increased the risk of some types of inland floods, particularly in valleys, where people, infrastructure, and agriculture tend to be concentrated. With little redundancy in their infrastructure and, therefore, limited economic resilience, many rural communities have limited ability to cope with climate-related changes.

Population Density

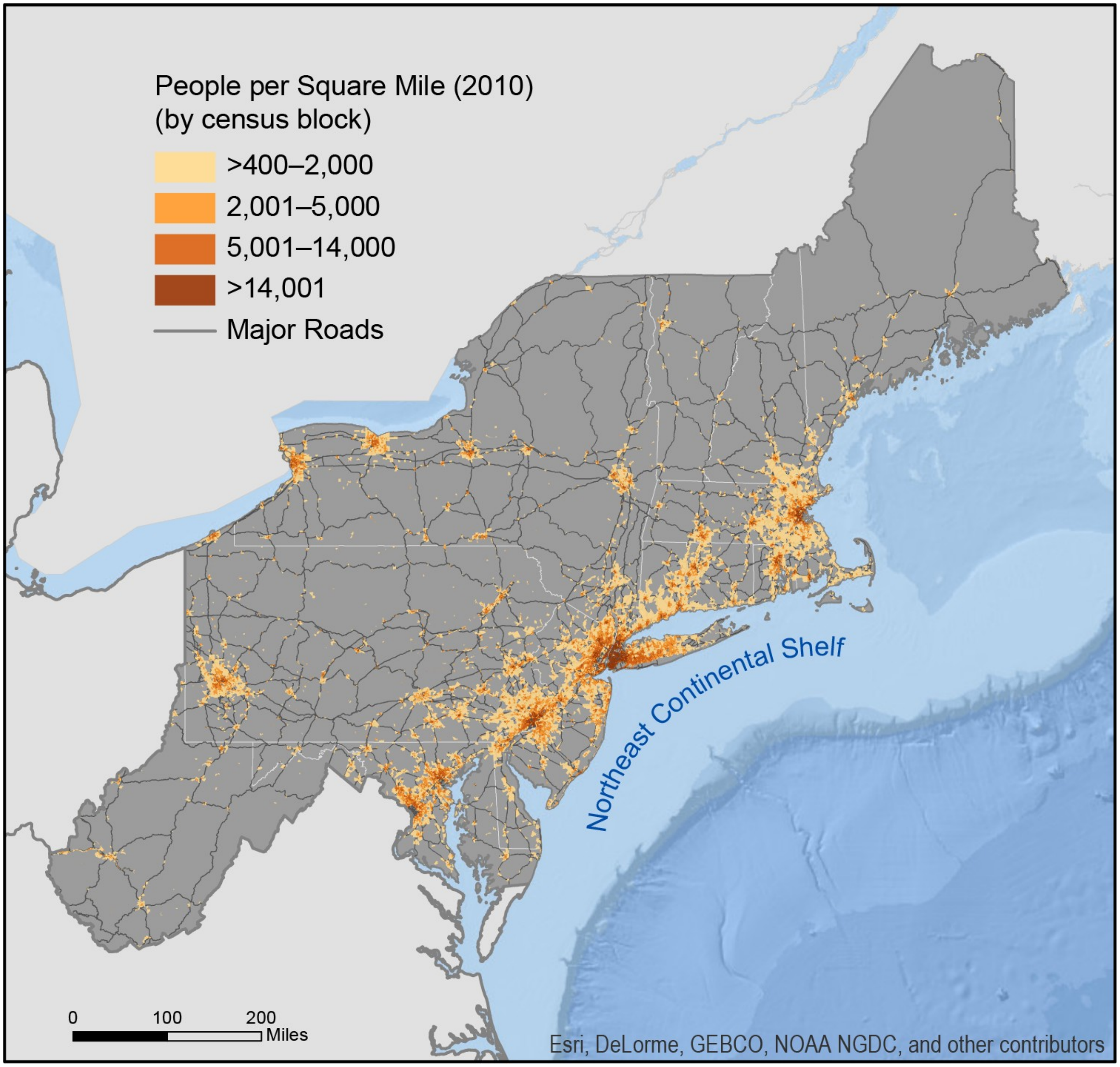


Figure 18.1: A map showing primary roads and population density highlights the diverse characteristics of the region in terms of settlement patterns, interconnections among population centers of varying sizes, and variability in relief across the ocean shelf. Sources: U.S. Department of Transportation, U.S. Geological Survey, and ERT, Inc. *This caption was revised in June 2019. See Errata for details: https://nca2018.globalchange.gov/downloads*

Residents in urban areas face multiple climate hazards, including temperature extremes, episodes of poor air quality, recurrent waterfront and coastal flooding, and intense precipitation events that can lead to increased flooding on urban streams. These physical changes may lead to large numbers of evacuated and displaced populations and damaged infrastructure; sustaining communities may require significant investment and planning to provide emergency response efforts, a long-term commitment to rebuilding and adaptation, and support for relocation. Underrepresented communities, such as the poor, elderly, language-isolated, and recent immigrants, are more vulnerable due to their limited ability to prepare for and cope with extreme weather and climate events.[59] Service infrastructure in the Northeast is at increasing risk of disruption, resulting in lower quality of life, economic declines, and enhanced social inequality.[17] Interdependencies across critical infrastructure sectors such as water, energy, transportation, and telecommunication (and related climate security issues) can lead to cascading failures during extreme weather and climate-related disruptions (Ch. 17: Complex Systems).[17,59,60] The region's high density of built environment sites and facilities, large number of historic structures, and older housing and infrastructure compared to other regions suggest that urban centers in the Northeast are particularly vulnerable to climate shifts and extreme weather events. For example, because much of the historical development of industry and commerce in New England occurred along rivers, canals, coasts, and other bodies of water, these areas often have a higher density of contaminated sites, waste management facilities, and petroleum storage facilities that are potentially vulnerable to flooding. As a result, increases in flood frequency or severity could increase the spread of contaminants into soils and waterways, resulting in increased risks to the health of nearby ecosystems, animals, and people—a set of phenomena well documented following Superstorm Sandy.[61,62,63]

The changing climate of the Northeast threatens the health and well-being of residents through environmental changes that lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, higher risk of infectious diseases, lower quality of life, and increased costs associated with healthcare utilization. Health impacts of climate change vary across people and communities of the Northeast and depend on social, socioeconomic, demographic, and societal factors; community adaptation efforts; and underlying individual vulnerability (see Key Message 5) (see also Ch. 28: Adaptation).

Maintaining functioning, sustainable communities in the face of climate change requires effective adaptation strategies that anticipate and buffer impacts, while also enabling communities to capitalize upon new opportunities. Many northeastern cities already have or are rapidly developing short-term and long-term plans to mitigate climate effects and to plan for efficient investments in sustainable development and long-term adaptation strategies. Although timely adaptation to climate-related impacts would help reduce threats to people's health, safety, economic well-being, and ways of life, changes to those societal elements will not be avoided completely.

Key Message 1

Changing Seasons Affect Rural Ecosystems, Environments, and Economies

The seasonality of the Northeast is central to the region's sense of place and is an important driver of rural economies. Less distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and environments in ways that adversely impact tourism, farming, and forestry. The region's rural industries and livelihoods are at risk from further changes to forests, wildlife, snowpack, and streamflow.

The distinct seasonality of the Northeast's climate supports a diverse natural landscape adapted to the extremes of cold, snowy winters and warm to hot, humid summers. This natural landscape provides the economic and cultural foundation for many rural communities, which are largely supported by a diverse range of agricultural, tourism, and natural resource-dependent industries (Ch. 10: Ag & Rural, KM 4).[1] The outdoor recreation industry contributes nearly $150 billion in consumer spending to the Northeast economy and supports more than one million jobs across the region.[64] Additionally, agriculture, fishing, forestry, and related industries together generate over $100 billion in economic activity annually, supporting more than half a million jobs in production and processing region-wide.[65] Projected changes in the Northeast's seasons will continue to affect terrestrial and aquatic ecosystems, forest productivity, agricultural land use, and other resource-based industries.[1] Alpine, freshwater aquatic, and certain forest habitats are most at risk.[66] Without efforts to mitigate climate change, warming winters and earlier spring conditions under a higher scenario (RCP8.5) will affect native ecosystems and the very character of the rural Northeast.[67]

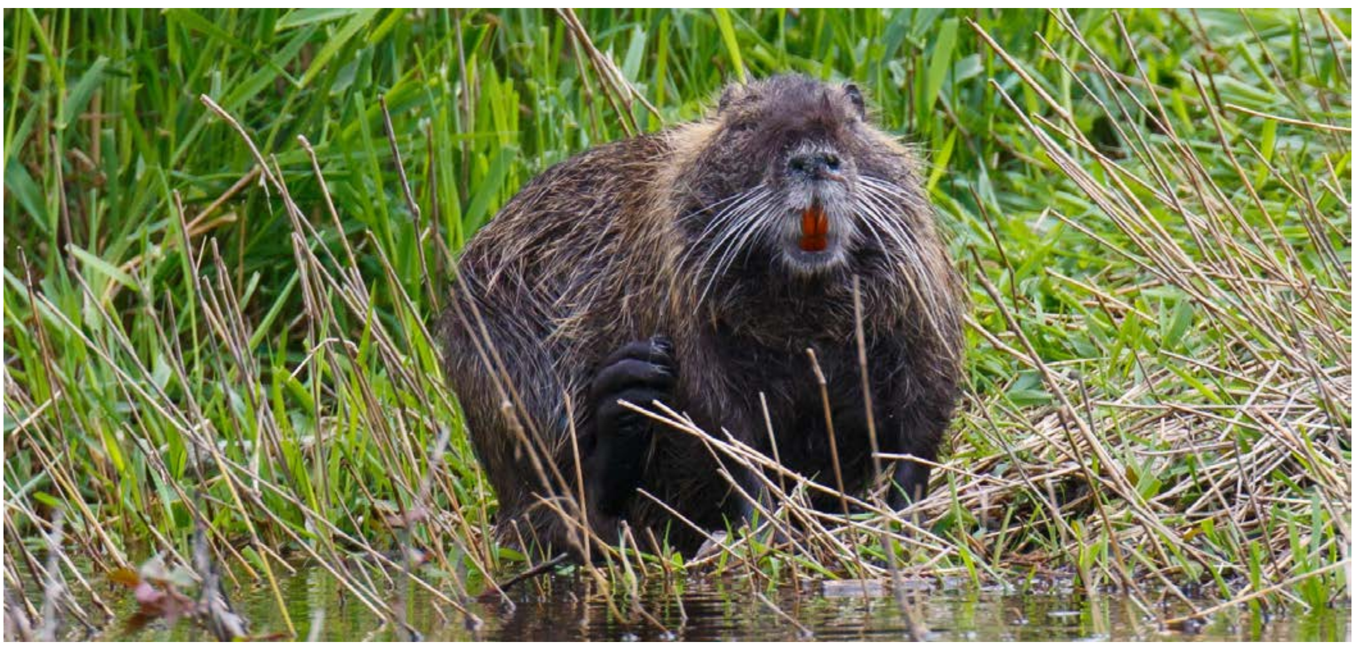
Seasonal differences in Northeast temperature have decreased in recent years as winters have warmed three times faster than summers.[3] By the middle of this century, winters are projected to be milder still, with fewer cold extremes, particularly across inland and northern portions of the Northeast.[3] This will likely result in a shorter and less pronounced cold season with fewer frost days and a longer transition out of winter into the growing season.[68] Under the higher scenario (RCP8.5), the trend of decreasing seasonality continues for the northern half of the region through the end of the century, but by then summer temperatures across the Mid-Atlantic are projected to rise faster than those in winter.[4]

A Changing Winter–Spring Transition

Forests are already responding to the ongoing shift to a warmer climate, and changes in the timing of leaf-out affect plant productivity, plant–animal interactions, and other essential ecosystem processes.[69,70] Warmer late-winter and early-spring temperatures in the Northeast have resulted in trends towards earlier leaf-out and blooming, including changes of 1.6 and 1.2 days per decade, respectively, for lilac and honeysuckle (Ch. 7: Ecosystems, Figure 7.3).[71] The increase in growing season length is partially responsible for observed increases in forest growth and carbon sequestration.[72]

While unusual winter or early-spring warmth has caused plants to start growing and emerge from winter dormancy earlier in the spring, the increased vulnerability of species to subsequent cold spells is yet unknown. Early emergence from winter dormancy causes plants to lose their tolerance to cold temperatures and risk damage by temperatures they would otherwise tolerate. Early budbreak followed by hard freezes has led to widespread loss of fruit crops and reduced seasonal growth of native tree species in the Northeast.[35,73]

Shifting seasonality can also negatively affect the health of forests (Ch. 6: Forests, KM 1) and wildlife, thereby impacting the rural industries dependent upon them. Warmer winters will likely contribute to earlier insect emergence[74] and expansion in the geographic range and population size of important tree pests such as the hemlock woolly adelgid, emerald ash borer, and southern pine beetle.[75,76,77] Increases in less desired herbivore populations are also likely, with white-tailed deer and nutria (exotic South American rodents) already being a major concern in different parts of the region.[78] According to State Farm Insurance,[79] motorists in West Virginia and Pennsylvania are already the first and third group of claimants most likely to file an insurance claim that is deer-related. Erosion from nutria feeding in lower Eastern Shore watersheds of Maryland has resulted in widespread conversion of marsh to shallow open water, changing important ecosystems that can buffer against the adverse impacts from climate change.[80] Species such as moose, which drive a multimillion-dollar tourism industry, are already experiencing increased parasite infections and deaths from ticks.[81,82,83] Warmer spring temperatures are associated with earlier arrivals of migratory songbirds,[84] while birds dependent upon spruce–fir forests in the northern and mountainous parts of the region are already declining and especially vulnerable to future change.[85] Northern and high-elevation tree species such as spruce and fir are among the most vulnerable to climate change in the Northeast.[70,86,87]



A nutria shows off its signature orange teeth. These large South American rodents are already a major concern in parts of the Northeast. Photo credit: ©Jason Erickson/iStock/Getty Images Plus.

Challenges for Natural Resource-Based Industries

Shorter, more moderate winters will present new challenges for rural industries. Poor surface and road conditions or washout have the potential to limit future logging operations, which need frozen or snow-covered soils to meet environmental requirements for winter operations.[70,88] Maple syrup production is linked to climate through potential shifts in sugar maple habitat,[89] tapping season timing and duration,[90,91] and the quality of both the trees and sap.[92,93] Climate change is making sugar maple tapping more challenging by increasing variability within and between seasons. Research into how the industry can adapt to these changes is ongoing.[89,94,95] With changes in weather and ecology come shifts in the cultural relationships to seasons as they have historically existed. Indigenous women from across these northeastern forests have come together to protect and sustain cultural traditions of the land they call Maple Nation. These climate impacts not only threaten the maple tree itself but also the seeds, soil, water, plants, and cultural lifeways that Indigenous peoples and tribal nations in the region associate with them.[96,97]

On the other hand, the impacts of warming on forests and ecosystems during the summer and autumn are less well understood.[98] In the summer, flowering in many agricultural crops and tree fruits is regulated in part by nighttime temperature, and growers risk lower yields as these temperatures rise.[35] Warmer autumn temperatures[98] influence processes such as leaf senescence (the change in leaf color as photosynthesis ceases), fruit ripening, insect phenology,[35] and the start of bird migration and animal hibernation.[99] October temperatures are the best predictor of leaf senescence in the northern hemisphere,[100] but other climatic factors can also shift the timing of autumn processes. Agricultural drought can advance leaf coloring and leaf drop, while abundant soil moisture can delay senescence.[101,102] Early frost events or strong winds can also result in sudden leaf senescence and loss.[98] Many deciduous trees are projected to experience an overall increase in their amount of autumn foliage color.[103]

As Northeast winters warm, scenarios project a combination of less early winter snowfall and earlier snowmelt, leading to a shorter snow season.[104,105] The proportion of winter precipitation falling as rain has already increased and will likely continue to do so in response to a northward shift in the snow–rain transition zone projected under both lower and higher scenarios (RCP4.5 and RCP8.5).[106,107,108] The shift in precipitation type and fewer days below freezing[3,4,35] are expected to result in fewer days with snow on the ground; decreased snow depth, water equivalent, and extent; an earlier snowmelt;[105,109,110] and less lake ice.[111] Warming during the winter–spring transition has already led to earlier snowmelt-related runoff in areas of the Northeast with substantial snowpack (Figure 18.2).[112] Earlier snowmelt-related runoff and lower spring peak streamflows in these areas are expected in the 2041–2095 period compared with the 1951–2005 period.[105]

Historical Changes in the Timing of Snowmelt-Related Streamflow

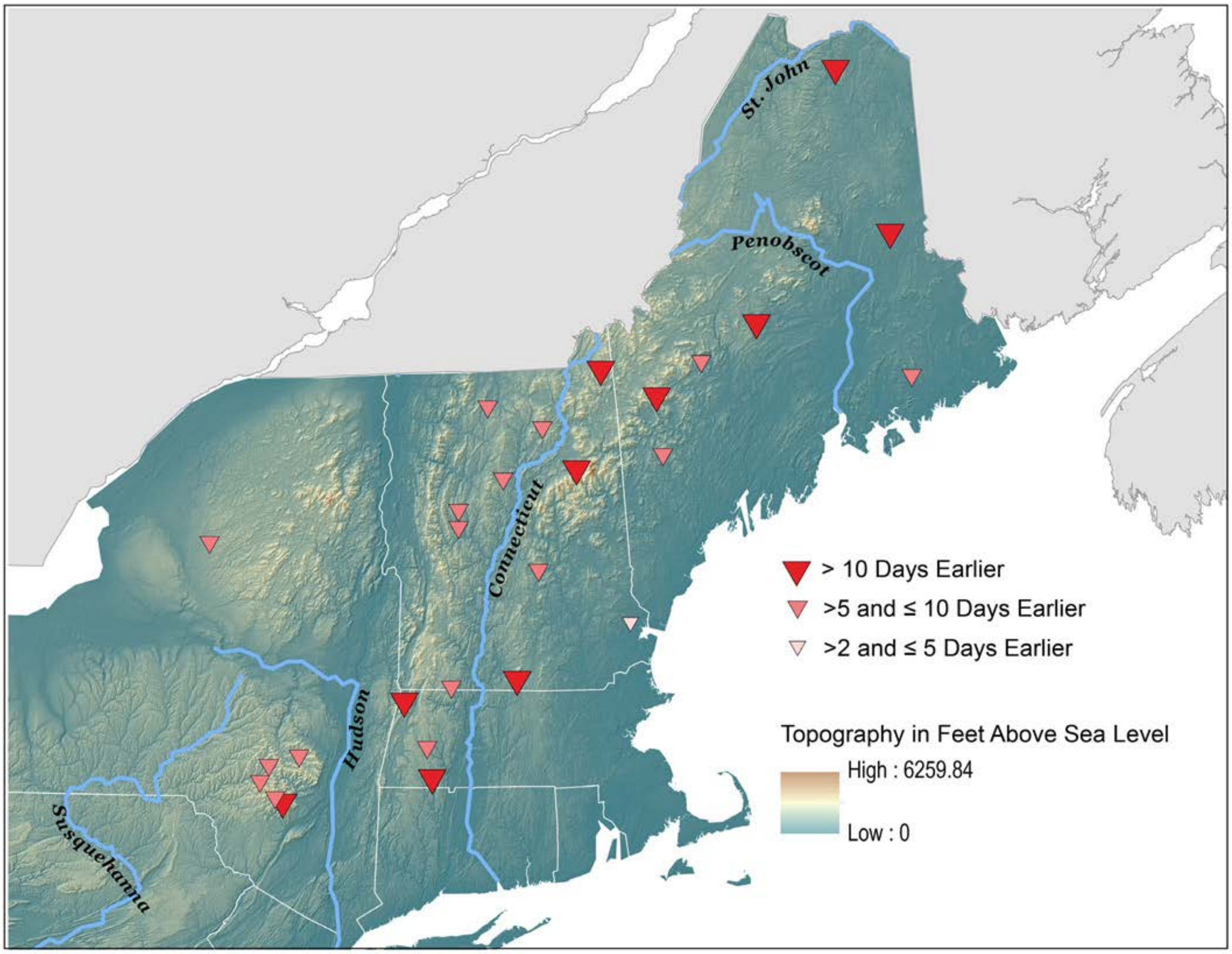


Figure 18.2: This map of part of the Northeast region shows consistently earlier snowmelt-related streamflow timing for rivers from 1960 to 2014. Each symbol represents the change for an individual river over the entire period. Changes in the timing of snowmelt potentially interfere with the reproduction of many aquatic species[113] and impact water-supply reservoir management because of higher winter flows and lower spring flows.[114] The timing of snowmelt-related streamflow in the Northeast is sensitive to small changes in air temperature. The average winter–spring air temperature increase of 1.67°F in the Northeast from 1940 to 2014 is thought to be the cause of average earlier streamflow timing of 7.7 days.[112] The timing of snowmelt-related streamflow is a valuable long-term indicator of winter–spring changes in the Northeast. Source: adapted from Dudley et al. 2017;[112] Digital Elevation Model CGIAR–CSI (CGIAR Consortium for Spatial Information). Reprinted with permission from Elsevier.

The Northeast winter recreation industry is an important economic resource for rural areas, supporting approximately 44,500 jobs and generating between $2.6–$2.7 billion in revenue annually.[115,116] Like other outdoor tourism industries, it is strongly influenced by weather and climate, making it particularly vulnerable to climate change.[116,117,118] Even under the lower scenario (RCP4.5), the average length of the winter recreation season and the number of recreational visits are projected to decrease by mid-century.[118] Under the same scenario, lost time for snowmaking is expected to delay the start of the ski season across southern areas, potentially impacting revenues during the winter holiday season. Activities that rely on natural snow and ice cover are projected to remain economically viable in only far northern parts of the region by end of century under the higher scenario (RCP8.5).[117,118]

Sensitivity to projected changes in winter climate varies geographically, and venues are adapting by investing in artificial snowmaking, opening higher-elevation trails, and offering a greater range of activities and services.[115,117] As the margin for an economically viable winter recreation season (a season with more than 100 days for skiing; more than 50 for snowmobiling) shifts northward and toward higher elevations, some affected areas will be able to extend their seasons with artificial snowmaking. However, the capacity of some vulnerable southern and low-elevation locations to adapt in the long term is expected to be limited by warming nighttime temperatures.[115,116,119] Markets farther north may benefit from a greater share of regional participation depending on recreationist preferences like travel time[118,120] and perceived snow cover conditions informed by local weather, referred to as the backyard effect.[121]

Intense Precipitation

The recent dominant trend in precipitation throughout the Northeast has been towards increases in rainfall intensity,[2,58] with recent increases in intensity exceeding those in other regions in the contiguous United States. Further increases in rainfall intensity are expected,[3] with increases in precipitation expected during the winter and spring with little change in the summer.[4] Monthly precipitation in the Northeast is projected to be about 1 inch greater for December through April by end of century (2070–2100) under the higher scenario (RCP8.5).[4]

Studies suggest that Northeast agriculture, with nearly $21 billion in annual commodity sales,[122] will benefit from the changing climate over the next half-century[35,123] due to greater productivity over a longer growing season (Figure 18.3) (see also Ch. 10: Ag & Rural). However, excess moisture is already a leading cause of crop loss in the Northeast.[35] Recent and projected increases in precipitation amount, intensity, and persistence[124,125] indicate increasing impacts on agricultural operations. Increased precipitation can result in soil compaction,[126] delays in planting, and reductions in the number of days when fields are workable.[127] If the trend in the frequency of heavy rainfall prior to the last frost continues, overly wet fields could potentially prevent Northeast farmers from taking full advantage of an earlier spring.[35] Increased soil erosion and agricultural runoff—including manure, fertilizer, and pesticides[128,129]—are linked to excess nutrient loading of water bodies as well as possible food safety or public health issues from food and waterborne infections.[130] Warmer winters are likely to increase livestock productivity in the Northeast[129] but are expected to also increase pressure from weeds and pests,[35] demand for pesticides,[128] and the risk of human health effects from increased chemical exposures.[130]

The projected changes in precipitation intensity and temperature seasonality would also affect streams and the biological communities that live in them. Freshwater aquatic ecosystems are vulnerable to changes in streamflow, higher temperatures, and reduced water quality.[131] Such ecosystems are especially vulnerable to increases in high flows, decreases in low flows, and the timing of snowmelt.[113,132,133] The impact of heavy precipitation on streamflows partly depends upon watershed conditions such as prior soil moisture and snowpack conditions, which vary throughout the year.[134,135,136,137] Although the annual minimum streamflows have increased during the last century,[138,139,140] late-summer warming[4,141] could lead to decreases in the minimum streamflows in the late summer and early fall by mid-century.[142]

Species that are particularly vulnerable to temperature and flow changes include stream invertebrates, freshwater mussels, amphibians, and coldwater fish.[66,131,143] For example, a recent study of the habitat suitable for dragonflies and damselflies (species that are a good indicator of ecosystem health along rivers) in the Northeast projected, under both the lower and higher scenarios (RCP4.5 and RCP8.5), habitat declines of 45%–99% by 2080, depending on the species.[144] Other particularly vulnerable groups include species with water-dependent habitats, such as salamanders and coldwater fish.[66,145] Increasing temperatures within freshwater streams threaten coldwater fisheries across northern New England and south through the Appalachian Mountains. A decrease in recreational fishing revenue is expected by end of this century under a higher scenario (RCP8.5) with the loss of coldwater habitat.[29,131,146]

Lengthening of the Freeze-Free Period

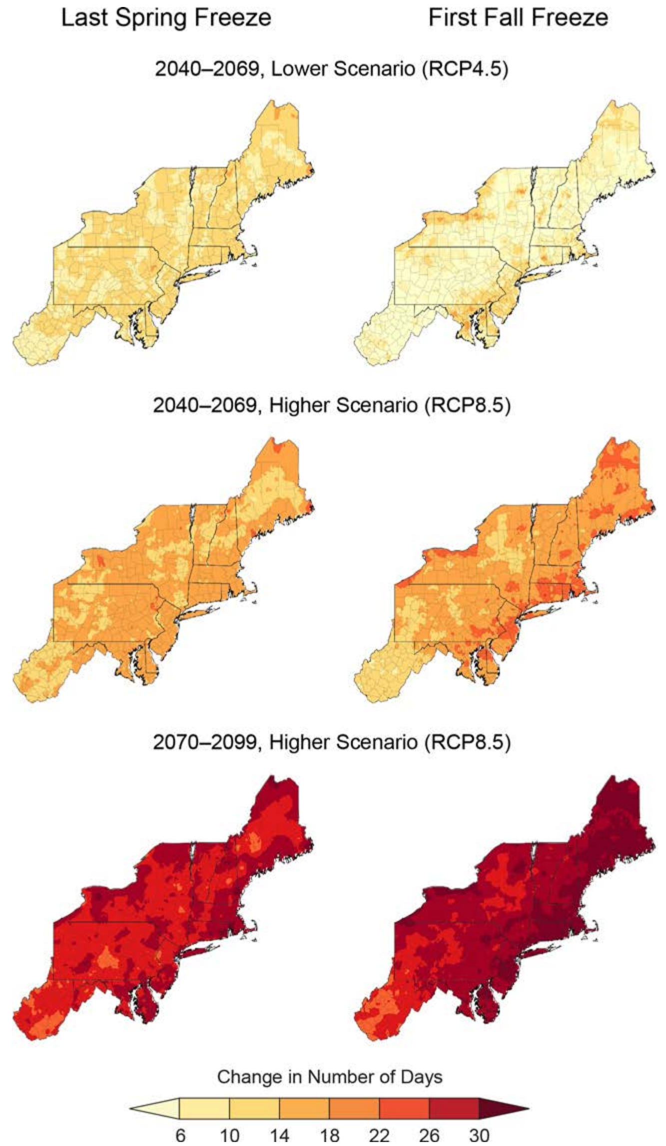


Figure 18.3: These maps show projected shifts in the date of the last spring freeze (left column) and the date of the first fall freeze (right column) for the middle of the century (as compared to 1979–2008) under the lower scenario (RCP4.5; top row) and the higher scenario (RCP8.5; middle row). The bottom row shows the shift in these dates for the end of the century under the higher scenario. By the middle of the century, the freeze-free period across much of the Northeast is expected to lengthen by as much as two weeks under the lower scenario and by two to three weeks under the higher scenario. By the end of the century, the freeze-free period is expected to increase by at least three weeks over most of the region. Source: adapted from Wolfe et al. 2018.[35]

Key Message 2

Changing Coastal and Ocean Habitats, Ecosystem Services, and Livelihoods

The Northeast's coast and ocean support commerce, tourism, and recreation that are important to the region's economy and way of life. Warmer ocean temperatures, sea level rise, and ocean acidification threaten these services. The adaptive capacity of marine ecosystems and coastal communities will influence ecological and socioeconomic outcomes as climate risks increase.

Ocean and coastal ecosystems are being affected by large changes in a variety of climate-related environmental conditions. These ecosystems support fishing and aquaculture,[5] tourism and recreation, and coastal communities.[6] They also provide important ecosystem services (benefits to people provided by the functions of various ecosystems), including carbon sequestration,[147] wave attenuation,[148,149] and fish[150] and shorebird[151] habitats. Observed and projected increases in temperature, acidification, storm frequency and intensity, and sea levels are of particular concern for coastal and ocean ecosystems, as well as local communities and their interconnected social and economic systems (Box 18.1).

Change in Sea Surface Temperature on the Northeast Continental Shelf

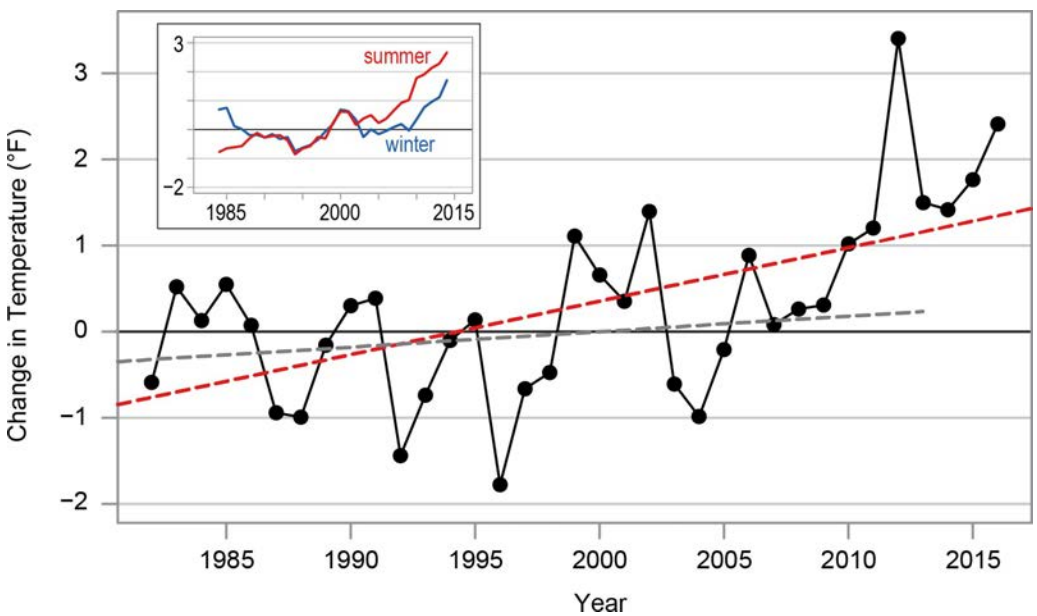


Figure 18.4: The figure shows annual average sea surface temperature (SST) differences from the 1982–2011 average (black dots and line). Over the period 1982–2016, sea surface temperature on the Northeast Continental Shelf has warmed at a rate of 0.06°F (0.033°C) per year (red dashed line). This rate is three times faster than the 1982–2013 global SST warming rate of 0.018°F (0.01°C) per year (gray dotted line).[39] The inset shows Northeast Continental Shelf seasonal SST differences from the 1982–2011 average as five-year rolling means for summer (July, August, September; red line) and winter (January, February, March; blue line). These seasons are centered on the warmest (summer) and coolest (winter) months for Northeast Shelf SSTs. Both seasons have warmed over the time period, but the summer warming rate has been stronger. Source: Gulf of Maine Research Institute.

Ocean Warming

Ocean and coastal temperatures along the Northeast Continental Shelf have warmed by 0.06°F (0.033°C) per year over the period 1982–2016 (Figure 18.4), which is three times faster than the 1982–2013 global average rate of 0.018°F (0.01°C) per year.[39] Over the last decade (2007–2016), the regional warming rate has been four times faster than the long-term trend, with temperatures rising 0.25°F (0.14°C) per year (Figure 18.4). Variability in ocean temperatures over the Northeast Continental Shelf (see Figure 18.1 for the location) has been related to the northern position of the Gulf Stream, the volume of water entering from the Labrador Current, and large-scale background warming of the oceans.[39,48,152,153] In addition to this warming trend, seasonality is also changing. Warming has been strongest during the summer months, and the duration of summer-like sea surface temperatures has expanded.[154] In parts of the Gulf of Maine, the summer-like season lengthened by two days per year since 1982, largely due to later fall cooling; the summer-like period expanded less rapidly (about 1 day per year) in the Mid-Atlantic, primarily due to earlier spring warming.[154]

Increasing temperatures and changing seasonality on the Northeast Continental Shelf have affected marine organisms and the ecosystem in various ways (Ch. 7: Ecosystems, KM 1; Ch. 9: Oceans). Seasonal ocean temperature changes have shifted characteristics of the spring phytoplankton blooms[158] and the timing of fish and invertebrate reproduction,[163,164] migration of marine fish that return to freshwater to spawn,[165,166] and marine fisheries.[155] As the timing of ecosystem conditions and biological events shifts, interactions between species and human activities such as fishing or whale watching will likely be affected.[42,155,163,166,167,168] These changes have the potential to affect economic activity and social features of fishing communities, working waterfronts, travel and tourism, and other natural resource-dependent local economies.

The warming trend experienced in the Northeast Continental Shelf has been associated with many fish and invertebrate species moving northward and to greater depths (Ch. 1: Overview, Figure 1.2h).[7,8,9,10,11] As these shifts have occurred, communities of animals present in a given area have changed substantially.[169] Species interactions can be affected if species do not shift at the same rate; generally, species groups appear to be moving together,[10] but overlap between pairs of specific species has changed.[42]

Rising ocean temperatures have also affected the productivity of marine populations. Species at the southern extent of their range, such as northern shrimp, surf clams, and Atlantic cod, are declining as waters warm,[39,170,171] while other species, such as black sea bass, are experiencing increased productivity.[11] Some species, such as American lobster and surf clam, have declined in southern regions where temperatures have exceeded their biological tolerances but have increased in northern areas as warming waters have enhanced their productivity.[40,171,172,173] The productivity of some harvested and cultured species may also be indirectly influenced by changing levels of marine pathogens and diseases. For example, increasing prevalence of shell disease in lobsters and several pathogens in oysters have been associated with rising water temperatures;[174,175] other pathogens that infect shellfish pose risks to human health (see Key Message 4).

Temperature-related changes in the distribution and productivity of species are affecting fisheries. Some fishermen now travel farther to catch certain species[176] or target new species that are becoming more prevalent as waters warm.[155] However, these types of responses do not always keep pace with ecosystem change due to constraints associated with markets, shoreside infrastructure, and regulatory limits such as access to quota licenses or permits.[177,178,179] In addition, stock assessment and fishery management processes do not explicitly account for temperature influences on the managed species. In the case of Gulf of Maine cod, rising temperatures have been associated with changes in recruitment, growth, and mortality; failure to account for declining productivity as a result of warming led to catch advice that allowed for overfishing on the stock.[39,180] Proactive conservation and management measures can support climate resilience of fished species. For example, long-standing industry and management measures to protect female and large lobsters have supported the growth of the Gulf of Maine–Georges Bank stock

Box 18.1: Ocean Heat Wave Provides Glimpse of Climate Future

In 2012, sea surface temperatures on the Northeast Continental Shelf rose approximately 3.6°F (2°C) above the 1982–2011 average. This departure from normal was similar in magnitude to the changes projected for the end of the century under the higher scenario (RCP8.5) and represented the largest, most intense warm water event ever observed in the Northwest Atlantic Ocean (Ch. 9: Oceans).[155,156,157] This heat wave altered seasonal cycles of phytoplankton and zooplankton,[158,159] brought Mid-Atlantic fish species into the Gulf of Maine,[155] and altered the occurrence of North Atlantic right whales in the Gulf of Maine.[160] Commercial fisheries were also affected. A fishery for squid developed quickly along the coast of Maine, but the New England lobster fishery was negatively affected. Specifically, early spring warming triggered an early start of the fishing season, creating a glut of lobster in the supply chain and leading to a severe price collapse.[155] During 2012, the dockside price for lobster hit its lowest level in the past decade and dropped from an average per-pound value of $3.62 for June and July 2000–2011 to just $2.37 in those months in 2012. The experience during the 2012 ocean heat wave revealed vulnerabilities in the lobster industry and prompted a variety of adaptive responses, such as expanding processing capacity and further developing domestic and international markets[161] in an attempt to buffer against similar industry impacts in the future. Although an outlier when compared with our current climate, the ocean temperatures in 2012 were well within the range projected for the region by the end of the century under the higher scenario (RCP8.5).[162] The 2012 ocean heat wave provided a glimpse of impacts affecting ecological and social systems, and experiences during this event can serve as a stress test to guide adaptation planning in years to come (akin to 2015 in the Northwest) (see Ch. 24: Northwest, Box 24.7).

Ocean Heat Wave of 2012

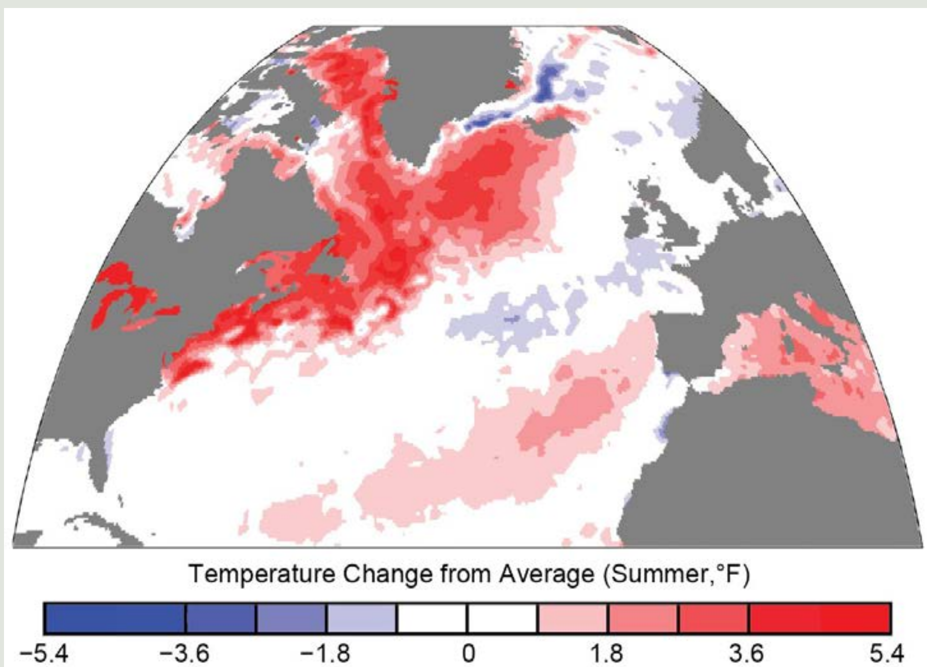


Figure 18.5: The map shows the difference between sea surface temperatures (SST) for June–August 2012 in the Northwest Atlantic and the average values for those months in 1982–2011.[155] While ocean temperatures during 2012 were exceptionally high compared to the current climate, they were within the range of end-of-century temperatures projected for the region under the higher scenario (RCP8.5). This heat wave affected the Northeast Continental Shelf ecosystem and fisheries, and similar extreme events are expected to become more common in the future (Ch. 9: Oceans). Source: adapted from Mills et al. 2013.[155] Reprinted with permission from Elsevier.

as waters warmed, but the lack of these measures in southern New England exacerbated declines in that stock as temperatures increased.[40]

Ocean Acidification

In addition to warming, coastal waters in the Northeast, particularly in the Gulf of Maine, are sensitive to the effects of ocean acidification because they have a low capacity for maintaining stable pH levels.[181,182] These waters are particularly vulnerable to acidification due to hypoxia (low-oxygen conditions)[183] and freshwater inputs, which are expected to increase as climate change progresses.[142,181,184] At the coastal margins, acidification is exacerbated by nutrient loading from land-based runoff and atmospheric deposition during heavy rainfall events. When added to the system, these nutrients promote the growth of algae that release carbon dioxide, which contributes to acidification, as they decay.[185]

Fisheries and aquaculture rely on shell-forming organisms that can suffer in more acidic conditions (Ch. 9: Oceans).[181,182,186] Some of the most valuable wild- and culture-based fisheries in the region harvest shelled organisms—including lobsters, scallops, blue crabs, oysters, surf clams, and mussels.[5] To date, there have been few studies of how local populations and different life stages will be affected by ocean acidification,[182] but actions taken by industry to counter the potential negative impacts are emerging. For example, when an oyster hatchery in Maine experienced low survival rates of larval oysters following exposure to low pH water during large runoff events, it collaborated with scientists to develop systems to monitor and control carbonate conditions in the facility (Ch. 9: Oceans).[187]

Future Projections of Ocean Warming and Acidification

Climate projections indicate that in the future, the ocean over the Northeast Continental Shelf will experience more warming than most other marine ecosystems around the world.[48,49] Continued warming and acidification are expected to further affect species and fisheries in the region. Future projections indicate that declines in the density of a zooplankton species, *Calanus finmarchicus*—an important food source for many fish and whales in the Northeast Shelf region—will occur as waters continue to warm through the end of the century.[188] Northward species distribution trends are projected to continue as ocean waters warm further.[189] A species vulnerability assessment indicated that approximately 50% of the commercial, forage, and protected fish and invertebrate species on the Northeast Continental Shelf will be highly or very highly vulnerable to climate change through 2050 under the higher scenario (RCP8.5).[143] In general, species in the southern portion of the region are expected to remain stable through mid-century, but many species in the northern portion are expected to be negatively affected by warming and acidification over that timeframe.[143,186] Species population models projected forward under future ocean conditions also indicate declines of species that support some of the most valuable and iconic fisheries in the Northeast, including Atlantic cod,[39,190] Atlantic sea scallops,[191] and American lobster.[40] In addition, species that are already endangered and federally protected in the Northeast—such as Atlantic sturgeon, Atlantic salmon, and right whales—are expected to be further threatened by climate change.[192,193,194,195]

Changes in Distribution and Abundance of Marine Species

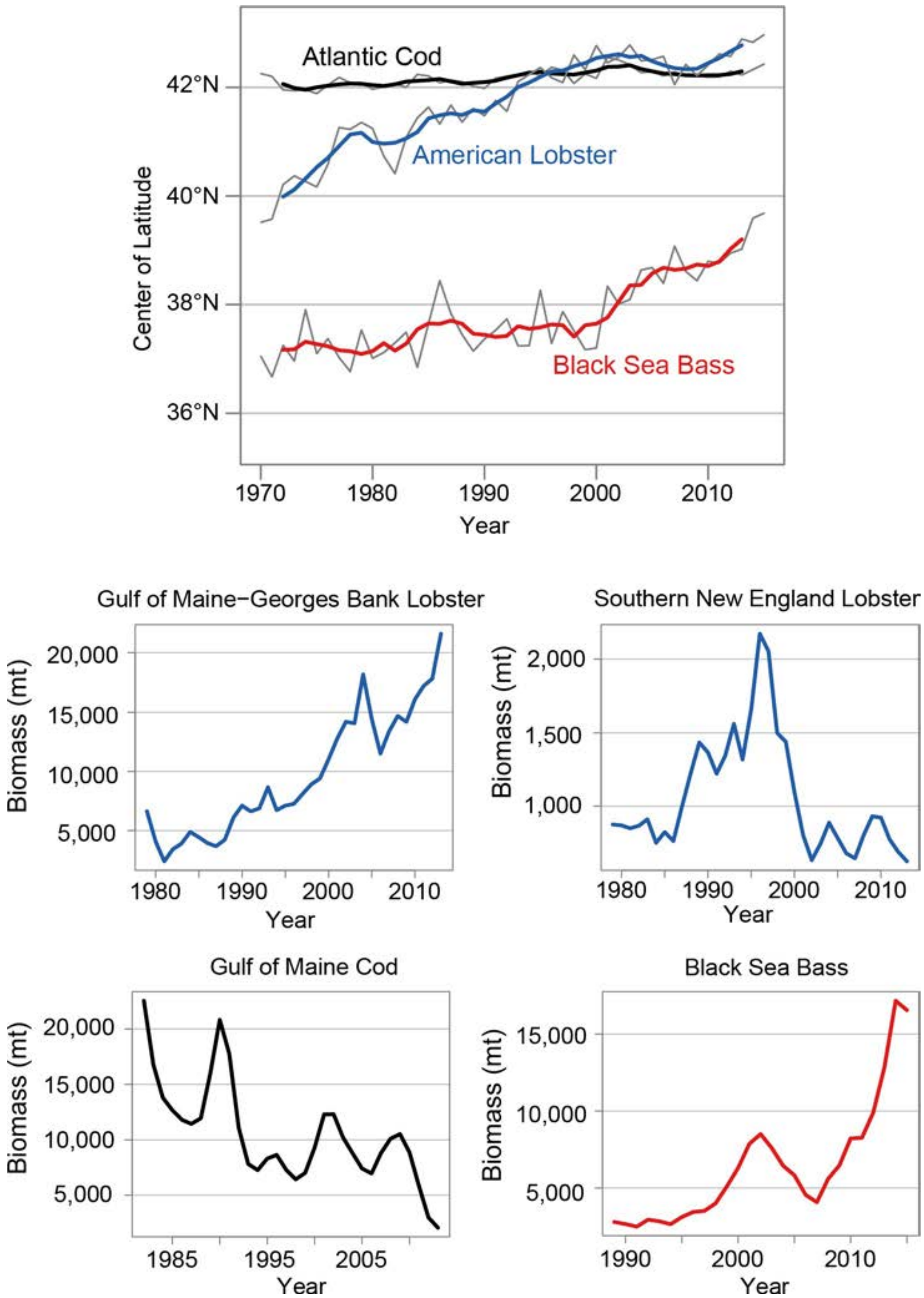


Figure 18.6: The figure shows changes over time in geographic distribution (top panel) and biomass (four bottom panels) for various marine species along the Northeast Shelf. As waters in the region have warmed, the spatial distributions of many fish species have been shifting northward, while population trends of several marine species show more variability over time. The top panel shows shifts in spatial distribution over time for select fish species, based on their latitudinal centers of biomass. The four panels on the bottom show biomass estimates for the same marine resource stocks. Gulf of Maine cod, a coldwater species, has not shifted in location but has declined in biomass, while black sea bass (a warmwater species) has moved northward and increased in biomass as waters have warmed. The lobster distribution shift reflects declines in productivity of the southern stock and increasing biomass of the northern stock. Sources: (black sea bass) adapted from Northeast Fisheries Science Center 2017;[204] (all others) Gulf of Maine Research Institute.

A number of coastal communities in the Northeast region have strong social and cultural ties to marine fisheries, and in some communities, fisheries represent an important economic activity as well.[196,197] Future ocean warming and acidification, which are expected under all scenarios considered, would affect fish stocks and fishing opportunities available to coastal communities. Fisheries targeting species at the southern extent of their range have already experienced substantial declines in landings with rising ocean temperatures,[170,173,198,199,200] and this pattern is projected to continue in the future (e.g., Cooley et al. 2015, Pershing et al. 2015, Le Bris et al. 2018[39,40,191]). Fishers may need to travel farther to fishing locations for species they currently catch,[189] increasing fuel and crew costs. Distribution shifts (Figure 18.6) can also create opportunities to target new species moving into an area.[155] The impacts and opportunities associated with these changes will not be evenly shared within or among fisheries, fleets, or communities; as such, adaptation may alter social dynamics, cultural ties, and economic benefits.[201,202,203]

Sea Level Rise, Storms, and Flooding

Along the Mid-Atlantic coast (from Cape Hatteras, North Carolina, to Cape Cod, Massachusetts), several decades of tide gauge data through 2009 have shown that sea level rise rates were three to four times higher than the global average rate.[46,205,206] The region's sea level rise rates are increased by land subsidence (sinking)—largely due to vertical land movement related to the melting of glaciers from the last ice age—which leaves much of the land in this region sinking with respect to current sea level.[47,207,208,209] Additionally, shorter-term fluctuations in the variability of ocean dynamics,[210,211] atmospheric shifts,[212,213] and ice mass loss from Greenland and Antarctica[214] have been connected to these recent accelerations in the sea level rise rate in the region. For example, a slowdown of the Gulf Stream during a shorter period of extreme sea level rise observed over 2009–2010 has been linked to a weakening of the Atlantic meridional overturning circulation—the northward flow of upper-level warm, salty waters in the Atlantic (including the Gulf Stream current) and the southward flow of colder, deeper waters.[215] These higher-than-average rates of sea level rise measured in the Northeast have also led to a 100%–200% increase in high tide flooding in some places, causing more persistent and frequent (so-called nuisance flooding) impacts over the last few decades.[44,47,216,217]

Coastal flood risks from storm-driven precipitation and surges are major drivers of coastal change[218,219] and are also amplified by sea level increases.[217,220,221] Storms have unique climatological features in the Northeast—Nor'easters (named for the low-pressure systems typically impacting New England and the Mid-Atlantic with strong northeasterly winds blowing from the ocean over coastal areas) typically occur between September and April, and when coupled with the Atlantic hurricane season between June and September, the region is susceptible to major storms nearly year-round. Storm flood heights driven by hurricanes in New York City increased by more than 3.9 feet (1.2 m) over the last thousand years.[14] When coupled with storm surges, sea level rise can pose severe risks of flooding, with consequent physical and mental health impacts on coastal populations (see Key Messages 4 and 5).

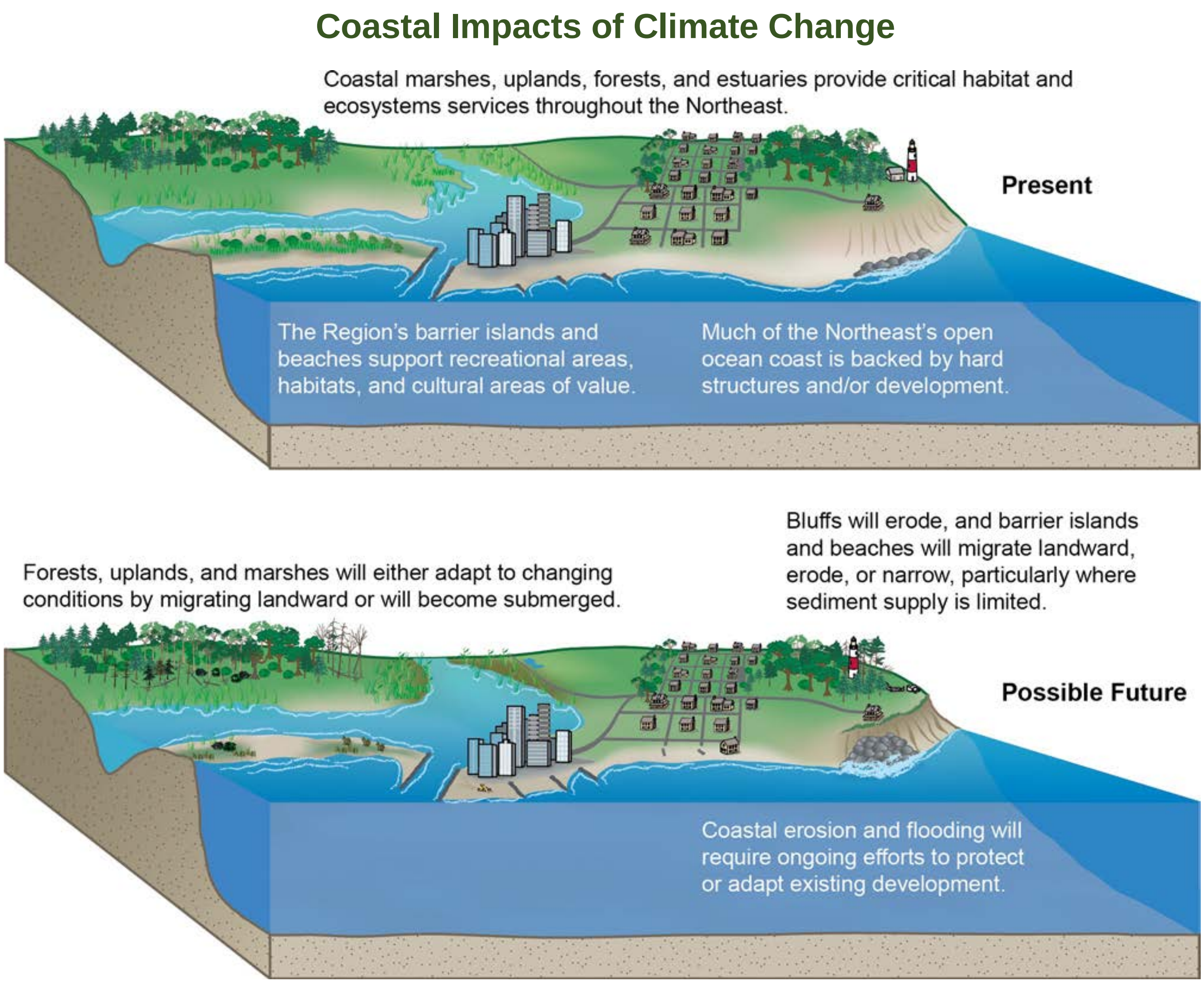


Figure 18.7: (top) The northeastern coastal landscape is composed of uplands and forested areas, wetlands and estuarine systems, mainland and barrier beaches, bluffs, headlands, and rocky shores, as well as developed areas, all of which provide a variety of important services to people and species. (bottom) Future impacts from intense storm activity and sea level rise will vary across the landscape, requiring a variety of adaptation strategies if people, habitats, traditions, and livelihoods are to be protected. Source: U.S. Geological Survey.

Landscape Change and Impacts on Ecosystems Services

Because of the diversity of the Northeast's coastal landscape, the impacts from storms and sea level rise will vary at different locations along the coast (Figure 18.7).[12,13] Rocky and heavily developed coasts have limited infiltration capacity to absorb these impacts, and thus, these low-elevation areas will become gradually inundated.[222,223] However, more dynamic environments, such as mainland and barrier beaches, bluffs, and coastal wetlands, have evolved over thousands of years in response to physical drivers. Such responses include erosion, overwashing, vertical accretion (increasing elevation due to sediment movement), flooding in response to storm events,[218,224,225] and landward migration over the longer term as sea level has risen.[226] Uplands, forests, and agricultural lands can provide transitional areas for these more dynamic settings, wherein the land gradually converts to a tidal marsh.

Varied ecosystem services and natural features have long attracted and sustained people along the coast of the Northeast region. Ecosystem services—including the provisioning of groundwater resources, the filtering of non-point source pollution, sequestering carbon, mitigating storm impacts and erosion, and sustaining working waterfronts and cultural features such as iconic regional landscapes, recreation, and traditions—are facing multiple climate threats. Marshes and beaches serve as the first line of defense for coastal property and infrastructure in the face of storms.[227] They also provide critical habitat for a variety of migratory shorebirds and, when combined with nearshore seagrass and estuaries, serve as nurseries for many commercial marine species.[37,38,150,151,228,229] Regional marshes trap and store carbon[147,230,231,232] and help to capture non-point source pollution before it enters seawater.[233,234,235] Regional beaches are important tourist and recreational attractions, and many coastal national parks and national historic sites throughout the region help preserve cultural heritage and iconic coastal landscapes.[236,237] The Northeast coast is also home to many Indigenous peoples whose traditions and ways of life are deeply tied to land and water (Box 18.2). Coastal tribes often have limited resources, infrastructure, and land ownership, and these limitations can worsen the impacts of climate change and prohibit relocation (Ch. 15: Tribes, KM 1 and 3).

Box 18.2: Indigenous Peoples and Tribal Nations

Indigenous peoples and tribal nations of the Northeast region have millennia-long relationships with the diverse landscapes and climate zones found throughout the region.[238,239,240] Currently, for the 18 federally recognized, numerous state-recognized, and federally unrecognized tribal nations of the Northeast,[241,242] the challenges of adapting to a changing climate add additional uncertainty to existing efforts for reclamation of land and sovereignty and the revitalization of languages and cultures (Ch. 15: Tribes, KM 1 and 3).[97,243] However, in response to a regional shift in the seasons, there has been an increase in climate adaptation work by tribes over the last decade (Ch.15: Tribes, Figure 15.1). These projects have been framed by Indigenous knowledges to address impacts to culturally and economically important resources and species, such as brown ash, sweetgrass, forests, and sugar maple, as well inland and ocean fisheries.[238,244,245,246] These projects provide important results for the tribal nations themselves but could also provide examples of adaptation and survival for other tribal nations and non-tribal communities to consider as they work towards a deeper and more complex engagement to address future landscapes.[97,240] Although not all tribally led climate research and projects across regions have been reported or published, there are even fewer publicly available examples in the Northeast region, and especially for state-recognized and unrecognized tribes. This seems to present itself as a potential future research opportunity for tribal engagement and collaborations in the Northeast (Ch. 15: Tribes).[97]

Projections of Future Sea Level Rise and Coastal Flooding

Projections for the region suggest that sea level rise in the Northeast will be greater than the global average of approximately 0.12 inches (3 mm) per year.[247,248] According to Sweet et al. (2017),[47] the more probable sea level rise scenarios—the Intermediate-Low and Intermediate scenarios from a recent federal interagency sea level rise report (App. 3: Data & Scenarios)—project sea level rise of 2 feet and 4.5 feet (0.6 m and 1.4 m) on average in the region by 2100, respectively.[47] The worst-case and lowest-probability scenarios, however, project that sea levels in the region would rise upwards of 11 feet (3 m) on average by the end of the century.[47] The higher projections for the region as compared with most others in the United States are due to continued changes in oceanic and atmospheric dynamics, thermal expansion, ice melt contributions from Greenland and Antarctica, and ongoing subsidence in the region due to tectonics and non-tectonic effects such as groundwater withdrawal.[47,50,249,250,251,252] Furthermore, the strongest hurricanes are anticipated to become both more frequent and more intense in the future, with greater amounts of precipitation (Ch. 2: Climate, Box 2.5).[50,253,254,255] Thirty-two percent of open-coast north and Mid-Atlantic beaches are predicted to overwash during an intense future nor'easter type storm,[256] a number that increases to more than 80% during a Category 4 hurricane.[257,258]

Future Adaptability of the Coastal Landscape

The dynamic ability of coastal ecosystems to adapt to climate-driven changes depends heavily upon sufficient sediment supply, elevation and slope, barriers to migration,[225] tidal restrictions, wave climatology,[219,259] and the rates of sea level rise. Although nearly 70% of the Northeast coast has some physical ability to dynamically change,[13] an estimated 88% of the Northeast population lives on developed coastal landforms that have limited ability to naturally adapt to sea level rise.[260] Built infrastructure along the coast, such as seawalls, bulkheads, and revetments, as well as natural barriers, such as coastal bluffs, limits landward erosion; jetties and groins interrupt alongshore sediment supply; and culverts and dams create tidal restrictions that can limit habitat suitability for fish communities (see Figure 18.7).[261] An estimated 26% of open ocean coast from Maine to Virginia contains engineering structures.[262] While these structures can help mitigate hazards to people and property, they also reduce the land area for ecosystem migration, as well as the adaptive capacity of natural coastal environments.[43,227,263,264] The ability of marshes in the region to respond to sea level-induced change varies by location, with some areas increasing in elevation, experiencing vegetation shifts, and/or expanding in extent while others are not.[265,266,267,268,269,270,271] Forest diebacks, or "ghost forests," due to wetland encroachment[70,272] are being observed in southern New Jersey and Maryland (Figure 18.8), although one study found that southern New England forests are not showing similar signs of dieback.[273]

Forest Dieback Due to Sea Level Rise

Figure 18.8: Atlantic white cedars dying near the banks of the Bass River in New Jersey show wetland encroachment on forested areas. Photo credit: Ted Blanco/Climate Central.

Projected changes in climate will threaten the integrity of coastal landforms and ecosystems that provide services people and animals rely on and that act as important natural buffers to hazards. Under more extreme scenarios (such as the higher scenario, RCP8.5), marshes are unlikely to survive and, thus, would convert to open water.[224,274,275] At lower rates of sea level rise, marsh health will depend heavily upon site-specific hydrologic, physical, and sediment supply conditions.[259,275,276,277,278] Long-term coastal erosion, as driven by sea level rise and storms, is projected to continue, with one study finding the shoreline likely to erode inland at rates of at least 3.3 feet (1 m) per year among 30% of sandy beaches along the U.S. Atlantic coast.[279] Continued increases in the rate of sea level rise—on the order of 0.08 inches (2 mm) per year above the 20th-century rate—could cause much of the open ocean coasts in the Mid-Atlantic to transition to a state wherein coastal barrier systems migrate landward more rapidly, experience reductions in width or height, and overwash and breach more frequently.[280] Such an increase is projected to occur this century under the Intermediate-Low scenario, which suggests that global sea levels will rise approximately 0.24 inches (6 mm) per year.[47]

An ongoing challenge, now and in the future, is to adequately account for and determine the monetary value of the ecosystem services provided by marine and coastal environments[6,41,281] and to adaptively manage the ecosystems to achieve targets that are responsive to both development and conservation.[282]

These changes to the coastal landscape would threaten the sustainability of communities and their livelihoods. Historical settlement patterns and ongoing development combine to increase the regional vulnerability of coastal communities to sea level rise, coastal storms, and increased inundation during high tides and minor storms. For example, estimates of coastal property losses and protective investments through 2100 due to sea level rise and storm surge vary from less than $15 billion for southeastern Massachusetts to in excess of $30 billion for coastal New Jersey and Delaware under either the lower (RCP4.5) or higher (RCP8.5) scenarios (discounted at 3%).[29] Saltwater intrusion can also impact drinking water supplies, including the alteration of groundwater systems.[283,284] A growing area of research explores potential migration patterns in response to climate-related coastal impacts, where coastal states such as Massachusetts, New Jersey, and New York are anticipated to see large outflows of migrants, a pattern that would stress regional locations further inland.[285] In addition to property and infrastructure impacts (Key Message 3), the facilities and cultural resources that support coastal tourism and recreation (such as parking lots, pavilions, and boardwalks), as well as cultural landscapes and historic structures,[236,237] will be at increased risk from high tide flooding, storm surge, and long-term inundation. In some locations, these culturally and socially important structures also support economic activity; for example, many fishing communities rely on small docks and other shoreside infrastructure for their fishing operations, increasing the risk of substantial disruption if they are lost to sea level rise and increasing storm frequency.[45,286]

Key Message 3

Maintaining Urban Areas and Communities and Their Interconnectedness

The Northeast's urban centers and their interconnections are regional and national hubs for cultural and economic activity. Major negative impacts on critical infrastructure, urban economies, and nationally significant historic sites are already occurring and will become more common with a changing climate.

Climate–Infrastructure Interaction and Heightened Risks

Northeastern cities, with their abundance of concrete and asphalt and relative lack of vegetation, tend to have higher temperatures than surrounding regions due to the urban heat island effect (increased temperatures, typically measured during overnight periods, in highly urbanized areas in comparison to outlying suburban, exurban, and rural locations). During extreme heat events, nighttime temperatures in the region's big cities are generally several degrees higher than surrounding regions, leading to higher risk of heat-related death. In urban areas, the hottest days in the Northeast are also often associated with high concentrations of urban air pollutants including ground-level ozone (Ch. 13: Air Quality, KM 1). This combination of heat stress and poor urban air quality can pose a major health risk to vulnerable groups: young children, elderly, socially or linguistically isolated, economically disadvantaged, and those with preexisting health conditions, including asthma. Vulnerability is further heightened as key infrastructure, including electricity for air conditioning, is more likely to fail precisely when it is most needed—when demand exceeds available supply—with the potential for substantial negative health consequences.[287] Finally, vulnerability to heat waves is not evenly distributed throughout the region. Rather, outdoor versus indoor air temperatures, baseline health, occupation, and access to air conditioning are important determinants of vulnerability (see Key Message 4).

Urban areas are at risk for large numbers of evacuated and displaced populations and damaged infrastructure due to both extreme precipitation events and recurrent flooding, potentially requiring significant emergency response efforts and consideration of long-term commitment to rebuilding and adaptation, and/or support for relocation where needed. Poor, elderly, historically marginalized, recent immigrants, and linguistically or socially isolated individuals as well as those populations with existing health disparities are more vulnerable to precipitation events and flooding due to a limited ability to prepare for and cope with such events.[59]

Critical Infrastructure Service Disruption

Much of the infrastructure in the Northeast, including drainage and sewer systems, flood and storm protection assets, transportation systems, and power supply, is nearing the end of its planned life expectancy. Current water-related infrastructure in the United States is not designed for the projected wider variability of future climate conditions compared to those recorded in the last century (Ch. 3: Water, KM 2). In order to make Northeast systems resilient to the kind of extreme climate-related disruptions the region has experienced recently—and the sort of disruptions projected for the future—would require significant new investments in infrastructure. For example, in Pennsylvania, bridges are expected to be more prone to damage during extreme weather events, because the state leads the country in the highest percentage of structurally deficient bridges.[288] Pennsylvania's water treatment and wastewater systems are also notably aging, requiring an estimated $28 billion in new investment over the next 20 years for repairs and to meet increasing demands.[288]

Climate-related disruptions will only exacerbate existing issues with aging infrastructure. Sea level rise has amplified storm impacts in the Northeast region (Key Message 2), contributing to higher surges that extend further inland, as demonstrated in New York City.[14,15,16] Sea level rise is leading to an increase in the frequency of coastal flooding, a trend that is projected to grow for cities such as Baltimore and Washington, DC.[289] High tide flooding has increased by a factor of 10 or more over the last 50 years for many cities in the Northeast region and will become increasingly synonymous with regular inundation, exceeding 30 days per year for an estimated 20 cities by 2050 even under a very low scenario (RCP2.6).[216] More frequent high tide flooding (also referred to as nuisance, or sunny day, flooding) will be experienced at low-elevation cities and towns in the region (Figure 18.9). Sea level rise (see Key Message 2) under higher scenarios will likely increase property losses from hurricanes and other coastal storms for the region by \$6–\$9 billion per year by 2100, while changes in hurricane activity could raise these estimates to \$11–\$17 billion per year.[260] In other words, projected future costs are estimated to continue along a steep upward trend relative to what is being experienced today. However, there is limited published research that quantifies the costs associated with increased damage across an entire system in response to amplified storm events. Actions to replace and/or significantly modify the Northeast's aging infrastructure provide opportunities to incorporate climate change adaptation and resilience into standard capital upgrades, reducing these future costs.

King Tide Flooding in Northeast

Figure 18.9: The photo shows king tide flooding on Dock Street in Annapolis, Maryland, on December 21, 2012. Photo credit: Amy McGovern (CC BY 2.0).

Mitigation in the Northeast

The Northeast region has traditionally been a leader in greenhouse gas mitigation action, serving as a potential model for other states. The Regional Greenhouse Gas Initiative is the first mandatory market-based program in the United States to cap and reduce CO_2 emissions from the power sector through a cooperative effort among Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

Impacts on Urban Economies

Service and resource supply infrastructure in the Northeast region is at increasing risk of disruption, resulting in lower quality of life, economic declines, and increased social inequality.[17] Loss of public services affects the capacity of communities to function as administrative and economic centers and triggers disruptions of interconnected supply chains (Ch. 16: International, KM 1). Interdependencies across critical infrastructure sectors such as water, energy, transportation, and telecommunication can lead to cascading failures during extreme weather and climate-related disruptions,[17,59] as occurred during the 2003 blackout in New York City (Ch. 17: Complex Systems, Box 17.5; Ch. 11: Urban). For example, the Northeast is projected to experience a significant increase in summer heat and the number and/or duration of heat waves that will further stress summertime energy peak load demands from higher air conditioning use and the greater need to pump and treat water. Energy supply failures can also affect transportation operations, and even after electricity is restored, a significant time lag can occur until transportation services such as subway signals and traffic lights return to operation.[290] Understanding and coping with these interdependencies require cross-sector analysis and engagement by the private sector and within and across different levels of government. As a result, the connection between climate impacts, adaptation, and sustained economic development of cities is a major concern in the region.

The large number of manufacturing, distribution, and storage facilities, as well as historic structures, in the region are also vulnerable to climate shifts and extremes. For example, power plants in New York City tend to be located along the coastline for easy access to water for cooling and maritime-delivered fuel and are often located within about 16 feet (5 m) of sea level.[59] This is not unusual, as there are many power plants and petroleum storage facilities located along the Northeast coastline.[291]

The historic preservation community has begun to address the issue of climate change.[292,293] Many historic districts in cities and towns, such as Annapolis, Maryland, and Newport, Rhode Island, are at low elevations along the coast and now face the threat of rising sea levels.

Preparedness in Cities and Towns

Projected increases in coastal flooding, heavy precipitation, runoff, and extreme heat would have negative impacts on urban centers with disproportionate effects on at-risk communities. Larger cities, including Boston, MA, Burlington, VT, Hartford, CT, Newark, NJ, Manchester, NH, New York, Philadelphia, PA, Pittsburgh, PA, Portland, ME, Providence, RI, and Washington, DC, have begun to plan for climate change and in some instances have started to implement action, particularly when upgrading aging infrastructure (e.g., NYC Special Initiative for Rebuilding and Resiliency 2013, Climate Ready Boston 2016, City of Philadelphia 2016, City of Pittsburgh 2017[294,295,296,297]). Examples from municipalities of varying sizes are common (e.g., U.S. EPA 2017[33]). These cities seek to maintain the within-city and intercity connectivity that fosters growth, diversity, liveliness of urban neighborhoods, and protection of vulnerable populations, including the elderly, young, and disadvantaged. Further, city leaders hope to avoid forced migration of highly vulnerable populations and the loss of historical and cultural resources. City managers and stakeholders recognize that extreme heat events, sea level rise, and storm surge have the potential to lead to complex disasters and sustained critical infrastructure damage. Specific actions cities are taking focus largely on promoting the resilience of critical infrastructure, enhancing the social resilience of communities (especially of vulnerable populations), promoting ecosystem service hazard mitigation, and developing new indicators and monitoring systems to achieve a better understanding of climate risks and to identify adaptation strategies (see Key Message 5) (see also Ch. 11: Urban). In the Northeast region, Superstorm Sandy illustrated urban coastal flooding risk, and many localities, not just those directly impacted by the storm, have developed increased coastal resilience plans and efforts. New York City has been able to put in place a broad set of efforts in a variety of critical infrastructure sectors, including making the subway more protected from flooding (Figure 18.10).

Subway Air Vent Flood Protection

Figure 18.10: The photo shows a subway air vent with a multiuse raised flood protection grate that was installed as part of the post–Superstorm Sandy coastal resilience efforts on West Broadway in lower Manhattan, New York City. Photo credit: William Solecki.

Many Northeast cities are served by combined sewer systems that collect and treat both storm water and municipal wastewater. During heavy rain events, combined systems can be overwhelmed and release untreated sewage into local bodies of water.[298] Moderate flooding events are expected to become more frequent in most of the Northeast during the 21st century because of more intense precipitation related to climate change.[58,142] Finally, increased precipitation and high streamflows also increase streambed erosion, especially when coupled with wetter soils prior to storm events.[299,300] Erosion at bridges can cause bridge failures,[301] leading to transportation disruption, injuries, and potential fatalities.

The impacts of changes in precipitation and temperature on water supply system behavior in the Northeast are complex. Future potable water supplies are expected to be adequate to meet future demand on average across the Northeast, but the number of watersheds where demand exceeds supply is projected to increase under most climate change scenarios.[302] Studies of specific water systems in the Northeast show mixed results. The New York City reservoir system shows high resilience and reliability under different climate change scenarios.[303] Projected flows in the Potomac River, the primary water supply for the Washington, DC, metropolitan area, are lower in most climate change scenarios, with minor to major impacts on water supply.[304]

Key Message 4

Threats to Human Health

Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise. These environmental changes are expected to lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, and a lower quality of life. Health impacts are expected to vary by location, age, current health, and other characteristics of individuals and communities.

Health Effects of Extreme Heat

Present-day high temperatures (heat) have been conclusively linked to a higher risk of illness and death, particularly among older adults, pregnant women, and children (Ch 14: Human Health). A number of studies have replicated these findings specifically in the Northeast (see Box 18.3; e.g., Wellenius et al. 2017, Bobb et al. 2014, Hondula et al. 2012[305,306,307]). Ambient temperatures and heat-related health effects can vary significantly over small geographic areas due to local land cover (for example, due to the urban heat island effect; see Key Message 3) (see also Ch. 5: Land Changes, KM 1), topography, and the resilience of individuals and communities.[307,308] For example, older or sicker individuals and those persons who are without access to air conditioning, living in older homes, socially isolated, or working outdoors are considered particularly vulnerable to the effects of heat.[309,310,311]

Annual average temperature over the contiguous United States has increased by 1.2°F (0.7°C) over the last few decades and by 1.8°F (1.0°C) relative to the beginning of the last century. Recent decades are the warmest in at least the past 1,500 years.[312] Average annual temperatures across the Northeast have increased from less than 1°F (0.6°C) in West Virginia to about 3°F (1.7°C) or more in New England since 1901.[18,19] Although the relative risk of death on very hot days is lower today than it was a few decades ago, heat-related illness and death remain significant public health problems in the Northeast.[20,21,22,23] For example, a study in New York City estimated that in 2013 there were 133 excess deaths due to extreme heat.[24]

Annual average temperature in the contiguous United States is expected to increase by an additional 2.5°F (1.4°C) over the next few decades regardless of future greenhouse gas emissions (Ch 2: Climate).[50] By 2050, average annual temperatures in the Northeast are expected to increase by 4.0°F (2.2°C) under the lower scenario (RCP4.5) and 5.1°F (2.8°C) under the higher scenario (RCP8.5) relative to the near present (1975–2005),[50] with several more days of extreme heat occurring throughout the region each year.

These projected increases in temperature are expected to lead to substantially more premature deaths, hospital admissions, and emergency department visits due to heat across the Northeast.[23,25,26,27,28,29] For example, in the Northeast we can expect approximately 650 more excess deaths per year caused by extreme heat by 2050 under either a lower or higher scenario (RCP4.5 or RCP8.5) and 960 (under RCP4.5) to 2,300 (under RCP8.5) more excess deaths per year by 2090.[29]

The risks associated with present-day and projected future heat can be minimized by reducing greenhouse gas emissions, minimizing exposure through urban design, or increasing individual and community resilience.[23,29,313] For example, in the Northeast region, Philadelphia and New York City have been leaders in implementing policies and investing in infrastructure aimed at reducing the number of excess deaths from extreme heat.[314] Compared to the higher scenario (RCP8.5), 1,400 premature deaths from extreme temperatures could be avoided in the Northeast each year by 2090 if global greenhouse gas emissions are consistent with the lower scenario (RCP4.5), resulting in $21 billion in annual savings (in 2015 dollars).[29]

Box 18.3: Rising Temperatures and Heat-Related Emergency Room Visits in Rhode Island

Moderate and extreme heat events already pose a health risk today,[305,306,315,316] and climate change could increase this risk. Of note, days of moderate heat occur much more often compared to days of extreme heat, such that days of moderate heat may, in aggregate, be associated with a larger number of adverse health events.[315] Average summertime temperatures are projected to continue to rise through the end of the century, raising concern about the public health impact of climate change across Northeast communities. A nationwide study projected that some of the largest increases in heat-related mortality would occur in the Northeast region, with an additional 50–100 heat-related deaths per year per million people by 2050 and 120–180 additional deaths per million people by 2100 under the mid-high scenario (RCP6.0).[28] Heat health risks seem to be highest at the start of the warm weather each year[317] and among vulnerable populations such as outdoor workers, young children, and the elderly.

Box 18.3: Rising Temperatures and Heat-Related Emergency Room Visits in Rhode Island, *continued*

In the small, coastal northeastern state of Rhode Island (population of about 1 million), maximum daily temperatures in the summer have trended upwards over the last 60 years such that Rhode Islanders experienced about three more weeks of uncomfortably hot weather over 2015–2016 than in the 1950s (Figure 18.11, left panel). A recent study looking at visits to hospital emergency rooms (ERs) found that the risk of heat-related ER visits increased sharply as maximum daily temperatures climbed above 80°F (Figure 18.11, middle panel).[26] The researchers projected that with continued climate change, Rhode Islanders could experience an additional 400 (6.8% more) heat-related ER visits each year by 2050 and up to an additional 1,500 (24.4% more) such visits each year by 2095 under the higher scenario (RCP8.5; Figure 18.11, right panel). Importantly, about 1,000 fewer annual heat-related ER visits are projected for the end of the century under the lower scenario (RCP4.5) compared to the higher scenario (RCP8.5), representing the potential protective benefit of limiting greenhouse gas emissions. Such reductions would also lead to improvements in air pollution and health starting today.[318,319]

In response to the health threat from heat, local National Weather Service offices issue heat advisories and excessive heat warnings when the forecast calls for very hot weather. Based on the results of a study across multiple states,[305] the National Weather Service Northeast Region updated its heat advisory guidelines to be issued when the heat index is forecast to exceed 95°F for any amount of time on two or more days or 100°F for any amount of time on a single day. Many communities in the Northeast have implemented plans to respond to these heat alerts to better protect the public's health (for example, with the Centers for Disease Control and Prevention's Building Resilience Against Climate Effects program), although gaps in knowledge remain.[34,314] Uncertainties exist in the estimation of the cumulative impact on health of multiple aspects of weather, including heat, drought,[320] and heavy precipitation,[321,322,323] all of which have potential adverse impacts on human health.

Observed and Projected Impacts of Excess Heat on Emergency Room Visits in Rhode Island

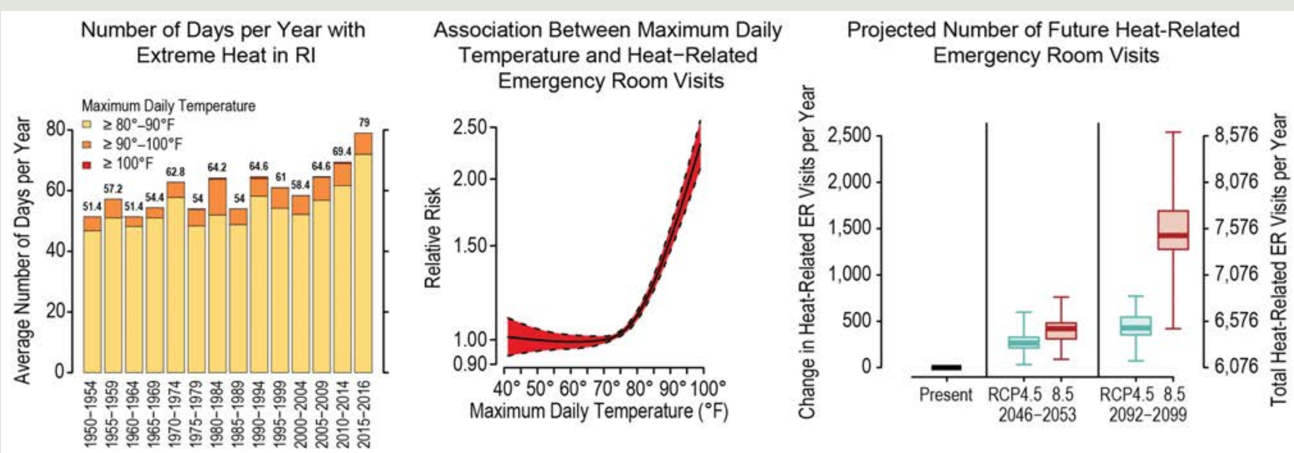


Figure 18.11: This figure shows the observed and projected impacts of excess heat on emergency room visits in Rhode Island. (left) In Rhode Island, maximum daily temperatures in the summer have trended upwards over the last 60 years, such that residents experienced about three more weeks of health-threatening hot weather over 2015–2016 than in the 1950s. (middle) A recent study looking at visits to hospital emergency rooms (ERs) found that the incidence rate of heat-related ER visits rose sharply as maximum daily temperatures climbed above 80°F. (right) The study estimates that with continued climate change, Rhode Islanders could experience an additional 400 (6.8% more) heat-related ER visits each year by 2050 and up to an additional 1,500 (24.4% more) such visits each year by 2095 under the higher scenario (RCP8.5). About 1,000 fewer annual heat-related ER visits are projected for the end of the century under the lower scenario (RCP4.5) compared to the higher scenario (RCP8.5), reflecting the estimated health benefits of adhering to a lower greenhouse gas emissions scenario. Sources: (left) Brown University; (middle, right) adapted from Kingsley et al. 2016.[26] Reproduced from Environmental Health Perspectives.

Health Effects of Air Pollution, Aeroallergens, and Wildfires

Climate change is increasing the risk of illness and death due to higher concentrations of air pollutants in many parts of the United States (Ch. 13: Air Quality). In the Northeast, climate change threatens to reverse improvements in air quality that have been achieved over the past couple of decades. For example, climate change is projected to influence future levels of ground-level ozone pollution in the Northeast by altering weather conditions and impacting emissions from human and natural sources.[324,325,326] This "climate penalty," whereby reductions in ozone precursor emissions are at least partially offset by a changing climate, is projected to lead to substantially more ozone pollution-related deaths;[324,325,327] 200–300 more excess deaths per year by 2050 compared to 2000 by one estimate.[325]

Excess deaths due to ground-level ozone pollution are projected to increase substantially under both lower (RCP4.5) and higher (RCP8.5) scenarios.[327] Reducing global emissions of greenhouse gases from a higher scenario to a lower scenario could prevent approximately 360 deaths per year due to air quality in 2090, saving approximately $5.3 billion per year (in 2015 dollars, undiscounted).[327] Moreover, many sources of the greenhouse gas emissions that contribute to climate change also contribute to degraded air quality today, with adverse effects on people's health. The adverse health risks from air pollution can be reduced in the present and in the future by addressing these common emission sources.[319]

More frequent and severe wildfires due to climate change pose an increasing risk to human health through impacts on air quality (Ch. 13: Air Quality, KM 2). Wildfire smoke can travel hundreds of miles, as occurred in 2015 when Canadian wildfire smoke caused air quality exceedance days in Baltimore, Maryland.[328]

Climate change is also expected to lengthen and intensify pollen seasons in parts of the United States, potentially leading to additional cases of allergic rhinitis (also known as hay fever) and allergic asthma episodes (Ch. 13: Air Quality, KM 3).[29,329] Among individuals with allergic asthma, exposure to certain types of pollen can result in worsening of symptoms leading to increases in allergy medication sales and emergency room visits for asthma, as already documented in New York City.[330]

Indoors, climate change is expected to bring conditions that foster mold growth, such as more dampness, and more frequent power outages that impair ventilation. Damp indoor conditions and mold are both known to be associated with respiratory illnesses including asthma symptoms and wheezing.[331] When damp conditions occur in buildings, rapid action could be warranted—remediation in a northeastern office building after the development of respiratory or severe non-respiratory symptoms by building inhabitants was not effective in reducing symptoms.[332]

Changing Ecosystems and Risk of Vector-Borne Disease

The risk posed by vector-borne diseases (those transmitted by disease-carriers such as fleas, ticks, and mosquitoes) such as Lyme disease and West Nile virus under a changing climate is also of concern in the Northeast region. These diseases, specifically tick-related Lyme disease, have been linked to climate, particularly with abundant late-spring and early-summer moisture. By 2065–2080, under the higher scenario (RCP8.5) it is projected that the period of elevated risk of Lyme disease transmission in the Northeast will begin 0.9–2.8 weeks earlier between Maine and Pennsylvania, compared to the climate observed over 1992–2007).[67] Similarly, a recent analysis estimates that there would be an additional 490 cases of West Nile neuroinvasive disease per year in the Northeast by 2090 under the higher scenario (RCP8.5) versus 210 additional cases per year under the lower scenario (RCP4.5).[29] The geographic range of suitable habitats for other mosquito vectors such as the northern house mosquito (*Culex pipiens* and *Culex restuans*, which transmit West Nile virus) and the Asian tiger mosquito (*Aedes albopictus*, which can also transmit West Nile virus and other mosquito-borne diseases) is expected to continue shifting northward into New England in the next several decades and through the end of the century as a result of climate change.[333,334]

Gastrointestinal Illness from Waterborne and Foodborne Contaminants

Another consequence of climate change is the spread of marine toxins and pathogens (Key Message 2). Some of these pathogens pose health risks through consumption of contaminated seafood. Harmful algal blooms, which can cause paralytic shellfish poisoning in humans, have become more frequent and longer lasting in the Gulf of Maine.[335] Similarly, pathogenic strains of the waterborne bacteria *Vibrio*—which are already causing thousands of foodborne illnesses per year—have expanded northward and have been responsible for increasing cases of illness in oyster consumers in the Northeast region.[336,337,338]

Combined sewer systems (where municipal wastewater and storm water use the same pipes) are particularly common in the Northeast given the older infrastructure typical of the region.[339] When runoff from heavy precipitation exceeds the capacity of these systems, combined sewer overflow containing untreated sewage is released into local waterways, potentially impacting the quality of water used for recreation or drinking. For example, a study in Massachusetts found an increased risk of gastrointestinal illness with heavy precipitation causing combined sewer overflows.[322] Increased risk of campylobacteriosis and salmonella has been documented in Maryland with increased heavy precipitation and streamflows.[340,341] Moderate flooding events are expected to become more frequent in most of the Northeast during the 21st century because of more intense precipitation related to climate change.[105,142] This could, therefore, increase the frequency of combined sewer overflows and waterborne disease. Some cities and towns are making substantial investments to reduce or eliminate the risks of combined sewer overflows (Figure 18.12).

Storm-related power outages can also pose a risk of foodborne illness.[343] Increased diarrheal illnesses from consumption of spoiled food have also been documented in New York City in 2003 following a power outage that affected millions in the Northeast (Ch. 17: Complex Systems, Box 17.5).[344]

District of Columbia Water and Sewer Authority's Clean Rivers Project

Figure 18.12: The District of Columbia Water and Sewer Authority's Clean Rivers Project[342] aims to reduce combined sewer overflows into area waterways. The Clean Rivers Project is expected to reduce overflows annually by 96% throughout the system and by 98% for the Anacostia River. In addition, the project is expected to reduce the chance of flooding in the areas it serves from approximately 50% to 7% in any given year and reduce nitrogen discharged to the Chesapeake Bay by approximately 1 million pounds per year. Photo credit: Daniel Lobo (CC BY 2.0).

Box 18.4: Role of Public Health and Healthcare Sector in Resilience and Prevention

There are numerous examples of how the public health and healthcare sectors are preparing for climate change and making energy saving changes, as highlighted in the U.S. Department of Health and Human Services' report on enhancing healthcare resilience.[345] One such example occurred in Greenwich, Connecticut, where Greenwich Hospital installed a combined heat and power system that conserves energy and provided stability in the wake of Superstorm Sandy.[346]

In June 2016, severe flooding in West Virginia resulted from a "thousand-year storm"[347] and highlighted the important role of the healthcare sector in building resilience to extreme precipitation events. A recent study of the event described the role of state and federal government working in partnership with healthcare volunteer organizations to effectively mobilize a response in the setting of such a disaster.[348] It emphasized the critical importance of healthcare professionals in providing emotional and mental health support to the response volunteers and the affected communities, as well as a need to increase capacity in these areas.[348] See Key Message 5 in this chapter and Chapter 14: Human Health, Key Message 3 for more information on additional adaptation efforts that protect health.

Figure 18.13: A Red Cross volunteer talks with a community resident after the 2016 West Virginia floods. Additionally, local medical professionals mobilized to staff temporary clinical sites. Photo credit: National Guard Bureau Public Affairs.

Mental Health and Well-Being

In addition to the adverse impacts on people's physical health, climate change is also associated with adverse impacts on mental health (Ch. 14: Human Health, KM 1). Specifically in the Northeast region, sea level rise, storm surge, and extreme precipitation events associated with climate change will contribute to higher risk of flooding in both coastal and inland areas—particularly in urban areas with large amounts of impervious surface that increases water runoff. In addition to the risks of physical injury, waterborne disease, and healthcare service disruption caused by flooding, lasting mental health consequences, such as anxiety, depression, and post-traumatic stress disorder can impact affected communities, as was observed in the wake of Superstorm Sandy in 2012 (Box 18.4).[349] Extreme weather events can have both immediate, short-term effects, as well as longer-term impacts on mental health and well-being that can last years after the specific event.

Extreme heat can also affect mental health and well-being. Higher outdoor temperatures are associated with decreases in subtle aspects of well-being such as decreased joy and happiness[350] and increased aggression and violence.[351] Underlying mental health conditions and geography also affect vulnerability. For example, a study of hospitalization for heat-related illness among people with mental health disorders showed increased risk in rural versus urban areas, possibly due to lower availability of mental health services in these rural areas.[352]

Separately, large population changes from climate-driven human migration could substantially influence both coastal and inland communities in the Northeast region (see also Key Messages 2 and 5).[285] The impacts of human migration on health and well-being depend on myriad factors, including the context of the migration.[353]

Regional Variation in Health Impacts and Vulnerability

Although climate change affects all residents of the Northeast region, risks are not experienced equally. The impact of climate change on an individual depends on the degree of exposure, the individual sensitivity to that exposure, and the individual or community-level capacity to recover (Ch. 14: Human Health, KM 2).[354] Thus, health impacts of climate change will vary across people and communities of the Northeast region depending on social, socioeconomic, demographic, and societal factors; community adaptation efforts; and underlying individual vulnerability (see Key Message 5) (see also Ch. 28: Adaptation). Particularly vulnerable groups include older or socially isolated adults, children, low-income communities, and communities of color.

Key Message 5

Adaptation to Climate Change Is Underway

Communities in the Northeast are proactively planning and implementing actions to reduce risks posed by climate change. Using decision support tools to develop and apply adaptation strategies informs both the value of adopting solutions and the remaining challenges. Experience since the last assessment provides a foundation to advance future adaptation efforts.

Communities, towns, cities, counties, states, and tribes across the Northeast are engaged in efforts to build resilience to environmental challenges and adapt to a changing climate. Developing and implementing climate adaptation strategies in daily practice often occur in collaboration with state and federal agencies (e.g., New Jersey Climate Adaptation Alliance, New York Climate Clearinghouse, Massachusetts StormSmart Coasts and Climate Action Tool, Rhode Island StormTools, EPA, CDC).[30,31,32,33,34,355,356] Advances in rural towns, cities, and suburban areas include low-cost adjustments of existing building codes and standards. In coastal areas, partnerships among local communities and federal and state agencies leverage federal adaptation tools and decision support frameworks (the National Oceanic and Atmospheric Administration's [NOAA] Digital Coast, the U.S. Geological Survey's [USGS] Coastal Change Hazards Portal, New Jersey's Getting to Resilience).

Increasingly, cities and towns across the Northeast region are developing or implementing plans for adaptation and resilience in the face of a changing climate (e.g., EPA 2017[33]). These approaches are designed to maintain and enhance the everyday life of residents and promote economic development. In some cities, adaptation planning has been used to respond to present and future challenges in the built environment. Regional efforts have recommended changes in design standards when building, replacing, or retrofitting infrastructure to account for a changing climate (Box 18.5). For example, the Port Authority of New York and New Jersey provided guidelines for engineers to account for projected changes in temperature, precipitation, and sea level rise when designing infrastructure assets.[357] The cities of Philadelphia, Pennsylvania,[296] Utica, New York,[358] and Boston, Massachusetts,[295] promote the use of green infrastructure to build resilience, particularly in response to flooding risk (Ch. 8: Coastal, Figure 8.2). In Jamaica Bay, New York, post–Superstorm Sandy efforts have fostered a set of local, regional, state, and federal actions that link resilience efforts to current climate risk, along with the potential for accelerated sea level rise and its implications for increased flood frequency (Ch. 28: Adaptation, KM 1).[359]

The issue of water security has emerged from vulnerability assessments and cuts across urban and rural communities. One example is the Washington, DC, metropolitan area's potential use of the Potomac and Occoquan estuaries as water supplies and of retired quarries as water storage facilities.[304] Adaptive reservoir operations have been implemented in the Northeast and other regions of the United States to better manage plausible future climate conditions and to meet other management goals (Ch. 3: Water, KM 3). Tribal nations have also focused on adaptation and the vulnerability of their water supplies, based on long-standing local values and traditional knowledge, including the use of water for drinking, habitat for fish and wildlife, agriculture, and cultural purposes.[97,360,361]

While resilience efforts have focused on microscale adaptations to current climate risks, communities are increasingly seeing a need for larger-scale adaptation efforts. Wide disparities in adaptive capacity exist among communities in the region. Larger, often better-resourced communities have created climate offices and programs, while response has lagged in smaller or poorer communities that are often more dependent on county- or state-level programs and expertise. The move from small-scale to larger-scale and more transformative adaptation efforts involves complex policy transition planning, social and economic development, and equity considerations (Ch. 28: Adaptation, KM 4).[362,363] This includes attention to community concerns about green gentrification—the practice of making environmental improvements in urban areas—that generally increases property values but often also drives out lower-income residents.[364]

Box 18.5: Adapting the Northeast's Cultural Heritage

A defining characteristic of the Northeast region is its rich, dense record of cultural heritage, marked by historic structures, archaeological sites, and cultural landscapes. The ability to preserve this cultural heritage is challenged by climate change. National parks and historic sites in the Northeast are already witnessing cultural resource impacts from climate change, and more impacts are expected in the future.[236] These cultural resources present unique adaptation challenges, and the region is moving forward with planning for future adaptation.

Superstorm Sandy caused substantial damage to coastal New York Harbor parks, including Gateway National Recreation Area and Statue of Liberty National Monument, where buildings and the landscape surrounding the statue and on Ellis Island were impacted and the museum collections were threatened by the loss of climate control systems that were flooded.[370,371] Sea level rise amplifies the impacts of storm events such as Superstorm Sandy, and the parks are using recovery as an opportunity to rebuild with more resilience to future storms.[371,372,373] Heating and electrical systems in historic buildings have been elevated from basement levels. Design changes, such as using non-mold-growing materials and other engineering solutions, have been made while maintaining the buildings' historic character. Following the storm, Gateway National Recreation Area added climate change vulnerability to their planning process for prioritizing historic structures between preserve, stabilize, or ruin. The recreation area has been implementing these priorities as part of the recovery process, providing examples of climate adaptation implementation.[359,374] The human community on Rockaways peninsula also responded to Sandy by using urban forestry and agricultural practices to recover and to buffer against the impact of future storms (see Building Resiliency at the Rockaways 360 tour[375]).

Decision Support Tools and Adaptation Actions

While adaptation is progressing in a variety of forms in the Northeast region, many efforts have focused on assessing risks and developing decision support tools. Many of these assessments and tools have proven useful for specific purposes. Structured decision-making is where decision-makers engage at the outset to define a problem, objectives, alternative management actions, and the consequences and tradeoffs of such actions—before making any decisions. It is being increasingly applied to design management plans, determine research needs, and allocate resources to preserve habitat and resources throughout the region.[151,365,366,367] There has been little attention devoted to evaluating and communicating the suitability and robustness of the many tools that are now available. Efforts to evaluate decision support tools and processes in a rigorous scientific manner would help stakeholders choose the best tools to answer particular questions under specific circumstances.

One significant advancement that communities and infrastructure managers have made in recent years has been the development of risk, impact, and adaptation indicators, as well as monitoring systems to measure and understand climate change and its impacts.[15] In recognizing the economic impacts of infrastructure service loss and disruption, government agencies have begun adaptation analyses to identify those infrastructure elements most critical for regional economic resilience during climate-related disruptions, as well as to identify communities most exposed to acute and chronic climate risks.[45,368,369]

Resource managers, community leaders, and other stakeholders are altering the management of coastal areas and resources in the context of climate change (Boxes 18.6 and 18.7).

Box 18.6: Building Resilience in the Chesapeake Bay Watershed

The Chesapeake Bay watershed is experiencing stronger and more frequent storms, an increase in heavy precipitation events, increasing bay water temperatures, and a rise in sea level. These trends vary throughout the watershed and over time but are expected to continue over the next century under all scenarios considered. The trends are altering both the ecosystems and mainland and island communities of the Chesapeake Bay watershed. Achieving watershed goals would require changes in policies, programs, and/or projects to achieve restoration, sustainability, conservation, and protection goals for the entire system.

To gain a better understanding of the likely impacts of climate change, as well as potential management solutions for the watershed, the 2014 Chesapeake Bay Watershed Agreement committed the NOAA Chesapeake Bay Program (CBP) Partnership to take action to "increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure and communities, to withstand adverse impacts from changing environmental and climate conditions." This new Bay Agreement goal builds on the 2010 Total Maximum Daily Load (TMDL) documentation and 2009 Presidential Executive Order 13508[376,377] that called for an assessment of the impacts of a changing climate on the Chesapeake Bay's water quality and living resources. To achieve this goal and regulatory mandates, the CBP Partnership is undertaking efforts to monitor and assess trends and likely impacts of changing climatic and sea level conditions on the Chesapeake Bay ecosystem and to pursue, design, and construct restoration and protection projects to enhance resilience. The CBP Climate

Box 18.6: Building Resilience in the Chesapeake Bay Watershed, *continued*

Resiliency Workgroup's Management Strategy recognizes that it is important to build community and institutional capacity and to develop analytical capability to build cross-science disciplinary knowledge and better understanding of societal responses. A significant activity now underway is geared towards the midpoint assessment of progress towards the 2025 Chesapeake Bay TMDL goal for water quality standard attainment. As part of the TMDL midpoint assessment, the CBP Partnership has developed tools and procedures to quantify the effects of climate change on watershed flows and pollutant loads, storm intensity, increased estuarine temperatures, sea level rise, and ecosystem influences, including loss of tidal wetland attenuation with sea level rise. Current modeling efforts are underway to assess potential climate change impacts under a range of projected climate change outcomes for 2025 and 2050.[378]

Addressing climate change within the context of established watershed planning and regulatory efforts is extremely complex and requires sound climate science, climate assessments, modeling, policy development, and stakeholder engagement (Ch. 28: Adaptation, Figure 28.1). The CBP Partnership is tackling this challenge on all of these fronts, with priority directed to understanding what is needed to achieve the 2025 nutrient reduction goals and the best management practices required to achieve climate-resilient rehabilitation goals.

For example, research in Delaware is exploring the use of seashore mallow as a transitional salt-tolerant crop because of gradual wetland migration onto agricultural lands as sea levels rise.[379] Commercial and recreational fisheries and tourism depend upon living marine resources. Climate adaptation in ocean fisheries will entail coping and long-term planning responses at multiple levels of communities, industry, and management systems.[380] Fishers have traditionally switched species as needed based on ecosystem or market conditions; this will continue to be an important adaptation option, but it is increasingly constrained by regulatory approaches in fisheries.[155,178,179,202] Longer-term planning for climate adaptation has included state commissions to evaluate ocean acidification threats,[381,382] federal efforts to articulate science strategies,[383,384,385] species vulnerability assessments,[143,186] coupled social–ecological vulnerability assessments for fishing communities,[45] and planning for the potential inland migration of coastal populations due to sea level rise.[386]

The winter recreation industry has long considered snowmaking an adaptation to climate change.[387] Snowmaking improvements should assist with the viability of some Northeast ski areas,[117] while new tourism opportunities emerge.[388]

In order to sustain and advance these and other planned efforts towards climate change adaptation and resilience, decision-makers in the Northeast need to be aware of existing constraints and emerging issues. Constraints from the management, economic, and social context are highly uncertain.[389] These efforts have faced a variety of barriers and limitations, including lack of funding and jurisdictional and legal constraints.[390,391] In many cases, adaptation has been limited to coping responses that address short-term needs and are feasible within the current institutional context, whereas longer-term, more transformative efforts will likely require complex policy transition planning and frameworks that can address social and economic equality.[363] The need for solutions that support industry and community flexibility in responding to climate-related changes has also been recognized.[45,178]

Earth's changing climate is one of several stressors on human and natural systems, and it can work to exacerbate existing vulnerabilities and inequalities. Implementing resilience planning and climate change adaptation in

Box 18.7: Science for Balancing Wildlife and Human Needs in the Face of Sea Level Rise

Policymakers, agencies, and natural resource managers are under increasing pressure to manage coastal areas to meet social, economic, and natural resource demands, particularly as sea levels rise. Scientific knowledge of coastal processes and habitat use can support decision-makers as they balance these often-conflicting human and ecological needs. In collaboration with a wide network of natural resource professionals from state and federal agencies (including the U.S. Fish and Wildlife Service and National Park Service) and private conservation organizations, a research team from the U.S. Geological Survey (USGS) is conducting research and developing tools to identify suitable coastal habitats for species of concern, such as the piping plover (*Charadrius melodus*)—an ecologically important species with low population numbers—under a variety of sea level rise scenarios.

The multidisciplinary USGS team uses historical and current habitat availability and coastal characteristics to develop models that forecast likely future habitat from Maine to North Carolina.[392,393] The collaborative partners, both researchers and managers, are critical to the program: they aid in data collection efforts through the "iPlover" smartphone application[394] and help scientists focus research on specific management questions. Because these shorebirds favor sandy beaches that overwash frequently during storms, the resulting habitat maps also define current and future areas of high hazard exposure for humans and infrastructure.

Land-use planners can use results to determine optimal locations for constructing recreational facilities that minimize impacts on sensitive habitats and have a low probability of being overwashed. Alternatively, results can help resource managers proactively protect the highest-quality habitats to meet near- and long-term conservation goals and, in so doing, increase beach access for users by reducing human–bird conflicts and improving the certainty of beach availability for recreational use.

(a)

(b)

(c)

Figure 18.14: (a, b) These photographs show suitable piping plover habitat for (c) rearing chicks along the U.S. Atlantic coast. Photo credits: (a, b) Sara Zeigler, U.S. Geological Survey; (c) Josh Seibel, U.S. Fish and Wildlife Service.

order to preserve the cultural, economic, and natural heritage of the Northeast would require ongoing collaboration among tribal, rural, and urban communities as well as municipal, state, tribal, and federal agencies. The number and scope of existing adaptation plans in the Northeast show that many people in the region consider this heritage to be important.

Acknowledgments

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Traceable Accounts

Process Description

It is understood that authors for a regional assessment must have scientific and regional credibility in the topical areas. Each author must also be willing and interested in serving in this capacity. Author selection for the Northeast chapter proceeded as follows:

First, the U.S. Global Change Research Program (USGCRP) released a Call for Public Nominations. Interested scientists were either nominated or self-nominated and their names placed into a database. The concurrent USGCRP Call for Public Nominations also solicited scientists to serve as chapter leads. Both lists were reviewed by the USGCRP with input from the coordinating lead author (CLA) and from the National Climate Assessment (NCA) Steering Committee. All regional chapter lead (CL) authors were selected by the USGCRP at the same time. The CLA and CL then convened to review the author nominations list as a "first cut" in identifying potential chapter authors for this chapter. Using their knowledge of the Northeast's landscape and challenges, the CLA and CL used the list of national chapter topics that would be most relevant for the region. That topical list was associated with scientific expertise and a subset of the author list.

In the second phase, the CLA and CL used both the list of nominees as well as other scientists from around the region to build an author team that was representative of the Northeast's geography, institutional affiliation (federal agencies and academic and research institutions), depth of subject matter expertise, and knowledge of selected regional topics. Eleven authors were thus identified by December 2016, and the twelfth author was invited in April 2017 to better represent tribal knowledge in the chapter.

Lastly, the authors were contacted by the CL to determine their level of interest and willingness to serve as experts on the region's topics of water resources, agriculture and natural resources, oceans and marine ecosystems, coastal issues, health, and the built environment and urban issues.

On the due diligence of determining the region's topical areas of focus

The first two drafts of the Northeast chapter were structured around the themes of water resources, agriculture and natural resources, oceans and marine ecosystems, coastal issues, health, and the built environment and urban issues. During the USGCRP-sponsored Regional Engagement Workshop held in Boston on February 10, 2017, feedback was solicited from approximately 150 online participants (comprising transportation officials, coastal managers, urban planners, city managers, fisheries managers, forest managers, state officials, and others) around the Northeast and other parts of the United States, on both the content of these topical areas and important focal areas for the region. Additional inputs were solicited from other in-person meetings such as the ICNet workshop and American Association of Geographers meetings, both held in April 2017. All feedback was then compiled with the lessons learned from the USGCRP CLA-CL meeting in Washington, DC, also held in April 2017. On April 28, 2017, the author team met in Burlington, Vermont, and reworked the chapter's structure around the risk-based framing of interest to 1) changing seasonality, 2) coastal/ocean resources, 3) rural communities and livelihoods, 4) urban interconnectedness, and 5) adaptation.

Key Message 1

Changing Seasons Affect Rural Ecosystems, Environments, and Economies

The seasonality of the Northeast is central to the region's sense of place and is an important driver of rural economies. Less distinct seasons with milder winter and earlier spring conditions (*very high confidence*) are already altering ecosystems and environments (*high confidence*) in ways that adversely impact tourism (*very high confidence*), farming (*high confidence*), and forestry (*medium confidence*). The region's rural industries and livelihoods are at risk from further changes to forests, wildlife, snowpack, and streamflow (*likely*).

Description of evidence base

Multiple lines of evidence show that changes in seasonal temperature and precipitation cycles have been observed in the Northeast.[3,4,109,110,124,154,158] Projected increases in winter air temperatures under lower and higher scenarios (RCP4.5 and RCP8.5)[3,4] will result in shorter and milder cold seasons, a longer frost-free season,[3] and decreased regional snow cover and earlier snow-melt.[108,109,110,395,396,397] Observed seasonal changes to streamflows in response to increased winter precipitation, changes in snow hydrology,[112,138,139,140] and an earlier but prolonged transition into spring[68] are projected to continue.[105]

These changes are affecting a number of plant and animal species throughout the region, including earlier bloom times and leaf-out,[71,73,158] spawning,[164] migration,[84,166,398] and insect emergence,[74] as well as longer growing seasons,[72] delayed senescence, and enhanced leaf color change.[103] Milder winters will likely contribute to the range expansion of wildlife and insect species,[399] increase the size of certain herbivore populations[78] and their exposure to parasitism,[81,82] and increase the vulnerability of an array of plant and animal species to change.[66,103,143]

Warmer winters will likely contribute to declining yields for specialty crops[35] and fewer operational days for logging[88] and snow-dependent recreation.[115,116,118] Excess moisture is the leading cause of crop loss in the Northeast,[35] and the observed increase in precipitation amount, intensity, and persistence is projected to continue under both lower and higher scenarios.[3,4,124,125]

Major uncertainties

Warmer fall temperatures affect senescence, fruit ripening, migration, and hibernation, but are less well studied in the region[98] and must be considered alongside other climatic factors such as drought. Projections for summer rainfall in the Northeast are uncertain,[4] but evaporative demand for surface moisture is expected to increase with projected increases in summer temperatures.[3,4] Water use is highest during the warm season;[141,400] how much this will affect water availability for agricultural use depends on the frequency and intensity of drought during the growing season.[302]

Description of confidence and likelihood

There is *high confidence* that the combined effects of increasing winter and early-spring temperatures and increasing winter precipitation (*very high confidence*) are changing aquatic and terrestrial habitats and affecting the species adapted to them. The impact of changing seasonal temperature, moisture conditions, and habitats will vary geographically and impact interactions among species. It is *likely* that some will not adapt. There is *high confidence* that over the next century, some species will decline while other species introduced to the region thrive as conditions change. There is *high confidence* that increased precipitation in early spring will negatively impact farming, but the response of vegetation to future changes in seasonal temperature and moisture conditions depends on plant hardiness for *medium confidence* in the level of risk to specialty crops and forestry. A reduction in the length of the snow season by mid-century is *highly likely* under lower and higher scenarios, with *very high confidence* that the winter recreation industry will be negatively impacted by the end of the century under lower and higher scenarios (RCP4.5 and RCP8.5).

Key Message 2

Changing Coastal and Ocean Habitats, Ecosystem Services, and Livelihoods

The Northeast's coast and ocean support commerce, tourism, and recreation that are important to the region's economy and way of life. Warmer ocean temperatures, sea level rise, and ocean acidification (*high confidence*) threaten these services (*likely*). The adaptive capacity of marine ecosystems and coastal communities will influence ecological and socioeconomic outcomes as climate risks increase (*high confidence*).

Description of evidence base

Warming rates on the Northeast Shelf have been higher than experienced in other ocean regions,[39] and climate projections indicate that warming in this region will continue to exceed rates expected in other ocean regions.[48,49] Multiple lines of research have shown that changes in ocean temperatures and acidification have resulted in distribution,[7,8,10] productivity,[39,173,191,401] and phenology shifts[155,158,163,164,166] in marine populations. These shifts have impacted marine fisheries and prompted industry adaptations to changes.[155,176,200]

Research also shows that sea level rise has been[12,46,205,206] and will be higher in the Northeast with respect to the rest of the United States[12,249,250,251] due largely to vertical land movement,[207,208,209] varying atmospheric shifts and ocean dynamics,[210,211,212,213,215,252] and ice mass loss from the polar regions.[214] High tide flooding has increased[216,402] and will continue to increase,[403] and storm surges due to stronger and more frequent hurricanes[50,254,255] have been and will be amplified by sea level rise.[217,220,221,289] Climate-related coastal impacts on the landscape include greater potential for coastal flooding, erosion, overwash, barrier island breaching and disaggregation, and marsh conversion to open water,[12,216,223,226,256,257,258,259,263,279,404] which will directly affect the ability of ecosystems to sustain many of the services they provide. Changes to salt marshes in response to sea level rise have already been observed in some coastal settings in the region, although their impacts are site specific and variable.[265,266,267,268,269,270,271,405] Studies quantifying sea level rise impacts on other types of coastal settings (such as beaches) in the region are more limited; however, there is consensus on what impacts under higher rates of relative sea level rise might look like due to geologic history and modern analogs elsewhere (such as the Louisiana coast).[12,226,404] Although probabilistically low, worst-case sea level rise projections that account for ice sheet collapse[47,406] would result in sea level rise rates far beyond the rates at which natural systems are likely able to adapt,[274,275,280] affecting not only ecosystems function and services but also likely substantially changing the coastal landscape largely through inundation.[223]

Major uncertainties

Although work to value coastal and marine ecosystems services is still evolving,[6,41,281] changes to coastal ecosystem services will depend largely on the adaptability of the coastal landscape, direct hits from storms, and rate of sea level rise, which have identified uncertainties. Lower sea level rise rates are more probable, though the timing of ice sheet collapse[407] and the variability of ocean dynamics are still not well understood[210,211,215] and will dramatically affect the rate of rise.[47,406] It is also difficult to anticipate how humans will contend with changes along the coast[389] and how adjacent natural settings will respond. Furthermore, specific tipping points for many coastal ecosystems are still not well resolved[275,277,280] and vary due to site-specific conditions[224,274]

The Northeast Shelf is sensitive to ocean acidification, and many fisheries in the region are dependent on shell-forming organisms.[181,182,186] However, few studies that have investigated the impacts of ocean acidification on species biology and ecology used native populations from the region[182] or tested the effects at acidification levels expected over the next 20–40 years.[143] Moreover, there are limited studies that consider the effects of climate change in conjunction with multiple other stressors that affect marine populations.[39,40,178,408] Limited understanding of the adaptive capacity of species to environmental changes presents major uncertainties in ecosystem responses to climate change.[143,409] How humans will respond to changes in ecosystems is also not well known, yet these decisions will shape how marine industries and coastal communities are affected by climate change.[45]

Description of confidence and likelihood

Warming ocean temperatures (*high confidence*), acidification (*high confidence*), and sea level rise (*very high confidence*) will alter coastal and ocean ecosystems (*likely*) and threaten the ecosystems services provided by the coasts and oceans (*likely*) in the Northeast. There is *high confidence* that ocean temperatures have caused shifts in the distribution, productivity, and phenology of marine species and *very high confidence* that high tide flooding and storm surge impacts are being amplified by sea level rise. Because much will depend on how humans choose to address or adapt to these problems, and as there is considerable uncertainty over the extent to which many of these coastal systems will be able to adapt, there is *medium confidence* in the level of risk to traditions and livelihoods. It is *likely* that under higher scenarios, sea level rise will significantly alter the coastal landscape, and rising temperatures and acidification will affect marine populations and fisheries.

Key Message 3

Maintaining Urban Areas and Communities and Their Interconnectedness

The Northeast's urban centers and their interconnections are regional and national hubs for cultural and economic activity. Major negative impacts on critical infrastructure, urban economies, and nationally significant historic sites are already occurring and will become more common with a changing climate. (*High Confidence*)

Description of evidence base

The urban built environment and related supply and management systems are at increased risk of disruption from a variety of increasing climate risks. These risks emerge from accelerated sea level rise as well as increased frequency of coastal and estuarine flooding, intense precipitation events, urban heating and heat waves, and drought.

Coastal flooding can lead to adverse health consequences, loss of life, and damaged property and infrastructure.[368] Much of the region's major industries and cities are located along the coast, with 88% of the region's population and 68% of the regional gross domestic product.[260] High tide flooding is also increasingly problematic and costly.[47] Rising sea level and amplified storm events can increase the magnitude and geographic size of a coastal flood event. The frequency of dangerous coastal flooding in the Northeast would more than triple with 2 feet of sea level rise.[93] In Boston, the areal extent of a 1% (1 in 100 chance of occurring in any given year) flood is expected to increase multifold in many coastal neighborhoods.[295] However, there will likely be notable variability across coastal locations. Using the 2014 U.S. National Climate Assessment's Intermediate-High scenario for sea level rise (a global rise of 1.2 meters by 2100), the median number of flood events per year for the Northeast is projected to increase from 1 event per year experienced today to 5 events by 2030 and 25 events by 2045, with significant variation within the region.[410]

Intense precipitation events can lead to riverine and street-level flooding affecting urban environments. Over recent decades, the Northeast has experienced an increase of intense precipitation events, particularly in the spring and fall.[411] From 1958 to 2016, the number of heaviest 1% precipitation events (that is, an event that has a 1% chance of occurring in any given year) in the Northeast has increased by 55%.[58] A recent study suggests that this trend began rather abruptly after 1996, though uniformly across the region.[411]

Urban heating and heat waves threaten the health of the urban population and the integrity of the urban landscape. Due to the urban heat island effect, summer surface temperatures across Northeast cities were an average of 13°F to 16°F (7°C to 9°C) warmer than surrounding rural areas over a three-year period, 2003 to 2005.[412] This is of concern, as rising temperatures increase heat- and pollution-related mortality while also stressing energy demands across the urban environment.[413] However, the degree of urban heat island intensity varies across cities depending on local factors such as whether the city is coastal or inland.[414] Recent analysis of mortality in major cities of the Northeast suggests that the region could experience an additional 2,300 deaths per year by 2090 from extreme heat under RCP8.5 (compared to an estimated 970 deaths per year under the lower scenario, RCP4.5) compared to 1989–2000.[29] Another study that considered 1,692 cities around the world suggested that without mitigation, total economic costs associated with climate change could be 2.6 times higher due to the warmer temperatures in urban versus extra-urban environments.[415]

Changes in temperature and precipitation can have dramatic impacts on urban water supply available for municipal and industrial uses. Under a higher scenario (RCP8.5), the Northeast is projected to experience cumulative losses of $730 million (discounted at 3% in 2015 dollars) due to water supply shortfalls for the period 2015 to 2099.[29] Under a lower scenario (RCP4.5), the Northeast is projected to sustain losses of $510 million (discounted at 3% in 2015 dollars).[29] The losses are largely projected for the more southern and coastal areas in the region.

Major uncertainties

Projecting changes in urban pollution and air quality under a changing climate is challenging given the associated complex chemistry and underlying factors that influence it. For example, fine particulates ($PM_{2.5}$; that is, particles with a diameter of or less than 2.5 micrometers) are affected by cloud processes and precipitation, amongst other meteorological processes, leading to considerable uncertainty in the geographic distribution and overall trend in both modeling analysis and the literature.[29] Land use can also play an unexpected role, such as planting trees as a mitigation option that may lead to increases in volatile organic compounds (VOCs), which, in a VOC-limited environment that can exist in some urban areas such as New York City, may increase ozone concentrations (however, it is noted that most of the Northeast region is limited by the availability of nitrogen oxides).[327]

Interdependencies among infrastructure sectors can lead to unexpected and amplified consequences in response to extreme weather events. However, it is unclear how society may choose to invest in the built environment, possibly strengthening urban infrastructure to plausible future conditions.

Description of confidence and likelihood

There is *high confidence* that weather-related impacts on urban centers already experienced today will become more common under a changing climate. For the Northeast, sea level rise is projected to occur at a faster rate than the global average, potentially increasing the impact of moderate and severe coastal flooding.[47]

By the end of the century and under a higher scenario (RCP8.5), Coupled Model Intercomparison Project Phase 5 (CMIP5) models suggest that annual average temperatures will increase by more than 9°F (16°C) for much of the region (2071–2100 compared to 1976–2005), while precipitation is projected to increase, particularly during winter and spring.[50]

Extreme events that impact urban environments have been observed to increase over much of the United States and are projected to continue to intensify. There is *high confidence* that heavy precipitation events have increased in intensity and frequency since 1901, with the largest increase in the Northeast, a trend projected to continue.[50] There is *very high confidence* that extreme heat events are increasing across most regions worldwide, a trend very likely to continue.[50] Extreme precipitation from tropical cyclones has not demonstrated a clear observed trend but is expected to increase in the future.[50,253] Research has suggested that the number of tropical cyclones will overall increase with future warming.[416] However, this finding is contradicted by results using a high-resolution dynamical downscaling study under a lower scenario (RCP4.5), which suggests overall reduction in frequency of tropical cyclones but an increase in the occurrence of storms of Saffir–Simpson categories 4 and 5.[50]

Key Message 4

Threats to Human Health

Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise (*very high confidence*). These environmental changes are expected to lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, and a lower quality of life (*very high confidence*). Health impacts are expected to vary by location, age, current health, and other characteristics of individuals and communities (*very high confidence*).

Description of evidence base

Extreme storms and temperatures, overall warmer temperatures, degradation of air and water quality, and sea level rise are all associated with adverse health outcomes from heat,[20,21,22,23,305,306,307] poor air quality,[324,325,326] disease-transmitting vectors,[67,333,334] contaminated food and water,[322,340,341,344] harmful algal blooms,[335] and traumatic stress or health service disruption.[17,349] The underlying susceptibility of populations determines whether or not there are health impacts from an exposure and the severity of such impacts.[307,308]

Major uncertainties

Uncertainty remains in projections of the magnitude of future changes in particulate matter, humidity, and wildfires and how these changes may influence health risks. For example, health effects of future extreme heat may be exacerbated by future changes in absolute or relative humidity.

Health impacts are ultimately determined by not just the environmental hazard but also the amount of exposure, size and underlying susceptibility of the exposed population, and other factors such as health insurance coverage and access to timely healthcare services. In projecting future health risks, researchers acknowledge these challenges and use different analytic approaches to address this uncertainty or note it as a limitation.[23,28,326]

In addition, there is a paucity of literature that considers the joint or cumulative impacts on health of multiple climatic hazards. Additional areas where the literature base is limited include specific health impacts related to different types of climate-related migration, the impact of climatic factors on mental health, and the specific timing and geographic range of shifting disease-carrying vectors.

Description of confidence and likelihood

There is *very high confidence* that extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise threaten the health and well-being of people in the Northeast. There is *very high confidence* that these climate-related environmental changes will lead to additional adverse health-related impacts and costs, including premature deaths, more emergency department visits and hospitalizations, and lower quality of life. There is *very high confidence* that climate-related health impacts will vary by location, age, current health, and other characteristics of individuals and communities.

Key Message 5

Adaptation to Climate Change Is Underway

Communities in the Northeast are proactively planning (*high confidence*) and implementing (*medium confidence*) actions to reduce risks posed by climate change. Using decision support tools to develop and apply adaptation strategies informs both the value of adopting solutions and the remaining challenges (*high confidence*). Experience since the last assessment provides a foundation to advance future adaptation efforts (*high confidence*).

Description of evidence base

Reports on climate adaptation and resilience planning have been published by city, state, and tribal governments and by regional and federal agencies in the Northeast. Examples include the Interstate Commission on the Potomac River Basin (for the Washington, DC, metropolitan area),[304] Boston,[295] the Port Authority of New York and New Jersey,[357] the St. Regis Mohawk Tribe,[360] the U.S. Army Corps of Engineers,[368] the State of Maine,[381] and southeastern Connecticut.[417] Structured decision-making is being applied to design management plans, determine research needs, and allocate resources[365] to preserve habitat and resources throughout the region.[151,366,367]

Major uncertainties

The percentage of communities in the Northeast that are planning for climate adaptation and resilience and the percentage of those using decision support tools are not known. More case studies would be needed to evaluate the effectiveness of adaptation actions.

Description of confidence and likelihood

There is *high confidence* that there are communities in the Northeast undertaking planning efforts to reduce risks posed from climate change and *medium confidence* that they are implementing climate adaptation. There is *high confidence* that decision support tools are informative and *medium confidence* that these communities are using decision support tools to find solutions for adaptation that are workable. There is *high confidence* that early adoption is occurring in some communities and that this provides a foundation for future efforts. This Key Message does not address trends into the future, and therefore likelihood is not applicable.

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