U.S. Fish & Wildlife Service

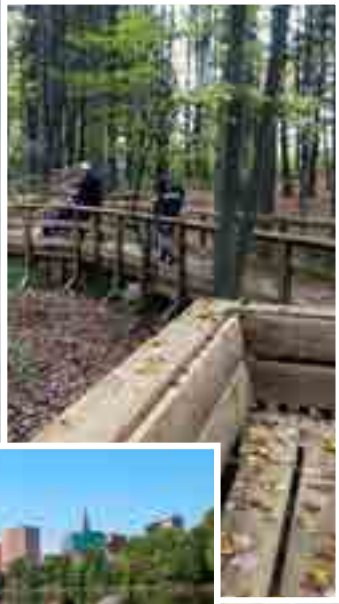
Silvio O. Conte National Fish and Wildlife Refuge

Final Comprehensive Conservation Plan and Environmental Impact Statement

December 2016

Volume 1—Chapters 1 through 7

including Bibliography, Glossary, and Acronyms



Front cover:

Connecticut River from Mount Sugarloaf
Lamar Gore

Insets:

Hunting on the refuge
USFWS

Conducting research on puritan tiger beetles
USFWS

Kayaking on the Connecticut River
USFWS

Enjoying the universally accessible trail on the refuge's Fort River Division, Massachusetts
USFWS

Fishing along the Connecticut River near Hartford, Connecticut
USFWS

This blue goose, designed by J.N. "Ding" Darling, has become the symbol of the National Wildlife Refuge System.

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service manages the National Wildlife Refuge System comprised of over 150 million acres including over 565 national wildlife refuges and thousands of waterfowl production areas. The Service also operates 70 national fish hatcheries and over 80 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Assistance Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

Comprehensive Conservation Plans (CCPs) provide long-term guidance for management decisions on a refuge and set forth goals, objectives, and strategies needed to accomplish refuge purposes. CCPs also identify the Service's best estimate of future needs. These plans detail program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. CCPs do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

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Silvio O. Conte National Fish and Wildlife Refuge

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Final Vision Statement

The Connecticut River is treasured by all for its majesty and significance in supporting diverse aquatic and terrestrial plant and animal life along its winding 410-mile passage through urban and rural communities in New Hampshire, Vermont, Massachusetts, and Connecticut. Working with our partners, we are inspired to protect and enhance the natural and cultural richness throughout the watershed, especially on lands and waters entrusted to our agency as the Silvio O. Conte National Fish and Wildlife Refuge.

Together with our partners, we design, support, and implement strategic conservation actions across the watershed, and communicate conservation needs and successes through extensive outreach and education programs. On refuge lands, and in our conservation partnership areas, we offer visitor programs and activities that promote an appreciation of the Connecticut River watershed as an intact, interconnected, and healthy ecosystem. Visitors respond to this greater awareness by becoming active stewards of the watershed's natural and cultural resources. Through our Urban Partnership Program, we are promoting the relevancy of conservation to healthy communities. Our actions exemplify the Service's vital role in conserving the Connecticut River watershed and the refuge's important contribution to the mission of the National Wildlife Refuge System.

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Summary

Type of Action: Administrative—Development of a Comprehensive Conservation Plan

Lead Agency: U.S. Department of the Interior, U.S. Fish and Wildlife Service

Location: Silvio O. Conte National Fish and Wildlife Refuge
Connecticut, Massachusetts, New Hampshire, and Vermont

Administrative Headquarters: Silvio O. Conte National Fish and Wildlife Refuge
Sunderland, MA

Responsible Official: Wendi Weber, Regional Director, Region 5

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Alternative A—Current Management: This alternative represents continuing current management and serves as a baseline for comparing the other alternatives. Under this alternative, we would continue our current habitat and visitor services management activities on existing refuge lands. We would also continue to work with our existing partners throughout the Connecticut River watershed (watershed) to support our conservation, education, and recreation programs. We would continue to actively manage forest habitats on the Nulhegan Basin Division (Vermont) to benefit forest-dependent species of conservation concern, and manage grasslands and shrublands habitats on our Pondicherry (New Hampshire) and Fort River (Massachusetts) Divisions for species dependent on those habitats. We would maintain our hunting and fishing programs on refuge lands, which generally are managed consistent with respective State regulations. We would also continue to acquire lands from willing sellers under our existing approved land acquisition authority of approximately 97,830 acres. Our focus would continue to be on acquiring lands that were identified in the refuge's 1995 Master Plan and its accompanying EIS.

Alternative B—Consolidated Stewardship: This alternative would strategically focus our work with partners, and our staffing, funding, and other resource commitments across the watershed, in 16 defined geographic areas called Conservation Partnership Areas (CPAs). CPAs are large areas, defined by sub-watersheds, with concentrations of high-value habitat for fish and wildlife. Within CPAs, we have identified a total of 18 areas we call Conservation Focus

Areas (CFAs). These are areas with particularly high value to Federal trust resources and represent where we would focus our future refuge land acquisition. Under alternative B, we would not seek to expand the refuge beyond our current acreage authority. Instead, we propose to focus acquisition in CFAs rather than in the smaller, scattered areas proposed in the refuge's 1995 Master Plan and EIS. Under alternative B, we would expand our current wildlife habitat and visitor services management activities to other refuge divisions, and support those same opportunities within CPAs on other ownerships across the watershed.

Alternative C—Enhanced Conservation Connections and Partnerships (Service's Preferred Alternative): Similar to alternative B, we would prioritize our work with partners in CPAs, and focus future refuge acquisitions in CFAs. However, under alternative C, we would seek to expand the refuge's approved acquisition authority in the watershed up to approximately 197,337 acres. The expanded network of 19 CPAs and 22 CFAs would allow for greater flexibility and opportunity for us to work with partners to achieve common conservation goals. We would be a more significant contributor to a well-connected conserved lands network in the watershed. Under alternative C, we would be able to increase our benefits to species of conservation concern by managing more acres of habitat with better distribution across the watershed. Expanding the refuge land base would also enhance our ability to address, and adapt our management to, climate change. We would be able to provide more public access for compatible recreational opportunities such as hunting, fishing, wildlife observation, and photography. We would also expand our education and interpretive programs with an emphasis on engaging urban communities.

Alternative D—Conservation Connections Emphasizing Natural Processes: Similar to alternative C, we would prioritize our work both on and off refuge lands in the same 19 CPAs, and would focus refuge acquisition in the same 22 CFAs. However, under alternative D, we would further expand individual CFAs and seek additional acquisition authority of up to approximately 231,307 acres. The increased acres would further enhance the refuge's capability to establish connections in the watershed's conserved lands network, and would strengthen our ability to adapt refuge lands to climate change. A major difference between alternatives C and D is that alternative D proposes to limit active habitat management. We would only intervene in natural processes when a federally listed species is in jeopardy, or a major wildfire or pest outbreak occurs and restoration is a critical need. Under alternative D, we would be able to provide more public access due to the increased land base, but our visitor services programs would emphasize a reduced human footprint, with a focus on backcountry opportunities and fewer developed areas.

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Appendix O Conservation Plans and Initiatives Guiding the Development of the CCP

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Chapter 1

J Norton/USFWS

Black Branch Falls on the Nulhegan Basin Division

Purpose of, and Need for, Action

- Introduction
- The Connecticut River Watershed and Refuge's Context
- The Final CCP/EIS Structure
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- Refuge Establishment History
- Refuge Purposes
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Introduction

The U.S. Fish and Wildlife Service (Service, we) has developed this final Comprehensive Conservation Plan (CCP) and Environmental Impact Statement (EIS) for the Silvio O. Conte National Fish and Wildlife Refuge (Conte Refuge, refuge). Congress authorized the refuge in 1991 through the Silvio O. Conte National Fish and Wildlife Refuge Act (Public Law 102-212; 105 Stat. 1655; Conte Refuge Act). The refuge is part of the National Wildlife Refuge System (Refuge System). Named in honor of Silvio O. Conte, the late Congressman who represented Massachusetts' First Congressional District from 1959 until his death in 1991, Conte Refuge was established in the 7.2 million-acre Connecticut River watershed (watershed) in Connecticut, Massachusetts, New Hampshire, and Vermont to conserve native fish, plants, and wildlife (map 1.1). Appendix K includes the full text of the Conte Refuge Act. The Service officially created Conte Refuge through a Record of Decision (ROD), Final Action Plan, and Final Environmental Impact Statement (FEIS) in 1995 (USFWS 1995).

From its inception, Conte Refuge has represented an important evolution for the Service in terms of the purpose, scope, and management of a national wildlife refuge. It was the first refuge in the Refuge System with a boundary that encompassed a large ecological landscape; that is, a major river's whole watershed, and with mandated conservation objectives that reached beyond refuge administrative units to affect the entire watershed (USFWS 1995). Congressman Conte and the other authors of the establishing legislation recognized that the resources of the Service alone could never meet the full scope and scale of the conservation needs for the entire watershed (Conte Refuge Act of 1991). Those authors emphasized that the key to success would lie in creating partnerships, most notably with the four states' natural resource agencies, with other Federal agencies, and with regional and community organizations and individuals. Their vision was to seek wide support and initiate broad-based efforts through partnerships to achieve meaningful conservation action, including the protection of Federal trust resources so vitally important to our agency's mission. This landscape-scale, partnership-based approach to achieving conservation was prescient for the Refuge System. The approach is now established in the framework for the Refuge System's bold new vision which is articulated in "Conserving the Future: Wildlife Refuges and the Next Generation" (USFWS 2011) and subsequent implementation documents (*http://americaswildlife.org*; accessed August 2016).

The emphasis on partnerships across the watershed remains the underpinning of this final CCP/EIS as we look toward Conte Refuge's future. Partnerships are essential to all that we do. The ultimate goal is for Conte Refuge to be an integral component of the natural, cultural, and economic fabric of the diverse communities in the watershed. To convey our intent, early in the process we developed as the mission for Conte Refuge…"Work in partnership with others to inspire stewardship, magnify achievements, and celebrate shared successes that enhance, nurture, and protect the natural, cultural, and sustainable economic richness of the Connecticut River and its watershed on public and private land."

Our existing partnerships are diverse in scope and reflect the refuge's influence in the watershed. One highlight includes our partnership with the Friends of the Silvio O. Conte National Fish and Wildlife Refuge (Friends of Conte), which is comprised of more than 70 national, regional, and local conservation and environmental advocacy organizations. Other key partnerships include our collaborations across the watershed with the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) offices, and respective state's fish and wildlife agencies. A list of our partnerships is included as appendix N.

Map 1.1. Location of the Connecticut River Watershed and the Service's Northeast Region (Region 5)

The Connecticut River Watershed and Refuge's Context

The Connecticut River has had a storied human and ecological history. The present-day Connecticut River formed after the last ice-age and since that time humans have depended on it for their livelihood. The first people to inhabit the Connecticut River Valley were Paleo-Indians who hunted caribou, woolly mammoth, and other cold-adapted animals. Over time, as the climate became drier and warmer, native peoples continued to rely on the river and associated wetland areas for settlements, travel, hunting, gathering, fishing, and horticulture. During colonial times, its 410 miles were a highway from Long Island Sound to the Canadian border for fur traders. Others sought its bountiful fisheries and wildlife, its deep, fertile soil, hydropower from its waters, its beauty as inspiration for art, and its timber for shipbuilding and crafts (Levin 2009). For additional information on the history of the Connecticut River, see chapter 3.

The current-day watershed retains many of the cultural, demographic, and political characteristics acquired at the time of its earliest habitation and development by European immigrants. It also maintains its diversity of natural resources and range of habitat types–from coastal estuaries in the south, to rich agricultural soils in the middle, and to alpine terrain in the north–that represent an unusually wide variety when compared with other refuges in the Refuge System. Understanding the history and diverse cultures of this iconic American landscape is instructive to capitalizing on the opportunities and challenges that face us as we pursue conservation action. Within the 7.2 million-acre watershed, over 1.8 million acres have some form of permanent protection, which we describe as the conserved lands network (map 1.2). Those conserved lands include the refuge and tracts owned by state and local governments, local and national non-governmental organizations, and other Federal agencies. The refuge is currently comprised of ten divisions and eleven units totaling 37,000 acres (as of February 2016; map 1.3). The current approved acquisition authority is 97,830 acres, based on the 1995 ROD/FEIS and subsequent amendments to expand certain divisions pursued through subsequent National Environmental Policy Act (NEPA) compliant decisions. A summary of those acres in chapter 4, table 4.5, represented by alternative A. Chapter 3 provides a detailed history of land acquisition. The refuge footprint encompasses rural and urban communities throughout the watershed where political bodies, state agencies, and individual residents have vested interests in how refuge activities–from land protection to environmental education, recreation, and community partnerships–affect their work and daily lives. Refuge staff are developing cooperative relationships with a diverse array of municipal and community constituents who will be key in the success or failure of an appropriation for a needed refuge initiative.

The Final CCP/EIS Structure

This final CCP/EIS combines two documents required by Federal law: a CCP required by the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd, et seq.; Refuge Improvement Act), and a final EIS required by NEPA of 1969. NEPA requires a thorough analysis be made of a reasonable range of alternatives, including the proposed action and no action. It also requires that we analyze the socioeconomic, biological, physical, and cultural consequences of implementing each alternative.

In August 2015, we distributed a draft CCP/EIS for public review and comment. This final CCP/EIS is structured similarly. It also presents four management alternatives which represent a range of different ways to achieve the refuge's purposes and four goals related to conservation, environmental education, recreation, and partnerships (see more on purposes and goals below). Generally, the distinction between the alternatives lies in their proposed management objectives and strategies which range in how well they achieve the refuge purposes and goals over the next 15 years.

Map 1.2. Conserved Lands in the Connecticut River Watershed

Map 1.3. Existing Refuge Ownership

This map reflects refuge ownership as of February 2016. aFor the most recent boundary files, contact refuge headquarters.

Early in the development of alternatives, it became clear that because of the geographic scope and scale of the refuge's legislative boundary and the limited staff and other refuge resources available, it was important to prioritize where we propose to direct our attention. To this end, we introduce in this document two tiers of priority areas of interest for refuge staff to focus their time and resources. The first tier we refer to as "Conservation Partnership Areas" (CPAs). CPAs are areas within the watershed where we propose refuge staff use their resources to facilitate and support the great conservation, education, and recreation work led by others on other ownerships. The second tier we refer to as "Conservation Focus Areas" (CFAs). CFAs are areas of particularly high importance and significance to the Service, typically nested within CPAs, where we propose refuge staff take the lead role in conservation, education, and recreation actions. Any future land acquisition for the refuge would be focused in CFAs. These concepts are explained in more detail in chapter 4 under our summary of alternative B.

NEPA establishes that the required "no-action" alternative can be either (1) taking no management action or (2) not changing current management (Bass et al. 2001). In this final CCP/EIS, alternative A is the latter and simply means current management would continue. Alternative A also serves as the basis for comparing and contrasting the other action alternatives. We define current management direction as that which is outlined in the 1995 ROD and Final Action Plan and FEIS, as amended by subsequent NEPA documents detailed in chapter 3.

The final CCP will guide the refuge's management over the next 15 years. Once approved, the CCP will become the new master plan for the refuge, setting out goals, objectives, and strategies organized by four major categories of management activities: wildlife and habitat conservation; environmental education, outreach, and interpretation; recreation; and partnerships. The CCP also identifies the Service's best estimate of future needs. It will detail program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization. CCPs do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisitions.

The final CCP will replace the 1995 Final Action Plan. Review and comment by the public and refuge partners on this final CCP/EIS is an essential prerequisite to developing a final CCP/EIS, which will also be distributed for public review and used in the ultimate selection and approval of an alternative to implement by our Regional Director.

This final CCP/EIS document has 7 chapters, 15 appendixes that provide supporting documentation, a glossary of terms, list of acronyms used, list of common and scientific names, and a bibliography. Below we describe what the reader can expect in each chapter.

The remainder of chapter 1 explains the purpose of, and need for, preparing a CCP and EIS for Conte Refuge. It also presents the regional context and project analysis area we considered in developing this plan, an overview of the refuge's establishment history, the refuge's legislated purposes, and our vision and four refuge goals.

Chapter 2–The Planning Process: This chapter explains the planning steps in developing this final CCP/EIS; describes the influences of other national, regional, ecosystem, and state plans; and presents the regulations, policies, and laws covering units of the Refuge System. Its last section is a summary of the

issues, concerns, and opportunities that were raised during the planning process and explains how they are addressed in this plan.

Chapter 3 – Affected Environment: This chapter describes the physical, biological, historic, and human environment generally for the watershed, followed by details of what is known about those resources on refuge lands. It describes the threats posed by climate change and land use changes, and how dynamic influences have and will affect management outcomes.

Chapter 4 – Description of Alternatives, Including the Service-preferred Alternative: This chapter presents the four management alternatives evaluated in detail (alternatives A, B, C, and D) and relates the actions proposed to meet the refuge's purposes and goals, and respond to key issues, concerns, and opportunities. Briefly described, the four alternatives are as follows:

Alternative A: Current Management
This is the "No Action" or "No Change" alternative that NEPA requires as a baseline to which all other alternatives are compared. Current habitat and visitor services management activities on existing refuge lands would continue. Existing partnerships would continue to be supported. There would be no increase in the refuge's land acquisition authority of 97,830 acres which has been primarily focused on acquiring 65 scattered Special Focus Areas (SFAs) as detailed in the 1995 ROD, FEIS and Final Action Plan, as amended.

Alternative B: Consolidated Stewardship
Similar to alternative A, under alternative B, we would continue to conserve resources and provide visitor services on existing refuge lands. However, this alternative would also direct and concentrate additional staff and resources toward facilitating and supporting partnerships and management activities across ownerships in a network of biologically determined CPAs (described in more detail in chapter 4) throughout the watershed. Another change from alternative A is that future refuge land protection on up to 97,772 acres would be focused on seeking opportunities from willing sellers within high conservation value CFAs (described in more detail in chapter 4), instead of SFAs.

Alternative C: The Preferred Alternative–Enhanced Conservation Connections and Partnerships
Under alternative C, the refuge would build off alternative B to support and facilitate partnerships and management activities; however, it would occur in an expanded CPA network. Thus, we would engage in conservation activities on more acres, and on more and different types of ownerships in the watershed. In addition, we would seek an expanded authority to acquire up to 197,337 acres for the refuge from willing sellers within a larger CFA network than proposed in alternative B. The expanded networks of CPAs and CFAs would allow for greater flexibility and opportunity in working with partners to achieve common landscape-scale conservation goals.

Alternative D: Conservation Connections Emphasizing Natural Processes
Under alternative D, there would be a focus on reducing the human footprint on the landscape and promoting natural habitat functions and processes. Generally, less active habitat and visitor services management would occur, except those needed for priority restoration activities. Visitor services programs would emphasize backcountry, low density, walk-in opportunities. This alternative also proposes to further expand the CPA and CFA networks included in alternative C up to 231,307 acres.

Chapter 5 – Environmental Consequences: This chapter evaluates how the environment in the watershed may be affected (i.e., the foreseeable consequences), both positively and adversely, by management actions proposed under each of the four alternatives.

Chapter 6 – Consultation and Coordination with Others: This chapter addresses a key element of NEPA and Service planning policy by describing the public and partner involvement used throughout the planning process.

Chapter 7 – List of Preparers: This chapter provides a list of members of the CCP Core Team, other Service and state personnel, and others who assisted in developing this final CCP/EIS.

Purpose of, and Need for, Action

This final CCP/EIS was developed in the context of a changing landscape. The watershed's natural environment, the influences of societal and land use changes, and the implications of climate change, have all affected the refuge setting since the 1995 establishing documents for the refuge were approved. This CCP is designed to address those changes and establish management and protection of valuable natural resources into the future, a future where continued change is even more likely to occur.

Thus, the ***purpose*** of this final CCP/EIS is to establish strategic management direction to ensure that our management of the refuge will best integrate the areas of concern listed below. Our use of the term "strategic" means approaches that are ecologically sound and sustainable in light of physical and biological change, and are practical, viable, or economically realistic, and responsive to the following three areas of concern:

1. Abides by, and contributes to, the Service and Refuge System missions, legal mandates, Executive and Secretarial Orders, and Service and Refuge System policies. We provide a description of the Service and Refuge System missions, legal mandates, specific orders, and policies relevant to this planning process in chapter 2.

2. Helps meet the refuge's legislated purposes, vision, and CCP goals. The refuge's purposes, vision, and goals are listed below. The vision statement broadly interprets the refuge purposes and is an inspiring statement of the desired future for the refuge. The refuge goals articulate that desired future condition further and provide a framework for developing management objectives and strategies under each alternative.

3. Addresses key issues, including the concerns of the Service, other Federal and State agencies, and the public. Interest in the future management of Conte Refuge is widespread. The concerns and interests of our partners, local communities, and interested members of the public are diverse. Through our scoping and outreach, coupled with our understanding of the particular threats and challenges to conservation in the watershed, and the need to incorporate the best available scientific and technical information, we have identified seven key issue categories to focus on in this CCP and address through objectives and strategies under each alternative. We provide additional details on these issue categories in chapter 2:

   - Landscape-level land conservation and resource protection.
   - Habitat management.
   - Species management.
   - Public uses.
   - Socioeconomic factors.
   - Community relations and partnerships.
   - Administration (e.g., budget, staffing, and facilities).

The ***need*** for a CCP on this refuge is great due to landscape and demographic changes in the watershed, shifts in refuge management priorities due to the expanded refuge land base, and new opportunities for refuge management, new partnerships, and the Service's adoption of new policies and major initiatives since refuge establishment. In addition, the economy and patterns of land use and land ownership in local communities are changing. The pressures for public use and access on existing and new refuge lands across the watershed have continued to increase. Climate change and natural processes have also altered, and will continue to alter, the refuge and watershed environment. For example, record-setting temperatures, ice and snowstorms, tornados, and flood events have occurred and significantly affected habitats in recent years. The CCP is needed to help ensure that the refuge continues to conserve the Connecticut River watershed's fish, wildlife, and ecosystems in the face of climate change and these other pressures. Also, when Conte Refuge was established in 1995, a fundamental concept was that refuge ownership would be limited to smaller SFAs scattered throughout the watershed, with a particular emphasis on federally listed and state-listed species. Since that time, conservation priorities and opportunities have resulted in a different configuration of Service acquisition. Support has increased for investments of land in the conservation estate for plants, fish, wildlife, and people.

Another need for a CCP is because, with the exception of invasive species control, limited active habitat management was detailed in the 1995 plan. Refuge staff are currently working on habitat restoration and management activities that would benefit from strategic direction. In addition, the 1995 Final Action Plan (USFWS 1995) identified some partnership programs and infrastructure with the Service taking the lead that are no longer feasible while other partnerships and program emphases have emerged. Over the last 10 years, we have continually evaluated administrative and visitor facilities, including their locations, accessibility, and functionality, to ensure the best customer service possible, resulting in some differences from what was proposed in 1995.

One major Service initiative that is influencing refuge management is the agency's concerted shift to operating under a Strategic Habitat Conservation (SHC) planning framework (USFWS 2008). This framework guides the Service in identifying, planning, implementing, and monitoring conservation priorities and activities. Relating to refuges, this planning framework and subsequent guidance, recommends steps to identify priority species, develop outcome goals for these species, design actions that allow refuge management to meet these goals by strategically addressing issues and threats to priority species, and–most importantly–implement the actions, measure their results, and adapt the actions as necessary to produce better outcomes. All of these steps have a solid basis in using sound scientific principles. Monitoring, evaluation, and adaptive management is required as part of this framework to ensure our actions protect and restore the ecological integrity of refuge and watershed resources, and do not result in additional degradation of environmental conditions.

Bill Thompson

Cedar waxwing

In summary, the final CCP will detail strategic management direction for the refuge for 15 years, by:

(1) Stating clearly the desired future conditions for refuge habitat, wildlife, visitor services, staffing, and facilities through presentation of goals, objectives, and strategies.

(2) Explaining concisely to state agencies, refuge neighbors, visitors, partners, and other stakeholders the reasons for management actions.

(3) Ensuring that refuge management conforms to the policies and goals of the Refuge System and legal mandates.

(4) Ensuring that present and future public uses on refuge lands are appropriate and compatible.

(5) Providing long-term continuity and consistency in management direction.

(6) Justifying budget requests for staffing, operations, and maintenance funds.

The CCP will serve as an important means of conveying the vision and priorities for Conte Refuge to our partners, watershed communities, and interested and affected individuals to encourage successful integration of Service priorities with partner priorities. Our hope is that creative and diverse coalitions will stimulate and maintain the vital momentum necessary to meet the conservation challenges and explore opportunities in the watershed.

Regional Context and Project Analysis Area

As stated in the "Introduction," it is essential to understand the geographical, ecological, and socioeconomic setting of the watershed, and the refuge's context within it, to fully relate the actions proposed in this final plan. The regional context for our analysis is the entire Connecticut River watershed (map 1.1). The watershed encompasses the heart of New England, covering 11,000 square miles — or 7.2 million acres. This river serves as the border between Vermont and New Hampshire and bisects Massachusetts and Connecticut. The river originates in Canada just north of Fourth Connecticut Lake in Pittsburg, New Hampshire, eventually emptying into Long Island Sound in Old Saybrook, Connecticut, after traveling 410 miles (CRWC 2012).

There is considerable diversity in both ecological and socioeconomic terms within the watershed, which influences opportunities and capabilities both on and off refuge lands. Along its length, the river flows through well-recognized landscapes–the Northern Forest of Vermont and New Hampshire; the Upper Valley of those same two states; the Pioneer Valley of Massachusetts, including Springfield, Massachusetts; the Tobacco Valley of Connecticut; and the urban corridor that stretches from Hartford, Connecticut, to Long Island Sound. It also includes the eastern slopes of the Green Mountains in Vermont and the Berkshires in Massachusetts, and the western slopes of the White Mountains in New Hampshire. Over 2.3 million people live in the watershed, with the majority of the population in its southern reaches. Its largest cities include Hartford, Connecticut (population 124,775), and Springfield, Massachusetts (population 153,060) (U.S. Census 2013).

The watershed boundary serves as the context for evaluating the physical, ecological, and socioeconomic relationship of the refuge and its management activities to regional resources of concern, and the communities within the watershed (CRWC 2009). The land ownership, land use, or management patterns in this political, social, and ecological environment affect our management of refuge lands. Of particular note, map 1.2 depicts the regional land conservation network in and around the watershed. Many prominent land-based partners

cooperate in that network (appendix N). Greater detail on the project area and environment is provided in chapter 3.

Refuge Establishment History

As discussed in the "Introduction," the refuge was legislated by Congress through the 1991 Conte Refuge Act and was created by the Service in 1995 with completion of a ROD, FEIS, and a Final Action Plan (USFWS 1995). A refuge becomes established into the Refuge System once its first parcel of land is acquired. Conte Refuge was established on October 3, 1997, when the Connecticut River Watershed Council (CRWC) donated Third Island in Deerfield, Massachusetts, to the Service. We highlight the refuge's land acquisition history in chapter 3.

In 1996, even though there was no land base yet for the refuge, the Service began a competitive challenge cost-share program (USFWS 1995). This was a unique program that provided matching grants to selected applicants who wished to accomplish education, research, inventory, or management projects that would further refuge purposes. For example, funding for projects to conduct invasive species control in critical habitat or wetlands areas was a major interest. Unfortunately, the refuge challenge cost-share program was discontinued after 2001 due to the growing needs to use operational funds to support the refuge land base.

Also early in the refuge's development was the focus on establishing cooperatively run education centers — four as prescribed by the Conte Act, which we have interpreted as one in each state. In 2002, two cooperative education centers opened their doors: the Great North Woods Interpretive Center in Colebrook, New Hampshire, and the Conte Refuge Education Center at the Montshire Museum of Science in Norwich, Vermont. In 2003, a third major cooperatively run visitor facility opened as the Great Falls Discovery Center in Turners Falls, Massachusetts. Our Friends groups were instrumental in developing and supporting these facilities.

Refuge Purposes

The 1991 Conte Refuge Act created the specific refuge purposes listed below. Refuge purposes guide management priorities and actions on refuges. The legislated purposes for the Conte Refuge are as follows:

- To conserve, protect, and enhance the Connecticut River populations of Atlantic salmon, American shad, river herring, shortnose sturgeon, bald eagles, peregrine falcons, osprey, black ducks, and other native species of plants fish and wildlife.
- To conserve, protect, and enhance the natural diversity and abundance of plant, fish, and wildlife species, and the ecosystem upon which these species depend within the refuge.
- To protect species listed as endangered or threatened, or identified as candidates for listing, pursuant to the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.).
- To restore and maintain the chemical, physical, and biological integrity of wetland and other waters within the refuge.
- To fulfill the international treaty obligations of the United States relating to fish, wildlife, and wetlands.
- To provide opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation and access to the extent compatible with the other purposes stated in this section.

Forest, Nulhegan Basin Division

Sharon Lindsey

Refuge Vision

This vision statement was developed by the planning team and is intended to capture the essence of what is important as we look to the future about refuge resources and activities, and to excite and motivate people to action. The vision should also reflect the refuge's purposes and goals. We developed the following vision statement with those considerations in mind.

> *The Connecticut River is treasured by all for its majesty and significance in supporting diverse aquatic and terrestrial plant and animal life along its winding 410-mile passage through urban and rural communities in New Hampshire, Vermont, Massachusetts, and Connecticut. Working with our partners, we are inspired to protect and enhance the natural and cultural richness throughout the watershed, especially on lands and waters entrusted to our agency as the Silvio O. Conte National Fish and Wildlife Refuge.*
>
> *Together with our partners, we design, support, and implement strategic conservation actions across the watershed, and communicate conservation needs and successes through extensive outreach and education programs. On refuge lands, and in our conservation partnership areas, we offer visitor programs and activities that promote an appreciation of the Connecticut River watershed as an intact, interconnected, and healthy ecosystem. Visitors respond to this greater awareness by becoming active stewards of the watershed's natural and cultural resources. Through our Urban Partnership Program, we are promoting the relevancy of conservation to healthy communities. Our actions exemplify the Service's vital role in conserving the Connecticut River watershed and the refuge's important contribution to the mission of the National Wildlife Refuge System.*

Refuge Goals

Goals are designed to direct management priorities toward achieving the refuge's vision and legislative purposes, and contribute to the Refuge System's mission. Goals are succinct, descriptive, broad statements of the desired future condition of a refuge, and comprise the whole of the refuge's effort in pursuit of its vision. Goals lay the foundation from which all refuge activities arise as they provide

the platform upon which the more measurable and time sensitive objectives and strategies are developed (USFWS 2004).

Our planning team developed these four goals after reviewing the refuge purposes, the mission of the Service and Refuge System, our proposed vision, and the mandates, plans, and conservation strategies mentioned above. We also updated these goals based on input from the public and our partners.

Goal 1. Habitat Conservation

Promote the biological diversity, integrity, and resiliency of terrestrial and aquatic ecosystems within the Connecticut River watershed in an amount and distribution that sustains ecological function and supports healthy populations of native fish, wildlife, and plants, especially Federal trust species of conservation concern, in anticipation of the effects of climate, land use, and demographic changes.

This goal supports the purposes of the Conte Refuge Act related to the protection of important wildlife and associated habitats that are of special concern. The act's purposes highlighted the protection and conservation of migratory fish, migratory birds, threatened and endangered species, and native fish and wildlife across the watershed. That charge to protect this diversity is immense with the many species which occur here, including approximately 59 mammals, 250 birds, 22 reptiles, 23 amphibians, 142 fish, 1,500 invertebrates; and, approximately 3,000 plants (USFWS 1995). The Conte Refuge Act purposes also noted the urgency to protect and enhance the natural diversity and abundance of the ecosystems upon which these species depend in the watershed, and to restore and maintain the chemical, physical, and biological integrity of wetlands and other waters within the refuge. A foundation of this goal involves the use of scientific research, and inventory and monitoring programs to support management decisions.

Diverse habitats in the watershed include:

- Internationally important tidal wetlands and riverine habitats valuable to migratory and resident fish, freshwater mussels, and other aquatic species.
- Floodplain forests and other riparian habitats valuable to migrating songbirds, waterfowl, and many other species of plants and animals.
- Old field grasslands, sandplains, and agricultural fields valuable to grassland-nesting birds and other species.
- A wide variety of forest types, including large areas of relatively unfragmented northern forest types, valuable to nesting migrant interior forest birds, as well as many other plant and animal species.

Forests are the dominant land cover type and are increasing as abandoned agricultural lands revert to forest cover. Generally, the forests in the northern section of the watershed are northern hardwood (maple–beech–birch) at lower elevations and coniferous (spruce–fir) at higher elevations (and more northerly latitudes). Stretching southward into Massachusetts, the northern hardwoods are intermixed with red and white pine. An oak–hickory forest predominates in the lower reaches of the watershed. Other upland plant communities include grasslands maintained for pastures, hayfields, airports, and retired landfills; shrubby fields which occur as abandoned fields experiencing plant succession; orchards; and cultivated fields.

Restoring and maintaining the integrity of wetlands and other waters is specifically mentioned in the refuge's purposes. The watershed contains approximately 257,000 acres of wetlands, representing 3.6 percent of its area.

Goal 2. Education, Outreach, and Interpretation
Inspire residents and visitors to actively participate in the conservation and stewardship of the exceptional natural and cultural resources in the Connecticut River watershed, and promote a greater understanding and appreciation of the role of the Silvio O. Conte National Fish and Wildlife Refuge in conserving those resources.

This goal supports the purposes of the Conte Refuge Act to provide opportunities for environmental education. Using a network of education centers, exhibits, and programming, refuge personnel and partners introduce visitors to watershed fish, wildlife, and habitats, and emphasize the value of species and habitat diversity, and habitat connectivity. Through partnerships and targeted outreach, educators try to motivate specific groups of citizens to tackle tough problems like controlling invasive plants, improving water quality, and minimizing habitat fragmentation in the face of a changing climate and land use patterns. Interpreters work with teachers and students to enrich their visits and their own curricula using an array of entertaining, interactive, and informational material, media, and formats. The refuge also has a mobile visitor center, the Watershed on Wheels Express (WoW Express). The WoW Express allows refuge staff and volunteers to bring interpretive and environmental educational experiences directly to the 396 communities within the watershed.

Goal 3. Recreation
Promote high quality, public recreational opportunities in the Connecticut River watershed that are complementary between ownerships and provide regional linkages, with emphasis on promoting wildlife-dependent activities that connect people with nature in the outdoors.

This goal supports the purposes of the Conte Refuge Act to provide opportunities for fish and wildlife oriented recreation and access to the extent compatible with the other purposes stated in this section. Many of the refuge's existing divisions and units provide opportunities for hunting and fishing according to state regulations. In addition, visitors may view and photograph wildlife while driving on gravel roads (Nulhegan Basin Division), hiking on nature trails (Nulhegan Basin, Pondicherry, and Fort River Divisions) or using wheelchair accessible trails (Nulhegan Basin, Pondicherry, and Fort River Divisions) that include overlooks, interpretive displays, and informational kiosks. Also, all refuge divisions and all but three of the refuge units are open to one or more of the priority public uses (Wissatinnewag, Saddle Island, and Dead Man's Swamp units are closed to the public to protect sensitive resources, and the Mount Tom Unit is closed due to public safety and vandalism concerns).

Goal 4. Partnerships to Conserve and Enjoy the Connecticut River Watershed
Enhance the conservation, protection, and stewardship of natural and cultural resources, and promote wildlife-dependent recreation, throughout the Connecticut River watershed by initiating, supporting, and promoting partnerships with other Federal, State, and local agencies, Tribal governments, and private organizations.

While this goal is listed fourth, it is by no means lowest in priority. We present this goal last to illustrate how significant partnerships are to implementing the priority actions we describe in goals 1 through 3 in chapter 4 and appendix A. In fact, it is very important to us that we convey that our partnerships underpin all that we do. We recognize daily the critical importance of working with diverse and extensive partnerships to achieve the purposes of the refuge, as well as support the compatible and complementary missions, goals, and objectives of our partners.

Refuge personnel maximize beneficial effects across the landscape by working with public and private landowners and other partners on a variety of research, inventory, habitat improvement, and education projects. Partnerships often are established and nurtured by refuge management with state environmental and wildlife agencies in Vermont, New Hampshire, Massachusetts, and Connecticut, other Federal agencies such as NRCS, and with a host of non-governmental conservation organizations, many of whom comprise the Friends of Conte. Since its inception, the refuge has contributed funds to at least 170 grants within the watershed for habitat restoration, research, surveys, environmental education, and outreach with hundreds of partners large and small. Examples of these partners include the University of Massachusetts, Vermont Institute of Natural Science, Roaring Brook Nature Center, University of Connecticut, Woodstock Conservation Commission, and Cromwell Fish and Game Club.

We strive to do the best we can with the staff and funds allotted, but always need help to do more. Volunteers provide vital assistance in refuge offices, education centers, and afield on refuge land and in the greater watershed. There are several Friends groups that work tirelessly to assist: the Friends of Conte, the Friends of Nulhegan Basin Division, the Friends of the Great Falls Discovery Center, and the Friends of Pondicherry Division. Additional Friends groups are forming at the Fort River, Salmon River, and Blueberry Swamp Divisions. Members of these groups generously donate their time and enthusiasm working on a wide variety of projects that contribute to their division in the form of conservation, education, and recreation initiatives and accomplishments. The partnership between the Friends groups and refuge staff is a relationship that thrives on a balance between the preferences and abilities of the Friends members and the needs of the refuge resources. In addition, the refuge staff have been actively working within subwatershed-based invasive species partnerships in the watershed. Such partnerships, generally termed Cooperative Invasive Species Management Areas (CISMAs) currently exist in the upper watershed, Ottauquechee, Upper White, Westfield, Upper Farmington, and Eightmile watersheds and are making considerable progress in creating surveys, control plans, and raising awareness about invasive species among landowners and target audiences.

Red-breasted mergansers

Bill Thompsona

Chapter 2

David Govatski

Moose at Moose Bog near Nulhegan Basin Division

The Planning Process

- Introduction
- Service Policies, Legal Mandates, Service and Refuge System Conservation Priorities and Initiatives, and Resource Plans Guiding the Planning Process
- Conservation Plans and Initiatives Guiding Development of the CCP
- The Comprehensive Conservation Planning Process
- Issues, Concerns, and Opportunities
- Issues, Concerns, and Opportunities Outside the Scope of This Final CCP/EIS Analysis
- Issues, Concerns, and Opportunities Not Needing Alternative Management Options
- Issues, Concerns, and Opportunities Evaluated Under Alternative Management Options

Introduction

This chapter highlights Service policies, legal mandates, Service and Refuge System conservation priorities and initiatives, and existing Federal, regional, state, and local resource plans that influenced development of this final CCP/EIS. We follow that discussion with a description of the Refuge System's conservation planning process steps, indicating what we accomplished at each step as we developed this final plan. The final sections in this chapter detail the issues, concerns, and opportunities that were raised during the planning process, and how we intend to address them.

Service Policies, Legal Mandates, Service and Refuge System Conservation Priorities and Initiatives, and Resource Plans Guiding the Planning Process

As part of the Refuge System, Conte Refuge is subject to all applicable Federal laws, regulations, and policies pertaining to refuge management and administration. This section presents the Service and Refuge System mission, policy, legal mandates, and conservation priorities that directly influenced the development of this final CCP/EIS.

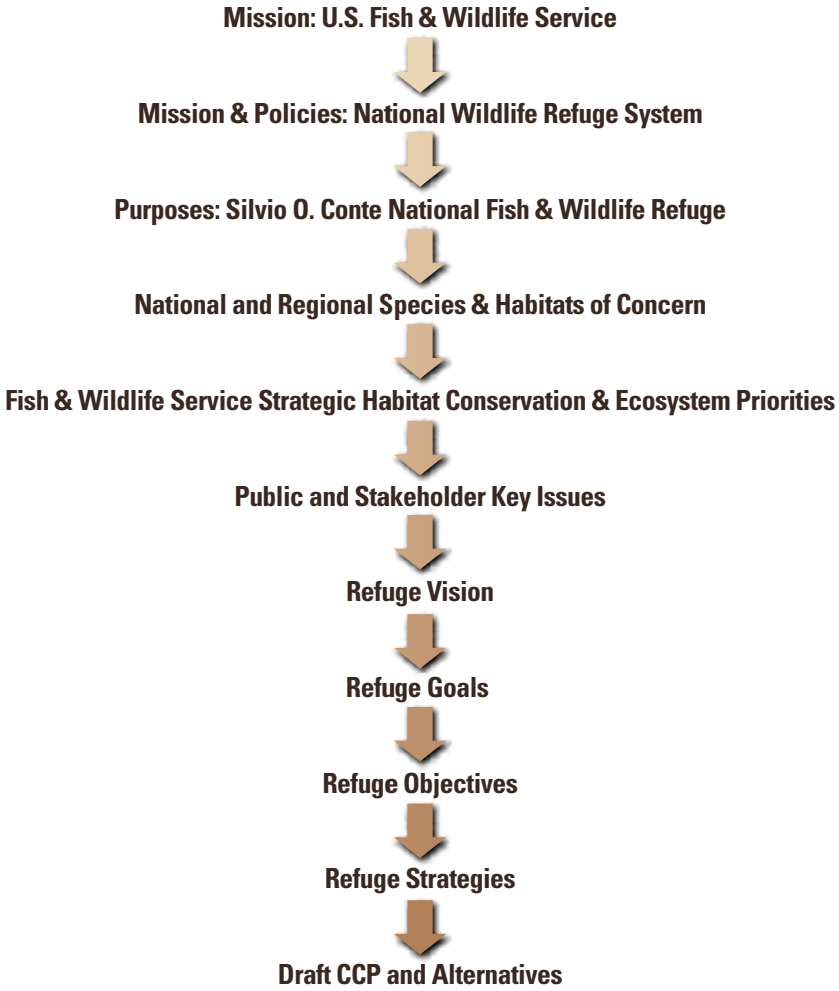


Figure 2.1. Information Used in Development of a CCP

The U.S. Fish and Wildlife Service and its Mission

The Service, an agency in the Department of the Interior (DOI), administers the Refuge System, along with many other conservation programs. The Service's mission is: "Working with others, to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people."

Through legislation, Congress entrusts certain natural resources, referred to as "Federal trust resources," to the Service for conservation and protection. These include migratory birds, federally listed endangered or threatened species, migratory inter-jurisdictional fish, wetlands, certain marine mammals, and national wildlife refuges. The Service also enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists states with their fish and wildlife programs through grants, regulates recreational harvest of migratory game birds, advises other Federal agencies on reducing their operational impacts to fish and wildlife, hosts major conservation partnerships, offers partnership grants for national and international habitat conservation, and helps countries around the world develop conservation programs.

Although Service and Refuge System policies and the refuge's purposes provide foundation for its management, other Federal laws, executive orders (Presidential, Secretarial, or Service Director), treaties, interstate compacts, and regulations on the conservation and protection of natural and cultural resources also affect how national wildlife refuges are managed. The Digest of Federal Resource Laws of Interest to the Service provides a comprehensive list and description of all Federal laws under which the Service functions, including administrative laws, treaties, executive orders, interstate compacts, and memoranda of agreement. The digest is available online at: *http://fws.gov/laws/Lawsdigest.html* (USFWS 2010a; accessed August 2016).

The Service Manual describes the Services authorities and responsibilities, as well as provides guidance on its activities (USFWS 2013a; *http://www.fws.gov/policy/manuals/*; accessed August 2016). Part of the Service's responsibilities includes regulating certain activities of public and private interests, such as development of lands used by endangered and threatened species or hunting on national wildlife refuges. These regulated activities are published in the U.S. Code of Federal Regulations (CFR). Most of the current regulations that pertain to the Service are issued in 50 CFR parts 1 to 99 that can be viewed at: *https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR* (GPO 2013; accessed August 2016).

Policies are developed to implement and administer laws and directives. The Refuge System manual provides a central reference for current policy governing the operation and management of the Refuge System not covered by the Service manual, including technical information on implementing Refuge System policies and guidelines. This manual can be reviewed at: *http://www.fws.gov/policy/manuals/* (accessed August 2016). Policies can also be viewed at: *http://www.fws.gov/refuges/policiesandbudget/refugepolicies.html* (USFWS 2012a; accessed August 2016). Following are brief descriptions of the policies that most directly pertain to the development of CCPs.

The National Wildlife Refuge System, its Mission, and Policies

The Refuge System is the world's largest collection of lands and waters set aside specifically for the conservation of wildlife and ecosystem protection. The Refuge System began in 1903, when President Theodore Roosevelt designated Pelican Island, a pelican and heron rookery in Florida, as a bird sanctuary. Today, more than 560 national wildlife refuges are part of the Refuge System. They encompass more than 150 million acres of lands and waters in all 50 States and several island territories. Over 40 million visitors hunt, fish, observe and photograph wildlife, or participate in environmental education and interpretive activities on national wildlife refuges across the nation each year (Carver and Caudill 2007).

In 1997, the Refuge Improvement Act passed as an amendment to the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 6688dd, *et seq.*).

The amended law established a unifying mission for the Refuge System, a new process for determining compatible public use activities on refuges, and the requirement to prepare CCPs for each refuge. The Refuge Improvement Act states, first, that the Refuge System must focus on wildlife conservation. It further states that the Refuge System's national mission, coupled with the purpose(s) for which each refuge was established, will provide the principal management direction for each refuge. As provided by Section 4 of the Refuge Improvement Act, the mission of the Refuge System is: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

In July 2011, the Refuge System convened the "Conserving the Future: Wildlife Refuges and the Next Generation" conference to renew and update its 1999 vision document, originally called Fulfilling the Promise. After the conference and an extensive public engagement process, a renewed vision document was finalized in October 2011 (USFWS 2011). The document has 24 recommendations, covering a variety of topics from habitat and species management, visitor services, refuge planning, land conservation, communications, building partnerships, and urban refuges. Currently, implementation teams are developing strategies to help us accomplish the vision. We will incorporate implementation strategies, as appropriate, in our refuge step-down plans. You may view the document and see the latest updates at: *http://americaswildlife.org/* (National Wildlife Refuge Association 2013; accessed August 2016).

The following list of Refuge System policies represents those that most directly affected the development of this final CCP/EIS. They are presented in the order in which they appear in the Service manual, in Series 600 (Land Use and Management), Parts 601 to 609 covering refuge management.

Policy on National Wildlife Refuge System Mission, Goals, and Refuge Purposes: This policy (601 FW 1, USFWS 2006a) presents the mission and goals of the Refuge System and their relationship to refuge purposes. This policy recognizes the priority of the Refuge System for management activities and uses set forth in the Refuge Improvement Act (i.e., conserve fish, wildlife, and plants and their habitats; facilitate compatible wildlife dependent recreational uses; and other uses). This policy describes the Refuge System mission, revises the Refuge System goals, and provides guidance for identifying or determining the purpose(s) of individual refuges and their incremental land additions within the Refuge System.

Policy on Maintaining Biological Integrity, Diversity, and Environmental Health: This policy (601 FW 3, USFWS 2001) provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System, including protecting the broad spectrum of fish, wildlife, and habitat resources found in refuge ecosystems. The policy includes the following definitions:

- Biological diversity is the "variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur."

- Biological integrity is the "biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities."

- Environmental health is the "composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment."

The policy also provides refuge managers with a process for evaluating the best management direction to prevent additional degradation of environmental conditions and restore lost or severely degraded environmental components. Guidelines are provided for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem.

Policy on Coordination and Cooperative Work with State Fish and Wildlife Agencies: This policy (601 FW 7; 2008a) establishes procedures for coordinating and working cooperatively with state fish and wildlife agency representatives on management of units of the Refuge System. The purpose of this policy is to ensure timely and effective cooperation with state fish and wildlife agencies during the course of acquiring and managing refuges. A focus of this policy is the importance of state agency involvement in CCPs. Specifically, the policy calls for inviting state fish and wildlife agency participation on CCP core teams, and otherwise provide them timely and meaningful participation opportunities throughout the planning process, and that we include a summary of state comments in the final CCP. With regard to hunting and fishing programs developed for a refuge, we are to ensure regulations for those programs, are, to the extent practicable, consistent with state fish and wildlife laws, regulations, and management plans.

Policy on Refuge System Planning: The requirements for refuge planning are covered in two chapters (602 FW 1, USFWS 2000a; 602 FW 3, USFWS 2000b). Part 602 FW 1 provides an overview of Refuge System planning, identifies who is responsible, defines terms, and establishes when certain refuge plans are required. This chapter stipulates that all refuges will be managed in accordance with an approved CCP, which, when implemented, will achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; help achieve the goals of the National Wilderness Preservation System (National Wildlife Preservation System); and meet other mandates. Further, this policy states that the CCP will guide management decisions and set forth goals, objectives, and strategies to accomplish these ends. It also establishes that refuge step-down management plans may also be required to provide additional details about meeting CCP goals and objectives and to describe strategies and implementation schedules. This policy requires that each plan will be founded on principles of sound fish and wildlife management and available science, and be consistent with legal mandates and our other policies, guidelines, and planning documents. Finally, this policy requires that we comply with NEPA and its regulations in developing plans, and provide opportunities for others to participate in refuge planning, including other Service programs; Federal, state, and local agencies; Tribal governments; conservation organizations; adjacent landowners; and the public.

The purpose of chapter 602 FW 3 is to describe a systematic decision-making process that fulfills the requirements for developing a CCP. This chapter provides guidance, step-by-step direction, and establishes minimum requirements for all CCPs. This chapter establishes the following goals for comprehensive conservation planning:

A. To ensure that wildlife comes first in the Refuge System and that we manage each refuge to help fulfill the mission of the Refuge System, maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System, as well as achieve the specific purposes for which the refuge was established.

B. To provide a clear and comprehensive statement of desired future conditions for each refuge or planning unit.

C. To encourage use of an ecosystem approach when we conduct refuge planning. This includes conducting concurrent refuge planning for refuges within the same watershed or ecosystem and considering the broader goals and objectives of the refuges' ecosystems and watersheds when developing management direction (see Ecosystem Approach to Fish and Wildlife Conservation [Part 052 of the Fish and Wildlife Service Manual]).

D. To support management decisions and their rationale by using a thorough assessment of available science derived from scientific literature, on-site refuge data, expert opinion, and sound professional judgment.

E. To ensure that the six priority wildlife-dependent recreational uses receive priority consideration during the preparation of CCPs.

F. To provide a forum for the public to comment on the type, extent, and compatibility of uses on refuges, including priority wildlife-dependent recreational uses.

G. To provide a uniform basis for budget requests for operational, maintenance, and capital improvement programs.

H. To ensure public involvement in refuge management decisions by providing a process for effective coordination, interaction, and cooperation with affected parties, including Federal agencies, state conservation agencies, Tribal governments, local governments, conservation organizations, adjacent landowners, and interested members of the public.

According to refuge policy, a final approved CCP is intended to provide the refuge manager with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while providing opportunities for compatible wildlife-dependent recreational uses. To the extent practical, these plans should be consistent with respective state's fish and wildlife conservation plans. Below we highlight where in this final CCP/EIS we include certain specific details required by Section 7 of the Refuge Improvement Act and planning policy:

- The purposes of the refuge (see chapter 1).
- The distribution, migration patterns, and abundance of fish, wildlife, and plant populations and related habitats within the planning unit (see chapter 3).
- The archaeological and cultural values of the planning unit (see chapter 3).
- Areas within the planning unit that are suitable for use as administrative sites or visitor facilities (see chapters 3 and 4).
- Significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants within the planning unit and the actions necessary to correct or mitigate such problems (see chapters 2, 3, and 4).

- Opportunities for compatible wildlife-dependent recreational uses (see chapters 2, 3, and 4).

Policy on Appropriate Refuge Uses: Federal law and Service policy provide the direction and planning framework for protecting the Refuge System from inappropriate, incompatible, or harmful human activities and ensuring that all visitors can enjoy its lands and waters. This Service policy (603 FW 1) provides a national framework for determining appropriate refuge uses to prevent or eliminate those that should not occur in the Refuge System. It describes the initial decision process the refuge manager follows when first considering whether to allow a proposed use on a refuge. An appropriate use must meet at least one of the following four conditions:

- The use is a wildlife-dependent recreational use, as identified in the Improvement Act.
- The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act became law.
- The use involves the take of fish or wildlife under state regulations.
- The use has been found to be appropriate after concluding a specified findings process using the 10 specific criteria included in the policy.

Appendix D includes the findings of appropriateness for Conte Refuge. You may view the appropriateness policy on the Web at: *http://www.fws.gov/policy/603fw1.html* (accessed August 2016).

Policy on Compatibility: This policy (603 FW 2) complements the appropriateness policy and provides guidance on how to prepare a compatibility determination. The refuge manager first must find a use appropriate before determining if the use is compatible. If the proposed use is found not to be appropriate, a compatibility determination is unnecessary and the use is not allowed. According to this policy, a compatible use is one "… that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge."

Monarch butterfly

Ron Holmes/USFWS

Other guidance in that chapter follows:

- The Refuge Improvement Act and its regulations require that the refuge manager must find a public use compatible before it is allowed on a refuge.

- The act defines six wildlife-dependent uses that are to receive enhanced consideration on refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. The refuge manager may authorize these six priority uses on a refuge when they are compatible and consistent with public safety.

- When the refuge manager publishes a compatibility determination, it will specify the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses or 10 years for other uses. However, the refuge manager may reevaluate the compatibility of a use at any time: for example, sooner than its mandatory date, or even before we complete the CCP process, if new information reveals unacceptable impacts or incompatibility with refuge purposes (603 FW 2.11, 2.12).

- The refuge manager may allow or deny any use, even one that is compatible, based on other considerations such as public safety, policy, or available funding.

Appendix D includes the draft compatibility determinations for Conte Refuge. You may view the compatibility policy on the Web at: *http://www.fws.gov/policy/603fw2.html* (accessed August 2016).

Policy on Wildlife-Dependent Recreation Uses: This policy (605 FW 1-7) presents specific guidance about wildlife-dependent recreation programs within the Refuge System. We develop our wildlife-dependent recreation programs in consultation with state fish and wildlife agencies and with stakeholder input based on the following criteria:

- Promotes safety of participants, other visitors, and facilities.

- Promotes compliance with applicable laws and regulations and responsible behavior.

- Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.

- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.

- Minimizes conflicts with neighboring landowners.

- Promotes accessibility and availability to a broad spectrum of the American people.

- Promotes resource stewardship and conservation.

- Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.

- Provides reliable/reasonable opportunities to experience wildlife.

- Uses facilities that are accessible to people and blend into the natural setting.

- Uses visitor satisfaction to help to define and evaluate programs.

Policy on Managing Cultural Resources: This policy (614 FW 1-6) provides the authorities, definitions, and responsibilities for managing cultural resources on the lands, facilities, and programs we administer. Our policy is to identify,

protect, and manage cultural resources located on our lands and affected by Service and Service-authorized activities, in consultation with tribes where appropriate, and in compliance with cultural resources legislation. A full list of relevant legal authorities for cultural resources management can be found in the handbook as listed above. The scope of the Service's cultural resources program is broad, including both prehistoric and historic archaeological resources, historic and architectural properties, and areas or sites of traditional or religious significance to Native Americans.

Program objectives are to:

- Recognize the intrinsic value of the Service's cultural resources by properly protecting and maintaining them in compliance with historic preservation legislation and Departmental policy;
- Plan for the potential public and scientific use of Service-managed cultural resources for the benefit of present and future generations;
- Maintain and preserve unique cultural resources and make them applicable to our ongoing natural resource and wildlife conservation mission;
- Identify, evaluate the importance of, and seek the appropriate protective designation of cultural resources in compliance with existing legal requirements, regulations, and professional standards;
- Ensure that when we are conducting activities to meet the Service's mission and program goals, we do not inadvertently transfer, sell, demolish, or alter our cultural resources until we can adequately identify them, evaluate impacts, and make informed decisions and necessary plans;
- Ensure that when acquiring property, potential historic resources are identified prior to acquisition and anticipatory demolition does not occur;
- Prevent or avoid damage and deterioration to cultural resources that result from erosion, abandonment, lack of maintenance, and neglect;
- Encourage and enhance educational, interpretive, and research opportunities for Service cultural resources consistent with overall Service management objectives;
- Ensure employees recognize the importance of cultural resources to habitat and land management issues and safeguard them so that the Service can maximize opportunities to enhance the public's knowledge and understanding of the environmental and cultural contexts of conservation; and
- Protect and manage cultural resources that are important for maintaining the traditional culture of Native American tribes, Native Hawaiians, Alaska natives, and other traditional communities.

Policy on Climate Change Adaptation: This policy (056 FW 1) establishes overall Service policy and staff responsibilities on climate change adaptation. The policy recognizes the role adaptation plays in reducing the negative impacts of climate change on the Service's trust resources. The policy directs the Service to take steps to understand, evaluate, and address the impacts of climate change, and then use this information to effectively and efficiently implement climate change adaptation measures into the Service's operations.

Director's Land Protection Planning Interim Guidance: This guidance was issued on May 18, 2016. It is intended to ensure that the strategic growth of the Refuge System is based on explicit priorities, rigorous biological planning, and conservation design that support achieving measurable population objectives that are developed in cooperation with State fish and wildlife agencies and our conservation partners. This guidance applies to new refuges and to additions to existing refuges where land acquisition is the proposed method of land protection.

Chief's Guidance on Landscape Conservation Design: This guidance was issued on October 3, 2016. Its purpose is to help build a consistent understanding across the Refuge System of what constitutes a landscape conservation design (LCD) and to provide guidance on our responsibilities in the collaborative processes and product development associated with LCD. The guidance is also designed to help regional leadership prioritize the participation in, and advocacy for, LCDs that are relevant to priorities of the Refuge System, regardless of planning funding levels.

Other Mandates

Although Service and Refuge System policy and the purposes of each refuge provide the foundation for a refuge's management, refuges are also administered consistent with other Federal laws, executive orders, treaties, interstate compacts, and regulations on conserving and protecting natural and cultural resources. A centralized library of Servicewide policies, executive orders, Secretarial orders, Service Director's orders, and the "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service" can be viewed at: *http://www.fws.gov/policy/* (accessed August 2016).

Federal Laws

Below we highlight some of the more than 100 Federal laws that could affect refuge planning. The laws below directly influenced development of this final CCP/EIS.

National Environmental Policy Act: NEPA (42 U.S.C. 4321 *et seq.*; 83 Stat. 852) requires Federal agencies to take a systematic, interdisciplinary approach to analyze the effects of agency decision-making on the human environment (Bass et al. 2001). This final CCP/EIS represents our compliance with NEPA and the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1500–1508). The primary purpose of an EIS is to define a proposed action, describe reasonable alternatives to that action, disclose potential environmental impacts and any actions that would avoid or minimize adverse impacts, and provide opportunities for public review and comment before a final decision is made.

Historic Resources: Federal laws require the Service to identify and preserve its important historic structures, archaeological sites, and artifacts. NEPA mandates our consideration of cultural resources in planning Federal actions. The Refuge Improvement Act requires that the CCP identify the refuge's archaeological and cultural values. The following four Federal laws also cover historic and archaeological resources on national wildlife refuges:

- The Archaeological Resources Protection Act (ARPA) (16 U.S.C. § 470aa–470ll; Public Law 96–95), approved October 31, 1979 (93 Stat.721). ARPA establishes detailed requirements for issuance of permits for any excavation for, or removal of, archaeological resources from Federal or Native American lands. It also establishes civil and criminal penalties for the unauthorized excavation, removal, or damage of those resources; for any trafficking in those resources removed from Federal or Native American land in violation of any provision

of Federal law; and for interstate and foreign commerce in such resources acquired, transported, or received in violation of any state or local law.

- The Archaeological and Historic Preservation Act (AHPA) (16 U.S.C. § 469–469c; Public Law 86–523), approved June 27, 1960 (74 Stat. 220), as amended by Public Law 93–291 approved May 24, 1974 (88 Stat. 174). APHA carries out the policy established by the Historic Sites Act (see below). It directs Federal agencies to notify the Secretary of the Interior whenever they find that a Federal or federally assisted licensed or permitted project may cause the loss or destruction of significant scientific, prehistoric, or archaeological data. The act authorizes the use of appropriated, donated, or transferred funds for the recovery, protection, and preservation of that data.

- The Historic Sites, Buildings, and Antiquities Act (16 U.S.C. § 461–462, 464–467; 49 Stat. 666) of August 21, 1935, popularly known as the Historic Sites Act, as amended by Public Law 89–249, approved October 9, 1965 (79 Stat. 971). This Historic Sites Act declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provides procedures for designating, acquiring, administering, and protecting these sites and objects. Among other things, National Historic and Natural Landmarks are designated under the authority of this act.

- The National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. § 470–470b, 470c–470n), Public Law 89–665, approved October 15, 1966 (80 Stat. 915), and repeatedly amended. The NHPA provides for the preservation of significant historical features (buildings, objects, and sites) through a grant-in-aid program to the states. It establishes the National Register of Historic Places (National Register) and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. § 468–468d). This act establishes an Advisory Council on Historic Preservation, which became a permanent, independent agency in Public Law 94–422, approved September 28, 1976 (90 Stat. 1319). The act created the Historic Preservation Fund. It directs Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing on the National Register.

The Service also owns and cares for museum properties. The most common are archaeological, zoological, and botanical collections, and historical photographs, objects, and art. Each refuge maintains an inventory of its museum property. Our regional museum property coordinator in Hadley, Massachusetts, guides the refuges in caring for that property, and helps us comply with the Native American Grave Protection and Repatriation Act and Federal regulations governing Federal archaeological collections. Our program ensures that those collections will remain available to the public for learning and research.

The Wilderness Act of 1964: (16 U.S.C. 1131–1136; Public Law 88–577) establishes a NWPS that is composed of federally owned areas designated by Congress as "wilderness areas." The act directs each agency administering designated wilderness to preserve the wilderness character of areas within the NWPS, and to administer the NWPS for the use and enjoyment of the American people in a way that will leave those areas unimpaired for future use and enjoyment as wilderness. The act also directs the Secretary of the Interior, within 10 years, to review every roadless area of 5,000 acres or more and every roadless island (regardless of size) within National Wildlife Refuge and National Park systems for inclusion in the NWPS. Service planning policy (602 FW 3) requires that we evaluate the potential for wilderness on refuge lands, as appropriate, during the CCP planning process. At this time, we are not recommending that any existing refuge lands be designated as wilderness areas. Our wilderness review for this refuge is detailed in appendix E.

The Wild and Scenic Rivers Act of 1968: (16 USC 1271-1287; Public Law 90-542) as amended, selects certain rivers of the nation possessing remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, preserves them in a free-flowing condition, and protects their local environments. Service planning policy (602 FW 3) requires that we evaluate the potential for wild and scenic rivers designation on refuge lands, as appropriate, during the CCP planning process. Our wild and scenic rivers review for this refuge is detailed in appendix F.

Other Laws: Chapter 5, "Environmental Consequences," evaluates this plan's compliance with the acts noted above, and with the Clean Water Act of 1977 as amended (33 U.S.C. 1251, et seq.; Public Law 107–303), the Clean Air Act of 1970 as amended (42 U.S.C. 7401 *et seq.*), and the ESA of 1973 (16 U.S.C. 1531–1544), as amended.

Presidential, Secretary, and Service Director Orders

The Presidential Executive Order 13443-Facilitation of Hunting Heritage and Wildlife Conservation: This order, issued on August 16, 2007, directs Federal agencies that have programs and activities affecting public land management, outdoor recreation, and wildlife management, including the Department of the Interior and the Department of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat. Federal agencies are directed to pursue certain activities listed in the executive order, consistent with their missions. Those activities include managing wildlife and habitats on public lands in a manner that expands and enhances hunting opportunities, and working with state and Tribal governments to manage wildlife and habitats to foster healthy and productive populations and provide appropriate opportunities for the public to hunt those species. The Service issued a memorandum on November 30, 2007, outlining short-term and long-term steps the agency will take to implement the order, including promoting new youth hunts, expanding education on America's hunting heritage, and using Web-based technology and the evolving social media to improve communication on hunting opportunities.

The Presidential Executive Order 13653–Preparing the United States for the Impacts of Climate Change: This order, issued on November 1, 2013, directs federal agencies to build on existing agency Adaptation Plans first issued in 2013, by continuing to develop, implement, and update comprehensive plans that integrate consideration of climate change into agency operations and overall mission objectives. The plans must identify and assess climate change related impacts on and risks to the agency's ability to accomplish its missions, operations, and programs; describe the agency's plans and actions to manage climate risks in the near term and build resilience in the short and long term; describe how they will deal with any climate change related risk that is deemed so significant that it impairs an agency's statutory mission or operation;" and discuss how they will consider the costs and benefits of actions needed to improve climate adaptation and resilience.

The Presidential Executive Order 13693–Planning for Federal Sustainability in the Next Decade: This purpose of this order, issued on March 19, 2015 is to maintain Federal leadership in sustainability and greenhouse gas emission reductions. It introduces new requirements and expands upon previous requirements for Federal agencies to reduce greenhouse gas emissions, improve energy conservation and use of renewable energy, use green building technology, improve agency water use and efficiency (including stormwater management), divert at least 50% of non-hazardous solid waste annually, and other requirements.

The order establishes a "Climate Change Response Council" that will execute a coordinated Department-wide strategy to increase scientific understanding and the development of adaptive management tools to address the impact of climate change on our natural and cultural resources. The Council will help coordinate activities within and among Federal agencies. Land management agencies are directed to pursue appropriate activities to reduce their carbon footprint, adapt water management strategies to address the possibility of a shrinking water supply, and protect and manage land in anticipation of sea level rise, shifting wildlife populations and habitats, increased wildland fire threats, and an increase in invasive and exotic species. This order can be accessed at: *http://www.doi.gov/whatwedo/climate/cop15/upload/SecOrder3289.pdf* (accessed August 2016).

Landscape Conservation Cooperatives
As part of this secretarial order, the Secretary also directed the Department of the Interior's bureaus to develop a network of Landscape Conservation Cooperatives (LCCs) to respond to stressors, such as climate change.

LCCs are public-private partnerships composed of states, tribes, Federal agencies, nongovernmental organizations, universities, and others (NALCC 2013). Although originally developed in the context of climate change concerns, LCCs are working to transcend political and jurisdictional boundaries to address a variety of complex, broad-scale conservation issues and opportunities in a holistic, collaborative, adaptive, and science-based approach. The science provided by these partnerships will inform future habitat management and land conservation planning, as well as help direct research and monitoring to support these efforts.

Currently, a network of 22 individual LCCs has been established. The Connecticut River watershed lies within the North Atlantic LCC, which is led by the Service's Northeast Region (map 2.1). The North Atlantic LCC extends from the Atlantic coast of Canada to central Virginia, including most of New England and the Mid-Atlantic Coast. The vision of this LCC is to conserve landscapes that sustain our natural resources and cultural heritage through active collaboration between conservation partners in the North Atlantic region.

We have used a variety of information from the North Atlantic LCC while developing this final CCP/EIS. In particular, we used the North Atlantic LCC's lists of terrestrial and aquatic representative species to help us identify priority refuge resources of concern (USFWS 2013b, *http://www.fws.gov/northeast/science/representative_species.html*; accessed August 2016). According to the North Atlantic LCC, a representative species is a species "whose habitat needs, ecosystem function, or management responses are similar to a group of other species." Based on this, it is assumed that land conservation and habitat management for that representative species will also address the needs of other species. We include our lists of priority refuge resources in appendix A. To learn more about the process we used to identify priority refuge resources of concern, please see appendix B "Process for Establishing Refuge Focal Species and Priority Habitats."

In addition, during 2014-15 we participated in a project with the North Atlantic LCC, and about 30 other Federal, state, and non-governmental conservation partners to pilot the development of a landscape conservation design[1] for the Connecticut River watershed. The *Connect the Connecticut* landscape conservation design integrated the best available spatial and ecological scientific data to produce a complete design package. During the process, partners

[1] Landscape conservation design is a partner-driven approach to achieve a sustainable, resilient socio-ecological landscape. It is an iterative, collaborative, and holistic process resulting in strategic and spatial products that provide information, analytical tools, maps, and strategies to achieve landscape goals collectively held among partners.

Map 2.1. North Atlantic Landscape Conservation Cooperative (LCC) and the Connecticut River Watershed

This order supercedes Executive Order 13514 ("Federal Leadership in Environmental, Energy, and Economic Performance"). It also expands on the energy reduction and environmental performance requirements for Federal agencies identified in Executive Order 13423 ("Strengthening Federal Environmental, Energy, and Transportation Management").

Secretarial Order 3289–Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources: This Order was issued on March 11, 2009, and establishes a Department-wide, science-based approach to increase understanding of climate change and to coordinate an effective response to its impacts on tribes and on the land, water, ocean, fish and wildlife, and cultural heritage resources that the Department manages.

This order replaces Secretarial Order No. 3226, Amendment No. 1, issued on January 16, 2009, and reinstates the provisions of Secretarial Order No. 3226, issued on January 19, 2001.

The Order calls for the incorporation of climate change into long-term planning documents such as CCPs: "Each bureau and office of the Department must consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and when making major decisions regarding potential use of resources under the Department's purview (these requirements were set forth in Secretarial Order No. 3226, and remain in effect). Departmental activities covered by this Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department, management plans and activities developed for public lands, planning and management activities associated with oil, gas, and mineral development of public lands, and planning and management activities of water projects and water resources.

Youth Conservation Corps tree restoration

USFWS

identified shared conservation goals and objectives, and deliberated on how to combine and balance trade-offs among the various species and ecosystem components of the design. The final products include prioritized core and connector networks within the watershed that take into account the needs of both common and rare species of fish, wildlife, and the ecosystems that support them. The conservation design informed by this planning effort is intended to guide collective conservation actions within the watershed and connect to broader regional conservation goals for conserving sustainable fish and wildlife populations. The design process established through this pilot project is currently being applied in geographies within the Northeast region as well as the region as a whole *(http://northatlanticlcc.org/teams/rcoa*). It is also being used as a model for landscape conservation design. We will use results from *Connect the Connecticut*, where applicable, to inform the implementation of this CCP. More on this project can be found at: *http://connecttheconnecticut.org (*accessed August 2016).

For additional information on the North Atlantic LCC, its near-term priorities, and projects, visit: *http://northatlanticlcc.org/* (accessed August 2016). We will continue to partner with the North Atlantic LCC and adapt management if additional supporting information becomes available.

"*Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change*"
This was a plan developed in 2010 in response to this order and Secretarial Order 3226, "Evaluating Climate Change Impacts in Management Planning" described above. This strategic plan establishes a basic framework for the Service's work as part of the conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change (USFWS 2010b). It also details specific steps the Service will take during the next 5 years to implement the strategic plan. The plan can be accessed online at: *http://www.fws.gov/home/climatechange/strategy.html* (accessed August 2016).

The strategic plan's six guiding principles are:

(1) We will continually evaluate our priorities and approaches, make difficult choices, take calculated risks, and adapt to climate change.

(2) We will commit to a new spirit of coordination, collaboration, and interdependence with others.

(3) We will reflect scientific excellence, professionalism, and integrity in all our work.

(4) We will emphasize the conservation of habitats within sustainable landscapes, applying our SHC (see 1-10) framework.

(5) We will assemble and use state-of-the-art technical capacity to meet the climate change challenge.

(6) We will be a leader in national and international efforts to address climate change.

The plan also lists three key strategies to address climate change: adaptation, mitigation, and engagement.

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects" (IPCC 2007). For

example, this could include raising river or coastal dikes. In the strategic plan, adaptation refers to planned management actions the Service will take to reduce the impacts of climate change on fish, wildlife, and their habitats. Adaptation forms the core of the Service's response to climate change and is the centerpiece of our strategic plan. This adaptive response to climate change will involve strategic conservation of terrestrial, freshwater, and marine habitats within sustainable landscapes.

The IPCC defines mitigation as technological changes or substitutions that reduce greenhouse gas emissions (IPCC 2007). Mitigation involves reducing our "carbon footprint" by using less energy, consuming fewer materials, and appropriately changing our land management practices. Mitigation is also achieved through biological carbon sequestration, which is a process in which carbon dioxide (CO_2) from the atmosphere is taken up by plants through photosynthesis and stored as carbon in biomass (e.g., tree trunks and roots). Sequestering carbon in vegetation, such as native hardwood forests or grassland, can often restore or improve habitat and directly benefit fish and wildlife.

Engagement involves reaching out to Service employees; local, national, and international partners in the public and private sectors; key stakeholders; and the general public to find solutions to the challenges to fish and wildlife conservation posed by climate change.

The Association of Fish and Wildlife Agencies (AFWA) has developed guidance for states as they update and implement their respective wildlife action plans (AFWA 2009). This publication, "Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans," also includes strategies that will help conserve fish and wildlife species and their habitats and ecosystems as climate conditions change. The broad spatial and temporal scales associated with climate change suggest that management efforts that are coordinated on at least the regional scale will likely lead to greater success. The Service will work with our state partners, among others, to meet the climate change challenge.

The Service's Climate Change Web site at*: http://www.fws.gov/home/climatechange/strategy.html* (USFWS 2013c; accessed August 2016), provides detailed information on the priority actions the Service is taking to begin to implement the strategic plan.

Secretarial Order 3331–Supporting Watershed Partnerships: This order was issued on January 3, 2014, affirming the Department's commitment to supporting regionally or nationally significant rivers, their watersheds, and community-based watershed partnerships. It maintains the designation of the Connecticut River as a National Blueway, which recognizes the economic, recreation, and natural values of the Connecticut River watershed. The order recognizes the importance of watershed partnerships that work across Federal agencies, state, local, and Tribal governments, nonprofit organizations, private landowners, and businesses that are able to successfully accomplish their shared conservation objectives. This program is voluntary, and when sought out by local communities and stakeholders, Federal agencies will help support collaboration among communities and across jurisdictions to strive for an integrative adaptive approach for sustaining the whole river system. The order does not affect private property rights, does not create any new regulations, and would not interfere with any Federal, state, local, or Tribal laws or regulations.

Director's Order 217 – Collaboration with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) to Conserve Listed, Candidate, and Other At-Risk Species: This order, issued on August 9, 2016, directs the Service to prioritize working with NRCS to promote voluntary conservation actions by non-Federal landowners and managers through Working Lands for

Wildlife and other wildlife conservation-focused programs. It supplements U.S. Fish and Wildlife Service policy on USDA Conservation Programs (504 FW 5). It calls for Service employees to work closely with NRCS to implement more effective and efficient programs that advance both agencies' missions, with a special emphasis on addressing conservation of at-risk and ESA-listed species. The order can be accessed online at *https://www.fws.gov/policy/do217.htm* l (accessed August 2016).

Other Conservation Priorities and Initiatives for the Refuge System

America's Great Outdoors

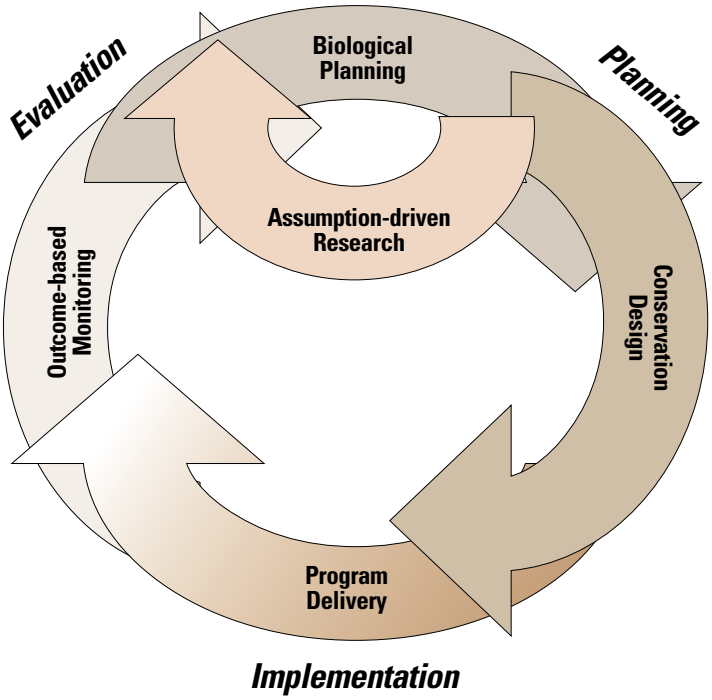
On April 16, 2010, President Obama launched the America's Great Outdoors (AGO) Initiative—a conservation and recreation effort to help increase Americans' connections to the outdoors. The premise of the AGO initiative is that lasting conservation solutions should come from citizens who share in the responsibility to conserve, restore, and provide better access to our nation's lands and waters.

In February 2011, America's Great Outdoors: A Promise to Future Generations Report (U.S. Department of the Interior et al. 2011) was released. This report laid the foundation for the initiative by identifying 10 major goals for the AGO, from expanding youth programs to increasing public awareness about conservation to better managing our public lands. Three of these goals focus on the Federal government's collective conservation and recreation efforts: creating and enhancing urban parks and greenspaces, renewing and restoring rivers, and conserving large, rural landscapes.

Strategic Habitat Conservation

SHC (USFWS 2008b, USFWS 2009) is a structured, science-driven approach for making efficient, transparent decisions about where and how to expend Service resources to conserve species that are limited by the amount or quality of habitat. It is an adaptive management framework that integrates planning, design, delivery, and evaluation (figure 2.2).

Figure 2.2. Strategic Habitat Conservation Process



The conservation problems we now face are much broader and complex and cannot be addressed within the boundaries of refuges alone. In response, the Service has adopted a management framework capable of facilitating conservation at the national and continental scale. This SHC approach becomes more urgent as we continue to address the ever-expanding, multiple threats of human development and invasive species that now converge in a 21st century environmental "perfect storm" with a changing climate. The former requires the Service to act quickly, while the latter demands that we move forward strategically. More specifically, SHC incorporates the following elements within a framework that allows Service managers to improve management actions based upon lessons learned from previous management plans and activities:

- Biological planning involves identifying priority trust resources, determining population objectives, assessing the current status of populations, identifying threats and limiting factors, and using models to describe the relationship of populations to habitat and other limiting factors. The conservation plans discussed below contribute to an SHC approach.

- Conservation design uses the results of biological planning to develop decision support tools, including maps and models, to guide management. It also identifies priority geographic areas for conservation and determines population-based objectives for habitat or other limiting factors based on these tools.

- Conservation delivery involves implementing conservation actions through programs and partnerships that are guided by decision support tools and targeted to achieve specific biological results (outcomes).

- Monitoring collects data to evaluate the effectiveness of conservation actions in reaching biological outcomes and to provide feedback to future planning and delivery.

- Research tests assumptions in biological planning and conservation design that have the greatest impact on management decisions and provides feedback to future planning.

Development of CCPs fully embraces the elements of SHC through the setting of specific goals, measurable objectives, and implementation strategies. There is ample room for evaluating the management effects of a CCP, and making appropriate adjustments over time, especially during revisions to CCPs and step-down management plans. More information regarding SHC can be found at: *http://www.fws.gov/landscape-conservation/* (accessed August 2016).

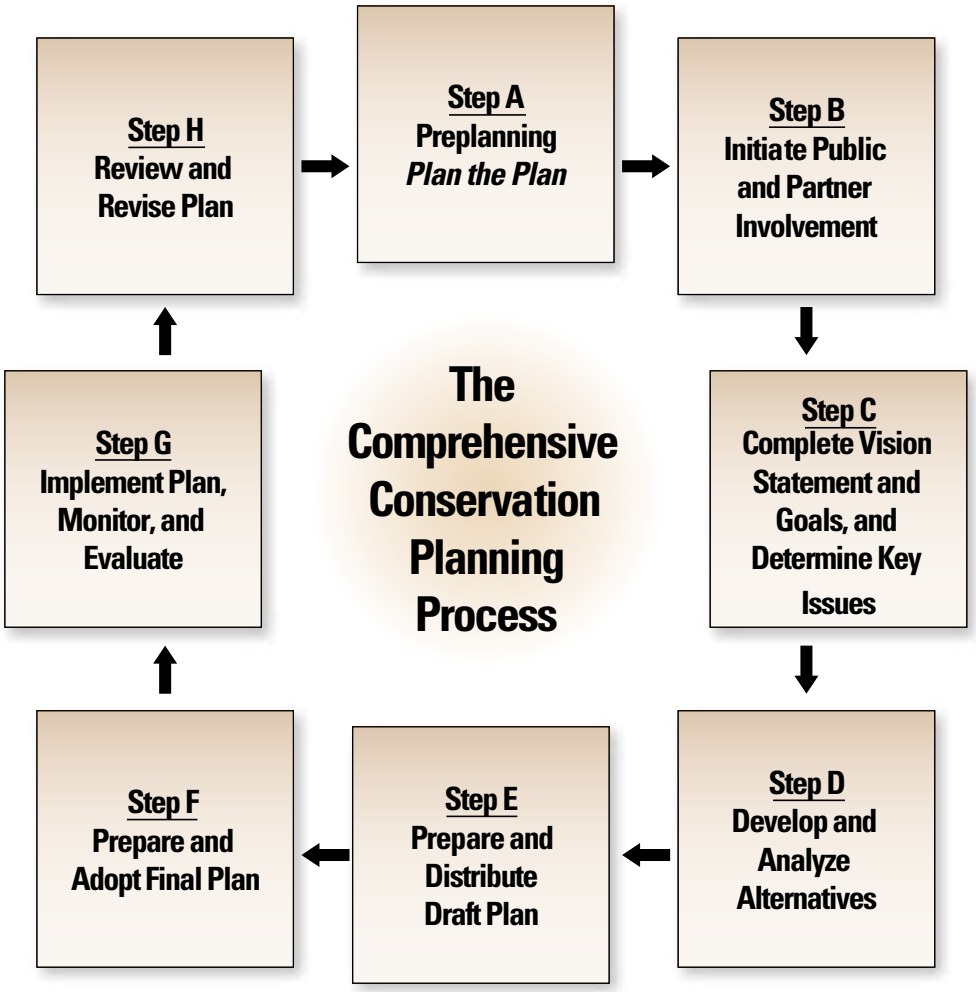
Conservation Plans and Initiatives Guiding Development of the CCP

In addition to the laws, orders, and policies previously presented in this chapter, the planning for, and management of, a refuge is guided by its establishment purpose(s) and vision, and further directed by goals and objectives detailed in an approved CCP. The goals and objectives, in particular, are greatly influenced by the ecological role a refuge may play within its local and regional ecological landscape. That role can be determined with the help of existing national and regional conservation plans that relate to the refuge's planning analysis area.

Refuge planning should consider the goals and objectives of existing regional and ecosystem conservation plans for the landscapes in which the refuges reside to determine how a refuge can best contribute to the functioning of the ecosystems, while also achieving refuge purposes and vision. This is also important because the Service is directed to coordinate refuge planning with state fish and wildlife agencies, and, to the extent practicable, develop CCPs consistent with state fish and wildlife action plans. We also strive to be as consistent as possible with the conservation programs of Tribal, other Federal agency, and nongovernmental and private partners within the ecosystem.

The number of conservation plans and initiatives that relate to our project analysis area is staggering. New plans and information are being produced at such a rapid pace that is has been challenging for the planning team to stay current and be aware of them all. Appendix M includes a brief summary of the over 60 habitat, species, and other conservation plans we consulted during development of this final CCP/EIS. In particular, these plans were helpful as we developed our goals, objectives, and strategies.

Figure 2.3. The CCP Planning Process and its Relationship to NEPA.



The Comprehensive Conservation Planning Process

Service policy (602 FW 3) describes the eight-step comprehensive conservation planning process and provides detailed guidelines for developing CCPs (figure 2.3). This policy also ensures that CCPs comply with NEPA by integrating NEPA requirements into the CCP process. The full text of the policy and a detailed description of the planning steps are at: *http://policy.fws.gov/602fw3.html* (accessed August 2016).

Below we describe the planning process for the Conte Refuge's CCP/EIS, including each step's relationship to NEPA and what actions we have, or plan to have, completed under each of the eight steps. With the release of this final CCP/EIS, we have completed steps A through E.

Step A: Preplanning

During the preplanning step, the planning team:

- Reviews the refuge purposes, history, and establishing authority.
- Reviews the Service mission and policies; the Refuge System mission, vision, and goals; and other relevant legal mandates, Executive orders, and Secretarial orders.
- Gathers existing data and identifies knowledge gaps, including referring to other, existing conservation plans and initiatives.
- Identifies the purpose and need for the plan (see chapter 1).
- Conducts internal scoping to identify management issues and concerns, and opportunities to resolve them.
- Drafts a vision and goals for the refuge.

The planning team started the preplanning step for this CCP in 2006. We began to gather existing information on wildlife, habitat, historical and archaeological, and socioeconomic resources, as well as refuge management and administration. We also started mapping refuge habitats. Much of this information is included in chapter 3, which describes the existing physical, biological, and socioeconomic environment of the watershed and the refuge.

Step B: Initiate Public Involvement and Scoping

The Service recognizes that effective and responsive conservation begins with community involvement. During this step, the planning team notifies the public that the Service is developing a CCP for the refuge and seeks public involvement in the planning process. CCP development provides opportunities for state agencies, refuge neighbors, visitors, partners, and the public to be involved, and to gain a clear understanding of the reasons for refuge management actions. Through this planning process, we expect to develop the most environmentally appropriate CCP possible that addresses key issues and public points of interest.

From these various sources of information, we developed a list of points of interest, challenges, opportunities, or any other item requiring a management decision.

We announced the initiation of the Conte Refuge CCP/EIS and a public scoping and comment period through a *Federal Register* notice of intent on October 11, 2006. During the public and partner scoping period we used the following techniques to ensure we reached out to a wide variety of stakeholders and obtained all of the points of interest, challenges, and opportunities identified by the public, our conservation partners, and other Service program staff:

- An “issues workbook” which asked recipients questions about their interests and concerns related to the refuge.
- Public scoping meetings throughout the watershed (at these meetings, we explained the planning process and gathered comments. We held 9 meeting in the fall of 2006 and then another 12 in the winter of 2007 to 2008).
- CCP planning team meetings with state representatives and invited guest experts to share information.
- Meetings sponsored by the Friends of Conte.
- Meetings to coordinate with other Service programs and other Federal and state agencies.

- Conversations between staff and individuals or groups.

Step C: Review Vision Statement and Goals, and Determine Significant Issues

Based on comments we received during the public and partner scoping period, we revised our vision statement and goals (see chapter 1). We also developed a list of key issues, concerns, and opportunities to respond to in the plan based on both our internal and public scoping periods, and updated as we proceeded through the planning process. Due to the length of the narrative describing those issues, concerns, and opportunities, they are presented under a separate subheading below.

Step D: Develop and Analyze Alternatives, Including the Proposed Action

Following a review of the issues generated under steps B and C, we refined our range of proposed alternatives. We then proceeded to develop them fully in the form of objectives and strategies, and assessed the impacts that might be expected with their implementation. In this final CCP/EIS, we describe and analyze four alternatives in chapter 4 and their anticipated impacts in chapter 5. We have identified alternative C as our proposed action and the Service-preferred alternative.

Step E: Prepare Draft Plan and NEPA Document for Public Review

With the release of the draft CCP/EIS, we completed Step E. The draft CCP/EIS was available for 90 days of public review and comment. We announced the release of the draft CCP/EIS in the *Federal Register*, through news releases on local media, and in a newsletter sent to our CCP project mailing list. We held 14 public information meetings and 4 public hearings. During this comment period, we sought substantive comments on the draft document. We used these comments to help create the final CCP/EIS.

Step F: Prepare and Adopt Final Plan

The Service's Northeast Regional Director will select a CCP alternative based on:

- How well the alternative meets the Service and Refuge System missions.
- How well it achieves the refuge purposes.
- How well it complies with other legal mandates.
- How well it anticipates and responds to predicted impacts.
- Public and partner responses to the draft and final versions of the CCP/EIS.
- Whether the Service Director has approved a refuge expansion.

The alternative selected could be the preferred alternative C as described in this final CCP/EIS, the "no action" alternative, any of the other alternatives, or even a combination of actions from the four alternatives presented. The final decision will identify the desired combination of species protection, habitat management, public use and access, land protection, and administration for the refuge.

This final CCP includes appendix O, which is a summary of the comments received on the draft document and our response to them. This final CCP/EIS will go through another 30-day public review. After that review and consideration of the comments that were received, we will draft a ROD. The ROD identifies the Regional Director's final decision and describes their approval of the chosen alternative and the rationale for this decision. Their decision will be a reasoned judgment based on public and partner comments, evaluating the potential impacts, opportunities to achieve refuge purposes and goals, and contribute to the Refuge System mission. The ROD also certifies that we have met agency compliance requirements. The availability of the ROD will also be published in the *Federal Register* and a copy of the ROD and final CCP will be made available to interested parties and posted on our website.

Step G: Implement, Monitor, and Evaluate Plan

Once the ROD is signed and released, we can begin to implement the CCP. The final CCP will serve as the principal guiding document for management of the refuge for the following 15 years. As we implement the plan, we will monitor our success in achieving our refuge goals and objectives.

Step H: Review and Revise Plan

We will also review and revise the CCP at least every 15 years in accordance with the Refuge Improvement Act and Service planning policy (602 FW 3). Annual or other periodic reviews could lead to revisions prior to the required minimum 15-year update.

Issues, Concerns, and Opportunities

The Service defines an issue as "any unsettled matter requiring a management decision" (602 FW 1). Issues can include an "initiative, opportunity, resource management problem, threat to a resource, conflict in use, or a public concern." Issues arise from many sources, including refuge staff, other Service programs, state agencies, public and local officials, other Federal agencies, Tribes, other partners, neighbors, user groups, individuals with an interest in the refuge, or Congress. One of the distinctions among the proposed management alternatives is how each addresses issues, concerns, and opportunities.

We define three categories of issues, concerns, and opportunities.

- **Issues, concerns, and opportunities outside the scope of this final CCP/EIS analysis.** These are issues, concerns, and opportunities whose resolution falls outside the scope of this CCP/EIS, or are outside the jurisdiction or authority of the Service. Although we discuss them briefly in this chapter, we do not address them further in this final CCP/EIS.

- **Issues, concerns, and opportunities not needing alternative management options.** These are issues, concerns, and opportunities that deserve management attention; however, there is often only one reasonable solution to the issues. Due to this, we propose to resolve them similarly across all of the alternatives. These issues are dealt with in chapter 4 as "Management Actions Common to all Alternatives." We only list them in this chapter, but direct the reader for a more detailed discussion in chapter 4.

- **Issues, concerns, and opportunities evaluated under alternative management options.** These are issues, concerns, and opportunities needing management attention that may have more than one viable solution, and their resolution falls within the jurisdiction and authority of the Service. Typically, these issues generated a wide range of opinions on how to resolve them. The range of options for addressing them helped form the basis for developing and comparing objectives and strategies among the four proposed management alternatives detailed in chapter 4.

Specific issues, concerns, and opportunities that were raised during the planning process are presented under each category below.

Issues, Concerns, and Opportunities Outside the Scope of This Final CCP/EIS Analysis

a. Why doesn't the refuge take a lead role in managing dams in the watershed to help restore the natural hydrology to the Connecticut River?

Some people felt that refuge staff should play a more active role in controlling or influencing appropriate water flows in the river to benefit wildlife, fish, and native plant communities in the mainstem Connecticut River and its main tributaries. We heard concerns that water levels in the river and its tributaries are sometimes too high and that dam releases were often poorly timed. This can negatively affect habitat for nesting and migrating birds, migratory fish, and other aquatic species. Others expressed concern that low water levels during the summer exposed mudflats and affected shoreline access to open water for recreation, including wildlife observation and fishing.

While a more natural annual flow regime would best contribute to the refuge's legislated purposes, Refuge staff do not have the jurisdiction to control dams and river flows. There are over a dozen dams spanning the Connecticut River mainstem and over a thousand dams on its tributaries. These are depicted on map 2.2. The flow regimes in the Connecticut River result primarily from management at federally permitted hydroelectric dams, USACE flood control projects, and a myriad of smaller dams on the river's tributaries that are state or privately owned and operated. These dams and projects are under the jurisdiction of the Federal Energy Regulatory Commission (FERC) (FERC 2012; *http://www.ferc.gov/industries/hydropower/gen-info.asp;* accessed August 2016) and must be operated under the terms and provisions of their FERC license. Map 2.2 also portrays those dams that are FERC-licensed on the Connecticut River's mainstem. As of June 2013, there are five FERC dams that are currently under review for their upcoming 2018 relicensing. Those dams are: the Turners Falls, Northfield Mountain Pumped Storage, Vernon, Bellows Falls, and Wilder projects. The 5-year review process began in early October 2012. The projects collectively impact more than 175 miles of the river, which supports federally listed aquatic species, including dwarf wedgemussel and shortnose sturgeon, and other sea-run fish, including American eel, American shad, and river herring.

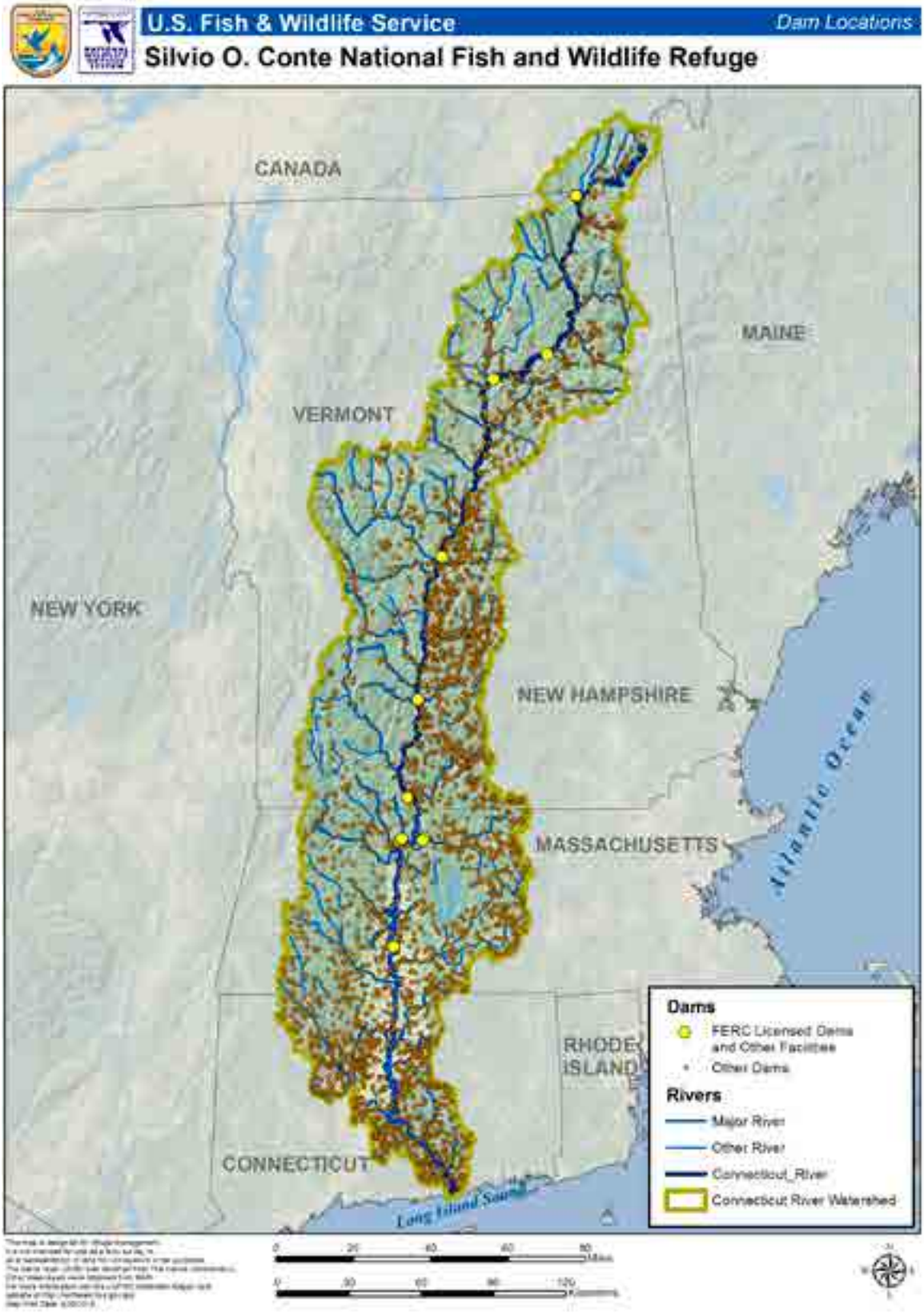
The Service's New England Field Office in Concord, New Hampshire, part of the Ecological Services program, has responsibility for reviewing and advocating for Federal trust resources during FERC license renewals on the Connecticut River. The Field Office is currently involved in the review of the five dams noted above. Refuge staff provide the Field Office staff with relevant refuge resource information during the permit renewal process, and the welfare of the refuge and its goals play heavily in permit review proceedings. Another Service program, the Connecticut River Coordinator's Office (CRCO), also provides detailed resource information to the Field Office during the license review process. The CRCO is dedicated to working with partners throughout the watershed to restore migratory fish, by identifying and addressing obstructions to fish passage, dealing with issues and threats related to hydropower relicensing and development of wetlands, and conserving and restoring the quantity and quality of aquatic and riparian habitat. Their mission is "to work with partners to restore migratory fish and their habitats in the Connecticut River Basin" (USFWS 2013d; *http://www.fws.gov/r5crc/index.html;* accessed August 2016).

Once FERC has issued a license, any party wanting to change the terms must petition FERC to reopen the license. The procedure for doing so requires the petitioner to supply a detailed justification of the proposed change to the license sufficient to convince FERC that its analysis in issuing the license is no longer accurate, and that a change in the license terms is necessary. The licensee has a right to a full administrative process under FERC regulations before its license can be changed by that agency. Although such challenges fall outside the scope of this CCP, the Service's New England Field Office is able to give a voice to fish and wildlife concerns during the FERC license review.

The USACE operates dams on the mainstem primarily for flood control; however, the New England District of the Army Corps has constructed dams and reservoirs, hurricane protection barriers, and local protection projects to reduce flood risk, improve and maintain navigation, and protect streambanks and shorelines throughout the watershed (USACE 2013; *http://www.nae.usace.army.mil/About.aspx*; accessed August 2016). Some of the dams they constructed are owned and operated by the Army Corps, while others are operated and maintained by respective states.

Assuming responsibility for Army Corps projects, or attempting to control state and private dam operations elsewhere in the watershed, is also outside the scope and purpose of this final CCP/EIS, which is to provide guidance to refuge

Map 2.2. Locations of Dams Throughout the Connecticut River Watershed



* *Please use this map as an approximation of dam locations. The data sources may differ in terms of detail and definitions by State.*

staff in the form of goals, and detailed objectives and strategies, for managing refuge lands and programs. This plan's purpose does not provide guidance to the Service concerning matters within the jurisdiction or authority of different Federal or state agencies.

b. Why doesn't the refuge lead efforts to control and reduce water pollution in the Connecticut River and its tributaries?

Some people want us to be more actively and directly engaged in managing water pollution in the watershed. Concerns were expressed about the human health threat, as well as the threat to critical habitat for fish and other aquatic species, and other wildlife, that are sustained by the river. People reminded us that it was only in the 1950s when the river was referred to as "America's best landscaped sewer." Initially driven by the specific threat from water pollution, the CRWC was formed in 1952 (CRWC 2013; *http://www.ctriver.org/*; accessed August 2016). Their website summarizes many of the concerns we heard, and lists many of the perceived sources of water pollution, including returning insufficiently cooled water and dumping pollutants into the river, utility and waste storage areas in riparian areas, non-point source pollution from farms and other industrial operations in floodplains, poorly-stabilized river and stream banks adding silt, and construction of impermeable surfaces and its resulting runoff.

The four individual states in the watershed, under authority from the EPA, are responsible for implementing and enforcing provisions of the Clean Water Act of 1972. In the years following passage of this act, the EPA, states, and Tribal governments focused primarily on "pipe discharge" or point source pollution. Point source pollution often includes toxic chemicals, sewage effluent, and thermal "heated" waters from utility power generation. Non-point source pollution from surface runoff has taken on a more prominent role over the past several decades, and includes runoff of agricultural fertilizers and chemicals, petroleum chemicals and salts from roadways, and soil runoff leading to high sediment loads and excessive turbidity.

Refuge staff do not have a specific role or authority in enforcing water quality regulations; however, we could become involved in the event that any source of water pollution was directly impacting refuge lands or priority Federal trust resources (e.g., federally listed endangered and threatened species). Refuge System policy on maintaining and restoring biological integrity, diversity, and environmental health (601 FW 3) offers sequential steps a refuge manager is to follow when refuge lands and wildlife may be impacted by activities originating off refuge property. If a situation were to occur, the refuge manager would work in concert with the Service's New England Field Office to help address the matter. While we will remain vigilant to threats of water pollution and the degradation of water quality, and report those that we observe, the process of issuing violations and seeking remedial actions falls outside the jurisdiction of refuge staff and the scope and purpose of this CCP, which, as noted above, is to provide goals, objectives, and strategies for managing refuge lands and programs.

c. Why doesn't the refuge provide leadership in controlling overdevelopment and the loss of open space in the watershed?

Many people expressed concern about the effects of land use developments that are reducing open space and adversely impacting natural resources in the watershed. This is a more prominent issue in the watershed in Massachusetts and Connecticut where development and increases in population growth and other demographic shifts have been more rapid, but there are areas in New Hampshire and Vermont where concerns are similar.

Refuge staff do not have jurisdiction or authority over state or local planning, or zoning and land use permitting, including private developments adjacent to refuge lands. If a land use in proximity to a refuge causes concern, the refuge manager would work in concert with the Service's New England Field Office to provide fish and wildlife information to regulating and permitting agencies. Similar to our response to water pollution, we will remain vigilant to development concerns that threaten Federal trust resources and we will report our concerns, but the process of deciding on what land uses to allow falls outside the jurisdiction of refuge staff and the scope and purpose of this CCP.

Ryan Hagerty/USFWS

Canadian bunchberry

While we note our limited ability to directly affect population growth, and influence state and local planning and zoning ordinances that allow land development, we indirectly affect the level of development through our refuge land acquisition program, and working with our conservation partners to assist them in conserving lands of high natural resource value. Through refuge and partner-led land protection programs, thousands of acres in the watershed are no longer available for development. Chapter 4 describes how each of the alternatives would address land protection on the refuge in the future, and how we would work in concert with our partners to achieve their land protection goals. Also, it should be noted that many local governments are employing smart growth measures that help minimize growth impacts. For example, in western Massachusetts, the Pioneer Valley Planning Commission (PVPC 2001), which promotes smart growth, has been the designated regional planning body encompassing 43 cities and towns responsible for increasing communication, cooperation, and coordination among all levels of government, ultimately to benefit the Pioneer Valley region and to improve its residents quality of life.

d. Why doesn't the refuge lead the restoration of endangered and threatened species, especially reintroducing species such as the gray wolf and Canada lynx?

Some people think refuge staff should lead the effort to restore endangered and threatened species on refuge lands, with an emphasis on large predators, such as the gray wolf and Canada lynx, in order to reestablish populations in the Northeast. They expressed the opinion that the refuge should reestablish large predators to help balance the natural levels of species diversity and abundance. Others expressed concern with reestablishing, reintroducing, or introducing listed species, especially large predators. Their range of concerns included risks to humans, pets, or livestock from large predators; to economic impacts on private lands should listed species become established.

The Service's lead for issues and programs relating to federally listed species is the Ecological Services program. They develop species reintroduction and recovery plans, which considers those species' threats and needs across their entire ranges, after consulting with many technical experts. The Ecological Services program also establishes and leads species recovery teams. For the gray wolf and Canada lynx, in particular, the Connecticut River watershed comprises only a small portion of their ranges. Any proposed reintroduction effort would be considered a major Federal action and would require separate NEPA analysis and public and partner engagement.

In summary, all actions related to reintroductions, introductions, or reestablishing federally listed species would be led by our Ecological Services program through an administrative process that includes consultations with state wildlife agencies, technical experts, and the public following the NEPA process. It is a process outside the scope of this final CCP/EIS which is intended to direct refuge staff and resource management programs. That being said, we assume refuge lands will play a big role in implementing species recovery plans

once they are complete and under consultation with our Ecological Service's program and respective recovery teams. Chapter 4 presents how the alternatives propose to work with established recovery teams and plans on refuge lands and in partnership with others.

e. Why doesn't the refuge take a more direct role regarding woody biomass and wind energy developments and their impacts to watershed forests and wildlife?

Woody biomass and wind driven electrical generation is being advanced in many states as a viable source of alternative energy. Some people expressed concern with these sources because of impacts on natural resources. Concerns we heard about woody biomass involved the potential pressure to harvest large quantities of vegetation, and potentially impacting a wider range of tree species and size classes that were not traditionally harvested by the forest products industry. Those expressing concerns with wind energy primarily referenced reports of wildlife mortality from the turbine blades, and the disturbance to wildlife from construction and maintenance activities and associated noise pollution.

The four states in the watershed are signatories to the Regional Greenhouse Gas Initiative (RGGI). It is a cooperative effort by all six New England states, and Delaware, Maryland, and New York to use alternative energy and limit greenhouse gas emissions. The signatory states have agreed to cap CO_2 emissions from the power sector, and require a 2.5 percent cut in emissions each year from 2015 to 2020. This commitment, along with other respective state initiatives, has resulted in a concerted effort by the states to pursue alternative energy sources (RGGI 2013; *http://www.rggi.org/*; accessed August 2016).

As noted previously, the Service has no jurisdiction or authority to dictate activities on state or private lands, unless federally listed species are affected. The Service's Ecological Services program is the lead division within our agency to address any issues related to energy developments on other ownerships, including reviewing proposals for new plans or permits. In March 2012, the Service published land-based wind energy guidelines (USFWS 2012b;*https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf;* accessed August 2016) to provide wind developers with the necessary considerations for avoiding and minimizing wildlife impacts.

Conte Refuge staff would work in concert with the Service's New England Ecological Services Field Office to help provide technical information in support of their review of any projects in the watershed. However, the request to have refuge staff take a more direct role in addressing woody biomass and wind power proposed on other ownerships is outside the scope and purpose of this final CCP/EIS that is intended to direct refuge staff and resource management programs.

f. Why doesn't the refuge take a more direct role in addressing safety concerns related to certain types of recreational uses on the Connecticut River?

Some people expressed concerns with certain water-based activities on the river and how they were occurring in an unsafe manner. Specifically, we heard about boating at high speeds, waterskiing, the use of personal watercraft, kayaking, canoeing, tubing, and generally, the mixing of these activities in certain areas.

Refuge staff have limited jurisdiction for regulating and enforcing watercraft activities on the Connecticut River. State and other Federal law enforcement agencies have the lead in enforcing navigation and recreational use of the river. The U.S. Coast Guard also patrols Federal waters and enforces Federal laws, which in this watershed is along Long Island Sound. Refuge law enforcement

officers may become involved on the river in cooperation with other lead enforcement agencies. Generally, municipal police officers, state conservation police officers, town marine officers, and certified harbormasters enforce state boating regulations, which typically include boating speed, restricted zones, and safety requirements.

Given our limited jurisdiction to control activities in state waters, we regard this issue as outside the scope of this final CCP/EIS that is intended to direct refuge staff and resource management programs. However, refuge staff will continue to work in close cooperation with agencies that regulate water-based activities and support activities that are of mutual concern.

g. Can the Service reduce the impacts from refuge land acquisition on adjacent land property values and tax burdens?

We heard concern expressed by landowners adjacent to the refuge that their property values have been affected, thus affecting their property taxes. Private land is assessed, and property values are determined for tax purposes, by either state, county, or local taxing authorities. The Service has no direct influence or control over tax rates or determining property values, nor can we control the desirability and interest of others to purchase land adjacent to the refuge, which affects market values. That being said, we acknowledge that landowners may see their property values rise from owning property next to the refuge. A 2002 report (Boyle et al. 2002) shows that land and property values are typically higher next to a national wildlife refuge, when holding other factors constant. The report states "The significant premium people pay to purchase properties near refuges clearly indicates that refuges provide desirable environmental amenities and permanent open space to local residents." We also recognize that as property value increases, it is likely that taxes may increase. While this may result in increased revenue for the local taxing authority, it also increases the tax burden for the individual private landowners.

Establishing private property values and establishing tax rates is not within the jurisdiction of the Service and thus, we determine that this issue is outside the scope and purpose of this final CCP/EIS. Indirectly, however, the refuge influences this issue through its land acquisition program. Chapter 4 describes how each of the alternatives would address land protection on the refuge in the future.

Issues, Concerns, and Opportunities Not Needing Alternative Management Options

The following is a list of issues that will be addressed similarly among the alternatives and are covered in chapter 4 under "Actions Common to All Alternatives":

- How will the existing camp lease agreements, under special use permit at the Nulhegan Basin Division, be affected by the CCP?
- How will refuge staff protect against and manage wildfires? Will fire be used as a habitat management tool?
- Will existing offices, facilities, and other infrastructure remain open?
- Will Refuge Revenue Sharing payments continue?
- Is the Silvio O. Conte Refuge Advisory Council, established in the 1995 FEIS, officially disbanded?
- Will the refuge preserve and protect cultural resources on refuge lands?
- Will the refuge continue to support youth programs, such as the Youth Conservation Corps?

Issues, Concerns, and Opportunities Evaluated Under Alternative Management Options

These are issues, concerns, and opportunities that may be addressed differently between the four alternatives. Chapter 4 describes the four alternatives in more detail, and appendix A provides specific management direction for alternative C, the Service-preferred alternative. For the discussion below, we grouped this list of issues, concerns, and opportunities into the following categories:

(a) Landscape-level Land Conservation and Resource Protection
(b) Habitat and Species Management
(c) Public Uses
(d) Socioeconomic Factors
(e) Community Relations and Partnerships
(f) Administrative Resources

Landscape-level Land Conservation and Resource Protection

(1) What future role should the refuge play in land protection in the watershed; should the Service pursue additional refuge land acquisition to protect Federal trust resources, or minimize that focus and support the land protection work of our conservation partners? Or, is there some combination of the two strategies?

This is the issue that garnered the most public interest due to the wide variety of opinions we heard about the need for, and extent of, additional land protection in the watershed, including expanding the refuge's approved acquisition boundary.

Of particular interest to us is the wide variety of opinions on whether the refuge should continue to expand, or whether future land protection should be led by the states and conservation partners. Some people expressed concern that Federal ownership will result in a greatly diminished local voice in how those lands are managed and used, and they expect the result will be additional restrictions on non-priority public uses, which they view as traditional uses. Others believe the Service will not be responsive to local concerns, and that the lands will no longer be subject to local influences. Many people specifically fear a significant loss of commercial timber harvest, taking agricultural lands out of production, and the resulting potential impacts on the local economy. We heard other concerns about the loss in property taxes, because the Federal government does not pay property taxes. Some of those opposed to a refuge expansion did support state agencies, local governments, or non-governmental entities taking the lead in land protection, with the Service playing only a supporting role.

On the other hand, there were many supporters of land conservation and protection in the watershed, with some indicating it should happen by "whatever means necessary" in order to be able to act quickly in response to development threats. Others specifically encouraged the Service to continue an active land acquisition program for the refuge. Those who support all available means expressed concern with the pace of development, including the selling of landholdings and subdividing them into smaller tracts at a rapid rate. Some people expressed the opinion that ownership by the Federal government, whether in fee title or conservation easement, was the only way to guarantee the permanent conservation and management of lands to support Federal trust resources. They also noted that Federal ownership would increase opportunities for permanent public access and recreation in areas either not currently open or not guaranteed to be open long term. Virtually everyone in support of land protection recognized the critical role of the land conservation partnership that exists and the value of the conserved lands network, and encouraged that we continue to be an active partner.

In chapter 4 under goal 1, we present the range of options for refuge land acquisition by alternative. We also cover this topic in more detail in appendix C, the Land Protection Plan for the Service-preferred alternative. The alternatives also present different levels of support for our partners' land conservation efforts,

and for a private lands coordination program. This is also covered in chapter 4 under goal 1.

(2) How should the refuge's future land acquisition efforts be divided between fee-title acquisition and conservation easement? Which method is best to complement our partners' efforts, meet the needs of landowners, and support local communities?

For those supporting an active refuge acquisition program, there were differences of opinion on whether the Service should acquire lands from willing sellers in fee or conservation easement. For some, their major concern was halting development in sensitive areas, so they were recommending Federal acquisition of development rights via a conservation easement. This acquisition method was favored by several commenters since it would have less impact on property tax revenues. Some of these individuals favoring easements specifically mentioned they supported the Service acquiring other rights, including public access for recreation.

Others supported the Service pursuing fee-title acquisition as a means to ensure permanent protection for Federal trust resources, and to secure permanent access for wildlife-dependent recreation, such as hunting and fishing.

The alternatives vary in the amount and distribution of land proposed for refuge acquisition. The alternatives also vary in the amount of acres proposed for acquisition in fee and easement. In practice, we often need to defer to the preference of each individual landowner, so the actual ratio of fee to easement is difficult to predict with certainty. We can only convey our proposed intent at this time. In chapter 4 under goal 4 we present the refuge land acquisition proposals by alternative. We primarily cover the topic of acquisition method in appendix C, the land protection plan for the Service-preferred alternative.

(3) Should refuge staff focus more effort on outreach, private lands coordination, and/or demonstration of practices to influence management on other ownerships and potentially affect more acres in the watershed?

During public scoping, we heard people express concern with human-caused impacts such as overdevelopment, the loss of open space, pollution, habitat loss and degradation, and the negative impacts from high-impact recreation. Some felt that if landowners understood how they are contributing to these impacts that they would become better land stewards. There were particular areas in the watershed, such as the urban corridor from Hartford to Long Island Sound, where people thought education and outreach programs would be most beneficial. Others felt that there was a general need for outreach and education programs throughout the watershed.

Some people noted that the original 1995 FEIS establishing Conte Refuge had a major emphasis on private lands coordination and they recommended that refuge staff expand this program. A few suggested that a Partners for Fish and Wildlife (Partners) program position be added to the refuge staff to increase our ability to provide technical assistance to private landowners, town officials, and land trusts interested in incorporating wildlife habitat restoration and management. On the other hand, state representatives noted that their agencies already had a private lands program and preferred that refuge staff focus on helping to find alternative funding sources to implement projects.

In contrast, there were some who thought that refuge staff should concentrate on managing refuge lands, given the limited staffing and funding available. These commenters felt that the states or nongovernmental organization had adequate programs to assist on other ownerships in the watershed.

Woodchuck

Andrew MacLachlan

The alternatives differ in the refuge's level of commitment to a private lands program, and offer differences in what that program's priorities should be. We primarily cover this topic in chapter 4.

(4) What are the impacts from Service acquisition on the local economy from loss of property taxes?

Many were concerned about the potential impacts of Federal ownership on the local property tax base. The Federal government is not required to pay property taxes. However, the Service has a program specifically authorized by the Refuge Revenue Sharing Act of 1935, as amended, under which revenues earned on refuges are collected and then disbursed to local taxing authorities where refuge land is located. These payments are intended to help offset property tax losses in communities due to land acquisition and property ownership by the Service; however, they may be less than the historical property tax levels. This can be an important issue for small towns if payments are reduced under Service ownership, but may be insignificant in towns with larger, more diverse tax bases.

Congress sets the revenue sharing payment rate each year. The maximum rate is approximately three-fourths of one percent of the market value of the property. The Service has no control over what rate Congress sets. Although historically revenue sharing exceeded the corresponding tax revenues generated from private lands, payments in recent years have fallen considerably.

Among our four alternatives, the impact to taxing districts will vary depending on the proposed land acquisition under each alternative. Our refuge expansion proposal for each alternative is detailed in chapter 4 under goal 4.

(5) What is the refuge's role in addressing climate change and its potential impacts on fish and wildlife in the watershed? What is the refuge's role in ensuring that Federal trust resources are conserved for future generations in the face of climate change?

We heard a mix of concern about climate change and its potential effect on plants, fish, and wildlife in the watershed. Some respondents question whether evidence of climate-induced changes is conclusive. Others agree with predictions that climate change is occurring and recommended that immediate action be taken. Many recommend that we manage refuge lands to minimize predicted impacts and use our technical outreach and education programs to reduce the impacts of climate change on other ownerships in the watershed.

The Service officially recognizes that climate change is occurring based on firm and growing science on the validity of predictions, noting that much of that science deals specifically with fish and wildlife and their ecosystems. The Secretary of the Interior issued Secretarial Order 3289 on September 14, 2009, designed to enable the Department to apply scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts on Tribes and on the land, water, ocean, fish and wildlife, and cultural heritage resources that the Department manages.

Climate change and its corresponding effects on species migrations or range distributions, extreme shifts in temperature and precipitation, and invasive species introductions may potentially pose dramatic threats and alterations to the habitats encompassed within the refuge. The ability to adapt or address these ever-changing concerns requires a comprehensive understanding of the refuge's landscape context, individual habitats, species utilization, and their resilience. Adaptive land management in response to climate change is an emerging science.

All of the alternatives would manage wildlife and habitats under an adaptive management framework in response to climate change, and all would increase biological monitoring and inventories. These actions are critically important as strategies to effectively respond to the uncertainty of future climate change effects. The alternatives differ, however, in the extent to which they take other specific actions to reduce predicted climate change impacts, including actions recommended to land managers by The Wildlife Society in Wildlife Society Technical Review 04-2 (Inkley 2004): reduce environmental stressors, manage for self-sustaining populations of fish and wildlife, and ensure widespread habitat availability through land protection and conservation. We primarily cover this topic in chapter 4 under goals 1 and 4.

(6) Are there existing special area designations within the watershed that should be enhanced with refuge support, or are there new ones that should be considered, including on refuge lands? The list of special designation areas includes: Wilderness, Wild and Scenic Rivers, National Natural Landmarks, Important Bird Areas, Convention on Wetlands of International Importance Sites (Ramsar sites), National Historic Sites, National Scenic Trails, and Research Natural Areas.

Some people expressed concern with any actions proposed in the CCP that would impact, or detract from, the character or values used in establishing existing special designation areas in the watershed. Other people expressed interest with establishing new special designation areas, both on and off refuge lands. For some, however, there is concern with special designation areas and their impact on opportunities for historic and traditional uses of the lands (e.g., forestry, farming, and recreation).

Service planning policy (602 FW 3) requires that we evaluate the potential for special designation areas on refuge lands. The results of our Wilderness

Review and Wild and Scenic Rivers Inventory are included as appendix E and F, respectively.

All of the alternatives would maintain the values and character of existing special designation areas. Also common to the alternatives is that we would support special designation areas on other ownerships. The alternatives differ, however, in enhancing or expanding existing special areas and recommending new areas on refuge lands. We primarily cover this topic in chapter 4 under goals 1 and 3.

Habitat and Species Management

(1) Which species and habitats should be management priorities on refuge lands? What degree of active versus passive habitat management should be employed on refuge lands? How can refuge habitat management complement conditions in surrounding landscapes?

The comments we received yielded a range of recommendations for what species and habitats to prioritize for management on refuge lands. There were people who wanted us to focus management on particular priority species, namely our Federal trust species. Others recommended we concentrate on protecting and managing large forest blocks to benefit forest-dependent species, including those that require early successional forest habitat, such as American woodcock. Some of these same commenters would like to see a broader range of size classes in our forests. Other people recommended we focus on grassland and shrubland habitats that are becoming increasingly rare in the region, and which require an annual management commitment. Yet other people wanted us to focus only on the suite of species and habitats specifically mentioned in the Conte Refuge legislation and refuge purposes. Those include federally listed species, migratory birds, diadromous fish and other aquatic species, and wetlands. We also heard from people who want our management to emphasize game species valued by hunters and anglers. Others recommended we focus on rare species and species of "greatest conservation need" identified in each state's wildlife action plan.

Others recommended we focus more on fish and other aquatic species in our management because the Conte Act legislation identifies these organisms as a priority. Specific concerns were expressed not only for migratory fish such as Atlantic salmon and American shad, but for their habitats, notably riparian areas, floodplains, and wetlands. We also heard from people concerned about fish passage and impairment of spawning habitat along the mainstem and its tributaries because of more than 1,000 dams and thousands of culverts, many of which block access to historic stream reaches. Water quality was also raised as an issue. Some people felt that we should provide technical support and resources to landowners with riparian and floodplain property and be more active in advising in fish passage matters. It was also suggested that we should be a leader in monitoring the effects of recreational activities on aquatic and riparian resources.

With regard to habitat management for any of the above noted species, there are some who support active management using the wide range of techniques (e.g., prescribed burning, mowing, herbicides, silviculture, etc.), while others recommend that we primarily let "nature take its course."

This issue is one of the most complex we are dealing with in the final CCP/EIS and is possibly the one that most distinguishes the alternatives. The alternatives differ in the species and habitats identified as a priority for management, and the level of active management that would be used to support those priorities. The alternatives also represent different levels of support for influencing private lands management to benefit wildlife. Finally, this issue is also affected by choices made concerning a refuge expansion, which also differs among alternatives.

We primarily cover this topic under our discussion for goal 1 in chapter 4 and in the matrix at the end of chapter 4. Appendix A provides more detailed information on the priority species and habitats we identified for alternative C, the Service-preferred alternative. In appendix A, for each proposed CFA, we provide lists of the priority species and habitats and describe our proposed habitat and species management actions. Appendix B describes the process we completed to identify what species and habitats were priorities for the refuge under alternative C.

(2) What emphasis should the refuge place on managing for ecosystem diversity and resilience versus managing for targeted species?

Many commenters referenced Service policy to manage for biological integrity, diversity, and environmental health (601 FW 3), suggesting this should drive our management priorities rather than management for specific species. For some, managing for ecosystem diversity and resilience would best position refuge lands to minimize the anticipated impacts of climate change. We heard the recommendation that we should strive to reduce or eliminate environmental stressors (e.g., pollution, land use developments, ozone depletion, invasive and exotic species) on refuge lands; and in the watershed, promote diversity, health, and resilience. Suggestions were made to manage refuge lands, and work with partners on their lands, to reduce the risk of catastrophic events; manage for self-sustaining wildlife populations; and look for opportunities to ensure corridors and habitat connections are available for wildlife and plant communities. On the other hand, there were other people who felt that refuge lands should be managed more consistent with refuge purposes in support of certain species. Comments related to which species and habitats are recommended for refuge management were discussed under issue #7 above.

Eastern bluebird

Bill Thompson

This is a complex issue, both in understanding how diversity and resiliency relate to refuge management, and what we could effectively do to address it. The alternatives offer a range in management focus; from one that emphasizes species and habitat to one that emphasizes natural processes and proposing management only when there is threat of, or in response to, a catastrophic event. The range of land protection proposals among the alternatives reflects our potential ability to respond to recommendations on reducing environmental stressors. Further, the alternatives represent different levels of support for influencing private lands management. We primarily cover this topic in chapter 4 under goals 1 and 4.

(3) How can the refuge effectively and economically control invasive plants which displace native plants and negatively affect refuge habitats, and habitats throughout the Connecticut River watershed? Which invasive plant species should be the highest priority to control?

This issue relates to the amount of resources the refuge should dedicate to the control and management of invasive, exotic plants, and where that work should occur. Virtually everyone we spoke with recognized the impact these plants have on native plant diversity, agricultural lands, and residential landscaping.

However, there was a mix of opinion on whether the limited resources available to the refuge should focus on refuge lands only, or continue to be used, in part, to assist other landowners (see chapter 3 for details on our current program). Also, some people commented that they would like to see a prioritization of invasive plant species to control.

Most people recognize the value of our participation in invasive species management, but recommended we decide on the most appropriate and effective role going into the future. As such, the alternatives vary in the amount of resources, timing, and priority dedicated to invasive species control on and off refuge lands. We primarily cover this topic in chapter 4 under "Actions Common to All Alternatives" and under goal 4.

(4) What effort should be made by the refuge to manage for federally listed threatened, endangered, and candidate species?

We heard from people who thought this should be the singular focus of the refuge, noting its prominence in the Conte Refuge Act and refuge purposes. Others viewed it as one of several top priorities for refuge management. Some expressed concerns that management for listed species is too restrictive and would impact opportunities to benefit a broader suite of wildlife and potentially impact recreational and other uses of refuge lands.

The Service has a statutory responsibility to protect and conserve federally listed species. Common to all alternatives, we will ensure our management does not impact known populations of listed species and we will continue to work closely with respective species' recovery teams to stay current with the latest information. That being said, the alternatives differ in the amount of active management to enhance or expand habitats for listed species. The alternatives also represent different levels of support for influencing private lands management to benefit listed species. Finally, this issue is also affected by choices made concerning a refuge expansion, which also differs among alternatives. We primarily cover this topic in chapter 4 under goals 1 and 4.

(5) How will the refuge manage furbearer populations on refuge lands?

We use the term furbearer to identify species traditionally hunted or trapped for their fur, including carnivores and rodents. Beaver, bobcat, coyote, fisher, fox, mink, and muskrat are common furbearers on refuge lands. This issue is complex and controversial. Most of the controversy surrounds the use of trapping. We heard from people who strenuously object to trapping as a means to manage furbearer populations. Some of those opposed do so because they believe it is inhumane, cruel, and unethical. Others oppose trapping because they feel it is unnecessary and ineffective in controlling furbearer populations.

We heard proponents of regulated trapping say they believe it provides an important, effective method for managing furbearer populations, is a sustainable use of wildlife resources, and allows for a rural, self-sufficient, subsistence lifestyle of historical significance. Supporters of trapping contend that harvesting some furbearers does not threaten the continued survival of their populations, and compare it to our hunting and fishing programs.

The use of trapping as a tool to protect human health and safety, and to protect infrastructure, is an action common to all alternatives. This typically occurs in a specific area and on a very limited basis. For example, trappers may remove specific beavers whose activities threaten to flood critical refuge roads. There are years when we do not trap for this purpose. Trapping for safety and infrastructure protection is conducted by refuge staff or other Federal agency, by state-licensed trappers under contract, or by state-licensed trappers under

a special use permit. The alternatives do differ, however, in whether or not they provide a more extensive program designed to minimize the likelihood of future problems, as well as provide for a compatible, wildlife-dependent outdoor activity that has historical significance. We primarily cover this topic in chapter 4 under Actions Common to All Alternatives.

Public Uses

(1) How can we most effectively provide environmental education and interpretation to target audiences? What opportunities are available for environmental education partnerships?

We heard comments that environmental education and interpretation should be a higher priority for refuge staff. There were recommendations that we target special audiences in our education and interpretation programs; for example, audiences that can influence or solve conservation problems in the watershed (e.g., landowners, foresters, land trusts, recreational users). Others felt we should target kindergarten through 12th grade students and K-12 teachers. There was general agreement among people who commented on this issue that the existing visitor centers should be fully staffed and available to the public when people are most likely to visit. Some felt that establishing a greater presence for education in Connecticut is a high priority due to the challenges urbanization presents to the watershed. Many respondents believed that the top educational priority was the concept of how personal choices can affect ecosystem health. Other important education and interpretive topics that were suggested include resource stewardship, the value of biodiversity, and wildlife/habitat concepts. A number of educational tools were suggested, including field trips, workshops, mobile exhibits, articles published in local media, demonstration projects, and deploying an electronic media strategy.

The alternatives vary in the amount of resources, infrastructure, and priority attention dedicated to environmental education and interpretation programs, both on and off refuge lands. We primarily cover this topic in chapter 4 under goal 2.

(2) What is the appropriate mix and level of commitment for other priority public use programs (e.g., hunting, fishing, wildlife observation, and photography) on each of the refuge's divisions and units?

Generally, people were supportive of wildlife observation and photography on refuge lands. Concerns seemed to focus on where the uses occurred and what infrastructure was needed to support quality programs. Most people we heard from think hunting and fishing should be allowed; however, there were some people who felt these are not appropriate activities on a refuge. Some expressed concerns about how we will resolve differences when situations arise where priority uses conflict with each other. Some people wondered if we may allocate refuge resources disproportionately toward one use to the detriment of another. A few people feel public use is already too high and should be reduced, while others recommended that we should establish our capacity limits and manage accordingly.

The alternatives vary in access and opportunity for priority public uses, and the amount of resources, infrastructure, and priority attention dedicated to each. We primarily cover this topic in chapter 4 under goal 3.

(3) What visitor centers and contact facilities do we need, and where should they be located? How will we staff them to best meet our goal for effective outreach and quality visitor programs?

We heard from some people who expressed a particular interest in a greater refuge presence in Connecticut. They mentioned that the Conte Refuge Act authorized four refuge education centers, and this has been interpreted by some

that there would be one in each state in the watershed. The Hartford area was mentioned most as a preferred location in Connecticut, but other localities were also mentioned. Other people commented that existing visitor centers were not being run as they hoped. One respondent noted that the refuge's presence at the Montshire Museum of Science in Vermont had a very low profile. A similar comment was made about the Great Northwoods Visitor Center in New Hampshire. We heard from some other people that the Nulhegan Basin Division visitor contact facility should be open when people are most likely to visit, namely on holidays and weekends. One individual noted that the Great Falls Discovery Center in Massachusetts is nice but not oriented to older users.

There were other people who noted that there are numerous environmental centers already in each state, and the refuge should explore partnership opportunities rather than establishing any new centers. Others had concerns about partner-led facilities because the refuge is reliant on others to keep brochures and handouts available, and keep displays fresh and visible.

Common to all alternatives is maintaining a refuge presence in each of the currently established facilities. However, the alternatives differ in enhancing or expanding our presence in those facilities, and in pursuing new opportunities. We primarily cover this topic in chapter 4 under goals 2 and 4.

(4) What access will be allowed for public use activities on refuge lands? Specifically, what road and trail network is necessary to meet our goals and objectives? Are there redundant or unnecessary facilities that could be restored to natural conditions?

Having access to the refuge by way of parking lots, trails, boardwalks, boat launches, and other infrastructure is an important issue for many people who provided us comments. These access points and trails are used by visitors to engage in various recreational uses, as well as by refuge staff for management purposes.

Most access concerns we heard about related to the Nulhegan Basin and Pondicherry divisions because they are the largest refuge units with the most visitation. People expressed concern with the balance of opportunities for motorized versus nonmotorized access and the trail infrastructure for each. In particular, we heard from users wanting more trails at the Nulhegan Basin Division devoted to non-motorized use. There are people that consider the current levels of snowmobile and vehicular access too high for a national wildlife refuge. For those concerned about motorized access, they recommended we review our refuge road network and look for those roads that are redundant or not necessary for our programs, and restore them to native vegetation. Others supported motorized access and think that these uses are causing no environmental harm and an expansion should be considered.

A number of individuals have urged that the refuge provide canoe and kayak launches at Fort River, Mill River, Nulhegan Basin, and Pondicherry Divisions. In general, a common theme we heard from state agencies as well as the public, was to facilitate public access to the Connecticut River to the extent possible. The alternatives differ in enhancing or expanding our roads and trails network and providing access for a variety of refuge activities. We primarily cover this topic in chapter 4 under goal 3.

(5) Will the refuge allow non-priority public uses?

We heard a range of opinions and ideas on non-priority public uses. Some people stated that because refuge resources are so limited, we should not allow these activities at all and should stay focused on priority public uses. Others simply stated they do not believe these activities are appropriate for a national wildlife

refuge, and would question any that we found compatible. Additional opposition for allowing these uses ranged from those opposed to certain activities on ethical and moral grounds, to those concerned with visitor safety and impacts on wildlife and habitats.

Some people suggested new and different activities to allow, assuming they could be managed compatible with the refuge purposes. Uses that were suggested include horseback riding, all-terrain and other off-road vehicles, dog sledding, bicycling, and camping.

Of all the existing non-priority public uses allowed on the refuge, people voiced the most concern about snowmobile use, particularly at the Nulhegan Basin Division. Opponents argued that snowmobiling disrupts wildlife behavior, pollutes, conflicts with the six priority wildlife-dependent public uses, and diverts limited resources from other important refuge programs. Others expressed concern that it compromises visitor safety, that use is too high, or that motorized access should not be allowed on a national wildlife refuge. Other people in support of snowmobiling told us it is an important recreational pursuit that allows people to get out on the refuge during winter. Proponents felt that snowmobiling on the refuge enhanced opportunities for people of all capabilities to enjoy the scenery and a chance to see wildlife.

Common to all alternatives is adherence to Service policy (603 FW 2) that requires we evaluate all refuge uses for their appropriateness and compatibility with refuge purposes. For non-priority activities to be compatible and allowed, they would have to be managed so they do not conflict with refuge purposes, and the goals and objectives for biological and visitor services priorities in the final CCP, are consistent with public safety, and are manageable within the limitations of the refuge budget and available staff. If a priority and non-priority public use conflict, the priority public use will take precedence (603 FW 2). That being said, the alternatives differ in which non-priority public uses would be allowed. We primarily cover this topic in chapter 4 under goal 3.

Socioeconomic Factors

(1) How will the refuge's priorities integrate into the working landscape and local economies?

Concerns were expressed during scoping about how refuges affect local, regional, and national economies. The concern with property values and taxes was discussed above. Some individuals perceive the presence of a refuge as eliminating economic opportunities, because refuge lands limit or exclude commercial activities. A number of individuals questioned whether the refuge would be able to integrate wildlife conservation into the working landscape, where farming and logging are important economic drivers. Other respondents commented that refuge lands integrate well with community goals to maintain certain desirable qualities such as "rural," "remote," and "unspoiled," and provide recreational activities. Some people noted that refuge lands also play a role in protecting water quality and quantity, filtering pollution, and protecting against flood events.

The alternatives differ in the extent to which refuge staff will work in partnership with local communities to achieve mutual goals. We primarily cover this topic in chapter 4 under goal 4.

(2) Should the refuge allow commercial outfitting and guiding in support of compatible activities?

We heard a range of opinions about the desirability of guided or group tours to facilitate compatible wildlife-dependent activities on refuge lands. Several individuals expressed concern that guided tours are known to occur, but do not appear to be regulated, and there are no controls or enforcement. We heard from

people who enjoy a more solitary experience on their refuge visits and would not enjoy encountering guided groups. Others expressed their concern that outfitting and guiding would adversely impact areas already near capacity because they would facilitate getting more visitors to those areas.

Lee Karney

Great blue heron

Others supported outfitting and guiding as an activity, because it was their livelihood, or because they believe it enhances visitors' experiences by providing safe and accessible opportunities for viewing wildlife, photographing nature, hunting, or fishing. These supporters also believe it encourages an outdoor experience for individuals who are either inexperienced or not comfortable going out to natural surroundings alone.

Our alternatives differ in the range of allowing and accommodating commercial outfitting and guiding. We primarily cover this topic in chapter 4 under goal 3. Common to all alternatives, however, is that Service policies would be followed if these commercial activities are allowed. According to Federal regulations and Service compatibility policy (603 FW 2), we may only authorize public or private economic uses of the natural resources on a refuge in accordance with 16 USC § 715s and 50 CFR § 29.1 when we determine that the use contributes to the achievement of the refuge purposes or the Refuge System mission. We may authorize an economic use, such as commercially guided trips, by special use permit only when the refuge manager has determined the use is appropriate and compatible. The permit must contain terms, conditions, and stipulations to ensure compatibility. Our authority to administer these activities is reserved for only lands and waters where the Service has an ownership interest.

Community Relations and Partnerships

(1) How do we improve the visibility of the Service and the refuge in the local communities affected by our work? Given the geographic range and area of influence of this refuge, how do we best communicate with, or outreach to, the communities throughout the watershed affected by our management?

A number of respondents expressed concern that the refuge does not have a high enough profile or presence in the watershed. They suggest the refuge itself is not even known in certain areas. There were some who would like the refuge to be a more integral part of the economic and social health and vitality of local and regional communities. Many ideas were expressed on how to raise visibility, improve outreach, and engage people. One other suggestion was to ensure a transparent planning process with frequent opportunities for local communities

to participate and share information. We direct readers to review the differences among the alternatives in chapter 4 under goal 4 related to local community partnerships and private lands coordination.

(2) What partnerships should we maintain or develop to meet refuge purposes, goals, and objectives?

Most commenters applaud the refuge's extensive and diverse partnerships. Virtually everyone recognized that the scope and scale of the watershed necessitates partnerships as the only way for successful conservation. Most agreed that no entity alone has the capacity to address all the priority issues and opportunities. That being said, there were some people who suggested that the refuge was spreading itself too thin among partnerships and should focus attention on either a particular subregion within the watershed, or on certain programs or partners, in order to narrow the focus. One solution suggested was to substantially increase staffing levels to allow refuge staff to work more closely with state agencies, local town governments, private landowners, and organizations, or with nontraditional partners such as the forest product and agricultural industries.

The role of partnerships was recognized by the planning team as being important enough to establish as a separate goal in the final CCP/EIS. The alternatives differ on the partnerships that would be promoted and the geographic areas within the watershed that would be a priority for partner collaborations. The discussion on partnerships is primarily covered in chapter 4 under goal 4.

(3) How can we best coordinate resource management with state and Federal agencies with jurisdiction in the watershed?

This issue is related to issue #20 above. It represents a particular partnership of importance to us. We address how the alternatives support partnerships with state and Federal agencies in chapter 4 under goal 4.

Administrative Resources

(1) What staffing and budgets are needed to effectively administer the refuge and provide good customer service?

We heard a range of opinions on whether or not the refuge should increase their budget and staffing, and whether current levels are adequate. Some people were opposed to any additional budget or staff increases because they do not want the Federal government to grow further. Others commented that they would rather see funding go to local contractors and businesses for work needing to be done, or to state agencies or partners via cooperative agreements.

Many people expressed concern about our ability to maintain existing and proposed infrastructure and implement programs on this refuge, given current levels of staffing and funding. They recognized the logistical challenges of our staff trying to manage the refuge land base, which straddles four states and is stretched along hundreds of miles. We also heard their observations that the refuge's capability is currently limited as evidenced by the challenges in implementing habitat management projects, conducting inventories and monitoring, conducting outreach to raise the visibility of the refuge, and staffing visitor contact facilities. They expressed concern that any new proposals in this final CCP/EIS would further exceed capabilities of annual budget allocations, thus raising unrealistic expectations. We heard acknowledgement that funding can vary widely from year to year because of shifting demands in the Congressional appropriations process, posing management challenges for the refuge. Other people supported our pursuit of new management objectives

and strategies, including those that may increase staffing and budgets, in the hopes that the final CCP/EIS will serve as a strategic guide to establish new partnerships and identify other sources of funding. Some people had suggestions on what new staff should be a priority to add, including the need for increased law enforcement capability on refuge lands.

Common to all alternatives is the following statement that will be prominent in the final document:

> *"Comprehensive Conservation Plans (CCPs) provide long-term guidance for management decisions on a refuge and set forth goals, objectives, and strategies needed to accomplish refuge purposes. CCPs also identify the Service's best estimate of future needs. These plans detail program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. CCPs do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition."*

Otherwise, the alternatives recommend varying amounts of funding and staffing (both permanent and seasonal) to support their respective objectives and strategies over the next 15 years. In chapter 4, staffing needs are identified as strategies under appropriate objectives. Appendix H portrays staffing charts for each of the alternatives. Appendix G summarizes staffing, project, and maintenance budgets to support the Service-preferred alternative.

(2) What refuge administration facilities do we need and where should they be located?

We heard concerns about whether existing refuge administrative facilities are adequate, including office, storage, and maintenance facilities. Issue #14 deals with issues about visitor services facilities, so they will not be addressed here. Some partners find it challenging to interact with the current refuge staff because they are spread out across three facilities. Some people also questioned whether the refuge headquarters in Sunderland, Massachusetts, was in the most strategic location to facilitate customer service and manage the land. People also wondered whether other refuge buildings are effectively being used, or are necessary to maintain, using the example of the buildings acquired on the Fort River Division. Also, we heard complaints that the Nulhegan Basin Division's office in Brunswick, Vermont, is too large and therefore underutilized.

Common to all alternatives is maintaining a staff presence in the refuge's Sunderland, Massachusetts, and Brunswick, Vermont, offices. However, the alternatives differ in staffing other facilities, and in the use of the Fort River and Nulhegan Basin Division's respective buildings as a community resource. We primarily cover this topic in chapter 4 under goals 2 and 4.

Chapter 3

USFWS

Federally endangered Jesup's milk-vetch

Affected Environment

- Introduction

Part I: The Connecticut River Watershed Environment

- Land Use: Historic and Current
- Physical Environment
- Biological Environment
- Socioeconomic Environment

Part II: General Refuge Information

- Refuge Administration and Facilities
- Urban Wildlife Conservation Initiative
- Land Acquisition History
- Conte Refuge General Public Use

Part III: Description of Individual Refuge Divisions and Units

- Refuge Divisions
- Individual Refuge Units

Introduction

This chapter describes the existing physical, ecological, socioeconomic, and historical environment of the refuge and larger Connecticut River watershed. This description serves as the baseline condition for determining the potential environmental impacts of the four management alternatives we analyze in this final CCP/EIS. See chapter 4 for full description of these four alternatives and chapter 5 for the analysis of the alternatives' environmental impacts.

This chapter is divided into three parts to describe the environment at different scales. Part I describes the entire watershed's environment. Part II provides more general refuge information, while part III provides more specific and information on the refuge's existing divisions and units.

Several appendixes include supporting documentation and descriptions used to compile this chapter. For example, appendix M describes resource plans we used as references. Consulting these individual plans would provide the reader more detailed information on a wide variety of resources of interest. Of particular note, we recommend readers consult the respective State Wildlife Action Plans for Connecticut, Massachusetts, Vermont, and New Hampshire. These plans provide a comprehensive description of each State's fish and wildlife, historic and current habitat trends, and species and habitats of elevated conservation concern (New Hampshire Game and Fish Department 2005, Connecticut Department of Environmental Protection Bureau of Natural Resources 2005, Vermont Fish and Wildlife Department 2005, Massachusetts Department of Fish and Game 2006).

As we noted in chapter 2, the amount of information about the watershed is impressive, and new plans and information are being produced at a rapid pace. We highlight below the information we think is most important to relate about the watershed and refuge resources; it is based on information that was available during preparation of this final document. Some of this information may become dated before making the final decision, but we will provide updates before the final CCP is issued.

Part I: The Connecticut River Watershed Environment

Land Use: Historic and Current

As noted in chapter 1, our project analysis area is the entire 7.2 million-acre Connecticut River watershed, located in the Northeastern U.S. (map 1.1). It covers portions of four states: New Hampshire, Vermont, Connecticut, and Massachusetts (a very small portion also occurs in Maine and Canada). Of the watershed's total acreage, 13 percent (13%) lies in Connecticut, 24 percent (24%) in Massachusetts, 28 percent (28%) in New Hampshire, and 35 percent (35%) in Vermont. The watershed also includes more than 20,000 miles of tributaries and streams.

Both historic and current land uses in the watershed have been, and continue to be, largely influenced by its diverse geography and the changing needs of society. The next two sections describe the land use history of the Connecticut River from its earliest settlement by humans to the current day. We also direct readers to some interesting facts about the watershed on the CRWC Website (CRWC 2013; *http://www.ctriver.org/river-resources/about-our-rivers/watershed-facts/;* accessed August 2016)

Cultural and Historic Resources Overview for Connecticut River Watershed
Starting with the earliest human occupation of the Connecticut River watershed more than 11,000 years ago, the river has provided focus for settlement, cultural exchange, and travel. People have been influenced by the environment and the types of natural resources that were available. In turn, they affected the ecology

of the watershed through their activities and land use (Waller and Cherau 2011, T. Binzen, personal communication 2013).

According to archaeological evidence, the first inhabitants were Paleoindian explorers who entered a sparsely vegetated landscape dominated by lakes of glacial meltwater. These people were highly mobile. They exchanged stone materials over great distances, and preferred to live on sandy plains of glacial outwash (Waller and Cherau 2011, T. Binzen, personal communication 2013).

Over the ensuing millennia, the climate changed within the watershed and the types of vegetation and animal species evolved as well. The Native American inhabitants formed societies that occupied different topographic zones within the watershed, adjusting to shifts in climate and ecology. After 7,000 years ago, tools for fishing become more common in the archaeological record. Native settlement tended to focus in upland areas. After 3,000 years ago, the vegetation regime in the watershed became similar to what is seen today. Along the coast, sea levels stabilized and systems of estuaries took the form that can be recognized today. Native Americans reoriented their settlement systems to the valley floors and coastal areas. Vast seasonal runs of diadromous fish drew people to gather at waterfalls and rapids along the Connecticut River and its tributaries. In addition to hunting and fishing, horticulture played an increasing role in Native American subsistence, and settlements became larger and more permanent (Waller and Cherau 2011, T. Binzen, personal communication 2013).

The native peoples of the watershed belonged to the Algonquian culture, sharing a common language and social structure and following an annual subsistence cycle. Landscapes they inhabited were highly variable, from the mountainous headwaters in the north, to the broad verdant plains of the central valley, down to the southern tidal area. Through time, the river formed a common chain and a route for travel, exchange, and communication (Waller and Cherau 2011, T. Binzen, personal communication 2013).

When the first European explorers arrived on the lower Connecticut River in the early 17th century, they encountered large Native populations, including members of the following tribes: Western Abenaki in the upper Connecticut River valley; Squakheag in New Hampshire; Norwottuck, Agawam, Woronoco, and Pocumtuck in the middle valley; and Wangunk in Connecticut. Dutch and English traders competed for influence with tribes, incrementally working their way further up the river to centers of trade in present-day Hartford and Springfield. Competition between tribes increased as the fur trade made control of headwater areas more important (Waller and Cherau 2011, T. Binzen, personal communication 2013).

Between 1620 and 1700, colonial settlement was rapid in the lower watershed. Within the Connecticut River watershed in the Connecticut and Massachusetts Bay colonies, the establishment of townships followed a common pattern. Proprietors were granted tracts of land which they were expected to “improve” by felling trees, building farmsteads, and cultivating cropland. The soils of the lower valley were highly favorable for this enterprise. Simple industries such as sawmills, grist mills, and tanneries were ubiquitous on the streams and smaller tributaries. As late as 1700, however, the northern frontier of colonial settlement was not far above Springfield. The watershed from that point north to the French colonies of Canada was unfamiliar to the colonial settlers. In the aftermath of regional conflicts in the early and middle 1700s (including Queen Anne’s War and the French and Indian War), the Native American inhabitants of the lands north of the frontier were decimated by disease and conflict, and colonial settlement

expanded progressively northward (Waller and Cherau 2011, T. Binzen, personal communication 2013).

During the Industrial Revolution in the 1800s, forms of land use transformed the ecology of the Connecticut River watershed. Agriculture, population growth, and a profusion of new industries characterized the southern portion of the watershed. The establishment of the planned industrial city of Holyoke, Massachusetts, was emblematic of transformations in the central and northern watershed. By the 20th century, the availability of electrical power meant that industrial enterprises could be established away from the watercourses on which they had previously depended (Waller and Cherau 2011, T. Binzen, personal communication 2013).

Forests and Farmland

The landscape of eastern North America was completely transformed by logging, land clearance, and agriculture during the 18th and 19th centuries (Torrey and Allen 1906; Fisher 1933; Raup 1966; Cronon 1983; Whitney 1994). In central New England, 50 to 80 percent (50-80%) of the forested uplands were converted to pasture, hay fields, and tilled land by the mid-1800s and supported thriving agricultural activity based upon livestock and crop production (Bidwell and Falconer 1941; Black and Brisner 1952). In the late 1800s and early 1900s, urban manufacturing jobs and homesteading opportunities in the fertile Midwestern United States lured the population from eastern farms and triggered broad-scale reforestation. By the 1940s, 60 to 85 percent (60-85%) of the land in New England supported forests (Baldwin 1942).

Historical and ecological data from north-central Massachusetts suggest that widespread and intensive human disturbance, namely in the form of land clearing by European settlers, led to a shift in forest composition. Prior to European settlement, there was regional variation in forest composition, where oak, chestnut, and hickory communities were common at low elevations and hemlock, beech, sugar maple, and yellow birch communities were common at higher elevations. After European settlement, forest composition changed markedly in response to human land practices, leading to a more homogenous and broad-scale forest composition, and the rates of vegetation change remained high, reflecting continuing disturbance on the landscape (Fuller et al. 1998). One author suggests that the dynamic equilibrium in the ecology of upland oaks, notably white oak, which existed for thousands of years, had been destroyed in the few centuries following European settlement due to land clearing, extensive clear-cutting, catastrophic fires, chestnut blight, fire suppression, and intensive deer browsing (Abrams 2003).

Agriculture and forestry are the two main land use industries in the upper portion of the watershed, often characterized by dairy farms along the main stem and a few of the tributaries and expansive pastures for livestock. A majority of the land along the river is zoned for limited residential use, but there are commercial and industrial sites. New England Power Company owns 117 miles of river frontage and manages it for timber, wildlife, and recreation (NHDES 1991).

Forests are no longer owned principally by large corporations. Between 1980 and 2005, ownership of almost 24 million acres changed hands in New England's Northern Forest Region, a distinct region of 26 million acres. Ownership shifted from industrial forest ownership to various new financial and non-profit investors (e.g., timber investment management organizations, real estate investment trusts, and conservation organizations). By 2005, financial investors owned about one-third of the large forest tracts and industry owned only 15.5 percent (15.5%; or, 1.8 million acres, mostly in a single ownership). Despite the rapid turnover of

timberland in the last decade, most forest blocks have remained intact, although there is a trend toward more forest owners with associated smaller parcel sizes (Hagan et al. 2005).

It is useful to understand broad patterns in land use for the watershed and how those patterns affect natural environments. Of all America's forests under pressure from development, New England's are shrinking the fastest. Connecticut and Massachusetts will lose the highest percentages of forest among all states by mid-century (Carpenter 2007). Although the region's forests made a remarkable comeback, since the early 20th century, these forests are being displaced and fragmented by ever-encroaching home development with larger homes and lot sizes. In a study released by Harvard Forest researchers titled *Wildlands and Woodlands,* following almost 200 years of natural reforestation, forest cover is declining in all six New England states (Foster et al. 2010). The authors of this report recommend conserving 70 percent (70%) of New England as "working and wild forestland," a target they say is critical to protecting vital natural benefits that would be costly, and in some cases impossible, to replace.

One example of land use trends in the watershed, described in the recent report *Losing Ground: Beyond the Footprint*, is that between 1971 and 1999 the land considered developed increased from 17 to 24 percent (17-24 %) in Massachusetts, while "wildlife habitat," which is defined as forest, wetlands, and open water, declined from 70 to 64 percent (70-64%). Massachusetts Audubon estimates that Massachusetts is losing 40 acres a day to development (DeNormandi 2009). Similarly, by 2050, 61 percent (61%) of Connecticut will be urbanized, according to a report in the Journal of Forestry (Nowak and Walton 2005) compiled by Forest Service researchers.

Potential future shifts in fuel and power production will also have an effect on the watershed's forests and rivers. The 4 states in the watershed are part of a 10-state agreement to limit greenhouse gas emissions (Carter, Ledyard, and Milburn LLP 2007). The 10 states have capped CO_2 emissions from the power generation sector, and agreed to a 10 percent (10%) reduction in these emissions by 2018. In order to meet that goal, the states are considering all viable alternative energy options such as wood biomass production mills, solar and wind-driven electrical generation, and hydropower. These alternative energy sources will influence the watershed forests and rivers due to the removal of trees and other vegetation to support biomass plants or to construct solar- and wind-farms and the use of water to cool biomass plant operations and to run hydropower generators.

Agricultural land uses continue to be a mainstay in the watershed. "Traditional" agriculture, such as dairy, apple orchards, and maple sugar production, is still prominent, although there has been some adaptation to fewer, larger dairies and organic dairies. "Niche" agriculture has become popular in the region over the last 10 years. For example, there has been an increase in farm stands, pick-your-own produce farms, community supported agriculture (CSA), community involved in sustaining agriculture (CISA), organic crop and grain production, farm cooperatives with local food markets and restaurants, organic meat production, farmers' markets, selling compost in bulk, and collecting and selling wild mushrooms (Taylor 2009). Tilled agricultural land is largely restricted to the valleys and lower slopes where prime soils occur. Dairy farms tend to be concentrated in the upper watershed, particularly in northern Vermont (Clay et al. 2006).

Agriculture is an ever-changing and dynamic industry. Farmland throughout the watershed is under pressure from the high value of land for development; between 1982 and 1997 the watershed lost 19 percent (19%) of its farmland and,

between 1997 and 2002, lost another 7.5 percent (7.5%). Additionally, only 11 percent (11%) of prime farmland and 16 percent (16%) of non-prime farmland are protected (Clay et al. 2006). The profitability of farm businesses is a high-risk endeavor, making farmland conservation an immense challenge. Prominent challenges include: an aging farm community, reduction in the number of farm owners, land values rising faster than the income it can generate, loss of farmland, and the economic inability to permanently protect farmland (Clay et al. 2006).

Conserved Lands Network in the Watershed

The Connecticut River watershed has an extensive network of conserved lands equaling 1.5 million acres or about 22 percent (22%) of the watershed (re: map 1.2. Conserved Lands in the Connecticut River Watershed "Map 1.2. Conserved Lands in the Connecticut River Watershed"). Conserved lands in the watershed are permanently protected from development through deed or easement restrictions, but in some cases may allow or require land uses such as farming and forestry. Our source of data for existing conserved lands was obtained by TNC (2011).

Within the watershed, many agencies, organizations, and private individuals own and maintain conserved lands for a variety of different purposes. Those include: water supply, flood protection, timber production, agricultural use, recreational use, and fish and wildlife habitat. Some owners place a restriction on development simply for aesthetic reasons.

Table 3.1 and map 1.2 show estimated acres in the watershed held by various agencies and organizations. It is important to note that there are likely small parcels held by municipalities, small land trusts, or private landowners that are not in the database yet, and more are being added all the time.

Table 3.1. Conserved Lands in the Connecticut River Watershed by State and Ownership. For each state, the total acreage by each ownership class is shown, along with the proportion of land in that class in each state. For example, 18% of Connecticut's conserved land within the Connecticut River Watershed is privately owned. In the totals line, the percentages represent the contribution of all lands in each state to the grand total.

Ownership	Connecticut		Massachusetts		Vermont		New Hampshire		Totals	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Federal	686	<1	11,497	2	217,795	35	227,089	36	457,067	25
State	77,013	53	284,006	57	157,106	30	116,140	18	634,265	35
Local[1]	41,583	28	77,830	16	25,119	5	27,416	4	171,948	10
Private	26,724	18	126,787	25	114,040	22	264,577	42	532,128	30
Unknown[2]	740	1	73	<1	2541	**<1**	**61**	<1	3,415	<1
Totals	**146,746**	**8**	**500,193**	**28**	**516,601**	**29**	**635,283**	**35**	**1,797,823**	

Sources: The conserved lands layer (2014) was obtained from The Nature Conservancy, and utilizes Gap Status codes 1, 2, 3, and 39. Other base layers were obtained from ESRI.
Refuge lands information provided by the Service.

[1] *Local lands includes approximately 22,159 acres held to protect water supplies.*
[2] *Ownership could not be determined from the data available.*

Some generalizations are possible with respect to conserved land ownership in the watershed. Most federal lands are held by the U.S. Fish and Wildlife Service or Forest Service. State-owned land is typically secured as State forest, park or wildlife management areas. Water supplies may be held by both State and

local or municipal governments (for example, the Quabbin Reservoir is owned by Massachusetts). In the southern half of the watershed Federal land ownership is very small, while in the northern half of the watershed local and municipal ownership is more rare.

Physical Environment

The watershed is part of several different regions based on topography and character: the Great North Woods of New Hampshire (*http://www.visitnh.gov/information/about-the-regions/great-north-woods.aspx*; accessed August 2016), the Northeast Kingdom of Vermont (*http://www.nekchamber.com/;* accessed August 2016), the Upper Valley of Vermont and New Hampshire (*http://www.nekchamber.com,* accessed August 2016), the Pioneer Valley of Massachusetts (*http://www.valleyvisitor.com/;* accessed August 2016), and the Tidelands of southern Connecticut (*http://www.ctrivergateway.org/*; accessed August 2016).

Traversing these regions the river changes course in response to elevation, gradient, and other physical features. The area of the watershed in the Northeast Kingdom includes mountains with elevations exceeding 3,000 feet. Here the river is a narrow, swift, cold-water stream that falls some 900 feet in 30 miles, the sharpest drop within the river's profile. There are three artificial impoundments within this northernmost section of the river: Second Connecticut Lake, First Connecticut Lake, and Lake Francis. Spruce-fir forests dominate this rural area.

As the river leaves the Northeast Kingdom, it travels from Pittsburg, New Hampshire, to Moore Reservoir near Littleton, New Hampshire. This stretch is characterized by elevations of 2,000 feet or less. Here the river is wider, slower, more meandering, while making its second greatest fall, dropping some 400 feet between Gilman, Vermont, and East Ryegate, Vermont. The width and slower flow here can be attributed in part to the presence of five dams.

Moving into the Pioneer Valley region, from approximately Moore Reservoir to Turners Falls, Massachusetts, the river flows through hilly and rolling country, with elevations of up to 2,000 feet and gradually drops 365 feet. This section of the river contains six dams. Farmland and dairies characterize this rolling landscape.

Continuing through the Pioneer Valley and into the Tobacco Valley of Connecticut—from Turners Falls, Massachusetts, to Middletown, Connecticut—the river is characterized by a wide elongated valley floor less than 500 feet above sea level, with adjacent uplands to the east and west that rise sharply in elevation. The river has an extensive floodplain and a gradual fall. There are two dams in this stretch of the river: one at Holyoke, Massachusetts, and one in Enfield, Connecticut. The Enfield Dam, built in 1827, has been in disrepair for many years and has naturally breached (Frisman 2002). These rich valley lands encompass some of the most valuable farmlands in the watershed and attracted settlement early in America's history.

South of Middletown, Connecticut, the area can be characterized as a plateau with a few hilly or mountainous elevations rising to 660 feet. Lands along the river are fairly steep and little valley floor exists. The river here is free-flowing and tidal, flowing through the most urbanized section of the watershed.

Moving into the Tidelands area, from Chester, Connecticut, south to Long Island Sound, the river continues its decrease in elevation, transitioning from uplands to tidal coves, extensive tidal marshes, meadowlands, and large estuarine islands. The mouth of the river is defined by sandy beaches and sheltered bays, as well as a number of offshore rocks, shoals, and shifting sandbars. Although this river

delta and coastal plain landscape is highly urbanized, the Connecticut River is one of the few large rivers in the U.S. that does not have a major city at its mouth.

Geomorphology — History of Geological and Climatic Processes
The Connecticut River valley's current diversity it topography and natural communities is a product of millions of years of geologic, glacial, climatic, and erosive dynamics). Uplift and glaciation were the predominant geologic and climatic events that shaped the current landscape. The Connecticut River began in a rift valley formed as the supercontinent Pangaea broke apart 180 million years ago along the deep ocean mid-Atlantic Ridge, which also formed the Atlantic Ocean. This was followed by valley layers tilting during earthquakes to form the basalt "traprock" ridges—the Holyoke Range and Mount Tom in Massachusetts, and Connecticut's Metacomet Ridge that were more resistant to the subsequent glacial scouring that wore down adjacent sedimentary rock. Over millennia, sedimentary sandstones and conglomerates filled the valley, and eons of flooding events have deposited deep, accumulated layers of terraced silt loams through which the river flows today (Freeman 2007, Sinton et al. 2007).

The Laurentide glacier reached its maximum southern extent about 18,000 to 21,000 years ago, depositing enormous amounts of glacial till and outwash gravels to form a massive terminal moraine. When the glacier melted back to the Hartford, Connecticut area, deposits blocked the whole valley, forming an earthen dam. Dammed meltwater formed glacial Lake Hitchcock, which stretched from Rocky Hill, Connecticut, to St. Johnsbury, Vermont, and existed for more than 4,000 years. As rivers drained into Lake Hitchcock, the heavy sand particles were deposited in deltas that formed sandplains in Windsor, Connecticut, Westfield, Massachusetts, Montague, Massachusetts, as well as a few other scattered locations. The finer clay particles that settled in the lake's bottom today support many wetland areas, and the rich sediments from the lake also provide for the productive agricultural lands in the Pioneer and Tobacco Valley regions (Zimmerman et al. 2007, Becker and Wunsch 2009).

When the dam forming Hitchcock Lake finally breached, the Connecticut River receded to approximately its current location and started to erode the Hitchcock sediments. Over time, the river has changed its course in places and left some abandoned channels (oxbow lakes) creating ecologically important floodplain areas. Some of the scenic, narrow valley segments we see today became established where the sediments were more difficult to erode, leading to the creation of waterfalls and rapids (Zimmerman et al. 2007, Becker and Wunsch 2009).

Hydrology and Water Quality
The movement of water through the watershed, its quantity and quality, and the impacts from human activities all play important roles in the management of the river system and the fish and wildlife populations that depend upon it. Many aquatic plants and animals are sensitive to stream flow and water pollution. The health of a river system and its watershed is reflected in the species it is able to support. Groundwater typically originates in upland recharge areas and moves to lower discharge points. Because groundwater percolates down through the soil, our land uses affect its quality and quantity (CRWC 2008).

The main stem of the Connecticut River is 410 miles long, draining well over 7 million acres of diverse rural and urban lands. It is the largest riverine ecosystem in New England. The Connecticut River and its watershed are largely defined by the occurrence, distribution, movement and properties of water, and its relationship with the environment through the hydrologic or water cycle. Like

Bald eagle

Steve Maslowski/USFWS.

its land, the water is in high demand and is critical for many uses in households, businesses and industries; irrigation of farms; conservation of parklands, fish and wildlife habitat; and for production of electric power (USGS 2013, USFWS 1994).

Under the National Watershed Boundary System, the watershed is classified as a subregional hydrologic unit (i.e., hydrologic unit code (HUC) 0108) within the Northeastern Region, one of 21 national hydrologic regions (Mulligan 2009). Within this subregion, there are 10 watersheds officially recognized by the USGS and NRCS. The main stem of the Connecticut River receives water from 36 major tributaries, 26 of which drain 100 square miles or more (table 3.2; map 3.1).

Table 3.2. The Connecticut River's Major Tributaries.

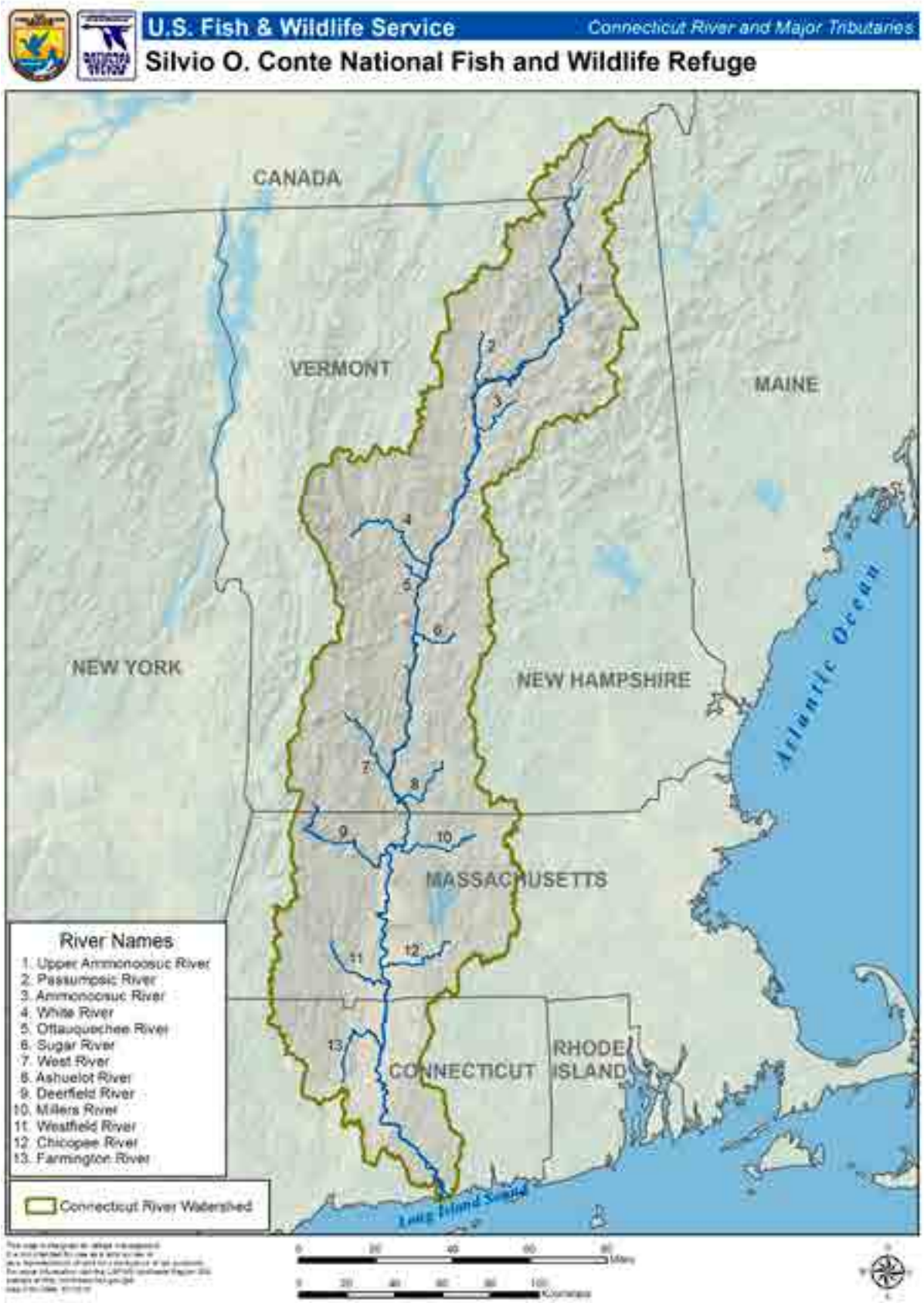
River - State	River Miles (upstream of Long Island Sound)	Length (in miles)	Drainage Area (in square miles)	Fall (in feet)
Lieutenant - CT	3	5	12	33
Eightmile - CT	9	11	62	300
Salmon - CT	18	20	152	520
Hockanum - CT	50	22	82	510
Farmington - CT	57	47	602	350
Scantic - CT	59	35	113	900
Westfield - MA	75	57	517	1,780
Chicopee - MA	80	17	721	260
Manhan - MA	92	18	106	900
Sawmill - MA	114	12	30	660

River - State	River Miles (upstream of Long Island Sound)	Length (in miles)	Drainage Area (in square miles)	Fall (in feet)
Deerfield - MA/VT	119	73	664	2,900
Falls - MA	122	12	36	400
Millers - MA	126	45	392	900
Ashuelot - NH	140	64	421	1,475
West - VT	149	53	423	1,780
Cold - NH	172	15	110	1,000
Saxtons - VT	173	20	78	1,565
Williams - VT	176	24	118	1,330
Black - VT	183	40	204	1,055
Sugar - NH	195	27	275	800
Ottauquechee - VT	210	38	222	1,485
Mascoma - NH	214	34	194	1,015
White - VT	215	58	712	2,170
Ompompanoosuc - VT	225	20	136	800
Ammonoosuc - NH	226	56	402	4,560
Waits - VT	247	24	146	1,950
Wells - VT	266	16	100	680
Stevens - VT	277	7	49	435
Passumpsic - VT	280	23	507	245
John's - NH	303	9	76	200
Israel's - NH	312	21	135	1,445
Upper Ammonoosuc - NH	325	40	254	1,345
Paul Stream - VT	340	14	58	940
Nulhegan - VT	345	16	151	285
Mohawk - NH	359	11	92	850
Headwater Areas - VT/NH	372	29	304	875

The average annual runoff for the watershed as a whole is about 23 inches or about one half of the average annual precipitation (Federal Power Commission 1976). Daily flow at the mouth of the Connecticut averages nearly 16,000 cubic feet per second (cfs), similar to Hudson and Delaware Rivers. However, the flow has ranged as high as 282,000 cfs and as low as 971cfs. In the spring, daily flows average over 24,000 cfs, but drop to less than 5,000 cfs in late summer. Mean monthly river discharges are highest during April and May and lowest during August and September (USFWS 1994).

Water temperatures in many of the streams within the watershed closely follow seasonal air temperatures. Summer water temperatures in the mid-Connecticut River main stem average between 70° Fahrenheit to 80°F with temperature peaks sometimes reaching 90°F in July and August (USFWS 2010). Minimum water temperatures occur from December through March with ice often

Map 3.1. The Connecticut River and Its Major Tributaries.



forming on water surfaces and temperatures ranging from the low to mid-30°F (USFWS 1995a).

The Upper Connecticut River watershed is mountainous, steep, and rugged. Streams, brooks, and rivers are fresh, and often descend quickly through this northern terrain, being fed through rainfall, snowmelt, and groundwater. Streamflow at the headwaters in New Hampshire can be just a trickle, often barely 1cfs. Streamflow increases southward as the area of land being drained increases and is about 10,000 cfs at the northern Massachusetts border. As a drowned river valley, the lower river is strongly influenced by waters of Long Island Sound. The Connecticut River discharges nearly 70 percent (70%) of the freshwater input into the Sound, thus exerting a major influence on this northeast estuary. The lower 60 miles of the Connecticut River from Long Island Sound to the Scantic River, 8 miles above Hartford, Connecticut, mix with sea water and are tidally influenced. The range of tide height during periods of low flow is from one foot at Hartford to 3.5 feet at the rivers mouth. The heavier saltwater moves under the overlying freshwater in a wedge and its "intrusion" upriver is dependent upon the amount of surface freshwater runoff, wind direction, and tide conditions (USFWS 1994).

The amount of salinity greatly affects the distribution of plants, animals, and habitat types in the lower river. For plants, the most significant salinity conditions for submerged and emergent plants are those that exist during the warm growing season. At the beginning of the growing season in early May, when river flows are at their peak, there is no detectable salt in the surface waters of the river estuary, regardless of the stage of the tide. However, as the summer season progresses, and the river flow decreases, the penetration of salt water and tidal influence increases, as does water temperature (USFWS 1994).

Fish and wildlife are adapted to natural, seasonal hydrologic events. Natural hydrology is greatly disrupted by artificial capture, holding, and release of river water for water supply, irrigation, snowmaking, flood risk reduction, electric power generation, and recreation. There are more than 2,700 dams of various sizes in the watershed and 18 main stem dams that impound over half the river's length (Map 2.2. Locations of Dams Throughout the Connecticut River Watershed "Map 2.2. Locations of Dams Throughout the Connecticut River Watershed"). Less conspicuous than dams are the 44,000 road culverts that can fragment aquatic ecosystems and impede the natural movement of water, fish, and other aquatic organisms (TNC 2010).

There are 38 flood risk reduction projects operated by the USACE and almost 1,000 small dams on the tributaries that were built to power mills in the 1700s and 1800s. Flows, especially during low-flow periods, are highly regulated and restricted by dams in the watershed (Kapala and Brown 2009). Maintaining a natural flow regime in such a highly controlled river system presents a tremendous challenge. The State of Connecticut adopted new stream flow regulations in 2011 (State of CT 2012), and efforts are underway by TNC and the USACE to develop a hydrologic model to better understand flow dynamics and use demands, thereby helping to more effectively manage human use of the river (UMass-Amherst 2012).

Water diversions out of the watershed are an important ecological consideration because flow and volume requirements for aquatic resources in the Connecticut River can be significantly impacted. The Quabbin Reservoir located on the Swift River in the Chicopee River drainage, stores runoff from an 86-square-mile watershed for the greater Boston area. Flows in excess of 85 million gallons per day in the upper Ware River are diverted to either the Quabbin or Wachusett

Reservoirs. Out of watershed water diversions, including water from the main stem Connecticut River and Millers River, have been considered as a source of potable water for Boston. Fortunately, however, aggressive water conservation steps taken in Boston by the Massachusetts Water Resources Authority prevented diversions from the Connecticut River (Postel 2013).

The Connecticut River has undergone a dramatic transformation in the last three decades. During this time, a number of public agencies and private organizations have worked diligently to implement policies and measures aimed at improving the river's quality. Ample data collected over the years indicate that the actual water quality conditions of the Connecticut River, as measured by empirical parameters, have improved. The water quality of rivers and streams in the Connecticut River watershed has likewise improved considerably, with all waters now designated at least Class B. State water quality agencies actively work with industries, municipalities and agricultural groups to meet water quality standards within the watershed. However, point and nonpoint pollution is still a concern within the watershed.

Some municipalities in the watershed still have combined sewer systems. These systems are designed to treat both sewage and stormwater (as found in Hartford, Connecticut, and Holyoke and Springfield, Massachusetts) and often are inadequate to handle large storms, causing pulse overflows of raw sewage and stormwater into the Connecticut River and its tributaries.

Friends of Conte Refuge

Salmon River, Connecticut

"Nonpoint source pollution" also occurs in the watershed from land runoff, precipitation, atmospheric deposition, drainage, or seepage. Unlike "point source" pollution, nonpoint source pollution can not be traced back to specific site (e.g., a specific industrial or sewage treatment plant). Another form of nonpoint source pollution is hydrologic modification. Although soil erosion and sediment transport are natural processes, they can be aggravated by a particular use or recreation activity and alter hydrological processes (e.g., removal of vegetation, shoreline erosion from excessive boat wakes) (USEPA 2012a). Common nonpoint pollutants include excess fertilizer, herbicides, and pesticides from agricultural, and residential lands; oils and toxic chemicals from urban and industrial areas; excess nutrients and bacteria from agricultural lands and livestock; and acids and other pollutants from abandoned mines and industrial areas.

The primary pollutants in the Connecticut River watershed are sediments, nutrients (e.g., nitrates and phosphorus), animal wastes, pesticides, salt, and various toxic chemicals (e.g., antifreeze, motor oil) (SCCD 2013). Most erosion within the watershed results from agricultural practices, construction, and fluctuating water levels within tributaries and the main stem river. Nutrient and sediment laden agricultural and urban runoff and landfill leachate contribute to

pollution. Nutrient loads increase with increasing intensity of land use and with increasing population densities. Major sources of nutrients include atmospheric deposition, groundwater discharge, agricultural fertilizer and manure spread, urban nonpoint runoff from roads and impervious surfaces, and municipal wastewater discharge (USGS 1999).

Water quality in the watershed is affected by thermal pollution in certain locations. Thermal loading (i.e., increased water temperatures) resulting from impounding water behind dams and eliminating vegetative shading by clearing floodplain forests adversely affects indigenous wildlife, fish, and vegetation (Pace University 2000). The Vermont Yankee nuclear facility in Vernon, Vermont, uses water from the Connecticut River to cool the reactor, returning heated water to the river. The former Connecticut Yankee facility in Haddam, Connecticut, and the Rowe Yankee Nuclear Power Station in Rowe, Massachusetts, have been retired. Three fossil-fuel generating plants also use Connecticut River water for system cooling. Two of these are located in Massachusetts and one is in Connecticut.

The USGS sampled streambed sediments, fish tissues, surface water, and groundwater from a variety of sites in the Connecticut River watershed as part of its National Water Quality Assessment Program (USGS1998). The most common contaminants in sediments were chromium, copper, lead, mercury, nickel, zinc, chlordane, DDT (dichloro-diphenyl-trichloroethane), PCBs (polychlorinated biphenyls), and PAHs (polycyclic aromatic hydrocarbons). The most commonly detected compounds in fish were chlordane, DDT, DDE (dichloro-diphenyl-dichloroethylene) and PCBs. The highest concentrations are in the southern urban basins in Massachusetts and Connecticut.

The concentrations of PCBs and organochlorine pesticides in the Connecticut River were among the highest found in the country, and exceeded aquatic life criteria at several sites. Although most of these compounds are presently banned, they are very stable and still persist in the environment from applications that occurred prior to the ban. In general, the more chlorine present in a PCB, as there are many forms, the longer it will take to degrade and the more potential harm it may cause organisms.

Not only do PCBs persist in the environment for a long time, they also tend to bio-accumulate and bio-magnify. Pollutants that bioaccumulate are taken up and stored by organisms over time. Bio-magnification occurs when the concentration of these pollutants increase as they are transferred through the food web (i.e., predators have greater concentrations of a particular pollutant than their prey) (EPA 2012). Because of this, there are broad restrictions on eating many fish species, especially bottom-dwelling catfish and carp, from the Connecticut River in Massachusetts and Connecticut due to high PCB levels (MDPH 2011; CDPH 2013). A USGS (1998) investigation also detected a wide variety of pesticides, but concentrations in streams and groundwater were relatively low. Nitrate concentrations in shallow groundwater wells under agricultural areas were usually greater than the national average, with 15 percent (15%) of these wells exceeding the drinking water standards (USGS 1998).

All four states recommend restricting the consumption of resident freshwater fish caught in the watershed due to elevated mercury levels from atmospheric contamination, notably for pregnant and nursing women and small children. Coal contains mercury, and airborne mercury is released in emissions from coal-fired power plants. Rates of mercury deposition are estimated to be higher in the northeastern U.S. relative to other parts of the country. This is widely attributed to the presence of coal-fired power plants in the region, and the airborne transport of mercury on the prevailing winds from power plants outside the region.

Soils

Soil type and distribution in the Connecticut River watershed has an important influence on the distribution of plant communities and wildlife. Soil elements such as calcium, nitrogen, phosphorus, and potassium are the principle nutrients needed by plants. The valley is recognized for its highly diverse soils, including the rich agricultural soils in the lower valley regions of Massachusetts and Connecticut. The watershed contains 221,000 acres of "prime farmland" soils (Clay et al. 2006). As defined by the USDA, prime farmland is farmland that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed products, and is also available for those uses (USDHHS 2011).

Due to the variety of bedrock in the watershed and the influence of glaciers, plant growth, climate variation, elevation, wind, and water-born erosion over millennia, hundreds of soil types exist within four major orders of soils: entisols, histosols, inceptisols, and spodosols. Upland soils are generally well drained and often formed from glacial till. Many soils formed from alluvium on floodplains, and sandy and gravely outwash exist on stream and river terraces. Organic soils are frequent in lowlands and wetlands (Villars 2009).

The variety of soils in the watershed is too extensive to present in this chapter, but examples range from the well-drained, Turnbridge glacial till that supports forests and agriculture in the Green Mountains, to the Cabot glacial till that supports wetlands and agriculture in the Vermont Piedmont, and the Windsor sandy glacial outwash series that supports intensive agricultural development and sand and gravel extraction (Villars 2009, USDA 2013).

State and county soil surveys are published by the National Cooperative Soil Survey, a joint effort of the USDA, other Federal agencies, State agencies and their agricultural experiment stations, and local agencies. NRCS has leadership for the Federal part of the National Cooperative Soil Survey. These surveys are comprehensive and provide useful information on soils and wildlife habitat (e.g., Connecticut Soil Survey 2014; *http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm*; accessed August 2016). NRCS provides detailed soil surveys for soil conservation districts that are aligned with county boundaries. The NRCS "Web Soil Survey" provides access to the largest natural resource information system in the world, and the agency has soil maps and data available online for nearly all of the nation's counties.

Climate

Present Climate

The climate and seasonality of the Connecticut River Valley play a large role in the terrestrial and aquatic habitats and species that inhabit the valley landscape. Climate indicates a region's general, seasonal patterns of temperature, precipitation, humidity, wind, and air pressure. The current climate of the Connecticut River watershed is extremely varied and diverse for a variety of reasons. The watershed is influenced by the dynamic confluence of solar radiation, east-northeast moving continental air masses, the Hudson Bay's polar vortex, jet stream, and moisture from the Atlantic and Gulf of Mexico colliding over the unique geomorphology of the valley.

Hardiness zones are one indicator of long-term climate trends. The USDA determines hardiness zones based on the average annual minimum temperature during a 30-year period. The valley covers seven USDA plant winter hardiness zones, ranging in total from 0°F near Long Island Sound to -35°F in northern New Hampshire. Although hardiness zones are useful guides about the types of plants and animals that may occur in a given area, plants and animals are also

adapted to other environmental factors related to climate, such as precipitation, humidity, and wind. Their nesting, spawning, germination, leaf-fall, migrations, and hibernations are all driven by seasonal climate and available light (Maleski 2009, Koch 2009).

The climate varies considerably depending on elevation and distance from the coast. The watershed is subject to frequent, but generally short periods of heavy precipitation because it lies in the path of prevailing westerly winds and cyclonic storms or "nor'easters." Serious blizzards occur, as witnessed in 1717, 1888, 1969, 1978, and the 1993 "Blizzard of the Century" that blanketed eastern North America. Ice storms occur with regularity. The valley is accustomed to major flood events, as occurred in 1913, 1927, and 1936. The central and lower portions of the valley are exposed to occasional coastal storms, some of tropical origin, that travel up the Atlantic seaboard. The greatest weather disaster ever to hit Long Island and New England was a category 3 hurricane referred to as the 163 mile per hour *Long Island Express* that roared up the Connecticut River valley in 1938 causing extensive damage. Watershed temperature extremes range from a recorded summer high of 105 ^{o}F in 1975 to a winter low of -50 ^{o}F in 1933. Average annual rainfall is over 40 inches. Average annual snowfall ranges from 40 inches in the lower valley to over 100 inches in the northern watershed (Maleski 2009, Koch 2009).

Climate Change

Climates are dynamic, although time frames for detectable changes typically are very long. Change is influenced by a number of major factors including the shape of the Earth's orbit, orientation of the Earth's tilt or axis, its wobble (precession) around its axis, variation in solar intensity, emissions from volcanic eruptions, and even continental plate tectonics. These climate change "drivers" often trigger additional changes or "feedbacks" within the climate system that can amplify or dampen the climates initial response (whether the response is warming or cooling). These drivers include glacial (cold) and interglacial (warm) periods, increases and decreases in the Earth's solar reflectivity, and changes in global ocean currents. When changes in the Earths orbit become more elliptical, it triggers a cold glacial period, and conversely, when the orbit is more circular it promotes a warm (or interglacial) period. Increasing concentrations of carbon dioxide may amplify the warming by enhancing the greenhouse effect. When temperatures become cooler, CO_2 enters the ocean thus minimizing the greenhouse effect and contributes to additional cooling. During at least the last 650,000 years, CO_2 levels have tended to track the glacial cycles (IPCC 2013, Mithen 2003, and USEPA 2013).

There have been irregularities in the transition from the Last Glacial Maximum of 20,000 BC to the present with an abrupt warming around 13,000 BC and then an abrupt cooling around 10,000 BC. Even within the last 2,000 years, there have been irregularities including the warming period from about 900 to 1300 AD and the "Little Ice Age" from 1500 to 1850 AD. These changes can be explained by the interactions of the influences mentioned above. However, there is now sufficient evidence to unequivocally support the scientific consensus that manmade pollutants are warming the climate. Recent, historically unprecedented levels of greenhouse gases are being released into the atmosphere, largely from the combustion of fossil fuels, exacerbating the influences noted above, anthropogenically raising average global temperatures and causing changes in the global climate due to a stronger greenhouse effect. Predicted changes for the northeast, like less snow cover, more frequent large rain events, and more frequent fall droughts, could negatively affect native plants and wildlife (IPCC 2013, Mithen 2003, and USEPA 2013).

Between 1895 and 2011, temperatures in the Northeast increased by almost 2˚F (0.16˚F per decade), and precipitation increased by approximately five inches, or more than 10% (0.4 inches per decade). Coastal flooding has increased due to a rise in sea level of approximately 1 foot since 1900 (Horton et al. 2014). This increase has sped up in recent decades. Since 1970, the average annual temperature has increased 0.5°F per decade (Frumhoff et al. 2007). Winters have been warming even faster, by 1.3°F per decade from 1970 to 2000. If heavy reliance on fossil fuels continues and heat-trapping emission remain high, average temperatures in the Northeast are project to rise 8°F to 12 °F above historical levels in winter and 6°F to 14°F above historical elevels in summer by 2100. This projection is reduced by roughly half, if present energy sources are rapidly replaced with more renewable sources that minimize the carbon footprint and energy-efficient technologies are implemented. On the higher-emissions trajectory, summers in New Hampshire may resemble those currently experienced in the Piedmont region of Virginia and North Carolina by 2100 (Frumhoff et al. 2007).

Climatic changes are expected to alter current precipitation patterns. Winter precipitation is projected to increase and to fall more as ran than snow. Rainfall intensity is expected to increase, with more frequent periods of heavy rainfall. More storms are expected to travel further up the eastern seaboard. Rising temperatures are expected to increase evaporation rates and reduce soil moisture, leading to more frequent short-term droughts in the summer and fall (Frumhoff et al. 2007, IPCC 2013). Data available from the northeast from 1900 to 2001 show an average growing season of 190 days in the early to mid-1990s, but this has since increased to a 200-day growing season (Koch 2009). Earlier emergence of plants in spring has the potential to disrupt phenological relationships of plants and animals. For example, insect emergence synchronized to flower blooming may occur before spring migrating birds arrive, thereby diminishing a critical food source (Horton et al. 2014).

Climate scientists caution that "continued warming, and more extensive climate-related changes to come could dramatically alter the region's economy, landscape, character, and quality of life" (Frumhoff et al. 2007). Climate change is projected to alter the character of the region's forests over the coming century. Northern hardwood and boreal spruce-fir forests, which now characterize New England

Red eft

USFWS

forests, could retreat north, and be replaced with forest communities that are common today in southern New England and/or the Mid-Atlantic states. The impacts on wildlife and fish communities, as we know them today, could be profound. Such a shift could lead to losses of species that depend on northern forest types, like Bicknell's thrush, snowshoe hare, and Canada lynx. Northern hardwoods (American beech, yellow birch, and sugar maple) may persist, but the optimal climate zone may shift northward 350 to 500 miles. The long-term survival of fish, wildlife,and plant species that are closely adapted to their environment and are highly sensitive to climate change or have low adaptive capacity survival is at risk if they are unable to adapt to a changing climate and its effects on habitat. This is compounded by existing stressors such as invasive species and air and water pollution. There is an urgent need to manage preemptively to better enable species and habitats to adapt (Frumhoff et al. 2007, NFWPCAP 2012).

Analysis of breeding bird survey data over a 26-year period shows a northward range expansion (9 of 27 species studied), with an average shift of about 1.46 miles per year (2.35 kilometers per year). No significant shift to the south was observed (Burns 2008). Trout habitat may shrink 50 to 100 percent (50-100%) by next century; hemlock woolly adelgid will steadily move north thereby removing hemlocks and reducing shade that moderates stream temperatures, among other impacts; and the range and incidence of vector-borne illnesses such as Lyme disease will expand as insect vectors move north and winter temperatures increase. Changes in fall temperatures could affect the timing and vibrancy of the fall leaf colors, an important tourism feature of the region. "Southern" invasive species such as kudzu vine may expand its range northward (Frumhoff et al. 2007, Horton et al. 2014). Only a third of current national wildlife refuges in the Northeast Region will be in same biome by 2100 (Inkley 2008).

Greater winter rainfall and earlier snow melt may lead to higher flow levels and flooding during spring run-off (Hayhoe et al. 2007). In contrast, summer low-flow periods may extend impacting riparian habitats and in-stream fish, wildlife and invertebrate populations (Koch 2009). Aquatic and riparian species will need to adapt to these changes rapidly, or they may experience population declines. Replacement of some species by more southerly species is predicted. Warmer waters in Long Island Sound may exacerbate shellfish diseases, harmful algae blooms, and the duration and frequency of hypoxia and anoxia, as well as interfere with temperature-regulated fish migrations (Frumhoff et al. 2007.

If global temperatures rise as projected by high-emissions scenarios, glaciers and sea ice will melt, raising sea levels by 1 to 4 feet (Horton et al. 2007). Sea level could rise as much as 20 feet over the next few centuries if the major Greenland and West Antarctic ice sheets melt (Frumhoff et al. 2007. The extensive marshes in the lower Connecticut River are probably at risk, first from salt regime changes as the precipitation patterns change, and second, as they are submerged by rising sea levels. Many of these marshes are surrounded by suburban infrastructure or steep banks, and cannot therefore "emigrate" as might have occurred historically during periods of climatic fluctuations (Hoover et al. 2010, Pardo and Whelchel 2013, Ryan and Whelchel 2015).

Air Quality

Local air quality affects our daily lives, and like the weather changes from day to day. Polluted air can impact wildlife and vegetation; cause acidification of water; degrade habitats; accelerate weathering of buildings and other facilities; and impair visibility. Ground-level ozone and airborne particles are two air pollutants that pose a threat to human health. Emissions from industrial facilities and

electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of nitrogen oxides and volatile organic compounds, components of smog. The southern portion of the watershed supports a large urban environment that often contributes to poor air quality. Similarly, there is a constant concern for the effects of toxic air emissions on the health of wildlife and their habitats (USEPA 2012b, USFWS 2013).

General air quality trends based upon state and county Air Quality Index (AQI) information (*https://www.epa.gov/outdoor-air-quality-data/;* accessed November 2016) show that air quality has improved in the Connecticut River valley since 1980. Air quality has historically been better in the less urbanized northern half of the watershed. The number of days rated Unhealthy or Very Unhealthy by the EPA has declined significantly since 1980, the earliest date of measurements in this dataset, and have become rare in recent years (Table 3.3).

Table 3.3. Annual Number of Unhealthy or Very Unhealthy Days[1] by State Counties substantially within the Connecticut River Watershed (based upon Air Quality Index (AQI). Dashes (—) indicate no data reported for that location.

State/County	1980	1985	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Connecticut												
Hartford	32	2	6	8	2	5	1	1	1	1	0	0
Middlesex	38	17	6	11	4	6	1	3	2	2	1	0
New Haven	35	18	15	12	6	8	0	6	7	3	0	3
Massachusetts												
Franklin	5	—	—	—	—	—	—	—	—	—	0	0
Hamden	15	22	9	8	1	6	1	2	0	0	0	0
Hampshire	—	13	16	7	2	7	1	0	0	0	0	0
Vermont												
Essex	—	—	—	—	—	—	—	—	—	—	—	—
Caledonia	—	—	—	—	—	—	—	—	—	—	—	—
Orange	—	—	—	—	—	—	—	—	—	—	—	—
Windham	—	5	0	0	—	0	—	0	0	0	0	0
Windsor	0	—	—	—	—	—	—	—	—	—	—	—
New Hampshire												
Cheshire	—	3	0	0	1	0	0	0	0	0	0	1
Coos	89	6	12	2	0	0	0	0	0	0	0	0
Grafton	—	—	—	—	0	0	0	0	0	0	0	0
Sullivan	—	—	0	0	1	0	—	—	—	—	—	—

[1] *EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. Air Quality Index is an indicator of overall air quality, because it takes into account all of the criteria air pollutants measured within a geographic area. The AQI is categorized into Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, and Very Unhealthy.*

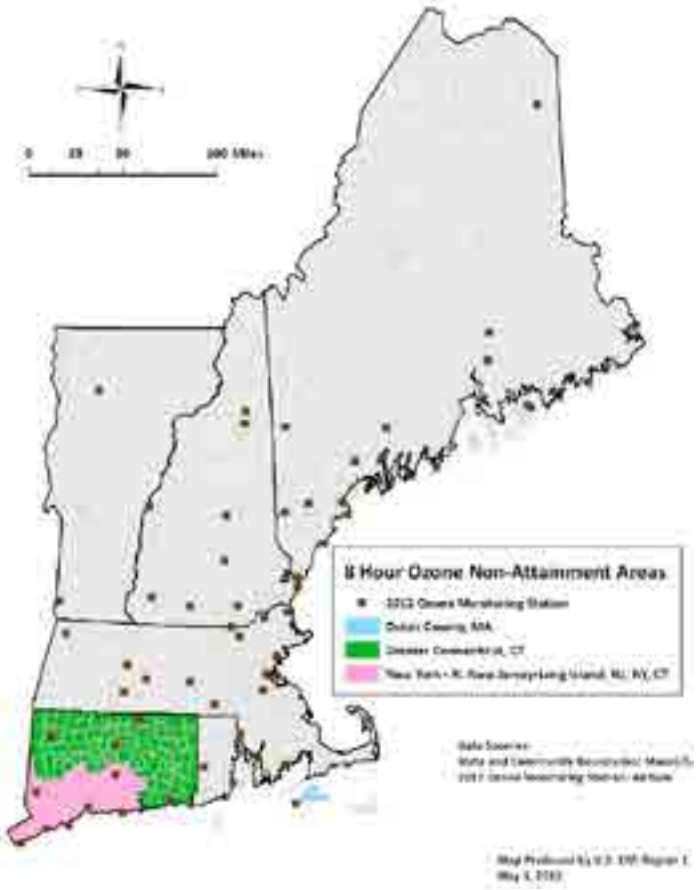
The Clean Air Act (CAA) of 1970, as amended, requires the EPA to set and regulate National Ambient Air Quality Standards (NAAQS) for six common air pollutants (42 USC Chapter 85). These six air pollutants are found all throughout the U.S., and include ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead, as well as other hazardous air pollutants, such as mercury (USEPA 2016a). Pursuant to the CAA, the Service has an affirmative responsibility to protect air quality related values on national wildlife refuges, with special emphasis on Class I Wilderness Areas (i.e., more than 5,000 acres formally designated as Wilderness prior to August, 1977). As noted earlier, there is no designated wilderness administered by the refuge; however, there are wilderness areas in the nearby White Mountain National Forest and the Green Mountain National Forest (note: the majority of these wilderness areas lie outside of the Connecticut River watershed). All other clean air regions are designated Class II areas with moderate pollution increases allowed (unless an area is redesignated by a state or Tribe).

Under the CAA, any area that violates national ambient air quality standards for any of the six criteria pollutants is designated as a "non-attainment area." Activities that emit significant levels of criteria pollutants in a non-attainment or maintenance area are subject to control, and the Service and any other Federal agency must demonstrate that their actions (e.g., prescribed burning) will not impede the state implementation plans to attain or maintain the ambient air quality standard.

In 2008, the EPA set a NAAQS for ground-level ozone at 0.075 parts per million (ppm)[1], averaged over eight hours. In New England, the states operate a network of 60 ozone monitoring stations during the ozone season (i.e., April 1 through September 30). Figure 3.1 below shows the 8-hour ozone non-attainment (failure to meet) areas for New England. The portions of Massachusetts within the Conte Refuge, and all of New Hampshire and Vermont, had met the 2008 standards as of 2012. However, all counties in Connecticut have been designated as non-attainment—marginal (USEPA 2012c). In 2015, EPA revised the primary and secondary ozone standard levels down to 0.070 ppm, averaged over eight hours (*https://www.gpo.gov/fdsys/pkg/FR-2015-10-26/pdf/2015-26594.pdf*; accessed November 2016*)*. Measurements taken from 2012-2014 indicated that the portions of Connecticut that overlap the Conte Refuge continue to be in non-attainment, as is Hampshire County, Massachusetts, which entirely overlaps the Conte Refuge. The EPA projects that most of this area, with the exception of southwestern Connecticut, will be in compliance with the revised standards by 2025 (*https://ozoneairqualitystandards.epa.gov/OAR_OAQPS/OzoneSliderApp/index.html#*; accessed November 2016*)*. States are required to develop implementation plans to attain and maintain the standards, and to specifically outline what actions they will take to meet the ozone standard (e.g., enhanced vehicle inspection programs) (USEPA 2016b).

[1] Based upon a required review of air quality standards every 5 years, EPA issued revisions to the ozone standard in 2008 to 0.075 ppm; however, EPA has not designated areas for this standard as nonattainment. In 2009, EPA announced reconsideration of 0.075 standard and is now considering ozone standards (*http://www.epa.gov/glo/actions.html*; accessed December 2014).

Figure 3.1. 8 Hour Ozone NFigure 3.1. 8 Hour Non-attainment Areas, 2012 (USEPA 2012c).



Biological Environment

The Service is legislatively authorized and entrusted to protect and manage a number of natural resources; the most prominent of these "Federal trust" resources are migratory birds, migratory or "interjurisdictional" fish, wetlands, and threatened and endangered species. These resources are protected by Federal law. National Wildlife Refuges are legislatively created and also constitute a Federal trust resource. These Federal trust resources are, in effect, the Service's legally explicit, manifest priorities. Of particular interest on Conte Refuge are those resources that were legislatively mandated in the Conte Refuge Act to be part of the refuge purposes (see chapter 1). The resources specifically mentioned in the enacting legislation are: Atlantic salmon, American shad, river herring, shortnose sturgeon, bald eagle, peregrine falcon, osprey, and American black ducks; native species of plants, fish, and wildlife and their ecosystems; endangered, threatened, and candidate species; and wetlands and other waters.

Through policy mandates, the Service is also responsible for assisting the conservation of priority State fish and wildlife resources, especially as they occur on national wildlife refuges and management is consistent with respective refuge purposes. Species of greatest conservation need (GCN) have been identified in each of the Wildlife Action Plans (WAP) for Connecticut (Connecticut Department of Environmental Protection Bureau of Natural Resources 2015), Massachusetts (Massachusetts Department of Fish and Game 2015), Vermont (Vermont Fish and Wildlife Department 2015), and New Hampshire (New

Hampshire Game and Fish Department 2015). Almost without exception, the GCN species include those already identified by the Service and are recognized by regional conservations partnerships (e.g., Joint Ventures) as a priority resources of concern. These species are also included in the *NatureServe* rankings supported by natural heritage programs. The WAPs are comprehensive and readers are directed to those individual plans for further details.

Recognizing the size of this 7.2 million-acre watershed, the biological environment of the Connecticut River Valley is extremely diverse and expansive. The wide range of habitats that occur in the watershed support approximately 140 species of fish, 60 mammals, 250 birds, 20 reptiles, 20 amphibians, 1,500 invertebrates, and more than 3,000 plants (USFWS 1995). Given these numbers, we are not able to provide an exhaustive review of the flora and fauna in the watershed. There are many sources for a more thorough discussion regarding the habitat needs and geographic distribution of mammals, birds, reptiles and amphibians, and fish and freshwater mussel species in New England.

Black-throated blue warbler

Bill Dyer

For more information on birds, refer to the *Atlas of Breeding Birds in Connecticut* (Bevier 1994), the *Atlas of Breeding Birds of Vermont* (Laughlin and Kibbe editors1985), *Atlas of Breeding Birds in New Hampshire* (1994), *Birds of Massachusetts* (Veit and Petersen 1993), *Online Breeding Bird Atlas of Massachusetts* (*http://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/breeding-bird-atlases/bba2*; accessed August 2016). Other sources include DeGraaf et al. (2005), Bevier (1994), Veit and Peterson (1993).

There are numerous sources for New England taxa, including mussels (Nedeau 2008), amphibians, reptiles, mammals, and birds (Hammerson 2004, DeGraaf and Yamasaki 2001, DeGraaf and Rudis 1986), reptiles, and amphibians (Klemens 1993, Taylor 1993). There are also plant checklists developed by the various states' natural heritage programs (e.g., Dow Cullina et al. 2011 for Massachusetts).

The remainder of this section provides a summary of the general habitat types in the watershed, and highlights the fish, wildlife, and plant species that are a priority for conservation.

General Habitat Types

Below we describe the general habitat types that occur within the watershed. These habitats types follow the Northeast Terrestrial Habitat Classification System (NETHC) developed by TNC (Gawler 2008). This classification system is also used by the NALCC. NETHC data suggests approximately 80 percent (80%) of the watershed is forested; 7 percent (7%) is in grassland, pasture, or croplands; 9 percent (9%) is developed; 4 percent (4%) is wetland (emergent, shrub-scrub or forested); 2 percent (2%) is shrub-scrub; and 2 percent (2%) is water.

The remainder of our discussion on habitat types in this section is organized under subheadings that correspond to the general habitat types addressed in our proposed management direction under each alternative in chapter 4 and in appendix A.

Steve Maslowski/USFWS.

American black bear

Forested Uplands and Wetlands

Spruce-fir/Conifer Swamp

Spruce-fir habitats are associated with cool, moist sites. These habitats are found at both low elevations and montane sites where conditions are suitable. Both occur primarily in Vermont and New Hampshire (Sperduto and Nichols 2004, Thompson and Sorenson 2000). Dominant trees include red spruce, black spruce, and balsam fir. Sites range from well or moderately well drained upland forests to poorly or very poorly drained swamps. These forests are important for several priority species including the Bicknell's thrush (montane), bay-breasted warbler (montane and lowland), and Canada lynx.

Recognition of the importance of these habitats has led multiple agencies to protect and manage this forest type. The Green Mountain National Forest in Vermont and the White Mountain National Forest in New Hampshire both contain substantial acreages of high-elevation spruce-fir habitat. Lowland spruce-fir forests are managed within the Nulhegan Basin, Blueberry Swamp, and Pondicherry Divisions of the Conte Refuge.

Hardwood Forest

Hardwood forest communities represent a large matrix community throughout the watershed. They include deciduous-dominated forests, such as northeast interior dry-mesic oak, Central Appalachian dry oak-pine, North Atlantic coastal plain dry hardwood forest, and Laurentian-Acadian northern hardwood forests, as well as mixed wood communities, such as Laurentian-Acadian pine-hemlock-hardwood, Appalachian hemlock-northern hardwood, and northeast coastal interior pine-oak forests.

Deciduous-dominated communities are often associated with moist, loamy, fertile soils and are most common below 2,500 feet elevation on gentle to steep slopes. Soil permeability, aspect, geographic area, as well as other micro and macro conditions influences the growth, abundance, and diversity of deciduous species present, thus leading to a number of sub-community types. Tree species common to this habitat are sugar and red maple, American beech, yellow and white birch, quaking aspen, and to a lesser extent basswood, white ash, and black cherry. As this community transitions into the northern extent of the central hardwood community, oak (red, white, black) and hickory (shagbark, bitternut, and pignut) become more abundant, especially on well drained soils.

Mixed-wood forests are often along transitional zones between deciduous and coniferous dominated habitats, and thus are characterized by plant species and soil properties that stem from both. Most often these are found on either gently sloping benches or plateaus or at higher elevations (2,000 to 2,500 feet), where soils are typically shallow above a restricting pan layer. Localized site conditions and past disturbance creates a considerable amount of variability in species composition. Composition in the northern portion of the Connecticut River watershed typically consists of sugar and red maple, yellow birch, red spruce, balsam fir, and aspen. Further south in the watershed red oak, red maple, eastern hemlock, and white pine become more abundant.

These forests are important for several priority species including wood thrush, American woodcock, and black-throated blue warbler. As with most large upland communities within the watershed, hardwood forests are not a resource of concern, although a variety of wildlife associated with this habitat are recognized as being in need of conservation efforts. Our understanding of the forest structure within the watershed comes exclusively from a reading of forest history in New England:a legacy of intensive past-use that altered the vegetation structure and composition, landscape patterns, and ongoing ecological dynamics (Cronon 1983; Whitney 1996; Foster *et al.* 1997; Bellemare et al. 2002; Hall *et al.* 2002). The CCP assumes the forests of the watershed are more homogeneous than those of three centuries earlier, and they include more sprouting and shade-intolerant species and fewer long-lived mature forest tree species (Foster et al. 1998; Goodburn and Lorimer 1998; Foster 2000; Cogbill 2002; Bellemare et al. 2002; Abrams 2003). Areas of the watershed also support forests with a simplified age structure where canopy layers, dead and dying trees, and down coarse woody material may be lacking. The list of threats to the health of forests is long, but the occurrence and spread of invasive species and over browsing by ungulates are common themes among the State WAPs.

Woodlands (Natural)

This habitat type includes Central Appalachian pine-oak rocky woodland, and alpine glade and woodlands–two habitats uncommon and interspersed throughout the watershed. This habitat type often occurs in isolated pockets within the larger forested landscape. It encompasses open or sparsely wooded hilltops and outcrops or rocky slopes. The vegetation is patchy, with woodland as well as open portions. Pine species are indicative and often are mixed with oak species. Some areas have a fairly well-developed heath shrub layer, others a grass layer. Conditions are dry and nutrient-poor, and many, if not most, sites have a history of fire (Gawler 2008). Woodlands are used by those species present in the surrounding forested landscape such as rufous sided towhee, ruffed grouse, pine warbler, white-throated sparrow, box turtle, white-tailed deer, and others.

Hardwood Swamps

Forested swamps occur in large and small patches within and around the larger upland formations throughout the watershed. They occur on terrain with little to no slope, in topographic depressions and sumps, and often in watershed headwater basins. Drainage is typically poor to very poor with seasonal fluctuations varying greatly in areas that stem from stream or lake flooding, and less so where ground water or surface runoff is the primary source. Soils vary from shallow to deep and can be predominately mineral, organic, or muck with occasionally a peat component (Gawler 2008). Hardwood forested swamps vary in their hydrological regimes—from wetlands having standing water for only a small part of the year, to wetlands which are quite wet and have seasonally flooded and/or saturated surfaces for a substantial part of the year.

Forested swamps provide important wildlife habitat; for example, forested wetlands tend to have more total birds as well as more bird species nesting in a given area than upland forested sites (Newton 1988).

Red maple swamps are the most common type of forested wetland in the watershed, reaching their greatest abundance in the southern part of the watershed. Red maple swamps occur in a wide range of settings and provide habitat for a large variety of wetland–dependent species including wood ducks, marbled salamanders, and beaver. Studies have demonstrated that red maple swamps constitute significant habitat for amphibians (Golet et al. 1993).

Hardwood swamps are larger and more common in the southern and central portion of the watershed. Hardwood swamps in the south are often dominated by red maple with a lesser component of swamp white oak, black and green ash, and black gum. Further north, red maple will typically continue to be the dominant

species in hardwood swamps, but species such as black ash will become more abundant and warmer climate species such as black gum and green ash less abundant to non-existent in the far northern reaches. In the northern part of the watershed, in the conifer forest region, the wetter areas support spruce–fir and northern white cedar swamps.

Pine Barrens and Maritime Forest

Pine barrens occur on sandplains such as outwash plains and stabilized sand dunes. Pitch pine is the usual dominant, and cover may range from closed-canopy forest to (more typically) open woodlands. Red oak, white pine, and gray birch are common associates. A tall-shrub layer of scrub oak and/or dwarf chinkapin oak is commonly present, although portions of some barrens (or occasionally the entire barrens) lack the scrub oak component. A well-developed low-shrub layer is typical, with lowbush blueberry, black huckleberry, and sweet fern characteristic (Gawler 2008).

USFWS

Peregrine falcon

The Montague sandplains in Massachusetts are recognized as an IBA by Mass Audubon, and consists of a 1,500-acre state wildlife management area managed by the Massachusetts Department of Fisheries and Wildlife. The Plains are an excellent example of an uncommon pine barren that supports habitat for many rare plants and animals. The Montague Plains, located on a large sand delta, formed more than 10,000 years ago when melt water streams from the retreating glaciers emptied into Lake Hitchcock. Four species of grassland birds breed there including grasshopper sparrows.

The structure and species composition within maritime forests are influenced by proximity to marine environments, and include both upland and wetlands. They are subject to salt spray, high winds, dune deposition, sand shifting and blasting, and occasional over-wash during extreme disturbance events. Species range from deciduous hardwoods to pitch pine and Virginia pine (Gawler 2008).

These habitats are uncommon in the watershed, and are being impacted by invasive species and recreational activities. Species such as the golden-winged warbler and Northern harrier use these habitats.

Shrub Swamps and Floodplain Forests

Shrub Swamps: Shrub swamps are wetlands dominated by woody shrubs. They occur throughout the watershed and are highly variable depending on climate, past disturbance, hydrology, and mineral enrichment. These habitats are typically subject to seasonal flooding and saturated soils. They are often found in transitional zones between marshes and forested wetlands, along pond and lake margins, and along rivers and streams (Gawler 2008, Thompson and Sorenson 2000). They provide habitat for a number of state and Federal resources of concern including rusty blackbird, chestnut-sided warbler, gray catbird, least flycatcher and American woodcock. Concern over degradation of the ecosystems is widely acknowledged. Changes in hydrology from development and the introduction of invasive species are two of the most significant threats.

Floodplain Forests: Annual spring high water flows in the Connecticut River valley have created a substantial number of floodplains. In the past, "bulldozing" by ice and large trees floating down river during floods produced naturally disturbed scour areas adjacent to the river channel. However, in areas without constant scouring, floodplains host rich forest habitats. Connecticut River floodplain forests are usually dominated by silver maple, Eastern cottonwood, and black willow, with an understory of ostrich fern, wood nettle, and/or false nettle. Historically, American elm was an important

constituent before eradication from Dutch elm disease. These riverside forests provide critical nursery habitats (e.g., shade, cover) for some fish and important migratory stopover habitat for many migrating songbirds including wood thrush, yellow warbler, Canada warbler, black-throated blue warbler, black-throated green warbler, black and white warbler, scarlet tanager, ovenbird, yellow-bellied sapsucker, rosebreasted grosbeak and veery (Smith College 2006). These are also important areas for wood duck and rusty blackbird during migration.

Although active flooding has limited development, many of these floodplain forests have been converted to agriculture, and others have been altered by a lack of seasonal flooding. Dams in the upper watershed have changed the flooding regime, reducing the frequency and intensity of large scouring events. Historic floodplains have been cut off by elevated railroad grades that follow the river course and/or by the dikes/levees built around urban areas (e.g., Northampton, West Springfield). Roads are commonly located adjacent to rivers/streams. In both situations, altered site hydrology is thought to negatively affect floodplain vegetation. Invasive plants pose serious threats to floodplain habitats because they often are well adapted to disturbed areas.

TNC collected data and used a number of models to look at floodplain remnants, identify the best quality remaining floodplains for conservation, and identify suitable restoration areas (Anderson et al. 2008). Additional research is underway to better understand the ecology and status of watershed floodplain forests (Marks et al. 2011).

Non-Forested Uplands and Wetlands

Rocky Outcrop

This habitat type includes the Northern Appalachian-Acadian rocky heath outcrop and Laurentian-Acadian calcareous rocky outcrop systems. These systems occur on ridges or summits of bedrock. Vegetation is often patchy; a mosaic of woodlands and open glades predominant. Species may include oaks and conifers, such as white pine and red spruce, and low heath shrubs. Exposure to the elements, bedrock type, and occasional fire are major factors in species composition and open areas (Gawler 2008).

Cliff and Talus

Cliff and talus systems occur below treeline at low to mid elevations. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places (Gawler 2008). The type of rock, microclimate, and soil availability from higher elevation sources directly and indirectly influence vegetation within these systems (Thompson et al. 2000). Rock types may include limestone, dolomite, granite, schist, slate or shale which breakdown differently in the environment providing varying levels of nutrients, moisture, ground stabilization, and soil availability. Sun exposure, aspect, elevation, and moisture provide different microclimate conditions affecting vegetation type and growth. These systems provide unique niches for rare and uncommon plants, and habitat for snakes, including the rare eastern timber rattlesnake, black rat snake and eastern garter snake. Exposed cliffs provide nesting habitat for turkey vultures, ravens, porcupines, and peregrine falcons: a refuge and state species of resource concern.

Freshwater Marshes

Freshwater marshes are open wetlands found throughout the watershed. They are dominated by herbaceous vegetation such as sedges, grasses, and cattails with little or no woody vegetation present. Soils are typically a mixture of muck, mineral, and peat and can be seasonally flooded to permanently saturated. Freshwater marshes generally have water at or above the surface throughout

the year and are further categorized through a number of factors such as surface water depth and vegetation (Gawler 2008, Thompson and Sorenson 2000).

Freshwater marshes are rich and very productive biological communities. They are identified as having high ecological and functional importance within the state wildlife action plans. Also within these plans, a common concern exists for the health and proliferation of these habitats. Development, invasive species, dredging, and sedimentation are a few of the threats that are damaging these ecosystems.

In the Connecticut River Valley, old oxbows form many of these marshes. Marshes may be shallow or deep, with water levels ranging from a few inches to several feet. Marshes support a variety of emergent plants such as cattails, grasses, and sedges. Some extremely rare plants grow in these freshwater marshes, including the federally endangered northeastern bulrush.

Peatland

The most commonly recognized peatlands are bogs and fens. These communities occur throughout the watershed in kettle holes, along pond margins, in isolated valley bottoms, and stream headwaters. They are permanently saturated wetlands that can be open or wooded. The characteristic that distinguishes these from other wetlands is the presence of peat soils. Peat is the accumulation of partially decomposed organic material, which accumulates due to water levels being at or near the surface creating anaerobic conditions that slow or halt decomposition of plant material. Bogs typically have deeper peat buildup than fens and are highly acidic and nutrient poor. Fens often receive additional water from ground discharge or inlets, which introduces varied amounts of mineral nutrients (Gawler 2008, Thompson and Sorenson 2000).

Peatlands are ecologically sensitive communities that provide habitat for several rare plant and wildlife species. These communities are recognized by most state and Federal agencies, and non-governmental conservation organizations as areas that are critically important for conservation efforts.

Bogs: Bogs are poorly drained acidic wetlands, unconnected to the water table, which form a floating mat of vegetation. Bogs vary from small floating mats along the edges of ponds to peat filled watersheds that may be as deep as 100 feet. Bogs contain unique plant communities specifically adapted to survive on few nutrients. The dominant vegetation is sphagnum moss. Other characteristic plants in bogs include tamarack, black spruce, sweet gale, orchids, and leatherleaf (TNC 1985). Due to their uniqueness and their extreme sensitivity to disturbances, bogs are given the highest priority for protection under New Hampshire State law RSA 483–A.

Fens: Fens (calcareous wetlands) are mineral rich with a hydrologic connection to the ground water table. These wetlands support a lush and diverse flora and a number of rare plants (Dowhan and Craig 1976). These calcium rich, low acidic wetlands host various orchids and sedges, particularly calcium loving species such as chestnut colored sedge. Besides protecting these wetlands, it is important to protect the surrounding aquifers as well, so that alkaline rich springs continue to flow through the calcareous wetlands.

Pasture/Hay/Grassland

In the Connecticut River watershed, pasture, hay, and grasslands are primarily the result of agricultural production activities. Although, historically there was natural grasslands in the region, most likely in major river valley and along the coast, very little natural grassland reminas today (Dettmers and Rosenberg 2000). Today, little historic natural grassland remains. Although agricultural lands are not native wildlife habitat; they can serve the needs of many species.

Forage lands or pasture, hay fields, open vegetable patches, and sod fields can be valuable to many species of birds, mammals, reptiles and amphibians. Some examples of species include Eastern American toad, Northern leopard frogs, spotted turtles, Eastern hognose snake, turkey vultures, Canada geese, horned lark, American or water pipit, Northern harrier, red-tailed hawk, American kestrel, American woodcock, mourning dove, Northern shrike, Northern rough-winged swallow, field sparrow, and Eastern meadowlark, least shrew, Eastern cottontail, Eastern pipistrelle bat, woodchuck, meadow vole, red fox, and striped skunk (DeGraf and Yamasaki 2001).

Currently, agricultural lands occupy roughly 8.5 to 12 percent (8.5-12%) of the watershed's land base, of which one-half to one-third, approximately 229,000 acres, is prime agricultural land. Most of the quality agricultural lands are in the broad Connecticut River Valley of Connecticut and Massachusetts although there is a large, agriculturally based grassland complex in northern New Hampshire. Current estimates suggest that of the overall cropped lands (approximately 229,000 acres), 69 percent (69%) is managed for forage, 6 percent (6%) in vegetable crops, and 3 percent (3%) in Christmas tree farms. The remaining includes corn, tobacco, potatoes, orchards, nurseries, sod, and "miscellaneous other" which is dominated by maple syrup production (Clay et al. 2006).

However, the amount of these habitats are currently declining in the Northeast. During European settlement millions of hectares of forests were cleared for agriculture in the eastern U.S. creating habitat for grassland dependent birds. As agricultural activities declined, open areas dominated by herbaceous vegetation began to convert back to forests, causing a drastic decline in grassland species in the region. Naturally occurring grassland ecosystems were not uncommon in the eastern U.S., but, were found closer to the coast rather than inland (Brennan et al. 2005). These grassland ecosystems have since been impacted by development and fragmentation.

Some level of grassland conservation and, where appropriate, restoration, is warranted based on the historic evidence and the desirability of retaining grassland species (often state-listed) in each state. The Partners in Flight plan for the Southern New England Physiographic region set a broad level goal of protecting 25,000 to 38,000 acres of grassland, to produce 250 breeding pairs of upland sandpipers, 800 pairs of grasshopper sparrows, and 15,000 pairs of bobolinks. In Connecticut, Connecticut Audubon recommended a 5,000-acre network of natural grasslands in patches at least 500 acres in size, 3,500-acre late harvest working hayfields (greater than 25 acre blocks), and giving priority to currently existing grasslands (Comins et al. 2005).

Considerable work has been done to identify grasslands suitable for conservation in New England. However, many potentially suitable lands, such as pastures and hayfields, are increasingly being converted into residential developments. The highest quality habitats for grassland birds in the watershed typically are in conservation areas or airports which delay mowing until the middle of July to allow the ground-nesting birds to fledge their young. The Northeast Grassland Bird Working Group is currently identifying important grassland focus areas within the watershed and for the northeast generally. Some initial work for New Hampshire illustrates four large focus areas occurring near the Connecticut River Valley. In the Massachusetts portion of the watershed there are four large functional grasslands: Westover Air Reserve Base (approximately 1,600 acres), Barnes Municipal Airport/Air Reserve Base (approximately 500 acres), Massachusetts Audubon Society's Arcadia Sanctuary (approximately 750 acres); and the Fort River farmland area where the Service purchased land that is now the Fort River Division. There are other large areas currently in row crops with grassland potential, such as the Meadows in Northampton, the Honeypot in Hadley, or the area around the Hatfield oxbow in Hadley. Smaller airports

in Turners Falls and the Orange Municipal Airport have been managed for grassland birds in the past.

The CTDEEP started a new Grasslands Habitat Conservation Initiative in 2006 aimed at conserving grassland habitat in order to protect critical nesting and breeding grounds for bird and other species (CTDEEP 2006). This initiative was selected as the first major statewide action to be addressed under Connecticut's WAP. Grasslands are a priority identified in this strategy because this habitat is important for 80 bird species in Connecticut, 13 of which are listed under the Connecticut ESA, and several mammal, amphibian, and reptile species and many invertebrate species. In support of the Grassland Habitat Conservation Initiative, the DEEP has committed $3.2 million for the acquisition of grassland habitat and has set aside an additional $4.5 million for future acquisitions.

Grasslands in New Hampshire are generally in hay fields, croplands, airports, capped landfills, and military installations. New Hampshire has over 232,000 acres (94,000 hectares) of grassland complexes at least 10 hectare in size, mostly occurring in Grafton County (20 percent (20%)) followed by Merrimack and Coos Counties (13 percent (13%) and 12 percent (12%), respectively). A number of programs exist that protect critical grasslands and farmland from development, including New Hampshire's Land and Community Heritage Investment Program (LCHIP), conservation easements through the New Hampshire Department of Agriculture, and Current Use Advisory Board within the Department of Revenue Administration, for the protection of agriculture and wildlife resources via reduced taxes. At the local level, many municipalities have passed open space bonds to help protect natural resources of local and statewide importance. At the Federal level, the NRCS administers the Farmland Protection Program through the USDA which provides funds to help purchase development rights to keep farmland in agriculture. New Hampshire Fish and Game also recognizes the importance of grassland habitats (NHFG 2006).

Old Fields, Shrublands, Young Forest

Old fields and shrublands are typically agricultural lands that are no longer in production. Young forests are generally the result of a recent forest harvest, or from natural disturbances such as, wind, ice, or fire. Beaver flowages are another way these habitats are created and probably contributed 3 to 4 percent (3-4%) to the amount of these habitat types in the Northeast historically (Gotie and Jenks 1982). Utility rights-of-way provide a relatively large and dependable amount of shrublands and early successional forest.

Vegetation may range from herbaceous dominance to a mixture of shrubs and herbaceous species, to shrub dominance. Vegetative composition is influenced by past disturbances (e.g., mowed, plowed, grazed, harvested), soil type and saturation, and seed availability. In the absence of disturbance, this upland habitat tends to be ephemeral, typically succeeding to forest.

The decline of these habitats is a consequence of historic and current land uses (Litvaitis 1993; Lorimer 2001, Trani et al. 2001, Brooks 2003). Prior to European colonization, the Northeast was predominately forested with seedling-sapling areas likely comprising only 3 percent (3%) of inland forests (Lorimer and White 2003). European settlement resulted in widespread clearing of forests for agriculture, timber, and fuelwood (Whitney 1994). Later, as more lands were settled in the Midwest, fossil fuels replaced fuelwood as the primary energy source, and better economic and social opportunities became available in the industrialized cities, the agricultural fields of the northeast were abandoned (Whitney 1994; Lorimer 2001). A period of relatively abundant grassland and shrubland habitat resulted during the early part of the 20th century (Lorimer

2001). Since that time, the amount of these habitats has generally declined, especially in southern New England.

Birds dependent on habitats such as old fields, shrublands, and young forest are experiencing steep population declines over the last decade in the Northeast (ACJV 2008). These include: American woodcock, chestnut-sided warbler, blue-winged warbler, brown thrasher, Eastern towhee, and field sparrow. Other species of conservation concern that rely on these habitats include New England cottontail and snowshoe hare, the hare being the main prey for Canada lynx, a federally listed threatened species.

Conservation of this habitat type has been identified as high priorities for conservation by the Service, state wildlife agencies, and other conservation partners. This urgency has led state, Federal, and non-governmental partners to implement a six-state collaborative shrublands restoration and protection effort. Conservation activities are already in progress, including assistance by numerous agencies and organizations to restore shrublands on private lands, and restoration on existing state and Federal secured lands, including shrubland management on existing national wildlife refuges. This partnership effort has identified a need for additional secured acreage and management capability to meet population and habitat goals.

Inland Aquatic Habitats

Open Water

Open water habitats include rivers, streams, ponds, lakes and associated transitional habitats influenced by fluctuating water levels. Diadromous and indigenous fish, freshwater mussels, mayflies, dragonflies, and amphibians rely on these communities for some stage of their life cycle. These habitats also provide foraging opportunities for other species including waterfowl, herons, egrets, mink, and otter.

Rivers and Streams: Many of the rivers and streams within the watershed are influenced by man-made dams and roads. The watershed has 38 flood risk reduction dam projects operated by the USACE, and almost 1,000 small dams on the tributaries that were built to power mills in the 1700s and 1800s. Flows, especially during low flow periods, are highly regulated and restricted by the numerous dams on the river system (Kapala and Brown 2009). Unrestricted free flowing streams, those that flow freely without restrictions from dams and roads, are considered one of 13 imperiled habitats in the State of Connecticut (Metzler and Wagner 1998). According to the Connecticut WAP, nearly all the State's streams have been influenced by dams, and the regulation of discharges and diversions. Segments of Hollenbeck River (South Canaan to Cornwall), Moore Brook (Salisbury), Eight-Mile River (East Haddam, Salem, Lyme), Moodus River (East Haddam), and Natchaug River (Eastford, Chaplin, Mansfield, Windham) provide examples of unrestricted free-flowing stream habitat (CTDEEP Bureau of Natural Resources 2005). The Fort River is the longest free-flowing tributary of the Connecticut River in Massachusetts (town of Amherst 2013). The White River in southern Vermont and several of its tributaries are free-flowing. Waterpower and flood risk reduction dams, land development and the introduction of nonnative species are affecting water temperatures, migration routes, and the structure and diversity of plant and wildlife communities.

Many fish species rely on specific river and stream habitats within the watershed. Many diadromous fish, such as American shad, blueback herring, and sea lamprey, as well as resident fishes, such as hogchoker, and mummichog use head-of-tide habitat as staging areas critical for spawning

and migration. Head-of-tide is the farthest point on a river where the tide from an ocean or bay influences water levels. There is generally a defined maximum point, but may vary due to storm, seasonal and annual precipitation, snow melt, and subsequent water flows. Tides tend to extend farther upriver during summer low-flow periods. The head-of-tide for various rivers within the watershed may be many miles upstream from the Atlantic Ocean, but concentrated toward the southern portion of its region, generally south of Hartford, Connecticut. There are few head-of-tide areas that are truly pristine, as most of these habitats are adjacent to developed urban areas *(http://library.fws.gov/pubs5/ramsar/web_link/area.htm#Salinity Distribution*; accessed August 2016).

Bill Thompson

Ruddy turnstone

Other species are sensitive to the warmer temperatures in the southern portion of the watershed. Species such as Eastern brook trout, slimy sculpin, white sucker, common shiner, longnose dace, and blacknose dace rely on cold water habitats. These streams are fed by small headwater streams, surface springs, or seeps, and flow rapidly over gravel or cobble substrate. Upland forest communities are often adjacent to the channel, where shade from the forest canopy help to maintain suitable and stable water temperatures (CTDEEP 2005).

Cold water streams are found throughout the watershed, though a higher concentration is found in the northern and central portions of the region due to higher elevations. Cold water streams are sensitive areas that are impacted by development and forest fragmentation (CTDEEP 2005).

Pond and Lakes: Ponds and lakes are large inland bodies of still water located in basins or low areas, and are often fed or drained by a river or stream. They provide habitat for a diversity of aquatic dependent species, as well as foraging habitat for birds and mammals, including osprey, bald eagles, waterfowl, herons, mink, and otter. Lakes and ponds within the watershed include those created during the glacial period, and man-made reservoirs that provide drinking water, energy production, recreational opportunities and flood risk reduction.

Coastal Non-forested Uplands

Dunes and Maritime Grasslands

These habitats include the Atlantic coastal plain northern dune and maritime grassland, and heathland and grassland. These systems occur along the coast of Connecticut, and are dominated by grasses and shrubs. The dune and maritime grassland communities are predominately herbaceous, with shrublands, resulting from succession from grasslands, occurring in limited areas. Both upland and non-flooded wetland vegetation are also included in this system. Small patches of natural woodland may also be present. Dominant ecological processes are those associated with the maritime environment, including frequent salt spray, saltwater overwash, and sand movement (Gawler 2008).

The coastal plain healthland and grassland communities may occur as heathlands, grasslands, or support a patchwork of grass and shrub vegetation. This system is related to dune grasslands but occurs on sandplains, not dunes, and lacks significant amounts of American beachgrass. In the absence of

disturbance (fire, grazing, mowing), coverage by pitch pine and scrub oak can increase, creating vegetation similar to a pitch pine-scrub oak barren; or in some cases, a tall-shrub community can develop in the absence of fire (Gawler 2008).

Coastal dune communities are fragile habitats that support priority species in need of protection from human development and disturbances. Barrier beaches protect salt marsh from storms and provide nesting and feeding habitat for piping plovers, least terns, and American oystercatchers. The most challenging issues facing dune habitat are recreational activities, oil spills, and rising sea level resulting from climate change.

Rocky Coast and Islands

This system encompasses coastal non-forested uplands in the watershed, and can be found at the mouth of the Connecticut River, and inland as far as the Whalebone Cove CFA in Connecticut. It is often a narrow zone between the high tide line and the upland forest; this zone becomes wider with increasing maritime influence. The substrate is rock, sometimes with a shallow soil layer, and tree growth is prevented by extreme exposure to wind, salt spray, and fog. Slope varies from flat rock to cliffs. Cover is patchy shrubs, dwarf-shrubs and sparse non-woody vegetation, sometimes with a few stunted trees (Gawler 2008).

Coastal Wetlands and Aquatic Habitats

Salt marsh

The name Connecticut is the French corruption of the Algonquin word quinetucket and means *long tidal river*. The second largest group of wetlands in the watershed is estuarine wetlands or tidal wetlands which are located in the lower part of the main stem of the Connecticut River. Estuarine wetlands are influenced by both tidal and freshwater flows. The lower part of the Connecticut River is considered the most pristine large river tidal marsh system in the Northeast (USFWS 1994). The wetlands at the mouth of the Connecticut River are intertidal marshes vegetated by grasses such as smooth cordgrass, saltmeadow cordgrass or hay grass, salt or spike grass, saltmeadow rush or black grass, and other salt tolerant plants. Salt marshes are among the most productive ecosystems in the world.

Further upstream, the Connecticut River has extensive, high-quality freshwater and brackish tidal wetland systems which provide habitat for several federally listed species, species at risk and globally rare species, including wintering bald eagles, shortnose sturgeon, and Puritan tiger beetles. This area also provides significant American black duck habitat for breeding, wintering, and migration. It serves as an important movement corridor for migratory birds, especially waterfowl, rails, many species of neotropical migrants, and raptors. Within this group of wetlands, wild rice marshes are considered rare and valuable and function as significant resting and feeding areas for waterfowl, shorebirds, and especially the sora rail.

The lower Connecticut River tidal wetlands complex has been designated a Wetland of International Importance by the multi-national Convention on Wetlands of International Importance (aka Ramsar Convention). The Ramsar project area contains 20,570 acres and consists of 20 discrete major wetland complexes (USFWS 1994). The Ramsar designation is used for wetland complexes that have international significance in terms of ecology, botany, zoology, limnology, or hydrology. The lower Connecticut River tidal wetlands complex is considered the best example of this type in the northeastern U.S.

Tidal wetlands provide foraging habitat for a variety of shorebirds, including willet, various species of sandpipers, ruddy turnstone, red knot, and whimbrel. These wetlands also support migrating and wintering waterfowl, various marsh birds, sparrows, bald eagles and osprey. Its tidal marshes and mudflats support significant concentrations of waterfowl and shorebirds, as well as nesting habitat for globally significant species such as the salt marsh sharp-tailed sparrow (ACJV 2005). This habitat is also important as nursery areas for a variety of aquatic species.

Plant Communities
Many different plant communities exist in the watershed, including common types of wetlands, forests, and grasslands, as well as a number of rare communities. There are roughly 3,000 plant species in the watershed. There are many rare natural plant communities that are tracked by the state natural heritage programs. Wetland plant communities are diverse and widely occurring. Upland forests are the dominant land cover type and are increasing as abandoned agricultural lands revert to forest cover. A number of non-forested, or open plant communities occur in the watershed such as grasslands, shrublands, and unique or rare uplands types.

Natural communities were used as the basis for the habitat types discussed below. Natural communities are defined as recurring assemblages of interacting plants, animals, their physical environment, and the natural processes that affect them (Sperduto and Nichols 2004, Thompson and Sorenson 2000).

Wetland Plant Communities
Restoring and maintaining the integrity of wetlands and other waters is one of the purposes in the Conte Refuge Act. The watershed contains many diverse types of wetlands whose plant and soil characteristics reflect the geomorphology and hydrology of the area. Descriptions of wetlands, in general, are grouped into easily recognized types: coastal/tidal (estuarine); rivers and streams (riverine); lakes and large ponds (lacustrine); and vegetated freshwater wetlands (palustrine). Each of these types contains a number of subtypes.

According to the Service's National Wetlands Inventory (NWI), the watershed contains approximatley 320,000 acres of wetlands (table 3.4), which represents 4.5 percent (4.5%) of the land in the watershed (USFWS 2016). The NWI figures should be considered conservative (i.e. more likely to overcount wetlands than undercount them) because mapping followed a standardized, nationwide process. NWI maps do not identify farmed wetlands, except cranberry bogs.

Table 3.4. Estimated Amount of Wetlands in Connecticut River Watershed by State.

State	Acres of Wetland Type in Each State within the Connecticut River watershed				Total Wetland Acres in watersheds for Each State
	Palustrine Wetlands	Lacustrine Wetlands	Riverine Wetlands	Estuarine Wetlands	
Connecticut	60,932	1,304	658	2,733	65,627
Massachusetts	109,202	2,466	2,730	0	114,398
Vermont	65,434	299	1,392	0	67,125
New Hampshire	66,097	481	6,925	0	73,503
Wetland Type Totals	301,665	4,550	11,705	2,733	320,653

Trends in Wetlands Plant Communities

Unfortunately, significant portion of the wetlands in the watershed have already been destroyed or degraded. Although the conversion and loss rates have been reduced due to the increased effectiveness of state and Federal regulations, incremental losses continue to occur due to exempted filling and those permits which are granted under the Section 404 provisions of the Federal Clean Water Act. Some states also regulate activities affecting wetlands that are not covered by the Clean Water Act, Section 404 program. A net loss of wetlands in both quantity and functional quality is anticipated to continue, although at lower rates than occurred historically.

Connecticut: Palustrine wetlands are by far the most common wetland type in the State, followed by estuarine wetlands; together, they constitute about 99 percent (99%), by area, of the State's wetlands. The combined area of lacustrine and riverine wetlands makes up the remaining 1 percent of wetland acreage. Palustrine forested wetlands constitute 54 percent (54%) of the State's wetlands and consist primarily of red maple swamps with some evergreen forested wetlands (Metzler and Tiner 1992, USGS 1996).

Although Connecticut has a strong wetland regulatory program, experts estimated that 1,200 to 1,500 acres of inland wetland will be filled each year. Commercial development and highway/road construction are the most significant causes of wetland loss. Also, there are losses due to golf courses and home construction. Another serious threat to wetlands is the discharge of materials (i.e., direct discharges of industrial and municipal waste and indirect discharges of urban and agricultural runoff) into waters and wetlands which degrades water quality and functional value for wildlife habitat. The most threatened wetlands are located close to urban areas. Large acreage of floodplain wetlands have been filled and/or diked for industrial and commercial development along the Connecticut River in Hartford and East Hartford. With a substantial increase in development activity and land values, impacts to wetlands are not likely to decrease in the near future. (USGS 1996, Metzler and Tiner 1992).

There is some disagreement on the original acreage of wetlands within Connecticut. Some estimate that the state has lost 74 percent (74%) of its original wetlands, while others believe losses in the range of 30 to 50 percent (30-50%) are more realistic. The CTDEEP estimates losses of 40 to 50 percent (40-50%) for freshwater wetlands and 65 percent (65%) for coastal wetlands (Metzler and Tiner 1992, USGS 1996).

Tiner et al. (1989) completed a wetland trend analysis for central Connecticut comparing 1980 aerial photos with 1985 to 1986 photos. The study area covered 780 square miles and contained 28,177 acres of wetland (6 percent (6%) of the area). Vegetated wetlands were the most abundant type (91 percent (91%)). A total of 117 acres of vegetated wetlands were converted to non-wetlands and 28 acres were made into ponds. Palustrine emergent wetlands (59 acres) and forested wetlands (53 acres) experienced the biggest losses.

In 2013 the U.S. Fish and Wildlife Service updated and enhanced the 1980s inventory and completed an assessment of wetland trends between 1990 and 2010. The method of analysis was a comparison of digital imagery covering the entire state, from 1990 and from 2010. (Tiner et al. 2013). The researchers concluded that between 1990 and 2010, Connecticut experienced a net gain of 425 acres in wetlands, due to pond construction across the state. Despite this gain, the state had a net loss of 273 acres

of freshwater vegetated wetlands plus a net loss of about 28 acres of estuarine wetlands. The new ponds are artificial or created wetlands, while marshes, swamps, and bogs are natural wetlands that developed over the past 12,000 years. Forested wetlands experienced the heaviest losses with roughly 314 acres converted to other wetlands (201 acres) or nonwetland (113 acres). Residential development was the most common source of loss of forested wetlands.

River otter

John White /USFWS

Massachusetts: Historically, Massachusetts wetlands may have extended across as much as 16.5 percent (16.5%) of the state. This estimate is based on an estimate of hydric (wet) soils, which can persist after wetland vegetation is lost. The NWI estimate of Massachusetts wetlands as shown in Table 3.4 above comprises only about 2 percent (2%) of the state. This implies that Massachusetts has lost a large majority of its original wetlands. Palustrine wetlands are the most common wetland type in the State, followed by estuarine and marine wetlands; all together, they constitute about 99 percent (99%), by area, of the State's wetlands. The combined area of lacustrine and riverine wetlands makes up the remaining less than 1 percent (1%) of wetland acreage.

A 1978 U.S. Soil Conservation Service (now National Resources Conservation Service) report estimated an annual statewide wetland loss rate of 0.4 percent (0.4%; lower than the U.S. average loss rate of 0.5 to 1.0 percent (0.5-1.0%) in the mid 1970s). In recent years the rate of loss has slowed dramatically. The 0.4% loss rate from 1978, applied conservatively to the existing acreage, would imply a loss of hundreds of acres of wetlands annually. Instead, approximately 1,250 acres of wetlands were lost or altered between 1991 and 2005 *(http://www.mass.gov/eea/agencies/massdep/water/watersheds/wetlands-loss-maps-qa.html*, accessed November 2016).

Vermont: Recent estimates of the area covered by wetlands in Vermont range from 4 to 6 percent (4-6%) of the State's total area. Many of the State's wetlands are small; about 80 percent are less than 10 acres. The largest wetlands are in the broad valleys of northeastern Vermont and in the flood plains and deltas of rivers that discharge into Lake Champlain. In the Connecticut River Valley, timber harvesting and the clearing and draining of wetlands for crops and grazing resulted in the degradation or loss of many wetlands during the 1800s and early 1900s. Prior to 1990, annual wetland losses were approximately 200 acres (USGS 1996, VT DFPR 2012*)*. Since 1995, the rate of regulated wetland loss in Vermont has been 20 acres

annually. In addition, there is likely a similar amount of unregulated wetlands that are lost each year (*http://vnrc.org/programs/water/wetlands/*, accessed November 2016).

Overall, the state has lost as much as 35 percent (35%) of its original wetland acreage. Approximately half of the wetlands lost have been palustrine emergent marshes. In Vermont, road construction, residential and commercial development, as well as the draining of wetlands for agricultural production, account for the majority of the loss. (Parsons 1988, VT DFPR 2012, USGS 1996). *New Hampshire:* The New Hampshire Wetlands Priority Conservation Plan (State of New Hampshire Office of State Planning 1989) lists agriculture as the major cause of freshwater wetland losses. Development in and near wetlands due to urbanization is also a major cause of wetland loss and degradation (USGS 1996). Wetlands have been drained for timber cutting, and ditched and drained for hay, grain, forage, and vegetable crops. Inland wetlands have been lost to road and highway construction, building construction, and peat and mineral/gravel mining. Moreover, the quality of many existing wetlands has been reduced by adverse environmental impacts, developmental pressures, and improper land use management practices (State of New Hampshire Office of State Planning 1989, USGS 1996).

A study of New Hampshire's wetlands from 1997 to 2012 shows a decline in the average acreage of wetlands lost annually. From 2007 to 2012, losses averaged 59 acres per year. This compares to an average wetland lost of 111 acres for the period 1997-2007. The cumulative loss recorded from 1997-2012 is just over 1,600 acres from projects permitted by the State. During this same time period, more than 28,000 acres of wetlands and upland habitat have been protected through wetland mitigation and conservation.

Special Designation Areas

Refuge lands often have areas subject to special management. Special management status may arise from legislation, administrative decision making, or the actions of other agencies and organizations. The influence that special designations have on the management of refuge lands and waters varies considerably. Authority for designation of some special management area types (e.g., Research Natural Areas) on refuges lies solely with the Service. Wilderness designations are passed only by Congress (USFWS 2013b).

Wilderness Areas

Wilderness is set aside by Congress to be part of the NWPS. There are over 109 million acres of wilderness across the U.S. managed by several agencies: National Park Service, Bureau of Land Management, Forest Service, and Fish and Wildlife Service. The Service manages over 20 million acres of wilderness. Generally, this designation means that special rules direct management to maintain or achieve an area's wilderness character. For example, motorized and mechanized equipment for transport, management, or recreation are not allowed. The Wilderness Act of 1964 defines wilderness in this way: "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain .... retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and generally appears to have been affected primarily by the forces of nature, with the imprint of mans work substantially unnoticeable … has outstanding opportunities for solitude or a primitive and unconfined type of recreation; … is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and may also contain ecological, geological, or other features of scientific, educational, scenic,

or historical value. The refuge does not, to date, include any areas designated as wilderness. The White Mountain National Forest contains approximately 148,000 acres of congressionally designated wilderness, and the Green Mountain National Forest includes about 58,600 acres of designated wilderness. However, much of these wilderness areas are outside of the Connecticut River watershed.

Wetlands of International Importance
The lower Connecticut River tidal wetlands complex has been designated a Wetland of International Importance by the Convention on Wetlands of International Importance (Ramsar Convention of 1971). The Ramsar project area contains 20,570 acres and consists of 20 discrete major wetland complexes (USFWS 1994). The Ramsar designation is used for wetland complexes that have international significance in terms of ecology, botany, zoology, limnology, or hydrology. The lower Connecticut River tidal wetlands complex is considered the best example of this type anywhere in the northeastern U.S.

Wild and Scenic Rivers
The Wild and Scenic Rivers Act, October 2, 1968, stated that: "It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Congress declares that the established national policy of dams and other construction at appropriate sections of the rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes."

Protection of a designated river is provided through voluntary stewardship by landowners and river users and through regulation and programs of Federal, state, local, or tribal governments. Not all land within boundaries is, or will be, publicly owned, and the Act limits how much land the Federal government is allowed to acquire. The Act purposefully strives to balance dam and other construction at appropriate sections of rivers with permanent protection for some of the countries most outstanding free-flowing rivers. For example, it prohibits Federal support for actions such as the construction of dams or other instream activities. Designation neither prohibits development nor gives the Federal government control over private property. The act specifically:

- Prohibits dams and other federally assisted water resources projects that would adversely affect river values.
- Protects outstanding natural, cultural, or recreational values.
- Ensures water quality is maintained.
- Requires the creation of a comprehensive river management plan that addresses resource protection, development of lands and facilities, user capacities, and other management practices necessary to achieve purposes of the act as of 2012.

The NWSRS protects 12,709 miles of 208 rivers in 40 states and the Commonwealth of Puerto Rico; this is a little more than one quarter of one percent (1%) of the nation's rivers (*http://www.rivers.gov/national-system.php*; accessed August 2016). Connecticut River tributaries have been designated under the act: 14 miles of the West Branch of the Farmington River in Connecticut;

25.3 miles of the Eightmile River in Connecticut, and 78 miles of the Westfield River in Massachusetts (NWSRS 2013). In recent years, local partners have been controlling invasive plants along these stretches. A study has been completed for the Lower Farmington and Salmon Brook system in Connecticut recommending its designation.

Research Natural Areas
The Service administratively designates Research Natural Areas (RNAs) on refuges. RNAs are part of a national network of reserved areas under various ownerships, often the Forest Service, National Park Service, Bureau of Land Management, and Fish and Wildlife Service. Research natural areas are intended to represent the full array of North American ecosystems with their biological communities, habitats, natural phenomena, and geological and hydrological formations. In research natural areas, as in designated wilderness, natural processes are allowed to predominate without human intervention. Under certain circumstances, deliberate manipulation may be used to maintain the unique features for which the research natural area was established. Activities such as hiking, bird watching, hunting, fishing, wildlife observation, and photography are permissible, but not mandated. Research natural areas may be closed to all public use if such use is determined to be incompatible with primary refuge purposes (USFWS 2013b).

There are no RNAs on the refuge. The nearby White Mountain National Forest contains 1,995 acres in three RNA units, all of which are outside of the watershed: Alpine Gardens (tundra), Nancy Brook (old growth spruce-fir), and The Bowl (old-growth spruce-hardwood). The Green Mountain National Forest contains one 290-acre unit known as the Cape (mesic northern hardwood) (USDA 2012).

National Natural Landmarks
The National Natural Landmarks (NNL) Program recognizes and encourages the conservation of outstanding examples of our countries natural history. It is the only natural areas program of national scope that identifies and recognizes the best examples of biological and geological features in both public and private ownership.

NNLs are designated by the Secretary of the Interior, with the owners concurrence. To date, nearly 600 sites have been designated. The National Park Service administers the program, and if requested, assists with the conservation of these important sites. There are 14 designated landmarks in or intersecting the watershed; 5 in New Hampshire, 2 in Vermont; 3 in Massachusetts, and 4 in Connecticut. Two NNLs occur on the refuge. The Pondicherry NNL, lies entirely within the refuge's Pondicherry Division in New Hampshire. We propose a 694-acre expansion to the existing 304-acre Pondicherry NNL (see the "Actions Common to All Alternatives" section in chapter 4). The Fannie Stebbins NNL at 505 acres, overlays the refuge's 98-acre Fannie Stebbins Unit in Massachusetts.

National Trails
The National Trails System Act (P.L. 90-543, as amended through P.L. 109-418, December 21, 2006) was passed: "In order to provide for the ever-increasing outdoor recreation needs of an expanding population and in order to promote the preservation of, public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas and historic resources of the Nation, trails should be established primarily, near the urban areas of the Nation, and secondarily, within scenic areas and along historic travel routes of the Nation which are often more remotely located. The purpose of this Act is to provide the means for attaining these objectives by instituting a national system of recreation, scenic and historic trails, by designating the Appalachian Trail and the Pacific Crest Trail as the initial components of that system, and by prescribing the methods by

which, and standards according to which, additional components may be added to the system." The Appalachian Trail is a National Trail that passes through the watershed. The Little Cherry Pond and Mud Pond trails on the refuge's Pondicherry Division were established as a National Recreational Trail in 2006 and 2013, respectively. The Little Cherry Pond Trail is a one-mile loop that winds through six different forest communities with a view of the pond from its shore. The Mud Pond Trail is a 0.6-mile universally accessible trail with 900 feet of raised boardwalk and rest stops that offer views of the boreal forest and wetland communities. Visitors walk through a forest to a beautiful pond and a boreal forest fen where three carnivorous plant species reside.

Important Bird Areas
The IBA of the National Audubon Society is a global effort to identify and conserve areas that are vital to birds and other biodiversity. By working with Audubon chapters, landowners, public agencies, community groups, and other non-profits, National Audubon endeavors to interest and activate a broad network of supporters to ensure that all IBAs are properly managed and conserved (Audubon 2013). IBAs are sites that provide essential habitat for one or more species of bird. IBAs include sites for breeding, wintering, and/or migration. IBAs may be a few acres or thousands of acres, but usually are discrete sites that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected.

To qualify as an IBA, sites must satisfy at least one of the following:

(1) Species of conservation concern (e.g., threatened and endangered species).

(2) Species with restricted ranges (i.e., species vulnerable because they are not widely distributed).

(3) Species that are vulnerable because their populations are concentrated in one general habitat type or biome.

(4) Species, or groups of similar species (such as waterfowl or shorebirds), that are vulnerable because they occur at high densities due to their tendency to congregate (Audubon 2013).

There are 11 recognized IBAs areas in the Connecticut River watershed. More information on each IBA can be found at each state's Audubon website (*http://nhbirdrecords.org/bird-conservation/nh-iba-program/about-new-hampshires-important-bird-area-iba-program/*; *http://ct.audubon.org/conservation/important-bird-areas; http://vt.audubon.org/conservation/important-bird-areas-vermont; http://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites, all accessed August 2016*).

(1) Pondicherry Basin IBA, which includes the Pondicherry Division, is a low elevation wetland complex featuring black spruce, tamarack, balsam fir, balsam poplar, red maple and a variety of wetland plant communities. The IBA supports populations of species such as Rusty Blackbird, Yellow-bellied Flycatcher, Lincoln's Sparrow, and several warblers. Emergent wetlands provide habitat for Virginia rail, American bittern, and the occasional sora or pied-billed grebe. Other forest types at higher elevations support hardwood species like veery and early successional species like American woodcock and chestnut-sided warbler. Extensive grasslands associated with an airport within the IBA boundary are used by bobolinks and northern harriers. The area is also home to seven species of breeding waterfowl, and as such is one of the more diverse assemblages of this group in New Hampshire.

(2) The Lower Connecticut Valley IBA stretches from the northern Massachusetts border up river to the vicinity of Claremont, New Hampshire. This area is used by a wide variety of waterfowl in migration and winter and supports nesting pairs of bald eagles. Important habitats include floodplain forests, emergent wetlands, and agricultural fields. The IBA boundary is defined as roughly 200 feet above the average river level, which covers an area roughly corresponding to the lower river terrace.

(3) The Northwest Park IBA in Windsor, Connecticut, is located along the Farmington River and has successional habitat with forest, wetland, shrub, and fields. Of the 128 bird species recorded, 59 are considered high-conservation priorities. The majority of these are associated with actively managed early successional forest, grasslands, and shublands, including the State-endangered grasshopper sparrow (Davison 2007).

(4) The Station 43 Marsh IBA in South Windsor, Connecticut, consists of a pond and associated fresh water wetland complex. It is situated in the Connecticut River floodplain in a large undeveloped block of several thousand acres of farmland, shrubland and floodplain forest on both sides of the river. Over 200 bird species have been recorded on the IBA with 9 of those listed as State-endangered, 7 as State-threatened, and 10 of special concern (Morrison 2006).

(5) Herricks Cove IBA consists of two parcels of about equal size in the town of Rockingham, Vermont. Herricks Cove is located where the Williams River enters the Connecticut River north of Bellows Falls. It consists primarily of agricultural lands bordered by wetlands to the west and floodplain forest to the south. The location along the Connecticut River and the diversity of habitats make this IBA ideal stopover habitat for migrating birds. At least 221 species have been recorded there including several priority marsh birds (e.g., pied-billed grebe, American bittern, sora, and Virginia rails) (*http://netapp.audubon.org/iba/Reports/1754*; accessed August 2016).

(6) The Nulhegan Basin IBA is Vermont's largest IBA comprising a mosaic of forest and wetland habitat types. The predominance of boreal habitats is typical of forest found further to the north and as such supports a number of species rarely found in Vermont. The largest population of the State-endangered spruce grouse is found in the IBA. The common loon, another State endangered species inhabits several ponds. Other State priority species include the gray jay, boreal chickadee, black-backed woodpecker, Cape May, bay-breasted, palm, and Tennessee warblers (*http://netapp.audubon.org/iba/Reports/1780*; accessed August 2016).

(7) Barton Cove-Poet's Seat IBA in Gill and Greenfield, Massachusetts includes the large impoundment of the Connecticut River main stem behind the Turners Falls dam and a wooded ridge on the west side of the river. Bald eagle pairs have been present during nesting season since 1989, with several successful

Atlantic sturgeon

Duane Raver/USFWS

nestings. The cove is an important feature for waterfowl including ducks, loons, and grebes. The Rocky Mountain Ridge (e.g. Poet's Seat area) in Greenfield, Massachusetts, is important for breeding and wintering birds.

(8) The Mount Holyoke/Mount Tom/East Mountain Range IBA in Amherst, Granby, and South Hadley (Amherst, Belchertown, Easthampton, Granby, Hadley, Holyoke, South Hadley, West Springfield, Westfield) is a forested area near the main stem, and includes the Mount Tom Unit of the refuge. It is primarily oak-conifer forest with lesser amounts of northern hardwoods, pitch pine/scrub oak, shrubland, grassland, and wetlands. This area is prime migratory habitat and supports nesting peregrine falcons. The ranges are a migration route for large concentrations of broad-winged, sharp-shinned and Coopers hawks, and American kestrel, as well as several other species including the northern goshawk, red-shouldered hawk, merlin, peregrine falcon, osprey, and bald eagle. It is also an important nesting habitat for many important species including the whip-poor-will, Louisiana waterthrush, worm-eating, black-and-white, blackburnian, black-throated blue, and cerulean warblers.

(9) Longmeadow Flats IBA is a floodplain area along the main stem of the river in Longmeadow, Massachusetts, ownership is divided among the Fannie Stebbins Wildlife Refuge, the town of Longmeadow, and private landowners. At least eight State-endangered, threatened, or special concern species use this site on a regular basis including peregrine falcons, bald eagles, American and least bitterns, blackpoll warblers, Northern parula, and pied-billed grebes.

(10) Montague Sandplains IBA is a pitch pine/scrub oak area in Montague, Massachusetts, owned by the Massachusetts Division of Fisheries and Wildlife and the town of Montague . The sandplains support State-threatened vesper and grasshopper sparrows, as well as numerous other important bird species.

(11) The Quabbin River watershed IBA is in the area surrounding the Quabbin Reservoir in several towns. It is a large reservoir that hosts wintering bald eagles, surrounded by thousands of acres of watershed forests managed by the Massachusetts Department of Conservation and Recreation. Three State-listed species are documented breeders: common loon, bald eagle, and pied-billed grebe. Thirty-five Partners in Flight priority bird species have been documented as breeding in this IBA including several forest-interior and early successional species.

American Heritage River
The entire 410-mile length of the Connecticut River is designated an American Heritage River. It stands at the heart of this regions human settlement and commerce; at the core of its history and culture; and represents the essence of its environmental quality and economic vitality. The American Heritage Rivers is an innovative non-regulatory partnership-based initiative designed to help river communities that seek Federal assistance and other resources to meet some tough challenges.

The Federal role is solely to support community-based efforts to preserve, protect, and restore these rivers and their communities. Without any new regulations on private property owners, state, local and tribal governments, the American Heritage Rivers initiative is about making more efficient and effective use of existing Federal resources, cutting red-tape, and lending a helping hand.

Federally Endangered, Threatened, and Proposed Species
Twenty-two federally listed endangered, threatened, or proposed species occur within the watershed. A brief description of each follows.

Canada Lynx —Threatened: Lynx were historically found from Alaska to the Canadian Maritime Provinces, extending south in the Rocky Mountains, around the Great Lakes, and into New England. Today the species is secure in Alaska and Canada, but imperiled or extirpated in the continental United States. Lynx occur in boreal and montane landscapes dominated by coniferous or mixed forest with thick undergrowth interspersed with more open habitats and young forests that support their principal prey, snowshoe hare.

Lynx are relatively rare in the contiguous U.S. because of habitats that are inherently unable to support cyclic, high-density snowshoe hare populations and are thus unable to sustain cyclic lynx populations (USFWS 2009). The principal factor affecting softwood forest types favored by lynx is timber harvest on non-Federal lands, however the influence of current forest practices on lynx is not known.

Lynx have been confirmed breeding in northeastern Vermont and New Hampshire. A family group was detected in the winters of 2012 and 2013 within the refuge's Nulhegan Basin Division. Lynx may also use habitats within the refuge's Pondicherry and Blueberry Swamp Divisions, though evidence of lynx at these divisions has not been detected. The Upper Connecticut River Valley is included as a peripheral recovery area in the Recovery Outline for this species, an interim document in advance of a Recovery Plan (USFWS 2005).

Piping plover — Threatened: The piping plover is a threatened shorebird which breeds along the sandy coastal beaches of eastern North America. Historically, it was severely reduced in numbers by hunting, although now the major threats are habitat degradation, human or human-related disturbances during the nesting season, and nest predation (USFWS 1996). The only suitable habitat for this species within the watershed is a one-mile long sand spit at the mouth of the Connecticut River known as Griswold Point. Owned by TNC, this beach provides nesting habitat for several nesting pairs.

Piping plovers also breed in several other nearby areas along the Long Island Sound in Connecticut, including the Stewart B. McKinney Refuge, but these areas are outside of the Connecticut River watershed. Over the last decade, up to two breeding pairs have attempted nesting at the Milford Point Unit of the Stewart B. McKinney Refuge, with very limited success (Long Island Sound Study 2011; *http://longislandsoundstudy.net/wp-content/uploads/2010/07/From-the-Shore-111.pdf*; accessed August 2016).

Atlantic sturgeon — Endangered: In 2012, five distinct population segments of Atlantic sturgeon were listed as either threatened or endangered under the ESA: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic distinct population segments (NOAA 2014). Atlantic sturgeons living in the Connecticut River are part of the New York Bight distinct population segment and are listed as endangered (77 FR 5880, 2/16/2012). According to the Connecticut River Coordinator's program, the Connecticut River population is considered extirpated. Currently, only a small amount of migrating individuals are found in the mouth of the Connecticut River and, therefore, it is likely no spawning activity is occurring in the river (CRCO 2010).

The Atlantic sturgeon is an anadromous fish, meaning they spend part of their lives in saltwater and part in freshwater (NOAA Fisheries 2012). Adult Atlantic sturgeons spawn in large, deep freshwater rivers. For spawning, they require clean, cold, moderately flowing water. Juvenile and non-spawning adults live in shallow, nearshore coastal waters, and estuaries.

The major historical threat to Atlantic sturgeons was overharvest, but in 1998 the Atlantic States Marine Fisheries Commission (ASMFC) put in place a coast-wide moratorium on Atlantic sturgeon harvest. Current threats include "by-catch"

from commercial fisheries targeting other species, habitat degradation from dredging, dams, water withdrawals, and development; ship strikes; and barriers to movement, including locks and dams (NOAA Fisheries 2012). ASMFC's Atlantic Sturgeon Fishery Management Plan and its amendments outline measures to help preserve existing sturgeon habitat, restore and improve degraded habitat, and monitor by-catch and species recovery (ASMFC 1998). The plan also describes protocols for breeding and stocking captive-reared sturgeon.

Shortnose sturgeon — Endangered: The shortnose sturgeon was first listed as endangered in 1967. The National Marine Fisheries Service (NOAA Fisheries) published a shortnose sturgeon recovery plan in 1998. Although it has disappeared from some rivers, it is still found in many rivers from Florida to New Brunswick. The Connecticut River population is considered one of 19 separate distinct population segments of this species in need of recovery.

Although it inhabits the Connecticut River from Turners Falls, Massachusetts, to Long Island Sound, the Holyoke dam separates the shortnose sturgeon into two populations. The total upriver population estimates ranged from 297 to 714 adult sturgeon (with less than 100 of those spawning in a given year), while the downriver population (which cannot reach the upstream spawning area) was estimated at around 875 adults. Recent evidence indicates that no successful reproduction occurs in the population below the Holyoke dam. This downstream population is sustained by the influx of out-migrating sturgeon from the upstream group. Spawning in the Connecticut occurs from the last week of April to mid-May, as the spring flows wane, in specific rubble/boulder substrate. Not all females spawn every year, and a percentage of adult females with tumors are unable to spawn (B. Kynard, pers. obs.). Breeding adults migrate north to their spawning grounds in the fall and stay there until spring. Most fish stay in freshwater all year, concentrating in decreased flow areas where they seek out freshwater mussels, a major prey item. Shortnose sturgeons forage day and night, and have a summer home range of about 10 kilometers. They overwinter in deep holes, usually within their summer range. Some adults from the downriver population spend several weeks in low salinity river reaches below Hartford in May and June, presumably feeding, and then return to the fresher upriver areas (NOAA 1998, NMFS 1998). The primary impediment to sturgeon recovery is the presence of dams that obstruct migration and modify the historic flow regimes that cued the fish to spawning at appropriate times and places. There is also mortality associated with accidental by-catch by fishermen (NOAA 1998).

Dwarf wedgemussel—Endangered: This freshwater mussel is an inhabitant of muddy sand, and sand or gravel bottoms of rivers and streams. It once occurred throughout the Atlantic coastal plain from North Carolina to New Brunswick, but has been lost from a majority of known sites. Primary threats include habitat loss and habitat fragmentation, and altered natural river processes; specifically, these threats include loss of riparian buffers, loss of floodplains, altered channel processes and sediment transport, altered hydrology, bank erosion, and dams. Pollutants from industrial and agricultural activities and other sources substantially impact mussel populations which are sensitive to pesticides, chlorine, potassium, zinc, copper, and cadmium (Nedeau 2009, USFWS 1993a).

This mussel once occurred along much of the Connecticut River and many of its tributaries, but is no longer found in the main stem in Connecticut and Massachusetts (USFWS 1993a). The species was rediscovered in the upper Connecticut River in 1995, including 68 sites in the main stem and 77 sites in tributaries. It occurs along a 16-mile main stem reach of the river between Orford and Haverhill (New Hampshire) in an area referred to as the Middle Macrosite, and along a 21-mile reach from Dalton to Northumberland (New Hampshire) in an area referred to as the Northern Macrosite (Nedeau 2009).

Small populations also exist in the Farmington River in the vicinity of Simsbury; Fort River, Mill River near Northampton, Massachusetts; a different Mill River in Deerfield and Whately, Massachusetts; and Ashuelot River near Keene, New Hampshire (Susi von Oettingen, 2010, pers. comm., USFWS). The Recovery Plan for this species was last issued in 1993 (USFWS 1993a).

Puritan tiger beetle— Threatened: The Puritan tiger beetle is an inhabitant of sandy riverine beaches along the Connecticut River and sandy bluffs along Chesapeake Bay in Maryland. The Puritan tiger beetle has declined along the Connecticut River due to inundation and disturbance of its shoreline habitat from dam construction, riverbank stabilization and human recreational activities. Of 11 known historic populations along the Connecticut River, 2 remain (USFWS 1993b). One occurs in Northampton, Massachusetts, on a river beach owned by the City of Northampton and the Massachusetts Division of Fisheries and Wildlife. The numbers of adult beetles in this population decreased in the late 1980s, dropping below 50 adult beetles. The refuge and it partners have been making a concerted effort there since 1996 to protect and augment this population. The last year the beetles were reintroduced to the Northampotn site was in 2006. In 2005 the number of adult beetles rose to 200, but unfortunately declined to only 2 adults in 2014. The other population is near Cromwell, Connecticut, and comprises 350 to 500 individuals at three sites in close proximity. The refuge's Deadman's Swamp Unit protects one of theses sites and supports adult beetles, although no larvae have been found there to date. The Recovery Plan for this species was issued in 1993 (USFWS 1993b).

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Puritan tiger beetles

In 2015, the Service awarded $220,000 in funding, under the Cooperative Recovery Initiative (CRI), to Conte Refuge and partners to conduct a habitat enhancement and population stabilization project for the Puritan tiger beetle populations in the watershed. CRI is a strategic, cross-programmatic approach to recover federally listed species on refuges and surrounding lands. The goals and objectives of the Puritan tiger beetle project are to:

- Secure the existing metapopulation in Connecticut.
- Establish two metapopulations in New England to meet recovery criteria.
- Restore riverine beach habitat.
- Establish a captive rearing lab at the Richard Cronin Aquatic Resource Center in Sunderland, Massachusetts.

Project activities planned include debris removal and control vegetative encroachment using mechanical and herbicide treatments, collecting adult tiger beetles for the captive rearing program, rearing beetles from eggs to larvae in enough quantities to allow for translocating captive reared beetles into restored habitats. Other species benefitting from this project include the tide water mucket, yellow lampmussel, cobra clubtail, midland clubtail, hairy necked tiger beetle, and sandbar willow.

Jesup's milk-vetch— Endangered: This plant exists only in the Connecticut River watershed and is confined to calcareous bedrock outcrops which are ice scoured annually (USFWS 1989). The only three known sites occur along a 16-mile stretch of the Connecticut River in the towns of Plainfield and Claremont, New

Hampshire, and Hartland, Vermont. Habitat alteration and botanical collecting have been the major impacts to this plant. Trampling by humans also poses a threat due to canoe and kayak portaging near one site. An invasive plant, black swallow-wort, has expanded into the area from the nearby railroad tracks and threatens to displace the milk-vetch. The Recovery Plan for this species was issued in 1989 (USFWS 1989b). Partners have worked to control the black swallow-wort.

Small whorled pogonia — Threatened: This threatened plant, also known as the green five-leaf orchid, inhabits upland sites in deciduous or mixed deciduous and coniferous forests in second or third growth forests. It is rare but widely occurring at about 85 sites in 15 states and Canada (USFWS 1992). There are only two known sites within the Connecticut River watershed, one in Connecticut and one in Massachusetts. Both are extremely small. Destruction of habitat from commercial and residential development has been a primary threat. Plant collectors decimated the only known population in Connecticut several years ago after its location was published in a newspaper. The species was originally listed as endangered in 1982 but that status was changed to threatened in 1994. A 5-year review of the listing of this plant species was initiated on March 6, 2012 (*https://www.gpo.gov/fdsys/pkg/FR-2012-03-06/pdf/2012-5212.pdf*; accessed August 2016). The Recovery Plan for this species was issued in 1992 (USFWS 1992).

Northeastern bulrush — Endangered: This plant is found in alluvial meadows and small headwater or coastal plain ponds characterized by seasonally variable water levels. Approximately 113 populations are known from 7 eastern states, with most of the populations occurring in Pennsylvania and Vermont (USFWS 2008). Within the Connecticut River watershed, 2 sites are known in Massachusetts, 9 in New Hampshire, and 22 in Vermont. Habitat alterations that make conditions consistently wetter or drier are the major threat to this species (USFWS 2006b). Other threats include agricultural runoff, logging roads, fire roads, off-road vehicle use, and unauthorized collection. The refuge's Putney Mountain Unit in southern Vermont was purchased to protect a population of this plant. The Recovery Plan for this species was issued in 1993 (USFWS 1993c), and the Service completed a 5-year status review for the species in the fall of 2008 (USFWS 2008).

Northern long-eared bat

Al Hicks/NYDEC

Rufa red knot — Threatened: In December 2014, the Service listed the *rufa* red knot as federally threatened (79 FR 73706-73748). The "rufa" subspecies of red knot (Calidris canutus *rufa)* winters near the tip of South America and begins its long journey north to Arctic breeding grounds in mid-February, when they spend time at a number of coastal habitats along eastern North America, particularly Delaware Bay beginning in mid-May. The species has been recorded during migration along the coasts of Connecticut, Massachusetts, and New Hampshire. Major threats to the subspecies include loss of breeding and nonbreeding habitat, predation during breeding, reduced prey availability, and mismatches in the time of the species migrations and the availability of food and favorable weather conditions.

Northern long-eared bat — Threatened: In April 2015, the Service listed the northern long-eared bat as federally threatened. The northern long-eared bat occurs in 39 states in the eastern and north central U.S. This medium-sized bat is currently being decimated by white-nosed syndrome, a fungal disease that affects certain types of bats. These bats are especially susceptible to the disease in their wintering hibernacula; namely, caves and mines. They typically use large caves or mines for hibernacula, with large passages and entrances, constant, cooler temperatures, and high humidity

with minimal air currents. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. In the Northeastern U.S., northern long-eared bat populations have dropped by 99 percent (99%) from pre-white-nosed syndrome numbers. As white-nose syndrome continues to expand throughout the remainder of the species range, scientists expect high losses will continue.

During summer, the bats roost singly or in colonies underneath bark, in cavities, or in crevices of reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavitities or crevices. Potential roosts may include live trees and/or snags greater than or equal to 3 inches diameter-at-breast height that have exfoliating bark, cracks, crevices, and/or cavities. It has also been found, rarely, roosting in structures like barns and sheds. Breeding begins in late summer or early fall when males begin swarming near hibernacula. Potential habitat for the species exists throughout the watershed. For more information on this species, visit: *https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=A0JE* (accessed August 2016).

Indiana Bat – Endangered: The Indiana bat recovery plan was drafted in 2007. Human disturbance and vandalism pose significant threats during hibernation, and loss and degradation of forested habitat impact summer roost sites. Permanent protection of hibernacula, conservation and management of summer habitat and public outreach are recovery criteria for this species. The western boundaries of two CFAs in Vermont are located within the Northeast Indiana Bat Recovery Unit (RU). The RUs serve to protect summer habitats, and aid in the conservation of natural variation across populations (USFWS 2007). Permanent protection through land acquisition, and management of potential summer roost and maternity sites within these CFAs will aid in the recovery of this species.

Roseate Tern – Endangered: The recovery plan for the northeastern population of roseate terns was updated in 1998. These terns occupy sandy beaches and tidal mudflats at the mouth of the Connecticut River during migration. Loss of nest habitat and predation are threats to this species. Land protection of migration habitat will provide undisturbed stop-over areas.

Northern Bog Turtle – Threatened: The northern population of the bog turtle was listed as a threatened species on November 4, 1997. These turtles prefer open-canopy wetlands, such as herbaceous sedge meadows and fens, which periodically flood and often bordered by wooded areas. Threats to its survival include the loss, degradation, and fragmentation of its habitat, compounded by the take of long-lived adult animals from wild populations for illegal wildlife trade. The protection of known bog turtle populations and their habitats, as well as the management of these habitats to maintain suitability (U.S. Fish and Wildlife Service 2001) are a few of the recovery actions which the refuge could undertake for this species. At this time, the bog turtle occurs in the Farmington River CPA.

Bicknell's Thrush – Under Review: Bicknell's Thrush was petitioned in 2010, and in 2012 the USFWS announced a "90-day finding" that the Bicknell's thrush may warrant protection as an endangered species. Bicknell's Thrush is a rare and geographically restricted habitat specialist of balsam fir-dominated forests in the northeastern U.S. and southeastern Canada. In its US breeding range, the Bicknell's thrush is found in high-elevation spruce-fir forest, regularly breeding only at elevations above 700 m. This species occurs in the White Mountains in New Hampshire and in Vermont's Green Mountains. These areas are on the outskirts of the Connecticut River Watershed.

Across its breeding range, bicknell's thrush appear to be declining, with some populations reported to be decreasing by 7-19% annually. Threats to this species

include recreational development, telecommunication construction, wind power development, acidic precipitation, mercury deposition, and climatic warming (Mollie Matteson 2010).

Brook floater – Under Review: The brook floater is a mussel species that occurs in rivers in the eastern part of the U.S. Significant declines have been noted in Massachusetts, New York, Pennsylvania, New Jersey, Rhode Island, Virginia, North Carolina, and South Carolina. Few known sites remain that hold healthy, viable populations. Species experts have determined that the brook floater occupies less than 50% of its historic range, primarily due to habitat destruction and land use practices that impact water quality. Populations are known to occur in Vermont and New Hampshire. Permanent conservation of lands adjacent to rivers with known occurrences of brook floater would protect and potentially improve water quality at these sites.

Ospreys

Bob Weiss/USFWS

Cobblestone tiger beetle– Under Review: The cobblestone tiger beetle is restricted to the open, cobbled, and sparsely vegetated areas of river islands and banks of free-flowing rivers (Allen and Acciavatti, 2002). Threats to this species include hydrologic alterations that impact habitat suitability, invasive plants, water pollution and river bank stabilization projects. This tiger beetle occurs in the Quonatuck CFA and West River CPA. The refuge can support this species by permanently protecting known populations and their habitats, as well as adjacent lands, to improve water quality and provide suitable habitat through management efforts.

Tri-colored bat – Under Review: Tri-colored bat was once the most common bat species found in eastern forests. This species hibernates in caves during the winter, and roosts within forested habitats during the summer. Potential habitat for the species exists throughout the watershed. The species has been documented occurring in at least three of the proposed CPAs/CFAs: Ompompanoosuc River, Ottauquechee River, and White River CFAs. Permanent protection of winter and summer habitats, as well as the management of roosting areas will benefit this species.

Monarch butterfly– Under Review: The monarch butterfly was petitioned for federal listing in 2014. This species is widely distributed across North America and is categorized into geographically distinct populations based on migration patterns. The monarch requires habitat that provides milkweed as host plants for breeding and flowering plants for foraging. This species has experienced dramatic declines which may be contributed to habitat loss, pesticide use and impacts from climate change. The refuge can support this species by protecting, creating and restoring high quality habitat.

Regal fritillary butterfly– Under Review: Regal fritillary is a rare butterfly that may be extirpated from much of the Northeast. This species requires habitat that provides various species of violets as host plants for breeding and flowering plants for foraging. Habitat loss, fragmentation, and degradation, and pesticide use are listed as threats to the survival of this species. The refuge can support this butterfly by protecting and creating suitable open habitat.

Yellow banded bumble bee– Under Review: Yellow banded bumble bee was petitioned for federal protection in 2015. According to recent studies, this species has declined by over 30% in range and persistence over its entire range; in some areas this species has been extirpated. This species forages on a diversity of plants within a wide variety of habitats including woodlands, farmlands, meadows, grasslands and wetlands. Threats to this important pollinator include disease, pesticide use and habitat loss (Hatfield et al. 2015). The refuge can

support this species by protecting, creating and restoring high quality habitat for extant populations

Wood Turtle– Under Review: Wood turtle was petitioned for federal protection in 2012. Wood turtles require riparian habitats, using aquatic and terrestrial habitats at different times of the year. This species is long lived, and thought to be experiencing population declines exceeding 50% over the past 100 years. Much of this decline is due to habitat degradation, fragmentation and destruction (van Dijk and Harding, J. 2016). Wood turtle occur in the Fort River, Quonatuck and Nulhegan Basin CFAs. Protection and management of riparian habitats will benefit populations.

Birds

The Connecticut River watershed serves as one of the major "north-south" migration corridors within the expansive Atlantic Flyway, flanked by the Atlantic coastal corridor to the east and the Champlain Valley corridor to the west (Browne 2009). Hundreds of species of migratory and resident birds inhabit the Connecticut River watershed. These species encompass 17 taxonomic orders and 46 families of birds ranging from the well-known Canada goose and American robin to the rare golden-winged warbler and Fox sparrow. Twenty-seven species of ducks, geese, and swans; 15 species of shorebirds; and 24 other water-dependent species such as rails, grebes, and herons use the watershed for breeding, wintering, or migration (USFWS 1995a).

The watershed is also host to 181 passerine and raptor species. Of these, 88 are neotropical migrants that breed in the watershed, 77 are residents that breed and winter here, and 16 are winter residents that migrate to the watershed from the north. Certain species such as mourning dove, American robin, red-tailed hawk, American crow, cedar waxwing, and American goldfinch have both migratory and resident populations (DeGraaf and Yamasaki 2001).

The Atlantic Coast Joint Venture (ACJV) has established habitat objectives within Waterfowl Focus Areas for supporting the full suite of waterfowl occurring within the Joint Venture boundaries. Three of these Focus Areas exist within the Connecticut River watershed: 1) the Connecticut River and Tidal Wetlands Complex Focus Area along the lower Connecticut River in the state of Connecticut; 2) the Connecticut River Focus Area, which runs along the Connecticut River in New Hampshire and Vermont from the Massachusetts boarder to the river's origin; and 3) Lake Memphremagog Focus Area in northern Vermont.

A study of spring stopover habitat use by neotropical migrant birds within the Connecticut River Valley, conducted by Smith College through funding by the Conte NFWR and R5 Migratory Bird Program, provides indications of the importance of the Connecticut River watershed to migrating birds (*http://www.science.smith.edu/stopoverbirds/*; accessed August 2016). Results demonstrated that spring migrant birds using the Eastern Flyway reach the southern portions of the Connecticut River watershed in large numbers, then disperse throughout the watershed and beyond as they continue north. Almost half (47 percent (47%)) of the birds counted within the defined count circles were at sites along the main stem of the Connecticut River. This trend was more pronounced during the early periods of spring migration along the Connecticut and Massachusetts portions of the River. Forested wetlands and shrub swamps are likely to be particularly valuable habitats along the main stem of the river because they provide more food and protection earlier in the spring migratory period due to warmer air and water temperatures and earlier tree leaf-out. Overall density of birds observed decreased by about half from south to north, as birds dispersed away from the main stem of the river as they moved north. The mouth and lower main stem of

the Connecticut River may serve as a landscape feature used by many Eastern Flyway migrants to orient north after reaching the southern New England coast.

For a complete list of birds in the watershed, please visit: *http://www.fws.gov/refuge/Silvio_O_Conte/about/library.html* (accessed August 2016).

Six landbird species are identified as Watch List species—those of highest conservation concern at the continental scale --- in the 2016 Partners in Flight Landbird Conservation Plan (see Table C.1) (Rosenberg et al.). We summarize studies on birds conducted on individual refuge divisions and units in Part III of this chapter.

Below, we provide some general information on different bird groups (e.g., waterfowl, raptors, etc.) in the watershed.

Waterfowl
The lower Connecticut River has abundant waterfowl year-round and has some of the highest and most significant concentrations of black duck in the Northeastern U.S. (Dreyer and Caplis 2001). The freshwater and tidal wetlands along the Connecticut River, particularly in the lower portion of the watershed, provide important stopover habitat during both spring and fall migrations of waterfowl, such as American black duck. The habitats most important to black duck are the tidal wetlands along the main stem, as well as the tidal wetlands and bays along the coast. In the winter, the river provides relatively ice-free open water habitat providing access to submerged aquatic vegetation, invertebrates and high calorie wetland vegetation. Many waterfowl also nest along the river, including mallards, black duck, Canada goose, green-winged teal, and gadwall. The lower Connecticut River (from Salmon River to the mouth) has been designated a Ramsar Wetland of International Significance, as well as an ACJV waterfowl focus area.

Further north in the watershed, many migrating ducks use flooded agricultural fields, floodplains, emergent wetlands, shrub swamps and backwater areas along the Connecticut River for stopover habitat. In fact, the Connecticut River is a waterfowl focus area under the ACJV for New Hampshire and Vermont, highlighting the importance of the river habitats to breeding and migrating waterfowl (ACJV 2005, NHFG 2006). Species such as Canada geese, teal, mergansers, American black ducks, mallards, wood duck, and some sea ducks use the river corridor during spring and fall migration. The river provides prime breeding habitat for American black duck, wood duck, mallard, common merganser, and Canada geese. Other species nest along the river, but are less common.

Shortnose sturgeon

Duane Raver/USFWS

Wood ducks are ubiquitous nesters in the watershed requiring large tree cavities which are associated with freshwater forested or shrub wetlands. They especially favor beaver ponds with heavy forest cover. Black ducks are a species of special management concern as previously described and are specifically mentioned in the Conte Refuge Act.

Forest, Shrubland, and Grassland Birds
According to the national species richness maps produced by the Breeding Bird Survey (Price et al. 1995), the watershed has a very high richness of nesting flycatchers and thrushes, and the northern watershed has the highest richness of nesting warblers, distinguishing it as nationally significant for this taxon. Within the watershed, the White Mountains to the east, Green Mountains to the west and the Berkshire Hills to the west provide the northern hardwood/spruce forest breeding habitat required by neo tropical migrants and residents. Species dependent on this type of habitat include the black throated blue warbler, black throated green warbler, American redstart, least flycatcher, veery, pileated woodpecker, and Northern goshawk.

A number of birds associated with old fields, pastures, and grasslands are declining in New England and are of special concern (Askins 2000, Vickery 1992). Grassland birds comprise one of the most imperiled groups of birds in the U.S., although the responsibility for recovering them belongs to bird conservation regions (BCRs) that include their core ranges in the Midwest. Grassland-dependent species, such as upland sandpiper, savannah sparrow, vesper sparrow, grasshopper sparrow, and bobolink, are declining across the Northeast as meadows succeed to forest stands or are replaced by development (Askins 2000). According to USGS Breeding Bird Survey, continental declines of grassland birds have been steeper, more consistent, and more geographically widespread than those of any other ecological group of birds (Sauer et al. 2001). The Wildlife Management Institute has estimated that natural grasslands have declined by 99 percent (99%) in the Northeast. The remaining grasslands are mostly agricultural and are under increasing pressure to be converted into residential developments.

Grassland-dependent birds in the watershed include: upland sandpiper which requires large contiguous grassland area with a mixture of tall and short grasses — minimum 150 acres and even fields as large as 300 acres or more (Vickery et al. 1994, Carter 1992); sedge wren (prefers wet fields); savannah sparrow (generalist — minimum 20 to 40 acres); vesper sparrow (areas with thin grasses and bare ground — minimum 30 acres); grasshopper sparrow (dry areas with bunch grasses and bare ground — minimum 30 acres); bobolink (prefers thick grass in old fields — minimum 5 to 10 acres); and Eastern meadowlark (old fields with dead grass layer — minimum 15 to 20 acres) (Jones and Vickery 1997).

Westover Air Force Reserve Base in Chicopee, Massachusetts, supports the largest populations of two State-listed bird species in the six state New England region: the upland sandpiper (Bartramia longicanda), State-listed as endangered, and the grasshopper sparrow (Ammodramus savannarum), State-listed as threatened ((U.S. Air Force 2015). The Connecticut River valley in Massachusetts provides the greatest potential for grassland habitat restoration in the watershed, as it has the greatest abundance of prime grassland habitat in the watershed and the river serves as an important migration corridor for birds (CT DEEP 2006). As New England becomes increasingly forested and urbanized, habitat for these species will continue to decline.

Neotropical migrants were surveyed in four sub-watersheds of the Connecticut River including the Farmington River watershed in Connecticut, the Deerfield River watershed in Massachusetts, the Ashuelot River watershed in New Hampshire, and the White River watershed in Vermont. The goal was to determine the importance of the Connecticut River watershed to neotropical migrants, and the habitat types used most often during migration. Twelve transects were established in each sub-watershed at specific geographic locations, and each transect was surveyed 6 different times throughout the spring each year, for 3 years (1996-1998). This survey effort was part of a study conducted by Smith College and Manomet Center for Conservation Sciences.

Waterbirds
The Connecticut River valley is inhabited by six species of colonial nesting heron: great blue heron, great egrets, black-crowned night herons, yellow-crowned night herons, snowy egrets, and little blue heron. Great blue herons forage in almost every type of shallow, open wetland including fresh, brackish, and saltwater wetlands. They are colonial tree nesters in wetlands, and many colonies can be found in the watershed; breeding is increasing. Great egrets are uncommon local breeders, common migrants and summer residents, and are generally increasing. Black-crowned night herons, another colonial nester, are locally common breeders; this species has experienced declines in the watershed and is restricted to the seacoast. Yellow-crowned night herons as well as little blue herons are rare breeders, both tending to use wooded wetlands and marshes. Double-crested cormorant are colonial nesters and their populations are increasing; there are one or two reports of them nesting near the Connecticut River (Bevier 1994).

The common loon nests on small and large ponds and lakes from Quabbin Reservoir north and winters along the coast.

Secretive Marsh Birds
Virginia, clapper, and sora rails are all fairly common nesters in the marshes along the river. King rail are rare and found almost exclusively in high salt marshes at the mouth of the Connecticut River. Freshwater tidal marshes with wild rice are important stopover areas for sora rails in the fall (Dreyer and Caplis 2001). Least and American bitterns are relatively uncommon across the watershed, although the latter is known to breed at the Pondicherry Division. American bitterns have declined of late due to loss of freshwater wetlands. Least bittern are rare local breeders preferring tall dense freshwater marshes (DeGraaf and Yamasaki 2001).

Shorebirds
During migration, mud flats along the main stem of the Connecticut River and sandy areas around the mouth of the river provide essential foraging habitat to several species of shorebirds such as the willet, solitary sandpiper, lesser yellowlegs, and federally endangered roseate terns. The mouth of the river also provides nesting areas for piping plovers, least terns, and common terns. The spotted sandpiper is common, frequenting shorelines along rivers, streams, lakes and ponds. Upland sandpipers rely on expansive grassland habitats and are generally rare in the watershed, most often seen at large airports. The American woodcock is found throughout the watershed in early successional forests, and locally is a common breeder. Declining early successional forests pose a challenge to this species (DeGraaf and Yamasaki 2001).

Raptors
The Connecticut River valley is a major corridor for raptor migration. Mount Tom in Massachusetts, Mount Monadnock in New Hampshire, and Putney Mountain in Vermont, are well known sites to observe raptor migrants in the fall. On certain days when strong fronts follow periods of harsh weather, thousands of broad winged hawks can be observed. At least a dozen other raptor species including red-tailed hawks, sharp shinned hawks, American kestrels, merlins, red-shouldered hawks, and osprey are common migrants. Many of these species and other raptors nest throughout the watershed.

Fish
The watershed supports a diversity of fishery resources. Cold, cool and warm-water species are in general abundance throughout the watershed. The watershed did not historically support as diverse a group of fishes as it does presently; many of the species considered resident were introduced (e.g., smallmouth bass, brown trout). The main stem and many of its tributaries were impounded following early European settlement through extensive dam

Craig Lewis/USFWS

White tailed deer

construction in all four basin states. Prior to environmental regulations, many industries in the river corridors discharged pollutants directly into the water. Many lakes, ponds, and wetlands were similarly degraded. The creation of reservoirs and subsequent degradation of aquatic habitats resulted in native species declines and provided opportunities for exotic species establishment.

There are 142 fish species found within the watershed: 33 native freshwater; 35 nonnative freshwater; 11 diadromous fish (migrate between salt- and freshwater for breeding purposes); 15 amphidromous (migration between fresh water and the sea for other than breeding purposes); and 48 saltwater (*http://www.fws.gov/refuge/Silvio_O_Conte/about/library.html*; accessed August 2016). Indigenous freshwater fish are, with few exceptions, generally found throughout the watershed. Diadromous fish are primarily found in the lower reaches of the watershed, south of Bellows Falls, Vermont, with higher numbers and more species near the mouth of the main stem. Saltwater species generally occur within Long Island Sound and amphidromous species are found in the lower reach of the Connecticut River and its tributaries.

The northern reaches of the river provide habitat for lake and Eastern brook trout and land-locked Atlantic salmon. The mid-section of the river supports chain pickerel, largemouth and smallmouth bass, Northern pike and walleye, and a variety of panfish such as bluegill and seasonal foraging migrations of striped bass, occur up to many first dam barriers including Holyoke Dam. Common carp, white suckers, American eel, and catfish such as the introduced channel catfish and native brown bullhead are present in many areas. The native population of Atlantic salmon in the watershed was extirpated; efforts to reestablish the population through hatchery stock persisted for decades, however the Service recently terminated the program due to poor success. The American shad population, with less precise habitat requirements, has experienced recent declines along the East Coast, in spite of habitat restoration efforts that are complicated by among other factors, fish passage issues.

Migratory Fish

Atlantic salmon, American shad, shortnose sturgeon, and river herring (i.e., alewife and blueback herring) are all specifically mentioned in the purposes of the Conte Refuge Act. In addition, each is a trust responsibility of the Service via the Magnuson Stevens Fishery Conservation and Management Act, the Anadromous Fish Conservation Act, the Atlantic Coastal Fisheries Cooperative Management Act, and the Atlantic Striped Bass Conservation Act (*http://www.fws.gov/laws/lawsdigest/fishcon.html; http://www.fws.gov/laws/lawsdigest/anadrom.html, http://www.fws.gov/laws/lawsdigest/atlstri.html*; all accessed August 2016).

Redback salamander

USFWS

Atlantic Salmon

Based on historical accounts from Native Americans and early European settlers, there used to be large Atlantic salmon runs in the Connecticut River. However, the salmon population declined rapidly as Europeans colonized American and constructed dams for power. The first dam across the main stem Connecticut River was constructed in 1798 near the present site of Turners Falls, Massachusetts. This and other dams blocked salmon migrations to their breeding areas in the northern portion of the river. Dams were also constructed along the lower basin tributaries. Additionally, unregulated harvest of salmon depleted the population. By the early 1800s, salmon had disappeared from the Connecticut River.

There have been several attempts to restore Atlantic salmon to the Connecticut River. An interagency state/federal program to restore salmon to the Connecticut River was initiated in the 1860s. Although the effort resulted in the return of hundreds of adult salmon for several years in the 1870s and 1880s, the program

eventually failed due to both uncontrolled harvest of fish in Connecticut waters and the failure to construct effective fish passage at dams in Massachusetts.

Another attempt began in 1967 when the Service, Connecticut, Massachusetts, New Hampshire, Vermont, and the National Marine Fisheries Service signed a statement of intent to restore anadromous fish, including Atlantic salmon, to the Connecticut River. The Service discontinued the Atlantic salmon portion of this program in 2012 due to reviews of scientific literature, low numbers of adults returning to the river since the 1990s, and severe damage to the White River National Fish Hatchery from flooding in fall 2011. Following the Service's announcement, Massachusetts decided it would no longer culture salmon at its Roger Reed State Hatchery. As of 2014, Vermont and New Hampshire have no plans for future stocking of any anadromous Atlantic salmon. However, Connecticut is continuing to operate an "Atlantic Salmon Legacy Program." The purpose of this program is to maintain Atlantic Salmon in the Salmon River and Farmington River, from spring fry stocking, with objectives that include school education programs and providing broodstock fisheries in out-of-basin waters. Atlantic salmon remain a priority refuge resource of concern due to its inclusion in the enacting legislation.

Other Diadromous Fish Species

Prior to extensive dam construction, migratory fish returning to the Connecticut River formerly consisted of larger numbers of American shad, alewife, blueback herring, American eel, and lesser numbers of Atlantic sturgeon, shortnose sturgeon, rainbow smelt, striped bass, and sea lamprey. Gizzard shad is a relative newcomer to the watershed; it has expanded its range northward to the Connecticut River, where it was first observed at the mouth in 1980. Migratory fish life histories are described by Scarola (1987) and Scott and Grossman (1973).

American shad are broadcast spawners using the river and larger tributaries for reproduction. Blueback herring spawn in the river and tributaries while alewives seek the smaller tributaries and coves for spawning. Alewife spawning habitat is mainly south of Longmeadow, Massachusetts, and alewives rarely are found as far north as Holyoke. Rainbow smelt historically spawn in the lower basin tributaries but are now considered extirpated. Historically, American shad and blueback herring were known to occur up Bellows Falls, Vermont, with American eel continuing further upstream than even Atlantic salmon, to the Connecticut Lakes in Pittsburgh, New Hampshire. Currently, American shad can ascend the river to Bellows Falls, Vermont, only after successfully passing the fish lift at Holyoke Dam, two fish ladders at Turners Falls Dam, and a fish ladder at Vernon Dam.

Migratory fish populations were impacted by overharvesting, pollution, and dam construction that blocked migration routes. Recognition of the impact to the migratory fish populations was quickly apparent to the inhabitants of the river valley upon completion of the dams. Two early attempts (in 1873 and 1940) to provide fish passage at the Holyoke Dam (built in 1849) in Massachusetts failed. In 1955 an elevator-type fishway was constructed, allowing a portion of the population of American shad and blueback herring to migrate upriver of the dam. The Enfield Dam in Connecticut, built in 1880, was a partial fish barrier until the late 1970s, when it began to disintegrate after being breached in several places. .

The enactment of the Anadromous Fish Conservation Act in 1965 provided the states and Federal agencies with the means to initiate anadromous fish enhancement and restoration programs within the watershed. This Federal legislation lead to the four basin state fish and wildlife agencies, the U. S. Fish and Wildlife Service and the predecessor to the National Marine Fisheries Service, creating the "Policy Committee for Fisheries Management of the Connecticut River Basin." The Committee was focused on establishing a coordinated anadromous fish restoration effort at the watershed scale. Both

M. Poole

Dragonfly

American shad and Atlantic salmon garnered the most interest at that early time and later lead to the Congressional Act of 1983 that created the Connecticut River Atlantic Salmon Commission (CRASC), that provided additional formalization of these efforts (for the agency partner) that included more work than salmon restoration alone. This included negotiations with power companies on fish passage plans for restoration. Outside of the Connecticut river basin agency efforts, ongoing coordinated management for East Coast diadromous species (i.e., shad and river herring) occurs through the Atlantic States Marine Fisheries Commission, which has additional federal acts to support coordinated actions. The CRASC Commissioners (agency Directors) and its Technical Committee, remain very active on all aspects of restoration, management, restoration, planning, and research for all diadromous fish species (*http://www.fws.gov/r5crc*; accessed August 2016).

American shad in the Connecticut River have been the focus of many studies, research, monitoring, dating back to the 1950s. Measures of abundance include commercial and recreational landings largely as determined by the State of Connecticut, and more recently by fishway passage counts. Although Holyoke Dam has provided upstream passage for many decades, it was really in 1976, following fish lift improvements, and the demise of the Enfield Dam that provided noted increases in shad counts at that location. Additional fish lift improvement occurred in 2004 following relicensing and downstream passage measures also occurred for both adults and juveniles to aid the population's restoration. The average number of shad passed at Holyoke Dam from 1976 to 2014 is 306,000, with a high of 721,000 (1992) and a low of 145,000 (1978) (*http://www.fws.gov/r5crc,* accessed August 2016). Since 2012, shad counts have been well above the long-term average at Holyoke, even as other East Coast rivers continue to experience all-time low levels of abundance. Fish passage, both up and downstream, for both adults and juveniles, remains one of the highest priority factors influencing this population's full restoration, with much work ahead, but much progress achieved. In fact, a new shad passage record was set at the Vernon Dam fishway in 2014 with over 39,000 shad passed, the highest number since the fishways start-up in 1981.

Connecticut River shortnose sturgeon were one of the first species to be identified for inclusion under the Endangered Species Act when first passed by Congress. Research in recent decades by both the University of Massachusetts Amherst, the Conte Anadromous Fish Research Center, and the Connecticut Department of Energy and Environmental Protection have shown the population to be stable to growing (slowly) with published research indicating that spawning is limited to an area downstream of the Turners Falls Dam (which is believed to be the upstream extent of their range). The population is fragmented by the Holyoke Dam which has initiated construction of new downstream passage protection

Federally endangered dwarf wedgemussel

Susi Von Oettingen/USFWS

measures for this species, for adults and juveniles in summer 2014. Upon completion, upstream passage of sturgeon will be permitted (currently prohibited pending safe downstream measures), allowing the potential for sturgeon downstream of that dam to contribute to the recovery of the population.

Blueback herring and sea lamprey use tributaries to the Connecticut River for spawning and nursery habitat often up to the first barrier encountered, typically not far upstream from the main stem. Blueback herring is a prolific fish that can ascend the river as far as American shad on the main stem and in tributaries beyond first barriers that have working fishways. Over the past two decades river herring populations have experience dramatic decline in abundance similar to what has been seen with American shad thoughout the Northeast. Currently, river herring have special status and harvest closures in place as state, federal, private entities try to determine causal factors and measure to reverse trends and improve status. Fishway counts for bluebacks and alewife in the Connecticut River have plummeted from the 1980s and 1990s, requiring annual inriver field sampling to obtain data on these species.

Blueberries

Ken Sturm/USFWS

Sea lamprey can presently migrate into the Vernon Pool passing through the Vernon Dam fishway located in southern Vermont and New Hampshire, although their historic upstream range is unclear, their migration abilities make them capable of reaching quite far into the basin Sea lamprey in some abundance may use the subsequent Bellows Falls Dam fishway, to access habitat upstream, with some lamprey utilizing the next and most upstream main stem upstream fishway at Wilder Dam. Other species including American eel may also use these fishways and are under study as part of these upstream dams' relicensing process. Alewife, similar in appearance to the blueback herring, generally occur in the lower reaches of the Connecticut River. Alewives currently migrate upriver as far as the vicinity of the former Enfield Dam. Together, blueback herring and alewives are referred to as "river herring." A February 2015 report prepared by the CRASC, Technical Subcommittee for River Herring, identifies river herring restoration status and plans in the Connecticut River basin (CRASC 2015). This 2015 report supplements the existing CRASC plan, "Management Plan for River Herring in the Connecticut River Basin" (CRASC 2004).

Gizzard shad is another diadromous fish occurring in the lower reaches of the Connecticut River. They were first observed in the main stem in 1985, and have been observed in limited numbers in the Holyoke Dam fish lift in Massachusetts. Gizzard shad may occur in greater abundance below the Holyoke Dam.

Striped bass are not known to spawn in the Connecticut River, but rather migrate to the system following river herring, a favorite forage due to size and schooling behavior. This seasonal feeding migration (Chesapeake Bay, Hudson and Delaware river origin) lasts generally for the run of river herring which concludes with river herring "adult outmigrants" (following spawning) leaving in mid to late June. The successful restoration of the migratory stock of striped bass in the early 1990s led to the develop of a popular striped bass fishery in the river upstream to Holyoke Dam and lower reaches of larger tributaries.

The American eel, which is petitioned for federally threatened status under the ESA, is another important migratory fish in the Connecticut River. Life history information for the American eel is presented in Stone et al. (1994), Scott and Grossman (1973), Bigelow and Schrodeor (1953). American eel are ubiquitous throughout the watershed with abundance decreasing from south to north. It is rarely observed above the confluence with the White River in Vermont.

The Service initiated a status review for American eel in 2004 at the request of the Atlantic States Marine Fisheries Commission, representing 15 states from Maine to Florida, along with a formal listing petition filed by

others shortly thereafter. The Service determined in 2005 that substantial biological information existed to warrant a more thorough examination and began a comprehensive review of all the available scientific and commercial information. The Service examined all available information about the American eel population from Greenland south along the coast to Brazil and as far inland as the Great Lakes and the Mississippi River drainage. While the eel population has declined in some areas, the species' overall population was not considered in danger of extinction or likely to become so in the foreseeable future, thus formally concluding that protecting the eel as an endangered or threatened species under the ESA was not warranted. However, in 2011 in response to another petition, the Service published a finding that the petition presented substantial scientific or commercial information indicating that listing this species may be warranted (76 FR 60432-60444).

Amphidromous Fish
Amphidromous fish (fish that migrate between freshwater and the ocean during some stage of their lives other than breeding) use the estuary of the Connecticut River and the marine environment of Long Island Sound. Fifteen amphidromous fish species occur in this classification. The most commonly recognized species in this category are: white perch, mullets, and killifishes.

Resident Fish
Resident fish are defined by two categories: indigenous (native) and nonindigenous (introduced). Species distribution is strongly correlated to temperature regimes. Cool and cold-water fishes (e.g., trout, sculpin, and burbot (cusk)) are found in the northern part of the watershed and in mountainous tributary streams. Smallmouth bass, chain pickerel, brown bullhead (horned pout), and white perch are found in the central and southern part of the watershed and the lower reaches of the main tributaries and the impounded areas of the main stem where warm waters occur. Forage fishes are abundant in the main stem of the river and in the larger tributaries. They include blacknose dace, spottail shinner, fallfish, white sucker, and common shiner. There are 33 native species in addition to the diadromous fish discussed previously.

One resident fish of conservation concern is the brook trout. In 2005, a group of public and private entities formed the Eastern Brook Trout Joint Venture (EBTJV) to address the decline of native brook trout and restore fishable populations. The group spearheaded a range-wide population and threats assessment to the species and its habitat in the eastern U.S. The long-term goals of the EBTJV are to develop a comprehensive restoration and education strategy to improve aquatic habitat, raise education awareness, and raise Federal, state, and local funds for brook trout conservation.

Although not currently threatened with extinction across the entire range, brook trout were extirpated from 21 percent (21%) and greatly reduced in 27 percent (27%) of sub-watersheds in a study by Hudy et al. (2005). Large portions of Maine, New Hampshire, New York and smaller portions of Vermont, Massachusetts, and West Virginia need increased monitoring. Most of the Connecticut River sub-watersheds still support brook trout to varying degrees. More subwatersheds in Vermont and New Hampshire have self-sustaining populations, whereas streams in Connecticut and Massachusetts have experienced more widespread declines due to habitat loss and degradation. The most important factors impacting brook trout across their range are increased water temperature, agriculture, urbanization, exotic fish species, and degraded riparian habitat.

In Connecticut, brook trout populations tend to be small and fragmented. The only sub-watershed in the State considered "intact" by the EBTJV is in the Litchfield Hills area which is outside the Connecticut River watershed. Intact

means at least 50 percent (50%) of this subwatershed has a self-sustaining population. Within the watershed in Massachusetts, there is one intact sub-watershed located along the New Hampshire border east of the Connecticut River. Vermont has the most sub-watersheds designated as intact. A substantial portion of that is in the Northeast Kingdom, where the Nulhegan Basin Division is located. Although only qualitative information is available for most of New Hampshire, there are intact sub-watersheds near the Pondicherry and Blueberry Swamp divisions, and within the proposed Ashuelot River area (EBTJV 2006).

Mammals

The watershed hosts a diverse assemblage of mammal species, from the widespread white-tailed deer to the rare and largely unfamiliar pygmy shrew found in a variety of forested habitats in the northern third of the watershed. Sixty-one mammal species occur in the watershed today. A number of species have been extirpated over the last hundred years due primarily to habitat loss and/or unregulated hunting/trapping. These include the eastern cougar, gray wolf, wolverine, Eastern elk, and woodland caribou. Two species have immigrated into the watershed in the last century: coyote and Virginia opossum (DeGraaf and Yamasaki 2001).

Most mammals within the watershed are forest inhabitants and include species such as near ubiquitous eastern chipmunks, gray squirrels, raccoon, and deer mouse, to the more solitary porcupine, black bear, bobcat, and Canada lynx, a federally listed species. Although heavily forested, the watershed holds a wide variety of wetland habitats (see below) which support a number of species well suited or limited to riparian and/or wetland habitats such as river otter, beaver, muskrat, and mink. Other species that commonly use wetland habitats include, water shrew, star-nosed mole, Eastern pipistrelle bat, meadow vole, Southern and Northern bog lemming, meadow jumping mouse, gray fox, raccoon, American marten, and ermine (DeGraaf and Yamasaki 2001).

The rocky and steep topography in the northern portion of the watershed provides natural caves and manmade mines for hibernating bats. Millions of North American bats have been killed by white-nose syndrome, a fungal disease discovered in a cave in New York State in 2006 (USFWS 2012). Winter surveys have shown 100 percent (100%) mortality in bat populations using hibernacula in Vermont (Bennett *pers.com.* 2013). This disease may be blamed as the principle cause for some bat species' extinction. Little brown, tricolored, and eastern small-footed bats have been decimated by this disease, and have been petitioned for listing under the ESA. As mentioned above, the northern-long eared bat is proposed as federally endangered.

Another mammal of particular concern in the watershed is the New England cottontail. The range of this once widespread rabbit has declined by about 86 percent (86%) since 1960 (Fuller and Tur 2012). The primary cause is loss of early successional forest and shrubland habitat. Other factors include high predation rates due to small, fragmented habitat patches, and gradual displacement by introduced eastern cottontails which use a wider variety of habitats and appear to be less susceptible to predation.

Recent surveys have revealed that the New England cottontail still occurs in scattered areas of Rhode Island, New Hampshire, southern Maine, western Connecticut, and in parts of Massachusetts (western Hampden County, southeastern Berkshire County, and Plymouth County). In the watershed, it has only been found in Hartland, New Hartford, East Haddam, and Lyme, Connecticut and in Hampden and Berkshire Counties in Massachusetts. Given this conservation urgency, a rangewide New England Cottontail Initiative was

established and a Conservation Strategy was approved in 2012. This initiative involves collaboration from multiple agencies, including the Service, state wildlife agencies, universities, Natural Resources Conservation Service, TNC, and Wildlife Management Institute, to address cottontail conservation on a landscape scale (USFWS 2011, Fuller and Tur 2012). The Conservation Strategy, titled "A Conservation Strategy for the New England Cottontail" provides management goals and strategies for this species (Fuller et al.2012) and recognizes the importance of conserving and actively managing habitats to the species' future. Forty-nine focus areas were identified as locations to manage and restore habitat for New England cottontail. Three of these focus areas are within the refuge acquisition boundary. Early successional forest management and protection of adjacent natural shrubland habitat will meet the conservation goals set for the New England cottontail.

The Service considered listing this species and published a summary for this petitioned candidate that summarizes the status of the New England cottontail (*Federal Register* 77(225):70009-70010). However, a determination was made by the Service in 2015 to not list the cottontail as a federally threatened species, was in part, due to the established conservation partnership dedicated to conserving and protecting shrubland habitat.

For a complete list of mammals found in the watershed, visit: *http://www.fws.gov/refuge/Silvio_O_Conte/about/library.html* (accessed August 2016).

Reptiles and Amphibians

There are 23 species of amphibians and 25 species of reptiles in the watershed. Reptiles include species such as wood turtle, Eastern box turtle, spotted turtle, musk turtle, common snapping turtle, painted turtle, Northern red-bellied slider, Northern black racer, Eastern timber rattler, Eastern ribbon snake, Eastern milksnake, and Eastern hog-nosed snake. Amphibians include species such as Northern leopard frog, wood frog, Eastern American toad, spotted salamander, red-backed salamander, marbled salamander, and Jefferson salamander. The painted turtle is probably the most ubiquitous turtle frequently seen basking in ponds, oxbows, and other quiet shallow bodies of water. The Northern diamondback terrapin, an estuarine species, is restricted to the tidal creeks and bays at the mouth of the Connecticut River. It may nest on some of the sandy spoil islands. The Eastern box turtle is the only completely terrestrial turtle within the watershed and is a resident of woodlands, field edges, and well-drained forest bottomlands (USFWS 2013c).

For a complete list of amphibians and reptiles found in the watershed, visit: *http://www.fws.gov/refuge/Silvio_O_Conte/about/library.html* (accessed August 2016).

The redback salamander, probably the most widespread and abundant salamander within the watershed, is a small woodland salamander with a completely terrestrial life history. It inhabits deciduous or mixed conifer-deciduous forests residing beneath wet leaf litter, within or beneath logs or other retreats. The common mudpuppy salamander is the only aquatic species within the watershed and occurs primarily in the main stem Connecticut River and immediate tributaries from Massachusetts to central Connecticut. The Northern spring peeper is a diminutive woodland frog widely distributed throughout the watershed. It is the earliest frog to call in the spring, breeding in a variety of wetlands including woodland swamps and ponds, vernal pools, and roadside ditches.

Amphibians and reptiles have only recently become fauna of management concern by conservation agencies and organizations, but are now a prominent part of wildlife and natural heritage programs (Mitchell et al. 2006). All of the state wildlife action plans provide information on species of herpetofauna that

are of greatest conservation need (GCN). These species in total embrace a broad range of habitats within the Connecticut River watershed. Examples of GCN species listed by watershed states include the blue-spotted salamander, Eastern spadefoot toad, wood turtle, Eastern box turtle, spotted turtle, Eastern ribbon snake, Jefferson salamander, marbled salamander, Northern leopard frog, and Fowler's toad. Suitable habitats include tidal wetlands, freshwater bogs, vernal pools, interior forests, grasslands, shrublands, streams, and rivers (NHFG 2005, Connecticut Department of Energy and Environmental Protection 2005, Vermont Fish and Wildlife Department 2005, Massachusetts Department of Fish and Game 2006).

One of the most seriously declining vertebrate species in New England is the Eastern timber rattlesnake. Although this species is classified as "Least Concern" on the Red List of Threatened Species by the International Union for the Conservation of Nature, it is listed as State-endangered in all watershed states (*http://www.masnakes.org/snakes/timber_rattle/*, *http://www.ct.gov/deep/cwp/view.asp?a=2723&q=326068, http://www.wildlife.state.nh.us/wildlife/profiles/timber-rattlesnake.html*, *http://www.vtfishandwildlife.com/cms/One.aspx?portalId=73163&pageId=149312,* all accessed online August 2016). The species ranges widely in the United States, though its overall population is decreasing. It is declining or extirpated in all northeastern states, with a few surviving populations in Massachusetts and Connecticut, one in New Hampshire, and two in Vermont. This rattlesnake is an inhabitant of deciduous forests, but it also requires rock ledges or outcroppings with southerly exposures for winter denning. Major threats to the species include habitat loss and fragmentation (i.e. from development) leading to population isolation, and direct mortality caused by humans (i.e. from collecting hunting, and vehicles) (Hammerson 2007).

The Eastern spadefoot toad is listed as "threatened" in Massachusetts and is most common on Cape Cod and in the Connecticut River Valley. Spadefoots breed only after very heavy or prolong rain events. When they do breed it may be as early as April or as late as September. This burrowing frog is associated with sandy, well drained soils and open forest or sparse shrub or fields (MA NAAMP 2009).

Invertebrates

Invertebrates are the most diverse and abundant group of animals within the watershed and encompass many large groups of animals such as single-celled protozoa, freshwater sponges, flatworms, snails, freshwater clams, worms, insects, arachnids, and crustaceans. These range from familiar insects such as butterflies, dragonflies, bees, and beetles to more obscure invertebrates such as clam shrimp and bryozoans. Perhaps the rarest invertebrate species in the watershed is Faxon's clam shrimp (also known as Agassiz's clam shrimp (*Eulimnadia agassizii*)). This crustacean is less than one-half inch long and enclosed by a chitinous clam-like shell. This species only occurs in three locations in Massachusetts (one in the Connecticut River watershed); it has also been recorded in Florida and Europe.

There are also several rare tiger beetles in the watershed. As mentioned under the section on federally listed species, several populations of threatened Puritan tiger beetle occur along the Connecticut River in Massachusetts and Connecticut. The cobblestone tiger beetle, currently petitioned for Federal listing, lives in riparian cobble bars and sandy beaches along rivers. Isolated populations of cobblestone tiger beetles occur along the Connecticut River in Massachusetts, Vermont, and New Hampshire, as well as in the White River in Vermont (NHWAP 2005).

Extensive information on invertebrates is presented in the State WAPs (NHFG 2005, Connecticut Department of Energy and Environmental Protection 2005, Vermont Fish and Wildlife Department 2005, Massachusetts Department of Fish and Game 2006). These plans identify many invertebrates of GCN such as the precious underwing moth and boreal turret snail, both endangered in Massachusetts and listed as "special concern" in Connecticut.

The role of invertebrates in the watershed cannot be underestimated. There are numerous species of invertebrates such as stoneflies, mayflies, and caddis flies that process stream detritus in their larval stage and serve as prey for fish (larvae) and birds and bats (adults). Trout are well known for their reliance on aquatic insect larvae such as mayfly, stonefly, caddis fly, midges, ants, and worms. Some species are common, while others are recognized as rare by individual states. Many species of invertebrates are excellent indicators of environmental health. Muskrats thrive on clams and mussels, and salamanders and frogs rely on aquatic insect larvae, snails, beetles, spiders, and earthworms.

Many invertebrates spend part or all of their lives in an aquatic environment. Most infamous are the various mosquitoes and black flies whose larvae grow in still waters and moving waters, respectively. Although their adult bloodsucking forms are seen as a nuisance, the larvae are important in the aquatic food chain, and winged adults are food for many birds such as cedar waxwings, swifts, and flycatchers, and all bats in the watershed such as little brown and hoary bats. Certain native and nonnative mosquitos, however, serve as vectors for serious diseases such as West Nile virus, which is well established in the watershed.

Mussels

The U.S. has the greatest diversity of freshwater mussels in the world, but of the nearly 300 species residing in North America, researchers believe that only 23.6 percent (23.6%) of the species are stable — the rest being either endangered, threatened, undetermined (5 percent (5%)) or of special concern, and 35 species are extinct or believed to be extinct (Williams et al. 1993, Nedeau 2008a). An extensive discussion of freshwater mussels for the watershed is provided in "Freshwater Mussels and the Connecticut River watershed" (Nedeau 2008a); much of the discussion on their critical ecological role was derived from this reference. As noted earlier, there are 12 species in the watershed, 8 of which are endangered, threatened, or of conservation concern by managing agencies and/or organizations. These include the federally endangered dwarf wedgemussel, the rare brook floater, and triangle floater. The yellow lampmussel is another rare species. The Tidewater mucket was documented from the Connecticut River in Massachusetts in 2005 and also occurs in Connecticut. The Eastern pearlshell and the Eastern pond mussel are both *uncommon.The* only relatively common mussels are the Eastern elliptio and alewife floater, the former having many cool and warm-water host fish species, and the latter being somewhat restricted to alosids (i.e., American shad, blueback herring, alewife). The Eastern elliptio is the most widely distributed of the mussels in the watershed, and the alewife floater is moderately well distributed, as are the Eastern pearlshell, triangle floater, creeper, and Eastern lampmussel (Nedeau 2008a).

Zebra mussel on native mussel

USFWS

As filter-feeders, freshwater mussels are recognized for being excellent indicators of watershed health, and they play an essential and significant role in the food web, improving water quality, nutrient cycling, and habitat quality. They are unique in their reproductive cycle in that their larvae, or glochidia, must attach to the gills or tail of fish, or as is sometimes the case in creepers, amphibians may be the host (Nedeau 2008a). As a group, they inhabit a wide range of riverine and stream habitats; however, individual species often have strict habitat requirements. Eight of the native species have broad distributions, four occur in the southern portion of the watershed (Nedeau 2008a), and nine species have been found within a 1-mile stretch of the Farmington, Fort, and Salmon rivers (Nedeau 2005a, 2005b, 2008b). Other rivers with high occurrence include the Mill River in Massachusetts and Eight Mile River in Connecticut. Of 47 recognized tributaries, seven contain between nine and 11 mussel species, 18 contain six, and 19 contain less than five. Each state has tributaries containing no mussels, such as the Mohawk River in New Hampshire and Fall River in Massachusetts (Nedeau 2008a).

Threats to freshwater mussels include dams and other aquatic blockages, destruction of riparian habitat, dredging, intensive agriculture and urbanization, stream flow alterations, and all aspects of water pollution: eutrophication, organic and heavy metal contaminants, acid rain, turbidity, power plant and urban source thermal pollution, anoxia and hypoxia, pH, pesticides, endocrine disruptors. Invasive fish, including the nonnative smallmouth bass, often displace native host fish, disrupting mussel breeding behavior, and mussels also are threatened by the invasive zebra mussel and quagga mussel, although these mussels are not currently in the watershed (Nedeau 2008a).

Pollinators

The health of the watershed and its habitats is greatly affected by pollinators, and quality habitats such as those found on national wildlife refuges are essential to pollinators. Pollinators (insects, birds, bats) are essential to our environment, including that of the watershed. The ecological service they provide is necessary for the reproduction of nearly 70 percent (70%) of the world's flowering plants, including more than two-thirds of the world's crop species. The U.S. alone grows more than one hundred crops that either need or benefit from pollinators, and the economic value of these native pollinators is estimated at $3 billion per year. Fruits and seeds derived from insect pollination are a major part of the diet of about 25 percent (25%) of all birds, and of mammals ranging from red-backed voles to black bears.

Four previously abundant species of native *Bombus* bumblebee have declined by 96 percent (96%) in the U.S., and their ranges collapsed by 87 percent (87%) (Cameron et al. 2011). A good example of an important wild pollinator is the rusty-patched bumble bee, once commonly distributed throughout the east and upper Midwest that has steeply declined in recent years. This bumble bee is an excellent pollinator of wildflowers, cranberries, and other important crops, including plum, apple, alfalfa, and onion seed. In many places, the essential service of pollination is at risk from habitat loss, pesticide use, and introduced diseases (The Xerces Society 2013).

Rare Plants

The New England Plant Conservation Program (NEPCoP), a collaboration between the New England Wild Flower Society and the state botanists in the natural heritage programs examined the status of all the rare plants in New England. They most recently published their findings in the 2012 *Flora Conservanda* (available online at: *http://www.newfs.org/conserve/saving-imperiled-plants/flora-conservanda*; accessed August 2016). NEPCoP then commissioned and published conservation plans for about 120 species of the

rarest plants. The refuge supported the development of conservation plans for the following six rare plants that had most of their occurrences in the watershed.

Yellow corydalis
This plant is at the northeastern limit of its range in Connecticut and occurs in only four populations in five towns in the south-central part of the State. It is listed in *Flora Conservanda* as a "regionally rare" species and by the State of Connecticut as threatened. It is restricted to a narrow belt of open outcrops and sparsely wooded summits along trap-rock ridges. Property supporting one of the populations is owned by a conservation organization, and another population is under the jurisdiction of two towns. The final two are privately owned. Trampling and damage from all-terrain vehicles is a threat at three of the four sites. Competition from invasive plant species and climate change are potential threats (Farnsworth 2001).

Garber's Sedge and Sticky False Asphodel
These two plants are considered together because they inhabit similar habitats. They often co-occur along calcareous river shores and riverside seeps, on sites that are regularly inundated and ice-scoured. Garber's sedge is considered a "globally rare species occurring in New England," while the more common sticky false asphodel is "locally rare." The watershed contains 11 occurrences of the former and 8 occurrences of the latter (they co-occur at six sites). Most of the sites are on the main stem of the Connecticut River in New Hampshire and Vermont, although there are two occurrences along the White River and one on the Passumpsic (Brumback 2001).

Many-fruited false-loosestrife
This perennial is a "regionally rare" species. It is listed as endangered in Vermont (two sites) and threatened in Massachusetts (seven sites in the Connecticut River watershed). The species occurs on floodplain and pond shore habitats. It is threatened by invasive plant species, recreational activities, and hydrological changes (Ramstetter and Mott-White 2001).

Musk flower
Also a "regionally rare" species, it is found at only three sites in Vermont, three in New Hampshire, and three sites in Massachusetts. It grows in wet, cool soils along brooks, springs, and wet seeps. Most occurrences contain only small numbers of plants, and invasive species are present at several of the sites (Ewing 2001).

Toothcup
Another "regionally rare" species, this plant is at the northern edge of its range with seven populations (four in the watershed) documented in Massachusetts and three in Connecticut. Toothcup inhabits exposed gravel or cobble shores of lakes, ponds and reservoirs that have wide fluctuations in water levels. It occupies the zone between low and high water, and does not compete well with other plants. Of 26 historic sites, the plant has only been observed at five since 1990. Invasive species, sedimentation, and habitat succession are all threats (Mattrick 2001).

Invasive Species
Introduced species that multiply in large numbers, displace native species, and cause ecological damage (i.e., loss of rare species and plant communities, loss of habitat value, change in soils, changes in fire regimes), economic damage (e.g., weeds, forest pests, zebra mussels), or impact human health (e.g., giant hogweed) are called invasive species. Since our Nation's founding, the U.S. has experienced the introduction of more than 30,000 species of plants, animals, fungi, and viruses, most introduced directly or indirectly by humans. Although

many are valuable crops and livestock, others are serious pests that have claimed the habitats of native species, forcing many of them to extinction, causing crop damage and human and animal disease. Economic damage is estimated to be $123 billion annually, and more than 40 percent (40%) of Federal endangered and threatened species are at risk due to the impacts associated with introduced species (Hall 1999).

Kathy Fournier/USFWS

Nulhegan Basin Division office

Invasive species have been introduced, purposefully or accidently, into the watershed from other countries or other regions of this country. Often these exotic species establish in natural ecosystems, becoming naturalized, but without noticeably affecting natives or their habitats. However, some outcompete and displace native species, especially if there are no natural population control mechanisms (e.g., habitat competition, predation, disease, and parasitism) in their new location. In fact, introduced species frequently have been introduced specifically because they were easy to establish, hardy, and disease resistant. In addition to the initial introductions, human activities that relocate surface soil layers and disturb existing stands of invasive plants or that result in generally disturbed soils, contribute excessive nutrients, and remove native plant cover, can favor the spread of exotics.

Invasive Exotic Fish

Nonindigenous fish species are found throughout the length of the Connecticut River and its tributaries. There are more introduced fish species (35) in the watershed than native species (33). Many species were introduced to provide additional recreational fisheries, specifically, trout, bass, pike, and sunfish. Native species populations often suffered from exploitation, habitat loss, and water quality degradation. Land management practices including unregulated timber harvest, some agricultural practices, dam installation, and industrial discharges resulted in altered habitat and water quality conditions that were better suited for hardier nonindigenous species. The distributions and populations of fish are better known than those of any other aquatic species. State and Federal agencies work together to avoid the loss of native fish species as a result of the purposeful or accidental introduction of nonnative plant and animal species.

Invasive Plants

Invasive, exotic plants like Oriental bittersweet, Japanese stiltgrass, purple loosestrife, garlic mustard, glossy buckthorn, water chestnut, and shrub honeysuckles can substantially degrade native plant communities in the watershed. Since the last ice age, the native plants and animals have co-evolved, and developed intricate interdependences. While there are an estimated 4,000 introduced plants in the U.S., only 400 are considered potentially invasive. Many of the alien plants, such as dandelion, naturalize and blend in with the native plants. A few others have a remarkable competitive advantage, and can overcome the native vegetation reducing their biomass and in turn impacting the wildlife dependent on them. Some introduced plant species can alter the soil chemistry and produce chemicals that inhibit or prevent other species from growing in close

proximity; others elevate erosion potential; some are so attractive to pollinators that native plants are avoided; others impact habitat suitability (UVPLC 2002).

Based on figures for Massachusetts, 950 of the 2,700 (or 35 percent (35%)) of plants in that State have been introduced (Bickford and Dymon 1990). In Massachusetts alone, at least 66 species are considered invasive, likely invasive, or potentially invasive, including Norway maple, autumn olive, mile-a-minute vine, burning bush and garlic-mustard (Somers et al. 2006). Although common reed and purple loosestrife degrade wetlands throughout the watershed, these plants are much more widespread in Connecticut, affecting a large number of wetlands. In general, the southern watershed has more and larger, well-established invasive plant populations, likely due to the warmer climate and larger human populations that cause the soil disturbance known to benefit invasive plant establishment.

Another plant affecting both wetland and upland habitats in Connecticut and Massachusetts is Japanese stiltgrass and refuge staff are working with partners to try to keep it from spreading northward. Mile-a-minute vine is being controlled where found in Connecticut and refuge staff and volunteers have assisted partners to control the few sites in the watershed in Massachusetts. It has newly been found in New Hampshire, but not at all in Vermont. Oriental bittersweet, Japanese knotweed, multiflora rose, buckthorns, and Japanese barberry are widespread in upland areas, with the knotweed extending into northern New Hampshire and Vermont. Eurasian milfoil is a problem in the watershed, even in many northerly ponds and lakes, including Lake Morey in Fairlee, Vermont; Halls Lake in Newbury, Vermont; and Mill Pond in Windsor, Vermont (LaSala 1994).

Water chestnut, a floating invasive aquatic plant that can rapidly become established and cover the entire surface of shallow coves, ponds, or lakes, was reported in the watershed in 1997. Since the late 1990s, the refuge has led a partnership effort comprised of local and state agencies, conservation partners, landowners, and many volunteers to find and remove this plant. Seeds of this annual weed can remain viable in bottom sediment for a dozen years. As of 2016, the refuge and partners are actively controlling or evaluating success at approximately 50 known sites in the watershed of Massachusetts and Connecticut. It was newly reported from Hinsdale, New Hampshire in 2012.

Rock snot or didymo, a diatom that creates large mats in flowing water, was found in the upper Connecticut River and White River in 2007. Didymo can form extensive "blooms" on the bottoms of rocky river beds, and it is thought that these smother aquatic life forms such as aquatic insects, native algae, and other organisms fed on by fish (NH DES 2008). However, evidence emerged in 2016 showing that this species is native to New England and becomes problematic in areas with low phosphorus levels.

Comprehensive descriptions of invasive plant species are available from the Invasive Plant Atlas of New England (IPANE), now administered by the Early Detection and Distributional Mapping System (EDDMapS, at *https://www.eddmaps.org/ipane/* , accessed July 2016)). Along with the University of Connecticut and the New England Wild Flower Society, the Conte Refuge was a founding partner of IPANE. Under a grant from the USDA from 2001 to 2005, citizen scientists where trained through IPANE to collect distributional data while refuge staff worked with IPANE partners to administer the networking arm of IPANE to connect New Englanders concerned about the invasive plant issue via email newsbriefs and regional conferences. This networking was done under the name "New England Invasive Plant Group (NIPGro)". . States

comprising the watershed also provide extensive information on invasive plants and create statewide lists after evaluating species for invasiveness at the state level. Links to much of that information, including lists for species targeted for early detection and rapid response, can be found at the New England Wild Flower Society website at *http://www.newfs.org/conserve/controlling-invasives/* (accessed August 2016)

Invasive Invertebrates
Zebra mussels were first found in the U.S. in 1988 in Lake St. Clair, Michigan, and later spread to all five of the Great Lakes, the Finger Lakes area of New York, and the Mississippi River basin. Zebra mussels are currently found in at least 30 states, although have not been found in the Connecticut River watershed. This invasive mussel could have a profound effect on the native freshwater mussels in the watershed. This mussel attains a size of one half inch to an inch and one half as an adult. It is of great concern because, similar to the Asiatic clam (below), this exotic mussel has an incredible propensity to reproduce. Once established, zebra mussels have the capacity to clog water intake pipes of waste water treatment plants, electric generation plants, and industrial operations. This mussel poses a serious threat to aquatic ecosystems because it can outcompete and displace native species, particularly mollusks and impact natural processes. Large, established populations of these filter feeders can remove vast amounts of algae, phytoplankton, and zooplankton greatly reducing food supplies for native organisms. The discovery in July 2009 of zebra mussels in Laurel Lake, located in western Massachusetts (Housatonic River watershed), prompted Massachusetts to develop an Interim Zebra Mussel Action Plan (MDCR and MDFG 2009) and later a series of recommendations from the Zebra Mussel Task Force (MEOEEA 2009).

Asiatic clam is a freshwater invertebrate that first entered North America in the early 1900s, reaching the Mid-Atlantic States in the 1970s and 1980s. The animal grows to one-half inch as an adult. It has been identified in the lower reach of the Connecticut River, and is of great concern because of its reproductive capacity: an average of 70,000 offspring per adult per year. This clam poses a serious economic threat because of its ability to clog industrial water intake pipes. It also is a serious environmental menace because it can outcompete and displace native mollusks. In suitable environments, Asiatic clam densities can reach 10,000 to 20,000 individuals per square yard, impacting a diverse array of aquatic plants and animals (USGS 2013b).

The quagga mussel (named after the quagga, an extinct African relative of the zebra) was first sighted in the Great Lakes in September 1989. This mussel is now well established in the lower Great Lakes, but has not been found in great numbers outside this region. Its occurrence in the St. Lawrence Valley presents a clear concern for its spread into the Connecticut River watershed (USGS 2011). Although not yet documented in Massachusetts, the education and action components of the State's 2009 Interim Zebra Mussel Action Plan is designed to prevent the occurrence and spread of quagga mussels as well.

Introduced forest pests are a concern throughout the watershed. The scale insect responsible for beech bark disease (BBD) was introduced to the northeastern U.S. from Europe in the 1890s (Koch 2010). BBD causes significant mortality and defect in American beech (*Fagus grandifolia*). The disease results when bark, attacked and altered by the insect beech scale (*Cryptococcus fagisuga*), is invaded and killed by native fungi, primarly (*Nectria coccinea*). Currently BBD affects all of the Refuge forests where American beech occurs. After the killing front has moved through a stand, the aftermath zone areas where heavy mortality occurred at some time in the past, is characterized by some residual larger

trees and many stands of small trees, often of root-sprout origin. Larges trees, over about 8 inches in diameter, succumb more readily than small ones, leaving landscapes devoid of larger-diameter mature beech trees. Gypsy moths have caused widespread damage over the years. In addition, attempts to control them severely affected non-target native species. Dichlorodiphenyltrichloroethane (DDT) spraying for gypsy moth control in the 1950s and 1960s severely depressed the populations of many butterflies and other insects. The hemlock wooly adelgid (HWA), an introduced aphid, is presently killing Eastern hemlock trees and compromising hemlock forest associations throughout the eastern U.S. HWA is now established from northeastern Georgia to southeastern Maine and as far west as eastern Kentucky and Tennessee, and may spread northward with climate change. Biological control of HWA using lady beetles is showing some promise (Cheah et al. 2004). Emerald ash borer (EAB) was discovered in Michigan in 2002 and has since spread to three of the four states in the Conte's acquisition boundary. New Hampshire is the most recent and most northerly discovery. EAB kills 99 percent (99%) of ash trees and infects all ash species. Eradication efforts are underway in many states, and often involve complete removal of all ash trees in front of the advancing EAB population. The Asian longhorn beetle is established in Worcester, Massachusetts, and efforts are in effect to restrict activities with infected trees and wood within regulated, designated areas (city of Worcester 2013). The current goal of Federal and state agencies is complete eradication of Asian long-horned beetle. The beetle is able to attack and kill healthy trees across a wide range of species including maples. Eradication efforts are currently underway and involve removal, chipping, and burning of any and all material from infested trees.

Invasive Fungi

A number of introduced fungi have had devastating effects on the plant and habitat characteristics of Eastern North America and Connecticut River Valley. Most prominent are the 1904 American chestnut blight, 1930 Dutch elm disease, and 1967 butternut tree canker, all of which have impacted forest composition and ecology in New England. The chestnut blight caused the collapse of the most dominant hardwood in the Appalachian Mountains and beyond, completely eliminating a critical mast source and shelter for wildlife and food and fiber for mountain communities. Ironically, stunted American chestnut remain ubiquitous as the fungus prevents trees from maturing and producing nuts; eastern woods are abundant with stump sprouts with some immature trees reaching 20 to 30 feet. in height (Bolgiano 2007).

Dutch elm disease (DED) was introduced to the U.S. from Europe in the 1930s, and by 1977, the disease had spread throughout most of the country, killing an estimated 46 million American elms. DED has mostly affected urban populations of American elm, a widely planted shade tree. In forest stands where elms are relatively isolated from one another, spread of the disease is sporadic. The USDA Forest Service's Northern Research Station, has established demonstration plantings of DED-tolerant American elms on many of its sites in the east and mid-west to develop DED-tolerant elms. Disease resistant elms are often planted as replacement to diseased and destroyed trees (USFS 2011). Currently, TNC is evaluating the efficacy of disease resistant elm plantings in the watershed, including a possible planting at the Fort River Division in 2014. Butternut, also known as White walnut, is a highly valued hardwood species native to eastern North American forests. Like Chestnut blight and DED, Butternut canker has effectively eliminated butternut as a thriving tree species within the northeast forest ecosystem. In 1995, the Forest Service estimated that 77 percent (77%) of the butternuts in the Southeast were dead. Surviving butternuts are often found in riparian zones, and, in contrast to American chestnut, butternuts usually will not sprout after stem death. Most butternut dies within 15 years of infection and

virtually all known populations of butternut are now infected (Schlarbaum et al. n.d., Lombard n.d.).

Socioeconomic Environment

We enlisted the assistance of economists with the USGS, Fort Collins Science Center, to assist us in a regional economic report. The full report is included as appendix I. Among other details and analysis, the report includes a description of the current economic setting and illustrates the refuge's contribution to local economic communities. The refuge management activities of greatest, direct economic impact in the watershed are:

- Refuge purchases of goods and services within the local communities.
- Refuge staff salary spending.
- Refuge visitor spending in the local communities.
- Revenues generated from timber harvesting for habitat management on the refuge.
- Refuge land purchases and changes in local tax revenue.

The report also notes that the economic value of a refuge encompasses more than just the direct impacts to the regional economy. Refuges also provide substantial nonmarket values (values for items not exchanged in established markets) such as conserving threatened and endangered species, preserving wetlands, and helping to maintain clean water and air (Caudill and Henderson 2003). These natural "services" (often called ecosystem services) provided by the conserved landscape can be extremely valuable to one's well-being and to society in a more traditional economic sense. Ecosystem service values can be substantial, and should be recognized as a contribution when evaluating refuge management activities. However, quantifying individual ecosystem service values is beyond the scope of the economic impact analysis.

Some highlights of the economic setting description follow. Please refer to appendix I for the full narrative.

In its entirety, the watershed encompasses an area of over 11,000 square miles and contains nearly 400 towns and cities. The 7.2 million-acre watershed is home to over 2.3 million people (Clay et al. 2006). The waters of the Connecticut River have played an important role in the watershed's social and economic history. The river itself provided a source of energy to power mills, factories, and entire communities, irrigation water for working farmlands, and a means of transportation for the watershed's people and goods. The regional economy has evolved from the original agricultural colonists and small goods traders, to robust manufacturing production and supporting commodity extraction industries, to relying more on the services sector and travel and tourism spending. Currently, large urban centers within the southern counties of the watershed serve as hubs to the greater New York City area with many residents employed in the service industry. Counties near the northern headwaters continue to provide a more rural way of life and are still highly dependent on manufacturing jobs.

Many of the towns within the watershed are attempting to capture more of the valuable tourism market by hosting annual festivals and cultural events that attract crowds from beyond the community borders. Many of these events are centered on the historic, cultural, and economic makeup of the region. Area farmers and artisans are once again finding local markets for their goods, while catering to buyers and their overall experience. Agritourism seems to be expanding at a considerable rate, with each State in the watershed now having a Web site and interactive map just for these enterprises.

There are abundant recreation opportunities within the counties of the watershed, including a range of opportunities on tracts under refuge management. Traditional activities on refuge lands include fishing, hunting, wildlife observation, photography, environmental education, and interpretation. Snowmobiling is very popular in various regions of the watershed, and is permitted on refuge land. The Appalachian Trail meanders through the northern-half of the watershed, making its way through the impressive White Mountain National Forest in New Hampshire. The middle portion of the watershed in Massachusetts is bordered by the Berkshire Mountains to the west, which have been attracting tourists and recreationists for decades. Towns in the southern portion near the mouth of the Connecticut River heavily promote recreation opportunities associated with saltwater experiences. While large tracts of the watershed remain undeveloped, sprawling communities, particularly in the southern portion of the watershed, have begun to alter the dynamics in the region.

Given the vastness of the watershed, and the extensive diversity within, the economic report focuses on describing and assessing six focal sub-regions. The sub-regions incorporate 11 counties that make up the bulk of the watershed and are central to the refuge's existing and proposed future land base. The sub-regions described are:

(1) Northern Sub-Region: Essex County, Vermont, and Co-s County, New Hampshire.

(2) White River Junction Sub-Region: Orange County, Vermont, Windsor County, Vermont, and Grafton County, New Hampshire.

(3) Tri-State Border Sub-Region: Windham County, Vermont, Cheshire County, New Hampshire, and Franklin County, Massachusetts.

(4) Greater Amherst Sub-Region: Hampshire County, Massachusetts.

(5) Greater Hartford Sub-Region: Hartford County, Connecticut.

(6) Southern Connecticut Sub-Region: Middlesex County, Connecticut.

Section 1 of the report provides detailed socioeconomic demographic profiles for each focal sub-region. Each sub-region profile addresses historic and current trends in the area, and highlights important demographic and economic statistics. Included are population, regional employment and income, commodity industries, recreation and tourism industries, and land use and ownership. Few of these trends are consistent across all the sub-regions in the watershed, so we recommend the reader review the sub-region description of interest.

Part II: General Refuge Information

Refuge Administration and Facilities

Refuge Staffing and Administrative Facilities

The Conte Refuge is managed by a staff of nine full-time employees and one shared employee. As funding allows, the refuge also has additional temporary staff to help support visitor services or biological programs. The refuge also administers the Stewart B. McKinney National Wildlife Refuge along the Connecticut coast and the John Hay National Wildlife Refuge in Newbury, New Hampshire.

The refuge includes three staffed facilities. The headquarters office in Sunderland, Massachusetts, has the lead wildlife refuge manager (also known as the project leader), the deputy project leader, a general biologist, a Partners Program biologist, and a visitor services specialist. One temporary staff is stationed at the Great Falls Discovery Center in Turners Falls, Massachusetts. Full-time staff at the Nulhegan Basin Division office in Brunswick, Vermont, includes a forester and a wildlife biologist. The refuge manager position there is vacant. The refuge shares a full-time law enforcement officer with the Umbagog National Wildlife Refuge (Errol, New Hampshire). Temporary positions vary between two and five per year and there are Youth Conservation Corps (YCC) crews, comprised of adult supervisors and local youths at the Nulhegan Basin Division, Pondicherry Division, and Fort River Division. During 2013 through 2016, 10-month Student Conservation Association crews were stationed at the Fort River Division. Please see appendix H for the current refuge staffing chart.

The three facilities for the refuge—Sunderland headquarters, Great Falls Discovery Center, and Nulhegan Basin Division Office—currently provide adequate space and amenities. The Sunderland headquarters office was made available following a renovation of the existing Connecticut River Fisheries Coordinator's facility, allowing for more cost effective office space in contrast to former leased space in Turners Falls, Massachusetts. Solar panels were installed on the roof of this building in 2012 to reduce long-term energy costs and utilize a renewable resource.

Lewis Pond, Nulhegan Basin Division

Sharon Lindsay

The Great Falls Discovery Center offers adequate space for one full-time visitor services specialist, and the public facilities are described below under "Public Use Facilities." Working with our state partner, this building has undergone an energy audit and steps (e.g., cleaning climate control duct work, furnace repair) have been taken to make this old building more energy efficient.

The Nulhegan Basin Division office and visitor contact station was constructed in 2006 and provides space for the three full-time staff and the shared law enforcement officer as noted above. This office/visitor contact station is one of the first in the Northeast Region to employ a standard design approach for refuge buildings. Its energy efficient design made it the first Energy Star building in the Service, and garnered a Silver designation from the "Leadership in Energy and Environmental Design for Existing Buildings" version 2.0 rating standard. This division also has two storage barns/garages and two heated quarters buildings: a 1990s era house occupied by permanent staff and the other is a 2004 modular home used for interns and visiting staff.

The Fort River Division includes a quarters building (i.e., three-bedroom house), a pole barn, stables building with two decrepit apartments, and office. Attached

to the stables is a large former indoor riding arena which has a former horse hot-walker room attached. The stables building has been determined to be surplus to the refuge's needs and will eventually be removed. Several water lines in this building are broken, leaving only barn water spigots functioning, which are used for cleaning equipment. The riding arena is used as a secured storage facility for vehicles and equipment. Utilities to this building have been shut off, although once the stables are removed, water and electrical services will be necessary. The arena is not insulated, but that is not necessary for its storage purposes. The quarters building was remodeled in 2009, including replacement of a large single-pane bow window and the entry doors. The original appliances also were replaced with energy efficient units. Potential additional energy conservation projects include installing energy efficient windows, replacing the water heater, additional insulation, solar and/or wind power.

The Salmon River Division includes a 1970s era two-story home on the shore of the Salmon River. At the present time this house has no functioning utilities and is not occupied. It will need a new electrical line from the house to the power lines and will likely require a new furnace, hot water heater, and some appliances should it be used as a quarters or support building. There are opportunities to incorporate energy efficient appliances and possibly solar panels.

There are some additional buildings on other units, such as the Pondicherry and Blueberry Swamp Divisions and the Roger Tory Peterson Unit.

Budget

Annual budgets are appropriated by Congress, and therefore, can vary year to year. Budget allocations are typically broken out into the following categories: wildlife and habitat, facility maintenance, visitor services, and law enforcement. Table 3.5 shows the refuge's budget for fiscal year 2016.

Table 3.5. Refuge Budget for Fiscal Year 2016

Budget Category	2016 Budget
Wildlife and Habitat	$921,478
Facility Maintenance	$91,710
Visitor Services	$351,285
Law Enforcement	$81,763
2016 Total Budget	**$1,446,236**

Young Adult Programs

Youth Conservation Corps

YCC is a government-funded summer program that gives young people (ages 15 to 18) paid opportunities to help work on public lands. While on board, participants conduct projects for the refuge while learning about the environment. Depending on annual appropriations, we host three or four crews at our divisions, with at least one each in Vermont, New Hampshire, and Massachusetts (and a crew at Stewart B. McKinney Refuge for which we handle the administrative aspects). Crews are typically comprised of a crew leader, an assistant leader, and four crewmembers. During the past 5 years, this program has served nearly 340 youth and young adults. The YCC crews provide valuable support to all refuge programs. Recent projects include boundary posting, multiple trail construction and maintenance projects, and invasive species control efforts and assisting partner organization with natural resource and environmental education projects.

The YCC crews working on the refuge are being administered through a cooperative agreement with Northwoods Stewardship Center, an established organization with a focus on youth employment in the outdoors. This provides us an opportunity to support this important program, but given our limited staff, allows us to rely on a partner to administer the program.

Student Conservation Association/AmeriCorps
AmeriCorps is a Federal community service program for young adults ages 18 to 23. The Student Conservation Association (SCA) is a youth training organization that places young adults interested in natural resources with government agencies and non-profits to assist the agency in work and provide job training skills to the young adults. Since 2013, the Conte Refuge has worked with 18 SCA interns that are subsided by AmeriCorps. During 2013 to 2015, the SCA/AmeriCorps crew worked at the Fort River Division helping with trail construction, invasive plant control, fisheries biology assistance and boundary posting. They also participated in visitor services programs at the Great Falls Discovery Center and WoW Express. During the 2016 year, the SCA/AmeriCorps interns assisted with trail maintenance, fisheries biology assistance, invasive species removal, Puritan tiger beetle translocations and rearing, as well as dwarf wedgemussel site surveys.

Career Discovery Internship and Pathways Programs
The Career Discovery Internship Program (CDIP) program is a recruitment tool that provides college-age individuals the opportunity to experience the refuge system from the perspective of a staff member, often filling roles in the biological or visitor services programs. CDIP was created in 2008 through a partnership with the Student Conservation Association. Designed to target diverse populations, the CDIP serves approximately 30 students every year, giving them the opportunity to pursue gainful summer employment on any of the Northeast's national wildlife refuges. These internships provide students with career experience in the field of conservation as well as the opportunity to develop professional networks with service employees. The Nulhegan Basin Division employed an intern the past 3 years: year one the intern worked with invasive plants, including the mapping of *Phragmites* locations on a neighboring parcel; the last 2 years interns have served at the visitor contact station.

The refuge has hosted a Pathways Program student in visitor services the past 2 years, and previously hosted a biological student under a similar program. In both cases, these students engaged in many diverse projects including field studies, administration, invasive plant control, in visitor services for the Great Falls Discovery Center and WoW Express, and to support the new Adopt-a-Habitat program. The goal of the Pathways Program is to offer students with internships in their field of study and prepare these students for future employment with the Service.

Hispanic Access Foundation Program
In 2016, refuge staff hosted one Hispanic Access Foundation (HAF) intern. HAF is a group that helps place Hispanic college students interested in natural resources with government agencies and non-profits to assist the agency with work and provide job training skills to the young adults. In 2016, the HAF intern assisted with trail maintenance, fisheries biology assistance, Puritan tiger beetle translocations, and environmental education.

Other Interns
Partner relationships allow us to support interns in unique ways. Often the partner organization recruits, hires, and pays the interns, and the Refuge

supplies housing, an office, or logistical support. A current partnership with Trout Unlimited (TU) serves as an example: interns with TU have stayed in Refuge quarters while conducting fish habitat and population surveys on and off Refuge lands. The Upper Connecticut River Cooperative Invasive Species Management Area hired interns who began mapping invasive plants along tributaries of the Connecticut River while staying in Refuge quarters. Nulhegan Basin staff supervised their day-to-day activities and provided logistical support to the CISMA effort through geographic information system (GIS) mapping.

Volunteer Program
Volunteers are vital to all our refuge programs. Individuals involved in volunteering range from youth to adults, and include local residents, clubs, and organizations. Some are long-term volunteers and have been with us for years, while others volunteer for a few hours in one day. In 2016, for example, approximately 100 volunteers provided 1,546 hours of work on refuge lands. Projects range from invasive plant control, particularly water chestnut removal, outreach at visitor contact facilities, maintenance of infrastructure, biological surveys, public use and environmental and interpretive programs.

Refuge Operational Plans (Step-down Management Plans)
Planning for the refuge occurs at three levels: a CCP, step-down refuge management plans, and annual work plans. The CCP addresses topics of species and habitat management, visitor use, refuge operations, and development in general terms. The refuge management step-down plans take the strategic direction from the CCP and provide more specificity on when, where, and how programs will be run, or how natural and cultural resources will be protected. The annual work plans identify fiscal year priority projects needed to implement the CCP and associated management plans.

Step-down Management Plans, identified in policy 602 FW 4, generally are prepared to provide detailed strategies and implementation schedules for meeting goals and objectives identified in CCPs, although they are also prepared to meet select policy requirements (e.g., Station Safety Plan). There are more than 25 step-down management plans that may be appropriate to ensure safe, effective, and efficient operation on every refuge, ranging from habitat management to pesticide use and disposal.

Some plans require annual revisions; others are on a 5 to 10 year revision schedule. Step-down management plans prescribe a host of activities (i.e., Federal actions) and are, consequently, subject to NEPA compliance, public involvement, compatibility determinations, and the like. Often CCPs provide sufficient management detail, provided adequate public involvement and NEPA compliance has occurred (along with necessary compatibility determinations), so that subsequent development of associated step-down management plans called for by a CCP may be done without further NEPA compliance considerations. Ideally, a CCP either contains the detailed management elements, thus precluding need for step-down plans, or it clearly sets the stage for needed step-down plans.

The following step-down plans have been through NEPA compliance and are current; they will be subject to possible revision following approval of the final CCP:

- Visitor Services Plan–Nulhegan Basin Division (completed in 2002).
- Hunt Management Plan–Pondicherry Division.
- Hunt Management Plan–Nulhegan Basin Division and Putney Mountain Unit.
- Furbearer Management Plan–Nulhegan Basin Division (completed in 2000).

We anticipate developing the following step-down plans after finalizing the CCP. This list is only tentative, once the CCP is complete we will better know which step-down plans are necessary. Additional plans may be required depending on the alternative selected for the final CCP.

- Hunt Plan–Fort River Division, Salmon River Division, Blueberry Swamp Division, Mill River Division, Westfield River Division, Dead Branch Division, Mount Toby Unit, Third Island Unit, Honeypot Wetlands Unit.
- Fishing Plan–Salmon River Division, Fort River Division, Mill River Division, Third Island Unit, Dead Branch Division, Westfield River Division, Pondicherry Division, Blueberry Swamp Division, Nulhegan Basin Division.
- Habitat Management Plan.
- Visitor Services Plan.
- Law Enforcement Plan.
- Fire Management Plan.
- Integrated Pest Management Plan.
- Cultural Resources Management Plan.
- Inventory and Monitoring Plan.
- Furbearer Management Plan.

Friends of Silvio O. Conte National Fish and Wildlife Refuge and Other Refuge Friends Groups

The refuge benefits from a strong, productive, and cohesive partnership with the non-profit Friends of Conte who provide a forum and a foundation to forge creative partnerships. The group is a broad based partnership of 22 conservation, education, and outdoor recreation organizations with representation from the local, state, and national level. The Friends of Conte is particularly focused on refuge goals related to conservation, education, and recreation in order to contribute toward the refuge's legislated purposes established by Congress. The Friends of Conte routinely collaborates on mutually beneficial projects under the umbrella of the NWRA mentored Friends initiative.

Several refuge units and divisions also have their own Friends groups. Existing Friends groups include: Friends of Nulhegan Basin, Friends of Pondicherry Wildlife Refuge, Friends of the Great Falls Discovery Center, Friends of the Connecticut River Paddler's Trail, Friends of the Fort River Trail, Friends of Salmon River, and Friends of the Roger Tory Peterson Unit. New Friends groups are a consideration on other units of the refuge. These groups play a vital role in outreach, education, and assisting in day-to-day refuge operations and maintenance. We discuss the importance of Friends groups under goal 4 in chapter 4.

Special Use Permits

The refuge manager issues special use permits on a case-by-case basis after determining whether the use is appropriate and compatible with refuge purposes. Most special use permits have a 1-year or shorter term (5-year permits for privately owned cabins at Nulhegan Basin Division). Since 2000, we have issued annual special use permits for: snowmobile trail maintenance and use; wildlife

research; access to privately owned hunting camps; horse hauling of moose during hunting season; furbearer trapping; surveying and monitoring wildlife; all-terrain vehicle (ATV) access for disabled hunters; group environmental education; and use of blinds to observe or photograph wildlife.

We also issued special use permits for use and occupancy of privately owned hunting camps located on the Nulhegan Basin Division. Lands on which the cabins sit were previously leased to cabin owners by the owner of the larger forested tracts and were included in the Service's original land acquisition effort. The environmental documentation describing the land acquisition noted the Service's intention to continue the camp lease program for the life of the camp leaseholders or 50 years, whichever period is shorter. If current owners decide to sell their camps, the Service will pay market value and then remove them and restore the site if not needed for refuge purposes. No change in camp management is expected with development of the CCP.

Research

Conducting research is one of the purposes of the Conte Refuge Act. Refuge staff, graduate students, conservation organizations, and others have conducted surveys and studies on the refuge. A sampling of those efforts follows; other research projects are identified in the descriptions of existing divisions and units at the end of the is chapter. Additional information on these studies can be obtained from refuge headquarters.

The U.S. Forest Service, Northern Research Station has included the Pondicherry Division in long-term northern goshawk nest monitoring, when there is an active nest. This work is ongoing. The station also included the Fort River Division in a pilot study of nesting American kestrels that began in 2012. To date, several nest boxes have been erected at the division to evaluate use during the 2013 nest season.

In 2002 through 2004, researchers from Salve Regina University in Newport, Rhode Island, conducted a study on Canada warblers at the Nulhegan Basin Division. The study measured habitat-specific estimates of Canada warbler productivity and survivorship in the Nulhegan Basin. The results of this study are available on the Center for Northern Forest Research Web site at: *http://cnfr.us/research.php* (accessed August 2016).

A basin-wide evaluation of floodplain forests by TNC's Connecticut River Program included sampling locations at the Fort River and Mill River divisions (TNC 2011). Results of the initial study informed a TNC report and subsequent scientific paper (Marks et al. 2011, Marks et al. 2014).

The refuge has sponsored long-term monitoring of the federally threatened Puritan tiger beetle population in Northampton, Massachusetts, since 1998. The focus of this work has been to estimate adult numbers, monitor larvae and their habitats, enhance larval habitat, and augment the population from an intact meta-population in Connecticut. During the mid-2000s there was an effort to educate beachgoers about these beetles. Numbers remain precariously low at this site and continued work at the site is needed to recover this species.

The University of Massachusetts initiated a study of the diversity and abundance of native bees in gravel and sand pits that included the Fort River Division in 2011. No results are yet available.

To help refuge staff choose the most effective control of pale swallow-wort, the invasive plant threatening rare plants on Mount Tom, the Connecticut

Agricultural Experiment Station conducted a small experiment on-site to test various herbicides from 2007 to 2008.

Invasive Plant Control Program
Refuge staff are very active in invasive plant issues in the New England region and work with partners to control invasive plants on both public and private lands. In 1999, the refuge published "The Invasive Plant Control Initiative Strategic Plan for the Connecticut River watershed/Long Island Sound Region," which highlighted agencies and organizations already working on invasive plant issues in the watershed and New England, identified needs, and described the actions that would best serve the region within the following 5 years (1999 to 2004). Many of the priority actions outlined in the document were undertaken by various agencies and organizations including the refuge.

The main priority actions undertaken by the refuge following this plan and then subsequent initiatives include:

- A watershed-wide effort with partners to find and control invasive water chestnut populations.
- Inventorying and controlling invasive plants on the Pondicherry, Nulhegan Basin and Fort River Divisions and the Mount Tom Unit, often within larger partnerships and with the help of Friends groups, volunteers, YCC and SCA members.
- Helping secure funding for the establishment of the Invasive Plant Atlas of engaged citizen-scientists to collect distributional data on invasive plants throughout New England and continue to serve as a comprehensive web-based informational resource.
- Facilitating communications and networking among numerous organizations and individuals through the formation and administration for several years of the NIPGro, including an informational e-newsletter distributed to more than 1,000 individuals.
- Planning and holding three large conferences on the invasive plant topic in cooperation with IPANE partners.
- Conducting numerous workshops on important topics such as prioritizing control on large parcels, control of key species, and early detection and rapid response.
- Working with partners to stop the spread of Japanese stiltgrass and mile-a-minute vine, two new invaders to Massachusetts and northward.

For nearly a decade, the refuge has been a leader on the issue of invasive plant management through:

- Our former coordination of the New England Invasive Plant Group (NIPGro.
- Our involvement in the Invasive Plant Atlas of New England project.
- Being a catalyst for water chestnut control in the southern portion of the watershed.

- Through our encouragement for the formation of subwatershed-based invasive species partnerships.

- Participating in educational offerings such as workshops and conferences with partnering organizations and landowners.

We also have actively controlled invasive species on several refuge divisions and units, including chemical and mechanical (cutting) treatment of Japanese knotweed and common reed on the Nulhegan Basin and Pondicherry Divisions, and served as a pilot for a national program enlisting volunteers to aid with invasive plant control (pulling) and monitoring efforts at the Pondicherry Division.

In 2011, the refuge participated in a national inventory and monitoring project that brought in experts to conduct an invasive plant inventory of the Salmon River, Blueberry Swamp, and Fort River Divisions, engage partners in discussions, and teach refuge staff how to continue with the inventory and prioritize invasive plant management. Subsequent inventories were conducted by seasonal staff on the refuge's Mill River Division, Putney Mountain Unit, and Peterson Unit.

Since 2010, refuge staff have encouraged subwatershed-based CISMA partnerships that actively work locally on inventory, public outreach, and control. A grant was secured to provide six such partnerships with limited funds for projects in 2012 and 2013. Through this grant, refuge staff members are working with state and regional experts to prioritize invasive plant control in the watershed, with a focus on protecting important natural resources and planning for better early detection and rapid response.

The following principles will continue to guide our program:

- Focus on controlling invasive species that cause the greatest potential for harming native ecosystems and/or threaten refuge management goals on individual properties.

- Focus on protecting sensitive or rare habitats and species, those with high natural diversity, and/or those most resilient to climate change.

- Strive for early detection and rapid response.

Urban Wildlife Conservation Initiative

The Urban Wildlife Conservation Initiative grew out of the recommendations from the 2011 Refuge System vision conference, "Conserving the Future: Wildlife Refuges and the Next Generation." The goal of the program is to engage urban communities in wildlife conservation through partnerships, both on and off refuges. As the nation becomes increasingly urbanized, it is vitally important to connect urban audiences to wildlife by protecting and enhancing wildlife habitats in urbanized areas. As part of the program, the Service has developed eight standards of excellence for urban national wildlife refuges:

(1) Know and relate to the community
(2) Connect urban people with nature via stepping stones of engagement
(3) Build partnerships
(4) Be a community asset
(5) Ensure adequate long-term resources
(6) Provide equitable access
(7) Ensure visitors feel safe and welcome
(8) Model sustainability

The Urban Wildlife Conservation Program is particularly relevant to the Conte Refuge due to its proximity to several major cities and many urbanized areas, such as the Springfield, Massachusetts and Hartford, Connecticut metropolitan areas. The refuge's existing and potential partnerships that operate in the urban environment are many and diverse. For example, Conte Refuge is an integral part of the Springfield Urban Wildlife Refuge Partnership, officially designated in September 2015. Urban Wildlife Refuge Partnerships are a key piece of the Service's Urban Wildlife Conservation Program; they are long-term partnerships, formalized through official agreements, that engage urban communities in conservation issues on partner-owned lands within urban neighborhoods. The partnerships serve as opportunities to help engage residents in place-based, outdoor experiences in their community, which foster connections with fish and wildlife and their habitats.

The Springfield Partnership brings together a multitude of partners including the Conte Refuge, Friends of Conte Refuge, ReGreen Springfield, Springfield Watershed Restoration Partnership, U.S. Forest Service, Massachusetts Division of Ecological Restoration, University of Massachusetts Amherst, Mount Holyoke College, Connecticut River Watershed Council, Keep Springfield Beautiful, Springfield Museums, Pioneer Valley Planning Commission, Chicopee 4Rivers Watershed Council, and the City of Springfield. The Partnership aims to engage students and community members in environmental education and urban restoration projects to create a network of conserved habitats in the Connecticut River watershed. One of these urban restoration projects focuses on restoring urban streams and forests in the Abbey Brook Conservation Area, which have suffered from erratic storm water flows, invasive plants, adverse amounts of sedimentation, and other pressures common to urban streams and forests. With careful planning and adequate resources, partners hope to reverse these impacts, resulting in a neighborhood haven for wildlife and an asset to the city's residents.

Implementation of the urban programs could also occur through existing refuge programs such as Adopt-a-Habitat, Conte Corners, WOW Express, YCC, SCA crews, and volunteers.

Land Acquisition History

The 1995 Final EIS identified 48 SFAs for land protection encompassing 65 individual sites, for potential protection by the Service and its partners. While the Service was identified as the lead for 26,250 acres of the total, it was also identified as an alternate for acquisition on the total acres in the event a partner was not in a position to accomplish the habitat protection objective. The 1995 FEIS land protection approval, coupled with subsequent NEPA document decisions, currently gives authority to the Service to acquire up to 97,830 acres for the refuge. The 1995 Final EIS also indicated that the refuge would seek to offer challenge cost-share matching grants to assist partners in acquiring the land where they were identified as the lead; however, funding resources have not been adequate to meet both the operational needs of the refuge and support a viable grants program since 2001.

The refuge was officially established in October 1997 when the Connecticut River watershed Council donated Third Island located in Deerfield, Massachusetts, to the Service. Currently, the refuge consists of nine divisions, eight smaller units, and two conservation easements totaling approximately 35,987 acres (table 3.5).

About 75 percent (75%) of the current refuge land base was acquired when Champion International Corporation liquidated nearly 133,000 acres in northeastern Vermont. The Conservation Fund purchased the entire liquidation package, of which, about 26,000 acres was ultimately acquired by the Service and became the Nulhegan Basin Division on July 20, 1999 (USFWS 1999). The other large Service holding, the Pondicherry Division was established on December 22, 2000, and is about 6,400 acres of fee and easement land. The area was primarily

purchased from Hancock Timber Resource Group in 2003 when they liquidated some of their land assets.

Although both divisions were SFAs in the 1995 FEIS, decisions by industrial forest owners to liquidate holdings in the Northern Forest necessitated a change in the refuge conservation strategy to protect important habitat that was previously considered secure. Due to the changes in the scope of what was identified in the 1995 FEIS for these two SFAs, the Service initiated the NEPA compliance process completing individual environmental assessments for these two divisions. Findings of No Significant Impact decisions for both projects were issued. In consultation with the public, these decisions allowed the Service to respond to the unanticipated changes and acquire these two high wildlife-value areas.

Richard Tetreault

Hunting deer on Nulhegan Basin Division

There are seven other divisions in the initial stages of acquisition: one in New Hampshire, four in Massachusetts, and two in Connecticut. The Blueberry Swamp Division (formerly called the Mohawk River Division) in New Hampshire was established in 2007. The divisions in Massachusetts include the Fort River (2005), Mill River (2007), Dead Branch (2011), and Westfield River (2013). The first acquisition for the Salmon River Division in Connecticut occurred in 2009, while the Whalebone Cove Division was established in 2013. In addition to these divisions, the Service owns several smaller units in Massachusetts, Connecticut, and Vermont that were identified in 1995 FEIS.

A full description of the refuge's existing divisions and units are provided below in part II of this chapter. Table 3.6 lists the acquisition history for the refuge as of October 7, 2013. Refuge acquisitions have been ongoing since 2013. Contact refuge headquarters for an update.

Table 3.6. Land Acquisition History for Conte Refuge as of February 2016.

Refuge Division/Unit	State	Funding[1] Source	Acquisition Year	Acres[2]
Dead Man's Swamp Unit	CT	LWCF	2005	30.75
Salmon River Division	CT	LWCF	2009	285.00
Salmon River Division	CT	LWCF-R	2011	40.00
Roger Tory Peterson Unit	CT	LWCF-R	2011	1.84
Roger Tory Peterson Unit	CT	LWCF	2011	54.26
Salmon River Division	CT	LWCF	2012	48.52
Salmon River Division	CT	LWCF	2012	4.80
Salmon River Division	CT	LWCF	2013	38.00
Salmon River Division	CT	LWCF	2013	9.00
Salmon River Division	CT	LWCF	2014	1.62
Salmon River Division	CT	LWCF	2014	9.59
Salmon River Division	CT	LWCF	2014	1.00
Salmon River Divison	CT	LWCF	2015	29.51
Salmon River Division	CT	LWCF	2016	.60
Salmon River Division	CT	LWCF	2016	.59
Whalebone Cove Division	CT	LWCF	2013	25.50

Refuge Division/Unit	State	Funding[1] Source	Acquisition Year	Acres[2]
Whalebone Cove Division	CT	Donation	2013	41.00
Whalebone Cove Division	CT	LWCF	2014	49.2
Total Connecticut Acres				**670.78**
Fannie Stebbins Unit	MA			98.0
Hatfield Unit	MA			19.0
Third Island Unit	MA	Donation	1997	3.80
Honeypot Road Wetlands Unit	MA	LWCF	1999	20.26
Wissatinnewag Unit	MA	LWCF	2001	20.81
Mount Tom Unit	MA	LWCF	2002	140.82
Mount Toby Unit	MA	LWCF	2003	30.04
Fort River Division	MA	LWCF	2005	22.70
Fort River Division	MA	LWCF	2007	1.80
Mill River Division	MA	MBCF	2007	197.00
Fort River Division	MA	LWCF	2008	82.00
Mill River Division	MA	MBCF	2008	13.86
Mill River Division	MA	MBCF	2008	19.52
Fort River Division	MA	LWCF	2009	66.52
Fort River Division	MA	LWCF	2010	24.40
Mill River Division	MA	LWCF	2010	18.50
Fort River Division	MA	LWCF	2011	19.32
Dead Branch Division	MA	LWCF	2011	80.00
Fort River Division	MA	LWCF	2012	32.07
Dead Branch Division	MA	LWCF	2012	17.54
Westfield River Division	MA	LWCF	2013	125.00
Fort River Division	MA	LWCF	2013	12.00
Total Massachusetts Acres				**1,064.96**
Pondicherry Division	NH	LWCF	2000	670.82
Pondicherry Division	NH	LWCF	2003	3,039.68
Pondicherry Division	NH	LWCF	2004	143.00
Pondicherry Division	NH	MBCF	2004	472.44
Pondicherry Division	NH	LWCF	2005	286.00
Pondicherry Division	NH	LWCF	2005	166.00
Pondicherry Division	NH	MBCF	2005	3.40
Pondicherry Division	NH	MBCF	2005	499.69
Pondicherry Division	NH	LWCF	2005	19.67

Refuge Division/Unit	State	Funding[1] Source	Acquisition Year	Acres[2]
Pondicherry Division	NH	LWCF	2006	12.54
Pondicherry Division	NH	LWCF	2006	16.23
Blueberry Swamp Division	NH	LWCF	2007	13.00
Pondicherry Division	NH	LWCF	2007	2.28
Pondicherry Division	NH	LWCF	2007	71.55
Pondicherry Division	NH	MBCF	2008	101.59
Blueberry Swamp Division	NH	MBCF	2009	51.50
Blueberry Swamp Division	NH	MBCF	2009	56.00
Blueberry Swamp Division	NH	MBCF	2009	419.50
Pondicherry Division	NH	MBCF	2009	80.09
Pondicherry Division	NH	Donation	2009	18.50
Pondicherry Division	NH	MBCF	2009	11.23
Blueberry Swamp Division	NH	MBCF	2010	62.50
Blueberry Swamp Division	NH	MBCF	2010	105.00
Blueberry Swamp Division	NH	MBCF	2010	113.00
Blueberry Swamp Division	NH	LWCF	2010	5.10
Blueberry Swamp Division	NH	LWCF	2010	5.00
Blueberry Swamp Division	NH	LWCF	2010	5.00
Blueberry Swamp Division	NH	MBCF	2010	66.00
Blueberry Swamp Division	NH	MBCF	2010	96.00
Blueberry Swamp Division	NH	LWCF	2010	25.42
Pondicherry Division	NH	MBCF/LWCF	2010	46.90
Pondicherry Division	NH	LWCF	2010	6.20
Pondicherry Division	NH	LWCF	2010	79.89
Pondicherry Division	NH	LWCF	2010	11.58
Pondicherry Division	NH	Donation	2010	21.15
Pondicherry Division	NH	LWCF	2010	65.00
Pondicherry Division	NH	LWCF	2011	18.00
Pondicherry Division	NH	MBCF	2011	510.00
Pondicherry Division	NH	LWCF	2011	31.84
Blueberry Swamp Division	NH	LWCF	2012	6.80
Blueberry Swamp Division	NH	LWCF	2012	136.00
Saddle Island Unit	NH			1.5
Pondicherry Division	NH	LWCF	2014	15.01
Pondicherry Division	NH	LWCF	2015	22.85

Refuge Division/Unit	State	Funding[1] Source	Acquisition Year	Acres[2]
Mascoma River	NH	LWCF	2015	761.32
Total New Hampshire Acres				**8,371.77**
Nulhegan Basin Division	VT	LWCF	1999	9,042.12
Nulhegan Basin Division	VT	MBCF	1999	16,868.00
Nulhegan Basin Division	VT	Donation	1999	76.00
Putney Mountain Unit	VT	LWCF	1999	278.69
Putney Mountain Unit	VT	Donation	1999	5.86
Nulhegan Basin Division	VT	LWCF	2002	5.66
Nulhegan Basin Division	VT	LWCF	2002	13.47
Nulhegan Basin Division	VT	MBCF	2002	74.20
Nulhegan Basin Division	VT	MBCF	2002	170.11
Nulhegan Basin Division	VT	LWCF	2006	40.00
Nulhegan Basin Division	VT	MBCF	2007	76.90
Nulhegan Basin Division	VT	LWCF	2010	57.18
Nulhegan Basin Division	VT	LWCF	2011	29.87
Nulhegan Basin Division	VT	LWCF	2012	72.58
Nulhegan Basin Division	VT	LWCF	2013	79.12
Total Vermont Acres				**26,889.76**
Refuge Total Acres				**36,997.27**

1 *LWCF = Land and Water Conservation Fund; MBCF = Migratory Bird Conservation Fund*

2 *The Service owns all acreage in full fee title, except for two conservation easements on about 170 acres at the Pondicherry Division, and on the 761 acres that comprises the existing Mascoma River Division; acres compiled as of February 2016.*

Refuge Revenue Sharing

Refuge lands are not on the local tax rolls. The Refuge Revenue Sharing Act (16 U.S.C. §715s) offsets the loss of local tax revenues from Federal land ownership through payments to local taxing authorities. In the four-state area, those payments go to the towns. The annual payments are calculated on the federally appraised value for tax purposes, and are reduced proportionally based on the amount appropriated by Congress. Lands are reappraised by the Department of the Interior every 5 years. Table 3.7 shows the Service made the following refuge revenue sharing payments to local townships in recent years.

Table 3.7. Refuge Revenue Sharing Payments to Towns, 2009 to 2015.

Refuge Division/ Unit	Town	County	Refuge Revenue Sharing Payments in Dollars by Fiscal Year								
			2007	2008	2009	2010	2011	2012	2013	2014	2015
Connecticut											
Dead Man's Swamp Unit	Cromwell	Middlesex	3,562	2,763	2,597	176	188	177	208	194	204
Salmon River Division	East Hampton	Middlesex	-	-	-	-	-	388	2,162	2,204	2,128
Salmon River Division	Haddam	Middlesex	-	-	-	1,629	1,746	1,887	2,393	2,240	2,365
Whalebone Cove Division and Roger Tory Peterson Unit	Old Lyme	New London	-	-	-	-	-	937	1,375	1,287	3,649
Massachusetts											
Third Island Unit	Deerfield	Franklin	7	5	5	6	6	6	7	6	6
Wissatinnewag Unit	Greenfield	Franklin	781	606	569	94	101	95	112	104	106
Mount Toby Unit	Sunderland	Franklin	778	604	567	1,063	1,139	1,070	1,256	1,176	1,236
Mount Tom Unit	Holyoke	Hampden	3,124	2,424	2,278	5,120	5,487	5,156	6,051	5663	5,955
Honeypot Road Wetlands Unit	Westfield	Hampden	463	359	338	19	21	20	23	22	23
Hatfield Unit	Hatfield	Hampshire	-	-	-	-	-	-	-	342	360
Fannie Stebbins Unit	East Longmeadow	Hampden	-	-	-	-	-	-	-		
Westfield River Division	Becket	Hampshire	-	-	-	-	-	-	370	346	364
Dead Branch Division	Chesterfield	Hampshire	-	-	-	-	-	517	607	568	597
Fort River Division	Hadley	Hampshire	1,484	5,975	5,615	4,233	6,901	8,141	9,678	9,058	9,523
Mill River Division	Northampton	Hampshire	-	900	846	211	258	243	285	267	280
New Hampshire											
Saddle Island Unit	Bath	Grafton	-	-	-	-	-	-	-		187
Blueberry Swamp Division	Columbia	Coos	-	95	212	2,975	3,632	3,413	4,398	4,117	4,328
Pondicherry Division	Jefferson	Coos	4,868	3,777	4,161	15,187	17,209	16,171	18,979	17,764	18,807
	Whitefield	Coos	950	737	692	339	895	841	987	923	971
Vermont											
Nulhegan Basin Division	Bloomfield	Essex	3,201	2,483	2,334	1,914	2,050	1,927	2,261	2,117	2,225
	Brunswick	Essex	2,745	2,151	2,021	2,126	2,278	2,141	2,570	2,405	2,529
	Ferdinand	Essex	2,069	1,605	1,508	1,063	1,139	1,483	1,740	1,629	1,712
	Lewis	Essex	13,952	10,863	10,208	7,335	8,402	7,984	9,370	8,770	9,221
Putney Mountain Unit	Brookline	Windham	191	148	139	109	117	110	129	121	127
	Putney	Windham	444	345	324	975	1,045	982	1,152	1,078	1,134
Total Payments by Fiscal Year			**$38,619**	**$35,840**	**$34,414**	**$44,574**	**$52,614**	**$53,689**	**$66,113**	**$62,221**	**$68,041**

Conte Refuge General Public Use

Hunting, fishing, wildlife observation and photography, environmental education and interpretation were established as priority public uses by Executive Order 12996 (March 25, 1996), and legislatively mandated by the Refuge Improvement Act. These activities are appropriate uses of national wildlife refuges, as long as they are compatible with the mission of the System and the purposes of the refuge, and are often referred to as the "Big 6" wildlife dependent public uses. All six priority public uses are available to the public at the Nulhegan Basin, Pondicherry, Blueberry Swamp, Salmon River, and Fort River Divisions, while certain wildlife-dependent uses are available at most refuge lands. With the exception of the Putney Mountain Unit, none of the smaller units have been officially opened to public uses. Certain non-priority uses are allowed and have been found to be appropriate and compatible. These include snowmobiling on designated trails at the Nulhegan Basin, Pondicherry, and Dead Branch Divisions

It is difficult to accurately characterize the amount or type of outdoor recreational activities occurring within the entire watershed, and numbers for refuge lands are broad estimates. This section will first provide an overview of the general hunting, fishing, and wildlife viewing trends occurring within the States based on the Service's 2011 National Survey which is available at (USFWS 2012). The 2011 survey shows that 90.1 million U.S. residents 16 years and older participated in wildlife-related recreation—a 3 percent (3%) increase from 2006. The number of hunters and anglers increased from 33.9 million in 2006 to 37.4 million in 2011. The most recent survey also showed 71.8 million people engaged in wildlife observation, an increase of about one percent (1%) since 2006, spending about $55.0 billion on their activities. Table 3.8 illustrates participation in wildlife-associated recreation by State residents both inside and outside their state of residence. Table 3.9 shows the reported annual refuge visitation for the six priority public uses.

Table 3.8. Results from the 2011 U.S. Fish and Wildlife Service National Survey of Fishing, Hunting, and Wildlife-associated Recreation for Connecticut, Massachusetts, Vermont, and New Hampshire.

	Connecticut	Massachusetts	New Hampshire	Vermont	Total
Participation in wildlife-associated recreation by state residents (either inside or outside of their own state)					
Number of individuals participating in hunting	82,000	66,000	44,000	71,000	263,000
Number of individuals participating in fishing	340,000	457,000	164,000	105,000	1,066,000
Number of individuals participating in wildlife watching	1,093,000	1,530,000	388,000	273,000	3,284,000
Total number of participants	1,515,000	2,053,000	596,000	449,000	4,613,000
Percent (%) of Total Population	42.4%	31.4%	45.3%	71.8%	38.2%
Total expenditures for wildlife-related recreation in state (by both state residents and nonresidents)					
Hunting	$302 million	$87 million	$61 million	$292 million	$742 million
Fishing	$436 million	$455 million	$209 million	$131 million	$1.2 billion

	Connecticut	Massachusetts	New Hampshire	Vermont	Total
Wildlife-watching	$935 million	$ 1.3 billion	$281 million	$289 million	$2.8 billion
Total	**$1.7 billion**	**$1.8 billion**	**$551 million**	**$712 million**	**$4.7 billion**

View entire report at: http://www.census.gov/prod/www/fishing.html (accessed August 2016).

Table 3.9. Reported Annual Refuge Visitation for Priority Public Uses, 2008 to 2016.

Estimated Annual Visitation									
Priority Public Use Activity	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Fishing	191	186	205	210	210	210	210	210	210
Hunting	2,109	2,108	2,095	2,105	2,105	2,105	2,075	1,940	1,910
Environmental Education	1,345	1,388	1,334	4,022	1,833	4,854	6,178	6,000	535
Interpretation	1,007	1,280	1,220	10,873	9,743	15,420	10,995	9,000	1,559
Wildlife Observation	4,775	5,354	5,581	5,850	4,786	4,550	5,150	5,050	5,050
Wildlife Photography	1,000	1,078	1,051	1,050	1,000	1,000	1,000	1,000	1,000
Total Visitation for Priority Public Uses	**10,527**	**11,394**	**11,486**	**24,110**	**19,677**	**28,139**	**25,608**	**23,200**	**10,264**

Public Use Facilities

The Conte Refuge Act mentioned establishment of "up to four visitor centers" but the preferred alternative in the 1995 FEIS recommended "multiple cooperative centers." The refuge currently has three partnership visitor centers, as well as a visitor contact station with exhibits at the Nulhegan Basin Division.

Great Falls Discovery Center

The Great Falls Discovery Center is owned by the State of Massachusetts and administered by the Massachusetts Department of Conservation and Recreation (DCR). DCR manages cooperatively with a number of partners, including the Service. Located near the intersection of the major north-south interstate (I-91) and the principal east-west route in northern Massachusetts (Route 2), it is convenient for local families, school groups, and tourists. The site and building are both fully accessible. Other nearby recreational opportunities include a multipurpose biking/hiking path along the Turners Falls canal and observation of a fish ladder at the nearby dam. In addition, Route 2, also known as the Mohawk Trail, is a popular highway for tourists during the fall leaf season.

Great Falls Discovery Center also is an important part of an ongoing effort by local, State, and Federal officials to revitalize downtown Turners Falls. The center is located in historic mill buildings purchased and renovated by the DCR for $3,000,000 in the early 1990s. The Service received an $850,000 appropriation in 1998 to design and build ecological exhibits. DCR spent over $350,000 retrofitting the building to house the Service's exhibits. The Center is primarily staffed by DCR and the Friends of the Great Falls Discovery Center, while the grounds and facilities are maintained by DCR. Other partners assisted in the planning stages, some of which remain involved by offering programs at the center: Conte Anadromous Fish Research Center, USGS; Connecticut River Watershed Council; Massachusetts Division of Fisheries and Wildlife; Massachusetts Audubon Society; Northeast Utilities; Friends of the Great Falls

Discovery Center; Hitchcock Center; and the Montague Economic and Industrial Development Corporation.

The Friends of the Great Falls Discovery Center is a non-profit group focused on a cooperatively managed visitor facility in Turners Falls, Massachusetts. Their mission is to "support and enhance the Great Falls Discovery Center and the Connecticut River watershed; to educate the public about the unique features of the Silvio O. Conte National Fish and Wildlife Refuge and the Commonwealth of Massachusetts' Connecticut River Greenway State Park; and to foster public use and enjoyment of the Center, the Park, and the refuge." The Friends group assists in running the visitor facility, maintaining exhibits, and coordinating exceptional programs. The facility and program schedules, as well as information on the Friends group, can be viewed at: *www.greatfallsdiscoverycenter.org* (accessed August 2013).

The Center's exhibits are a key component for delivering the refuge's messages to citizens of the watershed. The theme of the exhibits is "Our Shared Home," which emphasizes the concept that actions and choices of watershed citizens greatly affect wildlife habitats, and wise choices can conserve, protect, and enhance native species. Major exhibits include: a wall with portraits of our plant and animal neighbors; a watershed model; an introductory video that explains the concept of wildlife habitat; life-size walk-through dioramas depicting principal species and habitats of the watershed; text panels and interpretive walls with dioramas that reinforce key concepts regarding trade-offs in habitat resulting from human activities; and a video that describes habitat challenges facing diadromous fish; a photo gallery with pictures of agency personnel, volunteers, and citizens promoting "Our Shared Home," and an exhibit that offers the visitor opportunities to participate in upcoming events and partner-sponsored volunteer projects.

A variety of programs for different age groups and interests is offered during open hours and occasionally in the evenings. Events are posted at: *www.greatfallsdiscoverycenter.org* (accessed February 2013). The non-profit Friends of Great Falls Discovery Center hosts a monthly coffee house with live music, assists in supporting programs, and many of its members voluntarily assist in staffing the center. Because of refuge and DCR staff limitations, the Center is only open Fridays and Saturdays 10 a.m. to 4 p.m. or for groups by appointment during the winter and spring. In the summer, both the refuge and DCR provide seasonal employees allowing the center to be open 7 days a week.

Montshire Museum of Science
The Montshire Museum of Science located in Norwich, Vermont, is home to an official "Silvio O. Conte National Fish and Wildlife Refuge Education Center" (*http://www.montshire.org/;* accessed August 2016). The museum is a hands-on museum, offering dozens of exhibits relating to technology, astronomy, and the physical sciences. In cooperation with the refuge, the museum has several exhibits that illustrate the natural history of the Upper Connecticut River Valley, the refuge, and its resources. The facility is located on a 110-acre site adjacent to the Connecticut River.

Great Northwoods Interpretive Center
The Great Northwoods Interpretive Center is a rest area and information center on U.S. Route 3 just north of Colebrook, New Hampshire, that is administered by the New Hampshire Department of Transportation. The Service financially contributed to the construction of a community multi-purpose room which opened in 2002. The refuge has no staff at the Center. At the front desk, visitors can get tourism information about the local area. The multi-purpose room contains

interpretive displays informing visitors about the Service, System, and refuge, in addition to information about the Nulhegan Basin Division, Pondicherry Division, and Umbagog National Wildlife Refuge. It has displays with local themes. The room also contains a number of historical photographs and displays from the Colebrook area and other memorabilia. The interpretive center is open from Memorial Day to Columbus Day.

Nulhegan Basin Division Visitor Contact Station
The Nulhegan Basin Division has a headquarters office and visitor contact station on Route 105 in Brunswick, Vermont. The facility includes an exhibit hall where visitors can learn about "The Nulhegan Basin- Sculpted by Nature, Worked by Human Hands-A Unique Landscape Conserved for Habitat, Wildlife, and People." Informational exhibits include the cultural history of the basin, refuge partners, refuge research, geology and geography, habitat management, the watershed, the System, and northern forest habitats and species. Visitors can talk to staff to find out more about public uses, trails, and other refuge opportunities. The contact station is open 7 days a week, from 8 a.m. to 4:30 p.m.

Closed Refuge Units
The Dead Man's Swamp, Wissitinnewag, Hatfield, and Saddle Island units are closed year-round to protect sensitive resources. The Mount Tom Unit is currently closed due to public safety and vandalism concerns. The refuge also has a seasonal closure on the Third Island Unit during the bald eagle nesting period (January 1 to July 31).

Hunting
Currently, there are hunting opportunities on the Nulhegan Basin, Pondicherry, Fort River, Mill River, Mascoma River, Dead Branch, Blueberry Swamp, and Salmon River Divisions, and Putney Mountain Unit. In 2011, it was estimated there were 2,165 hunting related visits to these divisions. Game species include moose, white-tailed deer, black bear, waterfowl, ruffed grouse, American woodcock, and small game such as snowshoe hares.

Fishing
Currently, there are fishing opportunities on the Nulhegan Basin, Pondicherry, Blueberry Swamp, Fort River, Mill River, and Salmon River Divisions. In 2016, there were an estimated 210 fishing trips to the refuge. The Nulhegan Basin Division is often fished for Eastern brook trout, and stocked rainbow and brown trout.

Wildlife Observation and Photography
Wildlife observation and photography are popular activities on refuge lands. Both the Nulhegan Basin and Pondicherry divisions are designated IBAs, drawing many bird watchers during the spring and summer. Driving to see wildlife is a popular activity at the Nulhegan Basin Division where there are 40 miles of gravel roadway open during the summer. During the winter, many of these same routes become snowmobile trails totaling 37 miles. The Fort River Birding and Nature Trail is open year round to visitors for wildlife observation and photography. The ADA approved nd accessible trail makes it a desired and heavily used trail by diverse groups of people. During 2015, an estimated 7,750 visits were made to refuge lands to view and photograph wildlife.

Interpretation and Environmental Education
There are numerous opportunities in the watershed for environmental education. Environmental education is available through public and/or private organizations in 121 of the 384 towns and cities in the watershed. Environmental education related to the watershed resources is available in written materials, educational

programs and workshops, hands on activities, and public forums. Prominent examples include MassAudubon, Connecticut River Watershed Council, Connecticut River Joint Commission, and New England Wildflower Society. Additionally, conservation districts, conservation commissions, and university extension programs in the four-state region provide invaluable education and outreach resources. The private and public organizations or providers are too numerous to list here. For more information see Five College/Public School Partnership (1992), Hale and Schwartz (1991), National Wildlife Federation (1995), State of Connecticut (1994), and the Vermont State-wide Environmental Education Programs Web site at: *http://www.vermontsweep.org/* (accessed August 2016).

Small private groups have been active, not only in the watershed as a whole, but also in several tributary watersheds. Many tributaries are being monitored by local associations, such as the Farmington River Watershed Association in Connecticut, and the Deerfield and Chicopee River watershed associations in Massachusetts, as well as a growing network of local River Watch groups. These organizations strive to develop an awareness of these tributaries, and provide water quality monitoring and restoration through localized education programs. Scarce funding often hampers their ability to achieve goals. Larger organizations, however, such as the Connecticut River Watershed Council, Joint River Commissions, Vermont Institute of Natural Science, TNC, and Mass Audubon provide important educational services. In chapter 4, goal 2 we describe other existing programs occurring on refuge lands. We also describe environmental education and interpretation partnerships in chapter 4 under goal 4.

Watershed-On-Wheels (WoW Express)
In the fall of 2010, the refuge launched a new mobile visitor center known as the WoW Express. The WoW Express is a traveling exhibit designed to engage children of all ages in the beauty and wonder of the Conte Refuge. It includes three components: a walk-through immersion exhibit featuring the diverse sights and sounds of plants and animals from habitats found in the Connecticut River watershed; a watershed table showing how rivers form and change; and seven interactive kiosks exploring the cultural, economic, and environmental significance of the watershed which the Conte refuge seeks to conserve.

The WoW Express travels throughout the watershed visiting schools, natural resource-related fairs, festivals, and conferences. From April 2012 to July 2013, the WoW Express visited over 70 communities within the watershed. The more structured environmental education visits touched nearly 4,000 students and 377 teachers from 30 schools in four states. Including visits to summer camps and over 50 special events, the WoW Express reached over 18,500 people across the watershed in the most recent 11-month period. The exhibit has become popular in recent months.

Adopt-a-Habitat
The refuge recently initiated an Adopt-a-Habitat program intended to establish long-term relationships that spur schools, organizations, and individuals (adults and youth) to adopt and manage local areas within the watershed. Program participants will manage public and private land in order to promote healthy habitat for plants, wildlife, and people. The Adopt-a-Habitat initiative poses an opportunity to accomplish more for wildlife and habitat on lands not governed by the Service. In the process, new contacts are made, awareness is elevated, relationships are established, partnerships develop, and commitment to wildlife and habitat is fostered.

The full curriculum, which is under development, will be designed for students to gain a more thorough understanding of the physical, chemical, and biological interactions within the wetland, stream, pond, or forest habitat area they have selected. The class may choose to use this understanding to implement projects to improve their adopted habitat with the assistance of refuge staff. In the course of study and implementation of projects, students have the opportunity to work with their peers, teachers, community members, and staff from the Service, other Federal and state agencies, and conservation organizations.

Fort River Division

USFWS

As part of this program's development, the refuge is currently working with a college intern to identify target audiences, develop presentations that relate certain concepts to use in the curriculum, create lesson plans, and evaluate limitations to the effectiveness of the program.

Biological Assessment Trailer (BAT)
As a project under development, the refuge will support field work, either as part of the Adopt-a-Habitat or another environmental education program, with a Biological Assessment Trailer (BAT) equipped with field gear that will be available to schools such as waders, dip nets, water quality test meters, field guides, dissecting scopes, and other educational research toolsRefuge staff will bring the trailer to the school, introduce students to the equipment, and oversee its use. In some cases equipment may be loaned to the teacher for additional field work on the habitat.

Cooperatively Managed Visitor Centers
As mentioned above, the refuge has a presence at three education or interpretive visitor centers managed cooperatively by partners: the Great Northwoods Center in Colebrook, New Hampshire; the Montshire Museum of Science in Norwich, Vermont; and the Great Falls Discovery Center in Turners Falls, Massachusetts. For more information on these centers, see "Public Use Facilities" above.

Conte Corners
The intent of a Conte Corner is to provide interpretive exhibits about the refuge System, Conte Refuge, and the natural resources in the watershed. The exhibits are housed in facilities run by partners, and are designed to complement the conservation messages of the host partner. Other than minor exhibit maintenance, the Refuge has no other overhead expenses. The partnership is also beneficial in that it provides opportunities for refuge staff to give programs and participate in partner events. Conte Corners are flexible in concept and have the ability to take many forms. There are two existing Conte Corners: one at the Springfield Museum of Science (Springfield, Massachusetts) and another in Cabela's (East Hartford, Connecticut). Both include aquariums and several informational panels. Another Conte Corner, that will include sophisticated interactive displays, is planned for the Connecticut Science Center (Hartford, Connecticut).

Part III: Description of Individual Refuge Divisions and Units

Current refuge lands are comprised of ten refuge divisions and eleven refuge units (map 1.3. Existing Refuge Ownership "Map 1.3. Existing Refuge Ownership"). A refuge division is a relatively large, contiguous, or semi-contiguous area; a unit is often smaller and isolated from other refuge property. Table 3.10 lists each division and unit by state, and the acreage associated with each as of February 2016. Below we provide more descriptions on the natural

resources of each division and unit. We also provide additional information on current public use opportunities, as well as any cultural or historic information, if available. Appendix A provides additional details on the resources for each division and unit and how we propose to manage them.

Table 3.10. Current Refuge Ownership by Division and Unit.

Divisions (acres)*	Units (acres)*
Connecticut	
Salmon River (468 acres)	Deadman's Swamp (31 acres)
Whalebone Cove (116 acres)	Roger Tory Peterson (56 acres)
Massachusetts	
Fort River (261 acres)	Fannie Stebbins (98 acres)
Dead Branch (98 acres)	Hatfield (19 acres)
Mill River (249 acres)	Honeypot Road Wetlands (21 acres)
Westfield River (125 acres)	Mount Tom (141 acres)
	Mount Toby (30 acres)
	Third Island (4 acres)
	Wissatinnewag (21 acres)
New Hampshire	
Pondicherry (6,443 acres)	Saddle Island (2 acres)
Blueberry Swamp (1,166 acres)	
Mascoma River (761 acres)	
Vermont	
Nulhegan Basin (26,605 acres)	Putney Mountain (285 acres)

**This Refuge ownership information is current as of February 2016.*

Refuge Divisions

Salmon River Division, Connecticut (468 acres)

The Salmon River Division is located in the lower Connecticut River valley at the confluence of the Salmon River and the Connecticut River in the Haddam Neck section of the Town of Haddam, Middlesex County, Connecticut. The first acquisition for the Salmon River Division occurred in 2009, comprising 285 acres. The division corresponds to portions of SFA 6 "Salmon Cove" and SFA 7 "Salmon River, including tributaries below dam" in the 1995 FEIS (USFWS 1995).

Natural Resources

The Connecticut River is affected by tidal influences as far north as East Hartford which includes Salmon River. The soils of this area consist of surface deposits of relatively thin and often discontinuous layers of glacial till overlaying bedrock. This till is a poorly sorted mixture of clay, silt, sand, gravel, cobbles, and boulders. Sediments associated with the floodplain of the Connecticut River and the Salmon River can be 10 to 100 feet thick. The uppermost portion of these sediments consists of thin (less than 20 feet deep) alluvial silts and sands deposited by the two river systems.

All stream flows associated with the Salmon River and Salmon Cove are wholly within the Connecticut River Basin. Although tidal influence in the Connecticut River extends upstream to East Hartford, saline water extends only as far north

as East Haddam about two miles south of the confluence of the Connecticut and Salmon Rivers.

The aquatic habitats found within the Salmon River and Salmon Cove are recognized by the Service as a high-priority for fisheries. American shad, river herring, and a variety of other migratory fishes use this river system, and adult Atlantic salmon have entered its tributaries to spawn. Extensive beds of submerged aquatic vegetation provide significant overwintering, spawning, and feeding habitat for a large number of fish species, including commercial finfish and shellfish.

Recognized by the Service for its unusual terrestrial habitat types, the lower Salmon River/Salmon Cove complex provides an intact mosaic of diverse habitat types (table 3.11). Among them are tidally influenced rivers, internationally recognized freshwater tidal marsh and flats, riparian meadows, cold-water streams, floodplain forests, mixed hardwood forest, hemlock stands, and vernal pools. Downstream habitats include brackish tidal marshes and the estuarine system.

Table 3.11. Percentage of Salmon River Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Hardwood forest	86%
Hardwood swamp	2%
Woodlands	1%
Open water	1%
Developed	5.5%

1 See table A.52 at the end of appendix A for comparison.

Reflecting the diversity and quality of the lower Salmon River's habitats are a diversity and abundance of mammals (e.g., river otter, bobcat, fisher), reptiles and amphibians (e.g., Eastern box turtle, marbled salamander, Northern copperhead), breeding songbirds (e.g., warblers, thrushes, cuckoos), and breeding raptors (e.g., American kestrel, barred owl, Northern goshawk). The area harbors 15 state species of conservation concern.

The lower Connecticut River system is important stopover and breeding habitat for neo-tropical migrants, as well, and supports one of the largest concentrations of migratory waterfowl in southern New England. At the mouth of the Salmon River, Salmon Cove's freshwater tidal wetlands, flats, and adjacent intact forest provide neotropical birds and shorebirds with sources of food, water, and shelter and serve as bald eagle winter roost and perch sites. Ospreys also forage in these reaches. Wetland birds breeding in Salmon Cove include American black ducks, green-winged teals, wood ducks, and mallards.

In 2011, an extensive inventory of invasive plants revealed populations of several species that could degrade habitats. The most abundant species are Japanese stiltgrass (mostly along Pine Brook riparian areas and other wetland types), Oriental bittersweet (mostly along the Salmon River riparian areas), and Japanese barberry and multiflora rose (mostly within forest interior). Garlic mustard is newer to the refuge, but has the potential to spread quickly. Local volunteers have been removing garlic mustard and Japanese stiltgrass to prevent their spread within the more pristine interior. Kudzu, one of the most

prevalent invasive plants in the southeastern U.S. was found near the Salmon River Division; this is a very uncommon sighting in central Connecticut, and is of concern to State authorities.

Refuge Public Use
Hunting, fishing, wildlife observation and photography, environmental education and interpretation are allowed on this division. The latter four recreational activities occur year round. The well-defined riffles and pools and a boulder-cobble substrate of the Salmon River support a good cold water fishing; in fact, the Salmon River is considered one of the State's top trout streams.

Cultural Resources and Historic Preservation
The Salmon River Division was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted. However, the refuge recently acquired additional land on Haddam Neck in Haddam, Connecticut. This property is part of the Salmon River Division and contains multiple significant archaeological resources, including the Venture Smith Homestead archaeological site.

The Venture Smith Site is an 18th century homestead of African-American archaeological significance and has been identified as potentially eligible for listing on the NRHP. Venture Smith (Broteer Furro) was born around 1729 in West Africa, likely in current-day western Mali. Tradition holds that he was the eldest son of an African prince. At the age of six, he was kidnapped by an enemy tribe and sold to the steward of a Rhode Island slave ship. After a stop in Barbados, Smith was taken to Newport, Rhode Island, and then to Fisher's Island, where he was enslaved for about 13 years. In 1751, Venture married another slave. Later that year, he fled briefly from bondage, but changed his mind and returned. As a punishment for flight, he was separated from his wife. Eventually, the couple was reunited in the household of a slave owner in Stonington, Connecticut.

In 1765, Venture Smith purchased his freedom, and moved to Long Island, where he supported himself by farming, fishing, harvesting wood, river trafficking, and other activities. By 1775, Venture had purchased the freedom of his wife and children. Two years later, he sold his property on Long Island and purchased 10 acres on Haddam Neck in Connecticut, adding 70 acres abutting the Salmon River Cove where he built his dwelling house. He continued to prosper in farming, fishing, lumbering, and river commerce, adding a wharf, small warehouses, blacksmith shop, and other dwellings near his home. In 1798, Venture narrated his life story to Elisha Niles, a Yale graduate and Revolutionary War veteran of anti-slavery background. The published narrative provided an extraordinary account of the American experience of an enslaved African.

Prior to Service acquisition, extensive archaeological investigations were conducted at the Venture Smith homestead. Evidence of the various homestead buildings was identified, as well as numerous artifacts associated with the lives of Venture Smith and his family.

In addition to the Venture Smith homestead site, the Salmon River Division contains a variety of other archaeological resources, including pre-Contact Native American sites and evidence of other historical settlements. The Service is now responsible for the preservation and management of these cultural resources.

Whalebone Cove Division, Connecticut (116 acres)

The Whalebone Cove Division currently consists of 116 acres at the confluence of the Connecticut River and Whalebone Cove in Lyme, Connecticut. The division corresponds to portions of SFA 1l-"Whalebone Cove" in the 1995 FEIS (USFWS 1995).

Natural Resources

The division has 2,000 feet of frontage along the Connecticut River and forms the southern entrance to Whalebone Cove. It has a diverse topography, from low, flat tidal marsh to steep slopes (TNC 2013b, USFWS 2013, USFWS 2014). Its major soil type is the very poorly drained Westbrook mucky peat, found in tidal marsh areas. In the upland portions of the division, the major soil type is the moderately well-drained Pootatuck fine sandy loam (Web Soil Survey 2013).

The existing 116-acre division contains a diversity of habitat types, including high and low tidal marsh, wooded slopes, a kettle-pond wetland, floodplain forest, upland meadows, and mature forest with oak, hickory, and hemlock trees (table 3.12). The Whalebone Cove area is one of the most biologically important and undisturbed tidal marshes on the Connecticut River. It also has the largest stand of wild rice in the State of Connecticut. The cove is an important wintering area for bald eagles and black ducks because the tides prevent ice from forming in the cove. It is also a significant foraging area for migratory waterfowl, including black ducks, Canada geese, mallards, and wood ducks. Other birds that use the area include green and great blue herons, sora, and least bittern, marsh wren, Carolina wren, white-eyed vireo, osprey, and red-tailed hawks (TNC 2013b, USFWS 2014). The existing 67-acre division contains a diversity of habitat types, including high and low tidal marsh, wooded slopes, a kettle-pond wetland, floodplain forest, upland meadows, and mature forest with oak, hickory, and hemlock trees (table 3.11). The Whalebone Cove area is one of the most biologically important and undisturbed tidal marshes on the Connecticut River (TNC 2013). It also has the largest stand of wild rice in the State of Connecticut. The cove is an important wintering area for bald eagles and black ducks because the tides prevent ice from forming in the cove. It is also a significant foraging area for migratory waterfowl, including black ducks, Canada geese, mallards, and wood ducks. Other birds that use the area include green and great blue herons, sora, and least bittern, marsh wren, Carolina wren, white-eyed vireo, osprey, and red-tailed hawks.

Table 3.12. Percentage of Whalebone Cove Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percentage of Unit
Hardwood forest	29%
Hardwood swamp	less than 1%
Shrub swamp and floodplain forest	8%
Freshwater marshes	51%
Old fields and shrublands	2%
Pasture/hay/grassland	less than 1%
Open water	6%
Rocky coast and islands	less than 1%
Developed	2%

1 See table A.52 at the end of appendix A for comparison.

To date, no biological surveys, inventories, or habitat mapping have been conducted at this newly established division.

Refuge Public Use
Thid division is open to wildlife observation, photography, environmental education and interpretation. The area is also popular with kayakers and canoeists. Opportunities for hunting and fishing will be determined through subsequent detailed planning. The proposed action is to open this division to those uses as well to accommodate all six priority public uses.

Cultural Resources and Historic Preservation
The Whalebone Cove Division was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Dead Branch Division, Massachusetts (98 acres

The Dead Branch Division currently consists of 98 acres in the town of Chesterfield, Massachusetts, formerly owned by Berkshire Hardwoods. The property slopes east to west toward the Dead Branch River. There are several buildings and log landings remaining from sawmill operation. A former gravel pit has been recontoured and revegetated. The Dead Branch River forms the division's western boundary. The division corresponds to portions of SFA 20 "Westfield River, including West Branch and Middle Branch" in the 1995 FEIS (USFWS 1995).

Natural Resources
The Dead Branch originates at Damon Pond in Chesterfield, Hampshire County, Massachusetts, and flows south through the Dead Branch Division eventually entering the Westfield River on the Chesterfield/Huntington town line. Seventy-one miles of river in the Westfield River watershed are classified as wild, scenic, or recreational, although the Dead Branch is not included *(http://www.nps.gov/pwsr/westfield_pwsr_sub.html*; accessed August 2016). Headwaters of the several branches of the Westfield River are in the Berkshire Hills. The watershed includes historic villages, prime farmland, natural landscapes, several waterfalls, and gorges. One of the State's largest roadless areas is in the Westfield watershed.

The current division is primarily hardwood forest, with about 10 to 15 acres containing buildings, access roads, and landings from the former sawmill (table 3.13). A small one- to two-acre gravel pit has been reclaimed and now provides grass/forb habitat, along with small areas on the north side of East Street that were mowed by the previous landowner. No biological inventories have been initiated on this newly established division, except a cursory invasive plant survey on part of the property in 2013. Two invasive plant species were found: two populations of garlic mustard, which were partially pulled by staff and volunteers, and multiflora rose in the northwest boundary and riparian area.

Table 3.13. Percentage of Dead Branch Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Hardwood swamp	90%
Freshwater marsh	1%
Pasture/hay/grassland	6.5%
Developed	3%

1 See table A.52 at the end of appendix A for comparison.

Migratory birds expected to breed in this area include blackburnian warbler, wood thrush, Canada warbler, and American woodcock. Resident wildlife such as white-tailed deer, Eastern wild turkey, and ruffed grouse are likely found there.

We are not aware of stream surveys of the Dead Branch, but it appears to be a cool water stream that could support trout. Mussel surveys revealed two species in the Dead Branch: a large, viable population of Eastern elliptio and a small number of Eastern floater (Neadeau 2009). The former is the only viable mussel population in the upper Westfield River watershed, likely due to the low-gradient valley near the division with extensive wetland influence.

Refuge Public Use

The refuge completed pre-acquisition compatibility determinations so that hunting, fishing, wildlife observation and photography, environmental education and interpretation could continue at this division until the CCP is complete. Hunting is a popular recreational activity in the Berkshire hill towns and the Dead Branch Division offers a small area, but good habitat for white-tailed deer and eastern wild turkeys on the eastern and southern areas with good forest cover. Ruffed grouse also are present along with other small game. Fishing is available in the Dead Branch River on the western boundary of this Division, with trout likely being the primary game fish.

Cultural Resources and Historic Preservation

The Dead Branch Division was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Fort River Division, Massachusetts (261 acres)

One of the SFAs in the 1995 Conte Refuge FEIS (USFWS 1995) was the Grassland Complex, now identified as the refuge's Fort River Division. This SFA, as described in the 1995 EIS, consisted of several disjunct areas totaling about 2,200 acres. In the years following 1995, the refuge worked with Massachusetts Audubon, Amherst College, the University of Massachusetts, the town of Amherst, and a private landowner to encourage the restoration and appropriate management of several additional grasslands within the SFA. The current division is comprised of a total 261 acres that were acquired in several separate acquisitions since 2005.

Natural Resources

The Fort River, located in the eastern portion of the Pioneer Valley, drains a 35,830-acre watershed, and is the longest free-flowing tributary to the Connecticut River in Massachusetts. The area lies on a valley plateau within a circle of hills. The north-south spine of hills running through the middle of Amherst are glacial drumlins that became the islands of ancient Lake Hitchcock that formed as glaciers receded. The area has a number of distinct geologic features including Rattlesnake Knob and Mount Norwottuck; and traprock formations of the former volcanic summit. The Fort River watershed is bounded by Bay Road and the Holyoke Range on the south, Route 47 on the west, the Norwottuck bicycle path on the north, and the Amherst town line on the East (town of Amherst 2009).

The area contains about 15 percent (15%) agricultural lands, and holds large farm fields, many with a high clay content which is undesirable for some higher value crops. Most farms are in Hadley and Amherst. Typically, these produce silage corn, hay, or are used for pasture. Approximately two percent (2%) of the area's 5,473 farmland acres is protected as development rights have been sold to the state through the Massachusetts Department of Agriculture's Agricultural

Preservation Restriction program. About 65 percent (65%) of the watershed is forest, and 20 percent (20%) urban and other land use (TPL 2006).

Soils are mostly glacial tills of various types in the higher elevations in the east, whereas soils in the western portion of the watershed are finer, more organic sediments more suitable for agriculture. Soils in the northern portion of the watershed (Amherst) are generally sandy and loamy, including the Gloucester-Montauk-Paxton association, Hinkley-Merrimac-Windsor association, and Amostown-Scitico-Boxford association. Soils (Amostown association) in the area west of Route 116 in North Amherst have been put almost entirely into farming use, and the Mount Holyoke area also maintains more rock laden soils within the Rock Outcrop-Narragansett-Holyoke association. There are 6,185 acres of prime farmland in Amherst (town of Amherst 2009).

The Fort River and its tributaries help define South Amherst with its rich farmland and extensive wetlands. The river ranks high in freshwater mussel diversity, including the federally endangered dwarf wedge mussel that was historically found here. In 2009, 10 dwarf wedgemussels were documented in Hop Brook, a tributary of the Frot River. Also, recently, a single mussel was found (Nedeau 2008) above refuge ownership. The river also holds a naturally reproducing population of brook trout in headwater streams. Lawrence Swamp, located in the southeastern portion of the watershed, is an area rich in biodiversity. The upstream river has been heavily impacted by development in the town of Amherst, but in Hadley, where there is less development, the river has a narrow line of floodplain forest. The eastern Pelham Hills are less developed and its tributaries are generally in good condition (town of Amherst 2009).

The division has a variety of habitat types, including hardwood forest, floodplain forest, and grasslands (table 3.14). The largest tract of the division, located in Hadley, Massachusetts, was selected for Service acquisition because inventories by Massachusetts Audubon found notable populations of bobolinks and other grassland birds. In the early 2000s, owners of several of the parcels began planning housing subdivisions on their fields, so the refuge stepped up its acquisition efforts. The division land on Moody Bridge Road, Mill Valley Road, and South Maple Streets in Hadley, Massachusetts, is managed for grassland birds such as bobolinks, savannah sparrows, and potentially grasshopper sparrows and upland sandpipers, and floodplain forests and their associated wildlife including tree swallows, warbling vireos, and red-bellied woodpeckers.

Table 3.14. Percentage of Fort River Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Hardwood forest	22%
Hardwood swamp	5%
Shrub swamp and floodplain forest	12%
Pasture/hay/grassland	58%
Developed	3%

1 See table A.52 at the end of appendix A for comparison.

Wildlife management activities at the division include mowing fields after July 15 each year to retain grass-dominated habitat following the initial nesting period. These fields provide habitat for bobolinks, savannah sparrows, and potentially

grasshopper sparrows and upland sandpipers. Upland sandpipers nested here in the 1980s but were not seen again until recently in late summer, outside the breeding season (Parrish, pers. com. 2013). Invasive plants are impacting priority habitats including the floodplain of the Fort River. An invasive plant inventory has been undertaken, revealing substantial infestations. Invasive multiflora rose is a predominant shrub in both riparian floodplain forests and grassland fields and some control of this species has been undertaken by the YCC crew. Volunteers have been controlling garlic mustard, which is beginning to spread in the flood plain forests, adjacent wetlands, and forest edge. Oriental bittersweet threatens the health of floodplain trees. Other invasive species present include Japanese barberry, purple loosestrife, glossy buckthorn, reed canary grass, autumn olive and black locust, among others.

USFWS

Wood duck

The refuge has been engaged with academic and research partners on several projects at the division including: American kestrel nesting (U.S. Forest Service), abundance and diversity of native bees in sand and gravel habitats (University of Massachusetts), and smart phone use in early detection and mapping of invasive plants (University of Massachusetts).

Fields in the general vicinity of the division are often planted to either silage corn or cool season grasses to produce hay. Northern harriers hunt these fields during spring and fall migration. Red-tailed hawks and great horned owls nest in the area. Shorter grass areas in pastures provide nesting habitat for killdeer and Wilson's snipe. Horned larks are common in the winter, often in flocks of about 50 birds, often with a few Lapland longspurs and snow buntings. American woodcock, turkeys, and brown thrashers nest in the woods along the Fort River. Eastern bluebirds, Eastern kingbirds, barn swallows, and tree swallows are common breeders here. Also occurring are the sedge wren, wood turtle, marbled salamander, and spring salamander, all of which are state species of concern (town of Amherst 2009). The southern Mount Holyoke area of the watershed is a popular site of yearly hawk migrations, with thousands of birds making their way to southerly wintering grounds.

Refuge Public Uses

The refuge currently allows hunting, fishing, wildlife observation, and photography, environmental education and interpretation. Problem activities include trash dumping, driving vehicles in the fields, and illegal spotlighting of deer. The refuge completed a 1.1 mile long universally accessible trail on the division.. It is very popular and is the site for hosting many conservation events, tours, and programs.

Cultural Resources and Historic Preservation

Three Native American archaeological sites occur within (or partially within) the existing Fort River Division. Information about these sites does not indicate the time period(s) of their occupation.

The Massachusetts State site files indicate that 13 Native American sites are known within a 1-mile radius of the division, providing evidence of settlement that occurred during the Middle and Late Archaic periods (7,500 to 3,000 years

before present) and the Late Woodland period (1,000 to 450 years before present). The locations of a former sawmill and of a farmstead have also been documented.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Fort River Division (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites ranges from high to low depending on the location within the unit, with well-drained areas at greater elevations having higher sensitivity. Sensitivity for Euro-American sites is considered high where documentary evidence suggests historic land use, moderate near the roadway, and low throughout the poorly drained wetland areas of the division.

The recently acquired division properties (Bri-Mar Stables area north of Moody Bridge Road, and also the area on the south side of Moody Bridge Road) were not covered by the cultural resources overview (Waller and Cherau 2011). Detailed background research has not been conducted for these areas. One Native American site of unknown date is located within the Bri-Mar Stables area, near the Fort River.

Mill River Division, Massachusetts (249 acres)

The Mill River Division is located in Northampton, Massachusetts. The refuge has worked closely with the city of Northampton and the Kestrel Land Trust (formerly the Valley Land Fund, which recently merged with Kestrel Trust to form the Kestrel Land Trust) to conserve wildlife habitat. The division is currently 249 acres in size and was acquired as four separate parcels since 2007. The division corresponds to portions of SFA 24"Mount Tom/Mill River/Holyoke Range" in the 1995 FEIS (USFWS 1995).

Natural Resources

The Mill River begins at the outlet of Upper Highland Lake in Goshen at 1,440 feet above sea level and discharges into the Connecticut River in the City of Northampton with a total drop of 1,390 feet (*http://millrivergreenway.org/?page_id=1137*; accessed August 2016). The East Branch joins the Mill River in Williamsburg forming the main stem. The river flows through Haydenville, Leeds, and Florence before entering the City of Northampton. Major tributaries include Beaver Brook and Roberts Meadow Brook which join the river below Haydenville. On its course, it flows through Hulburt's Pond, Paradise Pond, and Look Park and there are two dams, Nonotuck and Cook's, on the main stem.

Beginning at Searsville, the river follows Route 9 into Leeds. From there the river flows on the south side of Florence and Northampton (City of Northampton 2002). At the time of Anglo settlement, the river flowed through what would become Northampton. A series of disastrous floods over the course of two centuries, culminating in the floods of 1936 and 1938 spurred a major flood risk reduction project. A dike was constructed at Smith College that diverts flow south, away from town, through Pynchon Meadows at the Arcadia Wildlife Sanctuary and finally emptying into the Oxbow.

As a consequence, only a fraction of the original channel from town to the Connecticut River remains (City of Northampton 2002). Now disconnected from the rest of the watershed, there is little flow in the original channel. It was noted to be a blight in town because of stagnant water, trash, mosquitoes, and objectionable odors. The last 6,900 feet of the original channel is located on the existing Mill River Division where it joins the Connecticut River. Like the channel in the city, this reach has little to no flow most of the year.

The Mill River Division is a high priority because of the potential for floodplain forest habitat bordering the Connecticut River (table 3.15). This division was included in TNCs floodplain forest inventory and assessment that began in 2008,

which concluded that the reach of the Connecticut River in Northampton and Hadley, Massachusetts, contained some of the largest patches of high quality remnant floodplain forest with some of the largest trees in the watershed (Marks et al. 2011). This floodplain forest is key stopover habitat for migratory landbirds and waterfowl during the spring and fall.

Table 3.15. Percentage of Mill River Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Hardwood forest	4%
Hardwood swamp	51%
Freshwater marsh	3%
Pasture/hay/grassland	9%
Open water	31%
Developed	2%

1 See table A.52 at the end of appendix A for comparison.

Unfortunately, Oriental bittersweet threatens the health of remaining canopy trees and is preventing the growth of saplings that would otherwise become future floodplain forests. Invasive black locust is outcompeting and replacing native cottonwoods and silver maples. In 2012, refuge staff and YCC crews began cutting bittersweet that was threatening overstory trees. Success in protecting the mature floodplain forest trees from bittersweet will be a long-term process.

Water chestnut, an aquatic invasive, is also a concern, occurring in one of two ponds within the Division. This species has been controlled by refuge staff and volunteers since 2003. Other invasive species on the division include exotic bush honeysuckle, garlic mustard, purple loosestrife, Japanese barberry, and Amur corktree.

Refuge Public Use

The Mill River Division has been open to all six priority public uses since the initial property was acquired by the Service. There are opportunities to hunt waterfowl on the Triangle and Magnolia ponds and in the river, as well as opportunities for white-tailed deer and small game hunting. Fishing occurs on the two ponds and from the banks of the Connecticut River. There are three native surface roads (Hockanum Road, 1st Square Road, and Parsons Swamp Road) which provide access to the refuge boundary and several unauthorized motorized trails. There is no refuge infrastructure other than boundary signs. The extent of public use is unknown. Nearby in the Mill River watershed there are extensive wood roads, trails, and forest with outstanding opportunities for hiking, hunting, fishing, walking, bicycling, mountain biking, and snowmobiling.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Mill River Division or within the division's current, approved acquisition boundary. However, the Massachusetts State site files indicate that 15 Native American sites are known within a 1-mile radius of the division, providing evidence of settlement that occurred during the Middle Archaic period (7,500 to 5,000 years before present) and greater Woodland period (3,000 to 450 years ago).

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Mill River Division (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered low except for an area at the northern edge of the Oxbow, which exhibits moderate sensitivity. Sensitivity for post-contact Euro-American sites is low throughout the division.

Westfield River Division, Massachusetts (125 acres

The Westfield River Division currently consists of a 125-acre tract, purchased in 2013, on Benton Hill Road in Becket, Massachusetts. The division corresponds to SFA 14 "Westfield River, including West Branch and Middle Branch" in the 1995 FEIS (USFWS 1995).

Natural Resources

The northeast portion of this property has frontage on the West Branch of the Westfield River and Center Pond Brook. The West Branch of the Westfield River is the longest free-flowing river reach in Massachusetts (Westfield River Wild and Scenic Advisory Committee 2007). Over 78 miles of river in the Westfield River watershed are classified as wild, scenic, or recreational (*http://www.nps.gov/pwsr/westfield_pwsr_sub.html*; accessed August 2016). The West Branch (1993) and many of its headwater tributaries in the upper slopes of the Berkshires (2004) were designated as wild and scenic, including the reach on this division. The watershed includes historic villages, prime farmland, natural landscapes, several waterfalls, and gorges. One of the State's largest roadless areas is in the Westfield watershed.

The Westfield River is particularly important habitat for shad and American eel and has one of the largest shad runs in the Connecticut River watershed (TNC 2013a). Mussel surveys conducted for the Westfield River Wild and Scenic Advisory Committee yielded both Eastern elliptio and Eastern floater in Center Pond and Yocum Pond, both in the West Branch watershed (Nedeau 2009), about 2.6 miles from the current division.

The current division property is located on the eastern slope of the Berkshires in the West Branch of the Westfield River watershed. The current 125-acre division protects over 1,000 feet of riparian habitat along the West Branch. Habitat is primarily mixed hardwoods (table 3.16), hemlock stands with limited amounts of floodplain forest, vernal pools, and spruce/fir forest (TNC 2013a). Portions of the existing division have been logged within the past decade.

Table 3.16. Percentage of Westfield River Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percentage of Unit
Hardwood forest	100%

1 See table A.52 at the end of appendix A for comparison.

To date, no biological surveys, inventories, or habitat mapping have been conducted at this newly established division. However, migratory birds expected to breed in this area include blackburnian warbler, wood thrush, Canada warbler,

and American woodcock. Resident wildlife such as white-tailed deer, eastern wild turkey, and ruffed grouse are likely found there. The West Branch has excellent cold water habitat that supports a variety of fish species (Westfield River Wild and Scenic Advisory Committee 2007). In 2013, a cursory search for invasive species on the division, found very few invasive plant species.

Refuge Public Use

Public uses at the Westfield River Division will be determined through subsequent step-down planning. The preferred course is to open this division to the six priority public uses: hunting, fishing, wildlife observation and photography, environmental education and interpretation. This region in the Berkshires has long been a popular area for a variety of outdoor activities including these priority public uses.

Cultural Resources and Historic Preservation

The Westfield River Division was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Blueberry Swamp Division, New Hampshire (1,166 acres)

The Blueberry Swamp Division (formerly known as the Mohawk River Division) lies in northwestern Coos County in the town of Columbia, New Hampshire, about 5 miles southeast of the town of Colebrook, New Hampshire. The first 13-acre parcel for the division was purchased in 2007; since then, the division has grown to 1,166 acres. The Blueberry Swamp Division corresponds to SFA 47 "Colebrook Hill Farms" and SFA 46 "Mohawk River" in the 1995 FEIS (USFWS 1995), which included about 2,040 acres of pastureland and old field, shrubs and forest, fens, and swamps.

Natural Resources

This division lies within the Simms Stream watershed which drains into the Connecticut River about 1.5 miles south of Colebrook. Soils in this region of Coos County are derived from glacial till parent material, following the last glacial epoch and comprised of weathered phyllites, shales, and schists (Kerivan and Lanier 2006). They have a silt texture, relatively high pH, regardless of whether the substrate is granitic or sedimentary, and tend to be more productive than the igneous derived soils found south in the White Mountains region. The historic dairy farming and timber industries thrived, in large part, because of these relatively fertile soils.

The division lies in a bowl between Marshall Hill to the west, Cilley Hill to the south, and Baldhead Mountain to the west in the town of Columbia. Blueberry Swamp, the prominent wetland feature within the boundary, is drained to the west by East Branch Simms Stream, a tributary of Simms Stream.

The landscape is primarily mixed-wood forests and lowland spruce-fir (table 3.17). Blueberry Swamp is a large wetland in the northeast corner of the division consisting of shrub swamp, freshwater marsh and cedar swamp communities. These wetlands may contain suitable habitat for waterfowl like black ducks, mallards, and wood ducks. Common snipe and spotted sandpipers are shorebirds that can be expected on the fringes of the swamp.

Table 3.17. Percentage of Blueberry Swamp Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type *classification.Percentage* **of Blueberry Swamp Division by Habitat Type.**

General Habitat Type[1]	Percentage of Division
Conifer swamp/spruce-fir	67%
Hardwood forest	16%
Shrub swamp and floodplain forest	12%
Freshwater marsh	1%
Pasture/hay/grassland	2%
Developed	2%

1 See table A.52 at the end of appendix A for comparison.

Pasture, hay, and grassland habitats are also present within this division providing breeding habitat for northern harrier, a State-listed species, American woodcock and bobolink. Simms Stream and its East Branch flow through this division. Both Eastern brook trout and brown trout are found in Simms Stream and brook trout likely inhabit the east branch that drains Blueberry Swamp.

Several invasive plants were identified on the division during a survey in 2011, including autumn olive, purple loosestrife, reed canarygrass, glossy buckthorn, Canada thistle, and common reed. These weeds may be recent invaders to the area because they are found in small clusters and individual plants and do not appear to be firmly established. Control efforts at this stage have a good chance of success.

Refuge Public Uses

Pre-acquisition compatibility determinations were completed for the six priority public uses prior to acquisition, so the division is currently open to hunting, fishing, wildlife observation and photography, and environmental education and interpretation. No surveys or inventory of public uses have been undertaken, but hunting, wildlife observation, general hiking, and berry picking are probably popular activities in the area. Fishing may occur in East Simms Stream. Both Eastern brook trout and brown trout are found in Simms Stream and brook trout likely inhabit the east branch that drains Blueberry Swamp.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Blueberry Swamp Division or within the division's current, approved acquisition boundary. The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Blueberry Swamp Division (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered low throughout the division. Sensitivity for post-contact Euro-American sites is low except for areas bordering on East Road, where it is considered moderate.

Pondicherry Division, New Hampshire (6,443 acres)

The Pondicherry Division is located in Jefferson, Whitefield, and Carroll, Coos County, New Hampshire, 5 miles south of Lancaster, New Hampshire, and 12 miles northwest of Mount Washington. The Pondicherry area was SFA 41 in the 1995 FEIS (USFWS 1995) and was identified with 1,665 acres. Division lands have been acquired from several landowners and it now comprises 6,443 acres. Prior to expanding beyond the original SFA's 1,665 acres, and to comply with NEPA requirements, refuge staff re-engaged the public and completed a

separate environmental assessment and "finding of no significant impact" administratively authorizing the larger boundary for the Pondicherry Division. Officially, the division was established in 2000 when 670 acres were purchased from the Hancock Timber Resource Group.

Bill Buchanan

Raccoon

Natural Resources

Pondicherry Division's landscape is, in part, a product of ancient glacial activity. Approximately 10,000 years ago, as glaciers from the last ice age receded, this area was at the bottom of Lake Israel. As Lake Israel drained, huge residual glacial ice blocks remained embedded in the bottom substrate. These blocks melted, leaving water-filled depressions or kettle lakes known today as Cherry, Little Cherry, and Mud Ponds.

Pondicherry Division lies about 1,110 feet above sea-level in a three-sided basin, surrounded to the north, east, and south by peaks rising from 5,000 feet (Pliny Range) to 5,580 feet (Presidential Range) above the basin. To the west, low hills separate the basin from the Connecticut River Valley. Most of the division is drained by the John's River which flows west out of Cherry Pond into Little Cherry Pond. Little Cherry Pond drains to the west through a low-gradient reach known as the Deadwater. The river is about 10 feet wide and ranges in depth from 4 inches to 3 feet. An unnamed stream drains Mud Pond flowing into the north side of Little Cherry Pond. After the John's River leaves the division, it flows through Whitefield, New Hampshire, and reaches the Connecticut River across from South Lunenberg, Vermont. Stanley (a.k.a. Slide or Mill) Brook drains the eastern quarter of the division into the Israel River which enters the Connecticut River in Lancaster, New Hampshire.

The wetland and saturated soils are very deep and very poorly drained in depressions on outwash plains, lake plains, and glaciated uplands. They are influenced by herbaceous organic deposits and underlain by sandy textured sediments. Slopes range from zero to 2 percent (2%).

Noted habitat attributes included "…a wetland complex of bogs, streams, and ponds surrounded by spruce/fir forest…" The area was recognized as good stopover habitat for several waterfowl species and the site of a great blue heron rookery.

The most abundant habitats are lowland spruce-fir which is found throughout the division and mixed-wood forests in the uplands (table 3.18). Peatlands surround Little Cherry and Mud ponds and are found between Mud Pond and the northern shore of Cherry Pond. Wet meadow/shrub habitats are concentrated along the John's River, in the Moorhen Marsh/Cedar Marsh area south of Cherry Pond, and along the edges of the ponds and the John's River. Aquatic habitats include the three ponds, the John's River and its tributaries, and Stanley Brook which flows into the Israel River.

Nulhegan Basin Division

USFWS

Table 3.18. Percentage of Pondicherry Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Conifer swamp/spruce-fir	67%
Hardwood forest	16%
Shrub swamp and floodplain forest	6%
Freshwater marsh	Less than 1%
Pasture/hay/grassland	Less than 1%
Peatland	10%
Open water	Less than 1%
Developed	1%

1 See table A.52 at the end of appendix A for comparison.

Much of the existing forest is relatively young due to past natural disturbance and recent forest management activities. A large fire swept through the basin in the early 1900s resetting a substantial portion of the forest back to an early age structure. Throughout the 1900s trees were harvested on what is now Service land. The most recent harvests occurred during the 1980s and 1990s. Some of the peatlands were excluded from the last round of harvesting, because of the fragile saturated soils. A New Hampshire Public Service powerline corridor crossing the southern half of the division from east to west and a portion of the western boundary north to south is held in an early successional shrub/sapling structure. Acquired land not previously owned by timber companies has a varied history, ranging from active to passive forest management and agricultural use.

Invasive plants are a growing concern at the division. Documented species include purple loosestrife, Japanese knotweed, Canada thistle, spotted knapweed, Morrow's honeysuckle, *Phragmites*, and coltsfoot. Loosestrife and knotweed

appear to be the most problematic species. The former is gaining a foothold in emergent wetlands around Moorhen Marsh and in the riparian habitats of the John's River, including the Cherry Pond outlet. We released beetles of the genus *Galerucella* during the summer from 2007 to 2009 in an effort to control loosestrife. Subsequent monitoring indicated minimal success and no further releases are planned. Canada thistle is present in low numbers at log landings and on the logging road network. Volunteers and YCC crews hand pull any plants found each year. It does not seem to be spreading at this time. Spotted knapweed and Morrow's honeysuckle are confined to the railroad bed, near Waumbeck Junction. Coltsfoot has been found in an old corduroy road from the last timber harvest entry between the State Route 116 parking lot and Mud Pond. Surveys by volunteers indicate it is not a threat to spread at this time. *Phragmities* was found near the southern boundary in 2011 and chemical control was initiated in 2012. At this time the infestation is limited to a small, isolated wetland.

Pondicherry supports a broad array of wildlife, and is especially known for an abundance of breeding and migrating songbirds. A total of 238 birds have been documented on land that now comprises the division, and 129 of these are confirmed breeders. Pondicherry lies within the Atlantic Northern Forest BCR 14. Five of the six highest priority species for BCR 14 habitats found at Pondicherry are confirmed nesters. These are the American black duck, American woodcock, Canada warbler, wood thrush, and bay-breasted warbler. Ten of the 16 high priority species nest at Pondicherry and three others occasionally use the division as stopover habitat during migration.

The importance of Pondicherry to birds has been officially recognized several times. In 1963, New Hampshire Audubon and the New Hampshire Fish and Game Department collaborated to establish the Pondicherry Wildlife Sanctuary, comprised of Cherry and Little Cherry ponds and 166 acres of shoreline. The National Park Service recognized the Pondicherry Wildlife Sanctuary in 1972 for its "…relatively stable bog-forest supporting an unusual variety of birdlife…" by naming it a National Natural Landmark. The refuge subsequently purchased a conservation easement on these lands and they are now part of the refuge's Pondicherry Division. In 2003 the division and the adjacent Mount Washington Regional Airport were designated the first Important Bird Area in New Hampshire.

Aquatic habitats within the division boundary support several fish species one of which, the brook trout, has been identified as a conservation priority for the Service's Northeast Region. Other species documented from Pondicherry include chain pickerel and several perch species from Cherry Pond, and the northern red-bellied dace from riverine habitats.

This division has been part of larger studies on American woodcock habitat (Salve Regina University), the distribution and abundance of robber flies (Diptera: Asilida) (Connecticut Agricultural Experiment Station), and Northern goshawk nesting and reproduction (U.S. Forest Service). The refuge has conducted breeding bird surveys and habitat inventories. In partnership with the Friends of Pondicherry, there have been surveys of whip-poor-wills, and documentation of birds, reptiles, and amphibians on the division. In 2013, the refuge began an inventory of bats on the division.

Refuge Public Uses

Pondicherry is well known for its outdoor recreational opportunities. All six of the priority, wildlife-dependent uses (i.e., hunting, fishing, wildlife observation and photography, environmental education and interpretation) are available at Pondicherry.

Hunting has been a popular recreational activity at Pondicherry for decades. Ruffed grouse are probably the most popular game species sought by hunters, but white-tailed deer, moose, black bear, American woodcock, and snowshoe hare are also hunted. Division-specific regulations for sport hunting have been in place since the fall of 2005. Popular hunting areas include the powerline corridor, early successional forest stands, and forests adjacent to the old road network. In 1963, Cherry and Little Cherry Ponds (130 acres) and a 166-acre area around the ponds were closed to hunting by the New Hampshire Fish and Game Department and New Hampshire Audubon. In 2005, another 250 additional acres around the Little Cherry Pond Loop Trail was closed to reduce potential conflicts between hunters and non-hunters.

Fishing occurs at the Pondicherry Division, however, fishing pressure outside of the winter season is limited because the best fishing area, Cherry Pond, requires a 1.5-mile hike or bicycle ride on the State rail-trail. Most fishing probably occurs during the winter, as snowmobilers ride on the state trails to Cherry Pond. Little Cherry Pond and the John's River are less popular because they are more remote.

Wildlife observation and photography are probably the most popular activities at Pondicherry. People began birding there as early as 1911 when Horace Wright published *The Birds of the Jefferson Region in the White Mountains* (Wright 1911). Today people trek out to Cherry Pond, Little Cherry Pond, and more remote sections seeking wildlife. Guided group tours are offered by the Friends of Pondicherry each year in celebration of International Migratory Bird Day. Photographers are drawn to the spectacular view of the Mount Washington and the Presidential Range in the background from the western shore of Cherry Pond. The Appalachian Mountain Club (AMC) has offered outdoor photography courses that included a day at Cherry Pond.

The Friends of Pondicherry have offered field trips led by visiting instructors each year. The White Mountains Regional School uses the division for educational field trips. As discussed above, organizations such as Audubon and the AMC bring people to Pondicherry for nature-based learning. There are self-service educational materials at the informational kiosks located at the parking lots on State Route 116 and at the state trailhead on Airport Road.

Within the Pondicherry boundary are the Presidential Recreational Trail, an active railroad line, and Cherry Pond, and Little Cherry Pond which are under the jurisdiction of the State of New Hampshire. Hiking and bicycling are allowed on the rail-trail throughout the year and snowmobiling occurs during the winter months. The division proper is not open to motorized or mechanized travel, except during the winter on a state snowmobile trail (Powerline Trail) located on the Public Service of New Hampshire utility corridor easement.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Pondicherry Division or within the division's current, approved acquisition boundary. However, the New Hampshire State site files indicate that six Native American sites are known within a 1-mile radius of the division, providing evidence of settlement that occurred during the Paleo-Indian period (11,500 to 9,500 years before present).

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Pondicherry Division (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is variable. It is considered high in the level, northern plateau; moderate in areas where

wetland margins are well drained; and low in poorly drained wetland areas. Sensitivity for post-contact Euro-American sites also varies. It is considered high in documented settlement areas and in proximity to historic railroad easements, moderate near historic roads, and low elsewhere.

Mascoma River Division, New Hampshire (761 acres)

In 2015, the Service acquired a 761-acre easement which established the Mascoma River Division. This easement gives us the authority to manage habitat and public use in this area. The division is located within an existing network of conserved lands, including the White Mountain National Forest, Mascoma River and Cumins Pond Wildlife Management Areas, and several privately owned tracts.

Natural Resources

This division, and surrounding area, is identified as high priority for conservation for the State of New Hampshire and contains a large, intact forested area which has diversity in elevation and aspect and includes numerous small, scattered, forested wetlands.

Table 3.19. Percentage of Mascoma River Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map layer (citation).

General Habitat Type[1]	Percent of Division
Hardwood Forest	97%
Pasture/Hay/Grassland	1%
Open Water	2%
Developed	Less than 1%

1 See table A.52 at the end of appendix A for comparison.

Public Use

When the Service acquired a conservation easement on this division, the rights to manage habitat and provide public access for compatible uses was as acquired. Presently, the division is open to all six priority public uses since they were ongoing at the time the property was acquired. Consideration of additional public access will be evaluated when then visitor services step-down plan for this division is completed.

Cultural Resources and Historic Preservation

The Mascoma River Division was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Nulhegan Basin Division, Vermont (26,605 Acres)

The Nulhegan Basin Division was SFA 45 in the 1995 FEIS (USFWS 1995). It encompassed 71,900 acres, of which the refuge intended to acquire 11,000 acres. Since the 1995 Conte Refuge FEIS (USFWS 1995) was completed, the Service opted to purchase approximately 27,000 acres from The Conservation Fund as part of a larger land conservation effort. To comply with NEPA requirements, the refuge re-engaged the public and completed an environmental assessment and a "finding of no significant impact" which administratively modified the original 1995 Conte Refuge FEIS to allow expanded acres for refuge acquisition (USFWS 1999).

The Nulhegan Basin Division is located in Essex County in the towns of Brunswick, Ferdinand, Bloomfield, and Lewis, Vermont. The refuge headquarters and visitor contact station is located in Brunswick (about 10 miles east of Island Pond). A five-room quarters building and storage barn are

located adjacent to the headquarters building. There is a 200-foot interpretive boardwalk on Four Mile Road in the area known as Mollie Beattie Bog. There are interpretive kiosks at the main entrances of the division and scenic overlooks at the headquarters and at the end of Lewis Pond Overlook road. About 15 year-round residences and numerous seasonal cabins are within 1 mile of the division boundary, primarily along Vermont Route 105.

Natural Resources

The Nulhegan Basin was created when a pool of magma formed within existing metamorphic rock. The magma cooled into a relatively soft granitic rock called quartz monzonite. Once erosion wore away the cap of metamorphic rock, the softer monzonite eroded more rapidly than the surrounding metamorphic rock. This resulted in a relatively flat circular interior area, roughly 10 miles in diameter, surrounded by hills. Sand and gravel were later deposited in the bottom of the Basin by melting glaciers. Elevations on the division range from 1,000 feet to 2,800 feet above sea level.

Gary Kramer/USFWS

Bobcat

Three of the four major tributaries of the Nulhegan River, the North, Yellow, and Black Branches, flow north to south through the division. A network of smaller streams feed these branches. The main course of the Nulhegan River flows adjacent to the south boundary of the division. The 68-acre Lewis Pond is in the northwest portion of the division.

The division is predominantly forested with natural small openings. These openings are most frequently associated with wetlands (e.g., bogs and beaver flowages), although windthrow events temporarily create larger openings. Twenty-three natural communities are mapped on the Nulhegan Basin Division. These include the most significant mosaic of lowland conifer natural communities in the State, including spruce-fir-tamarack swamp, black spruce swamp, northern white cedar swamp, and peatlands. Six of the natural communities have a Vermont Natural Heritage classification of S2 (rare) and 10 are classified as S3 (uncommon). Wetland and aquatic natural communities support the majority of identified rare plants. Shrublands, primarily dominated by speckled alder, are restricted to poorly drained areas, small seepage zones, and wide alluvial stretches of the Nulhegan River and its principal tributaries (table 3.20).

Table 3.20. Percentage of Nulhegan Basin Division by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Division
Conifer swamp/spruce-fir	57%
Hardwood forest	40%
Shrub swamp and floodplain forest	1%
Cliff and talus	Less than 1%
Freshwater marsh	Less than 1%
Peatland	1%
Rocky outcrop	1%
Open water	Less than 1%
Developed	Less than 1%

1 See table A.52 at the end of appendix A for comparison.

Riparian habitats and wetlands are generally in good condition. Historically, dams and log drives impacted the area's streams. Forested habitats in the division have long supported the timber industry, dating back 150 years. The species removed and the intensity of harvesting varied over time as technologies and markets changed.

Northern hardwood forest, dominated by sugar and red maple, American beech, and yellow and paper birch, cloak the mountains of the Basin rim and the larger hills of the Basin interior. Notably absent in the Basin are oaks, another indicator of the more northern character of the forest. Spruce-fir forest covers large areas of the Basin bottom. Red and Black spruce and Balsam fir are the principal trees in these forests, which cover both wetlands on shallow to deep peat soil deposits, and adjacent glacial kame and till soils of the shallow valleys, flats, and low hills. Another northern forest conifer, white spruce, occurs sparingly in flood plains and certain swamps. In upland situations, successional stages of these spruce-fir forests can be dominated by quaking and bigtooth aspen, red maple and paper birch. Tamarack, northern white cedar, and black ash occur commonly in the basin, although restricted to wetlands more heavily influenced by groundwater.

State rare plants found in the division include white-fringed orchid, bog sedge, shining rose, drooping bluegrass, ligonberry, and the State-endangered auricled twayblade. Most of these plants are associated with bogs and other peatlands common in the division, and are more common to the north of the Basin. Peat mosses of the genus *Sphagnum* are a predominant groundcover in the numerous swamps and bogs of the refuge. No plant species are currently known to occur on the division that are federally listed as endangered or threatened, or are proposed for Federal listing.

The division provides habitat for a wide diversity of vertebrate and invertebrate fauna. Some notable species that inhabit the refuge are black bear, moose, marten, snowshoe hare, Eastern wild turkey, ruffed grouse, spruce grouse, coyote, red squirrel, fisher, bobcat, porcupine, raptors, amphibians and reptiles, many migratory and resident song birds, and fish including Eastern brook trout. Specifically, the division provides nesting and migratory habitat for numerous forest-dependent migratory bird species, waterfowl, and raptors.

In addition, the Basin contains the largest deer wintering area in the state, about 10,000 acres, the majority of which is located on the Division. White-tailed deer are at the northern end of their range on the Division and are limited by harsh winter conditions. Deer survival depends on adequate shelter and food. Deer wintering areas provide critical winter cover for deer; a core area of softwoods with high crown closure and patches of mixed hardwood or softwood providing accessible browse within or near the core of the area. Our management of spruce-fir habitat will provide a diverse canopy structure which will ensure adequate snow interception and regenerating intolerant hardwoods (e.g. white birch and red maple) associated with spruce-fir landscapes will provide important winter browse. The division was also designated part of the State's largest IBA by the Vermont chapter of The Audubon Society in 2001.

The following biological studies and inventories have occurred on the Nulhegan Basin Division:

- A 2000 to 2001 inventory of fish, macroinvertebrates, marsh birds, waterfowl broods (resurveyed in 2008), and small mammals.
- A 2000 to 2005 survey of owls.
- A 2000 to 2005 survey of breeding amphibians and vernal pools.

- A 2000 to 2006 breeding landbird survey. From 2003 and 2012, additional landbird data was collected at a Monitoring Avian Productivity and Survivorship (MAPS) banding station. Also, Canada warblers were monitored as part of a larger study effort, to obtain and model habitat-specific estimates of productivity, survivorship, dispersal, and site fidelity for northeast Vermont.

- A 2001 inventory and mapping of natural communities and rare plants. The mapping was updated in 2012 to include new refuge land acquisitions.

- A 2007 habitat inventory, including information on species composition, forest stand structure, fuel load, size class, height class, and amount of crown closure.

- A 2012 - 2015 bat acoustic survey.

- From 2009 to the present, surveys of refuge aquatic habitats, including assessing fish passage and in-stream features.

- From 2012 to present, snow tracking surveys conducted for Canada lynx and other carnivore distributions at the division and surrounding lands. Permanent camera trapsites established in 2014 and monitored year round within lynx habitat. Over 800 snowshoe hare pellet plots in 17 stands established in 2015, and monitored twice a year to index snowshoe hare abundance. These surveys are part of a study evaluating the relative influence of climate, habitat, and competition on predator-prey dynamics with a focus on snowshoe hare.

- In 2015, New Hampshire Audubon conducted research evaluating rusty blackbird habitat within the northern divisions of the Conte Refuge, Umbagog Refuge and other areas in northern NH to develop habitat management guidelines for the species.

- A recent inventory for invasive species.

There are also several ongoing surveys on the refuge:

- American woodcock surveys, including spring singing ground surveys and summer roosting surveys.

- Spruce grouse breeding surveys in partnership with the State.

Results of these studies and inventories can be obtained from refuge headquarters.

Refuge Public Use
The division is a popular area for hunting, fishing, wildlife observation, snowmobiling, and wildlife photography. These uses were allowed under the previous ownership. Much of the hunting on the division, particularly deer hunting, is based out of leased cabins located within the refuge boundary. Day use is frequent on a year-round basis, particularly for hunting, fishing, dog-training, wildlife observation, and photography. Major wildlife species of interest to the public for observation or harvest include white-tailed deer, black bear, moose, snowshoe hare, ruffed grouse, neotropical songbirds, furbearers, and Eastern brook trout. The division's "boreal" bird species, including spruce grouse, black-backed woodpecker, gray jay, and boreal chickadee are an important attraction for serious birdwatchers.

Snowmobiling on designated trails is currently allowed on the division to facilitate winter access in support of priority public use activities. Snowmobiling is confined to designated State trails, which are generally open the third week of December to about mid-April every year.

To prevent excessive damage to the division's 40-mile road network, public travel by motor vehicle is prohibited during the spring mud season. During this period, which generally is from snow breakup to late May, roads on the division (and adjacent West Mountain Wildlife Management Area (WMA) and Plum Creek Timber lands) are closed to vehicular access. After mud season, people may drive on the designated refuge road network.

Cultural Resources and Historic Preservation

The Nulhegan Basin Division was included in a 2001 cultural resource study assessment and management plan of 48,000 acres of the former Champion International forestlands in the Northeast Kingdom of Vermont (Scharoun et al. 2001). The study was conducted by the University of Maine-Farmington for the Vermont Land Trust and included 26,000 acres of Federal land (the Nulhegan Basin Division). The study identified no known Native American archaeological sites within the division. However, eight Native American sites are known within a 4-mile radius of the division, providing evidence of settlement that occurred during the pre-Contact period. Regarding historical sites, the study considered sites that were identified in the field during the study, sites referenced on historical maps and/or the archival record, and sites that were referred to anecdotally. Five historical resources, consisting of the remnants of log dams, were confirmed on division lands. The 2001 study also included a preliminary architectural assessment of all standing structures within the former Champion Paper Company forestlands, which included 59 former lumber camps and/or recreational camps dating to the late 19th century through the late 20th century.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Nulhegan Basin Division (Waller and Cherau 2011). The study referred to the previous cultural resource study assessment and management plan (Scharoun et al. 2001) and assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is variable. Sensitivity for post-contact Euro-American sites also varies, according to local topography and landscape features.

Individual Refuge Units

Dead Man's Swamp Unit, Connecticut (31 acres)

Natural Resources

This 31-acre unit consists of a freshwater wetland and sand spit adjacent to the Connecticut River (table 3.21, see appendix A for map). It is 45 miles upriver from the Long Island Sound, and therefore, not directly influenced by tides. River bulrush, tuckahoe or arrow arum, cattail, and water horsetail dominate the wetland. The water depth is mostly over one meter, and it has a quaking surface that cannot be negotiated on foot. Freshwater wading birds and secretive marsh birds use the swamp. The riverine sand spit along the Connecticut River main stem supports the federally listed Puritan tiger puritan beetle (CTDEEP 1999). The refuge has worked in partnership with CTDEEP to monitor Puritan tiger beetles and create suitable larval habitat by removing plants that are encroaching onto the spit.

Table 3.21. Percentage of Dead Man's Swamp Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	27%
Hardwood swamp	50%
Freshwater marsh	7%
Open water	17%

1 See table A.52 at the end of appendix A for comparison.

Public Use
The Dead Man's Swamp Unit is closed to public access to protect habitat for the federally threatened Puritan tiger beetle.

Cultural Resources and Historic Preservation
There are no recorded archaeological sites within the existing Dead Man's Swamp Unit and within the unit's current, approved acquisition boundary. However, the Connecticut site files indicate that several Native American sites are known within a 1-mile radius of the unit, offering evidence of settlement during the Middle Archaic period (7,500 to 5,000 years before present) and Early Woodland period (3,000 to 2,000 years before present). No historical archaeological sites have been identified within the unit to date, and there are no historic structures.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Dead Man's Swamp Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites ranges from high to low depending on the location within the unit (with the eastern portion having higher sensitivity). Sensitivity for post-contact Euro-American sites is considered low throughout the unit.

Roger Tory Peterson Unit, Connecticut (56 acres)

Natural Resources
This unit, located in Old Lyme, Connecticut, was once part of the estate of the famous author and naturalist, Roger Tory Peterson (see appendix A for map). The property extends from Route 156 to the Lieutenant River. The predominant habitat is hardwood forest, with fluvial wetlands along the river (table 3.22). This unit is an important component of migratory bird stopover habitat because the forest is intact and it is in close proximity to the Connecticut River flyway corridor.

Table 3.22. Percentage of Roger Tory Peterson Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map layer (citation).

General Habitat Type[1]	Percent of Unit
Hardwood forest	89%
Salt marsh	4%
Developed	7%

1 See table A.52 at the end of appendix A for comparison.

In 2012, an inventory for invasive plant species was conducted on this unit similar to other parcels within the refuge. Several invasive plants were identified, including common reed, multiflora rose, burning bush, and Japanese barberry. Although Japanese stiltgrass was not discovered within the boundaries of the unit, it's likely that new populations will arise given a known population's proximity to the parcel. In the southeast section of the parcel, common reed (commonly known as *Phragmites*), has severely invaded the brackish marsh outcompeting native *Juncus spp.* and *Spartina spp.* The eastern uplands of the unit are less invaded.

Public Use

The Roger Tory Peterson Unit was acquired 2012 and does not have any existing public use facilities, such as designated trails or interpretive kiosks and panels. This unit is not currently open to public use, including hunting. The unit also does not have any suitable areas for fishing.

Cultural Resources and Historic Preservation

The Roger Tory Peterson Unit was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted. The unit is located in Old Lyme and contains multiple historic landscape features (stone fences, historic road traces), as well as a small house (York House) that served as Roger Tory Peterson's office and an adjacent small garage. Peterson was a renowned naturalist, ornithologist, artist, and educator, best known for his series of successful nature field guides (Houghton Mifflin 2009). In 1934, his first book, "A Field Guide to the Birds," was published. The book's clear and simple bird identification system helped introduce many people to bird watching and nature observation (Roger Tory Peterson Institute 2008). By the time of his death in 1996, he had authored and illustrated dozens of books on birds, other wildlife, and plants and had received numerous awards for his work as a naturalist and conservationist, including the Presidential Medal of Freedom (Houghton Mifflin 2009).

Fannie Stebbins Unit, Massachusetts (98 acres)

Natural Resources

Beginning more than fifty years ago, members of the Allen Bird Club worked to acquire approximately 330 acres of land between Interstate 91 and the Connecticut River in Longmeadow, Massachusetts. This property became the Fannie Stebbins Memorial Wildlife Refuge, owned and managed by a separate Board of Trustees elected by Allen Bird Club members. Eventually the Town of Longmeadow began acquiring additional property in the area, leading to the protection of over 1000 acres. The Stebbins property and the larger floodplain area known as the "Longmeadow Flats" has been designated an NNL by the Department of the Interior and an Important Bird Area by the Massachusetts Audubon Society (Allen Bird Club 2015).

The area is subject to periodic flooding that is representative of this habitat. It includes bordering swamps, ponded water, vegetated wetlands, meadows that are maintained by mowing, hardwood forest, sandbars, riverbank, and an island. It encompasses one of the largest remaining patches of floodplain forests and wetlands along this heavily human-impacted section of the Connecticut River. The wetlands provide breeding habitat for marsh birds and stop-over habitat for migratory waterfowl. During summer and fall the shoreline offers shallows and sandbars for resting and feeding gulls, raptors, shorebirds, and herons. The woodlands and brushy areas provide important habitat for many species of breeding, migratory, and wintering land birds (Allen Bird Club 2015, Mass Audubon n.d.).

In order to ensure the protection of the Stebbins Refuge lands in perpetuity, the Fannie Stebbins Memorial Wildlife Refuge (a registered nonprofit) initiated negotiations with Conte Refuge (Allen Bird Club 2015). Fannie Stebbins was a SFA in the 1995 Conte FEIS. The Fannie Stebbins CFA area is considered important floodplain forest by The Nature Conservancy and the proposed CFA would allow for the restoration and conservation of the floodplain forest and associated wetland complex. Habitat conservation in this CFA will help allow for the landward migration of the coastal wetland complex (salt-, brackish-, and freshwater tidally influenced wetlands) due to climate change.

Table 3.23. Percentage of Fannie Stebbins Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	54%
Hardwood swamp	15%
Freshwater marsh	25%
Open water	3%
Developed	3%

1 See table A.52 at the end of appendix A for comparison.

Public Use

At the time of acquisition, this unit was open to wildlife observation, photography, environmental education and interpretation. These uses are allowed to continue. The unit is not presently open to hunting and fishing.

Cultural Resources and Historic Preservation

The Fannie Stebbins Unit was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Hatfield Unit, Massachusetts (19 acres

Natural Resources

The Hatfield Unit is approximately 19 acres. It includes a portion of the Connecticut River floodplain and forested upland approximately 150 to 200 feet above the floodplain. The western third of the unit, along Cronin Hill Road is primarily deciduous forest comprised of white ash (Fraxinus americana), red maple (Acer rubrum), beech (Fagus grandifolia), and black cherry (Prunus serotina) with some white pine (Pinus strobus). There is a steep drop east to the floodplain adjacent to Great Pond. Historically, this pond was part of the Connecticut River mainstem that was cutoff, forming an oxbow. Today this wetland complex is listed as Core Habitat and a Priority Wetland and Aquatic Core by the Massachusetts Natural Heritage and Endangered Species Program. Floodplain forests were at one time quite common in the state, particularly on the extensive alluvial silt deposits of the Connecticut River Valley, but they have been largely converted to agricultural land due to their high fertility (Paveglio and Taylor 2010; UMass 2012).

Table 3.24. Percentage of Hatfield Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	17%
Freshwater marsh	48%
Pasture/Hay/Grassland	23%
Developed	12.5%

1 See table A.52 at the end of appendix A for comparison.

Public Use

This unit is not presently open to public access, but will be evaluated for compatible recreational opportunities when a visitor services step-down plan is undertaken.

Cultural Resources and Historic Preservation

The Hatfield Unit was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Honeypot Road Wetlands Unit, Massachusetts (21 acres)

Natural Resources

Honey Pot Road Wetlands near Westfield, Massachusetts, is one of the original SFAs identified in the 1995 Conte Refuge FEIS (USFWS 1995); identified for three rare vertebrates and two rare invertebrates. The SFA identified 960 acres needing protection consisting of a complex of vernal pools and scrub/shrub wetlands along with associated forests and fields (table 3.25). In 1999, the Service purchased a 20-acre upland and wetland parcel adjacent to a unit of the Honey Pot WMA. Wetlands in the vicinity host some of the world's few known populations of the American clam shrimp recorded in Massachusetts, Florida, South Carolina, Georgia, and Europe (MassWildlife, NHESP 2008, see appendix A for map).

Table 3.25. Percentage of Honeypot Road Wetlands Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	71%
Hardwood swamp	24%
Pasture/hay/grassland	5%

1 See table A.52 at the end of appendix A for comparison.

Public Use

Honeypot Road Wetlands Unit is open to wildlife observation and photography, environmental education, and interpretation. Hunting under State regulations will be considered development of a step-down plan as the unit lies adjacent to the state-owned, 137-acre Honey Pot Natural Heritage Area and across Honey Pot Road from the 227-acre Westfield WMA. Both these state areas are

managed by the Massachusetts Division of Fisheries and Wildlife and are open to hunting, fishing, and passive recreation such as wildlife observation, photography, and hiking.

Cultural Resources and Historic Preservation
There are no recorded archaeological sites within the existing Honeypot Road Wetlands or within the unit's current, approved acquisition boundary. However, the Massachusetts State site files indicate that one Native American site is known within a 1-mile radius of the unit.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Honeypot Road Wetlands Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered moderate throughout the unit, while sensitivity for post-contact Euro-American sites is low.

Mount Toby Unit, Massachusetts (30 acres)

Natural Resources
Similar to Mount Tom, Mount Toby is a high (1,269-foot), traprock, heavily forested ridge containing small wetland areas including fens, seeps, and wooded swamps (table 3.26, see appendix A for map). Mount Toby Unit is one of the original SFAs identified in the 1995 Conte Refuge FEIS (USFWS 1995) known for its value to breeding and migrating neotropical and resident birds and a rare assemblage of plants and animals. In 2003, the refuge acquired 30 acres near the base of Mount Toby off Gunn Road in Sunderland, Massachusetts, helping to protect this traprock habitat along with the Massachusetts DCR which owns and manages portions of Mount Toby as part of the Connecticut River Greenways State Park (MDCR n.d.). The nearby 755-acre Mount Toby Demonstration Forest is owned by the University of Massachusetts and managed by the Massachusetts DCR Recreation (Caputo and D'Amato 2006).

Table 3.26. Percentage of Mount Toby Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	97%
Pasture/hay/grassland	3%

1 See table A.52 at the end of appendix A for comparison.

Public Use
The Mount Toby Unit is part of a partnership conservation effort with the University of Massachusetts, Massachusetts DCR, TNC, and The Trustees of Reservations. The Mount Toby Unit is open to wildlife observation and photography, environmental education, and interpretation. There are no fishing opportunities and the unit is not currently open to hunting.

Cultural Resources and Historic Preservation
There are no recorded archaeological sites within the existing Mount Toby Unit or within the unit's current, approved acquisition boundary. However, the Massachusetts State site files indicate that several Native American sites are known within a 1-mile radius of the unit.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Mount Toby Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered high in areas where exposed bedrock outcrops may have been used for rockshelters, and is moderate elsewhere. Sensitivity for post-contact Euro-American sites is considered low throughout the unit.

Mount Tom Unit, Massachusetts (141 acres)

Natural Resources

Mount Tom is a 1,800-acre area adjacent to the Connecticut River near Easthampton, Massachusetts, and was identified as an SFA in the original 1995 Conte Refuge FEIS (USFWS 1995, see appendix A for map). Mount Tom is part of the Metacomet Range, formed over 200 million years ago due to volcanic activity and subsequent geologic and erosive pressures (Sinton et al. 2007). The predominantly basalt or traprock mount offers unique habitat for State-listed rare and endangered species, and is recognized as one of the premier fall hawk watch locations in the eastern U.S. (Ortiz et al. 2003).

In 2002, the Service acquired 141 acres on Mount Tom in Holyoke, Massachusetts, part of a coordinated conservation purchase with the Massachusetts DRC (who purchased adjacent land to the north and owns a majority of the remainder of the mountain), The Trustees of Reservations (who bought the adjacent Little Mount Tom), and the Holyoke Boys and Girls Club (who bought the former ski lodge buildings at the base of the mountain). The portion owned by the Service holds former ski slopes, forests, streams, and vernal pools (table 3.27x). Mount Tom provides habitat for 13 State-listed plants, several State-listed reptiles, and amphibians, and is used heavily by raptors and other birds during migration.

Table 3.27. Percentage of Mount Tom Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	86%
Pasture/hay/grassland	11%
Open water	3%

1 See table A.52 at the end of appendix A for comparison.

A concerted effort to control invasive plants, especially pale swallowwort, was undertaken by the refuge and abutting partnering landowners for several years. Unfortunately, control of the swallowwort was not successful on Service land. More recently, control efforts have focused on a collaborative effort with the Massachusetts Natural Heritage Program to control pale swallowwort where it threatens State-listed plants and other priority habitat. Other invasive species present include spotted knapweed, Oriental bittersweet, multiflora rose, purple loosestrife, and exotic bush honeysuckles, among others. We have conducted some control of all of these species over the years.

Studies on this unit include natural community mapping, plant and invertebrate inventories, an initial breeding bird inventory, vernal pool and wetland delineations, and amphibian and reptile habitat use and home range studies.

Public Use

The Mount Tom Unit is not currently open to visitors because the partnership did not want to encourage public use with the nearby rock quarry (active until 2012) and the threat of vandalism to the former ski lodge facilities owned by the Holyoke Boys and Girls Club. There are no developed trails on the unit, however, the Metacomet-Monadnock Trail runs along the ridge at the top of the mountain. This trail is a 114-mile long hiking trail that runs from central Massachusetts to Mount Monadnock in southern New Hampshire. Hunting is not allowed on the unit and there are no fishing opportunities. There is also a right-of-way easement for access through the unit to the cellphone, radio, and television towers on Mount Tom. The intention of the partners is to open the property for compatible public uses, with an emphasis on environmental education and interpretation, particularly for adjacent cities such as Holyoke, once it is safe to do so.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Mount Tom Unit or within the unit's current, approved acquisition boundary. However, the Massachusetts State site files indicate that several Native American sites are known within a 1-mile radius of the unit, although these are on the valley floor and not the mountaintop area. Several Native American sites have been recorded in the mountaintop zone, but these are approximately 2 miles north of the Mount Tom Unit itself. Historical archaeological resources located on Mount Tom more than 1 mile from the Mount Tom Unit provide evidence of quarries, sawmills, inns from the 18th and 19th centuries, and 20th-century Civilian Conservation Corps (CCC) activities. In 1946, a World War II B-17 aircraft crashed into Mount Tom in what is now the southwest corner of the unit. The crash site is commemorated by a granite monument erected in 1996 by the town of Holyoke, before the property was acquired by Service. A makeshift shrine contains debris from the crash site collected over the years by visitors. This vicinity also contains a bronze plaque in memory of a local Vietnam veteran who died in 1995.

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Mount Tom Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered high in areas where exposed bedrock outcrops may have been used for rockshelters, and is moderate elsewhere. Sensitivity for post-contact Euro-American sites is considered low throughout the unit.

Third Island Unit, Massachusetts (4 acres)

Natural Resources

Third Island is a 4-acre island in the Connecticut River in Deerfield, Massachusetts. The island, 4.3 miles upriver from the Sunderland Bridge at Route 116, is contained within one of the original SFAs (#29A) known as the "Connecticut River Main stem–Turners Falls Dam to Highway 116 at Sunderland Bridge" (see appendix A for map). The refuge was established when this island was donated to the Service from the Connecticut River Watershed Council in 1997. It is upriver from First Island and Second Island, which are owned and managed by the Massachusetts Division of Fisheries and Wildlife. The island is mostly hardwood forest, with some shallow water habitats (table 3.28).

The island is used as a nesting site by bald eagles, and, as such, is off-limits during the first half of the year until young eagles have fledged. Along with the other two islands, Third Island provides valuable shallow water habitats for spawning Atlantic sturgeon and both American shad and blueback herring (USFWS 1995). Mussels are common on the river bottom near Third Island. Invasive plants including Japanese knotweed, Oriental bittersweet, and purple loosestrife are well established and some management has taken place. The bittersweet is of particular concern to the health of the trees supporting the eagle nest.

Table 3.28. Percentage of Third Island Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Hardwood forest	50%
Open water	50%

1 See table A.52 at the end of appendix A for comparison.

Public Use

The Third Island Unit is closed each year to public use during the bald eagle nesting season (January 1 through July 31). From August 1 to December 31 the refuge is open to wildlife observation and photography, environmental education, and interpretation. Because of the unit's location in the Connecticut River, it is also a popular stop for canoeists and kayakers. It is not currently open to fishing or hunting.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Third Island Unit or within the unit's current, approved acquisition boundary. However, the Massachusetts State site files indicate that three Native American sites are known within a 1-mile radius of the unit, providing evidence of settlement that occurred during the Late Archaic period (5,000 to 3,000 years before present) and the greater Woodland period (3,000 to 450 years before present).

The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Third Island Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is considered moderate in the Third Island Unit elsewhere, while sensitivity for post-contact Euro-American sites is considered low.

Wissatinnewag Unit, Massachusetts (21 acres)

Natural Resources

The 21-acre Wissatinnewag Unit was acquired by the Service in 2001. It, like Third Island above, is contained within SFA 29a "Connecticut River Main stem–Turners Falls Dam to Highway 116 at Sunderland Bridge" (see appendix A for map). The site lies opposite the Great Falls Discovery Center on the upper slope above the Connecticut River in Greenfield, Massachusetts.

The predominant habitat is hardwood forest on a steep, southeast facing slope (table 3.29). The forest serves as important migratory bird stopover habitat during the spring, and supports a variety of nesting songbirds. No biological inventories have been initiated on this unit.

Table 3.29. Percentage of Wissatinnewag Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percentage of Unit
Hardwood forest	50%
Woodlands (natural)	14%
Developed	6%

1 See table A.52 at the end of appendix A for comparison.

Public Use
The Wissatinnewag Unit is closed to the public to protect sensitive archaeological resources.

Cultural Resources and Historic Preservation
The 2011 cultural resources overview for the refuge compiled information about known archaeological resources within the Wissatinnewag Unit and evaluated its archaeological sensitivity (Waller and Cherau 2011). The unit is within a locality that witnessed Native American settlement over a span of thousands of years. The State site files indicate that at least 30 Native American archaeological sites have been recorded within 1 mile of the unit. More than half of these are contained within the Riverside Archaeological District, which is listed on the NRHP. Nearly all of this unit and its corresponding approved acquisition boundary are within this Archaeological District.

The Wissatinnewag Unit contains portions of the extensive, complex Mackin Sand Bank Site, which has produced burials and evidence of Native American settlement starting at least by the Middle Archaic period (7,500 to 5,000 years before present). The site has been damaged by looters, and has also been investigated by professional archaeologists. It is the subject of great interest and concern for the Narragansett Indian Tribe. It is very likely that additional, significant resources await discovery in undisturbed portions of the unit. The sensitivity for post-contact Euro-American sites is considered moderate.

Saddle Island Unit, New Hampshire (2 acres)

Natural Resources
The two acre Saddle Island is located in the Connecticut River, bordering the town of Bath, NH. This island has a unique physical environment due in part to its location in the Connecticut River, geological features and size. The upper portion of the island contains a wooded bluff which transitions to steep banks of sparsely vegetated bedrock ledges. Ice scour regularly clears woody vegetation and soils from the ledges which has a significant impact on the terrain and vegetation. The soils that settle into fractures and pockets in the bedrock provide conditions for unique plant species and communities.

Table 3.30. Percentage of Saddle Island Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percent of Unit
Open water	67%
Developed	33%

1 See table A.52 at the end of appendix A for comparison.

Public Use
This unit is not open to public access.

Cultural Resources and Historic Preservation
The Saddle Island Unit was not covered by the cultural resources overview that was completed for the refuge in 2011 (Waller and Cherau 2011) and no background research concerning known cultural resources has been conducted.

Putney Mountain Unit, Vermont (285 acres)

Natural Resources
The refuge acquired 285 acres at Putney Mountain in 1999 (see appendix A for map). This unit was acquired to protect a population of Northeastern bulrush, a federally endangered species. The population of bulrush is periodically visited by refuge staff and State of Vermont botanists. The population was sampled as part of a large-scale genetics study by researchers at Wilmington College and Wright State University. Their results have not been published yet.

Putney Mountain Unit is a forested mountain summit in Windham County, Vermont, with a height of 1,657 feet (table 3.31). It lies about 20 miles north of the Massachusetts border and 5 miles west of the Connecticut River. The Putney Mountain Hawkwatch is the most important survey point for monitoring migrating hawks in Vermont and also one of the most important along the east coast of the United States (*http://www.putneyvt.org/hawks/index.php*; accessed August 2016).

Table 3.31. Percentage of Putney Mountain Unit by Habitat Type. Values are based on a GIS analysis of the habitat in the division, using the Northeast Terrestrial Habitat Map data layer (TNC 2013c) and the North Atlantic LCC general habitat type classification.

General Habitat Type[1]	Percentage of Unit
Hardwood forest	99%
Developed	1%

1 See table A.52 at the end of appendix A for comparison.

In 2012, sections of the Putney Mountain Unit were inventoried for invasive plant species in a similar manner as the 2011 pilot inventory project. A variety of invasive species were identified, although glossy buckthorn was the most prominent. Glossy buckthorn is widespread along forest edges along roads adjacent to the parcel and is highly threatening forest interior and the wetlands in the eastern and northern parts of the parcel. Some plants are relatively small and may be easier to control. Other invasive plant species include Japanese barberry, multiflora rose, and reed canary grass.

Public Use

The Putney Mountain Unit is open to wildlife observation and photography, environmental education, and interpretation. It is also open to hunting under State regulations, with the following stipulations: retrieving, flusing, pointing, and pursuit dogs must be under voice command at all times and nighttime raccoon hunting with dogs requires a special use permit (78 FR 58771). The unit does not have any suitable fishing sites.

Cultural Resources and Historic Preservation

There are no recorded archaeological sites within the existing Putney Mountain Unit or within the unit's current, approved acquisition boundary. However, numerous large Native American settlement areas are known to have existed in the nearby lowlands adjacent to the Connecticut River. The 2011 cultural resources overview for the refuge evaluated the archaeological sensitivity of the Putney Mountain Unit (Waller and Cherau 2011). The study assessed the likelihood for additional unrecorded Native American and Euro-American archaeological sites. Sensitivity for Native American sites is variable. It is considered generally high on level natural terraces, hilltops, wetland margins, and areas adjacent to watercourses, while sensitivity is considered low in poorly drained or steeply sloping areas. Sensitivity for post-contact Euro-American sites also varies. It is considered high in locations of documented historic land use, moderate in proximity to historic road corridors, moderate near historic roads, and low elsewhere.

Chapter 4

Dave Govatski

Cherry Pond on Pondicherry Division, New Hampshire

Alternatives, Including the Service's Preferred Alternative

- Introduction
- Formulating the Alternatives
- Alternatives or Actions Considered but Eliminated from Detailed Study
- Detailed Description of the Alternatives:
  - Alternative A–Current Management
  - Alternative B–Consolidated Stewardship
  - Alternative C– Enhanced Conservation Connections and Partnerships–The Service-preferred Alternative
  - Alternative D–Reduced Management with Emphasis on Backcountry Recreation
- Actions Common to All Alternatives
- Actions Common to Alternatives B, C, and D Only
- Comparison of Management Objectives, Actions, and Strategies by Alternative
- Summary Comparison of Management Objectives, Actions, and Strategies by Alternative Proposed in the Conte Refuge CCP
- Maps of Proposed CPAs
- Maps of Proposed CFAs
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Introduction

This chapter presents:

- Our process for formulating management alternatives.
- Alternatives and actions considered but eliminated from detailed study.
- A description of the four management alternatives we evaluated in detail, and their relationship to refuge purposes and goals.
- Actions common to all alternatives, including the "no action" alternative, which we define as continuing current management (alternative A).
- Actions common to all the "action" alternatives (alternatives B, C, and D).
- A table (table 4.6) that compares how each of the alternatives addresses significant issues, supports major programs, and relates to refuge goals.
- Maps (maps 4.3 through 4.19) that depict the proposed CPAs.
- Maps (maps 4.20 through 4.40) that depict the proposed location and size of each CFAs under the four alternatives.
- Maps (maps 4.41 to 4.49) that show the proposed public use and access under the four alternatives for the Pondicherry and Nulhegan Basin Divisions, the two largest, existing refuge divisions.

Formulating the Alternatives

NEPA requires Federal agencies to evaluate a full range of reasonable alternatives to a proposed action. Alternatives should be relevant to the purpose and need of the proposal while minimizing or avoiding detrimental environmental effects. The development of alternatives as a part of the NEPA compliance process allows the Service to work with the public, stakeholders, interested agencies, and other partners to formulate alternatives that respond to issues and concerns identified during the planning process.

The four alternatives described in detail in this chapter, include a "no action" or "no change" alternative required by NEPA, and three "action" alternatives. We define the "no action" alternative as "continuing current management direction." Each of the alternatives describes a combination of priorities and actions for contributing to conservation work in partnership with others across the watershed, and for managing refuge lands, over the next 15 years. The alternatives are organized to show how they would address the four broad goals we have established for the refuge related to (1) conservation, (2) environmental education, interpretation, and outreach, (3) recreation, and (4) partnerships. Each alternative would ultimately result in a different future condition for the refuge and therefore make different contributions to the watershed over the long term.

As we described in chapter 2, developing watershed-based goals for the refuge was one of the first steps in our planning process and a prerequisite to developing alternatives. Goals are intentionally broad, descriptive statements of our desired future condition for the watershed's and refuge's resources. By design, they are less quantitative and more general in defining the targets of our management. They also articulate the principal elements of refuge purposes and our vision statement and provide the foundation for developing alternative management objectives and strategies. Our goals, listed later in the chapter, are common to all the alternatives.

Management alternatives were developed after identifying a wide range of possible management objectives and strategies that could achieve refuge goals. These alternatives can be described as packages of complementary objectives and strategies. Objectives are essentially incremental steps toward achieving a goal; they also further define the conservation and management targets in measurable terms. They typically vary among the alternatives and provide the basis for determining more detailed strategies, monitoring refuge accomplishments, and evaluating our success. Management objectives and strategies are also developed to respond to public input concerning challenges and opportunities identified during the planning process and public scoping meetings.

We analyze four alternatives in this final CCP/EIS that characterize different strategies for conservation in the watershed and, specifically, for managing refuge lands over the next 15 years. We have titled these alternatives as follows:

- Alternative A–Current Management (this represents the NEPA-required "No Action" alternative).
- Alternative B–Consolidated Stewardship.
- Alternative C–Enhanced Conservation Connections and Partnerships (Service-preferred alternative).
- Alternative D–Reduced Management with Emphasis on Backcountry Recreation.

We believe these four alternatives represent a reasonable range of proposals for achieving the refuge's vision, purposes, goals, and objectives, and for addressing the issues described in chapter 1. These four alternatives are described in more detail below under "Description of the Alternatives," where we also include maps, tables, and figures to present the alternatives.

Alternatives or Actions Considered but Eliminated from Detailed Study

There are some alternatives or actions that were suggested to us, but we did not analyze in detail. Below we discuss why we eliminated them from further analysis.

Continuation of the Special Focus Area (SFA) strategy for refuge land acquisition envisioned in the 1995 FEIS creating Conte Refuge.

The design for refuge acquisition in the 1995 FEIS was to acquire primarily small, scattered parcels within 65 SFAs distributed across the four states in the watershed. A main focus of this strategy was to target parcels with populations of federally listed endangered and threatened species, or rare and uncommon species and natural communities. Implementation of this strategy has proved problematic for several reasons. While many of the acquired parcels may contain breeding habitat for federally listed or rare species, and thereby offer an important, immediate, and direct level of protection for those species; over the long term, the distribution of small, scattered parcels does not consider other important factors. For example, this strategy does not consider species' travel or movement corridors. Nor does it necessarily provide for important habitats used by the species outside of breeding season. It also does not adequately resolve threats on adjacent or nearby lands, or support opportunities to restore habitats on a meaningful scale or in a sustainable way. Finally, this strategy does not address the potential impacts from climate or land use changes. Each of these considerations is important to address when considering the long-term viability of species populations and habitats in the watershed.

Administratively, managing small, scattered parcels is inefficient when considering resource investments and cost per acre. The resources expended

to get staff and equipment to these sites to manage small units (e.g., post boundaries, brush vegetation, mow fields, conduct surveys, maintain trails and facilities, resolve encroachments, and conduct law enforcement) is much less efficient on a cost per acre basis compared to larger, more contiguous parcels where more acres can be treated on a single trip. We also believe this acquisition strategy will not be effective in protecting species and crucial habitats over the long term, and unnecessarily limits our ability to practice strategic habitat conservation and fulfill the refuge's purposes.

Kathy Fournier/USFWS

Visitor contact station at Nulhegan Basin Division

In our judgment, due to the biological, ecological, and administrative concerns we raise above, the SFA strategy for refuge land acquisition is not in the best interest of the American public because taxpayer's monies can be used more efficiently, and this approach restricts our flexibility in addressing other factors necessary for conserving Federal trust species on a larger regional basis.

No additional refuge land acquisition by the Service; partners would assume all future land protection.

Under this scenario, the Service would not acquire any additional refuge lands, and we would fully rely on our local, State, other Federal agency, and private partners to expand the protected conservation lands network to accomplish the legislated refuge purposes and achieve the desired outcomes typically supported by land conservation actions when employed as a method to accomplish refuge objectives.

There was widespread support for the 1991 Conte Refuge Act and the 1995 FEIS decision to establish the refuge and to have the Service facilitate conservation partnerships and encourage coordinated conservation action among State and other Federal agencies, local governments, and non-governmental partners across the four states in the watershed. The 1995 decision incorporated direction for the Service to lead by example in protecting lands for the refuge, and managing and restoring those lands to benefit Federal trust resources. Refuge land protection was to complement the land protection efforts of our conservation partners to ensure that a watershed-wide, conserved lands network would be developed to permanently protect species of conservation concern and native biodiversity. From the refuge's beginning, the Service's policy is to only acquire lands from willing sellers. Our partners supported then, and continue to support today, a distribution of responsibility to contribute to the conserved lands network within the watershed with the Service a major contributor through refuge acquisition.

Eliminating the acquisition program for the refuge:

- Fails to promote the strategic long-term protection of important wetland and upland habitats for Federal trust resources in the congressionally designated project area.
- Impacts our relationship with State and conservation partners who have recommended and supported Service land conservation actions as part of continuing cooperative and strategic resource stewardship in the watershed.
- Risks losing a critical opportunity over the next 15 years to help provide vital, sustainable, and resilient connections between existing conservation lands of high resource value, and that opportunity will be lost as ownership and habitat fragmentation continues and important habitats are converted to other uses.
- Affects our ability to meet the refuge's legislated purposes and the Service's objectives for Federal trust resources, such as threatened and endangered species, migratory birds, and interjurisdicitional fish.

We recognize that, in addition to our partners' dedicated efforts to protect lands, there are also regulatory land use controls that exist to various extents in the four watershed States and offer varying degrees of protection. For example, all four states have wetland protection laws. However, this protection is not uniform or consistently enforced, and many areas of the watershed are experiencing accelerated fragmentation and conversion of wildlife habitat and agricultural land to development. We have observed that relying on local regulatory controls alone is not always adequate to protect habitat for our Federal trust species. Land acquisition by the Serves allows owners of important habitat an opportunity to benefit from the equity in their property and do something good for wildlife and for people.

In summary, we believe that eliminating the option of any further land acquisition from willing sellers for the refuge would be inconsistent with the legislative mandate in the Conte Refuge Act, significantly affect our ability to meet refuge purposes, and break commitments made in the 1995 FEIS to play a significant role in the watershed's conservation partnership.

Using only conservation easements as the acquisition method, or another less-than-fee option, for all future refuge purchases.

Under this scenario, we would accomplish our habitat objectives by purchasing from willing sellers only a partial interest in lands, primarily in the form of a conservation easement. This means that no full fee simple acquisition for the refuge would occur. The easement land would remain in private ownership, and development rights would typically be the minimum rights the Service would acquire. We may also pursue additional easement rights that would allow us some ability to manage the land and provide opportunities for public use. However, selling an easement may not always be the preference of the landowner. In addition, land further south in the watershed is generally acquired in smaller parcel sizes, and the percentage of full fee value required to purchase an easement increases. Therefore, the cost of fee versus easement can become negligible in certain areas of the watershed. However, we believe easements should continue to be an option for the landowner, just not the only option. Further, we would hope to structure easements to assure the permanent protection of existing habitat, allow for habitat restoration and/or management, provide us an ability to manage access if endangered or threatened species are present, and provide public use opportunities if the landowner is willing.

We will continue to acquire conservation easements where appropriate, but on balance, a total reliance on this strategy would not allow us to accomplish stated conservation goals and objectives. Presently, NRCS has a wide range

of landowner incentive programs that provide opportunities for the enrollment of private land in easement programs or access to other financial assistance. Reliance solely on less-than-fee ownership would essentially compete with other popular Federal and State initiatives, and restrict the options available to the majority of landowners who want to sell in fee. An easement-only approach would decrease our flexibility in working with landowners and providing them options. Further, this approach would compromise our ability to be an active land protection partner throughout the watershed, filling a specific conservation niche within the conservation community.

Pursuit of land acquisition outside the watershed boundary.

We rejected this strategy because the 1991 Conte Refuge legislation defined the project area to be lands only within the Connecticut River watershed.

Management of refuge forests and agricultural lands for net present value (i.e., for profit).

The 1997 Refuge Improvement Act identifies wildlife conservation as a priority of the Refuge System. While commercial forest management actions may be used to meet some of our biological goals and objectives, pursuing timber harvest and hay or crop production with the primary goal of ensuring a profit, would not be consistent with Refuge System regulations (50 CFR 29.1) and policies (603 FW 2). Rather, our management objectives are based on providing the greatest benefit to priority refuge species and their habitats, NALCC representative species and their habitats, and other priority resources. We did not fully develop this alternative because it would not meet the stated goals and objectives we have proposed for the refuge, nor would it be consistent with Refuge System regulations or policies.

Elimination of all hunting opportunities on refuge lands.

This option is inconsistent with the 1997 Refuge Improvement Act which established hunting as one of six priority public uses for national wildlife refuges when determined compatible, and would not meet one of the 1991 Conte Refuge Act purposes which states "Provide opportunities for …fish and wildlife-oriented recreation and access to the extent compatible with the other purposes…" Eliminating hunting would also fail to meet Executive Order No. 13443 (August 16, 2007) which directs the Department of the Interior and other Federal land management agencies to "facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitats." This order also states that Federal agencies are to "manage wildlife and wildlife habitats on public lands in a manner that expands and enhances hunting opportunities, including through the use of hunting in wildlife management planning."

We did not fully develop the option of eliminating hunting entirely from the refuge because:

(1) It would not support the purposes for which Conte Refuge was established.

(2) It would not support Executive Order 13443.

(3) It would not support the 1997 Refuge Improvement Act that identifies hunting as a priority public use on national wildlife refuges when determined compatible.

(4) It would not satisfy refuge goal 3 to provide compatible recreational opportunities.

Detailed Description of the Alternatives:

Alternative A–Current Management

NEPA requires this "No Action" alternative (which we define as continuing current management) to serve as a baseline to which all other alternatives are compared. This alternative reflects the management direction and authorities in the 1995 FEIS with amendments and modifications that either underwent a separate NEPA process or were administrative changes. Under alternative A, refuge staff would maintain the status quo and continue current management for the next 15 years. Table 4.1 summarizes the actions that amended the 1995 FEIS and are incorporated by reference into alternative A. These include environmental assessments (EA) and categorical exclusions (CE) that were prepared in compliance with NEPA, including public and partner involvement, where required.

Table 4.1. Actions that Represent Amendments to the 1995 FEIS[1] for Conte Refuge.

Amended Action and Corresponding NEPA Document	Year Approved
Expansion of the Pondicherry Division via EA[2] and CEs[3]	EA–2003 CEs–2005, 2006, 2008, 2009, 2010, 2011, and 2013
Expansion of the Nulhegan Basin Division via EA and CEs	EA–1999 CEs–2006, 2010, and 2011
Expansion of the Fort River Division via CEs	CEs–2008 and 2010
Pondicherry Division Public Access Plan - EA	2008
Pondicherry Division Hunt Plan - EA	2007
Pondicherry Division Public Access Plan - EA	2008
Nulhegan Basin Division and Putney Mountain Unit Hunt Plan - EA	2013
Fort River Division Trail Construction - EA	2013
Nulhegan Basin Division Trail Construction - EA	2012
Nulhegan Basin Division Furbearer Management Plan - EA	2000
Nulhegan Basin Division Woodcock Management Plan - EA	2006
Nulhegan Basin Division Headquarters and Visitor Contact Station - EA	2002
Nulhegan Basin Division Aquatic Habitat Enhancement - CE	2013
Nulhegan Basin Division Opening Package, including Hunt Plan	2013

[1] *1995 Final Environmental Impact Statement (FEIS) establishing Silvio O. Conte National Fish and Wildlife Refuge*

[2] *Environmental Assessment (EA)*

[3] *Categorical Exclusion (CE); current as of October 2013*

In the ROD for the 1995 FEIS, the Service selected "Revised Alternative D" for implementation. This alternative set a course for the refuge that employed new approaches not typical of national wildlife refuges established at that time. The distinction from other refuges was the emphasis on working with private landowners, State and local agencies, and private organizations to distribute refuge resources and assistance both on and off refuge lands to achieve conservation goals for the watershed. This final CCP/EIS appendix N attests to the level of current partner engagement, including the Friends of Conte and the wide range of non-governmental and governmental partners who have been instrumental in helping us achieve conservation priorities in the watershed. This focus on partnerships remains the intent under current management today, although our capabilities are limited by, and subject to, available funding and staffing.

The 1995 FEIS focuses on developing a private lands habitat management assistance program through the Service's Partners program, as well as implementing a Challenge Cost Share program to award grants to private landowners, State and local agencies, and private organizations for habitat and populations management projects. The expectation in the 1995 FEIS was that up to 25 percent of the watershed would be in conservation ownership, and refuge programs would contribute to improved habitat through management or land protection assistance to achieve that target. Environmental education opportunities are also a focus in the 1995 plan, with the intent to pursue governmental and nongovernmental education partners and establish a watershed-wide cooperative stewardship and education program.

The Service also approved a refuge land acquisition program under the direction of the 1995 FEIS to complement partner efforts while achieving refuge purposes. The land protection plan currently in operation on the refuge allows the use of easements, cooperative management agreements, and fee title acquisitions. It authorizes up to 97,830 acres within the watershed, including the land acquisition amendments listed in table *4.1.With* an emphasis on endangered, threatened, rare, and uncommon species and natural communities, approximately 65 SFAs are identified as target areas for Service acquisition. Many of the SFAs are generally small, scattered sites that met established criteria to achieve the refuge's legislated purposes that ranged in size from 15 acres to 22,000 acres. As of February 2016, the Service has acquired 37,000 acres of land since 1995 as a part of nine divisions and eight units distributed throughout the watershed. All land interest is acquired from willing sellers using the acquisition method (e.g., easement or fee title) the landowner prefers. Map 1.3 depicts current refuge ownership. Some of the current acres were acquired under the amendments noted in table 4.1above. Under alternative A, the Service would continue to acquire land under the original acreage authorization plus the amendments, concentrating land acquisition activities in the SFAs. As presented in tables 4.2 and 4.3 below, the current approved refuge acquisition authority is 97,830 acres. As envisioned in the 1995 FEIS, the Service would also continue to support land protection activities of other Federal and State agencies, as well as municipalities, non-governmental, and private partners, ideally through a fully funded Challenge Cost Share grant program, or by any other Service or other Federal agency programs designed for this purpose.

More details on alternative A by major resource program are provided below. Table 4.6 provides a summary of current and planned activities in comparison to the other action alternatives. The maps (maps 4.20 to 4.40) at the end of the chapter depict the CFAs under each alternative, including alternative A. Chapter 3 also provides some important details about refuge programs and priorities that would continue under alternative A. Finally, the actions covered in the section titled "Actions Common to All Alternatives" below is also incorporated into alternative A.

Wildlife and Habitat Conservation

On refuge lands, we would continue to harvest the woodcock habitat demonstration units on the Nulhegan Basin Division to improve forest habitat for American woodcock and other early successional forest dependent species (approximately 65 acres managed every 5 years). Approximately 155 additional acres of pasture, hay, grasslands, and shrublands would be managed to benefit woodcock or grassland-dependent breeding birds between the Nulhegan Basin, Pondicherry, Blueberry Swamp, Fort River, Salmon River, and Dead Branch Divisions. On the Nulhegan Basin Division we would continue to partner with Trout Unlimited to survey and evaluate barriers to fish passage, and prioritize and implement restoration projects. Table 4.6 provides a summary of habitat projects and targets that would continue on refuge lands.

In addition to ongoing management and restoration of refuge lands, under alternative A, refuge staff would continue to work with interested private landowners, State and local agencies, and organizations to help manage and restore habitats and wildlife populations on other ownerships through the Partners and/or Challenge Cost Share programs, or other available funding sources. A staff position working with Federal and State partners to pursue a coordinated private lands assistance program would continue as funds permit. This position was not funded until the end of fiscal year 2010, when it was made initially possible with funds from NRCS. The position is now funded solely by the refuge. The 1995 plan estimated that, on an annual basis, 50 Partners and Challenge Cost Share projects would be initiated with an emphasis on protecting and restoring wetlands and riparian habitats across the watershed, especially within SFAs. Initially, the goal was also to ensure that at least half of these projects would occur on dedicated or permanent open space. Unfortunately, this level of accomplishment has never been fulfilled to the extent planned, as funding levels for both the Partners and Challenge Cost Share programs have not been sustainable to meet the goal. In its early years, approximately $100,000 was available for distribution in the Challenge Cost Share budget for the refuge. In its last 2 years of implementation, years 2000 and 2001, 22 projects were funded each year, with an annual budget of approximately $89,000 and $75,000, respectively. The program has not been operational on the refuge since 2001 due to funding limits. However, under alternative A, the Service would continue to sustain partnerships with landowners, agencies, and organizations, subject to the availability of funds for these and other program priorities, in a concerted effort to assist where possible in implementing habitat restoration, population management, and other priority projects on both public and private lands.

The 1995 FEIS includes a focused effort targeting private landowners, State and local agencies, and private organizations to accomplish wildlife and habitat projects on land under their stewardship. This work continues through our Private Lands Coordinator. We have expanded the duties of this position to include recreation and education partnerships in the watershed.

Under alternative A, the refuge would continue to acquire lands in the existing approved acquisition boundary. We only purchase lands and conservation easements from willing sellers. Table 4.2 lists the existing SFAs and the total acreage we are approved for in each of these areas. These figures are based on the 1995 FEIS, plus additional expansions approved by subsequent NEPA-compliance documents. The Nulhegan Basin, Pondicherry, and Fort River Divisions were all expanded after the 1995 FEIS.

Table 4.2. Alternative A: Existing Approved Acquisition Acres by SFA

SFA Name	Total SFA Acres*
SFA 1a. Great Island Marshes	1,260
SFA 1b. Great Meadow	50
SFA 1c. Ragged Rock Creek	85
SFA 1d. Ferry Point	60
SFA 1e. Turtle Creek	20
SFA 1f. Lord Cove	700
SFA 1g. Essex Great Meadow	85
SFA 1h. Pratt and Post Coves	110

SFA Name	Total SFA Acres*
SFA 1i. Joshua Creek	25
SFA 1j. Deep River	70
SFA 1k. Chester Creek	90
SFA 1l. Whalebone Cove	150
SFA 2. Hamburg Cove/Eightmile River and East Branch	1,870
SFA 3. Burnham Brook	690
SFA 4. Selden Creek	340
SFA 5. Chapman Pond	365
SFA 6. Salmon Cove	1,790
SFA 7. Salmon River, including tributaries below dam	760
SFA 8. Pecausett Meadow	150
SFA 9. Round and Boggy Meadows/Mattabesset/Coginchaug River/Wilcox Island	300
SFA 10a. Deadmans Swamp	790
SFA 10b. Gildersleeve Island	80
SFA 10c. Wangunk Meadows	655
SFA 11a. Glastonbury Highlands	13,000
SFA 11b. Roaring Brook in Glastonbury	25
SFA 12. Great Meadows	4,085
SFA 13. South Windsor Meadows/Farmington Mouth	1,550
SFA 14. Farmington River and West Branch	215
SFA 15. Scantic River	490
SFA 16. Enfield Rapids/Kings Island	20
SFA 17. Honeypot Road Wetlands	600
SFA 18. Mt. Tekoa	3,000
SFA 19. Westfield Sandplain	400
SFA 20. Westfield River, including West Branch and Middle Branch	325
SFA 21. Chicopee River Mouth	115
SFA 22. Westover Airforce Base	365
SFA 23. Quaboag	1,200
SFA 24. Mt. Tom/Mill River/Holyoke Range	3,200
SFA 25. Grassland Complex	2,429*
SFA 26. Hatfield Oxbow	1,200
SFA 27. Whately Great Swamp	950
SFA 28. Mt. Toby	5,000

SFA Name	Total SFA Acres*
SFA 29a. Connecticut River-Turners Falls Dam to 116 Bridge in Sunderland	35
SFA 29b. Sawmill River to dam above Route 63	50
SFA 30a. Montague Plains	2,200
SFA 30b. Turners Falls Airport	250
SFA 31. Deerfield River, including most tributaries	940
SFA 32. Fall River in Massachusetts	30
SFA 33. Ashuelot River to Surry Mountain Dam, including the tributaries below the first dam	185
SFA 34a. Retreat Meadows	55
SFA 34b. Wantastiquet Mountain	4,600
SFA 35. West River, including Rock and Winhall Tributaries and Wardsboro Brook	350
SFA 36. Cold River	35
SFA 37. Williams River to Brockway Mills Dam	30
SFA 38. Macrosite, including the mouth of the Ompompanoosuc River	800
SFA 39. White River	615
SFA 40. Ammonoosuc and Wild Ammonoosuc Rivers	230
SFA 41. Pondicherry	6,677*
SFA 42. Victory Basin	870
SFA 43. Connecticut River--Murphy Dam to Northumberland Dam	420
SFA 44. Paul Stream	60
SFA 45. Nulhegan Basin	26,789*
SFA 46. Mohawk River	40
SFA 47. Colebrook Hill Farms	2,000
SFA 48. Indian Stream	180
Scattered rare species sites and important, scarce, and vulnerable wetlands	1,725†
Totals:	**97,830**

* *The acreage figures in this table are based off alternative D from the 1995 Final EIS, plus any additional expansions approved by subsequent NEPA-compliance documents. The Nulhegan Basin, Pondicherry, and Fort River Divisions were all expanded after the 1995 Final EIS.*

† *In the 1995 Final EIS, there was an addition error in the total acres for alternative D. To compensate for this error, we reduced the acreage allocated to "scattered rare species sites" and "important, scarce, and vulnerable wetlands."*

Environmental Education, Interpretation, and Outreach

Limited environmental education and interpretation programming would continue on refuge lands. The programs would be conducted by refuge staff on an opportunistic basis as funding allows. While we would continue to encourage the use of refuge lands for self-led programs, most of our efforts in support of education and interpretive programs would continue to be done in cooperation with partners in the partner-owned visitor facilities discussed below.

Other outreach efforts have focused on providing students and local communities with environmental and interpretive programs. In chapter 3 we describe several refuge programs that would continue under alternative A including the WOW Express, Adopt-a-Habitat program, an urban refuge initiative, the BAT, and Conte Corners. We would also continue our beneficial relationship in partner-owned visitor facilities including the Great Falls Discovery Center, the Great Northwoods Center, and the Montshire Museum of Science. We would also continue existing partnerships with organizations such as Vermont Institute of Natural Science, Springfield Museums, and Connecticut River Museum, and develop new partnerships as appropriate. We would augment these efforts subject to the availability of funds, and by the establishment of a Partners position and/or by a reinvigorated Challenge Cost Share program, and by working with partners to pursue indoor and outdoor environmental education curriculum development that would meet respective State education standards.

Recreation

The Service would continue to have sole responsibility for managing and regulating public use and access on all refuge units and divisions acquired in fee title or as allowed by an easement under this alternative. Some restrictions on public use and access would occur on these lands, especially the small, scattered sites being protected for federally listed endangered, threatened, candidate, and rare or uncommon species or communities, in order to assure the purposes for the acquisition were accomplished. Recreational uses allowed would be managed to avoid damage to habitat or disturbance to wildlife of concern. Hunting, fishing, wildlife observation, and photography are priority recreational uses to permit in areas where determined to be compatible with refuge management and consistent with applicable laws and policies. These and all other recreational uses that we would continue to allow under alternative A are described in chapter 3. A summary is presented in table 4.5. The maps (maps 4.41 to 4.49) at the end of the chapter depict existing public use on Pondicherry and Nulhegan Basin Divisions, the two largest existing refuge divisions. There are additional public use maps for other divisions included in appendix A. Managing or regulating public use and access on lands protected by Service easements or cooperative management agreements would be determined by the level of interest the Service acquired, which would have been negotiated with the landowner.

The Service would continue to work with landowners, who have projects funded through the Partners or Federal grant programs, and who voluntarily support public use and access on their lands, to determine the types and levels of use that would help promote the purposes of the Conte Refuge Act.

Partnerships

Diverse and effective partnerships with the Friends of Conte Refuge, Federal, State and local agencies, landowners, and the public would continue to be the backbone for implementing the full suite of refuge activities currently underway and planned in the 1995 FEIS. This includes activities on refuge lands and throughout the watershed. Appendix N provides a list of the many and varied partners that refuge staff are currently involved with. We would continue to develop new partnerships, with special effort to promote conservation education and outreach programs in urban areas within the watershed through our Urban Refuge initiative. Subject to the availability of staffing and funds, efforts to develop partnerships to implement priority conservation projects through the Partners for Fish and Wildlife Program and Challenge Cost Share programs, or other Federal grant programs, would continue to be an important part of this alternative.

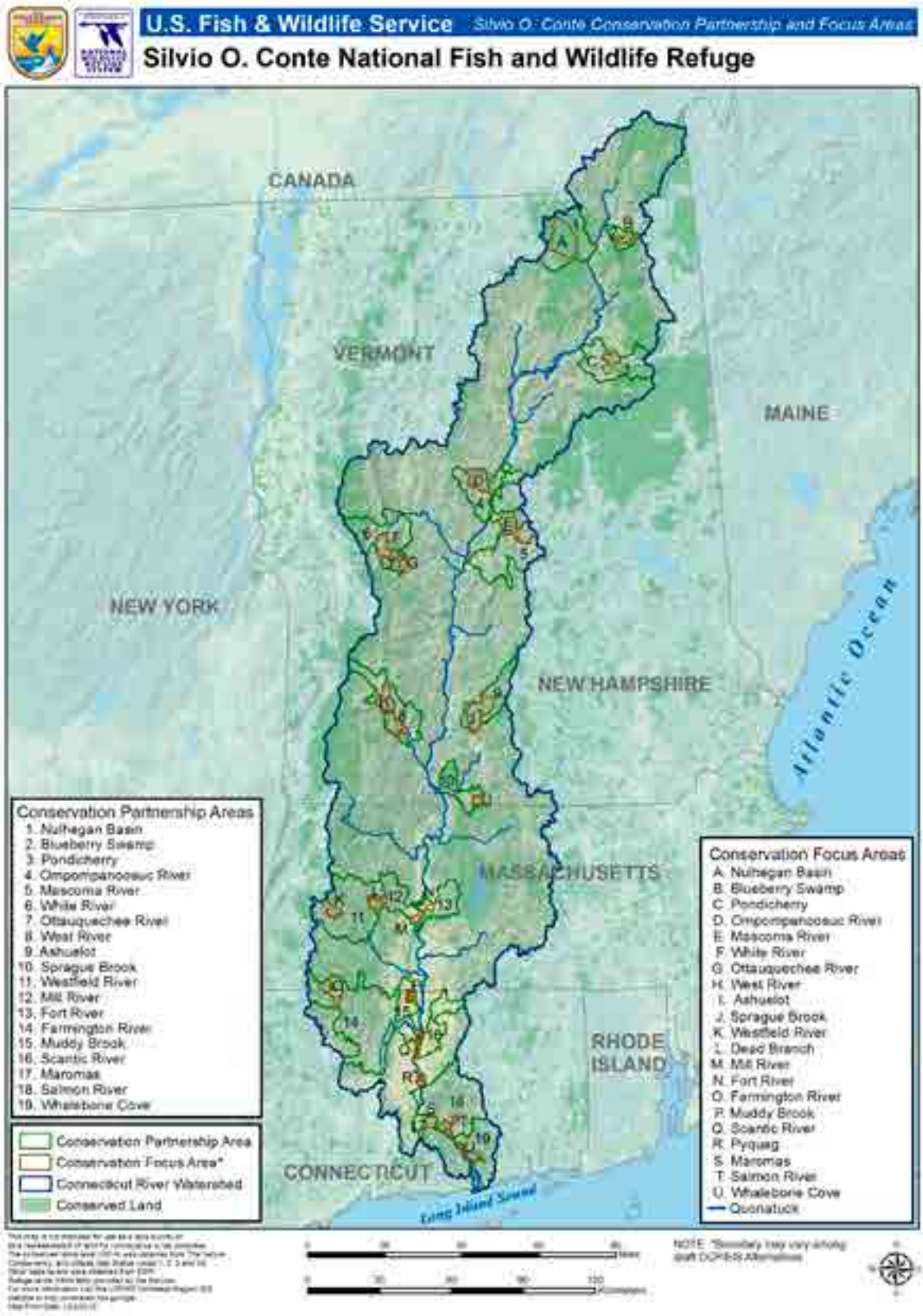
Alternative B–Consolidated Stewardship

Under alternative B, we propose to meet the wildlife and habitat conservation, environmental education, interpretation and outreach, recreation, and partnership goals for the watershed as described in the section below titled "Actions Common to Alternatives B, C, and D." Many of our existing programs would continue, but we would focus our effort and attention in geographic areas we are calling CPAs. This alternative identifies 17 CPAs that are distributed throughout the watershed (see map 4.1 and table 4.2). Maps 4.3 to 4.19 show the individual CPAs. CPAs are relatively large areas, generally defined along a subwatershed boundary, roughly corresponding with some combination of 12 digit hydrologic units codes USGS HUCs (*http://nh.water.usgs.gov/projects/ct_atlas/water_wsheds_huc.htm*; accessed August 2016). Refuge staff, other Service programs, our State partners, and resource experts identified CPAs as areas comprising concentrations of habitats important to Federal trust resources and State species of greatest conservation concern need while also providing important opportunities to protect connections between areas of high conservation value. Within CPAs, we would plan to concentrate our limited resource expenditures (e.g., staff, funds, equipment) and help facilitate the work of our partners consistent with our goals and objectives for the watershed and refuge purposes. In many instances, the Service would serve a supporting role in partner-led efforts on other ownerships in CPAs. It is not assumed that refuge or Service staff would take the lead role in all conservation activities in CPAs. In summary, CPAs would be geographic areas of emphasis for refuge staff to support and facilitate the activities of our partners that contribute to regional conservation goals, and refuge purposes and goals, and which complement management of refuge lands.

Table 4.3. Conservation Partnership Areas (CPAs) by Alternative Proposed in the Conte Refuge CCP

CPAs Proposed under Alternative A	CPAs Proposed under Alternative B	CPAs Proposed under Alternatives C and D
There are no CPAs under Alternative A	Ashuelot River	Ashuelot River
	Blueberry Swamp	Blueberry Swamp
	Farmington River	Farmington River
	Fort River	Fort River
	Maromas	Maromas
	Mascoma River	Mascoma River
	Mill River	Mill River
	-	Muddy Brook
	Nulhegan Basin	Nulhegan Basin
	Ompompanoosuc	Ompompanoosuc
	-	Ottauquechee River
	Pondicherry	Pondicherry
	Salmon River	Salmon River
	Scantic River	Scantic River
	-	Sprague Brook
	West River	West River
	Westfield River	Westfield River
	-	White River
	Whalebone Cove	Whalebone Cove

Map 4.1. Proposed Conservation Partnership Areas and Conservation Focus Areas



* *Some CFA boundaries vary by alternative. Not all CPA/CFAs appear in alternatives A and B. This map represents Alternative C. For more detailed maps of each CFA see the end of this chapter.*

Within CPAs, we are proposing nesting one or more smaller CFAs (map 4.1). The maps (maps 4.20 to 4.40) at the end of the chapter depict the individual CFAs under each alternative, including alternative B. It is within CFAs, where Federal trust resource values are particularly high, that we would focus on acquiring a Service interest in land from willing sellers in either fee, easement, lease, or cooperative management agreement.

Under alternatives B, we propose to move away from small, scattered SFAs to larger, more biologically sound and ecologically resilient CFAs. The total refuge acquisition acres are similar under alternatives A and B (table 4.5). However, we would reconfigure the refuge's approved acquisition totals for the SFAs into CFAs. Table 4.4 shows relationship of SFAs identified in the 1995 FEIS to the CFAs proposed in alternatives B, C, and D. For each proposed CFA, the table lists what, if any, SFAs are located within that area. This concentration and consolidation of refuge lands would enhance our implementation of the Service's strategic habitat conservation initiative, and better support other conservation priorities detailed in Service, ecoregional, and State wildlife action plans listed in appendix M.

The CPA/CFA configuration would also dramatically improve opportunities to accomplish the Service's climate change adaptation strategies, priorities of the NALCC, respective state wildlife action plan priorities, and other public and private partner landscape initiatives.

Once land is acquired in a CFA for the refuge, we would administratively establish and refer to that area as a refuge division. For example, the Farmington River CFA would become known as the Farmington Division of the Conte Refuge, should an interest in land be acquired by the Service in that area.

Realistically, we do not expect that we would acquire 100 percent of the lands identified in each CFA for a variety of reasons (e.g., landowner preferences, protection by other conservation organizations, changes in land use, impacts on farming and forestry, etc.). We propose that the Service would only acquire approximately 90 percent (90%) of the area within CFAs on average; and the remaining 10 percent (10%) of our proposal would come from the surrounding CPA. In appendix C we describe the criteria used to delineate and refine CFAs and would be used to guide the 10 percent (10%) land acquisition authority that would lie outside of delineated CFAs, but within CPAs. As we acquire lands, we would strive to protect Federal trust resources and promote connections among a diversity of habitats covering a range of elevations, latitudes, aspect, and processes.

Table 4.4. Relationship Between Proposed CFAs and the 1995 SFAs

CFA Name	SFA Name
Ashuelot River CFA	No SFAs
Blueberry Swamp CFA	SFA 46. Mohawk River SFA 47. Colebrook Hill Farms
Dead Branch CFA	SFA 20. Westfield River, including West Branch and Middle Branch (Also partially in the Westfield River CFA)
Farmington River CFA	No SFAs
Fort River CFA	SFA 25. Grassland Complex
Mill River CFA	SFA 24. Mt. Tom/Mill River/Holyoke Range

CFA Name	SFA Name
Maromas CFA	No SFAs
Mascoma River CFA	No SFAs
Nulhegan Basin CFA	SFA 45. Nulhegan Basin
Ompompanoosuc CFA	No SFAs
Ottauquechee River CFA	No SFAs
Pondicherry CFA	SFA 41. Pondicherry
Pyquag CFA	SFA 12. Great Meadows
Quonatuck CFA	SFA 1a. Great Island Marshes SFA 1b. Great Meadow SFA 1d. Ferry Point SFA 1e. Turtle Creek SFA 1f. Lord Cove SFA 1g. Essex Great Meadow SFA 1h. Pratt and Post Coves SFA 1j. Deep River SFA 1k. Chester Creek SFA 8. Pecausett Meadow SFA 9. Round and Boggy Meadows/Mattabesset/Coginshaug River/ Wilcox Island SFA 10a. Deadmans Swamp SFA 10b. Guildersleeve Island SFA 10c. Wangunk Meadows SFA 14. Farmington River and West Branch SFA 16. Enfield Rapids/Kings Island SFA 21. Chicopee River Mouth SFA 26. Hatfield Oxbow SFA 29a. Connecticut River-Turners Falls Dam to 116 Bridge in Sunderland SFA 29b. Sawmill River to dam above Route 63 SFA 33. Ashuelot River to Surry Mountain Dam, including the tributaries below the first dam SFA 34a. Retreat Meadows SFA 35. West River, including Rock and Winhall Tributaries and Wardsboro Brook SFA 38. Macrosite, including the mouth of the Ompompanoosuc River SFA 39. White River SFA 43. Connecticut River--Murphy Dam to Northumberland Dam
Muddy Brook CFA	No SFAs
Salmon River CFA	SFA 6. Salmon Cove SFA 7. Salmon River, including tributaries below dam
Scantic River CFA	SFA 13. South Windsor Meadows/Farmington Mouth SFA 15. Scantic River
Sprague Brook CFA	No SFAs

CFA Name	SFA Name
West River CFA	No SFAs
Westfield River CFA	SFA 20. Westfield River, including West Branch and Middlebranch (Also partially in the Dead Branch CFA)
Whalebone Cove CFA	SFA 1i. Joshua Creek SFA 1l. Whalebone Cove SFA 2. Hamburg Cove/Eightmile River and East Branch SFA 4. Selden Creek SFA 5. Chapman Pond
White River CFA	No SFAs
SFAs that do not occur in any CFA	SFA 1c. Ragged Rock Creek SFA 3. Burnham Brook SFA 11a. Glastonbury Highlands SFA 11b. Roaring Brook in Glastonbury SFA 17. Honeypot Road Wetlands (Existing refuge unit) SFA 18. Mt. Tekoa SFA 19. Westfield Sandplain SFA 22. Westover Airforce Base SFA 23. Quaboag SFA 27. Whately Great Swamp SFA 28. Mt. Toby (A portion of this is an existing refuge unit) SFA 30a. Montague Plains SFA 30b. Turners Falls Airport SFA 31. Deerfield River, including most tributaries SFA 32. Fall River in Massachusetts SFA 34b. Wantastiquet Mountain SFA 36. Cold River SFA 37. Williams River to Brockway Mills Dam SFA 40. Ammonoosuc and Wild Ammonoosuc Rivers SFA 42. Victory Basin SFA 44. Paul Stream SFA 48. Indian Stream

Table 4.5 lists the potential total acres that would fall under Service ownership within in each respective CFA by alternative. The acreage figures presented for each alternative include the acres already owned by the Service. The table also lists the amount of acres in each proposed CFA that are already conserved by others. We do not expect to purchase any lands already permanently conserved by others, except under extenuating circumstances. In all situations, we only purchase lands from willing sellers.

Table 4.5. Potential Refuge Ownership Under Each Alternative

		Alternative A		Alternative B			Alternative C			Alternative D	
Conservation Focus Area (CFA)/ Refuge Unit Name	Acres Currently Owned by Service[1]	Potential Acres Under Service Ownership[3]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]
Nulhegan Basin CFA	26,605	26,789	28,128	353	27,775	33,132	353	32,779	33,132	353	32,779
Blueberry Swamp CFA	1,166	2,040	1,996	0	1,996	4,636	0	4,636	6,662	161	6,501
Pondicherry CFA	6,443	6,677	6,714	0	6,714	10,249	0	10,249	10,520	0	10,520
Ompompanoosuc CFA	0	0	4,464	0	4,464	15,383	311	15,072	15,383	311	15,072
White River CFA	0	0	0	0	0	11,298	1,244	10,054	16,384	1883	14,501
Ottauquechee River CFA	0	0	0	0	0	5,985	0	5,985	10,017	1496	8,521
Mascoma River CFA	761	761	9,284	0	9,284	22,531	1,938	20,593	22,531	1938	20,593
West River CFA	0	0	11,243	1,488	9,755	25,965	3,018	22,947	25,965	3018	22,947
Ashuelot CFA	0	0	7,961	809	7,152	21,085	3,225	17,860	21,085	3225	17,860
Sprague Brook CFA	0	0	0	0	0	3,306	290	3,016	9,196	728	8,468
Westfield River CFA	125	225	4,337	571	3,766	7,339	1,162	6,177	15,838	6323	9,515
Dead Branch CFA	98	100	1,565	651	914	6,998	1,812	5,186	6,998	1812	5,186
Mill River CFA	249	3,200	2,115	826	1,289	3,231	931	2,300	3,231	931	2,300
Fort River CFA	261	2,429	2,075	580	1,495	2,274	614	1,660	3,072	770	2,302
Farmington River CFA	0	0	5,953	542	5,411	9,938	2,277	7,661	24,826	8831	15,995
Muddy Brook CFA	0	0	0	0	0	2,747	86	2,661	2,747	86	2,661
Scantic River CFA	0	2,040	2,556	416	2,140	4,610	466	4,144	4,610	466	4,144
Pyquag CFA	0	4,085	3,712	383	3,329	3,712	383	3,329	3,712	383	3,329
Maromas CFA	0	0	2,067	128	1,939	4,335	400	3,935	4,335	400	3,935
Salmon River CFA	468	2,550	2,495	124	2,371	5,519	1,064	4,455	5,519	1064	4,455
Whalebone Cove CFA	116	2,750	3,111	1,341	1,770	6,977	3,047	3,930	20,356	9341	11,015
SFAs outside of CFAs & Small Scattered Sites		35,704									
Quonatuck CFA	0	8,480	5,500		5,500	8,000		8,000	8,000		8,000
Hatfield Unit	19	19	19		19	19		19	19		19

Conservation Focus Area (CFA)/ Refuge Unit Name	Acres Currently Owned by Service[1]	Alternative A		Alternative B			Alternative C			Alternative D	
		Potential Acres Under Service Ownership[3]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]	Total Acres	Existing Acres Permanently Conserved by Others[3]	Potential Acres Under Service Ownership[4]
Saddle Island Unit	2	2	2		2	2		2	2		2
Putney Mountain Unit	285	285	285		285	285		285	285		285
Wissatinnewag Unit	21	21	21		21	21		21	21		21
Third Island Unit	4	4	4		4	4		4	4		4
Fannie Stebbins	98	98	98		98	98		98	98		98
Mount Toby Unit	30	30	30		30	30		30	30		30
Mount Tom Unit	141	141	141		141	141		141	141		141
Honeypot Road Wetlands Unit	21	21	21		21	21		21	21		21
Deadman's Swamp Unit	31	31	31		31	31		31	31		31
Roger Tory Peterson Unit	56	56	56		56	56		56	56		56
Totals	**37,000[2]**	**97,830**			**97,772**			**197,337**			**231,307**

[1] *Total as of February 2016*

[2] *Under alternative A, the 708 acres of existing units are accounted for in the CFAs.*

[3] *Existing conserved land acreages were calculated using TNC's 2014 secured lands layer, Gap Status 1, 2, 3, and 39 (see: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/secured/Pages/default.aspx).*

[4] *Includes acres currently owned by Service. These totals represent the estimated maximum acreage the Service would conserve associated with each CFA. We are requesting authority to acquire approximately 90% of total acreage, on average, within CFAs, and the reminaing 10% in surrounding CPAs (see maps in chapter 4). We only purchase lands from willing sellers and do not expect to purchase any lands already permanently conserved by others, except under extenuating circumstances.*

Additional discussion on alternative B by major resource program is provided below. Later in this chapter, the sections titled "Actions Common to All Alternatives" and "Actions Common to Alternatives B, C, and D" includes other major components of this alternative. The latter section describes our desired future conditions, programs, and priorities for conservation activities in the watershed, with particular focus in CPAs. Final CCP/EIS appendix A, which details management direction on current and proposed refuge lands (e.g., existing refuge divisions and units, and the proposed CFA network) under the Service-preferred alternative C, also represents management direction for alternative B on its smaller land base. Proposed staff to implement alternative B is included as appendix H. Table 4.6 provides a summary of current and planned activities under alternative B in comparison to the other action alternatives.

In summary, the complete description of alternative B management direction is the combination of the discussion immediately following, along with:

- The section below in this chapter titled "Actions Common to All Alternatives."
- The section below in this chapter titled "Actions Common to Alternatives B, C, and D."
- The summary table 4.6 at the end of this chapter.
- Appendix A of this final CCP/EIS (except the four CFAs not included in alternative B: White River, Ottauquechee River, Sprague Brook, and Muddy Brook CFAs).

Wildlife and Habitat Conservation

Opportunities to conduct habitat management is greatly expanded under alternative B compared to alternative A, in particular, where the consolidated and larger land base, configured around the network of CFAs and other conserved lands under alternative B, allows more flexibility and creates more efficiencies than the SFA configuration. Further, benefits from other conserved properties will accrue to refuge administered lands. Under alternative B, we would continue to protect and restore habitat for Federal listed species, but would also expand our focus to enhance habitat for other species of conservation concern. We have identified priority refuge resources of concern for each CFA in appendix A, many of which are also NALCC representative species. After acquiring a manageable unit, and inventorying and assessing habitat conditions in the field, we would develop detailed habitat management plans (HMPs) for each CFA to show how we plan to manage for those resources. In particular, floodplain forest and riparian habitat protection and restoration would be a focus under alternative B due to the wide variety of terrestrial and aquatic resources of concern that would benefit from that management.

Off refuge lands, we would continue to work in partnership with Federal and State agencies, communities, organizations, and landowners to accomplish the watershed-wide objectives for wildlife and habitat conservation that we identify in the section "Actions Common to Alternatives B, C, and D." However, we would concentrate our partnership efforts in CPAs, seeking to collaborate and leverage funds, labor, and general capacity. Expanded emphasis would be on sharing resource information among partners, leveraging Federal grants and other State and private lands assistance programs, and cooperating on developing baseline inventories, monitoring resources, and implementing NALCC priorities.

Environmental Education, Interpretation, and Outreach

With respect to environmental education, interpretation, and outreach, we would expand the initiatives currently underway under alternative A. Emphasis would be added on continuing existing educational programs within all four States on a community by community basis, but especially making refuge programs more relevant to urban communities through the Refuge System's Urban Initiative.

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Bobolink

We would make refuge environmental education assets, strategies, and curriculum available on a community basis by visiting schools, fairs, summer camps, and special events. The BAT trailer would become fully operational and the WOW Express, Conte Corners, and the Adopt-a-Habitat programs would all be expanded to support our education, outreach, and interpretation goals and objectives.

Recreation

Under alternative B, we would continue the commitment to create and maintain public access opportunities on refuge lands for compatible recreational uses. In the section "Actions Common to Alternatives B, C, and D Only", the goal 3 discussion provides detailed objectives for hunting, fishing, wildlife observation and photography, and other compatible recreational activities. Our emphasis would be on providing diverse and well-maintained trail systems, roads, and other supportive infrastructure for people of all abilities to facilitate an appreciation of refuge lands, the mission of the Refuge System, and overall outdoor recreational opportunities. Within CPAs, we would work with partners to enhance regional land- and water-based trail networks, especially those with National and State designations. We would support partner efforts to make trail connections where compatible, protect the integrity of these features, and provide access and infrastructure for people of all abilities, in order to encourage responsible use and enjoyment of natural resources.

The maps (maps 4.41 to 4.49) at the end of the chapter depict the proposed public use on Pondicherry and Nulhegan Basin Divisions, the two largest existing refuge divisions, under alternatives B and C. There are additional public use maps for other divisions included in appendix A.

Partnerships

We would continue the valuable partnerships we currently have, but would also look to seek new ones, or expand existing ones in CPAs that would advance our goals and those of our priorities. Our emphasis would be on looking for opportunities to coordinate, collaborate, and leverage Federal resources in accomplishing conservation, education, and recreation goals. We would make a concerted effort to engage other Federal agencies in order to maximize opportunities to assist State and private landowners in meeting mutually beneficial conservation priorities. We would also actively seek opportunities to enhance research, inventories, and monitoring that would advance our understanding of the watershed's resources on a landscape basis, and support science-based decision-making. We would work with partners to implement priorities identified by the NALCC and State WAPs, and coordinate efforts to respond to the challenges associated with a changing climate, land uses, and other landscape-level issues such as invasive species.

Alternative C– Enhanced Conservation Connections and Partnerships–The Service-preferred Alternative

This is the Service's preferred alternative because it expands on the benefits identified for alternative B based, in large part on our strategy to promote areas more resilient to the stressors associated with climate change and land use changes at the CPA levels, as well as within the larger watershed. This approach would approximately double the approved acquisition boundary for the refuge. Alternative C incorporates the same goals, objectives, and strategies as alternative B; however, it significantly increases opportunities to accomplish them by seeking authority to acquire a total of 197,337 acres for the refuge on 22 CFAs encompassed within 19 CPAs. Lands identified would be acquired from willing sellers only. Fee title, easements, leases, and cooperative management agreements would all be acquisition options available.

Compared to alternative B, the CFAs and CPAs under alternative C are generally larger, and new ones are added (4 and 3, respectively). Their size and distribution under alternative C are strategic for protecting core habitat areas for Federal trust resources, facilitating habitat connections for both terrestrial and aquatic species, and increasing the diversity in area, elevation, latitude, and aspect of habitats, and the diversity of ecological processes occurring on habitats represented in the watershed's current 1.8 million-acre conserved lands network. Further, they would promote representation, redundancy, and resiliency in the landscape to provide flexibility in adapting to climatic and landscape change. Similar to alternative B, once land is acquired for the refuge, we would administratively establish a refuge division.

The maps (maps 4.20 to 4.40) at the end of the chapter depict the CPAs and CFAs under each alternative, including alternative C.

The refuge's strategy for contributing to the conserved lands network is not only to protect crucial habitat and habitat connections for Federal trust resources as noted above, but is also based on an assertive strategy to address landscape threats associated with climate, land use, and demographic changes predicted for the watershed. For example, in conjunction with other conserved lands, CFAs would protect areas in anticipation of the landward migration of coastal wetlands predicated under climate change, and would generally provide more diverse opportunities for the successful emigration and adaption of flora and fauna with any environmental changes (e.g., allow for movement in area, elevation, latitude, and aspect). Further, compared to alternatives A and B, this expanded land base makes a more significant and sustainable contribution toward meeting the refuge's goals, objectives, and legislated purposes, and in supporting respective State WAPs and NALCC priorities.

Appendix C is the proposed land protection plan for the refuge under alternative C. Acquisition would be from willing sellers only. It proposes that approximately 90 percent of target acreage authority, on average, would be acquired in CFAs, and the remaining 10 percent of the acreage authority would occur within CPAs. Acquisition outside of CFAs would occur be in coordination with respective municipalities, the State, and abutting landowners. The criteria for acquisition outside of CFAs are the same as that defined for CFAs. Appendix C provides details on the process used to select CFAs, what approvals are being sought, the national policies and procedures the Service would employ for expanding the refuge, what tracts are under consideration and how we have prioritized them, and what acquisition methods and options would be available if approval is granted and there are willing sellers.

In summary, the complete description of alternative C management direction is the combination of the discussion immediately following, along with:

- The section below in this chapter titled "Actions Common to All Alternatives."

- The section below in this chapter titled "Actions Common to Alternatives B, C, and D."
- The summary table 4. 6 at the end of this chapter.
- This final CCP/EIS's appendixes A, B, C, D, and G.

Wildlife and Habitat Conservation

Appendix A details management objectives and strategies that would be implemented for each CFA under alternative C. As we described for alternative B, priority refuge resources of concern, many of which are also North Atlantic LCC representative species, are identified for each CFA. Our process for selecting those priority resources is detailed in appendix B. We would develop detailed step-down HMPs for each CFA to show how we plan to manage for those resources and how we will inventory and monitor habitat conditions. The HMPs will provide more detailed, specific, and quantifiable objectives and clear management strategies. For more established refuge divisions (e.g., larger existing refuge divisions or where we have owned and managed land for a while), in appendix A, we provide a higher level of detail on management strategies that would be incorporated into HMPs since we already know more about those areas. Wherever we identify acres for management, these are rough approximations and will be refined in subsequent HMPs.

In CPAs, we would continue to support our partners land protection efforts with an underlying goal to strive for the protection of important core habitat areas and establish connections between them. For example, one objective in forest habitats would be to strive to conserve contiguous forest blocks of at least 15,000 acres in the southern half of the watershed, and contiguous forest blocks of 25,000 acres in the northern half of the watershed. These sizes are estimated to be the minimum to retain adequate resiliency and withstand catastrophic events, and big enough to support breeding populations for migratory bird species of conservation concern (TNC 2004). Restoration of riparian and floodplain forest, and removing barriers and improving passage for aquatic species, would be priority activities we would also actively support.

Environmental Education, Interpretation, and Outreach

With respect to environmental education, interpretation, and outreach, we would expand the initiatives currently underway under alternative A, as well as those proposed under alternative B. The main appreciable difference from those alternatives is the increased opportunities afforded by the expanded and well distributed land base proposed under alternative C and the increased connections with more communities and their residents. Implementing the Refuge System's Urban Initiative would be a major focus, as would maintaining our existing relationships with partner-owned environmental education and interpretive facilities, and expanding such efforts to new partners.

Recreation

Under alternative C, we would continue to provide recreational access opportunities at all refuge divisions, which represents a much larger land base than under alternatives A and B. We would provide a level of development at each refuge division (e.g. contact facility, parking area, trails, kiosk, interpretation, education facilities or stations, etc.) commensurate with the level of use we anticipate and can accommodate, which overall, would represent an increase over alternative B. We would increase our commitment to provide access to refuge lands for people of all abilities to engage in compatible recreational uses. Providing public access to the Connecticut River for responsible use and enjoyment would be a priority. Table 4.6 summarizes objectives for priority public uses and other recreational activities that would be offered under alternative C.

The maps (maps 4.41 to 4.49) at the end of the chapter depict the proposed public use on Pondicherry and Nulhegan Basin Divisions, the two largest existing refuge divisions, under alternatives B and C. There are additional public use maps for other divisions included in appendix A.

Partnership

Under Alternative C, our partnership strategies would build off those in alternative B which are highlighted in the goal 4 discussion below and in the section "Actions Common to Alternatives B, C, and D Only." The partnerships and program priorities would essentially be the same. However, under alternative C, the capacity of refuge lands to influence conservation in the watershed, and the visibility and relevancy of the refuge as a partner across the 396 communities and 2.4 million residents in the watershed would be greatly enhanced with the larger land base.

Alternative D–Reduced Management with Emphasis on Backcountry Recreation

Alternative D proposes the largest refuge expansion of the all the alternatives. We would seek approval to expand the refuge boundary to a total of 231,307 acres. That represents an increase of 133,477 acres over existing approvals under alternative A. Alternative D includes the same conservation design concept of CPAs and CFAs as alternative C, but also includes additional flexibility (in the form of approximately 33,540 acres more than alternative C) for the Service to acquire lands that connect CPAs and CFAs. The ecological benefits to the watershed's conserved lands network would be notably enhanced from those described for alternative C due to the proposed larger land protection strategy. That expanded land base would include the proportionate increase in capability to promote representation, redundancy, and resiliency of refuge habitats via connectivity and diversity in area, elevation, latitude, aspect. It would also be better able to address landscape-scale threats and issues such as climate, land use, and demographic changes.

The maps (maps 4.20 to 4.40) at the end of the chapter depict the CFAs under each alternative, including alternative D.

Refuge land management under alternative D would be dramatically different than proposed under the other alternatives. This alternative would significantly reduce active habitat management, and would minimize public access infrastructure. The overriding management philosophy under this alternative is to allow natural habitat functions and processes to proceed on refuge lands without human intervention or impact from human activities, except in response to or prevention of a catastrophic threat. As such, with regard to public use and access on the refuge, alternative D would result in a reduced human footprint, including visitor infrastructure, and would emphasize backcountry, non-motorized and low-density, primitive public use opportunities.

Outside of refuge lands, our priorities for engaging in partnerships within CPAs would be similar to alternative C.

Wildlife and Habitat Conservation

With the exception of responding to catastrophic threats and events, habitat management on refuge lands would generally be focused only on controlling invasive pests and conducting limited restoration activities where continued degradation is expected to otherwise impede natural processes. Floodplain forest restoration and dam removal are examples of activities that might occur to manage severe habitat degradation. Off refuge lands, we would continue to support partners' priorities for habitat and land management that is consistent with our mission, goals, and priorities, including where active management would be necessary to meet their priorities.

Environmental Education, Interpretation, and Outreach

Alternative D would primarily differ from the other alternatives in how these programs would be implemented on refuge lands. Activities on refuge lands would be tempered to conform to an overall low impact, backcountry, and limited development approach to management. For example, interpretive trails, overlooks, kiosks, outdoor classrooms, and parking areas would not be expanded

and those that exist today may be removed rather than maintained when major repair is required.

Recreation

Under alternative D, we would continue to promote public access to refuge lands for compatible recreational uses as outlined in the previous alternatives. However, there would be a distinct difference in the amount of infrastructure and investment of resources to support those activities on refuge lands. And, restrictions on motorized vehicles would also be implemented. In general, facilities to support recreational uses would be substantially less. Table 4.6 summarizes objectives for priority public uses and other recreational programs that we would allow under alternative D. As indicated above, this alternative would promote backcountry, non-motorized and low-density, pedestrian public use opportunities. Snowmobiling would no longer be allowed under alternative D. We would also only allow motor vehicle use on primary roads, and eliminate that use on secondary roads. There would be minimal signage on roads and trails, providing only that quality of access which is necessary for safety and a quick orientation.

The maps (maps 4.41 to 4.49) at the end of the chapter depict the proposed public use on Pondicherry and Nulhegan Basin Divisions, the two largest existing refuge divisions, under alternative D. There are additional public use maps for other divisions included in appendix A.

Partnerships

Under alternative D, our strategy to establish, support, and maintain partnerships would be the same as those under alternative C. However, due to reduced active habitat management, restrictions on motorized activities, and reduced infrastructure proposed under this alternative, partnership opportunities with certain user groups, and/or organizations interested in active management on the refuge, would be reduced.

Actions Common to All Alternatives

All of the alternatives share some common actions. Some are required by law or policy, or represent NEPA decisions that recently have gone through public review, and agency review and approval. Others may be administrative actions that do not necessarily require public review, but we want to highlight them in this public document. They may also be actions we believe are critical to achieving the refuge's purposes, vision, and goals. These actions include:

- Partnerships.
- State Fish and Wildlife Agency Coordination.
- Community Relations.
- Grants Program.
- Urban Wildlife Refuge Partnerships.
- Land Stewardship Outreach.
- Land Conservation and Protection.
- Agricultural and Forest Lands Protection.
- Rare and Exemplary Natural Communities.
- Adaptive Management.
- Research.

- Inventory and Monitoring Program.
- Integrated Pest and Invasive Species Control.
- Refuge Staffing and Administration.
- Youth Conservation Corps.
- Volunteers.
- Refuge Operating Hours.
- Refuge Step-down Plans (e.g., HMPs, Visitor Services Plans, Fire Management Plans, etc.).
- Environmental Education, Interpretation, and Outreach.
- Hunting and Fishing.
- Appropriateness and Compatibility Determinations.
- Activities Not Allowed.
- Permitting Special Uses.
- Commercial and Economic Uses.
- Removing Unnecessary Structures and Site Restoration.
- Cabin Leases at Nulhegan Basin Division.

Bird banding at Nulhegan Basin Division

Ryan Hagerty/USFWS

- Boating Access.
- Furbearer Management.
- Fire Management.
- Expanding the Pondicherry National Natural Landmark.
- Cultural Resource Protection.
- Endangered Species Act Section 7 Consultations.
- Wilderness Review.
- Wild and Scenic Rivers Review.
- Distributing Refuge Revenue Sharing Payments.
- Silvio O. Conte Refuge Advisory Council.

Partnerships

Under all alternatives, we would continue to maintain the existing partnerships identified in appendix N, while seeking new ones. These relationships are vital to our success in managing all aspects of the refuge, from conserving land, to managing habitats and protecting species, to outreach and education, and providing compatible wildlife-dependent recreation. Their importance is

so paramount, we have dedicated goal 4 to highlight the present and future partnerships. The respective State wildlife agencies and partners comprising the Friends of Conte have been particularly important and valued conservation allies. We would continue to work collaboratively with existing partners and pursue new relations in areas of mutual interest that benefit refuge priorities. We highlight several partnership elements below. Implementing this program supports all refuge goals, with particular emphasis on goal 4 and the conservation and management of wildlife resources through partnerships.

State Fish and Wildlife Agency Coordination

Under all alternatives, refuge staff would continue to coordinate with the four respective State wildlife agencies in areas of mutual interest, including the protection of Federal and State listed species and other species of concern, hunting and fishing seasons and regulations, wildlife and aquatic habitat management projects (including aquatic species passage) both on and off refuge lands, environmental education, and land protection. This close coordination is grounded in the 1997 Refuge Improvement Act and Service policy (601 FW 7) directing "early and close coordination and cooperation" with our State counterparts in a "timely and effective manner." State coordination and cooperation is an emphasis in the recommendations from the 2011 Refuge System vision conference, "Conserving the Future: Wildlife Refuges and the Next Generation."

It is a clear imperative that refuges should coordinate with States when involved in planning efforts of mutual interest, including CCPs, habitat management plans, and hunting and fishing plans, as examples. The CCP process is specifically mentioned in 601 FW 7 policy as a Service action requiring close collaboration with affected States. Furthermore, the policy directs we ensure that Refuge System regulations and management plans are, to the extent practicable, consistent with respective similar State laws, regulations, and management plans. We would also continue to work with the States as they develop and implement their respective wildlife action plans. Finally, Presidential Executive Order #13443–Facilitation of Hunting Heritage and Wildlife Conservation, directs the Service to work with state fish and wildlife agencies to manage wildlife and habitats to foster healthy and productive populations and provide appropriate opportunities for hunting those populations. Close coordination with State agencies supports all four refuge goals.

Community Relations

Under all alternatives, we would continue to meet and work with community leaders, elected officials, local landowners, and the public. This remains a challenge given the small staff and landholdings spread across more than 300 miles in four states. However, we will continue to strive to maintain a good line of communications within each of the communities where the refuge is working. Enhanced community relations would help support all refuge goals. The WoW Express, BAT, Adopt-a-Habitat, open houses, and a range of public access facilities and opportunities will be employed to accomplish refuge purposes and strengthen community ties to the refuge.

Grants Program

Under all alternatives, the administrative capability to implement a grants program would remain in place so that refuge staff could award grants through the Partners program or through other grant funds should funds become available. At this time, no funding is available and the forecast for future funding is very uncertain. As we described under alternative A, the 1995 FEIS included an important program for awarding CCS grants and Partners program monies to fund projects for conservation, education, recreation, and land stewardship. Funding both public and private projects to manage and restore wildlife populations and habitats, and support environmental education programs, was the major focus of the grant program identified in the 1995 EIS.

In its early years, approximately $100,000 was available for distribution in the CCS budget for the refuge. In its last 2 years of implementation, years 2000 and 2001, 22 projects were funded by the refuge each year, with an annual budget of approximately $89,000 and $75,000, respectively. Both years prioritized awarding projects on partner lands.

Unfortunately, after 2001, the refuge was never able to secure a stable, annual funding source and the available funding declined to zero dollars. In fact, due to budget issues, the Service put the entire CCS program on hold nationally in fiscal year 2011. Despite this setback, under all alternatives, refuge staff seek to retain the authority and administrative framework to implement a CCS or other Federal grant program should funding become available, and continue to maintain a Partners program, because of the immeasurable benefits of leveraging funding among partners to achieve all four refuge goals.

The Service's most recent guidance on CCS grants was developed by the Department in 2010 (DOI Guidance Release 2012-05). The Service's manual chapter 055 FW 6, prepared in 1992, has not been updated to reflect this new guidance, but we would remain compliant with all current guidance. An active grants program would support all refuge goals, as well as the legislated refuge purposes.

Urban Wildlife Refuge Partnerships

The Refuge System's Urban Wildlife Conservation Program, and the refuge's current contributions to that program (e.g. establishing Urban Wildlife Refuge Partnerships), are described in chapter 3. As noted in chapter 3, opportunities for urban partnerships are particularly relevant for Conte Refuge due to the refuge's proximity to several major cities and many urbanized areas, such as the Springfield, Massachusetts and Hartford, Connecticut metropolitan areas. These refuge partnerships aim to engage students and community members in environmental education and urban restoration projects to create a network of conserved habitats in the Connecticut River watershed.

Under all alternatives, we would continue to support our existing urban wildlife refuge programs in Springfield and Hartford, and pursue new ones. Implementation of the urban programs could also occur through existing refuge programs such as Adopt-a-Habitat, Conte Corners, WOW Express, YCC, SCA crews, and volunteers. Working with partners to protect important habitats and engage urban audiences in conservation contributes to all refuge goals.

Land Stewardship Outreach

Under all alternatives, we would continue to encourage landowners and conservation organizations within the watershed to consider all opportunities to benefit wildlife and aquatic habitats when they are evaluating management options. This outreach would take many forms, including personal landowner contacts, community forums, and supporting their efforts to secure funding for restoration projects and for habitat and farmland protection, such as easements. Further we would seek opportunities to support sustainable recreational and economic practices. By working collaboratively where refuge priorities are an important consideration, and by sharing the most current science, research, and management practices with landowners and partner organizations, we hope to sustain the excellent standards of stewardship that are the hallmark of the region's strong land ethic. This program would support goals 1, 2, and 4.

Land Conservation and Protection

An important partnership is focused on land conservation in the watershed. The decision document establishing the refuge (USFWS 1995) emphasized that the refuge was part of a larger conservation mosaic to protect and manage wildlife and fish habitat in the four-state watershed. We carry that emphasis forward in the present plan. All alternatives include our continued participation in those

partnerships with the goal to permanently protect and sustain Federal trust resources, and other unique natural resource values, in the Connecticut River watershed. An important component of this goal is an objective to improve connectivity between existing and future conservation tracts, while preserving working landscapes, and public access. The refuge's conservation partnerships in the region have evolved into a dynamic, landscape-level, multi-partner effort, led primarily by the Friends of Conte. As an association of organizations, the total list of engaged partners is long and includes the Service, other Federal agencies, State agencies, private conservation organizations, local communities, private landowners, and private businesses. A list of partnerships we are involved with is included as appendix N. Chapter 3 and the proposed LPP (appendix C) include descriptions of some of the important refuge acquisition accomplishments to date, as well as some current land conservation projects. In our discussion of CPAs and CFAs under the alternative B summary above, we discuss that our land acquisition focus for the refuge would be in CFAs. Elsewhere in CPAs and the greater watershed, we would work to actively support partner-driven land protection initiatives, with a priority to facilitate connections among conservation lands, especially those that would build biological continuity with the refuge and watershed.

Under all alternatives, when the Service acquires land from willing sellers in full, fee-simple ownership in the future, our intent is to allow public access for compatible public recreation and other compatible refuge uses, consistent with what we currently allow. When a conservation easement, or a partial interest, is purchased, the Service's objective is to obtain all rights determined necessary to ensure protection of Federal trust resources on that parcel. Typically, at a minimum, the purchase would include development rights. However, we may also seek to obtain the rights to manage and enhance habitats, and/or to manage public use and access, if the seller is willing and funding is available. Implementing a land conservation and protection program helps to achieve all refuge goals.

Agricultural and Forest Lands Protection

Under all alternatives, we support the protection of high-value and productive working farms and forests.. We will seek opportunities to facilitate and support the enrollment of these lands into voluntary landowner incentive programs, and once enrolled, consider those lands conserved. The refuge does not intend to target these lands for acquisition. Instead, our priority would be to work with individual landowners, organizations, states, and other Federal agencies to protect these lands and ensure they continue to be part of an integrated, working landscape. There are many state and Federal programs that focus on protecting working farms and forests and help promote economically viable practices that benefit wildlife and help protect water quality. Through our private lands program, we will help landowners who are interested in these programs connect with the proper state and Federal agencies and programs.

Occasionally, we may acquire agricultural lands (in fee-title) from willing sellers, when other agricultural programs are not available to keep the land in agricultural production. Unfortunately, in certain economic times the costs to farmers to sustain agricultural protection are prohibitive, and the value of the lands for development is very high. In these situations, we may purchase agricultural lands to prevent development and ensure wildlife habitat conservation.

Working with partners to protect agricultural land from development would help achieve goals 1, 3, and 4.

Rare and Exemplary Natural Communities

All of the alternatives would strive to protect, maintain, and restore rare and exemplary natural communities across the watershed, and particularly on refuge lands. Natural communities are an assemblage of plants and animals within a

particular physical environment that are affected by natural processes such as soils, hydrology, topography, and climate (Thompson et al. 2000, Sperduto et al. 2004, Sperduto 2005, Garland 2011). Species composition, vegetation structure, and environmental conditions are distinguishing characteristics used to classify natural community types (Thompson et al. 2000, Sperduto 2004). Natural Heritage Programs evaluate these communities and assign them a quality rank based on the ecological integrity of the community relative to other examples of that community type. Rare and exemplary ranked communities are a conservation concern due to their minimal presence on the landscape. A community may be considered rare due to natural influences (e.g., edge of range), or from human disturbances. Exemplary communities are high quality examples of more common community types, and tend to have a high biological diversity (Thompson et al 2000, Sperduto et al. 2004).

Exemplary and rare natural communities in the Connecticut River watershed, such as vernal pools, are vitally important to the health, integrity, and biodiversity of the watershed and contribute to our understanding of natural systems and their functions. Despite the small size, patchiness, and ephemeral nature of some of these habitats, their value is disproportionately significant. All alternatives recognize their importance and promote their conservation and restoration, where feasible.

Our objective is to conserve and maintain all rare and exemplary communities identified by respective State natural heritage programs to maintain the integrity, amount, and distribution of these community types across the watershed. On other ownerships, we would work with willing landowners to protect and restore these areas, and seek special designations as appropriate. Within 10 years of CCP completion, and in coordination with the respective States and other conservation partners, we would:

Northeastern bulrush

USFWS

- Assist partners in completing inventories and mapping for known rare or exemplary communities within the watershed.
- Assist partners with assessing habitat conditions in mapped areas and identify any threats to those conditions.
- Evaluate the potential occurrence of rare or exemplary communities on refuge lands before refuge activities are initiated, and if they are located, ensure best management practices are followed to protect them.
- Facilitate the development and use of a decision support tool to prioritize any needed restoration efforts for these community types on refuge lands and use active restoration (e.g., tree plantings, tree girdling, non-commercial thinning, and removal of invasive species), as warranted.
- Help monitor species' response to restoration and protection efforts.
- Cooperate with willing landowners to promote special designation areas for these natural community types, as warranted, to support their protection.

Implementing this program supports refuge goal 1 relating to wildlife and fish habitat conservation.

All of the alternatives would continue to utilize an adaptive management approach on refuge lands that allows flexibility in management to respond to new information and spatial and temporal changes and environmental events, whether foreseen or unforeseen, or any other factors that influence our decisions. Our goal is to be able to respond in a timely manner to any new information or events.

The need for flexible or adaptive management is compelling today because our present information on refuge species and habitats is incomplete, provisional, and subject to change as our knowledge base improves.

One example of how we will implement adaptive management is in response to the regional impacts of climate change. Our watershed-level partnerships with state agencies, numerous conservation organizations, private and other public landowners, coupled with our refuge expansion proposals, would result in more resilient habitats across the landscape, and help reduce other non-climate stressors. Conserving and connecting protected lands provides wildlife migration corridors, maintains refugia for species on the edge of their range, removes dispersal barriers and establishes dispersal bridges, protects hydrology, and increases the ecological, genetic, geographical, behavioral and morphological variation in species. As funding permits, our plans to control invasive plants, maintain the integrity and function of forest floodplains and wetlands, and promote forest health and diversity, could also minimize climate change impacts.

At the refuge level, monitoring and assessing management actions and outcomes within a scientifically rigorous framework, and tracking critical resources and indicators of forest ecosystem health, is a fundamental component of an adaptive management strategy. As appropriate, the refuge manager, in consultation with stakeholders, would be responsible for changing management actions and strategies on refuge lands if they do not produce the desired conditions. As we develop HMPs and a variety of other public access and operation plans that build off this CCP, any significant changes may warrant additional NEPA analysis and public comment. Minor changes will not, but we would document them in our project evaluation reports or annual reports. Implementing an adaptive management strategy will support all refuge goals (goals 1 through 4).

Research

Under all alternatives, research on Federal trust and other priority species and their habitats would continue to be an important aspect of refuge administration and also encouraged through partnerships on lands throughout the watershed. Generally, we would continue to approve special use permits for research on refuge lands that provide a direct benefit to the refuge by informing decisions on managing natural resources on the refuge and throughout the watershed. The refuge manager may also endorse and support study proposals throughout the watershed that contribute to the conservation or enhancement of native species and biological diversity, inform climate change predictions, or support ecoregional conservation information needs, such as those identified by the NALCC, Joint Ventures, species recovery plans, or Friends of Conte Stewardship Committee.

All researchers operating on refuge lands would continue to be required to submit detailed research proposals following the guidelines established by Service and refuge policy. Special use permits will also identify the schedules for progress reports, the criteria for determining a completion date, and the requirements for publication of interim and final reports. All publications will acknowledge the Service's role as a key partner and in funding and/or operations. Researchers would be required to take steps to ensure that invasive species and pathogens are not inadvertently introduced to the refuge or the greater watershed, nor transferred from one part of the watershed to another. We would continue to ask our refuge biologists, to peer review and comment on research proposals and draft publications, and will share research results internally, with these reviewers, and other conservation agencies and organizations. We may also ask other divisions of the Service, USGS, select universities or recognized experts, or representatives from the four states to help review project proposals and publications.

Some projects, such as banding studies, require additional Service permits. The refuge manager would not approve those projects until all required permits are

received and for those projects that may affect federally listed species, not until the consultation requirements under the ESA have been met.

An active research program would support refuge goals 1, 2, and 4.

Inventory and Monitoring Program

Establishing a baseline of refuge resource information from which to make management decisions is critical to achieving our goals. There is much we would like to know about the refuge's resources, including how they function or move across the landscape, and what, if anything, are threats. Unfortunately, there is not enough time or funding to compile all the information that we would like to know. There are several studies that we have conducted recently, or plan to initiate, as soon as funding is available. These include:

- Breeding songbird baseline inventories (Pondicherry Division collected data in 2004 to 2006, and 2009 to 2011, and Nulhegan Basin Division collected data from 2000 to 2007).
- Puritan tiger beetle monitoring and population management (initiated in 1997).
- Habitat inventories (which we completed at Nulhegan Basin and Pondicherry divisions) in all refuge divisions, including forest health assessments; to be completed when enough lands are acquired to warrant an inventory effort.
- Breeding woodcock surveys conducted at Nulhegan Basin Division since 2000.

Other top priority activities we have identified as funding allows include:

- In conjunction with development of an Inventory and Monitoring Plan (IMP), identify inventory methods, priorities, and schedules to evaluate the status of other priority species and habitats identified in this CCP.

Other projects may arise as we develop our refuge HMPs and work cooperatively with partners to identify conservation priorities across the watershed and as funding becomes available. We would adjust our priorities listed above in response, as warranted, and update our IMP accordingly. Implementing this program supports refuge goal 1 relating to the conservation of wildlife and fish habitats.

Integrated Pest and Invasive Species Control

The Refuge System has adopted an Integrated Pest Management approach to eradicate, control, or contain invasive species on refuges (517 DM 1 and 7 RM 14). This refuge has a long history of collaborative control both on- and off-refuge lands. Our objectives are to develop criteria that will help us identify priority species for control, react quickly to reduce the chance that new invasive species become established, or pose a threat to susceptible resources, and control the spread of what does exist.

In partnership with others, we will identify and respond to invasive plant and animal species that pose a threat to the native diversity of the watershed, particularly where refuge lands are threatened. Of particular concern on the refuge are Japanese stiltgrass, Japanese knotweed, purple loosestrife, pale swallowwort, water chestnut, mile a minute vine, didymo (also known as "rock snot"), zebra mussels, mute swans, etc. We will continue to train staff and partners to identify, watch for, and report those species deemed by state and regional experts as posing the highest threat and warranting "Early Detection/ Rapid Response" status. These species would be the highest priority to control, if found. Another priority would continue to be eradicating new or very small occurrences of any invasive species before they have a chance to establish in order to keep areas weed-free.

We would continue to focus on controlling, and preventing the establishment of, invasive plants species that are the greatest threat to priority resources. On refuge lands, to the extent possible, we will physically remove invasive species. Chemical control on refuge lands will be assessed on a case-by-case basis. Any chemicals determined by the refuge manager to be necessary will only be used following the mandated internal review and approval, as well as complying with all applicable regulations and laws.

G.A. Cooper @ USDA-NRCS PLANTS Database

Multiflora rose

In conjunction with the HMP and IMP, we will develop a list of invasive species of greatest concern on the refuge, identify priority areas with which to be vigilant, and establish monitoring and treatment strategies. We will also consult States and their respective lists of prohibited and targeted invasive species. We will reference the National Wildlife Refuge System Invasive Species Management Strategy released in May 2004 (USFWS 2004b) for additional tools, processes, and strategies. The 2004 report is complemented by a technical report issued in May 2005 by USGS, titled "The Invasive Species Survey: A Report on the Invasion of the National Wildlife Refuge System" (USGS 2005). Additionally, in 2011, researchers completed an inventory of invasive plant species on a few refuge divisions (Edvarchuk et al. 2012). This inventory also included recommended actions to help control and prevent the spread of invasive plants on the refuge. Based on these reports and refuge-specific information, we have developed the following strategies in support of goal 1:

- Continue to support efforts by Friends groups to hand-control invasive plants on refuge lands where feasible and effective.
- Institute proper care and cleaning of all refuge equipment to avoid introduction or transport of invasive plants; require researchers and contractors on the refuge to take steps to prevent transport of invasive plants and pathogens.
- Implement outreach and education programs, including signage, where appropriate, to enlist the help of refuge visitors and actively support state initiatives on this topic.
- Ensure all management activities minimize disturbance to soils where invasive plants occur that benefit from disturbance.
- Use clean mulch, gravels, and other materials for all refuge projects.
- Use native species for soil erosion control and restoration purposes. If native plants are not available or suitable, at a minimum, use species with no known invasive tendencies.
- Provide outreach to refuge users, including hunters, anglers, and paddlers and visiting public, to inform them of the risks they pose to accidentally introducing invasive species through their use of the refuge. For example, consider constructing boot brush stations at trailheads of trails that pass through high priority habitat to further prevent the introduction of new seed sources and raise awareness among visitors. Consider encouraging visitors to avoid heavily infested areas to prevent the spread of seeds.

We describe additional actions to combat invasive species that we propose to do in partnership with others under the goal 4 discussion below.

Refuge Staffing and Administration

Our proposals in this document do not constitute a commitment for staffing increases, funding for operations and maintenance, or future land acquisition.

Congress determines our annual budgets, which our Washington headquarters and regional offices distribute to the field stations. Chapter 3 presents our levels of staffing and operating and maintenance funds for the refuge in 2012. The activities shared among the alternatives we describe below pertain to staffing, administration, and operations.

Under all alternatives, we would continue to administer and staff the refuge as efficiently and effectively as possible. Staffing, and operations and maintenance funds, over the last 5 years are presented in chapter 3. Below we describe activities related to staffing and administration that are shared among the alternatives; some are new, others are on-going. Implementing these activities supports the four refuge goals.

Permanent Staffing and Operational Budgets
Under all alternatives, our objective is to sustain annual funding and staffing levels that allow us to achieve our refuge purposes and goals. Currently, the refuge maintains a permanent workforce of 9.5 full time equivalents. This core staff is supplemented by term appointments, and Pathways Program students, within the constraints of the refuge's discretionary operating budget.

In response to Refuge System operational funding declines nationwide, our region initiated a new base budget approach in Fiscal Year 2007. The goal is to have a maximum of 75 percent of a refuge station's budget cover salaries and benefits, while the remaining 25 percent or more will be operations dollars. The intent of this strategy is to improve the refuge manager's capability to do the highest priority work and not have the vast majority of a refuge's budget tied up in inflexible, fixed costs. This strategy was successful for a few fiscal years; however, we now anticipate a level or declining budget environment, which will impact flexibility in managing financial resources and may have implications for the level of permanent staffing. A new round of workforce planning began in 2013 in response to the sequester and anticipated future budget reductions.

In 2011 the refuge entered into a Memorandum of Understanding (MOU) with the four State directors of NRCS. Funding derived from NRCS under this agreement supported a refuge term biologist position. This position was funded by NRCS in FY 2012 and the refuge has since funded it out of declining discretionary operational funding. The role of this position varies by state, but the primary responsibility is to assist NRCS, in coordination with the state wildlife agencies, to implement conservation projects on the property of willing landowners seeking opportunities to bridge gaps in assistance to private landowners. Every effort would be made to avoid competing or duplicating the efforts of partners, especially other state and Federal agencies. Under alternatives B, C, and D, a private lands biologist would become a permanent, full-time position.

Appendix G lists our Refuge Operations Needs System (RONS) and Service Asset Management and Maintenance System (SAMMS). We include currently listed projects, staffing, and maintenance needs in those databases, and also indicate their proposed refuge ranking. The SAMMS projects are a list of backlogged maintenance needs that we report to Congress. We also included in appendix G any new projects not yet in the databases, but proposed under alternative C. Once the CCP is approved, if funding is not available through annual budget requests, we would continue to seek alternate means of accomplishing our projects; for example, through our volunteer program, Service regional grants, or other partnership grants, and internships.

Under all alternatives, and within the guidelines of the budget allocations, we would seek to fill positions approved in this CCP to accomplish our highest priority projects. Alternatives B and C propose additional staff to provide depth in our biological, visitor services, law enforcement, and maintenance programs.

We identify our recommended priority order for new staffing in the appendix G RONS tables. Appendix H portrays the staffing requests we propose under each alternative.

Providing adequate staffing to manage refuge programs supports all refuge goals.

Facility Maintenance
All alternatives include the periodic maintenance and renovation of existing facilities to ensure the safety and accessibility for staff and visitors. Our current facilities are described in chapter 3. They include administrative facilities such as refuge quarters at the Nulhegan Basin, Pondicherry, Blueberry Swamp, Salmon River, and Fort River divisions, the refuge office/visitor contact station at the Nulhegan Basin Division. Visitor facilities to be maintained under all alternatives include: the road network and hiking trails at Nulhegan Basin Division, the hiking trails at Pondicherry Division, trailhead parking areas at Nulhegan Basin and Pondicherry divisions, and information kiosks, signs, boardwalks, and viewing platforms on several divisions. The North Branch Trail at the Nulhegan Basin Division and the Mud Pond Trail at the Pondicherry Division will also require periodic maintenance. Any new facilities recommended in the final CCP, once constructed, will be placed on the maintenance schedule. All facilities and fleet maintenance and upgrades would incorporate ecologically beneficial technologies, tools, materials, and practices. Under all alternatives we would also continue to remove unnecessary buildings whenever feasible, such as buildings at the Fort River and Dead Branch divisions.

Maintaining facilities and buildings that are necessary for refuge management supports all refuge goals.

Energy Efficiency and Reducing our Carbon Footprint
The Service and Refuge System are working to increase the energy efficiency of our buildings and reduce our carbon emissions. Under all alternatives, we would continue to replace, as needed, our current fleet of vehicles and equipment with more fuel-efficient models (e.g., hybrid cars and trucks). All new facilities that we construct would incorporate green building technologies (e.g., the use of recycled materials). Trails and related structures will be designed to be easily maintained. We would also explore alternative energy sources and look for ways to upgrade current facilities to be more energy efficient and (e.g., installation of solar panels).

USFWS
Youth Conservation Corps

Youth Conservation Corps

Dependent upon annual funding, under all alternatives we would continue the YCC program. The YCC is a summer youth employment program that gives local youth the opportunity to work on refuge biological and visitor services programs. Typically YCC crews are comprised of four to six persons (15 to18 years old), and two crew leaders. In the past, the refuge has had YCC crews located at the Nulhegan Basin, Pondicherry, Blueberry Swamp, and Fort River divisions. This has been a popular program in the local communities because of limited youth employment opportunities, especially in rural areas. If enough funding can be secured, we would continue to offer this program and expand this program to support additional crews near other divisions as they become established. Supporting the YCC program helps achieve all refuge goals.

Volunteers

Volunteer opportunities would continue to exist under all alternatives. Volunteerism has long been a tradition within the Refuge System and has served a critical role on this refuge. The 1997 Refuge Improvement Act and the 2010 National Wildlife Refuge System Volunteer Improvement Act encourage and promote meaningful volunteer services. Assistance by volunteers is recognized as key to successful management of public lands and vital to implementation of refuge programs, plans, and projects, especially in times of declining budgets. Working with volunteers builds personal and community relationships, and promotes a shared stewardship of refuges and their associated natural and

cultural resources to be treasured and enjoyed by both present and future generations. Refuge staff will stay apprised of the Refuge System's development of a strategic plan for volunteers, Friends Organizations, and Community Partners.

Refuge staff would continue to cultivate existing volunteers and recruit prospective new volunteers so that more citizens may work successfully to help steward refuge lands and resources. Staff will endeavor to connect with a wider cross section of the American public to increase the diversity of volunteers. Further, staff will strive to provide adequate orientation to the Service and the refuge, a structured, interesting opportunity, enough contact and oversight to give volunteers adequate direction and support, and will ensure the work is recognized and appreciated. We will provide volunteers with an:

- Orientation to the Service, Refuge System, and refuge.
- Explanation of expectations, policies, and procedures that impact the planned work.
- Training in safety, first aid, and best management practices for relevant tasks.
- Training on various management techniques and best management practices for the tasks at hand.
- Written evaluations of and by volunteers to help facilitate recruitment and retention.
- Volunteer appreciation, incentives, and awards.
- On-refuge housing opportunities, as appropriate and when funding and space allow.

An active volunteer program supports all refuge goals.

Refuge Operating Hours

To protect refuge resources, under all alternatives we would continue to open most refuge units and divisions to the public 7 days a week from ½ hour before sunrise to ½ hour after sunrise, with the following exceptions:

- To protect sensitive resources, Wissatinnewag Unit (cultural resources) and Dead Man's Swamp Unit (federally threatened Puritan tiger beetle) are closed to all public use year-round.
- The Nulhegan Basin Division is open 24 hours a day.
- Areas may be seasonally or temporarily closed to protect refuge resources.
- Snowmobilers under a group permit on designated trails on the Pondicherry and Dead Branch divisions are allowed outside of these hours.
- Hunters, in accordance with respective State and refuge hunting regulations, may be allowed on the refuge outside of these hours.
- Visitors actively engaged in fishing, in accordance with respective State and refuge fishing regulations, may be allowed on the refuge outside of these hours.
- Other exceptions would be by special use permit, such as for research; night or overnight group wildlife observation, interpretive, and environmental educational programs; fishing, and, campers in designated camping sites.

Promoting access on refuge lands for appropriate and compatible uses supports all refuge goals, particularly goals 2 and 3.

Refuge Step-down Plans
Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. These plans would be developed regardless of the alternative selected for the final CCP. We have identified the plans below as the most relevant to this planning process, and we have prioritized them. They are listed in priority order for completion. We offer a more detailed explanation of some of them following our listing.

Step-down plans will be updated or revised as we gain new information or acquire new refuge lands so we can continue to keep them relevant. Existing plans will be updated consistent with the final CCP. All of these plans contribute to the mission of the Refuge System, the refuge's purposes, and one or more of the refuge's goals. Other than step-down plans that are strictly for administrative purposes, all other plans related to public use and access or habitat management, will involve NEPA compliance and a public process, including including partner, community, and stakeholder participation, review, and comment prior to a final decision and implementation. Examples include HMPs, Hunting and Fishing Plans, and Visitor Services Plans.

Within 3 years of CCP approval, we would initiate:

- HMPs for the following refuge divisions; priority order for completion includes HMPs for Nulhegan Basin, followed by Pondicherry, and Fort River divisions. Other HMPs will be completed as refuge divisions reach a sufficient size for habitat management activities (see discussion below).

- Hunt plans and opening packages for refuge lands in each State. We will follow all required administrative procedures to develop and approve hunt plans on refuge lands.

- Fishing plans and opening packages for refuge lands in each State. We will follow all required administrative procedures to develop and approve fishing plans on refuge lands.

- Annual Habitat Work Plans (AHWPs) would be developed by refuge divisions to support HMP implementation (see discussion below).

Within 5 years of CCP approval, we would initiate:

- IMPs for the following refuge divisions (see discussion below); the order of completion follows development of HMPs

- Fire management plans for refuge divisions; use of prescribed fire may also be included in HMPs, as warranted. If, upon development, it appears to be more efficient to consolidate fire plans by combining multiple divisions (e.g. by state), this will be pursued.

Within 7 years of CCP approval, we would complete:

- A Visitor Services Plan, combining all refuge divisions and units. This plan will incorporate hunt and fishing plans, which will be written for each State.

- A Law Enforcement Plan, combining all refuge divisions and units.

- Facilities and Sign Plan, combining all refuge divisions and units.

- Integrated Pest Management and Invasive Species Plan (see discussion below), combining all refuge divisions and units.

Habitat Management Plans
A HMP for refuge divisions of manageable size is the requisite first step to achieving the objectives of goal 1, regardless of the alternative selected for implementation. For example, the HMP will incorporate the selected alternative's habitat guidelines and strategies developed herein, and identify "what, where, how, and when" actions will be implemented over the 15 year timeframe to achieve those objectives. Specifically, the HMP will define management areas/ treatment units, identify type or method of treatment, establish the timing for management actions, and define how we will measure success over the next 15 years. In this CCP, the goals, objectives, and list of guidelines and strategies under each objective identify how we intend to manage habitats on the refuge.

Both the CCP and HMP are based on public, stakeholder, and partner input; current resource information; published research; and our own field experiences. Our methods, timing, and techniques will be updated as new, applicable information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major vegetation changes (e.g., changes due to climate change) on at least a 5-year basis. As appropriate, actions listed below in "Actions Common to All Alternatives" will be incorporated into the HMP. When developing HMPs, refuge staff would follow all appropriate NEPA compliance requirements.

Annual Habitat Work Plans
The AHWPs for the refuge are priorities for completion upon CCP approval. Regardless of the alternative chosen, this plan is important and helpful when implementing habitat management actions and measuring our success in meeting the habitat objectives under goal 1. The AHWP is generated each year from the HMP, and will outline specific management activities to occur in that year. This document can also be used as an outreach tool to communicate our management plans and report our accomplishments for a given year.

Inventory and Monitoring Plans
IMPs will outline and prioritize the methodology to assess whether our original assumptions and proposed management actions are supporting our habitat and species objectives. For example, the IMP will help determine what types of inventories and surveys to conduct on refuge lands. Currently, we have some baseline information on our larger, more established refuge divisions (e.g., Nulhegan Basin and Pondicherry Divisions), but lack thorough baseline inventories on many of our smaller units and newer divisions. Also, as we acquire new refuge lands, our priority will be to conduct baseline vegetation and wildlife surveys and habitat mapping. All of these surveys will help us develop or refine an HMP.

Lupine restoration

USFWS

The IMP will also detail the types of long-term monitoring we plan to conduct on the refuge. During the development of our IMPs, we will coordinate our proposed projects with the work and priorities of the NALCC and with studies being conducted on other national wildlife refuges in the region. In particular, we will focus on monitoring NALCC representative species on the refuge. We will work with the NALCC and other partners (e.g., States, universities, and non-governmental organizations) to develop, prioritize, and implement inventories and monitoring that will help inform our management decisions on the refuge.

The IMP will also include efforts to assess the effects of climate change on refuge resources. The results of inventories and monitoring will provide us with more information on the status of our natural resources and allow us to make more informed management decisions. See more discussion on our inventory and monitoring program below.

Visitor Services Plans
The Service's policy on wildlife-dependent recreation (605 FW 1) directs refuges to develop visitor services plans to provide overarching guidance for the refuge's visitor services programs and facilities. The visitor services plan builds off the visitor services goals and objectives from the refuge's CCP and describes specific strategies for achieving these goals and objectives. The plan includes detailed information on the refuge's recreational program, including compatibility determinations and findings of appropriateness for refuge uses, and incorporates any hunting or fishing plans. When developing these plans, refuge staff would follow all appropriate NEPA requirements.

Environmental Education, Interpretation, and Outreach

Under all alternatives, we would continue working with our partners to enhance opportunities for quality environmental education, interpretation, and outreach. The refuge's mobile exhibit, the WoW Express, travels throughout the watershed to public events such as fairs and conservation-themed festivals. This exhibit also serves as a teaching tool for schools by contributing to specific state curriculum standards. In the near future, the refuge will unveil a Biological Assessment Trailer (BAT), a traveling environmental classroom that will bring tools and knowledge of conservation inventory, monitoring, and restoration to schools, providing them experiential learning focused on nearby habitats.. The ultimate goal is to use this tool to have schools, civic groups, local conservation organizations, and individuals form long-term connections to local natural areas and the refuge through an Adopt-a-Habitat program.

Under all alternatives, we would continue to develop curriculum, and adapt and implement programs in partnership with other educators using these teaching tools. We would also continue to offer on site programs at schools and other environmental educational facilities as resources allow. Our hope is that we can inspire a new generation of conservationists to embody a conservation ethic and form long-term relationships with the natural world through these connections. These programs would help achieve goals 2 and 4.

Hunting and Fishing

Under all alternatives we would continue to work with the respective States and our other conservation partners to provide quality opportunities for hunting and fishing throughout the watershed, and particularly on refuge lands where it is found to be compatible. Under the 1997 Refuge Improvement Act and Service policies (605 FW 2, 605 FW 3), hunting and fishing are two of the six priority public uses of the Refuge System (*http://www.fws.gov/refuges/hunting/*; accessed August 2016). The other four priority uses are wildlife observation, photography, environmental education, and interpretation. Additionally, with regards to hunting, Executive Order 13443 — Facilitation of Hunting Heritage and Wildlife Conservation, directs the Service "to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat."

All refuge lands currently open to hunting and fishing will remain open. With few exceptions, refuge lands are open consistent with State regulations. These regulations and limits are set annually using data about wildlife populations to ensure that species are not overharvested. Habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. State agencies also set safety regulations to reduce any safety concerns

(e.g., requiring hunters and recreationalists to wear hunter orange during the hunting season, and requiring safety zones around buildings).

In general, as new lands are acquired for the refuge, our intent is to officially open them to hunting and fishing under state regulations wherever they are determined to be compatible. We will complete our administrative requirements to formally open lands to these uses, which includes a NEPA compliant process. On newly acquired lands that were previously open to public hunting and fishing, we will allow these uses to continue on an interim basis, wherever possible and compatible, until the administrative process, associated with hunting and fishing step-down plans, is complete. Those step-down plans will provide details on how the programs will be managed.

Hunting and fishing programs would help achieve goal 3.

Encouraging the use of nontoxic ammunition and tackle
Under all alternatives, we would continue to work with the States and our partners to educate and inform hunters and anglers on the impacts associated with the use of lead ammunition and tackle. For example, we would continue to distribute materials providing hunters and anglers with information on those impacts on fish and wildlife; encourage visitors to use cost-effective, lead-free ammunition and tackle; and, describe actions that can be taken to protect wildlife from contamination when lead ammunition and tackle are used. In addition, we will work with the States to identify the impacts associated with requiring the use of non-toxic ammunition and some fishing tackle for hunting and fishing on refuge lands. This would include identifying, quantifying, and evaluating the impacts of lead exposure to wildlife on refuge lands, as well as considering the impacts of lead restrictions on hunters and anglers. Prior to any proposed actions or changes to the status quo there would be opportunities for public input and comment, consistent with NEPA and specific to the refuge opening package and the other Service administrative and legislated requirements.

Our interest is in minimizing the impacts to fish, wildlife, habitats, and human health. Lead from tackle (e.g., lead fishing sinkers, weights, jigs, and other tackle) and lead shot (e.g., spend lead shot, bullets) can be poisonous to fish and wildlife if ingested (Michael 2006). Lead poisoning can cause severe negative effects on the nervous and reproductive systems of fish and wildlife and is often fatal (USGS 2013). Symptoms of lead poisoning often include weakness and lethargy, weight loss, and the inability to fly in birds (USGS 2013).

The main way in which wildlife is exposed to lead is by ingesting lead-contaminated soil and prey (Kendall et al. 1996, Pattee and Pain 2003, MA EOEEA 2014). Due to their feeding habits, waterfowl and other waterbirds are particularly susceptible to lead poisoning (Michael 2006). Some species of wildlife, such as waterfowl, can accidently swallow lead shot and tackle while feeding (MA EOEEA 2014, USGS 2013). Up to 50 percent of adult loons are killed by ingesting lost fishing sinkers and jigs (VDFW 2014). Also, laboratory studies show that an amount of lead as small as 82.5 milligrams can be lethal for a bald eagle (Pattee et al. 1981, Hoffman et al. 1981); this lethal amount represents less than one percent of a single 12-gauge slug, a single 20-gauge slug, or a single muzzleloader bullet. There are also concerns about impacts to human health from lead ammunition. Several studies have shown that fragments from lead bullets were present in wild game meat processed from human consumption, even though measures were taken to try to remove lead during processing (NPS 2014).

Lead-free ammunition is already required by Federal regulations and the four States in the watershed for hunting ducks, geese, swans, other waterfowl, and

certain other migratory birds, such as coots (50 CFR 20.21; 50 CRF 20.108). However, lead-free ammunition is not currently required for deer, turkey, or small-game hunting by any of the States or by refuge-specific regulations. Three of the four watershed States currently restrict the use of lead fishing tackle. Massachusetts does not allow the use of any lead sinkers, jigs, or weights that weighs less than 1 ounce. New Hampshire prohibits the use of lead sinkers weighing 1 ounce or less and lead jigs less than 1 inch long along their longest axis. In Vermont, it is illegal to sell or use lead sinkers weighing one-half ounce or less. Connecticut does not prohibit lead tackle.

Hunting and fishing programs support goal 3.

Appropriateness and Compatibility Determinations

Chapter 1 describes the requirements for appropriateness and compatibility determinations. Appendix D includes proposed appropriateness findings and compatibility determinations to support the activities under alternative C, the Service-preferred alternative. Our CCP will include the final approved compatibility determinations for the management alternative selected. We would continue to only allow activities determined to be appropriate and compatible uses, and which meet or facilitate refuge legislated purposes, goals, and objectives, and contribute to the fulfillment of the Refuge System mission.

The refuge manager has determined that all six priority public uses can be accommodated in a manner compatible with refuge purposes on most portions of the refuge, although some uses allowed require stipulations to ensure compatibility. Stipulations are included in appendix D for each use the refuge manager proposes to be compatible. Appendix D also identifies some areas that are also closed to protect sensitive resources, while identifying others open only by special use permit. Non-priority public uses that the refuge manager proposes to be compatible on some or all of the refuge lands, and including stipulations, are also detailed in appendix C.

Managing compatible public uses supports refuge goals 2 and 3 related to education, interpretation, and recreation.

Activities Not Allowed

The 1997 Refuge Improvement Act states that “compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System.” Compatible hunting, fishing, wildlife observation and wildlife photography, and environmental education and interpretation are the priority general wildlife-dependent uses of the Refuge System. According to the Service Manual 605 FW 1, these uses should receive preferential consideration in refuge planning and management before the refuge manager analyzes other recreational opportunities for appropriateness and compatibility.

We have received requests for non-priority, non-wildlife dependent activities that have never been allowed on this refuge. Activities evaluated by the refuge manager and determined not to be appropriate on refuge lands include: ATV, off road vehicle, and dirtbike use, target shooting, manned and unmanned aircraft for recreational use, and off-road bicycling. Appendix C documents the refuge manager’s decision on their appropriateness. Most of these activities are sufficiently provided elsewhere nearby on other ownerships; therefore, the lack of access on the refuge does not eliminate the opportunity in proximity to refuge lands. Furthermore, many of these activities are not consistent with public safety when combined with existing appropriate and compatible uses, or they harm wildlife and habitats, further supporting the finding of not appropriate. According to Service policy 603 FW 1, if the refuge manager determines a use is not appropriate, it can be denied without determining compatibility.

Not allowing inappropriate or noncompatible uses supports all refuge goals.

Permitting Special Uses

All of the alternatives would require the refuge manager to evaluate whether refuge uses that require a special use permit need to be evaluated for appropriateness and compatibility on a case-by-case basis. Activities that require special use permits include, but are not limited to, research, commercial or economic uses (e.g., commercial guiding, haying, commercial forest management), and furbearer management, hunting dog training, and camp leases at the Nulhegan Basin Division (see discussion below on "Cabin Leases at Nulhegan Basin Division"). Access outside of normal refuge hours also requires a special use permit (except at the Nulhegan Basin Division and for hunters and anglers at other divisions and units who are engaging in these activities in accordance with respective State and refuge hunting and fishing regulations). Implementing this program supports refuge goals 1, 3, and 4.

Commercial and Economic Uses

All commercial and economic uses would continue to adhere to 50 CFR, Subpart A, §29.1 and Service policy which stipulates that we may only authorize these types of public or private uses where we determine that the use contributes to the achievement of refuge purposes or the Refuge System mission. Examples of these types of uses include commercial haying and forest management to improve wildlife habitat. Allowing these activities also requires the Service to determine appropriateness and prepare a compatibility determination and an annual special use permit that outlines terms, conditions, fees, and any other stipulations to ensure compatibility. These uses, if implemented according to Service policy, could potentially support refuge goals 1, 2, and 3.

Removing Unnecessary Structures and Site Restoration

In order to reclaim habitat values, all alternatives include restoring to desired habitat conditions, as soon as practicable, developed sites that are no longer needed for refuge administration, public access, or visitor programs. Strategies for doing so include:

- Continue to remove dwellings, such as cabins, houses, out-buildings, or other developed sites or structures, following Service acquisition, as soon as practicable, if determined to be surplus to refuge needs. Re-grade sites to natural topography and hydrology and re-vegetate to establish desirable conditions, if necessary.

- Within 5 years of CCP approval, inventory and assess existing roads, buildings, and other infrastructure within the refuge. Continue inventory and assessments on new lands as they are acquired. Implement procedures to remove unnecessary infrastructure and rehabilitate sites to desired conditions.

These actions would help achieve goal 1.

Cabin Leases at Nulhegan Basin Division

Under all alternatives, there are no modifications proposed for the existing cabin leases under special use permit at the Nulhegan Basin Division. The Service acquired much of the division in 1999. At that time there were over 60 cabins on the property. Over the past 15 years, the Service has acquired 38 cabins of which 27 have been removed and 8 are still occupied by the original leaseholders as part of a term use agreement. This approach allowed the owner to extract much of their equity and still retain use of the cabin for a set period of time. These permits are renewed every 5 years, assuming the terms of the permit are met, for the life of the current lessees up to a 50-year maximum (i.e., 2049). Among others terms, permit conditions would continue to specify: (1) the camps must be maintained in a manner compatible with the purposes of the refuge and produce the least amount of environmental disturbance; and, (2) no permits will be issued for construction of new camps. Many of these structures were built as hunting cabins and may be used year-round, although not occupied as primary residences. We are not proposing any changes to the special use permit within the context of

this CCP. Appendix D includes a compatibility determination for cabin leases.

Mark Maghini/USFWS

Nulhegan Basin Division camp

Boating Access

Under all alternatives, we would maintain existing boat launches at Nulhegan Basin and Pondicherry Divisions. Appendix D details how those uses would be managed consistent with our fishing program. Managing boat access on refuge lands supports goal 3 related to recreation.

Furbearer Management

Under all alternatives, we would continue to manage furbearer populations in a way that ensures we meet our refuge goals and objectives. There are times when individual furbearing animals, or local concentrations of those animals, affect our ability to achieve priority resource objectives. Protecting human health and safety, maintaining roads, trails, houses and other infrastructure, as well as concerns with impacts on other native wildlife and habitats, are a few of the reasons furbearers might need to be managed. The species most likely to cause concerns are beaver and muskrat. Both non-lethal and/or lethal techniques could be employed in any given situation. We would analyze each situation where these techniques would be employed, and choose the most appropriate method to achieve our objectives.

Beaver

Steve Hillebrand

The Service considers regulated trapping as an effective furbearer population management tool on national wildlife refuges (*http://www.fws.gov/refuges/hunting/whyAllowed.html*; accessed August 2016). Trapping by refuge staff, a Federal or State agency partner, or a State-licensed trapper working as an agent for the refuge, can occur at any time at the discretion of the refuge manager and is not subject to compatibility.

The alternatives differ in their provisions for a public regulated trapping program. Under alternatives A, B, and C, we would continue to have a public trapping program at Nulhegan Basin Division, based on refuge and State regulations, and as described in appendix D. Under these three alternatives, on lands we acquire in the future, we propose to allow trapping to continue as a tool to manage wildlife populations where it is presently occurring, and where the management need is supported by the respective State fish and wildlife agency. Prior to opening refuge lands to trapping, we would complete a NEPA compliant document, a compatibility determination, and a furbearer management plan.

In contrast, alternative D would only allow trapping as an administrative activity to address a management concern. Administering a furbearer management program supports refuge goal 1.

Fire Management

Under each alternative, prescribed fire could be used as a habitat management tool under specific criteria within the 15-year life of this CCP. While the chance of natural ignition is low, should a wildland fire occur, all alternatives also propose rapid and aggressive suppression in areas where property is likely to be threatened according to the guidance in appendix L, "Fire Management Program Guidance." Our suppression objective is to minimize human health or safety concerns, avoid property damage, and reduce the likelihood of resource damage. Fire is not a frequent natural ecosystem process in the Northern Forest. It has been suggested by researchers that stand-replacement fire occurs at 800-year or greater intervals in most regional forest types (Lorimer 1977). However, given Northeast Regional climate change predictions, the average temperatures may increase, especially in the summer. Coupled with little change in summer

rainfall, this may result in more frequent, short-term droughts (NECIA 2007). This, in turn, could alter the fire regime. We would continue to use an adaptive management approach and monitor changing conditions. If necessary, we could conduct prescribed burns to minimize the threat of a catastrophic fire event. Administering a fire program supports refuge goals 1, 2, and 4.

Expanding the Pondicherry Wildlife Refuge National Natural Landmark

The NNL program, administered by the National Park Service, recognizes and encourages the conservation of sites that contain outstanding biological and geological resources, regardless of landownership type (*http://www.nature.nps.gov/nnl;* accessed August 2016). Sites are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education. They are designated by the Secretary of the Interior, with landowner concurrence, and the program is entirely voluntary. To date, nearly 600 landmarks have received the NNL designation within the United States, American Samoa, Guam, Puerto Rico, and the U.S. Virgin Islands.

In Chapter 3, "Affected Environment," we describe the establishment of the Pondicherry Wildlife Refuge NNL in 1972. That NNL designation includes 304 acres of what is now the refuge's Pondicherry Division. Specifically, Cherry and Little Cherry Ponds and the land immediately surrounding them were included in the designation (map 4.2). This was the rationale for designating this area as a NNL: "Within Pondicherry Wildlife Refuge are two shallow, warm water ponds, surrounded by marsh, bog, and forest that support an abundance of submerged, floating, and emergent vegetation, and a great variety of birds. The wetland complex is the type locality for a species of pondweed and spike-rush."

The Pondicherry Division was established in 2000 and, through time, has grown to over 6,405 acres. Now included in the division are several areas adjacent to or in close proximity to the original NNL that contain several examples of relatively undisturbed boreal forest communities including:

- Black spruce–larch swamp.
- Black spruce–tamarack forest.
- Lowland spruce–balsam fir forest.
- Northern hardwood seepage swamp.
- Dwarf shrub fen.
- Alder shrubland.
- Open basin cattail marsh.
- Winterberry/cinnamon fern/spruce tall shrub thicket.
- Yellow pond lily-pickerelweed-pondweed aquatic bed.
- Aerenchymatous deep emergent marsh.
- Leatherleaf-sheep laurel/black spruce dwarf heath shrub bog/very poor fen.
- Black spruce-larch/heath sphagnum swamp.

These exemplary boreal communities support a diverse array of species including spruce grouse, boreal chickadees, black-backed woodpeckers, white cedar, and numerous other plants and animals that depend on this complex of habitats.

In cooperation with the NPS, all alternatives would expand the boundary of the Pondicherry NNL to one that includes the relatively undisturbed wetlands and boreal forests of the John's River and Mud Pond (map 4.2). We had initiated the administrative process for this expansion, but never completed it. The new, proposed boundary would encompass a total of 998 acres, and including the original 304 acres.

Within 5 years of CCP approval, we will complete all administrative procedures necessary for NPS to consider expanding the existing NNL boundary and convene a workshop with ecologists to determine what additional information should be collected and what monitoring should occur to document any potential loss or degradation of the area. We will also establish a baseline from which to

conduct monitoring and the collection of subsequent information. Implementing this program supports refuge goal 1 relating to the conservation of open water and wetlands habitats.

Cultural Resource Protection

As a Federal land management agency, the Service is entrusted with the responsibility to locate and protect all historic resources, specifically archeological sites and historic structures eligible for, or listed in, the National Register of Historic Places. This applies not only to refuge lands, but also on lands affected by refuge activities, and includes any museum properties. As described in chapter 3, archeological remains in the form of prehistoric camps or villages would most likely be located along streams and lakes where early inhabitants would have ample water, shelter, and good fishing and hunting opportunities. Under all alternatives, we would continue to conduct an evaluation on the potential to impact archeological and historical resources as required, before taking any ground disturbing action, and would consult with respective Tribal and State Historic Preservation Officers (THPOs and SHPOs). We would be especially thorough in areas along lakes, the confluence of streams, river corridors, and other areas where there is a higher probability of locating a site. These activities would ensure we comply with section 106 of the NHPA, regardless of the alternative. Compliance may require any or all of the following: a State Historic Preservation Records survey, literature survey, or field survey. Protecting cultural resources would support refuge goals 1, 2, and 4.

Endangered Species Act Section 7 Consultations

Under all alternatives, all projects would continue to comply with the ESA. Approved consultation processes would continue to be followed for projects potentially affecting listed species or designated critical habitat on a site-specific basis as project implementation occurs. Protecting federally listed species supports goals 1 and 4.

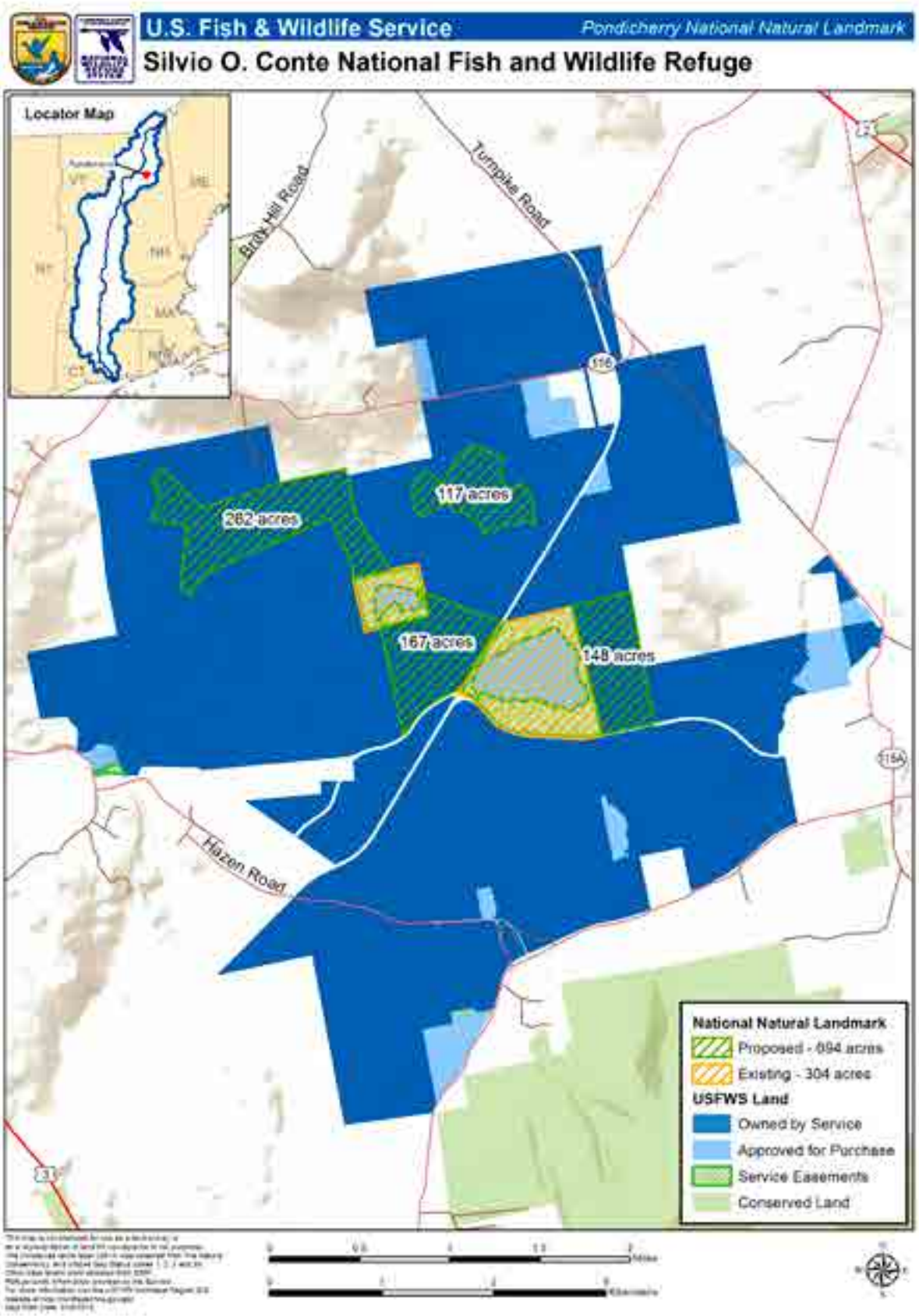
Wilderness Review

As we described in chapter 2, Refuge System planning policy requires that we conduct a wilderness review during the CCP process. The first step is to inventory all refuge lands and waters in Service fee ownership. Our inventory of this refuge determined that two areas at the Nulhegan Basin Division meet the eligibility criteria for a Wilderness Study Area (WSA) as defined by the Wilderness Act. Out of the wilderness study, four alternatives were developed for the two study areas. Under the Service's preferred alternative, neither of the WSAs would be proposed for new wilderness designation. Because the forest habitat has been heavily managed, it was concluded that a combination of active and passive management would be the best path to restore multi-aged forests, comprised of native species growing on appropriate natural community sites. In the absence of active management, restoration of desired natural community composition and structure would be unacceptably protracted. The results of the wilderness inventory and study are included in appendix E. The entire refuge would undergo another wilderness review as part of the next CCP planning process. Specifically, any lands acquired in fee by the Service in the interim, along with existing refuge lands, would become part of that wilderness review.

Wild and Scenic Rivers Review

Service planning policy also requires that we conduct a wild and scenic rivers review during the CCP process to determine their potential for Federal Wild and Scenic Rivers designation. We inventoried the river and river segments which occur within CPAs and determined that some river segments met the criteria for wild and scenic river eligibility. These river segments and their immediate environments were determined to be free-flowing and possess at least one Outstandingly Remarkable Value. However, we are not pursuing further study to determine their suitability, or making a recommendation on these river segments at this time, because we believe the entire river lengths should be studied (not just those on refuge lands) with full participation and involvement of our Federal, state, local, and nongovernmental partners and other stakeholders. The results of our Wild and Scenic River inventory are included in appendix F.

Map 4.2. Pondicherry National Natural Landmark, Including the Current and Proposed Expanded Boundary



In appendix F, we recognize our information may not be complete or current. Some of the river segments in the watershed are currently being evaluated by other entities for their potential to be designated. We learned of several studies underway or where there is interest in initiating a planning process; however, we do not provide status updates in this document because we simply did not have the resources to check out every potential project. However, for those planning efforts or studies underway in any of the CPAs, we request lead agencies or organizations to contact us so that we may partner in those efforts.

Sharon Lindsay

Black Branch of the Nulhegan River

All alternatives would provide protection for free-flowing river values, and other river values, pending the completion of future comprehensive inter-jurisdictional eligibility studies.

Distributing Refuge Revenue Sharing Payments

As we describe in chapter 3, we pay the associated localities annual refuge revenue sharing payments based on the acreage and the appraised value of refuge lands within their jurisdiction. These annual payments are calculated by a formula determined by, and with funds appropriated by, Congress. All of the alternatives would continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands, or new appropriation levels dictated by Congress. Additional towns would be added to the program with future acquisitions. Implementing the refuge revenue sharing payment program helps achieve goal 4.

Silvio O. Conte Refuge Advisory Council

All alternatives include our recommendation to officially disband the Silvio O. Conte NFWR Advisory Committee. The Conte Refuge Act (Section 108) called for the creation of this Advisory Committee to assist the Secretary on community outreach and education programs that further the purposes of the refuge. The Committee, which has never been fully constituted, was to be comprised of members from each of the four States, with members representing the refuge's municipal, state agency, and private conservation organization partners. Efforts were made to establish and maintain this formal, multi-agency, 15-member committee but, ultimately, these Secretarial and Gubernatorial appointments proved unsuccessful due to the short-term limits and the length of time it took to designate an appointee. Since the creation of Conte Refuge in 1991, we have accomplished the intent of the Advisory Committee through other means. The refuge's strong commitment to community outreach and environmental education has been, and would continue to be advanced through partnerships with the organizations that comprise the Friends of Conte Refuge, the Connecticut River Watershed Council, environmental educators in the four watershed states, and the operations of the refuge's visitor facilities.

Actions Common to Alternatives B, C, and D Only

The three action alternatives differ from alternative A in four important ways which we describe below.

(1) **Enhancing public access for compatible recreational uses on refuge lands.** The three action alternatives would allow permanent public recreational access across a proposed expanded Federal land base for priority public uses and other compatible recreational uses to the extent possible and consistent with refuge goals and objectives. The level of infrastructure to provide these opportunities differs among the alternatives, but they have in common the premise that refuge lands should be open to compatible public uses. The proposed refuge expansion also varies among the alternatives.

(2) **Implementing Strategic Habitat Conservation.** The three action alternatives incorporate the concept of SHC which is a planning framework that includes steps for planning, design, delivery, and monitoring (Figure 2.2). Each step integrates the best available ecological, biological, and climate science — from the Service's geographically based LCCs, partner research, university programs, and other sources — in an ongoing and iterative cycle of planning, implementation, and evaluation (*https://lccnetwork.org/*; accessed August 2016).

LCCs are applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales–beyond the reach or resources of any one organization. Their second function is to promote collaboration among their members in defining shared conservation goals.

Conte Refuge lies within the NALCC which pioneered the application of the concept of selecting surrogate species (or referred to in North Atlantic LCC publications as "representative species") for general habitat types. A representative species is a species whose habitat needs, ecosystem function, or management responses are similar to a group of other species. It is assumed that conservation planning, design, and actions for a representative species will also address the needs of other species and effectively sustain fish and wildlife populations at desired levels in the face of land use change, climate change, and other stressors occurring within the NALCC. The NALCC facilitated completion of the *Connect the Connecticut* Landscape Conservation Design (LCD) in the watershed which informed development of this CCP.

This LCD project is a collaborative effort among 30 partners, including the Service, to develop and implement a strategic plan for the watershed that will sustain habitat for fish, wildlife, and plants within a working landscape, while also reliably providing clean water, storm protection, recreation and many other natural benefits that support people and communities. It is intended to guide collective conservation actions within the watershed and connect to broader regional conservation goals for conserving sustainable fish and wildlife populations and their habitat for people within a working landscape. Science-based tools were developed that will serve to facilitate a conservation design for other geographies in the entire Northeast Region (*http://connecttheconnecticut.org/*; accessed October 2016).

Under alternatives B, C, and D, we would use the design and products that have been generated by the *Connect the Connecticut* LCD and any additional relevant resources of the NALCC and our partners in developing step-down plans.

Using the proposed CPA and CFA land conservation design to prioritize resource commitments. All three action alternatives would fully support and benefit from the land protection programs of other Federal and State agencies, and other partners. Alternatives C and D also seek to increase the

refuge's current approved acquisition authority. All three alternatives would concentrate Service partnership activities within CPAs and Service land acquisition activities primarily in CFAs. Under our summary of alternative B, we provide more detailed definitions of CPAs and CFAs. The delineation of CPAs and CFAs incorporates priority areas for conservation, namely core areas and connectors, recommended in the *Connect the Connecticut* LCD.

While the number of CFAs differ among the alternatives, and the size of individual CFAs may vary among alternatives, the process and criteria used to define them was similar. They were identified by refuge staff, State partners, and conservation organizations as important for conserving Federal trust resources, NALCC and State WAP priority species, addressing climate and other land use changes, and contributing strategic connections among the network of permanent conserved lands in the watershed.

Under each of the three action alternatives, the Service would consider land exchanges with State agencies and conservation organizations of some of the smaller, disjunct refuge parcels or units that were acquired under the 1995 FEIS authority. Such exchanges would be considered on a case-by-case basis, based on whether the exchange creates efficiencies in refuge management and cost, and the protection of resources could be ensured with the new owner. Also, all lands exchanged to the Service would have to be of equal or greater monetary and resource value than that which the Service is exchanging.

The remainder of this chapter describes objectives we have developed at the watershed scale that are common to alternatives B, C, and D. These watershed-level objectives indicate a desired future condition, and/or course of action, that we are recommending as we work cooperatively and collectively with our partners within CPAs to achieve conservation goals. In other words, at the watershed scale, we are presenting one set of goals and objectives to implement regardless of the action alternative, to achieve the four broad conservation, environmental education, recreation, and partnership goals we described in chapter 1. We provide a rationale for each objective to show why we think each one is important. It is also important to highlight that our implementation focus for these objectives would be within CPAs, across multiple ownerships, and only in partnership with willing landowners and our conservation partners.

The primary distinction among action alternatives B, C, and D is the management direction (e.g., primarily strategies) we propose to implement on existing and proposed refuge lands, including within proposed CFAs. Table 4.8 at the end of the chapter, presents many of the differences among the alternatives in the form of strategies that would apply to existing and proposed refuge lands. The listing of strategies and associated actions by alternative in table 4.8 assumes each respective alternative's full implementation, including the staffing, funding, and infrastructure needed to support those strategies and actions.

In addition, final CCP/EIS appendix A provides more specific details on implementing alternative C, the Service-preferred alternative. In appendix A, we present subobjectives, strategies, and a rationale for managing each refuge division, unit, or proposed CFA (which would ultimately become a refuge division). We indicate how the subobjectives and strategies presented in appendix A tier to the watershed-wide goals and objectives below, but we also provide further details on specific actions we would undertake to implement the subobjectives and strategies on existing and proposed refuge lands. None of the information in appendix A is intended to direct or prioritize management on other ownerships.

Watershed-wide Objectives

WILDLIFE AND HABITAT CONSERVATION

GOAL 1

Wildlife and Habitat Conservation. Promote the biological diversity, integrity, and resiliency of terrestrial and aquatic ecosystems within the Connecticut River watershed in an amount and distribution that sustains ecological function and supports healthy populations of native fish, wildlife, and plants, especially Federal trust species of conservation concern, in anticipation of the effects of climate, land use, and demographic changes.

Objective 1.1 Forested Uplands and Wetlands (Including Riparian and Floodplain Forests)

In cooperation with willing landowners and other partners, protect, manage, and restore forested habitats within the Connecticut River watershed. These forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate and land use changes and support forest-dependent species of conservation concern, including migratory birds and federally listed endangered and threatened species.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate the protection, management, and restoration of forested uplands and wetlands throughout the watershed, with priority attention to CPAs, include the following:

- **Core Forest Blocks**: Work with partners and willing landowners within the watershed to facilitate the protection and restoration of unfragmented, contiguous blocks of forest to benefit native interior forest wildlife and to sustain natural ecological processes and functions. To protect area-sensitive forest-interior species, these forest blocks should be a minimum of 500 acres in size and within a mile of other large forest blocks.

Rationale: Scientists consider habitat fragmentation to be one of the great threats to wildlife survival worldwide. We define habitat fragmentation as a process during which "a large expanse of habitat is transformed into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original (Wilcove et al. 1986)." This transformation has the ability to:

- Reduce the amount of habitat.
- Increase the number of disparate habitat patches.
- Decrease the size of intact habitat patches.
- Increase the isolation of these patches.

We differentiate habitat fragmentation from habitat loss, such as that which results from converting forest land to agricultural and urban uses. Habitat loss (or permanent fragmentation) refers to long-term conversion of forest to urban, residential, agricultural (e.g., forest production, row crops, pasture, hay, etc.), or other non-forest uses. Roads, trails, and utility corridors can also create permanent fragmentation. This permanent loss of contiguous forest habitat alters ecological processes and has a negative impact on biodiversity.

One ecological principle, the species-area relationship, has led to an emphasis on contiguous habitat conditions (MacArthur and Wilson 1963). Large forest blocks support more species than small areas because they support larger population sizes of individual species, which reduces the chances of stochastic extinction, promotes genetic diversity within populations, and buffers populations against disturbances. And, forest edges need to be minimized because the effects of habitat alteration extend for some distance beyond the areas directly altered. For instance, studies have documented edge-related habitat changes including: increases in invasive species introductions (Lake and Leishman 2004),

altered predator-prey dynamics (Brittingham and Temple 1983, Wilcove et al. 1986, Donovan et al. 1997), and declines in forest biodiversity (Fahrig 2003). The dispersal of plants and wildlife species can be affected if species or their propagules (e.g., seed and spores) cannot cross a disturbed area, find suitable habitat within it, or successfully compete with disturbance adapted species. The simple way to maintain a population of a particular species is to guarantee the existence of a sufficient area of suitable habitat that can be kept free of alien competitors, predators, and diseases. In practice, the design of such habitat areas must take into account the ecological requirements of the species and the minimum size of a population that can sustain itself in the face of environmental variation. As habitat becomes more and more the focus of conservation efforts, it becomes especially important to identify habitats that are most critical to maintaining species diversity as a whole and to determine the area of habitat required to maintain minimum viable populations of most species.

Recent literature indicates that a complex relationship exists between the relative importance of overall forest habitat acreage versus forest habitat patch size and the ultimate response of individual wildlife species (Lee et al. 2002). In general, the greater the amount of habitat within the landscape mosaic, the better. Empirical studies that have examined the independent effects of habitat loss versus habitat fragmentation suggest that habitat loss has a much larger effect than habitat fragmentation on the distribution and abundance of birds (Fahrig 2003). This is supported by other studies that found forest size and edge effects did not significantly affect either nesting success or the productivity of neotropical songbirds (e.g., Friesen et al. 1999). A further consideration is that landscape-scale effects may be different in largely forested environments in the northern part of the Connecticut River watershed compared to largely fragmented environments in the southern portion of the watershed. It is possible that in large forested areas birds respond primarily to local habitat effects (Lichstein et al. 2002) whereas in fragmented landscapes, landscape-scale forest cover may be critical (Trzcinski et al. 1999).

Generally, the nesting success of forest interior-nesting songbirds has declined as forest habitat loss has increased (Wiens 1989, Askins 2002). Focusing our protection efforts on creating large blocks of forest (more likely in the southern portion of watershed), or protecting existing blocks (more likely in the northern portion of watershed) will help to ameliorate the detrimental impacts of forest habitat loss and fragmentation. Forest blocks of a thousand acres or more increase the likelihood of providing habitat for the greatest number of area-sensitive species (Robbins et al. 1989) by providing a diversity of microhabitat conditions. Robbins et al. (1989) investigated the impact of shrinking forest habitat on forest interior species in the Mid-Atlantic States and showed a marked decline in the density and diversity of species in forest blocks smaller than 240 acres. Highly area-sensitive species were rare or did not occur in forest blocks this small.

Landscape-scale impacts from changes in habitat loss and changes in spatial patterns can result and impact species use and distribution. For example, studies of migratory birds indicate that cerulean warbler, yellow-throated vireo, and hermit thrush require a minimum area of 800 to 2,000 acres (Askins 2002). Other examples include the fact that wood thrush demonstrate higher area sensitivity to smaller patch sizes in the northern portion of their range than further south (Rosenberg et al. 2003), and the minimum area requirements for the scarlet tanager may depend on the amount of remaining forest and in the landscape (Rosenberg et al. 2001).

How core forest blocks are organized on the landscape and how they are managed has important consequences for ecological processes as well. We

USFWS
Cardinal flower

envision a pattern of conserved lands across the watershed that includes both "wildlands reserves" and forests that are sustainably managed to improve wildlife habitat (see Foster et al. 2010). Any landscape-scale conservation within the Connecticut River watershed involves an element of cultural influence. Although the landscape was largely forested prior to European settlement, it was highly dynamic in response to changing climatic conditions, natural disturbance processes, and American Indian activities. European settlement in the 17th and 18th centuries initiated a dramatic transformation, as much of the land in the watershed was deforested and farmed and the remainder was logged, grazed or burned. Despite the natural appearance of many portions of the modern landscape, a legacy of intensive past use remains in vegetation structure and composition, landscape patterns, and ongoing dynamics.

The appropriate size of a forest block needed to protect ecological processes is difficult to know, and is dependent upon the ecological process under consideration. TNC and others (TNC 2004; Foster et al. 2010) advocate for forest blocks between 5,000 and a million acres in New England. It's thought that conserving and restoring forests of this size in a matrix of other land uses may:

- Temper the impacts of climate change by supporting complex, aging forests that can store twice as much carbon as young forests.
- Provide rare habitats for a diverse array of plants, animals, and micro-organisms nested within larger, more robust core areas.
- Safeguard lands of natural, cultural, and spiritual significance.
- Serve as unique scientific reference points for evaluation and improvement of management practices elsewhere.

Further, TNC has recommended that large forest blocks be protected to (1) promote resilient forest ecosystems that can absorb, buffer, and better recover from the full range of natural disturbances; and (2) support enough breeding territories for interior forest species to conserve their genetic diversity over generations (TNC 2004). Combining both of those considerations, and evaluating each ecoregion's forested extent, ecology, and natural disturbance history, they conclude that a core forest block in the Lower New England ecoregion (including Connecticut, Massachusetts, and southern New Hampshire) be 15,000 acres minimum in size. In the Northern Appalachian ecoregion (including Vermont and northern New Hampshire), they recommend a core forest block be 25,000 acre minimum in size (TNC 2004).

As we delineated CFAs, we considered these general parameters in the context of the existing network of conserved lands and the Service's population and habitat objectives.

- **Forest Corridors:** Work with partners and willing landowners to facilitate the protection and restoration of travel and dispersal corridors for plants and wildlife. Special consideration will be given to protecting areas that span elevation, latitudinal, and longitudinal gradients. Forest corridors should be at least 300 meters (approximately 1,000 feet) in width to facilitate species movement, or designed to provide the habitat requirements for a target species. Special consideration should be given to forest corridors that connect forest blocks of at least 500 acres to provide movement opportunities to a suite of species, including those with large home ranges, and interior forest specialists. We will work with our partners to promote these general characteristics within the CPAs, emphasizing connections between the network of conserved lands.

Rationale: Conservation biologists generally agree that landscape connectivity enhances population viability for many species and that until recently, most species lived in well-connected landscapes (Noss 1987, Hunter Jr. 1990). Among the most popular strategies for maintaining populations of both plants and animals in fragmented landscapes is to connect current isolated patches with strips of habitat called corridors. We define corridor as a linear habitat, embedded in a dissimilar habitat type matrix, that connects two or more larger blocks of habitat and that is proposed for conservation on the grounds that it will enhance or maintain the viability of specific wildlife populations in the habitat blocks. Further, our definition of corridor also implicitly includes those linear habitats–such as riparian areas (Naiman et al. 1993) in agricultural landscapes–that support breeding populations of many species but do not connect larger habitat patches.

Increasing urbanization within the Connecticut River watershed continues to sever connections between habitat blocks. This habitat fragmentation can lead to an overall reduction in species populations and potentially local extirpation of a plant or animal species (Noss 1987, Fahrig and Merriam 1994, Tewksbury et al. 2002, Fahrig 2003). Species affected by habitat fragmentation become increasingly vulnerable to natural disasters (Pickett and White 1986) and predation (Brittingham and Temple 1983). They are also more susceptible to inbreeding (Young et al. 1996), increasing the prevalence of genetic defects.

Perhaps the best argument for corridors is that the original landscape was interconnected. Corridors are an attempt to maintain or restore some of the natural landscape connectivity (Noss 1987). Habitat corridors provide numerous benefits for plants and animals and can play a critical role for endangered species. The protection, and where necessary, the restoration of habitat connectivity through corridors has been shown to increase the exchange of individuals between habitat patches, promoting genetic exchange and reducing population fluctuations. Corridors provide food and shelter for a variety of wildlife and help with juvenile dispersal and seasonal migrations. The establishment of additional habitat corridors can also benefit people, with underpasses or overpasses for wildlife helping to reduce vehicle collisions with large animals.

Corridor management needs to consider the habitat requirements of the target species, landscape structure and subsequent species response (i.e., movement ability, movement patterns, reaction to boundaries). The utility of these corridors will vary among species; therefore, it is important to determine the function of the corridor (i.e., breeding habitat, dispersal) before management efforts occur. The guideline above is specific for corridors that are to provide species movement opportunities between similar habitats, and act as buffers along riparian and wetland habitats. The distribution of species and the different habitat values within the corridor makes it difficult to determine the precise width. Spackman et al. (1995) suggests a minimum corridor width of 30 to 50 meters (100 to 160 feet) to provide the habitat needs for at least 90 percent of streamside plants, and 75 to 175 meters (245 to 575 feet) for breeding bird species. The suggested terrestrial buffer for amphibians and reptiles ranged from 150 to 290 meters (490 to 950 feet) and 127 to 289 meters (415 to 950 feet), respectively (Semlitsch et al. 2002). Based on these studies, a minimum corridor width of 300 meters (985 feet) for species movement is suggested. This minimum guideline is not species specific, nor does it consider the landscape context. A width greater than 300 meters may be necessary, for example, if human disturbances adjacent to corridors are impacting species use.

Maintaining corridors of forested habitat between larger areas of core habitat can create a network of connected conserved lands across the landscape. In the face of environmental stressors such as climate change and other land uses changes, these networks of core and corridor habitats can help connect not

only areas of similar habitats, but also a diversity of habitats across a range of elevations, latitudes, aspects, soil types, and landform types. These connections will facilitate species movement as they migrate and otherwise adapt in response to these stressors.

- **Diversity of Forest Age, Structure, and Composition:** Work with partners and willing landowners to promote a sustainable range of forest age, structure, and composition that benefits resources of conservation concern and encourages a diverse assemblage of native plants and organisms within the landscape. Within a CPA, between 10 to 15 percent of forested habitats should provide the structural attributes common to early successional forests (e.g., dense shrub and herbaceous ground cover layer, soft mast, and low exposed perches) and a minimum of 15 percent of forested habitats should provide the structural attributes common to late successional forests (e.g., vertically differentiated canopies, higher densities of large snags and downed logs, and small gaps). Early successional forest habitat should be strategically located, recognizing the importance of interior forest habitat, and providing the full suite of habitat characteristics for resources of conservation concern. Ideally, targeted successional stages will be well-distributed across respective eco-regions and ownerships within the Connecticut River watershed and in areas where site conditions favor a prolonged stage of early successional forest.

Rationale: Many forests seem ancient from the time-scale of human lifespans, but they are not ageless, immutable features of the landscape. Their age is limited by the amount of time that has elapsed since a significant disturbance — hurricanes, fire, logging, agricultural clearing, landslide, ice storm, etc. — last set back the clock of ecological succession. Forest succession is paced by changes in the relative abundance and stature of a handful of conspicuous, dominant plants, but along with these species, thousands of plants and animals come and go too —their populations waxing and waning — as succession proceeds. Because of all these changes, managing forests — whether for biodiversity or for particular focal species—requires managing the patterns of succession that determine the age structure and species composition of the landscape.

Managing forest landscapes for diversity involves managing patterns of succession for two reasons: (1) some successional stages have more species than others; and (2) each stage has a different, although not usually unique, set of species. Forest management is done principally by controlling stand structure (the ages, sizes, and density of trees within a stand) and forest structure (the sizes and spatial arrangement of stands within a forest). Stand and forest structure appears to be generally more important than tree species composition in providing for habitat, although particular species are sometimes important for certain food requirements. Silvicultural treatments (forest management) can be applied most directly to creating particular stand structures for habitat purposes, just as it is done to meet other objectives. The principles of designing forest structure can partly be drawn from traditional concepts of forest management for sustaining timber production, but additional ideas also apply. In situations where individual animals range over very large areas or when the maintenance of a sustainable population of a species requires a large area (even in cases where individuals have limited ranges) the spatial scale of wildlife management differs from that of timber management. To achieve the goals of providing habitat for populations with large land requirements, the management of individual stands within a CPA will be developed considering the larger regional landscape context. This presents one of the more challenging aspects of forest land management requiring economic, social, and political innovations to coordinate efforts and anticipate actions and long-term trends within the region. Under almost all circumstances, desirable patterns of landscape diversity represent long-term

goals toward which foresters and biologists can work, but they are not patterns that can be created in a few years or even a few decades.

An idealized diversity of successional stages across the landscape of a CPA will take the form of approximately 10 to 15 percent of the acreage in an early successional condition; a minimum of 15 percent in a late successional condition; and the balance falling somewhere along a continuum between these two extremes. The role of the refuge in meeting these targets will depend upon successional diversity of the landscape at time of acquisition.

Late Succession — There is no generally accepted, or universally applicable, definition of late succession. A simple, more or less idealistic, definition would be a "climax forest that has never been disturbed by humans." This becomes unrealistic when considering the long history of landuse in New England. Native peoples regularly set the woods on fire (Day 1953; Cronon 1983; Cogbill 2000); land was cleared for agriculture (Raup 1966; Whitney 1996); and intensive logging removed lumber and pulpwood (Whitney 1996). Ecologists have defined the natural disturbance regimes common to the forests of the watershed–the disturbances that would have created a successional mosaic more free from human disturbances. We can use these studies to develop silvicultural analogs that emulate these forest disturbances and move forest succession toward later successional stages (Franklind et al. 2002; Lorimer and White 2003; Keeton 2006).

Small gap openings in the forest were the most common natural disturbance, which led naturally to a forest structure dominated by late-successional, multi-aged stands (Seymour et al. 2002). The structure and composition of late-successional forest ecosystems have been detailed by ecologists (Franklin et al. 1981, 2007, Goodburn and Lorimer 1998, Keeton 2006, D'Amato et al. 2009, Curzon and Keeton 2010). Four major structural attributes of late-successional forests are: living large-diameter trees, standing dead trees (snags), fallen trees or logs on the forest floor, and logs in streams. Additional important elements typically include multiple canopy layers, smaller understory trees, canopy gaps, and patchy understory development. Ecological processes include those natural changes that are essential for the development and maintenance of late-successional forest ecosystems. Although the processes that created the current late-successional ecosystems are not completely understood, they include: (1) tree growth and maturation, (2) death and decay of large trees, (3) low to moderate intensity disturbances (e.g., wind, insects, diseases, and ice) that create canopy openings or gaps in the various strata of vegetation, (4) establishment of trees beneath the maturing overstory either in gaps or under the canopy, and (5) closing of canopy gaps by lateral canopy growth or growth of understory trees.

Mike Sweet/USFWS

Wood duck

Many species are dependent on large living trees, large dead trees, or fallen logs, features that are common to late-successional forests but not younger or financially mature forests. These species tend to be small, non-charismatic

species, such as mosses, lichens, fungi, and insects (Hagan and Whitman 2004). Few of the charismatic species (e.g., birds and mammals) appear to be as tightly dependent on large old trees, though some do require large trees. On the White Mountain National Forest, Kursic et al. (1996) found that bat activity within the forest was highest in over-mature hardwood stands (greater than 119 years old), and suggest maintaining areas of older forest as roosting sites. Northern myotis, for example, tend to use tall, wide-diameter, partially-dead trees for roosting, and forest openings for feeding (Caceres et al. 1997). These habitat features are often associated with late successional forests. Bald eagles and osprey require tall, super canopy trees near foraging areas for nesting and roosting. Hollow trees and fallen logs are important den sites for certain mammals, and snags would be used by cavity nesting birds like wood ducks and black-backed woodpeckers. Once old forest elements such as large trees or logs are lost from a stand (e.g., as a result of a clearcut or a selection cut), it can take centuries for the species to return to that location. A species first has to wait for these structural features to redevelop, and then the species must colonize them.

Early succession — Forest disturbances were once viewed as an insult to the "balance of nature" and synonymous with habitat destruction (Marsh 1864). Certain forms of disturbance, however, are now held by ecologists and conservation biologists to play a fundamental role in maintaining the natural heterogeneity in environmental conditions that organisms experience. Early successional forest habitats have become critically uncommon in parts of the eastern United States, especially in the Northeast (Askins 2001; Brawn et al. 2001; Brooks 2003; DeGraaf and Yamasaki 2003), largely in response to forest maturation and land-use development. European settlement resulted in widespread clearing of forests for agriculture, timber, and fuelwood (Whitney 1996). Since that time, the amount and distribution of early-successional habitats has generally declined, especially in southern New England where the amount of early successional forest area has declined 31 percent since the 1950s (Brooks 2003).

The forests in the Connecticut River watershed were historically subject to several sources of disturbance. In much of the region, early-successional habitats were continuously produced in pre-settlement times by fire, wind, beaver, flooding, and Native American agriculture and burning. Many fire-prone areas were settled by Europeans and are now largely developed. Beaver, once extirpated but now increasing, cannot modify the landscape to the extent they did in pre-settlement times. Many drainages are confined or channelized now and beaver generally are not tolerated where key woods roads, suburban development, or agriculture occur. Wind still creates small openings in softwood stands, but mid-successional hardwoods, now predominant across much of southern New England, are fairly resistant to wind, even hurricanes (Foster 1988). The net result is that natural disturbances are much reduced compared to pre-settlement times and cannot be relied upon to produce early-successional habitats where and when they are needed. Most early-successional dependent species are not generalist species; rather, they are specialists in vegetation structure or area requirements.

Analysis of bird survey data in the early 1990s identified population declines of numerous species dependent on early-successional habitats (Vickery 1991, Askins 1998). North American Breeding Bird Survey data indicates that 48 percent of shrubland and 100 percent of grassland birds have declined significantly since 1966 in the northeast (Dettmers 2003). Other research has suggested that populations of other species, such as New England

cottontail are either declining or would generally benefit from additional early-successional habitat. These include various game birds (DeGraaf and Yamasaki 2003), mammals (Scanlon 1992, Litvaitis 2003), reptiles (Scanlon 1992), and rare plants (Latham 2003).

The Connecticut River watershed is now dominated by human uses, and maintaining early and late successional habitats throughout in proportion to presettlement levels is not possible. However, a mix of successional and developmental stages across forested landscapes of the watershed represents potential habitat for a host of important species. Sustainable forestry practices across managed landscapes can contribute to the maintenance of biological diversity and ecosystem functioning (Lindenmayer and Franklin 2002). The challenge lies in:

- Determining the mix of management approaches necessary to achieve sustainability objectives.
- Anticipating trends due to economic and social changes.
- Coordinating responses with other landowners in the conserved land networks.

The approach identified throughout our CCP focuses on the architecture of individual forest stands and their spatial arrangement, with consideration given to the aggregate representation of multiple structural (or habitat) conditions at landscape scales. This is partly in response to a call from researchers for an approach where management creates currently under-represented structures and age classes on some portion of the landscape (Franklin et al. 2002, DeGraaf and Yamasaki 2003, Keeton 2004). In the Connecticut River watershed, this would include managing for late and early successional structures, which are geographically underrepresented relative to pre-European settlement conditions (Whitney 1996, Cogbill 2000, Lorimer 2001, Lorimer and White 2003). The proportion of early-successional habitat in northern industrial forests is currently several times that which occurred in presettlement times (Lorimer and White 2003) and in the southern portion of the watershed, mature forests are a disproportionate fraction of the landscape. Strategic partnerships between public and private landowners and managers to create a landscape that accounts for the characteristic successional and developmental stages—with forest stands ranging from small to large—will facilitate the conservation of biodiversity within the watershed. Utilizing silvicultural systems that more closely emulate natural disturbance and stand development processes will aid in sustaining ecological complexity and biodiversity (Seymour and Hunter Jr. 2000, Ontario Ministry of Natural Resources 2001, Franklin et al. 2007).

- **Forest Wetland Integrity:** Work with partners and willing landowners to maintain the important hydrologic functions and wildlife values of forested wetlands by protecting and restoring natural hydrological regimes and vegetative edges and buffers. These vegetated buffers are a critical component of wetland complexes. The buffer or edge habitat is important to wildlife, as well as wetland water quality. The protection of these wetland and waterway edges may include protection and restoration of floodplain forests, and replacement or installation of culverts or bridges. In particular, work with partners to protect existing floodplain forests identified and mapped by TNC (Marks 2011).

Rationale: Forested wetlands are common within the Connecticut River watershed where moisture is abundant, particularly along rivers and in the mountains. They are best defined as "an area where water is at, near or above

the land surface long enough to be capable of supporting aquatic or hydrophytic (water-loving) vegetation, and which has soils indicative of wet conditions" (Cowardin et al. 1979). Their vegetation community generally consists of an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer. Description of hydrologic characteristics becomes more complicated and requires detailed knowledge of the duration and timing of surface water inundation, both yearly and long-term, as well as an understanding of groundwater fluctuations; forested wetlands generally fall into two categories based on water regimes: tidal and non-tidal. The watershed's wetlands include marshes, bogs, floodplain forests, wet meadows, and low prairies.

Habitat destruction has been recognized as a universal threat to biodiversity (Soule 1991). Studies continue to reveal that humans have been significantly altering the landscape since prehistoric times (Cronon 1983, Whitney 1996), and in New England, that effect has dramatically reduced wetland coverage. Wetlands have been drained on a widespread basis on inland as well as coastal sites, and changes in local hydrology have left us with distinctly different habitats and vegetation cover than have occurred historically (Tiner Jr. 1984). Increased population densities and suburban sprawl have often converted these drained wetland areas of natural land to urban, industrial, and agricultural use.

Threats beyond simple wetland destruction are prevalent as well. For instance, poor water quality due to low oxygen conditions or the presence of toxic substances may explain why fish and wildlife communities are impaired when other aspects of suitable habitat appear to be present. Some researchers believe that declines in amphibian populations in apparently pristine habitats may be due to factors such as viruses, acid rain, concentrations of nitrates, or increased exposure to ultraviolet B light (UVB). Wetland plant communities are being detrimentally impacted as well through the introduction of nonnative, invasive plants and insects (Orwig et al. 2003), which can displace native plants reducing biodiversity (Silliman and Bertness 2004).

In the Connecticut River watershed, patterns of glacial deposition strongly influence wetland occurrence and function. Many wetlands are associated with permeable soils and owe their existence to groundwater discharge. Whether developed on soils of high or low permeability, wetlands are often associated with streams and appear to play an important role in controlling and modifying streamflow (O'Brien 1988), minimizing harm to downstream areas. Due to dense vegetation and location within the landscape, wetlands are important for retaining stormwater from rain and melting snow entering rivers and lakes. Wetlands that overlie permeable soils have the capacity to store and filter pollutants ranging from pesticides to animals wastes. The flow characteristics of wetland waters allow particles of toxins and nutrients to settle out of the water column. Larger wetlands and those surrounded by dense vegetation are most effective at protecting water quality.

Where these complex hydrological regimes have been altered by man, recurrent negative effects on migratory and resident wildlife have been realized (Tiner Jr. 1984). A high proportion of the Connecticut River watershed's fish and wildlife species inhabit wetlands during part of their life cycle. Forested wetlands provide breeding habitat for species of conservation concern such as Canada warbler, northern parula, wood duck, and American black duck. Forested wetlands adjacent to the Connecticut River mainstem are important for migrating landbirds (Smith College 2006), and during high water events, migrating waterfowl. Wetlands also provide lifelong habitat for some frogs and turtles, as well as essential habitat for smaller aquatic organisms in the food web, including crustaceans, mollusks, insects, and plankton. Degradation of forested wetlands

and riparian areas can also have impacts on water quality and increase the risk of flooding downstream.

- **Climate Change Adaptation:** Work with partners, willing landowners, and other stakeholders to identify the best forested uplands and wetlands to manage for conservation and natural diversity. Identify corridor and stopover locations that will help connect these lands. Use climate change vulnerability assessments, climate models, and ecological models to prioritize and strategically implement forest management that promotes resistance and resilience, or facilitates transition as species' ranges shift over time. Develop and implement adaptation strategies that allow us to achieve our more specific goals within the watershed (e.g., protecting movement corridors, managing forests to support forest-dependent species, restore forested habitats). Participate in and use outputs from the landscape conservation design modeling effort being led by the North Atlantic LCC. Work with partners to identify likely changes in climate variables over 50 years, the likely impacts of projected climate changes on the abiotic and biotic components of the watershed's existing forested uplands and wetlands, and the habitat suitability for these ecosystems into the future. Monitor changes to forested uplands and wetlands over time and measure the effectiveness of climate change adaptation measures, using an adaptive management strategy to evaluate decisions when necessary.

***Rationale**:* Climate change is increasing the vulnerability of many forests to ecosystem changes and tree mortality through fire, insect infestations, drought, and disease outbreaks (Glick et al. 2011). Changing climatic conditions may affect the establishment and growth of forest species currently present on the Conte Refuge, leading to a shift over time in forest community structure and composition, which could lead to cascading effects on wildlife and overall ecosystem function. The ability of refuge managers to adapt to future climate change will be enhanced by their capacity to alter management regimes relatively rapidly in the face of changing conditions. The lack of fine-scale information about the possible effects of climate changes on locally managed forests limits the ability of managers to weigh these risks to their forests against the economic risks of implementing forest management practices such as adaptation and/or mitigation treatments. This knowledge gap will impede the implementation of effective management on public or private forestland in the face of climate change (Joyce et al. 2014).

Climate change vulnerability assessments provide two essential contributions to adaptation planning. Specifically, they help in identifying which species or systems are likely to be most strongly affected by projected changes, and in understanding why these resources are likely to be vulnerable, including the interaction between climate shifts and existing stressors. Computer models and biological research are used to assess sensitivity, exposure, and adaptive capacity: the three components of a vulnerability assessment. Models are computer-based programs that may be used to simulate a wide variety of ecological processes, and can incorporate the effects of stochastic or fixed stressors. Those models, in conjunction with vulnerability assessments, can then be used to develop strategies for building resistance to climate-related stressors, enhancing resilience in order to improve the capacity of species and systems to persist during changes, and anticipating and facilitating ecological transitions that reflect the changing environmental conditions (Glick et al. 2011).

Modeling can also occur outside the vulnerability assessment framework. In an effort supported by the USFWS and the North Atlantic LCC, a landscape change, assessment, and design model that assess eocsystems and their capacity to sustain fish, wildlife, and plant populations in the northeastern U.S. in the

Putney Mountain wetland

Rachel Cliche

face of urban growth, climate change, and other stressors is being developed by a coalition of partners representing the federal government, states, and nongovernmental organizations. A landscape conservation design for the Connecticut River watershed has been completed that used this model to develop tools and information the Conte Refuge will use to build resistance, enhance resilience, and facilitate transitions among the natural systems in and around Refuge-managed lands (Schwenk and Mallek 2016).

Monitoring of how species and natural systems are reacting to climate impacts and adaptation actions will be a critical part of reducing uncertainty and increasing the effectiveness of management responses (NFWPCAP 2012). We will work with partners to monitor species range shifts, phenological shifts (e.g., changes in flowering time and lengths of growing seasons), changes in precipitation and related effects of surface and groundwater, invasive species, increased wildfire and storm events frequency and intensity, and sea level rise.

Also see the discussion on “Forest Corridors” above.

Objective 1.2 Non-forested Uplands and Wetlands (Freshwater Wetlands, Pasture, Hay and Grasslands)

In cooperation with willing landowners and other partners, protect, manage, and restore non-forested wetlands and uplands within the Connecticut River watershed. These non-forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species’ ranges from climate and land use changes, and support dependent species of conservation concern-including migratory birds and federally listed endangered and threatened species.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate the protection, management, and restoration of non-forested uplands and wetlands throughout the watershed, with priority attention to CPAs, include the following:

- **Wetlands Integrity:** Work with partners and willing landowners to facilitate the protection and management of wet meadows, shrub swamps, peatlands and emergent marsh, to ensure the health and persistence of these communities. Prioritize the restoration and maintenance of site specific wetland buffers that provide habitat functions for wetland-associated fauna, and filter nutrients and contaminants. We will use the following criteria to prioritize efforts:

  * Emphasize rehabilitation of wetlands in headwater areas for groundwater discharge and recharge and floodplains for flood attenuation.

  * Focus on the control of invasive plant and animal species, and the restoration of native species.

Rationale: Wetlands include a wide range of plant communities that have adapted to being inundated by or saturated with water for varying periods during the growing season. Non-forested wetlands within the Connecticut River watershed include shrub swamps, wet meadows, peatlands, and emergent marsh, and make up only 1.4 percent of the watershed.

Wetlands, overall, are influenced from natural disturbances and succession. However, beavers play an important role in the disturbance regime and maintenance of non-forested wetlands, especially in mostly forested landscapes where natural openings are uncommon. Beavers are associated with riparian areas, where their dam building activities alter the hydrology and flood low lying areas creating a mosaic of wetlands. These wetlands provide a diversity of vegetation types, are rich with invertebrates, and are valuable for waterfowl, landbirds, amphibians and reptiles (Gauthier and Aubry, 1996, Chandler et al. 2009, Thompson et al. 2000). Regardless whether the habitat has been modified by beaver activity or by some other natural disturbance, non-forested wetlands in the watershed are essential to a variety of species, and provide critical habitat to wildlife throughout various life stages.

As is the case with many of the habitats in the watershed, development is a threat to the integrity of these wetland types. Commercial and residential development adjacent to wetlands introduces pollutants which decrease water quality. Roads and man-made ditches fragment wetlands and alter the hydrology. Nonnative invasive species are a common occurrence near developed areas, and when introduced to wetland habitats compete with native species.

Amercian woodcock

Carlos Guindon/USFWS

Wetlands in the Connecticut River watershed are valuable from an ecological and economic view point. Non-forested wetlands contribute to the diversity within the landscape, and provide critical habitat for a variety of wildlife species, some of which are species of conservation concern. American woodcock, for example, is declining across its range, and is dependent on shrub swamps for daytime cover and feeding (Kelley et al. 2008, Sepik et al. 1994). American black duck rely on the abundance of invertebrates and wetland vegetation to feed their young, and dense wetland vegetation to conceal nesting sites (Longcore et al. 2000, DeGraaf et al. 2001). Wetlands adjacent to the Connecticut River mainstem provide significant stop-over and wintering habitat for a diversity waterfowl species, and feeding areas for migratory shorebirds.

Wetlands adjacent to rivers and streams protect inland areas from flooding by reducing water velocities and peak flows immediately downstream. Wetland vegetation stabilizes shorelines and reduces the risk of erosion. This prevents the loss of property, reduces sediment delivery to water bodies, and helps maintain stream channels. Wetlands also play a significant role in water-quality improvement, by filtering nutrients and contaminants (EPA 2001, Thompson et al. 2000). The protection and management of these wetland communities in the watershed is essential to maintain habitat and wildlife diversity, and local property values.

- **Grasslands, Old Fields, Shrublands, Pasture and Hayfields:** Work with partners and willing landowners to facilitate the protection of open habitats such as grasslands, old fields, shrublands, pasture and hayfields, and to ensure restoration and the long-term management of these important habitats to complement the surrounding landscape. Priority for protection and/ or restoration should be given to open habitats that have high development pressures, are within an active floodplain, or can provide critical habitat for Federal or State listed species, or other species of conservation concern. Continuing support for pasture and hayfield management over the short-term may be warranted to facilitate long-term goals for sustaining grasslands, old field, and shrublands. However, if working pasture and hayfields are incorporated into the refuge, they will be evaluated on a case-by-case basis to evaluate management actions that would support long-term habitat objectives.

Rationale: In the section above titled "Actions Common to All Alternatives," we emphasize that we support the continuation of working agricultural lands and agricultural land protection programs because of their significance to communities in the watershed. However, there may be circumstances when a farmer is selling their farmland and another agricultural landowner is not available. Their only choice may be to either sell to a developer or a conservation landowner. We promote the latter choice if the lands have important conservation values.

Grasslands, old fields, shrublands, pasture, and hayfields are our descriptions of agricultural fields that are no longer in commercial production, but may be currently, or recently, managed to maintain open conditions through grazing, mowing, brushing, or burning. Disturbance adapted plant communities are often present, and typically include forbs, grasses, shrubs, and small trees.

These open habitats are prime areas for commercial or residential development. As development pressure increases in the watershed, many of these areas will be replaced by urban sprawl, impacting the integrity of the watershed's ecosystems. Many agricultural fields within the watershed, for example, are located in floodplains, and development of these areas would not only impact adjacent and downstream riparian habitat and remaining agricultural lands, but also upland habitats through fragmentation and flooding. Development within these areas

would introduce pollutants to rivers and streams, increase the number of invasive nonnative species and urban predators, and interrupt ecological functions, such as a floodplain's ability to effectively retain high water levels during a flooding event.

Conservation and restoration of open habitats, especially those located in a floodplain, will not only increase ecological integrity and protect human property, but will also provide habitat for wildlife including species of conservation concern. Blue-winged warbler, American woodcock, and New England cottontail, for example, are declining species that require shrub dominated habitats, and contiguous tracts of grassland habitat would benefit declining grassland dependent birds. The watershed is a major migration corridor. Migrating landbirds concentrate in habitats along the Connecticut River mainstem (Smith College 2006), and protection or restoration of these open habitats would provide important stop-over habitat.

A landscape scale approach is needed to determine the appropriate management objectives for these open habitats. Consistency with adjacent land management and habitat types will provide a more contiguous, resilient, and functional landscape. The management focus should be on restoration of natural communities and providing habitat for species of conservation concern.

- **Climate Change Adaptation:** Work with partners, willing landowners, and other stakeholders to identify the best non-forested uplands and wetlands to manage for conservation and natural diversity. Identify corridor and stopover locations that will help connect these lands. Use climate change vulnerability assessments, climate models, and ecological models to prioritize and strategically implement wetland, agricultural, and grassland management that promotes resistance and resilience, or facilitates transitions as species' ranges shift over time. Develop and implement adaptation strategies that allow us to achieve our more specific goals within the watershed (e.g., protecting movement corridors, managing freshwater wetlands, agricultural areas, and grasslands to support dependent species, restore wetland and grassland habitats). Participate in and use outputs from the landscape conservation design modeling effort being led by the North Atlantic LCC. Work with partners to identify likely changes in climate variables over 50 years, the likely impacts of projected climate changes on the abiotic and biotic components of the watershed's existing non-forested uplands and wetlands, and the habitat suitability for these ecosystems into the future. Monitor changes to non-forested uplands and wetlands over time and measure the effectiveness of climate change adaptation measures, using an adaptive management strategy to evaluate decisions when necessary.

***Rationale**:* Climate change is increasing the vulnerability of many freshwater wetlands, grasslands, and agricultural lands to ecosystem changes and disturbances like invasive species, shifting precipitation regimes, and extreme weather events. Changing climatic conditions may affect the establishment and growth of species currently present on the non-forested uplands and wetlands of the Conte Refuge, leading to a shift over time in community structure and composition, which could lead to cascading effects on wildlife and overall ecosystem function. The ability of refuge managers to adapt to future climate change will be enhanced by their capacity to alter management regimes relatively rapidly in the face of changing conditions. The lack of fine-scale information about the possible effects of climate changes on locally managed non-forested lands limits the ability of managers to weigh these risks against the economic risks of implementing wetland, grassland, or agricultural land management practices such as adaptation and/or mitigation treatments. This knowledge gap will impede the implementation of effective management on public or private land in the face of climate change (Joyce et al. 2014).

Please see Rationale for guideline "Climate Change Adaptation" under Objective 1.1.

Objective 1.3 Inland Aquatic Habitats (Freshwater Rivers, Streams, Ponds and Lakes)

In cooperation with willing landowners and other partners, protect and restore in-stream and riparian habitat structure and function, and restore aquatic species passage and water quality within the Connecticut River watershed to improve the ecological integrity and environmental health of the river ecosystem and enhance habitat for migratory and inter-jurisdictional fish, mussels, and other native aquatic species of conservation concern.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate the protection, management, and restoration of inland aquatic habitats throughout the watershed, with priority attention to CPAs, include the following:

- **Habitat Assessments:** Work with partners, State natural resource agencies, and willing landowners to facilitate the development and use of effective and efficient tools to evaluate aquatic habitat conditions and water quality across the watershed in an effort to improve the ecological integrity and environmental health of the river ecosystem. Assessment may include physical, chemical, or biological attributes and results will direct the planning and prioritizing of management and restoration activities.

***Rationale**:* Aquatic habitats include streams, rivers, lakes, and ponds. Lakes and ponds are bodies of standing or slow moving water often located in hollows formed by past glacier, tectonic activities, and by humans. Water levels are influenced by rainwater, groundwater, or most often by streams and rivers. Lakes and ponds provide habitat for a diversity of organisms that perform different ecological functions. Plankton, for example, are microscopic organisms that are food for larger aquatic vertebrates, such as fish and amphibians. Waterfowl rely on lakes and ponds as staging areas during migration, and feeding areas for broods during the breeding season. Mammals, such as bats, rely on these habitats as a source of drinking water. Several federally listed invertebrates also rely on these habitats: the federally threatened Puritan tiger beetle and the federally endangered dwarfwedge mussel.

Streams and rivers are bodies of flowing water confined to a stream channel (consisting of a stream bed and banks) that start from a headwater (i.e., lakes, spring, snowmelt) and move to its mouth (i.e., another body of water). Stream ecosystems extend well beyond the channel, taking in the entire stream corridor. The stream corridor is comprised of the stream channel, streambanks, the hyporheic zone (i.e., region beneath and alongside a stream bed, where there is mixing of shallow groundwater and surface water), and the surrounding riparian and floodplain area. Stream corridors are extremely productive in terms of fish and wildlife resources. The stream ecosystem encompasses, connects, and integrates both aquatic and terrestrial habitat. Healthy stream corridors and floodplains provide tremendous (and sometimes the only) habitat for fish and wildlife. Stream corridors offer all the elements for aquatic life: food, water, shelter, and habitat connectivity (travel lanes). Stream corridors with intact floodplains are subject to flooding and drought but are resilient and quick to recover when the forces of flows and sediment transport are at equilibrium. Equilibrium is maintained by allowing streams access to their floodplains, retaining native vegetation, and retaining the appropriate stream dimension, pattern, and profile (Saldi-Caromile et al. 2004).

On average there are seven dams interrupting every 100 miles of river in the Northeast. Industrial, agricultural, urban and suburban development over the years has resulted in mankind moving, straightening and confining streams and rivers in an effort to force the flows to move in a pattern deemed more desirable to humans. Mankind has destabilized untold miles of river and stream due to our

collective lack of understanding that a river must have access to its floodplain to avoid catastrophic flood damage and must move in a specific pattern, width and depth to maintain stable banks and transport water, sediment load, and woody material. Past practices to accommodate land development included re-aligning streams, straightening streams, diking streams (cutting off the river's access to its floodplain), channelizing streams, removal of riparian vegetation (which exposes banks to erosion), creation of fish passage barriers (dams, culverts, pollution, temperature, exposure), narrowing streams and armoring (e.g., riprap, concrete), water diversions, construction in floodplains, construction of impervious surfaces (thus accelerating and intensifying runoff), and eliminating large woody material in channels (Saldi-Caromile et al. 2004, Martin et al. 2011).

We now have a new understanding of how streams and floodplains operate and appreciation of the costs of past practices and benefits of more sustainable approaches. We no longer think of streams as pipes moving water but instead as complicated systems responding to geology, physics, hydrology, hydraulics, and ecology. We now recognize relationships between valley and stream slope, stream shape, stream sediment transport capacity, flow regimes, floodplain function, and stream stability and we can predict how streams will respond to disturbances and restoration efforts.

Stable stream channels with access to their floodplains are resilient to flooding and drought and provide habitat and refuge during a variety of climate conditions. Structural complexity within a stream and floodplain creates an array of microhabitats that provide for the needs of an assortment of species through their various life stages. Structural complexity in the stream consists of riffle and pools, variation in the stream bottom and banks, and large woody material. Structural complexity in the floodplain consists of a variety of plant species at a variety of heights and ages and a complex riparian zone that consists of downed and regenerating trees. The complex channel/floodplain structures generate hydraulic complexity (i.e., varying flow velocity, depth, direction and turbulence) throughout a range of flow conditions. This is critical to meeting the diverse needs of aquatic organisms through all life stages (Saldi-Caromile et al. 2004). Stream corridors provide habitat for priority Federal trust species such as inter-jurisdictional fish, migratory birds, threatened and endangered species, and species of concern.

- **Population Assessments:** Work with the Connecticut River Atlantic Salmon Commission (CRASC), other Service programs, partners, State agencies, and willing landowners to conduct short and long-term inventory and monitoring programs for migratory and inter-jurisdictional fish, rare invertebrates, and other native aquatic species of conservation concern in an effort to restore and maintain healthy populations within each species' historic range. Continue support for aquatic species programs, recovery plans, and other initiatives (e.g., stocking programs, the Connecticut River Diadromous Fish Restoration Program, and the Eastern Brook Trout Joint Venture) (See also goal 4).

Rationale: The goal of the Service is to achieve fisheries populations within the watershed that contain desired representative age classes, size classes, sex ratios, and repeat spawners all in adequate abundance to be resilient and self-sustaining. Short and long-term monitoring programs are designed to provide critical information that will inform management options. For example, assessments may be designed to: detect changes in population size, distribution or range, age structure, health and disease status, virgin vs. repeat spawners, individual growth, fish condition, spawning success or juvenile production, genetic variability, sources of mortality (e.g., impingement and entrainment at power stations), and stocking considerations. Some of these data or metrics are required annually for States to be in compliance with the Atlantic States

Marine Fisheries Commission's Fishery Management Plans (e.g., American shad, blueback herring), or fisheries may be closed by Federal law.

Within the watershed, native fish species and other aquatic organisms (including invertebrates such as dwarf wedgemussel, Puritan tiger beetle, and cobblestone tiger beetle) face numerable challenges to survival and reproduction. To flourish, aquatic species must have access to healthy ecosystems and be able to move throughout the river network. Currently, individuals must overcome a variety of challenges: fish passage barriers (e.g., dams, culverts, stream degradation), competition with nonnative species, water quality and quantity, inappropriate commercial and recreational take, stream corridor habitat degradation, disease, hydropower dams and turbines, impingement and entrainment on water diversions.

Diadromous fishes are of particular importance in the watershed. Many migratory fish species are considered Federal trust species and are the focus of large coordinated restoration efforts through the CRASC. These species are often considered keystone species from which we can deduce the health of many associated species based on the presence and health of these migratory species. Diadromous fish species cannot survive unless they migrate. Critical life stages are dependent upon different habitat types (e.g., freshwater and marine environments) and the fish must be able to migrate long distances to and from these habitat types. Due to this critical migratory behavior, the Service and its partners must monitor populations to evaluate the effectiveness and sustainability of fishways at barriers (i.e., are fishways moving adults and juvenile fish upstream and downstream safely?) and assess the impacts of other variables, natural or man-induced, that affect fish health and movement. The fish response to changing environmental conditions can be interpreted through a combination of activities such as fishway counts, tagging and telemetry, studies on rates of movement, studies on short-term and long-term effects related to barriers or fishways. Some of these data or metrics are required annually for states, as outlined in the Atlantic States Marine Fisheries Commission's Fishery Management Plans (e.g., American shad, blueback herring), or fisheries may be closed by Federal law.

- **Stream and Floodplain Functions:** Work with partners, State natural resource agencies, and willing landowners to maintain and restore in-stream, riparian, and floodplain habitats, sustain hydrological connectivity (e.g., restoration of floodplain forest, stream connectivity, or improve aquatic species passage), and improve stream structural features (e.g., increase woody material or restoration of streamside buffers) and water quality (e.g., reduce nutrient run-off) in an effort to improve ecological integrity, environmental health, and aquatic species habitat.

Rationale: As mentioned above in the habitat assessment guideline under Objective 1.3, stable stream channels with connectivity to their floodplains are resilient to flooding and drought and provide habitat for wildlife during a variety of climate conditions. Many aquatic resource managers understand the significance of restoration and maintenance of these connected systems, but are hindered with limited staff and funding. This challenge requires a strategic approach to ensure that conservation investments and efforts provide the most benefit to the resource. Many conservation groups are working in partnership to pull together resources and expertise to accomplish common aquatic ecological goals. TNC, for instance, formed a Northeast Connectivity Workgroup to strategically assess barriers to fish passage in the Connecticut River watershed, and the Eastern Brook Trout Joint Venture is a unique partnership working toward brook trout conservation. The support of such initiatives is essential, especially in the face of climate change and increasing developmental pressures on the Connecticut River aquatic ecosystems.

- **Hydrological Modeling:** Work with partners to support the development of hydrologic models within the Connecticut River watershed. Specifically, models that advance our understanding of existing impacts (e.g., dams and roads) and projected future impacts (e.g., climate and land use change) would serve as valuable planning and prioritization tools. Further, models that characterize the impact of dam operations on water flow regimes within the watershed, and the resulting impacts on fish and other aquatic species populations, riparian vegetation, floodplain vegetation, and river meadows could inform a recommended seasonal and annual flooding regime.

Rationale: Models are computer based programs that simulate processes under various stressors. Hydrological models, for example, simulate the hydrological process, and its response to environmental and human induced stressors (i.e., storm surges, dams). Modeling is used as a tool to better understand complex problems, and provide guidance to decision makers. Hydrological models for the Connecticut River watershed are being developed as part of a Northeast Climate Science Center-led project, also co-funded by The Nature Conservancy and the US Army Corps of Engineers. These models will be used by multiple conservation agencies as a tool to assist with strategic habitat conservation efforts. Existing data will be entered into these models to assess current hydrological ecosystem functions and predict how these ecosystems may respond to landscape changes. The study has resulted in a full calibrated hydrology model of the Connecticut River Basin, a set of 112 different future hydrology scenarios associated with climate change, and a simulation and optimization model of the major reservoirs in the basin.

- **Climate Change Adaptation:** Work with partners, willing landowners, and other stakeholders to identify the best instream and riparian habitat to manage for conservation and natural diversity. Identify corridor and stopover locations that will help connect riparian habitats. Identify key aquatic passage locations that will help restore or maintain aquatic connectivity within the waterhsed. Use climate change vulnerability assessments, climate models, and ecological models to prioritize and strategically implement aquatic and riparian habitat management that promotes resistance and resilience, or facilitates transitions as species' ranges shift over time. Develop and implement adaptation strategies that allow us to achieve our more specific goals within the watershed (e.g., protecting movement corridors, improving aquatic connectivity, managing and restoring aquatic ecosystems and riparian habitats to support dependent species). Participate in and use outputs from the landscape conservation design modeling effort being led by the North Atlantic LCC. Work with partners to identify likely changes in climate variables over 50 years, the likely impacts of projected climate changes on the abiotic and biotic components of the watershed's aquatic and riparian ecosystems, and the habitat suitability for these ecosystems into the future. Monitor changes to these systems over time and measure the effectiveness of climate change adaptation measures, using an adaptive management strategy to evaluate decisions when necessary.

Rationale*:* Climate change is increasing the vulnerability of many aquatic and riparian ecosystems to ecosystem changes and disturbances like invasive species, shifting precipitation regimes, and extreme weather events. Changing climatic conditions are raising water temperatures and changing stream flows, affecting productivity and decomposition, and disrupting food web relationships. Water temperature affects the physiology, behavior, distribution, and survival of freshwater organisms, and even slight changes can have an impact . Water temperature increases will allow the geographic area suitable for warm-water aquatic species to expand. The number of streams with temperatures suitable for warm-water fish and other freshwater organisms is projected to increase. This would likely mean a concomitant decline of coldwater fisheries habitat. These

Salt marsh

©Chuck Fullmer

changes will help some species and hurt others (NFWPCAP 2014). Precipitation changes in the Northeast are expected to occur as higher precipitation and runoff in the winter and spring, which can have a variety of effects. It may create wider floodplains, alter habitat, increase connectivity, displace riparian and bottom-dwelling species, or further distribute invasive species. As the climate warms, altered precipitation patterns may manifest as heavy storms that punctuate extended periods of hot, dry weather, yielding floods. Heavy storms will also cause increased run-off with associated erosion, sedimentation, and pollution (Hayhoe et al. 2008, NFWPCAP 2014).

The ability of refuge managers to adapt to future climate change will be enhanced by their capacity to alter management regimes relatively rapidly in the face of changing conditions. The lack of fine-scale information about the possible effects of climate changes on locally managed non-forested lands limits the ability of managers to weigh these risks against the economic risks of implementing wetland, grassland, or agricultural land management practices such as adaptation and/or mitigation treatments. This knowledge gap will impede the implementation of effective management on public or private land in the face of climate change (Joyce et al. 2014).

Please see Rationale for guideline "Climate Change Adaptation" under Objective 1.1.

Objective 1.4 Coastal Non-forested Uplands (Coastal Beaches and Rocky Shores)

In cooperation with willing landowners and other partners, protect, manage, and restore coastal non-forested uplands within the Connecticut River watershed. These non-forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river estuary ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate change and land use changes, and support coastal upland-dependent species of conservation concern including migratory birds and Federally listed endangered and threatened species.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate the protection, management, and

restoration of coastal non-forested uplands throughout the watershed, with priority attention to CPAs, include the following:

- **Habitat Restoration:** Work with partners and willing landowners to support the Long Island Sound Study (LISS) Habitat Restoration Initiative (HRI) goals and objectives to (1) restore the ecological functions of degraded and lost habitats; (2) restore at least 2,000 acres of coastal habitats and 100 miles of riverine migratory corridor habitat; and (3) to allow for the landward migration of coastal wetlands, and (4) use partnerships to accomplish restoration objectives so as to leverage financial resources from multiple public sources.

Rationale: Long Island Sound is an estuary of the Atlantic Ocean located between Connecticut and Long Island, New York. Over eight million people live within the Sound's watershed, and several large cities are situated on its shoreline (Connecticut River Watershed Council 2012). Estuaries are known to be quite diverse ecosystems, and the Long Island Sound is no exception. It was designated by Congress as an Estuary of National Significance for providing habitat for thousands of species, as well as numerous opportunities for commercial and recreational activities (Long Island Sound Study 2012).

Unfortunately, this estuary has also been heavily impacted from past and current land uses. Increased development has introduced pollutants, including sewage, industrial toxins, pathogens, and man-made debris that has impacted the Sound's water quality. The Environmental Protection Agency and the states of New York and Connecticut recognized the need to focus on improving the overall health of the Sound's ecosystem. They formed a partnership in 1985 called the LISS that consists of Federal and state agencies, user groups, citizens and organizations interested in the restoration and protection of the Sound. The LISS wrote a Comprehensive Conservation and Management Plan (1994) that provides goals and management recommendations to restore the Sound. Since 1998, the LISS partners have focused on hypoxia (oxygen depletion), habitat restoration, public involvement and education, and water quality monitoring (Long Island Sound Study 2012).

The Connecticut River enters Long Island Sound near Lyme, Connecticut, and provides almost 70 percent of the freshwater to this estuary (Connecticut River Watershed Council 2012). The health of Long Island Sound is directly tied to the health of the Connecticut River. Restoration efforts of Long Island Sound should not only focus at the mouth of the Connecticut River, but within the entire Connecticut River watershed. The LISS partnership provides an opportunity to pull together resources and expertise to accomplish this goal.

- **Public Use Management:** Provide information to partners and willing landowners to support informed decisions about balancing human use of shorelines with the needs of nesting birds of conservation concern and sensitive dune habitats. Promote the use of signage and fencing, the planting of dense vegetation such as beach plum, and construction of permanent pathways over sensitive dunes to encourage access that minimizes habitat damage. In highly sensitive and/or dynamic areas, work with partners and landowners to eliminate dune access, and identify alternative access points.

Rationale: Coastal beaches and dunes are located at the mouth of the Connecticut River, where erosion, water movement, and wind current influence the creation of these habitat types. These coastal systems are not a prominent feature within Long Island Sound, however, due to the absence of significant wind and water activity, and the available source of erodible sand. Many of the beaches formed in Long Island Sound are from sand that is deposited in long strips parallel to the shoreline, and often extend across the mouth of rivers (Long Island Sound Study 2003). These coastal habitats are dynamic systems, and are often characterized by vegetation that withstands constant wind and wave

action, fluctuating temperatures, and salt spray. Species such as beach plum and American beach grass, have adapted to this harsh environment, but are sensitive to disturbances such as constant foot traffic. Beaches and dunes also provide critical habitat for a diversity of wildlife, including rare, endangered and threatened species. Piping plover, for example, is a federally listed species that nests on non-vegetated beaches in Long Island Sound, including at the mouth of the Connecticut River. These habitats are also important for providing protection to inland areas from coastal storms, dissipating effects from strong winds and tide surges.

Residential development of these areas has created a more static system by impeding the natural movement of sand. This affects species of native wildlife that depend on the more dynamic, natural coastal processes. Development also increases erosion as native beach vegetation is removed, or sometimes a portion of a dune is removed to improve the view for residents. Sensitive beach vegetation can be trampled from the creation of foot paths, or vehicle use. Recreational activities can also disturb wildlife species that are nesting or feeding in these habitats. The presence of nonnative species tends to increase with residential development and recreational activities. Nonnative plants are competing and replacing native beach vegetation and increased predation from domestic pets are impacting nesting wildlife species. Other threats include oil spills, and rising sea levels attributed to climate change.

Protecting and restoring this dynamic ecosystem is critical to maintaining the ecological and economic integrity of Long Island Sound. Coastal beaches and dunes provide vital habitat for rare, endangered and threatened species; many of which have adapted to and require this sometimes harsh and shifting environment. In addition, these coastal systems provide protection to inland habitats from coastal storms, and provide numerous recreational activities. An economic study, commissioned by the LISS, determined that beach recreation in Long Island Sound contributed millions of dollars to the local economy (Long Island Sound Study 2003). The value of these coastal habitats to provide reliable recreational opportunities and shoreline protection to local communities is contingent on the ecological strength and integrity of these ecosystems.

- **Climate Change Adaptation:** Work with partners, willing landowners, and other stakeholders to identify the best coastal non-forested uplands to manage for conservation and natural diversity. Identify corridor and stopover locations that will help connect these lands. Use climate change vulnerability assessments, climate models, and ecological models to prioritize and strategically implement management of coastal beaches and rocky shores that promotes resistance and resilience, or facilitates transition as species' ranges shift over time. Develop and implement adaptation strategies that allow us to achieve our more specific goals within the watershed (e.g., protecting movement corridors, managing beaches and rocky shores to support coastal upland-dependent species, sustain the river estuary ecosystem). Participate in and use outputs from the landscape conservation design modeling effort being led by the North Atlantic LCC, sea level rise models in development by USGS, and other research that can inform the development of adaptation strategies. Work with partners to identify likely changes in climate variables over 50 years, the likely impacts of projected climate changes on the abiotic and biotic components of the watershed's existing coastal non-forested uplands, and the habitat suitability for these ecosystems into the future. Monitor changes to coastal non-forested uplands over time and measure the effectiveness of climate change adaptation measures, using an adaptive management strategy to evaluate decisions when necessary.

***Rationale**:* Climate change is increasing the vulnerability of many non-forested coastal uplands to ecosystem changes. Sea level rise is a key driver of vulnerability because it causes coastal geomorphologic change. The immediate

effects of sea level rise are the submergence and increased inundation of coastal land and increased salinity in estuaries and coastal rivers. Additional physical effects include increased erosion, changes in geomorphology, and saltwater intrusion in groundwater and into tidal freshwater marsh systems. Sea level rise also will exacerbate flooding events ranging from spring tides to tropical or extratropical storms, and will cause inland penetration of storm surge into areas not accustomed to inundation. These areas will likely experience flooding more often. Increased coastal flooding and inundation may result in release of contaminants from coastal soils, sediments, and infrastructure and increased exposure of fish, wildlife, and plants to these pollutants. While sea level changes have occurred repeatedly in the geologic past, changes of similar magnitude have not occurred since construction of modern human infrastructure along coastal areas, and the accelerated pace of sea level rise in the 20th and 21st centuries raises questions about how coastal ecosystems will respond (NFWPCAP 2014).

Increased storm wind strength due to elevated sea surface temperatures could lead to increases in wave height and storm surge and would be magnified by a higher sea level. The primary impacts associated with more intense storm systems include increased flooding and erosion. More intense storms, coupled with common manmade ecosystem alterations such as shoreline stabilization measures that impede or eliminate long-shore transport could lead certain beaches (and their habitats) to fragment and disappear instead of migrating and rebuilding. Impacts to coastal and estuarine beaches would affect biota such as: microscopic invertebrates that are critical to the food web; horseshoe crabs that rely on beaches for egg deposition; and migratory shorebirds that feed on the eggs, such as the red knot. Shifts in the seasonal distribution of major storm events could also affect plants, wildlife, and fish. For example, an increase in the number or intensity of storms during the spring and early summer could substantially affect breeding success of coastal birds such as the piping plover. More infrequent but intense precipitation events can also lead to scouring of sediment and vegetation during peak flows, redistribution of sediment, resuspension of contaminated sediments, as well as increased pollutants from events such as combined sewer overflows (NFWPCAP 2014).

The ability of refuge managers to adapt to future climate change will be enhanced by their capacity to alter management regimes relatively rapidly in the face of changing conditions. The lack of fine-scale information about the possible effects of climate changes on locally managed coastal non-forested uplands limits the ability of managers to weigh these risks to their forests against the economic risks of implementing adaptation and/or mitigation treatments. This knowledge gap will impede the implementation of effective management on public or private beaches or rocky shores in the face of climate change (Joyce et al. 2014).

Please see Rationale for guideline “Climate Change Adaptation” under Objective 1.1.

Objective 1.5 Coastal Wetlands and Aquatic Habitats (Tidal Salt Marsh and Estuary)

In cooperation with willing landowners and other partners, protect, manage, and restore coastal wetlands and other coastal aquatic habitats within the Connecticut River watershed. These coastal aquatic habitats will sustain the biological diversity, ecological integrity, and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species’ ranges from climate and land use changes, and support coastal wetland-dependent species of conservation concern-including inter-jurisdictional fish, native aquatic species, waterfowl and wading birds and Federally listed endangered and threatened species.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate the protection, management, and restoration of coastal wetlands and aquatic habitats throughout the watershed, with priority attention to CPAs, include the following:

- **Habitat Restoration:** Work with partners and willing landowners to support the LISS HRI goals and objectives to (1) restore the ecological functions of degraded and lost habitats, (2) restore at least 2,000 acres of coastal habitats and 100 miles of riverine migratory corridor habitat, and (3) use partnerships to accomplish restoration objectives so as to leverage financial resources from multiple public sources. Work with partners to restore salt and brackish marshes by remediating drainage ditches; remove water control structures such as tide gates to restore natural tidal flows; and control invasive species populations like common reed (*Phragmites*) to improve species diversity and habitat function.

Rationale: Please see Rationale for guideline "Habitat Restoration" under Objective 1.4.

- **Population Assessments:** Work with partners, State natural resource agencies and willing landowners to conduct short and long-term monitoring programs for migratory and inter-jurisdictional fish, mussels, and other native aquatic species of conservation concern.

Rationale: Please see Rationale for guideline "Population Assessments" under Objective 1.3.

- **Climate Change Adaptation:** Work with partners, willing landowners and other stakeholders to identify the best coastal wetlands and aquatic habitats to manage for conservation and natural diversity. Identify corridor and stopover locations that will help connect these areas. Use climate change vulnerability assessments, climate models, and ecological models to prioritize and strategically implement management of tidal salt marshes and estuaries that promotes resistance and resilience, or facilitates transition as species' ranges shift over time. Develop and implement adaptation strategies that allow us to achieve our more specific goals within the watershed (e.g., protecting movement corridors, managing tidal salt marshes and estuaries to support coastal upland-dependent species, sustain habitat for waterfowl and wading birds).

  Work with partners to develop and use coastal system models in the watershed that would advance our understanding of existing impacts (e.g., stormwater and contaminants runoff) and projected future impacts (e.g., climate change, sea level rise, and marsh migration) and support local decisions on land use. For example, develop a model to characterize the role of storm water and other sources of contaminants runoff in degrading coastal habitats and help identify where best to locate sediment control structures to prevent further deposition, or use the Sea Level Affecting Marshes Model (SLAMM), a web browser-based application that visually shows the modeling of sea level rise predictions, and other analyses to predict where inland migration of tidal marsh and other tidally influenced habitats may occur. Implement habitat protection and management in accordance to the recommendations of such modelling. Participate in and use outputs from the landscape conservation design modeling effort being led by the North Atlantic LCC, sea level rise models in development by USGS, and other research that can inform the development of adaptation strategies.

  Work with partners to identify likely changes in climate variables over 50 years, the likely impacts of projected climate changes on the abiotic and biotic components of the watershed's existing coastal wetlands and aquatic habitats, and the habitat suitability for these ecosystems into the future. Monitor changes to coastal wetlands and aquatic habitats over time and measure the effectiveness of climate change adaptation measures, using an adaptive management strategy to evaluate decisions when necessary.

Rationale: Climate change is increasing the vulnerability of many coastal wetlands and aquatic habitats to ecosystem changes. Sea level rise is a key driver of vulnerability because it causes coastal geomorphologic change. The Connecticut River watershed is tidally influenced from Long Island Sound to Hartford, Connecticut. In general, the immediate effects of sea level rise are the submergence and increased inundation of coastal land and increased salinity in estuaries and coastal rivers. Additional physical effects include increased erosion, changes in geomorphology, and saltwater intrusion in groundwater and into tidal freshwater marsh systems. Sea level rise also will exacerbate flooding events ranging from spring tides to tropical or extratropical storms, and will cause inland penetration of storm surge into areas not accustomed to inundation. These areas will likely experience flooding more often. Increased coastal flooding and inundation may result in release of contaminants from coastal soils, sediments, and infrastructure and increased exposure of fish, wildlife, and plants to these pollutants.

While sea level changes have occurred repeatedly in the geologic past, changes of similar magnitude have not occurred since construction of modern human infrastructure along coastal areas, and the accelerated pace of sea level rise in the 20th and 21st centuries raises questions about how coastal ecosystems will respond. To preserve the current acreage of tidal wetlands, either wetlands need to keep pace with sea level rise or migrate inland to adjacent lands that are undeveloped. The success of wetland migration depends on the availability and slope of an upland corridor, the pace of the sea level rise, erosion rates, and the potential for wetland accretion. Because the Connecticut River is free-flowing from Long Island Sound to Holyoke, Massachusetts, there is an opportunity for the landward migration of tidally influenced coastal wetlands (e.g., salt, brackish, and freshwater wetlands) as sea levels rise.

Paul Erickson

Visitors to Mollie Beattie Bog, Nulhegan Basin Division

Other important factors that affect wetland response to sea level rise are salinity, sediment dynamics, nutrient input, and the habitats and species present. In populated coastal areas, wetland migration is often constrained by land development and shoreline stabilization measures. These conditions can result in the crowding of foraging and bank-nesting birds and the loss of crucial coastal habitat. In addition, the degradation and loss of tidal marshes affect estuarine habitat, production of commercially important fish and shellfish species, and flood attenuation, key ecosystem services for coastal communities. Sea level rise may also result in the inland movement of seawater, shifting the tidal influence zone of streams and rivers upstream and permanently inundating downstream riparian/coastal portions with brackish water. Salinity increases in formerly fresh or brackish surface waters and saltwater intrusion of shallow coastal groundwater aquifers will also result from sea level rise. This may threaten systems such as tidal freshwater forested wetlands that support a variety of wildlife species and critical drinking water sources (NFWPCAP 2014). Research is currently

underway by The Nature Conservancy[1] and the USGS[2] to evaluate how sea level rise is likely to affect this watershed. This and other decision support tools can assist refuge managers in making decisions on how to best address climate change impacts in their geographic area.

Changes in precipitation will primarily impact coastal systems through changes in quantity, timing, intensity, and quality of freshwater flow into estuarine systems. The quantity of freshwater will affect salinity gradients and nutrient inputs, while changes in peak flow timing could affect phenology and migration cues. Changes in the timing and amount of freshwater, nutrient, and sediment delivery will also impact estuarine productivity. For example, changes in flow regimes may affect the abundance and distribution of suspension feeders, such as mussels, clams, and oysters, which could in turn alter food web dynamics as well as water clarity. Increases in flow, turbidity, and eutrophication could also impact submerged aquatic vegetation due to reduced light penetration, as well as organisms that rely on this habitat for food and shelter. These impacts of precipitation changes in estuaries will likely be exacerbated by non-climate stressors such as freshwater demand and extraction, eutrophication, and hypoxia (NFWPCAP 2014).

Increased storm wind strength due to elevated sea surface temperatures could lead to increases in wave height and storm surge and would be magnified by a higher sea level. The primary impacts associated with more intense storm systems include increased flooding and erosion. More intense storms, coupled with common manmade ecosystem alterations such as shoreline stabilization measures that impede or eliminate long-shore transport could lead some salt marshes to fragment and disappear instead of migrating and rebuilding. Shifts in the seasonal distribution of major storm events could also affect plants, wildlife, and fish. More infrequent but intense precipitation events can also lead to scouring of sediment and vegetation during peak flows, redistribution of sediment, resuspension of contaminated sediments, as well as increased pollutants from events such as combined sewer overflows (NFWPCAP 2014).

The gradual temperature increase due to climate change is correlated with increasing nearshore water temperatures. While coastal salt marshes and forested wetlands could experience increased growth due to warmer temperatures, they could also cause expansion of invasive species and disease pathogens. In estuarine environments, increased water temperature will affect water column stratification and eutrophication; and could cause range shifts. Extreme changes may also stress organisms to the point of mortality. In addition, warmer temperatures will exacerbate low summer oxygen levels due to increased oxygen demand and decreased oxygen solubility (NFWPCAP 2014).

The ability of refuge managers to adapt to future climate change will be enhanced by their capacity to alter management regimes relatively rapidly in the face of changing conditions. The lack of fine-scale information about the possible effects of climate changes on locally managed coastal non-forested uplands limits the ability of managers to weigh these risks to their forests against the economic risks of implementing adaptation and/or mitigation treatments. This knowledge gap will impede the implementation of effective management on public or private beaches or rocky shores in the face of climate change (Joyce et al. 2014).

Please see Rationale for guideline “Climate Change Adaptation” under Objective 1.1.

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[1] See *www.coastalresilience.org* for project updates.

[2] See *http://woodshole.er.usgs.gov/project-pages/coastal_response/* for updates on the USGS project, Coastal Landscape Response to Sea-Level Rise Assessment for the Northeastern United States.

ENVIRONMENTAL EDUCATION, INTERPRETATION, AND OUTREACH

GOAL 2

Education, Interpretation, and Outreach. Inspire residents and visitors to actively participate in the conservation and stewardship of the exceptional natural and cultural resources in the Connecticut River watershed, and promote a greater understanding and appreciation of the role of the Silvio O. Conte National Fish and Wildlife Refuge in conserving those resources.

Objective 2.1 Environmental Education

In collaboration with public and private educators from all four States in the watershed, lead or facilitate the implementation of structured, high quality, natural and cultural resource curricula. The focus will be on guiding educators and students to: develop an awareness of, and concern about, natural and cultural resources and associated challenges; appreciate our conservation history; make informed decisions and work individually or collectively toward solutions; and model responsible environmental stewardship in their everyday lives.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate high quality environmental education programming throughout the watershed, with priority attention to activities within CPAs and urban areas, include the following (also see "Urban Initiative" discussion in the section "Common to All Alternatives" earlier in this chapter):

- **Environmental Education Planning and Training:** Work with all four watershed State fish and wildlife agency environmental education coordinators, non-profit organizations, and private educational organizations to facilitate and develop high quality, model environmental education curricula, as well as develop highly trained environmental educators to conduct environmental education. Curricula will:

  * Take into account student and teacher needs.

  * Incorporate each state's education standards, national learning standards, and next generation learning standards.

  * Incorporate nationally recognized education initiatives, when appropriate.

  * Be designed with specific goals and objectives.

  * Promote refuge missions.

  * Promote refuge and partner-conserved lands and facilities as environmental education resources.

  We will also work with our partners to improve coordination among educators through the following actions:

  * Host an annual meeting with the four States fish and wildlife agency environmental educators to share respective program priorities and look for opportunities to share resources.

  * Coordinate with existing State and national environmental education programs.

  * Seek ways to support each States outdoor education program and events.

  * Develop and implement high quality professional development for educators, to promote the training of refuge staff and volunteers in the knowledge, skills, and abilities of environmental education.

* Use our volunteers, including Friends members, to enhance environmental education opportunities.

* Identify and engage a diversity of audiences, with an emphasis on urban and non-traditional audiences, but not excluding others within the watershed.

Rationale: See rationale for entire objective below.

- **Environmental Education Delivery:** In collaboration with all four watershed states, other government agencies, non-profit organizations, private educational organizations, staff, volunteers, and members of Friends groups, offer high quality environmental education programs at existing refuge lands and facilities, at partner lands and facilities, and at schools within the watershed. The refuge will seek to:

  * Use the WoW Express and the BAT to deliver high quality, environmental education at schools and at environmental-based camps within the watershed.

  * Formally partner with local schools within the watershed and to conduct environmental education to these audiences multiple times per year.

  * Promote partner lands as outdoor classrooms, and to help deliver priority educational programs.

  * Facilitate the use of refuge and partner lands by educator-led classes, by teachers, and by students.

  * Implement an Adopt-a-Habitat initiative and a traveling mobile environmental education classroom to help individuals learn about and connect with their local environments.

  * Develop an evaluation system to measure the effectiveness of environmental education programs.

  * Continue cooperative relationship with the State of Massachusetts at the Great Falls Discovery Center in Turners Falls, Massachusetts (See appendix A for more detailed information on our proposed environmental education, interpretation, and outreach objectives and strategies at this facility).

Rationale: The Conte Refuge shares its jurisdictional boundaries of the 7.2 million acre Connecticut River watershed with over 2.3 million individuals from urban, suburban, and rural areas. These residents make up a diverse demographic with varying attitudes and interests. Environmental education is a key tool that the refuge can use to reach out to, to partner with, and to share important messages with these residents about wildlife conservation and watershed concerns, and to inspire them to become stewards of their communities; consequently, the Connecticut River watershed. Given ever changing environmental concerns, it will be important to work with partners to develop quality environmental education experiences and to offer different tools and experiences that meet the needs of, and engage various audiences. The importance of environmental education was recognized by the Refuge System when it was identified as one of the six priority public uses legislatively mandated in the 1997 Refuge Improvement Act and further detailed in Refuge System Policy (605 FWS 6). Further, environmental education was identified as an important strategy for the refuge when it was identified within one of the six legislative purposes guiding the establishment of the refuge (1995 FEIS).

The North American Association for Environmental Education states that "environmentally literate" persons know:

- Their daily choices affect the environment.
- How those choices can help or harm the environment.
- What they need to do—individually or as part of a community—to keep the environment healthy and sustain its resources, so that people can enjoy a good quality of life for themselves and their children (*https://naaee.org/about-us/about-ee-and-why-it-matters*; accessed August 2016.)

Through environmental education, interpretation, and outreach, we are striving to help individuals throughout the watershed become environmentally literate, to develop a sense of connection with the environment, and to build a sense of stewardship toward the environment. Our intent is not to direct environmental education priorities or be redundant with the high-quality educational programs offered by the States and non-governmental organizations; rather, we are striving to support those programs, and share new models, or recommend other improvements and efficiencies, as we discover them.

Objective 2.2 Interpretation

Develop, lead, and facilitate interpretive programs that emotionally and intellectually connect the audience to natural and cultural resources in the watershed.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and facilitate high quality natural and cultural resource interpretation, with priority attention to activities within CPAs and urban areas, include the following:

- **Natural and Cultural Resource Interpretive Planning and Training:** Collaborate with partners to develop high quality interpretive programming, facilities, and other media on and off refuge lands within the watershed that identify and relate natural history and refuge management strategies of the watershed's natural systems. The information will forge emotional and intellectual connections between the interests of the audiences and the habitats and wildlife that exist, and will instill stewardship values. The refuge will also work to develop relationships with constituent cultural groups such as Tribes and historical societies to create programming on cultural and historic resources on the refuge and in surrounding communities. The development of highly trained interpreters will be encouraged by offering interpretive training to permanent and temporary refuge employees, as well as Friends members, partners, and volunteers on a regular basis. A system of monitoring and evaluation will be developed to test interpretive tools for effectiveness.

***Rationale*:** See rationale for entire objective below.

- **Interpretive Program Delivery:** Collaborate with partners to deliver high quality interpretive experiences within the Connecticut River watershed. With partners the refuge will strive to:
  - Provide interpretive opportunities throughout the watershed, on and off refuge lands.
  - Establish partnerships at interpretive facilities (see goal 4 for existing partnerships).
  - Use the WoW Express to deliver interpretive programs throughout the watershed.

* Create interpretive messages to be included in region-wide media.
* Incorporate thematic messages into partners' interpretive programming and other interpretive media.
* Provide programming, signs, publications, and digital media when consistent with public use and management strategies.
* Train refuge staff, Friends, and other volunteers to initiate discussions with visitors and deliver interpretive messages and programs.
* Work with local commercial vendors to offer on-refuge interpretive programs. Vendors would operate under a special use permit and may be charged a fee.

Rationale: The National Association of Interpretation states that interpretation is a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource (*http://www.interpnet.com/nai/About/What_We_Believe/nai/_About/Mission_Vision_and_Core_Values.aspx?hkey=ef5896dc-53e4-4dbb-929e-96d45bdb1cc1*; accessed August 2016). Interpretation is a communication tool used by Federal and State agencies, non-governmental organizations, and the private sector to encourage the public to become better stewards of the environment. Well designed and well communicated interpretive messages have the opportunity to educate individuals, including the 2.3 million residents of the Connecticut River watershed about: watershed concerns; the habitats and wildlife that share the watershed; the refuge, and human connections to the watershed and the environment. Ideally, quality interpretive experiences will take into account the needs of the audience, have relevance to people's lives, and inspire individuals to take an active role in the stewardship of the Connecticut River watershed; and, consequently, the refuge.

The importance of interpretation was recognized by the Refuge System when it was identified as one of the six priority public uses in the 1997 Refuge Improvement Act. The importance of quality interpretation was further recognized by Refuge System Policy (605 FW 7) that addresses interpretation as a management tool with the following direction: "Well-designed interpretive programs can be effective resource management tools. For many visitors, taking part in an interpretive program may be their primary contact with a refuge, the Refuge System, and the Service. It is their chance to find out about refuge resource management objectives and could be their first contact with conservation and wildlife. Through these contacts, we have the opportunity to educate visitors about natural resources, refuges, the Refuge System, and the Service and to influence visitor behavior when visiting units of the Refuge System.

Objective 2.3 Public and Community Outreach

Support, promote, and coordinate a wide range of outreach tools and activities to facilitate and improve communications and relationships with the American public and to articulate the importance of local conserved lands, including the refuge, to the watershed. Target audiences include: community members, adjacent landowners, and elected officials in the Connecticut River watershed. Citizens will be empowered to recognize and resolve local natural resource issues and promote conservation and the responsible use of natural resources.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and conduct effective public and community outreach, with priority attention to activities within CPAs and urban areas, include the following:

- **Local Community Residents and Officials:** Through effective outreach to local community residents and officials, refuge staff will:

  * Work directly with respective Chambers of Commerce, Rotary Clubs, and other civic and non-profit organizations.

  * Keep landowners informed of land management activities on the refuge that may affect neighboring properties through personal contacts, direct mailings appearing on cable TV, writing articles for local newspapers and press releases.

  * Inform and educate community members on refuge regulations and management practices to prevent miscommunication and/or conflict between the refuge and its neighbors. Tools could include newsletters, media andpublic meetings.

  * Disseminate economic benefit information of the refuge to the local community.

  * Support and participate in community celebrations and events.

  * Develop and publicize locally focused events and programs held at the refuge.

  * Support outreach activities of all refuge Friends groups, community groups, and partners.

  * Develop and implement an outreach plan for communicating with landowners to inform and educate them on their role within the watershed and how they can contribute. Plan would include tools and strategies. Possible tools would include landowner workshops, behind the scene tours, special open houses, and publications oriented toward them specifically.

  * Write issue-driven outreach plans to keep elected officials informed of refuge and partner accomplishments and of issues within the watershed that have possible impacts to the refuge.

  * Pro-actively schedule consistent meetings with elected officials to share and update each other on constituent concerns and opportunities.

  * Develop messages and actions that frame refuge units as an asset to the local community. Example benefits that the refuge provides the community include: environmental education and interpretation programming, special events hosted for the community, employment for local youth through YCC, and mutual aid agreements..

  * Learn how to coordinate effectively with partners to spread the Conte message to their membership (e.g., Audubon, TNC, Trust for Public Land).

  * Develop at least 10 Conte Corners well-distributed in the watershed with at least two in each state.

  * Create special programming that will draw local residents and media (e.g., participating in community events and festivals).

  * Implement an Adopt-a-Habitat program to be used in part as an outreach tool for schools and community residents to learn about and become stewards of their local environment.

* Institute regular meetings with community leaders and citizens with the goal of making the refuge more relevant to host communities. These could take the form of an annual meeting in which we present our management plans for the coming year, open houses to welcome the public to see new exhibits or learn about new refuge initiatives, and listening sessions for us to receive community feedback about operations at each of the refuge's divisions.

***Rationale*:** See rationale for entire objective below.

- **National and State Elected Officials:** Through effective outreach to relevant elected officials, refuge staff will meet regularly with local political leaders and officials to inform them of management practices occurring in their districts. Meetings will highlight potential areas of interest, conflict, and other topics of mutual interest.

Rationale: See rationale for entire objective below.

- **Media:** Through effective outreach to media, refuge staff will:

  * Develop a media outreach plan with consistent refuge messages.

  * Communicate often with media outlet representatives to highlight important watershed and refuge specific issues, concerns and opportunities.

  * Develop relationships with media representatives by inviting and hosting reporters at refuge sites on a regular basis. This will assure that correct messages and information appear in media throughout the watershed.

Rationale: See rationale for entire objective below.

- **Greater Watershed Community:** Through effective outreach to the greater watershed community, in an effort to articulate the importance of conserved lands, including the refuge, to the watershed, refuge staff will:

  * Attract visitors on a regional, national and international scale by linking the refuge and the watershed to regional tourism, birding and recreational programs.

  * Encourage citizen participation in activities throughout the watershed.

  * Maintain a well-written and informative web site that provides current information on refuge programs and resources.

  * Create displays promoting the refuge for placement at major regional points of entry such as airports.

  * Use the refuge's mobile exhibits to participate at regional environmentally and recreationally themed shows, conferences and special events.

  * Offer the WoW Express exhibits and an interpreter to partners when feasible. Also, establish partnerships across the watershed to jointly deliver WoW Express interpretive programs.

  * In cooperation with partners, seek to interpret messages with the expansion of the Connecticut River Birding Trail to a Source-to-Sea birding trail.

  * Work with non-traditional venues (e.g., airports, shopping malls, etc.) to install interpretive media appropriate for general audiences.

M. Poole

Fishing education

Rationale: The refuge is unique with its jurisdictional boundaries encompassing the entire watershed. The more than 2.3 million residents of the Connecticut River watershed live in urban, suburban, and rural areas, and comprise a diverse demographic with varying attitudes and interests. When Congressman Silvio O. Conte proposed the creation of the Conte Refuge, he stated his desire was to "…restore and maintain a swimmable, boatable, and fishable Connecticut River for his children and his children's children." This dream is still a primary guiding factor for management at the refuge; yet, the full dream can only be realized through the cooperation and combined effort of watershed residents, Federal, State, and local agencies, non-profit organizations, and other community organizations. Strategic, quality outreach targeted at specific audiences is vital to communicate with individuals about watershed and refuge concerns, to work toward a shared vision for the watershed and to gain support for refuge activities.

Facilitate the collection and exchange of information that increases the knowledge and understanding of natural and cultural resources, addresses climate and land use changes and other conservation issues, and provides land managers with better information to make management decisions affecting resources.

Our proposed guidelines and strategies for working cooperatively with others to help meet the objective and support effective scientific and technical outreach, with priority attention to activities within CPAs, include the following:

- **Institutes of Higher Learning:** Collaborate with institutes of higher learning to share knowledge, resources, and research. The refuge will seek to:

  * Develop relationships with institutions of higher learning and other partners conducting relevant conservation research.

  * Keep current on knowledge and experience generated by managers throughout the refuge system, particularly from refuges that are managed primarily for the same trust species as are managed by the Conte Refuge.

  * Promote the SHC framework. Monitor on-the-ground impacts of management practices and amend those practices as necessary.

  * Develop and maintain strong relationships with regional institutions of higher education, and encourage use of refuge lands for environmental research. Take advantage of partners' scientific based resources and engage partner input in the preparation of SHC plans and other resource protection activities.

Rationale: See rationale for entire objective below.

- **Technology and Information Exchange:** Collaborate with technical experts within governmental agencies, conservation organizations, academia, and individuals to facilitate the sharing of knowledge, resources, and research. The refuge will seek to:

  * Host workshops and seminars at rotating strategic locations throughout the Northeast on an annual basis to bring together experts for information and technology transfer on important topics.

  * Participate in professional conferences within the watershed to present information and experience on adaptive management practices to counter the effects on wildlife and habitat of climate change and other environmental challenges.

* If demonstration areas are created on the refuge, ensure lessons learned are shared. Ensure that the refuge outreach materials convey the most current scientific and technical knowledge.

* Work with the NALCC to share scientific information and tools (e.g., spatial data, technical papers, webinars, etc.) with interested landowners, municipalities, organizations, and agencies.

* Assure that technical experts are aware of the refuge's willingness to use refuge lands for research, inventorying and monitoring of natural occurrences, and management effects.

Rationale: See rationale for entire objective below.

- **Mentoring Students:** Collaborate with institutes of higher learning to mentor individuals hoping to enter a natural resource related field. The refuge will:

  * Seek opportunities to work with students at all levels on a regular basis. Examples include student chapters of professional societies, such as The Wildlife Society and the American Fisheries Society.

  * Participate in working with students through other professional associations like the National Association of Interpretation and The National Association of Environmental Educators.

Rationale: One of the six legislative purposes guiding the establishment of the refuge is "to provide opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation and access to the extent compatible with other purposes…" Conte Refuge is situated in the "Five College" area of western Massachusetts and is surrounded by approximately 45 universities and colleges in the New England States. The number of nearby local colleges, as well as the abundance of natural and cultural resources in the watershed makes the refuge a key resource for students looking to conduct research projects relating to conservation, wildlife management, resource protection, and human dimensions. Similarly, student research will benefit the refuge by answering management questions, and helping to guide management strategies.

RECREATION

GOAL 3

***Recreation*. Promote high quality, public recreational opportunities in the Connecticut River watershed that are complementary between ownerships and provide regional linkages, with emphasis on promoting wildlife-dependent activities that connect people with nature in the outdoors.**

Objective 3.1 Hunting

Support quality public hunting opportunities in the Connecticut River watershed in cooperation with willing landowners to promote a unique understanding and appreciation of natural resources and their management, including the role of the Service and other public lands in resource conservation, while also protecting a traditional outdoor pastime deeply rooted in America's natural and cultural heritage and conservation history.

Our proposed guidelines and strategies for working cooperatively with others to facilitate quality hunting opportunities throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- **Hunting Opportunities, Access, and Infrastructure:** Work with partners and willing landowners to facilitate quality hunting opportunities across ownerships and promote and support investments in hunter access and infrastructure. Quality hunting opportunities will promote resource stewardship, safety, and responsible behavior, and minimize conflicts with other recreationists and neighboring landowners. We will emphasize hunting opportunities that are accessible to a wide array of the American public and provide a reasonable opportunity to experience wildlife.

  We will seek out and promote programs, often in partnership with state fish and wildlife agencies, that encourage diverse opportunities, especially among urban residents, women, and youth. We will consider infrastructure to support the needs of disabled individuals on refuge lands, as well as, the establishment of parking areas and pullouts, and we will maintain formal (i.e., signed and mapped as part of a network) and informal access trails. Through our involvement in the establishment of Connecticut River access sites, we will work to see that consideration is given to waterfowl hunters.

Rationale: See rationale for entire objective below.

- **Hunter Education and Outreach:** Work with partners to promote a knowledgeable hunting public and increase interest in this traditional pastime through support of hunter training, education, and demonstration programs. State fish and wildlife agencies will be among our important partners in accomplishing this work. We will also work with fish and game clubs and individuals interested in providing hunting/outdoorsman-type learning experiences to the general public, both through our staff's participation in training seminars, as well as, hosting such events at our refuge facilities. We will also collaborate with the respective States to promote the use of nontoxic (e.g., lead-free) ammunition to reduce impacts to fish and wildlife. We will also provide refuge visitors with general information on the hunting program and refuge-specific and State regulations through the refuge website, information signs, and hunting brochures. In all materials related to the hunting program, promote and encourage the use of lead-free ammunition. We will also identify the impacts associated with requiring the use of non-toxic ammunition for hunting on refuge lands.

Rationale: We recognize hunting as a healthy, traditional outdoor pastime, deeply rooted in our American heritage and we will support this activity where it can safely occur on refuge lands and by permission of private landowners. Hunting is one of the six priority wildlife-dependent public uses of the Refuge System as established in the 1997 Refuge Improvement Act. In addition, Presidential Executive Order #113443-Hunting Heritage, "…directs Federal agencies to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat." Service policy (601 FW 7) establishes procedures for working with state fish and wildlife agency representatives to implement hunting and other programs of interest to both agencies on refuge units. Generally, the guidance is to implement hunt programs that are consistent with respective State hunting regulations. The Refuge System maintains a website with additional information on hunting on refuges, including refuge-specific regulations (*http://www.fws.gov/refuges/hunting/featured_articles.cfm?heid=12*; accessed August 2016)

Hunting opportunities on the refuge can provide wildlife-dependent recreational opportunities which help accomplish population management objectives while promoting visitors' understanding and appreciation for wildlife and their habitats. Prior to allowing hunting on refuge lands, we must determine that the use is compatible. This determination considers public safety and impacts among user groups. The compatibility determination also ensures that refuge hunting programs are biologically sound and support healthy wildlife population levels.

Where found compatible, we will complete all administrative requirements to formally open refuge lands to hunting. Please see appendix D in this final CCP/EIS for our proposed compatible determinations for hunting.

Opportunities for hunting have been in decline due to land use and ownership changes, with more southerly areas in the Connecticut River watershed incurring greater development and northerly areas increasingly posted against hunting. In the face of these declining opportunities, national wildlife refuges can provide important public hunting opportunities and contribute to continuation of a traditional use. On the refuge, hunting is a well-established and valued public use on several divisions. Some of these areas were hunted for decades prior to refuge establishment and visitors continue to come from all over the Northeast to hunt refuge lands.

Under all alternatives, we would continue to work with the states and our partners to educate and inform hunters about the impacts to fish, wildlife, habitats, and human health associated with the use of lead ammunition (See also "Actions Common to All Alternatives: Hunting and Fishing" above). For example, we would continue to distribute materials providing hunters with information on those impacts on fish and wildlife; encourage visitors to use cost-effective, lead-free ammunition; and, describe actions that can be taken to protect wildlife from contamination when lead ammunition are used. In addition, we will work with the States to identify the impacts associated with requiring the use of non-toxic ammunition for hunting on refuge lands. This would include identifying, quantifying, and evaluating the impacts of lead exposure to wildlife on refuge lands, as well as considering the impacts of lead restrictions on hunters. Any proposed actions or changes to the status quo would be vetted in a public forum, consistent with NEPA and specific to the refuge opening package and the other Service administrative and legislated requirements.

We will continue to work closely with respective state fish and wildlife agencies to ensure the provision of quality public programs, including hunting. The Service defines quality public use as programs that (605 FW 6, 1.6):

- Promotes safety of participants, other visitors, and facilities.
- Promotes compliance with applicable laws and regulations and responsible behavior.
- Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.
- Minimizes or eliminates conflicts with other compatible wildlife-dependent public uses.
- Minimizes conflicts with neighboring landowners.
- Promotes accessibility and availability to a broad spectrum of the American people.
- Promotes resource stewardship and conservation.
- Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.
- Provides reliable/reasonable opportunities to experience wildlife.
- Uses facilities that are accessible to people and blend into the natural setting.
- Uses visitor satisfaction to help define and evaluate programs.

Objective 3.2 Fishing

Support quality public fishing opportunities in the Connecticut River watershed in cooperation with willing landowners to promote an understanding and appreciation of natural resources and their management, including the role of the Service and other public lands in resource conservation, while also protecting a traditional outdoor pastime deeply rooted in America's natural heritage and conservation history.

Our proposed guidelines and strategies for working cooperatively with others to facilitate quality fishing opportunities throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- **Fishing Opportunities, Access, and Infrastructure:** Work with partners and willing landowners to facilitate quality fishing opportunities across ownerships and promote and support investments in fishing access and infrastructure. Quality fishing opportunities will promote resource stewardship, safety, and responsible behavior, and minimize conflicts with other recreationists and neighboring landowners. We will emphasize fishing opportunities that are accessible to a wide array of the American public and provide a reasonable opportunity to experience wildlife. We will seek out and promote programs, often in partnership with state fish and wildlife agencies, that encourage diverse opportunities, especially among urban residents, women, and youth. We will consider infrastructure to support the needs of disabled individuals on refuge lands, as well as, the establishment of parking areas and pullouts, and we will maintain formal (i.e., signed and mapped as part of a network) and informal access trails. Through our involvement in the establishment of Connecticut River access sites, we will work to see that consideration is given to anglers.

Steve Hillebrand

Great blue heron

Rationale: See rationale for entire objective below.

- **Angler Education and Outreach:** Work with partners to promote a knowledgeable fishing public and increase interest in this traditional pastime through support of angler training, education, and demonstration programs. State fish and wildlife agencies will be among our most important partners in accomplishing this work, both through demonstration programs and in the development of outreach materials. We will also work with fish and game clubs and individuals interested in providing angling/outdoorsman-type learning experiences to the general public, both through our staff's participation in training seminars, as well as, hosting such events at our refuge facilities. We will also collaborate with the respective States to promote nontoxic (lead-free) tackle and reduce impacts to fish and wildlife.

Rationale: We provide the Refuge System definition of a "quality" recreational program under our rationale for hunting.

Similar to hunting, we recognize fishing as a healthy, traditional outdoor pastime, deeply rooted in our American heritage and support this activity where it can safely occur on refuge lands and other lands when permitted by landowners. Fishing is also viewed as an initial means of engaging and connecting people, particularly children, in outdoor pursuits. Access to fishing is often a challenge due to private ownerships; thus we actively promote public opportunities for this recreational activity on refuge lands. Fishing is one of the six priority wildlife-dependent public uses of the Refuge System as outlined in the 1997 Refuge Improvement Act. The Refuge System maintains a Web site with additional information on fishing on refuges, including refuge-specific regulations *(http://www.fws.gov/refuges/fishingguide/*; accessed August 2016).

Opportunities for fishing have been in decline due to lack of access and competition for space with other recreational uses. Because of this, allowing fishing on the refuge can provide and protect important opportunities. Fishing is a well-established and valued public use on several refuge divisions. Fishing occurred in some of these areas for decades prior to refuge establishment, some of which are especially prized for trout fishing.

Fishing opportunities on the refuge can provide wildlife-dependent recreational opportunities which help accomplish population management objectives while promoting visitors' understanding and appreciation for wildlife and their habitats. Prior to allowing fishing on refuge lands, we must determine that the use is compatible. This determination considers public safety and impacts among user groups. The compatibility determination also ensures that refuge fishing programs are biologically sound and support healthy wildlife population levels. Where found compatible, we will complete all administrative requirements to formally open refuge lands to fishing. Please see appendix D in this final CCP/EIS for our proposed compatible determinations for fishing.

Under all alternatives, we would continue to work with the states and our partners to educate and inform anglers about the impacts to fish, wildlife, habitats, and human health associated with the use of lead tackle (See also "Actions Common to All Alternatives: Hunting and Fishing" above).

We will continue to work closely with respective state fish and wildlife agencies to ensure the provision of quality public fishing opportunities.

Objective 3.3 Wildlife Observation and Photography

Support quality, public opportunities to observe and photograph wildlife in a variety of natural habitats in the Connecticut River watershed in order to connect a broad spectrum of people with nature.

Our proposed guidelines and strategies for working cooperatively with others to facilitate quality opportunities for wildlife observation and photography throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- **Wildlife Observation and Photography Opportunities, Access, and Infrastructure:** Work with partners to encourage these activities through the provision of parking areas, trails, and observation blinds necessary to facilitate access and enhance opportunities for wildlife viewing and photography. Quality wildlife observation and photography opportunities will promote resource stewardship and a conservation ethic. We will emphasize wildlife observation and photography opportunities that are accessible to a wide array of the American public and provide a reasonable opportunity to experience wildlife, such as migratory songbirds in breeding plumage, and resident, charismatic species, such as white-tailed deer and moose.

Rationale: See rationale for entire objective below.

- **Aids to Support Wildlife Observation and Photography on Refuge Lands:** Work with partners to develop and promote both traditional resources, such as paper maps and brochures, as well as, emerging technologies, like phone applications and QR codes (Quick Response codes used with a cell phone to learn about a site), as information sources related to wildlife observation and photography.

Rationale: See rationale for entire objective below.

- **Watershed-based Initiatives to Support Wildlife Observation and Photography:** Work with partners and willing landowners to develop and promote watershed-wide viewing opportunities, such as the Connecticut River Birding Trail, Connecticut River Byway, and the Adopt-a-Habitat Initiative, which helps landowners, organization, and schools adopt an area and restore and manage its as habitat for wildlife and for wildlife viewing.

Rationale: We provide the Refuge System definition of a "quality" recreational program under our rationale for hunting. Wildlife observation and photography are an important way to connect people to the outdoors and nature–and a means to help people recognize their own role in the environment. We actively promote public opportunities for this recreational activity on refuge lands. Wildlife observation and photography are two of the six priority wildlife-dependent public uses of the Refuge System as outlined in the 1997 Refuge Improvement Act. The Youth in the Great Outdoors Secretarial Initiative promotes programs that connect people with nature *(http://www.fws.gov/northeast/cpwn/*; accessed August 2016).

While more opportunities exist for wildlife observation and photography, than perhaps hunting and fishing, the challenge is instead to make these uses more accessible to a changing demographic (i.e., increasingly urban, diverse, and minority audiences). These audiences may possess a different relationship to nature than the traditional, and often more rural, refuge audience–and yet, it is equally important to engage all potential users. Wildlife observation and photography is a valued public use on certain refuge divisions, especially those within particularly scenic landscapes and containing a good public road/trail network.

As desired by the respective state fish and wildlife agencies, we will partner with them to promote the provision of quality, public programs that enhance opportunities for wildlife observation and photography.

Objective 3.4 Other Recreational Activities

Support compatible, non-priority, outdoor recreational opportunities and public access that provide quality, nature-based experiences throughout the Connecticut River watershed to facilitate and improve community relationships, raise awareness and an appreciation for conserving natural resources, and garner support for the National Wildlife Refuge System.

Our proposed guidelines and strategies for working cooperatively with others to facilitate other appropriate and compatible outdoor recreational opportunities throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- **Regional Water-based Trail Initiatives and Opportunities:** Work with partners and willing landowners to support compatible, water-based trail initiatives within the Connecticut River watershed that promote a conservation/land ethic and quality outdoor experiences for people of all abilities. As opportunities arise, work with partners to establish a series of campsites and launches to ensure a fully functioning Connecticut River Paddlers' Trail throughout the full 410-mile length of the Connecticut River. Use our website and other outreach efforts to promote the Paddlers' Trail and Northern Forest Canoe Trail.

Rationale: See rationale for entire objective below.

- **Regional Land-based Trail initiatives and Opportunities:** Work with partners and willing landowners to support compatible, land-based trail initiatives within the Connecticut River watershed that promote a conservation/land ethic and quality outdoor experiences for people of all abilities. When appropriate and compatible, use refuge lands to provide linkages for existing, established regional or statewide trails. Where refuge ownership interests coincide with regional hiking trails, such as the Appalachian National Scenic Trail and New England National Scenic Trail; assist in the long-term protection of their continuity and quality by working with existing or prospective conservation owners to maintain trail and habitat connectivity. Deploy outreach methods to engage users of other land-based trails, such as equestrian, rail trail, cycling, and snowmobile trails in the mission of the refuge system, when they occur adjacent to refuge lands and support a conservation ethic.

Rationale: See rationale for entire objective below.

- **Unit-specific Land-based Trail Initiatives and Opportunities:** Work with partners to support land-based trail initiatives within or adjacent to refuge units to promote outdoor, nature-based activities, and strive to instill a conservation and land ethic. When appropriate and compatible, allow access across refuge lands to maintain, and provide new linkages for, existing established trails open to the public. In general, users would already have a nearby and logical connection to refuge lands and refuge lands would constitute a minority of the trail network's length (e.g., for example, less than 25 percent). The trail, and its associated use, would not be allowed if it is exclusive to anyone, or any club or organization. Site-specific compatibility determinations will be required in response to a request for any such trail segments.

Rationale: Although many people participate in the wildlife-dependent activities described above, we recognize that a large and diverse array of outdoor recreational trail pursuits occurs within the Connecticut River watershed and that many of these activities do not necessarily fit our definition of priority, wildlife-dependent recreational uses, such as hunting, fishing, and bird watching. Examples of trail activities we are aware of on nearby lands include equestrian riding, snowmobiling, cross-country skiing, and sled dog mushing. Nonetheless, engaging these users where it can be done within our compatibility standards represents an opportunity to build a connection with a new constituency–and a means to help people recognize their own role in the environment. In addition, we are pleased to be able to provide public opportunities for varied recreational activities on refuge lands.

As desired by various user groups and organizations, we will collaborate with them to promote the provision of such quality, public programs that enhance connections and develop a rapport with a new demographic. For example, we would cooperate with others to implement the recommendations in the Connecticut River Recreation Management Plan, to the extent practical.

As we support trail development and protection on either refuge or private lands, we will encourage managing for "soft" edges along a trail corridor to benefit both visitors and wildlife. Soft edges are those where the trail corridor perimeter is not an abrupt, straight-line vegetation change, but is one where the corridor has vegetation edges that are more gradual or undulating (e.g. soft). Soft edges are more aesthetically appealing, but they also buffer against disturbances better than those with straight and abrupt (hard) edges. This concept is most important

in providing a transition between urban or agricultural land uses and natural areas. Soft edges especially help minimize the diverse disparities between urban and natural areas, such as the difference between highly lit (at night) and louder urban areas and the low-light, more quiet natural areas.

PARTNERSHIPS

GOAL 4

***Partnerships*. Enhance the conservation, protection, and stewardship of natural and cultural resources, and promote wildlife-dependent recreation, throughout the Connecticut River watershed by initiating, supporting, and promoting partnerships with other Federal, State, and local agencies, Tribal governments, and private organizations.**

Objective 4.1 Strategic Habitat Conservation Partnerships

Create, enhance, and facilitate partnerships to plan, design, deliver, and evaluate SHC in the Connecticut River watershed, such as the *Connect the Connecticut* Landscape Conservation Design (LCD), with an emphasis on promoting action in CPAs. Special effort will be made to coordinate with the NALCC partnership, the four State fish and wildlife agencies, the *Connect the Connecticut* LCD partnership, and other partners advancing conservation in the watershed.

Our proposed guidelines and strategies for working cooperatively with others to facilitate strategic habitat conservation throughout the watershed, with priority attention to CPAs, include the following:

- ***Habitat Restoration and Management*:** Work with partners and willing landowners to restore, manage, and enhance habitat values for Federal trust resources and other species of conservation concern. Identify, with other Federal and State partners, programs and funding sources for projects and the availability of technical assistance regarding project feasibility and design. Service project priorities would include riparian and floodplain habitat restoration along the mainstem Connecticut River and its tributaries, reestablishing aquatic connections for migratory fish and other aquatic species (e.g., aquatic species barrier removal), restoring wetland functions and values, protecting federally listed and other Federal trust species, and treating invasive species that threaten important habitats for those species.

Many Federal, state, and regional and local partners, such as regional conservation partnerships, local land trusts, and regional and local watershed committees, are already actively engaged in restoration and management activities. We would continue to support those planning and implementation endeavors, both on and off refuge lands. Our intent would be to complement the great work already established by those partners. Refuge staff could also facilitate the sharing of ecological, GIS, and other information and technical resources, support fieldwork, and provide assistance in grant writing to support priority projects.

Coordination among Federal and state agencies will be particularly important to address major hydrologic and aquatic issues in the river. We will support the Service's Connecticut River Coordinator's Office in pursuing discussions with the USACE and other partners to identify opportunities to manage water resources (e.g., flood risk reduction infrastructure) in order to promote the structure, function, and flows (e.g. velocity and duration) of water resources in the watershed in a manner that is more natural. CRASC Commissioners and the Technical Committee, who have recognized for decades the importance of working on a landscape scale, will continue to be important partners in addressing aquatic passage issues and in implementing restoration projects across the watershed.

Generally, we would work with our Federal, state, regional and local partners to:

- Review and, as warranted, assist in the implementation of quality plans already in place consistent and compatible with refuge goals.
- Prioritize habitat conservation needs for Federal trust resources and other species of conservation concern, including prioritizing opportunities for restoration and management.
- Develop specific management and implementation strategies for those priorities, and identify and address limiting factors.
- Implement management strategies through existing and new partnerships.
- Develop and implement evaluation measures for management strategies as needed; and adapt management in response to what is learned through monitoring.

Rationale: See rationale for entire objective below.

- ***Private Lands Program Coordination*:** Use the Service's Partners for Fish and Wildlife Program (Private Lands program) to facilitate private landowner assistance among all four States, Federal agencies, and conservation organizations who are working with private landowners to protect and manage valuable fish and wildlife habitats. This program is guided by four objectives:
  - Promote and implement habitat improvement projects that benefit Federal trust species.
  - Provide conservation leadership and promote partnerships.
  - Encourage public understanding and participation
  - Work with the USDA to implement conservation programs.

This program details priority actions in regional strategic action plans. An updated plan for the Service's Northeast Region for years 2017-2021 is currently in development. Proposed program emphases include improving and restoring degraded wetlands and riparian habitat, improving and restoring aquatic connectivity, and improving and managing young forest and pollinator habitat.

We believe this Service program should complement partners' programs, implement the *Connect the Connecticut* LCD, and support the purposes of the refuge by:

- Working with landowners to identify specific habitat improvement opportunities.
- Assisting landowners in finding and preparing grants or other funding and cost-sharing opportunities, sponsored by State and Federal agencies or private organizations, to accomplish conservation work. In particular, connect these landowners with Federal programs and funding.
- Assisting landowners with their grant submissions.
- Sharing scientific knowledge and best management practices for designing and implementing projects.

Nulhegan Basin Division wildlife festival

USFWS

- Where appropriate and practical, implementing cooperative management agreements on private lands around refuge units and divisions to support work consistent with refuge purposes.

- Where it helps meet mutual goals, cooperating with local communities on projects such as trail work, access improvements, and drainage and water control structures.

The Private Lands program is our most effective way to outreach and create partnerships with private landowners to achieve shared regional habitat and wildlife conservation goals. Currently, the refuge staff includes one full-time employee who helps administer the Private Lands program serving as a permanent presence in the watershed–bringing people together, getting the right people talking to each other, helping partners prepare grants and other funding documents, and complementing Federal and State programs with similar aims. We will work with other organizations with land management expertise in developing and implementing the program.

Rationale: See rationale for entire objective below.

- ***Land Protection*:** Advance conservation in the Connecticut River watershed through a strategic, public-private land protection program. Our proposed land conservation goal is to assemble a well-distributed conserved lands network in the watershed that contributes to sustaining ecological function, supports healthy populations of native fish and wildlife, especially those of conservation concern, is respectful of the working landscape, and anticipates the effects of climate and land use changes. This is primarily represented by the core areas and connectors in the *Connect the Connecticut* LCD. We have identified a network of lands (e.g., CPAs and CFAs), supported by the LCD, that we believe have high ecological and Federal trust conservation value that will be priority areas for us to work with partners to protect. However, that focus would not exclude the very important conservation work of our partners being done elsewhere. Rather, we believe these are complementary actions. The focus of our refuge land protection design is to protect high Federal trust value habitats, promote connectivity in aspect, substrate, and process, and to insure

representation and redundancy of ecosystems in order to sustain resiliency in natural systems in light of predicted climate and land use change.

We propose that the Service would take a lead, but not exclusive role in land conservation within CFAs. We would also work in cooperation with partners on their initiatives in both CFAs and CPAs, and facilitate as practical and appropriate, other conservation projects led by others elsewhere in the watershed consistent with refuge goals and objectives. Refuge support could include the sharing of ecological data, grant writing, and technical field support, as needed and appropriate, to encourage land protection activities by partners within the CPAs.

Refuge staff would work in close cooperation with Federal and State agencies, land trusts, and other conservation partners, to foster a climate of cooperation and shared goals when pursuing land protection. In particular, we would ensure close coordination with State agencies by holding regular land acquisition coordination meetings to keep mutual agency interests moving forward and to avoid duplicative efforts. Refuge staff would facilitate a Federal acquisition process that is as efficient and responsive as possible.

Appendix C in this final CCP/EIS represents the Service's proposed refuge acquisition plan. Refuge staff would also share ecological and other GIS data, support grant writing, provide technical field support, as needed and appropriate, to encourage land protection activities by partners.

As we have emphasized, we only acquire land from willing sellers. Also, we do not expect to purchase any lands already permanently conserved by others, except under extenuating circumstances.

Rationale: The 1991 Conte Refuge Act legislatively mandated a refuge be established in the Connecticut River watershed for six different purposes related to conservation; the purposes include conservation for specific species, as well as ecosystems, natural diversity, wetlands protection, and a charge to support scientific research, environmental education, and wildlife-dependent recreational access. Supporting language for the legislation included the recognition that partnerships among the Service, other Federal agencies, State agencies, and the conservation community would be critical to fulfilling these purposes.

In particular, the Service would like to facilitate the leveraging of the various Federal agency's funds and grants, to State and private conservation partners, working in the watershed to implement the *Connect the Connecticut LCD* conservation ppriorities. Objective 4.11 discusses this in some detail. A recent acknowledgement of Federal agencies collaborating to achieve conservation is established in the Service's Directors Order 217, dated August 9, 2016. This order ensures that Service personnel place a priority on working with the USDA/NRCS to promote voluntary conservation actions by nonFederal landowners and managers through Working Lands for Wildlife (WLFW) and other wildlife conservation-focused programs. The goal is to leverage conservation on private lands through WLFW and other wildlife conservation-focused programs in collaboration with NRCS that support the Service's mission, with a particular focus on conserving listed, candidate, and other at-risk species (at-risk species).

All four watershed States, the Forest Service, land trusts, and conservation organizations have identified lands of high conservation value, and most have identified specific priority areas for protection respective to their agency's mission. Collectively, they collaborated on priorities in the *Connect the Connecticut* LCD. There is already a valuable exchange of resource information among the States, Federal agencies, and organizations that helps this process

and continues to help each partner update and refine their priorities. In addition, when identified lands become available from willing sellers, there is often communication among partners to assess who is best suited and has available resources to acquire the property. Maintaining this networking is critical for meeting land conservation and collaboration goals over the long term in the watershed.

We will continue to work closely with the NALCC partnership, the States, and other stakeholders to implement the *Connect the Connecticut* LCD over the long term. We will also work with the NALCC partnership and other stakeholders to consider conservation priorities identified in the initiative currently named "Regional Conservation Opportunity Areas" (RCOAs). This effort, scheduled for public release in 2017, builds upon *Connect the Connecticut* and expands the work across the entire Northeast region. Updated science and information exhanges provided by partners will help inform and prioritize our future biological planning within the watershed, and help direct assumption-driven research and monitoring necessary to shape decisions about conservation delivery within an adaptive management framework. Through this coordination, refuge management can be adapted in a timely manner as new information arises. Furthermore, working together with conservation partners, the refuge could serve as a demonstration area for implementing projects, or testing models and tools, that are developed.

Objective 4.2 Terrestrial Species Protection, Restoration, and Management Partnerships

Create, enhance, and facilitate partnerships to protect, restore, and manage populations of terrestrial species of conservation concern, including federally listed species, species proposed for listing, and migratory birds, throughout the Connecticut River watershed, with an emphasis on promoting action in CPAs.

Our proposed guidelines and strategies for working cooperatively with others to conserve species populations throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- ***Federally Listed Terrestrial Species Conservation***: Support the protection of federally listed and candidate species in the watershed, and minimize the listing of new species, by collaborating with Federal and State agencies, local towns, non-governmental organizations, and willing landowners. Work in partnership to develop and implement species recovery plans, spotlight action plans, species conservation strategies and targets, habitat conservation plans, State wildlife action plans, and other conservation measures with a goal to avoid new species listings. Those measures may include land protection, public use and access management, and invasive species control. Work closely with other Service programs to mobilize agency resources toward coordinated conservation work in the watershed with priority given to the following federally listed, candidate, and proposed species:

  - Puritan tiger beetle (federally threatened)
    - Recovery Plan 1993-*http://www.fws.gov/chesapeakebay/endsppweb/beetle/PDFs/1993RecoveryPlan.pdf* (accessed August 2016).

  - Jesup's milk-vetch (federally endangered)
    - Spotlight Species Action Plan 2009- *https://www.fws.gov/northeast/Endangered/pdf/Jessup's%20milk-vetch%20SSAP.pdf* (accessed August 2016).

  - Northeastern bulrush (federally endangered)
    - Recovery Plan 1993– *http://www.fws.gov/northeast/pafo/pdf/NB_Recovery_Plan.pdf* (accessed August 2016).

* Canada lynx (federally threatened)
  - Recovery Outline 2005– *http://ecos.fws.gov/docs/recovery_plan/final%20draft%20Lynx%20Recovery%20Outline%209-05.pdf* (accessed August 2016).

* Piping plover (federally threatened)
  - Revised Recovery Plan 1996– *http://www.fws.gov/northeast/pipingplover/pdf/entire_plan.pdf* (accessed August 2016).

* Small whorled pogonia (federally threatened)
  - Recovery Plan 1992– *http://ecos.fws.gov/docs/recovery_plans/1992/921113b.pdf* (accessed August 2016).

* Red knot *rufa* subspecies (federally threatened)
  - Spotlight Species Action Plan 2010– *https://www.fws.gov/northeast/endangered/PDF/red_knot_action_plan.pdf* (accessed August 2016).

* Northern long-eared bat (federally threatened)
  - Northern long-eared bat interim conference and planning guidance– January 2014 *https://www.fws.gov/northeast/virginiafield/pdf/NLEBinterimGuidance6Jan2014.pdf* (accessed August 2016).

* Roseate tern (federally endangered)
  - Roseate Tern Northeastern Population Recover Plan – 1998 *https://www.fws.gov/ecos/ajax/docs/recovery_plan/981105.pdf* (accessed November 2016).

* Indiana bat (federally endangered)
  - Indiana Bat Five-Year Review Summary and Evaluation - 2009 *https://ecos.fws.gov/docs/five_year_review/doc2627.pdf* (accessed November 2016).

* Northern bog turtle (federally threatened)
  - Bog Turtle Northern Population Recovery Plan – 2001 *http://ecos.fws.gov/docs/recovery_plan/010515.pdf* (accessed November 2016).

* Cobblestone tiger beetle (species under review)
  - *https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=8134* (accessed November 2016).

* Monarch butterfly (species under review)
  - *https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=9743* (accessed November 201).

* Yellow-banded bumble bee (species under review)
  - *https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=10403* (accessed November 2016).

* Wood turtle (species under review)
  - *https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6997* (accessed November 2016).

Rationale: See rationale for entire objective below.

- ***Migratory Bird Conservation***: Work with partners to plan, develop, and implement ecoregional migratory bird conservation programs to ensure the long term ecological sustainability of migratory birds and their habitat, and to increase awareness of the value of migratory birds and their habitats for their intrinsic, ecological, recreational, and economic significance within the watershed.

Support migratory bird ecoregional plans and priorities developed through the NALCC for migratory birds, through actions such as:

* Population monitoring, assessment, and management.
* Habitat restoration, management, and protection.
* Private lands coordination and grants writing and funding support.
* Communications and outreach.
* Recreational opportunities.

Rationale: See rationale for entire objective below.

- ***Other Terrestrial Species of Conservation Concern Identified by the Service, NALCC Partnership, or States*:** Work with partners to plan, develop, and implement other species' ecoregional conservation programs to ensure the long term ecological sustainability of species of conservation concern and their habitat, and to increase awareness of the value of those species and their habitats for their intrinsic, ecological, recreational, and economic significance.

Rationale: Partnerships and collaborations are essential to successful conservation of all species, particularly those that migrate or have large home ranges. No one partner has all the lands and resources necessary to meet a migratory species' goal. There are numerous species and habitat-focused regionally based partnerships comprising Federal and State government agencies, non-profit organizations, corporations, Tribal governments, and individuals who work to implement conservation plans in the watershed. For example, we are actively engaged in a New England cottontail conservation partnership. The science provided by the NALCC and other conservation partners will help inform existing ecoregional conservation plans and other strategic plans developed for conservation lands in the watershed, including the refuge. We indicate above some of the federally listed species plans (e.g., recovery plans), which will guide our management actions to benefit these species. Existing bird plans developed by the Service and partners include the BCR 14 and 30 plans, the North American Waterfowl Plan, the Waterbirds for the Americas Plan, the U.S. Shorebird Plan, PIF plans, and the Black Duck Joint Venture. We will also work with the four States to coordinate State WAP, especially with actions that support conservation of Federal trust resources.

We will continue to support and help implement the *Connect the Connecticut* LCD, initiated by the NALCC. As noted previously, this project is a collaborative effort among 30 partners, including the Service, to develop and implement a strategic plan for the watershed that will sustain habitat for fish, wildlife, and plants within a working landscape. It is intended to guide collective conservation actions within the watershed and connect to broader regional conservation goals for conserving sustainable fish and wildlife populations and their habitat for people within a working landscape. Science-based tools were developed that will serve to facilitate a conservation design for other geographies in the entire Northeast Region (*http://connecttheconnecticut.org/;* accessed October 2016).

Objective 4.3 Aquatic Species Protection, Restoration, and Management Partnerships

Support the conservation of migratory fish and other aquatic species of conservation concern by collaborating with Federal and State agencies, local towns, and non-governmental organizations in the implementation of fish and other aquatic species conservation plans.

Our proposed guidelines and strategies for working cooperatively with others to conserve fish and other aquatic species populations throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- ***Federally Listed Aquatic Species Conservation***: Support the protection of federally listed and candidate species in the watershed, and minimize the listing of new species, by collaborating with Federal and State agencies, local towns, non-governmental organizations, and willing landowners. Work in partnership to develop and implement species recovery plans, species conservation strategies, habitat conservation plans, State wildlife action plans, and other conservation measures with a goal to avoid new species listings. Those measures may include land protection, public use and access management, and invasive species control. Work closely with other Service programs to mobilize agency resources toward coordinated conservation work in the watershed with priority given to implementing the following plans:

  * Recovery Plan (1993) for the dwarf wedgemussel—*http://www.fws.gov/northeast/nyfo/es/dwm.pdf* (accessed August 2016).

  * Recovery Plan (1998) for the shortnose sturgeon—*http://www.nmfs.noaa.gov/pr/pdfs/recovery/sturgeon_shortnose.pdf* (accessed August 2016); and *http://www.fws.gov/r5crc/shortnose_sturgeon_program.htm* (accessed August 2016)

  * The Service's Region 5 Strategic Fisheries Plan for the Connecticut River watershed (Service 2009)—*https://www.fws.gov/northeast/fisheries/pdf/FAC_StrategyPlan_2016_2020.pdf* (accessed August 2016).

  * Atlantic States Marine Fisheries Commission numerous species plans—*http://www.asmfc.org/fisheries-management/program-overview* (accessed August 2016) Connecticut River Atlantic Salmon Commission priorities–*http://www.fws.gov/r5crc/who/crasc.html* (accessed August 2016)

  * The Nature Conservancy and Northeast Association of Fish and Wildlife Agency's Northeast Aquatic Connectivity, An Assessment of Dams on Northeastern Rivers (TNC 2011)—*http://cw-environment.usace.army.mil/restore/fishpassage/pdfs/NEAquaticConnectivity_Report.pdf* (accessed August 2016).

  Support the CRASC's diadromous fish restoration efforts, the Service's Connecticut River Coordinator's Program, State fish and wildlife and transportation agencies, NOAA Fisheries, TNA, TU, and other stakeholders in identifying, assessing, and removing fish and other aquatic species passage barriers, and restoring streams to natural channel designs where possible. Where barrier removal is not feasible, support efforts to design an appropriate fish passage facility. Promote the use of clear ecological criteria to prioritize work (e.g., amount and quality of habitat upstream of barrier, size, and status of affected populations) among partners. These prioritizations could apply to a single species, but would be most useful when all species of concern are evaluated together.

Rationale: See rationale for entire objective below.

- ***Other Aquatic Species of Conservation Concern Identified by the Service, the NALCC Partnership, or States***: We will work with Service programs, Atlantic States Marine Fisheries Commission, Connecticut River Atlantic Salmon Commission, other Federal agencies, and State agencies to advance conservation of other aquatic Federal trust species, NALCC aquatic representative species, or State aquatic species of greatest conservation need. Information on species of concern and associated management plans can be accessed at:

* American shad (*http://www.fws.gov/r5crc/american_shad_program.htm;* accessed August 2016)

* River herring (*http://www.fws.gov/r5crc/river_herring_program.htm;* accessed August 2016)

* American eel (*http://www.fws.gov/r5crc/american_eel_program.htm*; August 2016)

* Eastern brook trout (*http://easternbrooktrout.org/*; accessed August 2016)

* Sea lamprey (*http://www.fws.gov/r5crc/sea_lamprey_program.htm*; accessed August 2016)

* Striped bass (*http://www.fws.gov/r5crc/striped_bass_program.htm*; accessed August 2016)

We will also consult the numerous species plans developed by the Atlantic States Marine Fisheries Commission which can be reviewed at *http://www.asmfc.org/fisheries-management/program-overview* (accessed August 2016)

Promote the conservation measures on fish passage that are noted above for federally listed species. Work with States, NOAA Fisheries, TNC, and other partners to identify and prioritize these and other conservation actions, actively seek funding, and implement on-the-ground projects and monitoring with the goal to restore and maintain these native species to their historic range in the watershed.

Rationale: The Connecticut River and its tributaries provide important habitat for a wide range of aquatic species, including Federal trust resources, such as migratory fish and federally listed species. The refuge will continue to work with partners, including the Service's Connecticut River Coordinator's Office, to help protect and restore aquatic habitats for these species. In particular, we will work with partners to address threats to aquatic species, such as removing barriers to aquatic species passage.

Objective 4.4 Invasive Species Management Partnerships

Plan and implement coordinated and strategic actions among conservation partners and private landowners to reduce the ecological threat from invasive exotic plants and wildlife species in the Connecticut River watershed. Work with those partners to design and implement strategies for controlling the spread of established invaders, preventing new invasions, and in the early detection and rapid response to control new invaders.

Our proposed guidelines and strategies for working cooperatively with others to facilitate invasive species management throughout the Connecticut River watershed, with priority attention to CPAs, include the following:

- ***Cooperative Invasive Species Management Areas and Other Invasive Species Partnerships*:** Work with the Friends of Conte Science and Stewardship Committee to develop an organizational framework or network that would incorporate the invasive species control program into priority stewardship activities at all levels within the watershed, including watershed-wide, in subwatersheds, and at local levels. The goal is to create an organization that is well-integrated with other conservation partnerships and would result in on-the-ground invasive species inventories, monitoring, education, and management activities in priority habitats. Specifically, we would:

  * Take a leadership role in formalizing and continuing the work undertaken from 2012-2013 to set up a watershed-wide invasive species management partnership using the CISMA model partnerships. The pilot group

formed under this grant goes by the name "Connecticut River Watershed Invasive Species Partnership." To continue its work, this watershed-wide CISMA would function as a subgroup of the Friends of Conte Science and Stewardship Committee and coordinate closely with other stewardship activities deemed important by the group. This organization would also network existing invasive species partnerships and take recommended next-steps from the 2014 report "Identifying Priority Areas for Invasive Plant Management in the Connecticut River Watershed" written by the Strategic Planning Subcommittee of the Connecticut River Watershed Invasive Species Partnership. This report gives guidance in identifying the most important areas to undertake invasive species work, including the establishment of subwatershed CISMAs and/or partnerships at the local level. If Federal funding for CISMAs becomes available, the group could apply for funds to coordinate the umbrella CISMA and, using our legislative authority to administer a small grants program, distribute funds to the smaller groups for projects meeting umbrella group objectives.

* Work with existing partnerships, including the six CISMAs and other local watershed associations, to continue to identify priorities, and develop invasive species management objectives and strategies that support local efforts while fulfilling watershed-wide objectives; ensure that the partnership considers all taxa of invasive species, in addition to plants.

* Help develop invasive species partnerships in CPAs where none currently exist, with priority given to those CPAs falling within priority areas identified in the report specified above and additional analyses stemming from that report.

Rationale: See rationale for entire objective below.

- ***Invasive Species Outreach***: Provide target audiences and concerned citizens with the information they need to take meaningful actions to control or prevent species spread on their own lands or through their recreational and/or professional activities. Specifically we will:

  * Inform the public about the importance of each person doing their part and supply them with the information to take wise action.

  * Provide targeted outreach to public agencies that may have a role in the spread of invasive plants through their management actions, such as highway maintenance departments.

  * Prioritize actions by considering which species are of highest threat to biodiversity, are threatening rare species, or can most successfully be eradicated; as well as which areas are especially important to restore due to important natural resources; educate partners and public about these priorities.

  * Help groups successfully plan and implement volunteer control days in their communities for plants that are easy to control by hand such as garlic mustard.

  * Develop a list of volunteer opportunities at Refuge treatment areas, CISMAs, or adopted habitats.

Rationale: See rationale for entire objective below.

- ***Early Detection and Rapid Response Control***: Work with partners to design and implement strategies for prevention, early detection, and rapid control response to new invaders, especially those deemed to pose a serious threat to native species populations or biodiversity. Specifically we will:

  * Seek a seat on the Northeast Aquatic Nuisance Species Panel or regularly attend meetings, becoming active in its work to advance prevention, early detection and rapid response within the Northeast.

  * Work with the State invasive species groups to develop lists of the species that would pose serious threats to biodiversity if they enter the watershed and develop a protocol for early detection and rapid response. Focus first on priority species already known to be in New England such as zebra mussel, Asian longhorn beetle, monk parakeet, hemlock wooly adelgid, emerald ash borer, mute swan, hydrilla, mile-a-minute vine, and Japanese stiltgrass.

  * Continue water chestnut spread control actions by assisting to find funds for large populations, leading groups to hand-pull smaller populations, and inspecting other water bodies for this species. Locate groups willing to "adopt a water body for water chestnut control" to further the refuge's efforts.

Rationale: See rationale for entire objective below.

- ***Invasive Species Inventories and Mapping***: Work with partners to ensure that inventory results are documented and shared in a timely manner, and to coordinate inventory efforts where possible.

  * Research how much of the watershed is covered in the EDDMapS/ IPANE (Early Detection and Distribution Mapping System/Invasive Plant Atlas of New England) inventory project and what gaps exist, especially on refuge and other conservation lands.

  * Work with partners and volunteers to fill the gaps of the IPANE data within the watershed, (with a special focus on the CPAs and refuge-owned lands) and institute a procedure for the refuge to be notified if any invaders new to the area are discovered.

  * Work with EDDMapS staff to include existing refuge data on invasive plants into the EDDMapS/IPANE database.

Rationale: Addressing invasive plants has been a Service priority since refuge establishment. Much of the refuge's cost share grant program focused on funding invasive plant control projects. The refuge has one full time staff person dedicated to working with partners to control invasive species on both refuge lands and other ownerships in the watershed. We discussed many of the accomplishments of the program in chapter 3. This objective would build off of the existing program to include control work on other high priority invasive species problems within the watershed, including forest pests, aquatic organisms, and problematic wildlife species.

Objective 4.5 Special Designation Areas Partnerships

Support existing Federal and State designated special areas, and work with partners and willing landowners to promote additional designations that enhance the protection and/or recognition of natural, cultural, and recreational resources of significance within CPAs.

Our proposed guidelines and strategies for working cooperatively with others to promote special designations that benefit natural, cultural, and recreational

resources of concern throughout the watershed, with priority attention to CPAs, include the following:

- **Eligibility:** Work with partners to share information with willing landowners on eligibility requirements for, and the benefits of, special designation areas.

- **Monitoring:** Work with partners and willing landowners to establish a monitoring program, or implement ones already developed, and pool resources to accomplish that monitoring, in an effort to ensure that the special designation areas maintain their characteristics.

Rationale: Special designation areas in the watershed include, but are not limited to: Research Natural Area; Federal and State Wild and Scenic River; American Heritage River; National Recreation Trail (land and water trails); National Scenic Trail (land and water trails); National Historic Trail; National Natural Landmark; National Historic Landmark, Site, or Monument; National Register of Historic Places site; National Wilderness Preservation System Area; Important Bird Area; National Blueway; Scenic Byway; and Ramsar Wetlands of International Importance.

USFWS

Barred owl at festival

Each of these designations has distinctive criteria for qualifying, and many have specific guidelines for their maintenance and management. Some are designated by Congress or State legislatures and thereby supported by laws and regulations, while others are identified by conservation organizations or individuals and are voluntary programs. Establishing these areas promotes their uniqueness, and for those that are regulated, ensures their protection under law. In addition, a special designation can provide an advantage when seeking grants or other special funding opportunities for management and maintenance.

We would continue to work with partners to protect existing special designation areas and the characteristics that make them unique. Important to that effort will be cooperatively establishing and implementing monitoring protocols that evaluate the condition of special areas. In addition, we would support the designation of new areas that are of natural, cultural, or recreational significance in the watershed. For example, on refuge lands we are currently working with the Service's Regional cultural resources staff, the Connecticut State SHPO, members of Congress, and other stakeholders to evaluate what type of special designation is appropriate for the Venture Smith property on the Salmon River Division. We also propose to expand the existing National Natural Landmark on the refuge's Pondicherry Division.

Objective 4.6 Research and Demonstration Partnerships, Particularly in Support of Climate Change Adaptation

Create, enhance, or facilitate partnerships that advance conservation research in the Connecticut River watershed, leveraging resources among partners, with an emphasis on advancing our understanding of climate change and land use impacts and pursuing adaptation strategies in response, to ensure the long-term sustainability of native fish, wildlife, plants, and associated habitats found in the CPAs.

Our proposed guidelines and strategies for working cooperatively with others to facilitate deliberate research and demonstration projects in support of climate change adaptation throughout the watershed, with priority attention to CPAs, include the following:

- ***Conservation Science Partnerships and Information Exchanges*:** Promote research and development of applied management practices in the Connecticut River watershed to sustain and enhance the natural and cultural resources in concert with partners whose mission is to advance science. Seek opportunities that engage research institutions and organizations such as universities and

colleges and non-governmental organizations. Working with the NALCC and other partners, develop, implement, and support cooperative research programs that address priority conservation and management needs or which provide basic information on species' populations, their habitat needs, and response to climate change.

Facilitate use of the refuge to apply science tools and information and implement projects identified by the NALCC and other science partners in an effort to advance our collective understanding of natural systems and to address specific conservation challenges found in the watershed. Sponsor the development and implementation of a landscape conservation design project for the watershed in partnership with the NALCC members. Encourage opportunities on the refuge for research, inventory and monitoring, and the demonstration of management practices.

Rationale: See rationale for entire objective below.

- ***Inventory and Monitoring Program***: Support cooperation among partners involved in inventorying and monitoring resources of common conservation concern. Promote the efforts of the NALCC partnership to identify common inventory and monitoring needs and help the NALCC with sharing resources to accomplish priority work. Refuge staff can demonstrate to partners existing inventory and monitoring protocols that are implemented on refuge lands, as well as share the results of the Service's Regional Refuge IMP. Refuge experiences can serve as a practical application of what information is collected, how it is collected and used, and to help establish baseline ecological conditions across a larger land base. Similarly, we would support the Service's Land Management Research and Demonstration program (LMRD) and the inventory and monitoring priorities identified for the watershed.

Rationale: See rationale for entire objective below.

- ***Climate Science and Adaptation***: Work with partners at the federal, state, and local levels to identify threats from, and to promote adaptations for addressing, climate change. Promote planning by watershed communities for resilient landscapes in an effort to minimize the impacts of climate and land use changes, and to derive the full potential of ecosystem services benefits. Promote the work of the NALCC to model land use and climate change and the projected impacts on fish, wildlife and habitats. We will particularly encourage actions to restore floodplain forests and riparian buffers that protect public and private property from increased incidents of severe weather events, and any actions that would improve water quality in rivers and streams. We would continue to promote within the watershed the particular skills and resources that some partners have to address climate change. Examples of these capacities include Trout Unlimited's skill at restoring fish passages and reconnecting tributaries to the mainstem of the river, TNC's floodplain restoration program, NRCS's grassland restoration program, Southern New England-New York Bight Coastal Program's expertise on saltmarsh restoration, and the climate change programs in each of the four States respective university systems.

  The Northeast Climate Science Center (NECSC) is part of a Federal network of eight Climate Science Centers across the country created to provide scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change. The NECSC is hosted at the University of Massachusetts in Amherst, Massachusetts. Service staff will be active members of this important scientific community, and we will encourage other partners to be as well.

The Service plans to develop a system-wide set of best practices for adaptation to the effects of climate change. The refuge's responsibility will be to share this knowledge with partners, and implement and monitor those practices on units and divisions under our management at the refuge level. We will encourage partners to pursue these practices as well, and to share their results, local knowledge, practical experience, and observations.

Rationale: Because of the watershed's diversity of species and habitat types, it is an ideal landscape to research and monitor the effectiveness of species, habitat, and climate models developed through the NALCC and NECSC, as well as to apply adaptive land management practices. The watershed represents a north–south migration corridor for many species, with tremendous habitat diversity in terms of land cover, altitude, latitude, and aspect. It is a living laboratory to support research on fish, wildlife, and plant adaptation to the effects of climate change. Refuge lands can play a key role in research, inventories, monitoring, and evaluating land management practices attempting to address conservation issues. A list of our current scientific partnerships is included in appendix M.

Objective 4.7 Community-based Partnerships

Create, enhance, or facilitate partnerships within watershed communities that enhance the Service's ability to make positive contributions to civic life and local economies, and enrich community connections to a healthy, vibrant watershed (see objective 4.8 for those partnerships specifically dedicated to education, interpretation, and recreation).

Our proposed guidelines and strategies for working cooperatively with others to facilitate community partnerships throughout the watershed, with priority attention to CPAs, include the following:

- ***Economic Vitality within the Watershed***: In conjunction with the strategies described under goal 2–Education, Interpretation, and Outreach, above–enhance the economic vitality of communities in the Connecticut River watershed through nature-based and ecotourism initiatives, agriculture and forest protection programs, and recreational activities that both advance strategic conservation and improve broad-based visitation to the refuge. Meet with local community officials and leaders to establish how the Service can make a positive contribution to local economies consistent with the Service and Refuge System missions, and refuge purposes where refuge lands are involved. Also, communicate with local businesses when refuge staff are contemplating contracts that have the potential for economic opportunity, including timber harvest, and construction and maintenance activities.

Rationale: See rationale for entire objective below.

- ***Historic and Cultural Resources***: As appropriate, support the protection, management, and restoration of cultural resources in the Connecticut River watershed and promote opportunities to connect people to the area's rich history. Identify and develop working partnerships with academic institutions, museums, and Tribal governments with the goal of identification, protection, and interpretation of historic and cultural resources, particularly land-based features, archaeological sites and artifacts, Native American history and contemporary lives, historical buildings and sites. The refuge will not lead on projects involving the acquisition, restoration, and interpretation of historic structures, but where practical and appropriate on such projects within CFAs that include a significant land protection component, we will work to be an effective partner in the overall protection effort.

Rationale: See rationale for entire objective below.

- ***Public Safety and Wildland Law Enforcement and Emergency Response***: Whenever needed and appropriate, create law enforcement partnerships of mutual benefit to communities and the refuge. For example, the refuge's Federal wildlife officer would work collaboratively with State game wardens responsible for lands within CPAs in all four states. We would also offer to enter into mutual aid agreements to provide personnel and equipment resources to those municipalities bordering CFAs for the purpose of responding to natural disasters and other emergencies.

Rationale: See rationale for entire objective below.

Sharon Lindsay

Puddles at Mollie Beattie Bog at Nulhegan Basin Division

- ***Shared Facilities***: Whenever practical and appropriate, look for opportunities to treat the refuge land base and facilities as community assets. Make refuge buildings available for community meetings and other appropriate events. Consider opportunities to provide office space to State natural resource and other conservation partners in order to better serve the public interest. Share maintenance equipment and other resources with a wide range of partners when possible.

Rationale: See rationale for entire objective below.

- ***Easements, Leases, Cooperative Agreements, and Special Use Permits***: Employ a wide variety of agreement types to facilitate projects and other opportunities advancing conservation, environmental education, and recreation goals shared with partners in local communities. Ensure the most appropriate agreement is created for each opportunity given expected outcomes and responsibilities. For example, encourage easements to provide additional public access or manage habitats, or to protect important habitat from land development. The Service may pursue low or no-cost leases to facilitate the construction of capital improvements such as Conte Corner installations, boardwalks, trails, and interpretive kiosks. These amenities draw visitors to the area who may spend money in local communities. The Service may issue special use permits to local individuals or organizations for appropriate and compatible uses of the refuge. Cooperative agreements are also an important tool to engage partners in mutually beneficial projects where funding and resources in-kind are exchanged.

Rationale: See rationale for entire objective below.

- ***Constituent Organizations***: Promote relationships with bird clubs, outdoor recreation and sportsmen's clubs, and other constituent organizations to cultivate their support for the refuge's public use objectives, and to encourage constituent involvement in the formation and implementation of those objectives.

Rationale: Healthy watersheds are the foundation of sustainable communities and economies, in addition to benefitting fish and wildlife habitat. Among the many human benefits derived from healthy watersheds and functioning

natural ecosystems are clean air and water, food, waste assimilation, medicinal compounds, outdoor recreation and spiritual renewal (Daily et al. 1997). The economic value of such natural "goods and services" is significant and has been estimated to be twice the world's gross national product (Costanza et al. 1998). These social, economic, and ecological realities emphasize the importance of watershed based approaches to restoring and sustaining critical land and water resources, with support and recognition of the working landscape and the human communities that depend on them.

The refuge has a presence within multiple communities throughout the watershed by virtue of our management of a growing number of refuge units and divisions, and community outreach efforts. At the core of the rationale to create and maintain strong community partnerships is the requirement that we be good citizens and environmental stewards. We will continue to strive to play a positive role in the well-being of these cities and towns by managing the refuge in ways that improve the quality of the local environment, making refuge units, divisions and facilities attractive and welcoming to visitors, and capitalizing where practical and appropriate on local partnership opportunities from civic events to land management issues. A list of current partners important to our efforts to build and sustain strong community partnerships is included in appendix N.

There are many formal ways for the Service to show commitment and support for these partnerships, both monetary and non-monetary. Cooperative agreements with communities and private organizations can provide a means to share goals, such as the development and delivery of refuge-specific environmental education programming. Special use permits allow for compatible activities on refuge lands and are used to allow economic activities that enhance a visitor's experience, such as guided interpretive outings for hire. Through MOUs with other Federal agencies, state agencies, local municipalities, community groups and conservation organizations, the refuge and its partners can pool resources for important land protection projects, habitat management efforts, and recreational initiatives. Previously, the Service and NRCS shared the cost of an employee housed at the refuge, dedicated exclusively to advancing partnership opportunities between NRCS and the Service within the watershed.

Objective 4.8 Educational and Interpretation Partnerships

In conjunction with the strategies described under Goal 2–Environmental Education, Interpretation, and Outreach, above–coordinate our educational, outreach, and interpretive conservation programs with those of our partner agencies and organizations so that a consistent public message fosters respect for the natural world and gets more people motivated to promote conservation in their daily lives.

Our proposed guidelines and strategies for working cooperatively with others to facilitate connections between people and nature throughout the watershed, with priority attention to CPAs, include the following:

- ***Educational Partnerships***: Work with each of the four State environmental education program coordinators and other partners to identify effective education programs, to integrate curriculums where appropriate, and to promote consistent standards of excellence for educational programs offered in the watershed.

Rationale: See rationale for entire objective below.

- ***Integrated Messaging***: Work with environmental education partners to clearly communicate respective missions, goals, and priority programs and activities to minimize redundancy and facilitate targeted outreach and responses to constituent groups. Develop a common language about the goals of the education partnership as an effective way of attracting financial,

organizational, and human resources to the refuge and our partners. Develop and deliver integrated interpretive messages about natural, cultural, and historic resources along regional land and water trails and scenic byways that connect refuge lands with conserved properties owned by state and private partners. Contribute interpretive information regarding the refuge to partner programs such as Vermont's Scenic Byways publications. Reinforce the refuge as a location for educational programs.

Rationale: See rationale for entire objective below.

- ***Facilities Partnerships Designed to Connect People and Nature***: Continue and enhance those partnerships based in facilities that are effective in reaching a wide and diverse demographic with consistent and productive messages about the refuge and the Service's contribution to conservation in the watershed. Continue to seek new opportunities where this same goal can be met. The existing partnerships include:

  * MOU/Cooperative Agreement between the refuge and Vermont Institute of Natural Science: This relationship provides for the development and delivery of refuge-specific programming, such as a watershed-learning module and staffing the refuge's WoW Express.
  * Cooperative Agreement between the refuge and Montshire Museum: The Montshire constitutes the refuge's Vermont "visitor center." This relationship allows the refuge to have exhibits in the museum.

  * Cooperative Agreement between the refuge and Springfield Museum: The Museum provides space to host and maintain a Conte Corner exhibit and partners with the refuge in outreach programs involving the WoW Express.

  * Cooperative Agreement between the refuge and Northwoods Stewardship Center: The Northwoods Center provides for staffing and supervision of YCC crews at several refuge divisions. YCC participants assist with trail construction and maintenance, and habitat management projects. The program informs participants about refuge goals and resources and contains an environmental education element.

  * Cooperative Agreement between the refuge and Siskin Ecological Adventures: This collaboration reaches out to those communities surrounding the Nulhegan Basin Division, engages participants in activities at the division, and informs participants about the division's conservation role and recreational opportunities.

  * MOU between the refuge and Cabela's: The Cabela's outfitter store in East Hartford, Connecticut, provides space to host and maintain a Conte Corner exhibit and support other outreach and interpretive activities in partnership with refuge staff.

  * MOU between the refuge and Putney Mountain Association: This collaboration provides for designation and management of a shared hiking trail network across ownerships, as well as, trail enhancements and publications.

  * MOU Between the refuge, the Massachusetts Department of Conservation and Recreation, and the town of Montague Economic Development and Industrial Corporation: The partnership supports the operations of the Great Falls Discovery Center in Turners Falls, Massachusetts. The purpose of the center is to provide opportunities for the study, understanding, and

enjoyment of fish and wildlife in their native habitat. The center interprets the cultural, geological, and ecological history of the watershed and encourages visitors to get involved in conservation activities. (See appendix A for more details on our proposed environmental education, interpretation, and outreach objectives and strategies for this facility).

Rationale: The 7.2 million acres of the watershed offer an extraordinary range of active and passive opportunities to observe, interact with, and recreate in the natural world. Accentuating the refuge's relevance to our constituents and their communities allows us to maintain a position of environmental leadership and enhances our ability to deliver the outcomes envisioned under the four broad goals of this CCP. Though our fundamental mission is wildlife conservation, we recognize that to be successful, we must inspire the people of the watershed to connect with the abundant natural resources and participate as stewards of the refuge. As an integral part of local communities, the refuge is a great umbrella under which to build a broader conservation constituency. The refuge will work with schools, civic groups, and individuals to share our passion for the environment and our mission. We must push ourselves to reach out to those who are yet unfamiliar with who we are and what we do. Part of our mission is ensuring that all citizens within the watershed benefit from the refuge, and this will help sustain strong support for the refuge and Refuge System as a whole. Our goal must be to inspire all Americans to become part of a conservation constituency.

Objective 4.9 Recreation Partnerships to Connect People with the Outdoors

Work with partners to promote and provide outdoor recreational opportunities in the watershed that facilitates connecting people with nature in a meaningful way, and encourages those connections over their lifetimes. Promote the development of a landscape based recreation strategy within the watershed to connect, protect, and enhance a network of aquatic and terrestrial trails.

Our proposed guidelines and strategies for working cooperatively with others to facilitate recreational opportunities throughout the watershed, with priority attention to CPAs, include the following:

- ***Federal and State Agency and Local Community Strategic Recreation Plans***: Support Federal and State agency partners in their recreational planning and implementation efforts. Those include Forest Service plans, respective States Comprehensive Outdoor Recreation Plans, and Federal and state agency transportation plans. Also, support implementation of other recreation plans developed and adopted by local communities.

Rationale: See rationale for entire objective below.

- ***Making Connections Outdoors***: Promote activities that connect people with the outdoors through improving coordination with other Federal and State agencies, including the Federal Interagency Council on Trails, the Connecticut River Recreational Management Plan (2009), educational and recreational organizations, and user groups. Help sustain regional trails that connect people with nature, such as the Northern Forest Canoe Trail, Connecticut River Birding Trail, Connecticut River Paddlers' Trail, and the "Source to the Sea" birding trail. Engage with partners to develop concept plans, interpretive materials, and conduct inventories of infrastructure to support these trails and initiatives.

Rationale: Public recreation and enjoyment of the outdoors has been part of the culture of the watershed for centuries. The range of opportunities in the area allow for visitors seeking solitude and inspiration in its forests and mountains, water-based challenges afforded by one of the nation's great rivers, and more developed opportunities. The 2009 Connecticut River Recreation Management

Plan notes that the significance of the region for public recreation is growing, as evidenced by the many special designations bestowed on the region, including scenic byways and blueways, and heritage and historic water and hiking trails. These are in addition to the thousands of acres providing public recreation on Federal and State lands. We can only expect greater public use of the river and the valley which will provide both opportunities and challenges. The challenges include encouraging the use and enjoyment of public lands, while also protecting the region's natural resources, beauty, and quality of life.

Objective 4.10 Friends Groups

Develop and nurture active and vibrant Friends groups through formal, strategic support programs, and by strengthening communication, collaboration, and cooperation. Include them as full partners in the mission delivery of the refuge and the Refuge System. Implement national guidance on mentoring Friends groups designed to ensure each group's effectiveness in supporting the refuge, as well as to provide training and organizational resources, and encourage networking among Friends groups across the Refuge System. Provide guidance to partners who want to create Friends groups on other ownerships.

Our proposed guidelines and strategies for working cooperatively with others to facilitate the creation and support for Friends groups include the following:

- ***Friends of Conte Refuge***: Encourage and cultivate the incredibly effective "Friends of Conte" group and promote them as a model for how other groups around the country can support landscape-scale conservation. Support the Friends of Conte in their work on the ground as individual organizations, and in their collective advocacy role as a regional and national voice on environmental issues and matters of importance to the Refuge System and the Service. Continue to use the Friends Steering Committee recommendations to help evaluate refuge policies and priorities for all aspects of refuge operations.

Rationale: See rationale for entire objective below.

- ***Friends Groups for Refuge Units and Divisions***: Develop, promote, and support existing Friends groups at each of the refuge's divisions. As the refuge begins to form new divisions within CFAs, help develop and grow new Friends groups modeled on the success of the Friends of Pondicherry. Strong community outreach by refuge staff in new host communities will be the key to forming new groups, as well as being responsive to community needs and interests. Annual planning will occur to set goals and objectives for projects and programs in support of the refuge and the Friends group for the coming year, as well as to evaluate the past year's activities. We will formalize each group's relationship with the Service through a written agreement. We will also encourage each Friends groups to pursue status as a 501(c)(3) organizations (under the Service's new Friends group policy, official refuge Friends groups must have nonprofit status under Section 501(c)(3) Title 26 of the Internal Revenue Service code; 633 FW 1).

Rationale: See rationale for entire objective below.

- ***Support for Friends Groups on Other Ownerships***: Continue to promote and support the Friends of the Great Falls Discovery Center and provide resources to conservation groups, landowners, neighbors, and others interested in establishing a Friends group on other ownerships.

Rationale: Friends groups have become a vital component of the work we do on the refuge. Members serve as advocates for refuge resources, partners in refuge initiatives across all four broad goals, providers of science and research on issues affecting habitat and wildlife conservation at the refuge, and volunteers at individual refuge divisions or units. They provide support for specific essential

services to our sites and programs, including community outreach, coordinating special events, developing and delivering educational, interpretive, and other visitor services programs, coordinating volunteers, conducting habitat restoration and biological program support, and assisting in maintenance projects. Friends groups are an essential and irreplaceable resource to refuge management and visitor opportunities. The Service adopted policy for Friends groups in 2014. This policy (633 FW 1-4) recognizes the values Friends groups provide in achieving the Service and Refuge System mission and provides policy, guidance, and administrative procedures for Service employees to establish partnerships and working relationships with Friends organizations.

The Friends of Conte is an "association of organizations" that has become a leading advocate for conservation, environmental education, wildlife- and fish-related recreation, and stewardship in the Connecticut River watershed. This Friends organization is comprised of more than 70 of the country's most accomplished national, regional, and local land conservation, recreation, sustainable economic, and environmental advocacy organizations. Drawing upon the broad local experience and national prominence of group members such as TNC, Audubon Society, and the Trust for Public Land, this group has effectively supported a wide variety of refuge initiatives.

The refuge is also fortunate to have the support of strong and dedicated Friends groups at its Pondicherry and Nulhegan Basin Divisions, and at the Great Falls Discovery Center. Members of these Friends groups interact with visitors, identify and assist in maintenance needs, monitor wildlife, conduct educational workshops, and provide other valuable support activities. Other Friends groups that are forming include the Connecticut River Paddlers' Trail, Friends of Roger Tory Peterson Unit, and Friends of Salmon River.

In promoting and supporting Friends groups across the country, the Service has developed many resources to assist others in that endeavor. These materials are available to our partners who may be interested in developing a similar group. In addition, if there is interest, we could help identify mentoring opportunities whereby a refuge Friends group could assist a partner group.

Objective 4.11 Intergovernmental Partnerships

Pursue strategic and synergistic intergovernmental partnerships at all levels of government to achieve specific, shared, and compatible landscape-level goals for conservation, education, and recreation within the watershed. Work within existing Federal and State programs to the full extent possible to help leverage funding and staff resources, information, and expertise among public and private partners. Formalize agreements through MOUs, Memorandums of Agreement (MOAs), or other written, intergovernmental agreements, as warranted, when the identification of roles, responsibilities, and measures of success would enhance the likelihood of successful implementation.

Our proposed guidelines and strategies for working cooperatively with others to develop strategic, intergovernmental partnerships, with priority attention to benefitting CPAs, include the following:

- **Existing Intergovernmental MOUs:** Continue to support existing MOUs and other intergovernmental agreements that are facilitating the Service and Refuge System missions, Conte Refuge goals, or other conservation priorities in the watershed. Work with partners to monitor and evaluate MOUs prior to their renewal; continue, modify, or drop MOUs as warranted. The following provides a brief overview of MOUs' currently in place.

* MOU with Natural Resources Conservation Service: This MOU, entered into in 2011, created a "Connecticut River Partnership" between the Service and NRCS to pool human and financial resources where appropriate in pursuit of the Refuge's legislative purposes and the objectives of the Obama administration's AGO initiative.

* MOU establishing the Connecticut River and Watershed National Blueway**:** The purpose of this MOU (May 2012) between the Departments of the Interior, Agriculture, and Army, is to identify and create opportunities to work together as partners to accomplish shared, compatible, and priority conservation, restoration, outdoor recreation, and environmental education objectives. A principle goal of this partnership is the pursuit of a comprehensive and integrated management approach to conserving the Connecticut River's s land and water resources.

* MOU Between the Connecticut River Watershed Council, the Friends of Conte Refuge, and Conte Refuge: This MOU (April 2012) commits the partners to actively pursue opportunities with Federal agencies to recognize, value, and obtain the necessary resources for conservation, recreation, and education opportunities in furtherance of the refuge's legislative purposes.

* MOU Establishing the Connecticut River Watershed as a Large Landscape Demonstration Project under the America's Great Outdoors Presidential Initiative***:*** This MOU (December 2012) was established under existing authorities, including the President's Memorandum of April 16, 2012: *A 21st Century Strategy for America's Great Outdoors.*" This MOU recognizes the overlapping and complementary conservation interests of nine Federal agencies. It also recognized the "...great potential for mutual benefit from enhanced cooperation and synergies, especially in the area of large landscape conservation where alignment of multiple resources will result in strategic and effective conservation outcomes." Three guiding principles were identified relating to the importance of integrated planning and implementation, shared capacities, and shared science and information. Nine goals and objectives identify action items agreed upon.

Rationale: See rationale for entire objective below.

- **Federal Agency Coordination:** In addition to those relationships noted above, continue to engage Federal agencies in shared conservation goals and priorities for the watershed, and to expand, expedite, and enhance the deployment and desirable impacts of Federal programs through public and private partnerships. Seek opportunities, to the extent possible, to share financial and staff resources, information, expertise, and otherwise leverage multi-agency investments in the watershed to accomplish shared goals and attract other investors. Utilize the AGOs framework to catalyze and bolster local, community-driven conservation efforts and demonstrate how a strong Federal agency partnership can more effectively align, target, and leverage public resources across a large landscape to accomplish shared goals and objectives.

Specifically, expand on opportunities to partner with:

- The USDA and its existing agencies and programs that contribute toward the planning, managing, and sustainability of fish and wildlife habitat, water quality and watershed health, working landscapes (including agriculture and forestry), recreational opportunities, and land protection. The NRCS has eight landowner assistance programs. As mentioned under objective 4.1 above, there

is a 2016 Service Director's Order #217 detailing a partnership with NRCS to assist private landowners through their Working Lands for Wildlife and other programs and achieve agency conservation goals. The Forest Service supports land protection, management, and public access on other ownerships through their Forest Legacy, Community Forest, and Forest Stewardship programs. Additional private lands assistance is offered through the Farm Service and Rural Development agencies.

- The Department of Transportation (DOT) and its programs that facilitate public access to public lands, improve byways, develop and maintain trails, and address problematic fish barriers and wildlife crossings caused by transportation infrastructure. Public Lands Highway, Surface Transportation, National Scenic Byways, and Federal Highway Administration Recreational Trails Grants, are all DOT programs with potential funding to support projects by public and private partners.

- The Department of Labor and its programs that implement youth employment opportunities in the field of conservation. The Employment and Training Administration Program, pursuant to the Workforce Investment Act, supports grant opportunities to fund work for youth who could be employed and trained in work related to conservation.

- The Department of Commerce, NOAA, and its programs related to dam removal, aquatic species passage, and coastal wetlands restoration. Their Community-based Restoration grants and other related programs support grant opportunities for these types of projects.

- The Department of Housing and Urban Development, and its programs to help develop green open spaces in cities, restore habitats, and enhance water quality. Grants and other funding sources are available in support of these programs.

- The EPA and its programs to protect, preserve, and promote water quality, urban revitalization, habitat enhancement, and environmental stewardship. Grant funding opportunities are available for public-private partnerships through their Urban Waters Federal Partnership Initiative, Brownfields pilot program, Watershed Planning and Implementation program, Wetlands Program Development, as well as grants for monitoring and assessments, environmental education, and community watershed restoration projects.

- The USACE and its programs that manage water resources infrastructure to coordinate on fish passage concerns, opportunities to promote more natural riverine flows and function, and support outdoor recreational opportunities.

- **Tribal Government Coordination:** Under all alternatives, refuge staff would continue to coordinate with federally recognized Tribal governments in areas of mutual interest, including hunting and fishing opportunities and access, wildlife and aquatic habitat management, federally listed species management, wildlife and fish habitat projects, and land protection. Federally recognized tribes we would coordinate with include: Mashantucket Pequot Tribal Nation, Mohegan Tribe of Indians of Connecticut, Stockbridge-Munsee Band of the Mohican Nation, Narragansett Indian Tribe (Connecticut River Valley), Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head (Aquinnah).

Rationale: As noted above, there are multiple Federal agencies with conservation missions or conservation-related programs that offer valuable contributions to the conservation community. Each can bring significant resources in pursuit of

the four Conte Refuge goals related to conservation, education, recreation, and partnerships.

The AGO's initiative provides a framework within which to work together to meet those goals. The framework provides a catalyst for Federal agencies to lead or facilitate efforts promoting the watershed as nationally significant for conservation, education, and recreation. The design is to work within current Federal authorities and funding, and leverage those resources to attract other public and private partners to "invest" their resources consistent with their own priorities. This collaboration, as described in the America's Great Outdoors MOU would serve to "…bind together the many existing and complimentary visions for the River, held by a wide array of governmental and NGOs to stimulate new achievements and energize existing creative public and private partnerships in the spirit of the America's Great Outdoors Initiative."

While some beneficial programs are listed above, there are likely more to be explored, and some new programs have potential for the near future. For example, under consideration in Congress is a new Water Resources Development Act (WRDA) which would authorize the USACE, as managers of the nation's largest water resources program, to develop cost-effective, nature-based solutions to water problems and modernize our water infrastructure.

The status of the Farm Bill is always noteworthy. A 5-year reauthorization was recently enacted. Some argue that this Act represents the nation's largest investment supporting the voluntary and successful conservation, restoration, and management of America's private lands. It provides incentives to farmers, ranchers, and other private landowners that result in cleaner water, improved soil conservation, enhanced wildlife habitat and outdoor recreation opportunities, reduced flood risk, and stronger local communities.

With regards to federally recognized Tribal governments, the U.S. has a unique legal relationship with these governments as set forth in the Constitution, and in treaties, statutes, executive orders and court decisions. The U.S. recognizes these tribes as domestic dependent nations under its protection and has enacted numerous statutes and promulgated numerous regulations that establish and define a trust relationship with Indian tribes.

Due to this unique and distinctive political relationship, the Service maintains government-to-government relationships with federally recognized Tribal governments. In particular, the Service works directly with Tribes when planning and implementing natural resource programs, and to protect and respect Native American values.

Close coordination with federally recognized Tribes supports all four refuge goals.

Comparison of Management Objectives, Actions, and Strategies by Alternative

Table 4.6 below further compares and contrasts what distinguishes the four management alternatives evaluated in detail in this final CCP/EIS. It provides additional details on the strategic management direction and actions that would be undertaken for each alternative. The listing of strategies and associated actions by alternative in the table below assumes each respective alternative's full implementation, including the staffing, funding, and infrastructure needed to support those strategies and actions. The presentation is organized by resource and program features. Further details on implementing Alternative C, the Service-preferred alternative, are presented in appendix A and C. We recommend readers also consult the preceding sections in chapter 4 titled "Actions Common to All Alternatives" and "Actions Common to Alternatives B, C, and D" to understand the full range of actions proposed under each alternative.

Table 4.6. Summary Comparison of Management Objectives, Actions, and Strategies by Alternative Proposed in the Conte Refuge CCP

	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Management Framework	Alternative A represents our current management, as described in the 1995 FEIS for the refuge, as well as subsequent management direction outlined in EAs. Under alternative A, we would continue to manage existing refuge lands for native wildlife and fish and continue to acquire new refuge lands in SFAs, scattered rare species sites, and important, scarce and vulnerable wetlands delineated in the 1995 FEIS, as amended. The primary objective is to protect habitat for species listed in the refuge's purposes, including federally and State-listed threatened and endangered species. We would also continue to offer our existing level of public use and work with partners to achieve common goals throughout the watershed.	Our habitat management and public use programs would be very similar under alternatives B and C. The primary difference is the larger land base under alternative C, essentially doubling the area within which we would enhance and expand these programs. Under both alternatives we would focus on providing and enhancing habitat for migratory birds, fish, and other native wildlife; using SHC to address landscape-scale issues, such as climate change; emphasizing connections between conserved lands and recreational opportunities; and expanding opportunities for priority public uses. We would also continue to work with partners across the watershed, but prioritize where in the watershed we would focus our resources by creating Conservation Partnership Areas (CPAs; see below) that represent areas we think are most important for achieving the Service and Refuge System missions and refuge purposes and goals. Both alternatives B and C introduce the concept of Conservation Focus Areas (CFAs; see below). These are areas within CPAs that have high resource values for Federal trust resources and where we propose to acquire land for the refuge in fee, conservation easement, or through a cooperative agreement. Instead of the small, scattered SFAs under alternative A, the acres in CFAs are grouped into fewer, larger, contiguous blocks to provide more connected habitat. As compared with alternatives A and B, alternative C proposes to expand the approved refuge boundary by 99,957 acres. The proposed expansion would focus on protecting and conserving larger, contiguous blocks of habitat and providing habitat connectivity between conserved lands. Since we are proposing a greater refuge expansion under alternative C, there would be more public use opportunities (e.g., more acres open to hunting, more trails, etc.) and more habitat acres than in alternative B. New infrastructure would be provided to encourage access for people of all abilities, such as trails and trailheads, parking lots, interpretive signage, etc.		Under alternative D, we would focus on allowing natural processes to proceed with minimal management intervention. We would also focus on offering priority public uses that provide a more "back-country" experience. Public use infrastructure would be limited to trailhead information signs, narrower, less developed trails, and smaller parking lots. Alternative D would introduce the same CPA and CFA concept as alternatives B and C, but proposes the largest refuge expansion. The additional proposed acres would focus on making connections between conserved areas to create wildlife migration corridors, conserve larger, more contiguous tracts of land for area-sensitive species, and help mitigate climate change impacts.
Conservation Partnership Areas (CPAs)	No CPAs—instead of targeted conservation areas, we would work with partners throughout 7.2 million-acre Connecticut River watershed.	Work with partners in 7.2 million-acre Connecticut River watershed, with particular focus on developing and enhancing partnerships in 16 CPAs.	Work with partners in 7.2 million-acre Connecticut River watershed with particular focus placed in developing and enhancing partnerships in 19 CPAs. Approximately 10% of the approved acquisition authority (see below) would occur within CPAs, acquired from willing sellers only, and after coordination with respective municipalities, State, and abutting landowners. The criteria for acquisition are the same as CFAs.	
Conservation Focus Areas (CFAs)	No CFAs—we would continue to acquire lands in 65 SFAs, scattered, rare species sites, and important, scarce and vulnerable wetlands.	Establish 18 CFAs that would become refuge divisions with land purchased from willing sellers (includes existing 9 divisions).	Establish 22 CFAs that would become refuge divisions with land purchased from willing sellers only (includes existing 10 divisions). The CFAs are larger under alternative D than under alternative C. Approximately 90% of the approved acreage authority, on average, would be acquired in CFAs following criteria identified in appendix C. The remaining 10% acquisition authority would occur in the surrounding CPA as noted above.	

	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Total Approved Refuge Acquisition Authority	Total approved refuge acquisition authority 97,830 acres (This includes post-1995 FEIS expansions to Nulhegan Basin and Pondicherry Divisions).	Total approved refuge acquisition authority 97,772 acres	Total approved refuge acquisition authority 197,337 acres	Total approved refuge acquisition authority 231,307 acres
Existing Refuge Units	Maintain 11 existing units totaling 708 acres: • Putney Mountain (VT) • Hatfield (MA) • Fannie Stebbins (MA) • Wissatinnewag (MA) • Third Island (MA) • Mount Toby (MA) • Mount Tom (MA) • Honeypot Road Wetlands (MA) • Dead Man's Swamp (CT) • Roger Tory Peterson (CT) • Saddle Island (NH)			

	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Existing and Proposed Refuge Divisions, assuming full implementation of alternative	There are 10 existing divisions. As lands are purchased from willing sellers only, SFAs become refuge divisions or units: **Existing Divisions** • Blueberry Swamp (NH) • Dead Branch (MA) • Fort River (MA) • Mascoma River (NH) • Mill River (MA) • Nulhegan Basin (VT) • Pondicherry (NH) • Salmon River (CT) • Westfield River (MA) • Whalebone Cove (CT) • Assuming acquisition of new SFAs, potentially new divisions could be established.	Full implementation would result in the following 18 existing and new divisions (once purchased, lands in CFAs would become refuge divisions): **Existing Divisions** • Blueberry Swamp (NH) • Dead Branch (MA) • Fort River (MA) • Mascoma River (NH) • Mill River (MA) • Nulhegan Basin (VT) • Pondicherry (NH) • Salmon River (CT) • Westfield River (MA) • Whalebone Cove (CT) **Proposed Divisions** • Ashuelot River (NH) • Farmington River (MA/CT) • Maromas (CT) • Ompompanoosuc (VT) • Pyquag (CT) • Quonatuck (mainstem) • Scantic (CT) • West River (VT)	Full implementation would result in the following 22 existing and new divisions (once lands purchased from willing sellers only, CFAs would become refuge divisions): **Existing Divisions** • Blueberry Swamp (NH) • Dead Branch (MA) • Fort River (MA) • Mascoma River (NH) • Mill River (MA) • Nulhegan Basin (VT) • Pondicherry (NH) • Salmon River (CT) • Westfield River (MA) • Whalebone Cove (CT) **Proposed Divisions** • Ashuelot (NH) • Farmington River (MA/CT) • Maromas (CT) • Muddy Brook (CT)* • Ompompanoosuc (VT) • Ottauquechee River (VT)* • Pyquag (CT) • Quonatuck • Scantic (CT) • Sprague Brook (NH)* • West River (VT) • White River (VT)* *Proposed divisions under alternatives C and D, but not under alternative B	
Refuge Staffing	Maintain existing refuge staff (see appendix H for current staffing chart).	If funding allows, add additional administrative, biological, maintenance, and visitor services staff (see appendix H for proposed staffing chart).		Compared to alternatives B and C, under alternative D , we propose fewer additional staff (see appendix H for proposed staffing chart).

	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Administrative and Visitor Facilities	Maintain existing facilities, including: • Refuge office in Sunderland, MA (co-located with the Service's Connecticut River Coordinator's Office). • Refuge office and visitor contact station at Nulhegan Basin Division in Brunswick, VT. • Great Falls Discovery Center (State-owned, cooperatively managed building) in Turners Falls, MA. Primarily provide support for programs as funding allows.	In addition to alternative A: Depending on future staffing levels, additional office space may be needed. • Consider creating outdoor environmental education facilities at Fort River Division. This project may require additional NEPA analysis, including a public comment and review period.		In addition to alternative A: • Depending on future staffing levels, additional office space may be needed.

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Goal 1 Wildlife and Habitat Conservation. Promote the biological diversity, integrity, and resiliency of terrestrial and aquatic ecosystems within the Connecticut River watershed in an amount and distribution that sustains ecological function and supports healthy populations of native fish, wildlife, and plants, especially Federal trust species of conservation concern, in anticipation of the effects of climate, land use, and demographic changes.				
Objective 1.1 *Forested Uplands and Wetlands (Including Riparian and Floodplain Forests)* In cooperation with willing landowners and other partners, protect, manage, and restore forested habitats within the Connecticut River watershed. These forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate and land use changes, and support forest-dependent species of conservation concern, including migratory birds and federally listed endangered and threatened species.				
Forested Uplands and Wetlands: • **Core Forest Blocks** • **Forest Corridors** • **Forest Age, Structure, and Composition** • **Forest Wetland Integrity** • **Climate Change Adaptation**	*Off Refuge Lands* Limited and indirect support and guidance for restoration efforts on other ownerships within the watershed. *On Refuge Lands* The majority of forest on the refuge will be passively managed and protected as mid- to late-successional forest to benefit a variety of migratory birds and other native wildlife. Active habitat management on refuge lands is limited to the few, larger refuge divisions, including the Nulhegan Basin Division and Pondicherry Division. Majority of SFAs are small and scattered throughout the watershed. • Continue to implement woodcock habitat management at Nulhegan Basin Division (approximately 60 acres managed every 5 years). • Continue approximately 6 acres of forest stand management every 2 to 3 years at the Pondicherry Division.	*Within CPAs* Work with partners and willing landowners within the watershed, with a priority on CPA lands, to: • Protect, restore, and promote unfragmented, contiguous blocks of forest. • Promote a diversity of forest age, structure, and composition to benefit a diversity of native fish, wildlife, and plants. • Maintain hydrologic functions and wildlife values of forested wetlands by protecting and restoring natural hydrological regimes and vegetative edges (e.g., restore floodplain forests and replace culverts and bridges). • Assist with developing and implementing effective climate adaptation response strategies. • Support the development of climate change vulnerability assessment models for the Connecticut River watershed. • Support and provide guidance for forest restoration efforts off refuge lands through: ∗ Grant support, writing, and "ghost writing." ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements.	*Within CPAs* Same as alternatives B and C. *On Refuge Lands* • No active forest management on refuge lands, except limited control of invasive species and restoration of natural processes. Instead, use passive management (e.g., natural disturbance processes and successional changes). • Conduct forest inventories and survey wildlife use. • Map natural communities and vernal pools and protect rare and exemplary natural communities. • Assess hydrological conditions of forested wetlands. • Discontinue Nulhegan Basin Division public trapping program. Only manage furbearers via trapping for management purposes on refuge lands if there are threats to human health or refuge infrastructure.	

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Forested Uplands and Wetlands cont.	• Restore forested wetlands, including working with TNC to plant American elm in floodplain forests at Fort River Division. • Continue furbearer management program at Nulhegan Basin Division, including public trapping program, according to State and refuge regulations. Manage furbearers on other refuge divisions and units if there are threats to human health or refuge infrastructure.	*On Refuge Lands* Management of forested uplands and wetlands on the refuge are the same under alternatives B and C, except that there will be expanded and enhanced opportunities to protect, manage, and restore forested habitats to meet refuge and State WAPs under alternative C because of the expanded and better connected refuge land base. Under both alternatives, we would emphasize active forest management to provide contiguous forest habitat to benefit area-sensitive migratory birds and other native wildlife. Acreages below are a rough approximation. Details would be developed in step-down habitat management plans, which will be coordinated with States and stakeholders. • Under alternative B, actively manage approximately 7,660 acres of forested habitat over the 15-year CCP across refuge divisions to improve habitat for priority species, including the acres we are currently managing under alternative A. Under alternative C, this would increase to approximately 11,550 acres over the 15-year CCP horizon. • Conduct forest inventories and survey wildlife use. • Identify and implement active habitat management and restoration on refuge lands (e.g., tree plantings, timber harvesting, prescribed fire, etc.) improve forest age distributions, structural complexity, and species composition. • Work with partners to ensure habitat management on refuge complements adjacent land management activities. • Maintain at least 300-meter-wide forested corridors through non-forested matrix habitat to facilitate species movement. • Control invasive species. • Monitor species response to our management. • Map natural communities and vernal pools and protect rare and exemplary natural communities. • Assess hydrological conditions of forested wetlands. • Continue furbearer management program at Nulhegan Basin Division; manage furbearers on other refuge divisions Control invasive species. • Monitor species response to our management. • Map natural communities and vernal pools and protect rare and exemplary natural communities. • Assess hydrological conditions of forested wetlands. • Continue furbearer management program at Nulhegan Basin Division; manage furbearers on other refuge divisions and units, by methods including trapping, as a management tool. As new lands are acquired, and where trapping is already occurring, allow it to continue as a tool to manage wildlife populations, where the management need is supported by the respective State fish and wildlife agency and it is determined compatible. .		

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 1.2: *Non-forested Uplands and Wetlands (Freshwater Wetlands, Pasture, Hay and Grasslands)* In cooperation with willing landowners and other partners, protect, manage, and restore non-forested wetlands and uplands within the Connecticut River watershed. These non-forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate and land use changes, and support dependent species of conservation concern-including migratory birds and federally listed endangered and threatened species.				
Non-forested Uplands and Wetlands • **Wetland Integrity** • **Pasture, Hay, Grasslands and Shrublands**	*Off Refuge Lands* • Work with state and local agencies, private landowners, and other conservation partners to conserve active and former agricultural lands. • Work with partners to restore floodplain forests and other riparian habitats on former agricultural lands. *On Refuge Lands* • Restore degraded wetlands, where funding allows.	*Within CPAs* Work with partners and willing landowners within the watershed, with a priority on CPA lands, to: • To protect, manage, and restore freshwater wetlands, with emphasis on restoring wetland edge habitat, headwater streams, and floodplains. • To protect, manage, and restore shrublands to benefit shrubland-dependent species. • Work with partners (e.g., USDA-NCRS) and willing landowners to conserve pasture, hay, and grassland habitat to benefit wildlife and/or restore former agricultural fields and promote enrollment in agricultural protection programs. • Support state and local efforts to sustain farming on highly productive agricultural lands, but promote best management farming practices (especially in floodplain and riparian areas). • Priorities for restoration include lands in active floodplains, areas that have high development pressures, or can provide critical habitat for State- and federally listed species. • Support and guidance for restoration efforts on other ownerships will include: ∗ Grant support, writing, and "ghost writing." ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements and leases.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* Similar to alternative C, except no active management other than invasive species control, habitat restoration and for road maintenance. We would primarily use passive management and allow natural processes and succession to occur.

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Non-forested Uplands and Wetlands cont.	• Continue to manage approximately 200 acres of grassland and shrubland, including: ∗ Continue to manage (e.g., brushog) up to 11 acres of shrubland every 3 to 5 years at Pondicherry Division for shrubland dependent species (e.g., woodcock). ∗ Continue to implement woodcock habitat management at Nulhegan Basin Division (7 acres mowed every year for singing grounds, and 18 acres every 3 to 4 years for roosting fields). ∗ Continue to mow up to 67 acres of cool season grassland each year at the Fort River Division for grassland nesting birds (e.g., northern harrier, upland sandpiper, barn owl, grasshopper sparrows, and bobolinks). Also, mow up to 22 acres of warm season grassland each 2 to 3 years. ∗ Continue to mow approximately 60 acres of grasslands every 2 to 3 years at the Blueberry Swamp Division. ∗ Mow approximately 16 acres of grassland at the Salmon Division River every 2 to 3 years. ∗ Mow approximately 0.5 acres of grassland annually at the Dead Branch Division. ∗ Continue to mow approximately 60 acres of grasslands every 2 to 3 years at the Blueberry Swamp Division. ∗ Mow approximately 16 acres of grassland at the Salmon Division River every 2 to 3 years. ∗ Mow approximately 0.5 acres of grassland annually at the Dead Branch Division.	*On Refuge Lands* Alternative B and C are the same, except that there will be expanded and enhanced opportunities to protect, manage, and restore freshwater marsh habitats to meet refuge goals under alternative C because of the expanded refuge land base. Acreages below are a rough approximation. Details would be developed in step-down habitat management plans, which will be coordinated with States and stakeholders. In addition to alternative A: • Restore and actively manage these habitats based on management needs and priorities. • Conduct plant and wildlife inventories. • Evaluate wetland hydrology. • Assess habitat conditions for priority resources of concern. • Protect rare or exemplary communities. • Minimize activities that disturb wetland communities. • Work with the State Natural Heritage Program to annually monitor the presence/absence of current northeastern bulrush populations in emergent wetlands. • Explore and support research opportunities with academic partners to address information gaps for resources of concern (e.g., northeastern bulrush, New England cottontail). • Monitor plant and wildlife species responses to management. • Control invasive species. • Map natural communities. • Under alternative B, manage approximately 422 acres of grassland. Under alternative C, this would increase to approximately 548 acres of grassland. • Under alternatives B and C, manage (e.g., brushhog, hydroax, etc.) . Approximately 775 acres of shrubland habitat to benefit migratory birds, the New England cottontail, and other shrubland-dependent species.		

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Non-forested Uplands and Wetlands cont.		• Assess the condition of newly acquired acres of pasture, hay and grassland habitats to determine if they should continue to be maintained in these habitat types or if they should be restored to native forest. Use this assessment to inform more detailed management strategies in an HMP. Where appropriate, maintain contiguous grassland habitat for breeding and migrating grassland-dependent bird species. Also, where appropriate, restore pasture and grasslands to floodplain forest. • Work with partners to ensure management on refuge lands complements adjacent land management.Under alternative B, manage approximately 422 acres of grassland. Under alternative C, this would increase to approximately 548 acres of grassland. • Under alternatives B and C, manage (e.g., brushhog, hydroax, etc.) Approximately 775 acres of shrubland habitat to benefit migratory birds, the New England cottontail, and other shrubland-dependent species. • Assess the condition of newly acquired acres of pasture, hay and grassland habitats to determine if they should continue to be maintained in these habitat types or if they should be restored to native forest. Use this assessment to inform more detailed management strategies in an HMP. Where appropriate, maintain contiguous grassland habitat for breeding and migrating grassland-dependent bird species. Also, where appropriate, restore pasture and grasslands to floodplain forest. • Work with partners to ensure management on refuge lands complements adjacent land management.		

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 1.3: *Inland Aquatic Habitats (Freshwater Rivers, Streams, Ponds, and Lakes)* In cooperation with willing landowners and other partners, protect and restore in-stream and riparian habitat structure and function, and restore aquatic species passage and water quality within the Connecticut River watershed to improve the ecological integrity and environmental health of the river ecosystem and enhance habitat for migratory and inter-jurisdictional fish, mussels, and other native aquatic species of conservation concern.				
Inland Aquatic Habitats: • **Habitat Assessments** • **Population Assessments** • **Stream and Floodplain Functions** • **Hydrological Modeling**	*Off and On Refuge Lands* • Work with partners to protect and restore riparian habitats to increase water quality, reduce erosion, and maintain normal temperature regimes. • When funding is available, work with partners to remove barriers to aquatic passage. • When funding is available, work with partners to initiate fish passage projects.	*Within CPAs* • Work with partners to: • Develop hydrologic models of Connecticut River watershed and other tools to evaluate aquatic habitat conditions; work on priorities identified by Connecticut River Coordinator's Office. • Inventory wildlife and fish populations of conservation concern. • Conduct and/or participate in short and long-term monitoring programs for puritan tiger beetle, migratory fish, mussels, and other native aquatic species of conservation concern. • Maintain and restore in stream, riparian, and floodplain habitats. • Eliminate barriers to fish and other aquatic species passage. • Protect and increase spawning habitat for aquatic species. • Reduce combined sewer overflow. • Continue to support research opportunities on wildlife and fish populations of conservation concern. • Continue support for aquatic species programs and initiatives. • Work with USDA-Rural Development to address storm and waste water issues in rural areas of the watershed. • Work with USDA-NRCS to promote riparian habitat and streambank stabilization.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* No active management other than invasive species control and habitat restoration described under alternatives B and C. Instead, we would primarily use passive management and allow natural processes to occur.

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Inland Aquatic Habitats cont.		• Support and guidance for restoration efforts on other ownerships within CPAs will include: ∗ Grant support and writing. ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements. *On Refuge Lands* • Alternative B and C are the same, except that there will be expanded and enhanced opportunities to protect, manage, and restore inland aquatic habitats to meet refuge goals under alternative C because of the expanded refuge land base. Support and guidance for restoration efforts on other ownerships within CPAs will include: ∗ Grant support and writing. ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements. *On Refuge Lands* • Alternative B and C are the same, except that there will be expanded and enhanced opportunities to protect, manage, and restore inland aquatic habitats to meet refuge goals under alternative C because of the expanded refuge land base. Test the effectiveness of tools to evaluate aquatic habitat conditions. • Map natural communities and protect rare and exemplary communities. • Monitor species and habitat response to management. • Maintain conservation buffers along riparian habitats (at least 300 meters). • Control invasive species. • Work with partners to: ∗ Inventory aquatic resources including mussels, invertebrates, and fish. ∗ Manage and protect puritan tiger beetles at Deadman's Swamp Unit. ∗ Perform habitat surveys and quantify potential spawning and nursery habitat for fish such as brook trout. ∗ Evaluate the productivity and health of fish communities. ∗ Conduct stream assessments to identify man-made physical barriers (e.g., culverts, dams, impassible road crossings) to aquatic species passage. ∗ Develop a plan for protection and restoration of native races of brook trout, and other aquatic species. ∗ Develop and implement a plan to remove barriers to aquatic species passage. ∗ Protect and increase hard bottom substrate for spawning aquatic species. ∗ Reduce combined sewer overflow. ∗ Restore degraded streams.		

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 1.4 *Coastal Non-forested Uplands (Coastal Beaches and Rocky Shores)* In cooperation with willing landowners and other partners, protect, manage, and restore coastal non-forested uplands within the Connecticut River watershed. These non-forested habitats will help sustain the biological diversity, integrity, and ecological and hydrologic function of the river estuary ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate and land use changes, and support coastal upland-dependent species of conservation concern-including migratory birds and Federally-listed endangered and threatened species.				
Coastal Non-forested Uplands, including Coastal Beaches and Rocky Shores : • **Habitat Restoration** • **Public use management**	*Off Refuge Lands* Limited and indirect support and guidance for restoration efforts on other ownerships within the watershed.	*Within CPAs* • Support the LISS HRI goals and objectives. • Provide information to partners and willing landowners to support informed decisions about balancing human use of shorelines with the needs of nesting birds of conservation concern and sensitive dune habitats. • Provide support and guidance for restoration efforts on other ownerships within CPAs, which will include: ∗ Grant support and writing and "ghost writing." ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements. *On Refuge Lands* Alternative B and C are same, but not much of this habitat type occurs in proposed CFAs. • Conduct habitat and wildlife inventories. • Map natural communities; protect rare or exemplary examples. • Work with partners to ensure management on Service lands complement adjacent land management objectives. • Work with partners to restore these habitats on refuge lands.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* Similar to alternatives B and C, except no active management other than invasive species control and habitat restoration. Instead, we would use passive management and allow natural processes to occur.

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 1.5 *Coastal Wetlands and Aquatic Habitats (Tidal Salt Marsh and Estuary)* In cooperation with willing landowners and other partners, protect, manage, and restore coastal wetlands and other coastal aquatic habitats within the Connecticut River watershed. These coastal aquatic habitats will help sustain the biological diversity, ecological integrity, and hydrologic function of the river ecosystem, provide habitat connections and wildlife travel corridors, accommodate anticipated shifts in species' ranges from climate and land use changes, and support coastal wetland-dependent species of conservation concern - including inter-jurisdictional fish, native aquatic species, waterfowl and wading birds and Federally listed endangered and threatened species.				
Coastal Wetlands and Aquatic Habitat: • **Habitat Restoration** • **Population Assessments** • **Climate Change**	*Off Refuge Lands* Limited and indirect support and guidance for restoration efforts on other ownerships within the watershed. *On Refuge Lands* • Restore degraded wetlands, as funding allows.	*Within CPAs* Work with partners to: • Support the LISS HRI goals and objectives. • Conduct short- and long-term monitoring of migratory fish, mussels, and other native aquatic species of conservation concern. • Develop coastal system models that incorporate climate change predictions. • Inventory wildlife and fish populations of conservation concern. • Support research opportunities on wildlife and fish populations of conservation concern. • Support and guidance for restoration efforts on other ownerships within CPAs will include: ∗ Grant support and writing and "ghost writing." ∗ Technical and field assistance. ∗ Cooperative and other shared resource agreements. *On Refuge Lands* Alternative B and C are the same, except that there will be expanded and enhanced opportunities to protect, manage, and restore these coastal habitats to meet refuge goals under alternative C because of the expanded refuge land base. • Use active habitat management and restoration (e.g. restore ditched marshes, prescribed fire, and invasive plant control). • Minimize activities that disturb wetland communities. • Monitor response of priority refuge resources of concern species to refuge management. • Conduct habitat and wildlife inventories. • Map natural communities and protect rare and exemplary communities. • Work with partners to ensure management of Service lands complements adjacent land management objectives.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* Similar to alternatives B and C, except no active management other than invasive species control and habitat restoration. Instead, we would primarily use passive management and allow natural processes to occur.

Resource or Program Features	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Coastal Wetlands and Aquatic Habitat cont.: • **Habitat Restoration** • **Population Assessments** • **Climate Change**		*On Refuge Lands* Alternative B and C are the same, except that there will be expanded and enhanced opportunities to protect, manage, and restore these coastal habitats to meet refuge goals under alternative C because of the expanded refuge land base. • Use active habitat management and restoration (e.g. restore ditched marshes, prescribed fire, and invasive plant control). • Minimize activities that disturb wetland communities. • Monitor response of priority refuge resources of concern species to refuge management. • Conduct habitat and wildlife inventories. • Map natural communities and protect rare and exemplary communities. • Work with partners to ensure management of Service lands complements adjacent land management objectives.		

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Goal 2: Environmental Education, Interpretation, and Outreach Inspire residents and visitors to actively participate in the conservation and stewardship of the exceptional natural and cultural resources in the Connecticut River watershed, and promote a greater understanding and appreciation of the role of the Silvio O. Conte National Fish and Wildlife Refuge in conserving those resources.				
Objective 2.1 *Environmental Education.* In collaboration with public and private educators from all four States in the watershed, lead or facilitate the implementation of structured, high quality, natural and cultural resource curricula. The focus will be on guiding educators and students to: develop an awareness of, and concern about, natural and cultural resources and associated challenges; appreciate our conservation history; make informed decisions and work individually or collectively toward solutions; and, model responsible environmental stewardship in their everyday lives.				
Environmental Educational Planning and Training	Continue to offer these environmental educational opportunities in line with existing staff and resource capacities: • Design curricula for existing refuge environmental educational facilities and the WoW Express that incorporate at least one state science learning standard for Massachusetts, Connecticut, New Hampshire, and Vermont. • Identify and strive to engage non-traditional audiences regarding environmental educational opportunities. • Support the Service's initiatives such as Connecting People with Nature, Youth in the Great Outdoors, etc. • Provide refuge lands as outdoor classrooms. • Contribute to professional educator development by periodically hosting and/ or instructing teacher continuing education training.	Our first priority would be to provide environmental education in CPAs, on refuge lands, and in urban areas in the watershed. We would then, time and resources permitting, work throughout the rest of the watershed. In addition to strategies outlined under alternative A: • Host annual meeting with state agency environmental educators to look for opportunities to coordinate program priorities and share resources. • Develop school-focused curricula for all environmental educational efforts, that: ∗ Incorporate multiple state and national learning standards. ∗ Coordinate with existing state and national environmental education programs. ∗ Contain consistent messages and themes. ∗ Incorporate refuge purposes and management goals and objectives. ∗ Where appropriate, incorporate national based curricula and national recognized initiatives. • Develop specific goals, objectives, and strategies for each program/lesson. • Adapt and/or adopt an existing environmental educational evaluation system to assess all environmental educational curricula effectiveness. • Work with after school programs and summer camps to incorporate existing state curricula. • Provide support for curriculum-based programs such as Scouts, 4H, Boys and Girls Clubs, and Road Scholar. • Support state environmental educational programs (e.g., Hunter and Angler Education, Furbearer Education, Becoming a Great Outdoors Woman, etc.)		Similar to alternatives B and C, except that environmental education themes and messages would focus on natural processes, interpreting wilderness-type experiences, and low-impact land uses rather than active habitat management.

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 2.1 *Environmental Education.* In collaboration with public and private educators from all four States in the watershed, lead or facilitate the implementation of structured, high quality, natural and cultural resource curricula. The focus will be on guiding educators and students to: develop an awareness of, and concern about, natural and cultural resources and associated challenges; appreciate our conservation history; make informed decisions and work individually or collectively toward solutions; and, model responsible environmental stewardship in their everyday lives.				
Environmental Education Delivery	Continue to offer these environmental education opportunities in line with existing staff and resource capacities: • Use staff, volunteers, and members of Friends groups to facilitate teachers and students at existing refuge and partner facilities. • Use refuge facilities to provide opportunities for teacher-led classes as well as other environmental education entities. • Have the WoW Express visit schools in each of the four states targeting students in grades 3 through 5. The goal is to capitalize on student contacts by increasing the amount of time spent with students to create a better quality experience for them. • Have the WoW Express visit environmentally based summer camps in each of the four states. • Use staff, volunteers, and members of friends groups to facilitate teachers and students at existing partner facilities. • Continue to support partnership with the State of Massachusetts at the Great Falls Discovery Center.	Our first priority would be to provide environmental education in CPAs, on refuge lands, and in urban areas in the watershed. We would then, time and resources permitting, work throughout the rest of the watershed. In addition to strategies under alternative A: • Formally partner with local schools within the watershed and conduct environmental educational programs with these audiences multiple times per year. • Promote refuge and partner lands as outdoor classrooms. • Work with partners, educators, Friends group members, and other volunteers to offer environmental educational programs. • Fully implement the "Adopt-a-Habitat" initiative with developed curriculum plans. • Develop a traveling mobile environmental education classroom and BAT. • Develop an evaluation system to measure the effectiveness of environmental education programs. • Partner with other education centers, state programs, and other government agencies to meet environmental education objectives.		Same as alternatives B and C, except that the number of environmental education participants on refuge lands may decrease due to reduced access in keeping with this alternative's theme of promoting a low human footprint on refuge lands.

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 2.2 *Interpretation* Develop, lead, and facilitate interpretive programs that emotionally and intellectually connect the audience to natural and cultural resources in the watershed.				
Natural and Cultural Resource Interpretation Planning and Training	Continue to focus on these planning and training opportunities in line with existing staff and resource capacities: • Work with partners to develop a variety of different types of interpretive programs (e.g., talks, signs, brochures, audio/visual displays, etc.) • Develop self-guided interpretive services, such as interpretive trails and kiosks, exhibits, and printed media.	Our first priority would be to provide interpretive programs in CPAs and on refuge lands. We would then, time and resources permitting, work throughout the rest of the watershed. In addition to strategies under alternative A: • Work with partners to create consistent interpretive themes. • Develop interpretive goals, objectives, and strategies; incorporate these into a Visitor Services Plan. • Develop an evaluation process to measure effectiveness of interpretation programs. • Develop a core set of interpretive programs. • Establish relationships with Tribes and local and watershed historians to incorporate cultural history into interpretive programs. • Make Certified Interpretive Guide (National Association for Interpretation) training available once every other year for refuge personnel, volunteers, and others. • Update existing and develop new interpretive materials that incorporate interpretive messages and themes and new media and technologies (e.g., QR codes/cell ranger), including general brochures, bird lists, self-guided interpretive trails, signs, kiosks, etc.		Same as alternatives B and C, except that interpretation themes and messages will focus on low impact land use, natural processes, and interpreting wilderness experiences rather than active habitat management.

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 FEIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 2.2 *Interpretation* Develop, lead, and facilitate interpretive programs that emotionally and intellectually connect the audience to natural and cultural resources in the watershed.				
Natural and Cultural Resource Interpretive Program Delivery	Continue to offer these interpretive opportunities in line with existing staff and resource capacities: • Annually provide quality interpretive programs, exhibits, printed media at refuge facilities and properties. • Provide personal contacts at visitor centers, such as Great Falls Discovery Center and Nulhegan Basin Division, to initiate discussion and answer questions. • Support partner facilities such as Great Northwoods Visitor Center, VINS, and Springfield Science Museum through cooperative agreements and the sharing of resources.	Our first priority would be to provide quality interpretive programs in CPAs and on refuge lands. We would then, time and resources permitting, work throughout the rest of the watershed. In addition to strategies under alternative A: • Establish additional partnerships with interpretive facilities. • Create interpretive messages for region-wide media. • Incorporate thematic messages, measurable objectives, and evaluation measures into all interpretive programming. • Train staff, Friends, and other volunteers to deliver interpretive messages and programs. • Use both traditional and new media to deliver interpretive messages. • Contribute interpretive materials about the refuge for partner signs and publications (e.g., National Scenic Byway, State Parks, etc.) • Develop opportunities for commercial vendors who would like to offer on-refuge interpretation. Vendors would operate under a special use permit and may be charged a fee.		Same as alternatives B and C, except that the number of interpretation participants on refuge lands may decrease due to reduced access in keeping with this alternative's theme of promoting a low human footprint on refuge lands.

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Objective 2.3 *Public and Community Outreach* Support, promote, and coordinate a wide range of outreach tools and activities to facilitate and improve communications and relationships with the American public and to articulate the importance of local conserved lands, including the refuge, to the watershed. Target audiences include: community members, adjacent landowners, and elected officials in the Connecticut River Watershed. Citizens will be empowered to recognize and resolve local natural resource issues and promote conservation and the responsible use of natural resources.				
Local Community Residents and Officials	Continue these outreach opportunities in line with existing staff and resource capacities: • Maintain good lines of communication with refuge neighbors and community leaders. • Draft annual reports that introduce residents to the refuge, describe refuge accomplishments, detail visitor opportunities, and discuss refuge operations and current and future refuge projects. • Attend select board meetings, and visit town clerks, mayors, planners and other elected officials as needed to keep them apprised of refuge issues and projects.	In addition to alternative A: • Work directly with Chambers of Commerce, Rotary Clubs, and other civic and nonprofit organizations. • Keep neighboring and nearby landowners informed of refuge management activities. • Inform community members about refuge management practices, public use opportunities, and regulations, as well as the economic benefits of the refuge to the local economy. • Support and participate in community celebrations and events. • Develop and publicize special programming of interest to local residents and media on refuge lands. • Support outreach activities of refuge Friends groups and partners. • Evaluate and modify, as necessary, outreach efforts. • Conduct open houses on refuge divisions and partnership areas to introduce residents and local officials to the refuge. • Develop and implement an outreach plan for communicating with landowners to inform and educate them on their role within the watershed and how they can contribute. Plan would include tools and strategies. Possible tools would include landowner workshops, behind the scene tours, special open houses, and publications oriented toward them specifically.		

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Objective 2.3 *Public and Community Outreach* Support, promote, and coordinate a wide range of outreach tools and activities to facilitate and improve communications and relationships with the American public and to articulate the importance of local conserved lands, including the refuge, to the watershed. Target audiences include: community members, adjacent landowners, and elected officials in the Connecticut River Watershed. Citizens will be empowered to recognize and resolve local natural resource issues and promote conservation and the responsible use of natural resources.				
Local Community Residents and Officials cont.		• Write issue driven outreach plans to keep elected officials informed of refuge and partner accomplishments and of issues within the watershed that have possible impacts to the refuge. • Pro-actively schedule consistent meetings with elected officials to share and update each other on constituent concerns and opportunities. • Develop messages and actions that frame refuge units as an asset to the local community. Example benefits that the refuge provides the community include: environmental education and interpretation programming, special events hosted for the community, employment for local youth through YCC, mutual aid agreements, etc. • Learn how to coordinate effectively with partner organizations to spread the Conte Refuge message to their membership (Audubon, TNC, Trust for Public Land (TPL), etc.). • Develop at least 10 Conte Corners with at least two in each state. • Create special programming that will draw local residents and media (i.e., participating in community events and festivals, etc.). • Fully implement the Adopt-a-Habitat program to be used as an outreach tool for schools and community residents to learn about and become stewards of their local environment.		
State- and National-level Elected Officials	Continue these outreach opportunities in line with existing staff and resource capacities: • Provide briefings to members of Congress or their staff as needed or as requested.	*In addition to alternative A:* • Meet with political leaders and officials to inform and educate them on management practices occurring in their districts.		
Media	Continue these outreach opportunities in line with existing staff and resource capacities: • Write press releases detailing large refuge projects and accomplishments, and the joint efforts and accomplishments of the refuge and refuge partners. • Host media representatives on refuge lands regularly to disseminate refuge accomplishments and concerns.	In addition to alternative A: • Develop a media outreach plan with consistent refuge messages.		

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Objective 2.3 *Public and Community Outreach* Support, promote, and coordinate a wide range of outreach tools and activities to facilitate and improve communications and relationships with the American public and to articulate the importance of local conserved lands, including the refuge, to the watershed. Target audiences include: community members, adjacent landowners, and elected officials in the Connecticut River Watershed. Citizens will be empowered to recognize and resolve local natural resource issues and promote conservation and the responsible use of natural resources.				
Greater Watershed Community	Continue these outreach opportunities in line with existing staff and resource capacities: • Promote the refuge as a destination for recreation, interpretation, and environmental education opportunities. • Promote refuge lands for special events such as National Wildlife Refuge Week, International Migratory Bird Day, Earth Day, etc. • Support existing Friends groups and establish new groups as divisions are established. • Provide outreach materials at partners' facilities. • Promote cooperation with partners for the use of facilities, programs, and staff when conducting outreach.	In addition to alternative A: • Attract visitors by linking the refuge and watershed to regional tourism, birding, and recreational programs. • Encourage citizen participation in activities throughout the watershed. • Maintain a well-written and informative Web site. • Create displays promoting the refuge for placement at major regional points of interest or entry (e.g., airports). • Use the WoW Express, the BAT, and other mobile exhibits to participate at regional environmental- and recreational-themed events, shows, and conferences. • Produce conservation messages that reach a wide range of audiences through a variety of media (e.g., print, broadcast, social). • With partners, explore communication strategies to reach targeted audiences with common messages. • Sponsor at least one Bio Blitz on refuge lands in each state, and ultimately in each division/or local community in conjunction with Adopt-a-Habitat program. • Offer the WoW exhibits and an interpreter to partners when feasible. Establish partnerships across the Watershed to jointly deliver WoW Express interpretive programs. • In cooperation with partners seek to interpret messages with the expansion of the Connecticut River Birding Trail to a Source to Sea birding trail. • Work with non-traditional venues (e.g., airports, shopping malls) to install interpretive media appropriate for general audiences.		

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Objective 2.4 *Scientific and Technical Outreach* Facilitate the collection and exchange of information that increases the knowledge and understanding of natural and cultural resources, addresses climate and land use changes and other conservation issues, and provides land managers with better information to make management decisions affecting resources.				
Institutions of Higher Learning and Other Partners Conducting Relevant Conservation Research	Continue these outreach opportunities in line with existing staff and resource capacities: • Work with partners to conduct research relevant to refuge management issues.	In addition to alternative A: • Formulate a list of important natural resource research questions that the refuge is interested in and share them with colleges and universities as possible graduate and undergraduate research projects. • Develop formal agreements with universities and other partners to conduct research on refuge lands. • In collaboration with the Friends of Conte seek funding for high priority research.		Same as alternatives B and C, except the majority of research on the refuge would focus on studying, inventorying, and monitoring natural processes.
Technology and Information Exchange Related to Conservation Topics	Continue these outreach opportunities in line with existing staff and resource capacities: • Play an active role in technology and information exchange. • Sponsor/host science based conferences as opportunities arise. • Encourage staff to participate in relevant, natural and cultural resource conferences that will contribute to making good decisions.	In addition to alternative A: • Host science forums to share research results with partners and the general public. • Distribute 'lessons learned' from refuge management to interested parties. • Provide inventory and monitoring summaries through the refuge website.		
Mentoring Students	Continue these outreach opportunities, in line with existing staff and resource capacities: • Reach out to local universities for student employment positions. • Offer student internships and host field trips. • Participate periodically in presenting information to classes at local universities and colleges.	In addition to alternative A: • Seek opportunities to participate in student workshops, trainings, and events. • Develop a mentoring program to work with students to help them identify their career goals and introduce career paths within the Service. • Participate in undergraduate and graduate level classes at local universities and colleges, presenting information on various topics and issues of relevance to the refuge.		

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Goal 3: Recreation. Promote high quality, public recreational opportunities in the Connecticut River watershed that are complementary between ownerships and provide regional linkages, with emphasis on promoting wildlife-dependent activities that connect people with nature in the outdoors.				
Objective 3.1 *Hunting* Support quality public hunting opportunities in the Connecticut River watershed in cooperation with willing landowners to promote a unique understanding and appreciation of natural resources and their management, including the role of the Service and other public lands in resource conservation, while also protecting a traditional outdoor pastime deeply rooted in America's natural and cultural heritage and conservation history.				
Hunting Opportunities, Access, and Infrastructure	*On Refuge Lands* • Continue to allow hunting on the following refuge divisions and units: ∗ Nulhegan Basin Division ∗ Putney Mountain Unit ∗ Blueberry Swamp Division ∗ Pondicherry Division ∗ Fort River Division ∗ Mill River Division ∗ Dead Branch Division ∗ Salmon River Division • Complete all administrative requirements to maintain these hunts (e.g., hunt packages). • Hunting methods and seasons are generally consistent with state regulations. • When compatible, allow hunting on refuge lands purchased in the future.	*Within CPAs* • Continue to support hunting opportunities on lands within CPAs. • Collaborate with state fish and wildlife agencies to prepare and distribute a map of hunting opportunities within CPAs. *On Refuge Lands* Alternatives B and C are the same, except there will be greater hunting opportunities under alternative C (i.e., more acres open to hunting) due to the larger refuge land base. In addition to alternative A: • When compatible, allow hunting on current and future refuge lands, consistent with State regulations (some refuge-specific regulations may also apply and some units are not open due to sensitive resources). • Actively develop and maintain access enhancements on refuge facilities, including consideration for disabled hunters.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* In addition to alternative C: • Within current and future refuge lands, focus on providing "back country" hunting experiences. For example, reducing overall road density and not creating new infrastructure unless needed to reduce user impacts, enhance safety, or to better distribute use. • Within current and future refuge lands, consider providing opportunities for disabled hunters based on the existing infrastructure.

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Objective 3.1 *Hunting* Support quality public hunting opportunities in the Connecticut River watershed in cooperation with willing landowners to promote a unique understanding and appreciation of natural resources and their management, including the role of the Service and other public lands in resource conservation, while also protecting a traditional outdoor pastime deeply rooted in America's natural and cultural heritage and conservation history.				
Hunter Education and Outreach	Continue current levels of outreach, which is primarily through direct contact with the public, flyers posted at kiosks, and information posted on the refuge Web site.	• Offer refuge facilities as host sites for State-directed hunter education courses. • Engage staff and volunteers in the delivery of established programs such as "Becoming a Bowhunter." • Partner with state fish and wildlife agencies, hunt clubs, and others to host a National Hunting and Fishing Day event in each of the states annually. • Use the WoW Express to share important hunting messages regarding the traditional values, ethics, safety, etc. at festivals, fairs, and other public events. • Provide hunt brochures, including regulations and maps, on the refuge Web site and at visitor contact points. • Work with the state fish and wildlife agencies to identify and evaluate the impacts associated with requiring the use of non-toxic ammunition for hunting on refuge lands. • At the Nulhegan Basin Division, the refuge and/or Vermont Fish and Wildlife Department will maintain a contact list of those individuals training and/or hunting with pursuit hounds (bobcat, bear, coyote), as well as those training beagles in order to share information regarding the identification of Canada lynx and their sign and appropriate actions when lynx are present.		• Work with state fish and wildlife agencies and the outdoor guide community to inform hunters of the backcountry hunting opportunities on refuge divisions. • Stress the nature of, and expectations for, a backcountry hunting experience. • Use the WoW Express to share important hunting messages at festivals, fairs, and other public events. • Provide hunt brochures, including regulations and maps, on the refuge Web site and at visitor contact points.

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Objective 3.2 *Fishing* Support quality public fishing opportunities in the Connecticut River watershed in cooperation with willing landowners to promote an understanding and appreciation of natural resources and their management, including the role of the Service and other public lands in resource conservation, while also protecting a traditional outdoor pastime deeply rooted in America's natural heritage and conservation history.				
Fishing Opportunities, Access, and Infrastructure	*On Refuge Lands* Continue to offer fishing at: * Nulhegan Basin Division * Blueberry Swamp Division * Pondicherry Division * Fort River Division * Mill River Division * Dead Branch Division * Salmon River Division • Complete all administrative requirements to maintain these fishing opportunities (e.g., fishing packages).	*Within CPAs* • With partners, promote fishing opportunities in the watershed by securing access to waters and developing infrastructure. • Actively develop and maintain access enhancements on and off refuge lands, including consideration for disabled anglers. • Collaborate with state fish and wildlife agencies to publish a fishing guide to publicly accessible waters within the watershed. *On Refuge Lands* Alternative B and C are the same, except there will be greater fishing opportunities under alternative C due to the larger refuge land base. In addition to alternative A: • When compatible, allow fishing on current and future refuge lands with fishable waters, consistent with state regulations (some refuge-specific regulations may also apply and some units are not open due to sensitive resources).		*Within CPAs* • Collaborate with state fish and wildlife agencies to emphasize native fish of local origin in their stocking programs. *On Refuge Lands* In addition to alternative C: • Emphasize backcountry, low density fishing opportunities. • No new infrastructure unless needed to reduce user impacts, enhance safety, or to better distribute use.

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Angler Education and Outreach	Outreach is primarily through direct contact with the public, posted flyers on kiosks, and the refuge Web site.	• Host fly-tying and other fishing "seminars" at refuge facilities to encourage increased participation, especially by women and children. • Partner with others to host a National Hunting and Fishing Day event in the form of training and/or demonstrations at least once in each of the four states each year. • Partner with state fish and wildlife agencies, hunt clubs, and others to host a "Take Me Fishing" event in support of National Fishing Day. • Produce fishing flyers/brochures and make available at kiosks and on the refuge Web site. • Work with the state fish and wildlife agencies to identify and evaluate the impacts associated with requiring the use of non-toxic tackle for fishing on refuge lands.		
Objective 3.3 *Wildlife Observation and Photography* Support quality, public opportunities to observe and photograph wildlife in a variety of natural habitats in the Connecticut River watershed in order to connect a broad spectrum of people with nature.				
Wildlife Observation and Photography Opportunities, Access, and Infrastructure	*Within CPAs* Not addressed in 1995 FEIS. *On Refuge Lands* • All divisions and most units open to wildlife observation and photography through pre-acquisition compatibility determinations (Wissatinnewag, Saddle Island, and Dead Man's Swamp Units are closed to all public use to protect sensitive resources; Mount Tom currently closed due to public safety and vandalism concerns). • Continue to maintain existing refuge access and public use infrastructure, including roads and overlooks at Nulhegan Basin Division; and parking areas, and trails at Nulhegan Basin, Pondicherry, and Fort River Divisions and Putney Mountain Unit.	*Within CPAs* • Work with partners and willing landowners to encourage and facilitate wildlife observation and photography opportunities in the watershed. *On Refuge Lands* Alternatives B and C are the same, except there will be greater wildlife observation and photography opportunities under alternative C due to the larger refuge land base. In addition to alternative A: • When compatible, open current and future refuge lands to wildlife observation and photography. • When compatible, construct additional miles of hiking trails, blinds, and viewing platforms that highlight varied habitats, terrain, and vistas. Construct at least one Americans with Disabilities Act universally-accessible trail, parking area, and kiosk at every refuge division, once sufficient land is purchased. • Proposed projects include: 7.2 miles of trails at the Nulhegan Basin Division, 0.6 miles at the Putney Mountain Unit, and 1.9 miles at the Pondicherry Division. • When compatible, allow for professionally guided wildlife observation tours and photography seminars, subject to special use permits. • Evaluate all existing and proposed refuge infrastructure to provide access to those with disabilities. • At the more northerly Divisions, create pull-offs along plowed public roads to allow greater winter access for pedestrians. • Host a Big Sit at refuge divisions and other opportunities for visitors to get involved in refuge research and monitoring projects (e.g., bird banding, woodcock surveys).		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* • Maintain existing public use infrastructure, with no new trails, roads, etc. • Repurpose former logging roads and skid trails as "unimproved" hiking trails. • Limit additional infrastructure to that necessary to reduce impacts, better distribute use, or for safety considerations such as parking areas, informational kiosks, etc.

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Objective 3.3 *Wildlife Observation and Photography* Support quality, public opportunities to observe and photograph wildlife in a variety of natural habitats in the Connecticut River watershed in order to connect a broad spectrum of people with nature.				
Aids to Support Wildlife Observation and Photography on Refuge Lands	*On Refuge Lands* Continue to provide variety of resources such as interpretive signs, brochures, flyers, and wildlife checklists to visitors at visitor contact points, the refuge Web site, and from refuge staff.	*Within CPAs* *Work with partners to develop materials to promote wildlife observation and photography opportunities, such as brochures, maps, Web-based information, and On Refuge Lands* • information and applications for mobile phones and devices. • Develop species lists and a map of key wildlife viewing areas on refuge lands and distribute them at refuge kiosks and website. • Work with partners to identify "Birding Hotspot" locations throughout the watershed with publications and signage. • Host wildlife identification and photography workshops at refuge facilities. • Where appropriate, develop tools such as phone apps, QR codes, E-bird sites, etc. at kiosks, visitor contact points, and partner facilities that inform visitors about CPA-based wildlife observation opportunities. • Loan "birding backpacks", containing binoculars, field guides, checklists, etc. to the public at refuge visitor facilities.		
Watershed-based Initiatives to Support Wildlife Observation and Photography	Not addressed in 1995 FEIS.	• Promote the Connecticut River Birding Trail by offering the existing guides at refuge and partner facilities. • Support extension of the Birding Trail to include Massachusetts and Connecticut. • Provide a link to the Birding Trail via the refuge's website and work with the publisher to create a fully digital guide and aid in the transition to a paperless format. • Work with partners to develop and publish a list/map of key wildlife viewing areas on surrounding lands. • Promote the Connecticut River Byway by providing its informational materials at refuge facilities and providing a link via the refuge's website.		

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Objective 3.4 *Other Recreational Activities* Support non-priority, outdoor recreational opportunities and public access that provide quality, nature-based experiences throughout the Connecticut River watershed to facilitate and improve community relationships, raise awareness and an appreciation for conserving natural resources, and garner support for the National Wildlife Refuge System.				
Regional Water-based Trail Initiatives and Opportunities	*Off and On Refuge Lands* Currently, there are access points along sections of the Connecticut River maintained by the states and private organizations such as the Upper Valley Land Trust and Vermont River Conservancy.	*Within CPAs* • Assist Connecticut River Paddlers' Trail to complete a continuous network of launches and campsites so that the trail is fully functional for its 410-mile length, including the siting of trail infrastructure on refuge lands when appropriate and compatible. • Publicize the Connecticut River Paddlers' Trail on the refuge's web page, and write letters in support of grant funding. • Work with state, local, and other conservation partners to identify at least six appropriate sites in each watershed state in order to improve direct public access to the Connecticut River and its major tributaries for the purpose of site-appropriate boating, fishing, and wildlife observation. • Expand partnership with Northern Forest Canoe Trail to enhance the visitor experience. *On Refuge Lands* Alternative B and C are the same, except that opportunities may increase under alternative C due to the larger refuge land base. • On refuge lands, maintain a relevance to the larger recreational community and provide opportunities for non-traditional users to experience refuge resources by promoting regional water-based trails, such as the Connecticut River Paddlers' Trail and Northern Forest Canoe Trail. • Work with the Northern Forest Canoe Trail to provide a campsite and access point for paddlers at the Nulhegan Basin Division.		*Within CPAs* Same as alternatives B and C. *On Refuge Lands* No new access points or campsites on existing or newly acquired refuge lands; otherwise support the use and enjoyment of the Connecticut River Paddler's Trail and Northern Forest Canoe Trail.

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Objective 3.4 *Other Recreational Activities* Support non-priority, outdoor recreational opportunities and public access that provide quality, nature-based experiences throughout the Connecticut River watershed to facilitate and improve community relationships, raise awareness and an appreciation for conserving natural resources, and garner support for the National Wildlife Refuge System.				
Regional Land-based Trail Initiatives and Opportunities	Current connections to larger trail systems include: • Nulhegan Basin Division-snowmobile trails • Pondicherry Division-snowmobile trails, • Presidential Recreational Trail thru the division (hiking, bicycling, horseback riding, snowmobiling), • Cohos Trail • Mt. Tom Unit– Metacomet-Monadnock Trail • Putney Mt. Unit-Windmill Ridge Trail • Dead Branch Division-snowmobile trail	*Within CPAs* • Work with partners and willing landowners to support land-based trail initiatives within the Connecticut River watershed that promote conservation and land ethic. *On Refuge Lands* Alternative B and C are the same, except there will be greater opportunities under alternative C to form linkages between refuge lands due to the larger refuge land base. In addition to alternative A: • When appropriate and compatible, use refuge lands to provide linkages for existing, established regional trails. • Future trails would be evaluated for appropriateness and compatibility on refuge lands on a case-by-case basis and maintained by user organizations under a special use permit. For the most part, such trails will conform to existing, identifiable corridors. ∗ Winter trails: (snowmobiling, cross-country skiing, and snowshoeing) ∗ Spring, Summer, Fall trails: (biking and hiking) • Where refuge ownership interests coincide with regional hiking trails, such as the Appalachian National Scenic Trail and New England National Scenic Trail; assist in the long-term protection of their continuity and quality by using our land acquisition authority to acquire interest (fee and easements) in land to maintain the linear and lateral trail and habitat connectivity. • Work with Vermont Association of Snowmobile Travelers (VAST) to establish a snowmobile trail link to the Nulhegan Visitor Contact Station. Reduce redundant trail segments (approximately 1 acre) on the refuge (see appendix D compatibility determination for snowmobiling at Nulhegan Basin Division). • Open snowmobile trails at the Nulhegan Basin Division to snowshoers and cross-country skiers, similar to other public lands. • Partner with the Green Mountain Club to construct a 1.4-mile hiking trail segment to incorporate the Nulhegan Basin Division into their Gore Mountain Trail.		*Within CPAs* Similar to alternatives B and C, but more focused on non-motorized trail uses. *On Refuge Lands* • Where appropriate and compatible, use refuge lands to provide linkages for existing, established regional trails that offer backcountry experiences. • Discontinue snowmobiling on the refuge.

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Objective 3.4 *Other Recreational Activities* Support non-priority, outdoor recreational opportunities and public access that provide quality, nature-based experiences throughout the Connecticut River watershed to facilitate and improve community relationships, raise awareness and an appreciation for conserving natural resources, and garner support for the National Wildlife Refuge System.				
Other Recreational Opportunities that Enhance Visitor Use and Enjoyment of Refuge Lands	*On Refuge Lands* • Continue to allow other, compatible recreational opportunities in designated locations on existing refuge divisions and units, such as ∗ Pet walking. ∗ Boating in designated waterbodies. ∗ Bicycles and automobiles on designated roads. • As new refuge lands are acquired, determine if these uses are compatible. • Continue to allow snowmobiling on designated routes on the Nulhegan Basin, Pondicherry, and Dead Branch Divisions.	*On Refuge Lands* In addition to alternative A: • Offer virtual geocaching opportunities to help interpret refuge resources. • When compatible, allow commercial guiding in support of the six priority public uses by special use permit. • When compatible, allow recreational gathering of blueberries, blackberries, strawberries, raspberries, mushrooms, fiddleheads, and antler sheds. • Require pets to be on leash at all times. • Open to bicycling Nulhegan Basin Division roads that are also open to motor vehicles.		*On Refuge Lands* For non-motorized uses, same as alternative A. However, scale back use of motorized vehicles on refuge divisions and units, including: • Discontinue snowmobiling on the refuge.

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Goal 4 Partnerships. Enhance the conservation, protection, and stewardship of natural and cultural resources, and promote wildlife-dependent recreation, throughout the Connecticut River Watershed by initiating, supporting, and promoting partnerships with other Federal, State, and local agencies, Tribal governments, and private organizations.				
Objective 4.1: *Strategic Habitat Conservation Partnerships* Create, enhance, and facilitate partnerships to plan, design, deliver, and evaluate Strategic Habitat Conservation in the Connecticut River watershed, with an emphasis on promoting action in CPAs. Special effort will be made to coordinate with the North Atlantic LCC partnership, the four State fish and wildlife agencies, and other partners advancing conservation in the watershed.				
Habitat Restoration and Management	Continue to support existing habitat conservation partnerships.	*Within CPAs* Continue to work with habitat conservation partners throughout the Connecticut River Watershed, with priority attention to CPAs. • Work with partners and willing landowners to restore, manage, and enhance habitats for Federal trust resources and other species of conservation concern. Priorities include: ∗ Restoration of riparian and floodplain habitat along the Connecticut River main stem and tributaries. ∗ Removing barriers to aquatic passage, especially for migratory fish. ∗ Restoring wetland functions and values. ∗ Protecting federally listed species. ∗ Treating invasive species that threaten important habitats.			
Private Lands Coordination	As funding allows, continue existing private lands coordination program.	*Within CPAs* Enhance the refuge's private land coordination program to help complement private landowner assistance among the four States, NRCS, the Forest Service, and other conservation agencies. Priorities include • Working with landowners to find grant opportunities and submit grant applications. • Share scientific information and best management practices.		

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Land Protection	Continue to acquire refuge lands in SFAs.	*Within CPAs* *Support partners' efforts to acquire land of high importance to species and habitats, and/or that support the Connect the Connecticut Landscape Conservation Design.* *Within CFAs* Pursue from willing sellers only, acquisition of those lands identified in approved land protection plan. Actions taken would complement other partners' land conservation efforts and support the Connect the Connecticut Landscape Conservation Design.		
Objective 4.2 *Terrestrial Species Protection, Restoration, and Management Partnerships* Create, enhance, and facilitate partnerships to protect, restore, and manage populations of terrestrial species of conservation concern, including Federally listed species, species proposed for listing, and migratory birds, throughout the Connecticut River watershed, with an emphasis on promoting action in CPAs.				
Federally Listed Terrestrial Species Conservation	Continue to support existing federally threatened, endangered, and Federal candidate terrestrial species partnerships.	*Within CPAs* Enhance existing and build new partnerships to conserve federally threatened, endangered, and Federal candidate terrestrial species throughout the watershed, with priority attention to CPAs, including: • Collaborate with Federal and State agencies, local towns, nongovernmental organizations, and willing landowners. • Work with others to develop and implement species recovery plans, State WAPs, and other conservation measures with a goal to avoid new species listings. Measures may include land protection, public use and access management, and invasive species control. *Within CFAs* Complement partners' land conservation efforts by acquiring additional refuge lands within CFAs to protect important habitats for federally listed species.		
Migratory Bird Conservation	Continue to support existing migratory bird partnerships.	*Within CPAs* Enhance existing and build new partnerships to conserve migratory birds throughout the watershed, with a special focus on CPAs, including: • Supporting migratory bird ecoregional plans and priorities developed through the NALCC including: ∗ Population monitoring, assessment, and management. ∗ Habitat restoration, management, and protection. ∗ Private lands coordination and grants writing and funding support. ∗ Communications and outreach. ∗ Recreational opportunities.		

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Other Terrestrial Species of Conservation Concern Identified by the Service, NALCC Partnership, or States	Continue to support other existing partnerships that address other terrestrial species of conservation concern.	*Within CPAs* Enhance existing and build new partnerships to conserve other terrestrial species of conservation concern throughout the watershed, with priority attention to CPAs, including working with partners to develop and implement conservation programs.		
Objective 4.3 *Aquatic Species Protection, Restoration, and Management Partnerships* Support the conservation of migratory fish and other aquatic species of conservation concern by collaborating with Federal and State agencies, local towns, and non-governmental organizations in the implementation of fish and other aquatic species conservation plans.				
Federally Listed Aquatic Species Conservation	Continue to support existing federally threatened, endangered, and Federal candidate species partnerships.	*Within CPAs* Enhance existing and build new partnerships to conserve federally threatened, endangered, and Federal candidate aquatic species throughout the watershed, with priority attention to CPAs, including: • Collaborate with Federal and State agencies, local towns, NGOs, and willing landowners. • Work with others to develop and implement species recovery plans, State WAPs, and other conservation measures with a goal to avoid new species listings. Measures may include land protection, public use and access management, and invasive species control.		
Other Aquatic Species of Conservation Concern Identified by the Service, the NALCC Partnership, or States	Continue to support other existing partnerships that address other aquatic species of conservation concern.	*Within CPAs* Enhance existing and build new partnerships to conserve other aquatic species of conservation concern throughout the watershed, with priority attention to CPAs, including working with partners to develop and implement conservation programs. For example: • Work with others to remove barriers to aquatic species passage (e.g., dam removal and culvert replacement). • Work with others to restore native species; work together to identify, prioritize, seek funding, implement, and monitor success of projects.		

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Cooperative Invasive Species Management Areas and Other Invasive Species Partnerships	Continue to work with existing invasive species partners, including the six CISMAs and other local watershed groups to control and prevent the spread of invasive species.	Within CPAs: Work with partners to develop a framework for invasive species control at all levels within the watershed, including watershed-wide, in subwatersheds, and at local levels. The goal is to create an organization that would result in on-the-ground invasive species inventories, monitoring, education, and management activities in priority habitats. Specifically, we would: • Take a leadership role in forming and administering a watershed-wide, partnership-based invasive species management program using the CISMA model. Apply for Federal funds to run this "umbrella CISMA" and distribute funds to the smaller groups to complete projects. • Work with existing partners to develop invasive species management objectives and strategies. • Help develop invasive species partnerships in CPAs where none currently exist.		
Objective 4.3 *Aquatic Species Protection, Restoration, and Management Partnerships* Support the conservation of migratory fish and other aquatic species of conservation concern by collaborating with Federal and State agencies, local towns, and non-governmental organizations in the implementation of fish and other aquatic species conservation plans.				
Invasive Species Outreach	Continue current levels of outreach on invasive species.	Provide target audiences and concerned citizens with the information they need to take meaningful actions to control or prevent species spread on their own lands or through their recreational and/or professional activities. Specifically, we will: • Educate the public about the importance of each person doing their part and supply them with the information to take wise action. • Inform those who manage extensive amounts of vegetation and/or transport soils as part of their job duties about the potential transmission of invasive plants, and provide them with operational Best Management Practices (BMPs). • Prioritize actions by considering which species are of highest threat to biodiversity, are threatening rare species, or can most successfully be eradicated; as well as which areas are especially important to restore due to important natural resources; educate partners and public about these priorities. • Help groups successfully plan and implement volunteer control days in their communities for plants that are easy to control by hand such as garlic mustard.		

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Objective 4.4 *Invasive Species Management and Other Invasive Species Partnerships* Plan and implement coordinated and strategic actions among conservation partners and private landowners to reduce the ecological threat from invasive or exotic plants and wildlife species in the Connecticut River watershed. Work with those partners to design and implement strategies for controlling the spread of established invaders, preventing new invasions, and in the early detection and rapid response to control new invaders.				
Early Detection and Rapid Response Control	Continue to work with partners and volunteers to control water chestnut in waterbodies throughout the watershed.	Work with partners to design and implement strategies for prevention, early detection, and rapid control response to new invaders, especially those deemed to pose a serious threat to native species populations or diversity. Specifically we will: • Become more actively involved with the Northeast Aquatic Nuisance Species Panel. • Work with the State invasive species groups to develop lists of potential invasive species that would pose serious threats to biodiversity if they became established in the watershed and develop a protocol for early detection and rapid response. Focus, first on priority species already known to be in New England such as zebra mussel, Asian longhorn beetle, hemlock wooly adelgid, emerald ash borer, mute swan, hydrilla, mile-a-minute vine, and Japanese stiltgrass. • Continue water chestnut spread control actions by assisting to find funds for large populations, leading groups to hand-pull smaller populations, and inspecting other water bodies for this species. Locate groups willing to "adopt a water body for water chestnut control" to further refuge efforts.			
Objective 4.4 *Invasive Species Management and Other Invasive Species Partnerships* Plan and implement coordinated and strategic actions among conservation partners and private landowners to reduce the ecological threat from invasive or exotic plants and wildlife species in the Connecticut River watershed. Work with those partners to design and implement strategies for controlling the spread of established invaders, preventing new invasions, and in the early detection and rapid response to control new invaders.				
Invasive Species Inventories and Mapping	Continue to work with existing invasive species partners, including the six CISMAs and other local watershed groups to control and prevent the spread of invasive species.	*Within CPAs* Work with partners to inventory and monitor populations of invasive species across the watershed, with priority attention to CPAs. Specifically, we will: • Ensure that inventory results are documented and shared in a timely manner, and to coordinate inventory efforts where possible. • Research how much of the watershed is covered in the inventory of the IPANE project (Invasive Plant Atlas of New England) and what gaps exist, especially on refuge-owned lands. • Work with IPANE staff to recruit IPANE volunteers to fill the gaps of the IPANE data within the watershed, (with a special focus on the CPA's and refuge-owned lands) and institute a procedure for the refuge to be notified if any invaders new to the area are discovered. • Work with IPANE program to include existing refuge data on invasive plants into the IPANE database.		

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Objective 4.5 *Special Designation Area Partnerships* Support existing Federal and State designated special areas, and work with partners and willing landowners to promote additional designations that enhance the protection and/or recognition of natural, cultural, and recreational resources of significance within CPAs.				
Eligibility and Monitoring	Continue to support existing special designations in the watershed and on the refuge.	*Within CPAs* Work cooperatively with others throughout the watershed, with priority attention to CPAs, to promote special designations that benefit natural, cultural, and recreational resources, such as: • Work with partners throughout the watershed to share information with willing landowners on the benefits of and eligibility requirements for special designation areas. • Work with partners and willing landowners to establish a monitoring program, or implement ones already developed, and pool resources to accomplish that monitoring, in an effort to ensure that the special designation areas maintain their characteristics.		
Objective 4.6 *Research and Demonstration Partnerships, Particularly in Support of Climate Change Adaptation* Create, enhance, or facilitate partnerships that advance conservation research in the Connecticut River watershed, leveraging resources among partners, with an emphasis on advancing our understanding of climate change and land use impacts and pursuing adaptation strategies in response, to ensure the long-term sustainability of native fish, wildlife, plants, and associated habitats found in the CPAs.				
Conservation Science Partnerships and Information Exchanges	Not addressed in 1995 FEIS.	*Within CPAs* Work with partners to conduct research and demonstration projects to address climate change throughout the watershed, with priority attention to CPAs. For example: • Promote research and development of applied management practices to sustain and enhance the natural and cultural resources. • Seek opportunities that engage research institutions and organizations such as universities and colleges and NGOs. • Primarily working through the NALCC partnership, develop, implement, and support cooperative research programs that address priority conservation and management needs or which provide basic information on species populations, their habitat needs, and response to climate change. • Encourage opportunities on the refuge for research, inventory and monitoring, and the demonstration of management practices.		
Inventory and Monitoring Program	Continue current inventories and monitoring on refuge and with partners.	*Within CPAs* Work with other partners to inventory and monitor resources of conservation concern throughout the watershed, with priority attention to CPAs. For example: • Promote the efforts of the NALCC partnership to identify common inventory and monitoring needs and help the LCC with sharing resources to accomplish priority work. • Support the Service's LMRD and the inventory and monitoring priorities identified for the watershed.		

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Objective 4.6 *Research and Demonstration Partnerships, Particularly in Support of Climate Change Adaptation* Create, enhance, or facilitate partnerships that advance conservation research in the Connecticut River watershed, leveraging resources among partners, with an emphasis on advancing our understanding of climate change and land use impacts and pursuing adaptation strategies in response, to ensure the long-term sustainability of native fish, wildlife, plants, and associated habitats found in the CPAs.				
Climate Science and Adaptation	Not addressed in 1995 FEIS.	Work with partners at the Federal, State, and local levels to identify and address climate change threats to fish, wildlife, and habitats throughout the watershed, including: • Encouraging communities in the watershed to plan to minimize the impacts of climate and land use changes and to conserve ecosystem services benefits. • Promoting the work of the NALCC to model land use and climate change and the projected impacts on fish, wildlife, and habitats. • Encouraging and supporting the restoration of floodplain forests and riparian buffers to protect public and private property from increased incidents of severe weather events, and any actions that would improve water quality in rivers and streams. • Supporting the work of the Northeast Climate Science Center to help provide scientific information, tools, and techniques to help anticipate, monitor, and adapt to climate change. • Working with other Service programs to develop, and share information with partners about, best practices for climate change adaptation.		
Objective 4.7 *Community-based Partnerships* Create, enhance, or facilitate partnerships within watershed communities that enhance the Service's ability to make positive contributions to civic life and local economies, and enrich community connections to a healthy, vibrant watershed (see objective 4.8 for those partnerships specifically dedicated to education, interpretation, and recreation).				
Economic Vitality within the Watershed	Continue existing community-based partnerships.	*Within in CPAs* • Work to enhance the economic vitality of communities in the Connecticut River watershed through nature-based and ecotourism initiatives, agriculture and forest protection programs, and recreational activities that both advance strategic conservation and improve broad-based visitation to the refuge. • Meet with local community officials and leaders to establish how the Service can make a positive contribution to local economies consistent with the Service and Refuge System missions, and refuge purposes where refuge lands are involved. • Communicate with local businesses when refuge staff are awarding contracts that have the potential for economic opportunity, including timber harvest, and construction and maintenance activities.		

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Objective 4.7 *Community-based Partnerships* Create, enhance, or facilitate partnerships within watershed communities that enhance the Service's ability to make positive contributions to civic life and local economies, and enrich community connections to a healthy, vibrant watershed (see objective 4.8 for those partnerships specifically dedicated to education, interpretation, and recreation).				
Historic and Cultural Resources		• As appropriate, support the protection, management, and restoration of cultural resources in the Connecticut River watershed and promote opportunities to connect people to the area's rich history. Identify and develop working partnerships with academic institutions, museums, and tribal governments with the goal of identification, protection, and interpretation of historic and cultural resources, particularly land-based or archaeological features. The refuge will not lead on projects involving the acquisition, restoration, and interpretation of historic structures, but where practical and appropriate on such projects within CFAs that include a significant land protection component, we will work to be an effective partner in the overall protection effort.		
Community Outreach, Shared Facilities, and Public Safety Resources	Continue current level of community outreach.	*Within CPAs* • Institute regular meetings (e.g., annual meetings, twice annual listening stations, etc.) with community leaders and citizens to make the refuge more relevant and connected to communities. • Make refuge buildings available for community meetings and events. Consider opportunities to provide office space to State natural resource and other conservation partners in order to better serve the public interest. Share maintenance equipment and other resources with a wide range of partners when possible. • Establish partnerships with local and State law enforcement agencies to benefit both communities and the refuge. Enter into mutual aid agreements to share personnel and equipment.		
Easements, Leases, Cooperative Agreements, and Special Use Permits	Continue existing easements, leases, cooperative agreements, and special use permits.	*Within CPAs* • Employ a wide variety of agreement types to facilitate projects and other opportunities advancing conservation, environmental education, and recreation goals shared with partners in local communities. • Ensure the most appropriate agreement is created for each opportunity given expected outcomes and responsibilities. For example, encourage easements to provide additional public access or manage habitats, or to protect important habitat from land development. • We may pursue low or no-cost leases to facilitate the construction of capital improvements such as Conte Corner installations, boardwalks, trails, and interpretive kiosks.		
Constituent Organizations	Continue existing relationships with constituent organizations (e.g., bird clubs, sportsperson clubs, etc.).	*Within CPAs* • Promote relationships with bird clubs, outdoor recreation and sportsperson's clubs, and other constituent organizations to encourage their involvement in refuge management and to build support.		

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 4.8 *Educational and Interpretation Partnerships* In conjunction with the strategies described under Goal 2–Environmental Education, Interpretation, and Outreach, above–coordinate our educational, outreach, and interpretive conservation programs with those of our partner agencies and organizations so that a consistent public message fosters respect for the natural world and gets more people motivated to promote conservation in their daily lives.				
Environmental Education and Interpretation Partnerships	Continue to support environmental education and interpretation partnerships.	*Within CPAs* Enhance existing and build new partnerships to develop and provide high-quality environmental education and interpretive programs, with priority attention in CPAs, including: • Working with each of the four State environmental education program coordinators to identify effective education programs, to integrate curriculums where appropriate, and to promote consistent standards of excellence for educational programs offered in the watershed. • Working with education partners to develop and deliver integrated interpretive messages about natural, cultural, and historic resources of the Connecticut River watershed. • Contribute interpretive information regarding the refuge to partner programs. • Continue and enhance shared environmental education and interpretation facilities that are effective in reaching a wide and diverse demographic with consistent and productive messages about the refuge and the Service's contribution to conservation in the watershed. Continue to seek new opportunities for partnerships.		
Objective 4.9 *Recreation Partnerships to Connect People with the Outdoors* Work with partners to promote and provide outdoor recreational opportunities in the watershed that facilitates connecting people with nature in a meaningful way, and encourages those connections over their lifetimes. Promote the development of a landscape-based recreation strategy within the watershed to connect, protect, and enhance a network of aquatic and terrestrial trails.				
Federal and State Agency Strategic Recreation Plans	Continue to support existing recreational partnerships.	*Within CPAs* Work cooperatively with other Federal and State partners throughout the watershed, with priority attention to CPAs, to plan and implement recreational opportunities.		

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 4.9 *Recreation Partnerships to Connect People with the Outdoors* Work with partners to promote and provide outdoor recreational opportunities in the watershed that facilitates connecting people with nature in a meaningful way, and encourages those connections over their lifetimes. Promote the development of a landscape-based recreation strategy within the watershed to connect, protect, and enhance a network of aquatic and terrestrial trails.				
Making Connections Outdoors	Continue to support existing recreational partnerships.	*Within CPAs* Coordinate with other Federal and State agencies, educational and recreational organization and user groups to promote activities that connect people with the outdoors, including: • Help sustain regional trails that connect people with nature, such as the Northern Forest Canoe Trail, Connecticut River Birding Trail, Connecticut River Paddlers' Trail, and the "Source to the Sea" birding trail. • Engage with partners to develop concept plans, interpretive materials, and conduct inventories of infrastructure to support these trails and initiatives.		
Objective 4.10 *Friends Groups* Develop and nurture active and vibrant Friends groups through formal, strategic support programs, and by strengthening communication, collaboration, and cooperation. Include them as full partners in the mission delivery of the refuge and the Refuge System. Implement national guidance on mentoring Friends groups designed to ensure each group's effectiveness in supporting the refuge, as well as to provide training and organizational resources, and encourage networking among Friends groups across the Refuge System. Provide guidance to partners who want to create Friends groups on other ownerships.				
Friends Groups	Continue to support existing Friends groups, including the Friends of Conte Refuge, Friends of Pondicherry, Friends of Nulhegan Basin Division, Friends of Salmon River, and Friends of the Great Falls Discovery Center.	*In addition to alternative A:* • Enhance support for refuge Friends groups. • Develop, promote, and support development of Friends groups for other refuge divisions and units. • Formalize each refuge Friends group through a written agreement. • Encourage Friends groups to pursue non-profit status (501(c) 3 organization status). • Provide resources to conservation partners interested in establishing a Friends group on other ownerships.		

Resource or Program Sub-objectives	Alternative A Current Management (No change from 1995 Final EIS, as amended)	Alternative B Consolidated Stewardship (Within Existing, Approved Acquisition Authority)	Alternative C Enhanced Conservation Connections and Partnerships (Service-preferred Alternative) (Includes Expanding the Refuge's Approved Acquisition Authority)	Alternative D Reduced Management with Emphasis on Backcountry Recreation (Includes Expanding the Refuge's Approved Acquisition Authority)
Objective 4.11 *Intergovernmental Partnerships* Pursue strategic and synergistic intergovernmental partnerships at all levels of government to achieve specific, shared, and compatible landscape-level goals for conservation, education, and recreation within the watershed. Work within existing Federal and State programs to the full extent possible to help leverage funding and staff resources, information, and expertise among public and private partners. Formalize agreements through Memorandums of Understanding (MOUs), Memorandums of Agreement (MOAs), or other written, intergovernmental agreements, as warranted, when the identification of roles, responsibilities, and measures of success would enhance the likelihood of successful implementation.				
Multiagency or Public-Private Partnerships	Continue to support existing MOUs and other multiagency and public-private partnership agreements to meet refuge goals, the Refuge System mission, and other shared conservation priorities in the watershed.	*In addition to alternative A:* Enhance existing, and build new, multiagency and public-private partnerships to meet shared conservation goals throughout the watershed, with priority attention to CPAs, including: • Seek opportunities, to the extent possible, to share financial and staff resources, information, expertise, etc. • Work with partners to monitor and evaluate existing MOUs and MOAs prior to their renewal; continue, modify, or discontinue agreements as warranted.		
Federal Agency Coordination	Continue to engage other Federal agencies in shared conservation goals for the watershed, and to enhance the implementation of Federal programs through partnerships.	*In addition to alternative A:* Enhance existing, and build new, Federal agency partnerships to expand and expedite programs to benefit local communities. • Seek opportunities, where possible, to share financial and staff resources, information, expertise, and otherwise leverage multi-agency investments in the watershed to accomplish shared goals and attract other investors. • Utilize the AGOs framework to catalyze and bolster local, community-driven conservation efforts and demonstrate how a strong Federal agency partnership can more effectively align, target, and leverage public resources across the watershed to accomplish shared goals and objectives.		

Maps of Proposed CPAs

The following maps show the proposed location of the 19 individual CPAs, and the location of the 22 CFAs within them under the Service-preferred alternative C.

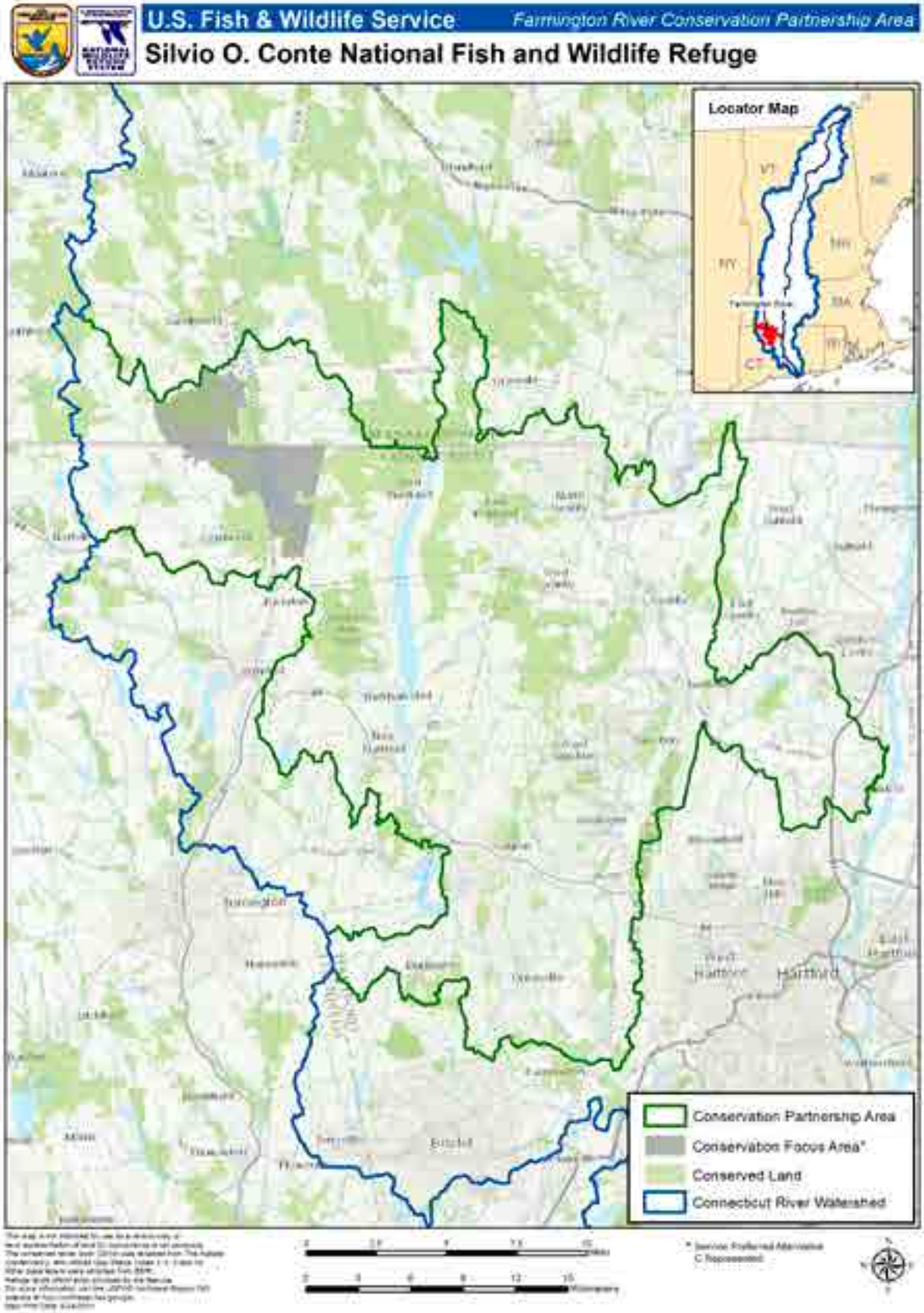
CPAs are areas where we propose to focus our support to our partners to best achieve shared conservation, education, and recreational goals. CFAs are areas where the Service would focus land acquisition efforts from willing sellers for Conte Refuge (fee title and easement) to make important contributions to the priority conservation targets.

The CPA maps below are organized alphabetically by State. Under alternative C, ninety percent (90%), on average, of our approved acreage authority would be acquiring land from willing sellers within CFAs, with the remaining ten percent (10%) from willing sellers within the surrounding CPAs. Since that 10% is not depicted as discrete areas, we will coordinate with local municipalities, States, and abutting landowners prior to taking action.

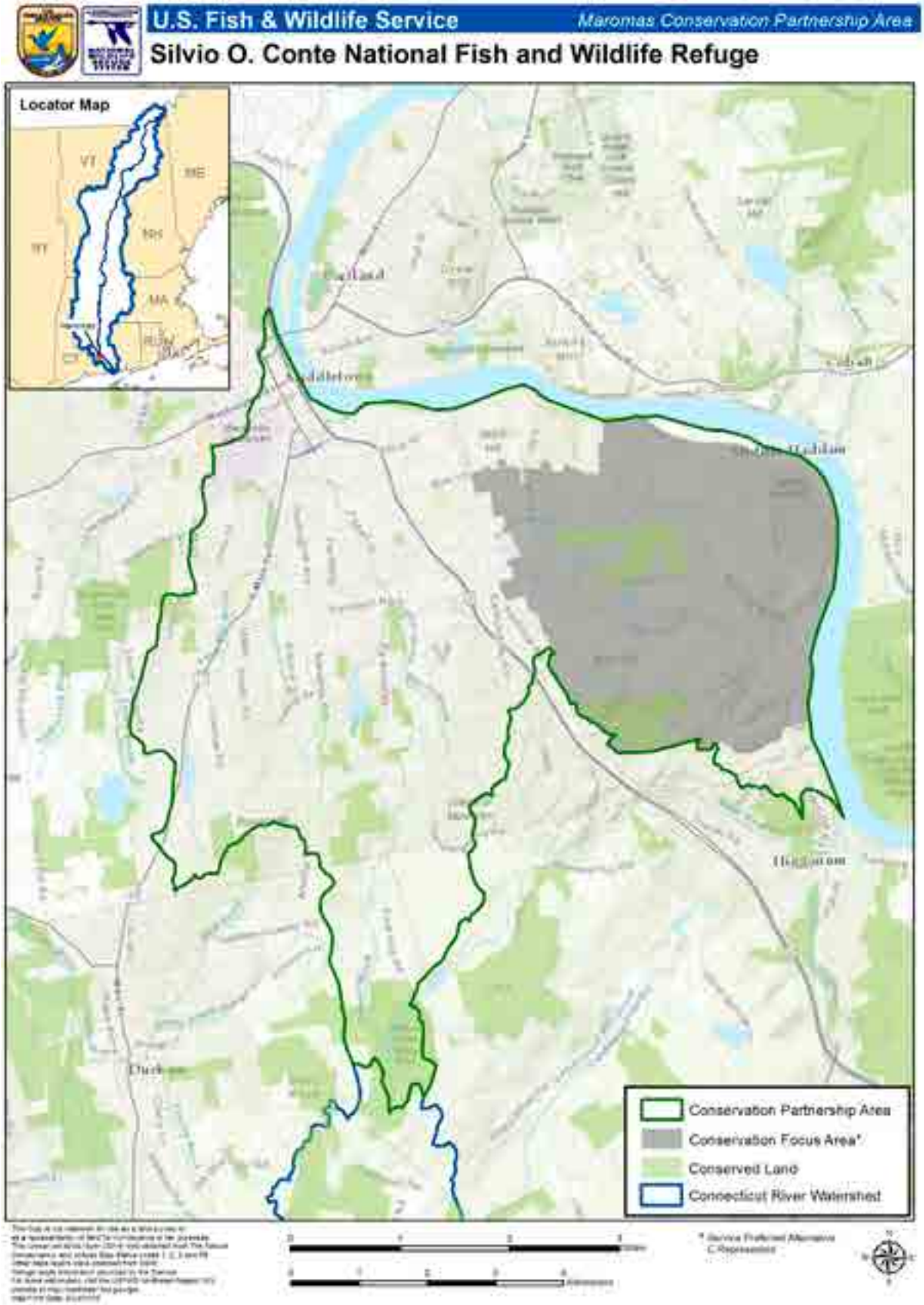
Each CPA map shows:

- The proposed CPA boundary.
- The delineation of the proposed CFA(s) under the Service-preferred alternative C (shown in gray).
- Conserved lands as defined by The Nature Conservancy's 2014 secured lands data using GAP status 1, 2, 3 and 39 definitions (*https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/secured/Pages/default.aspx*). The Service does not intend to pursue acquisition of existing conserved lands (shown in green).

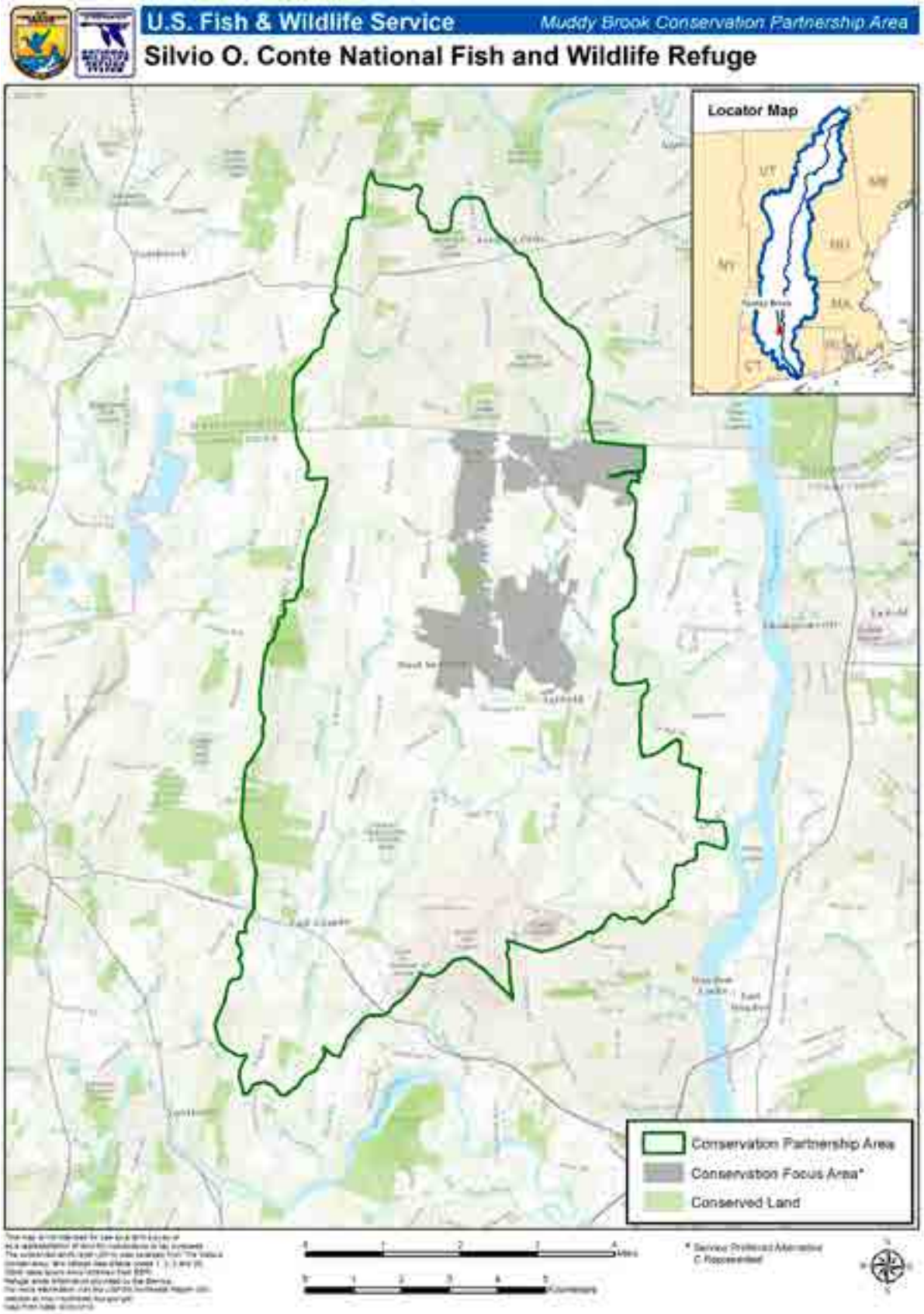
Map 4.3. Proposed Farmington River CPA, Connecticut and Massachusetts



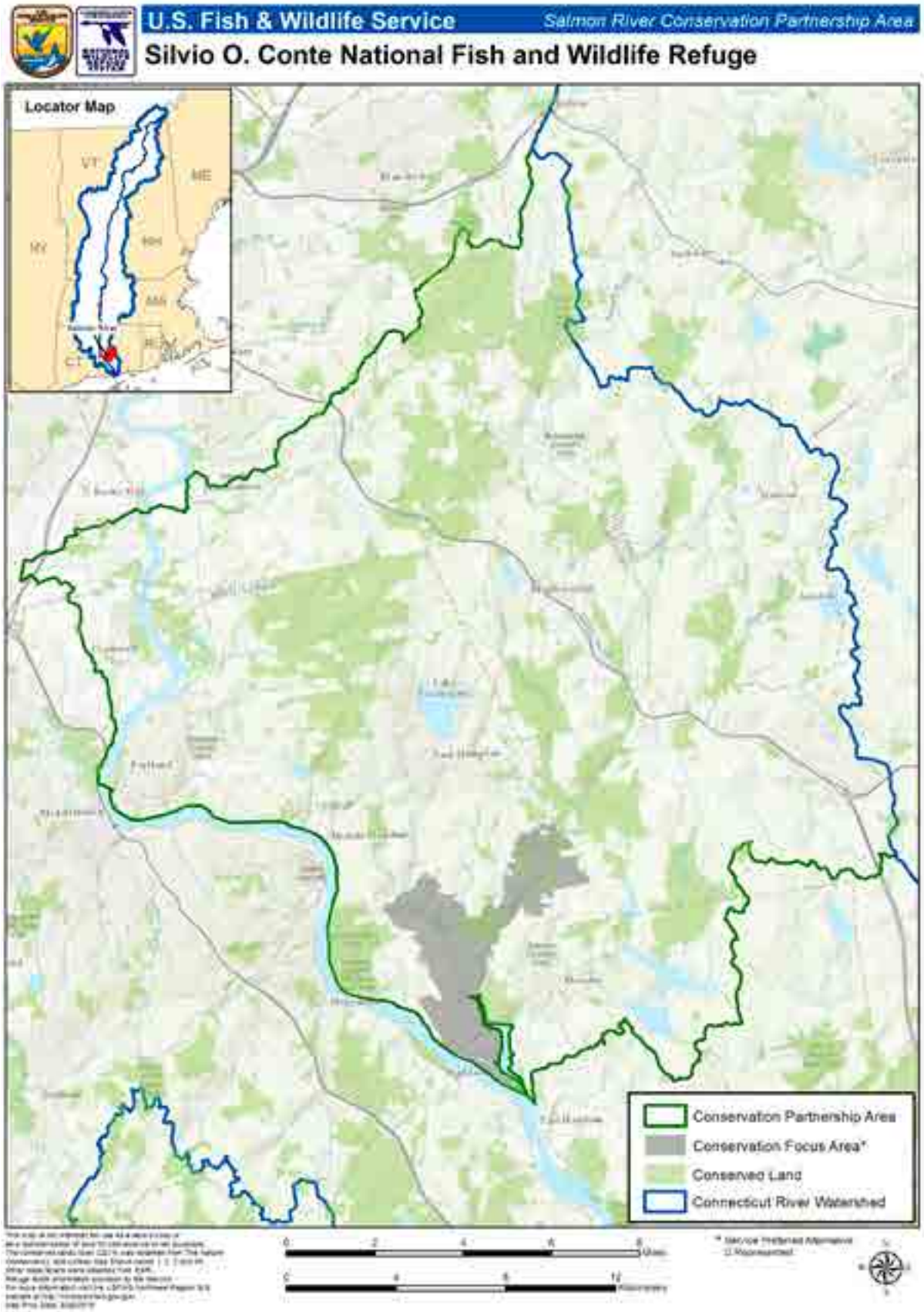
Map 4.4. Proposed Maromas CPA, Connecticut



Map 4.5. Proposed Muddy Brook CPA, Connecticut

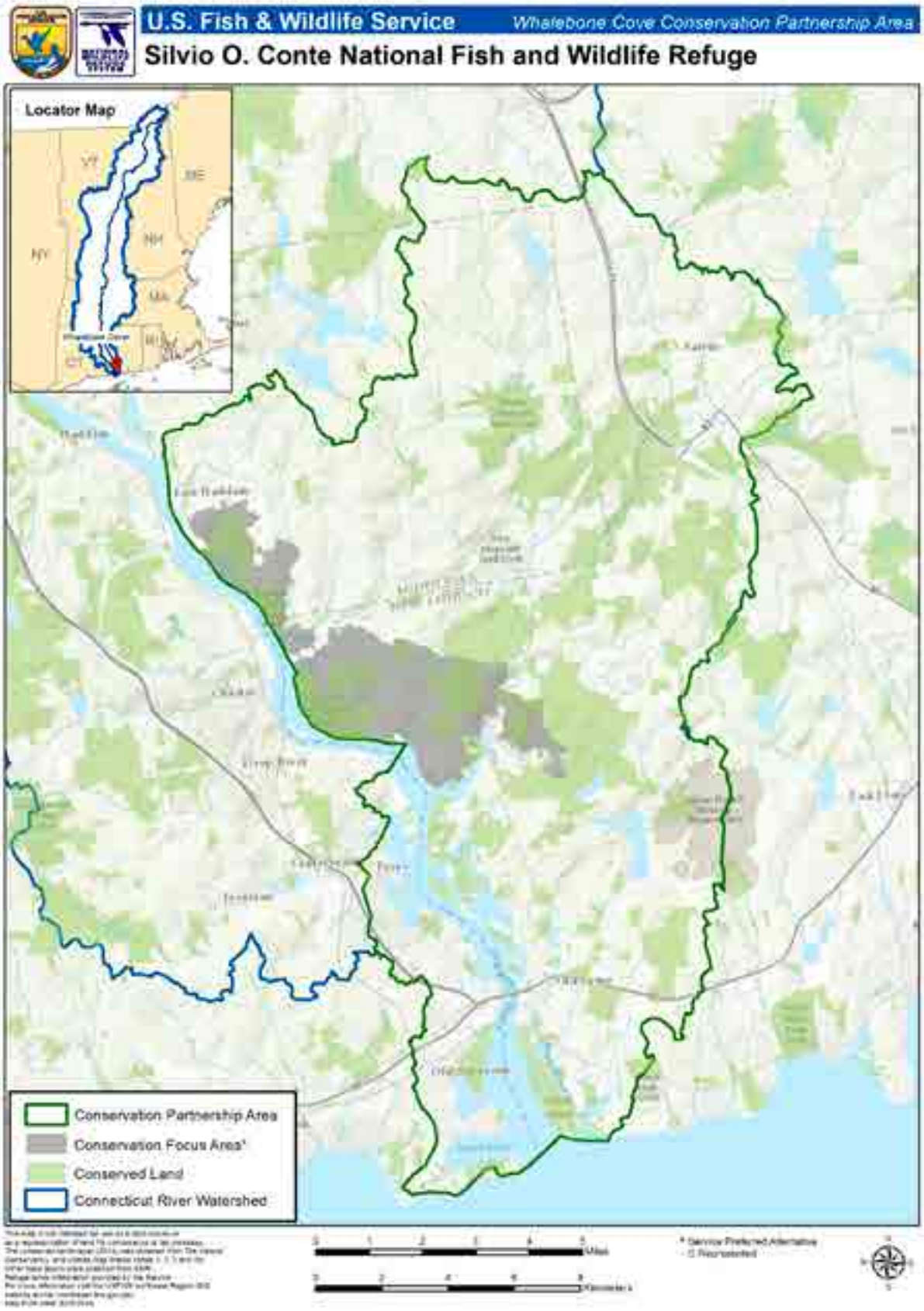


Map 4.6. Proposed Salmon River CPA, Connecticut

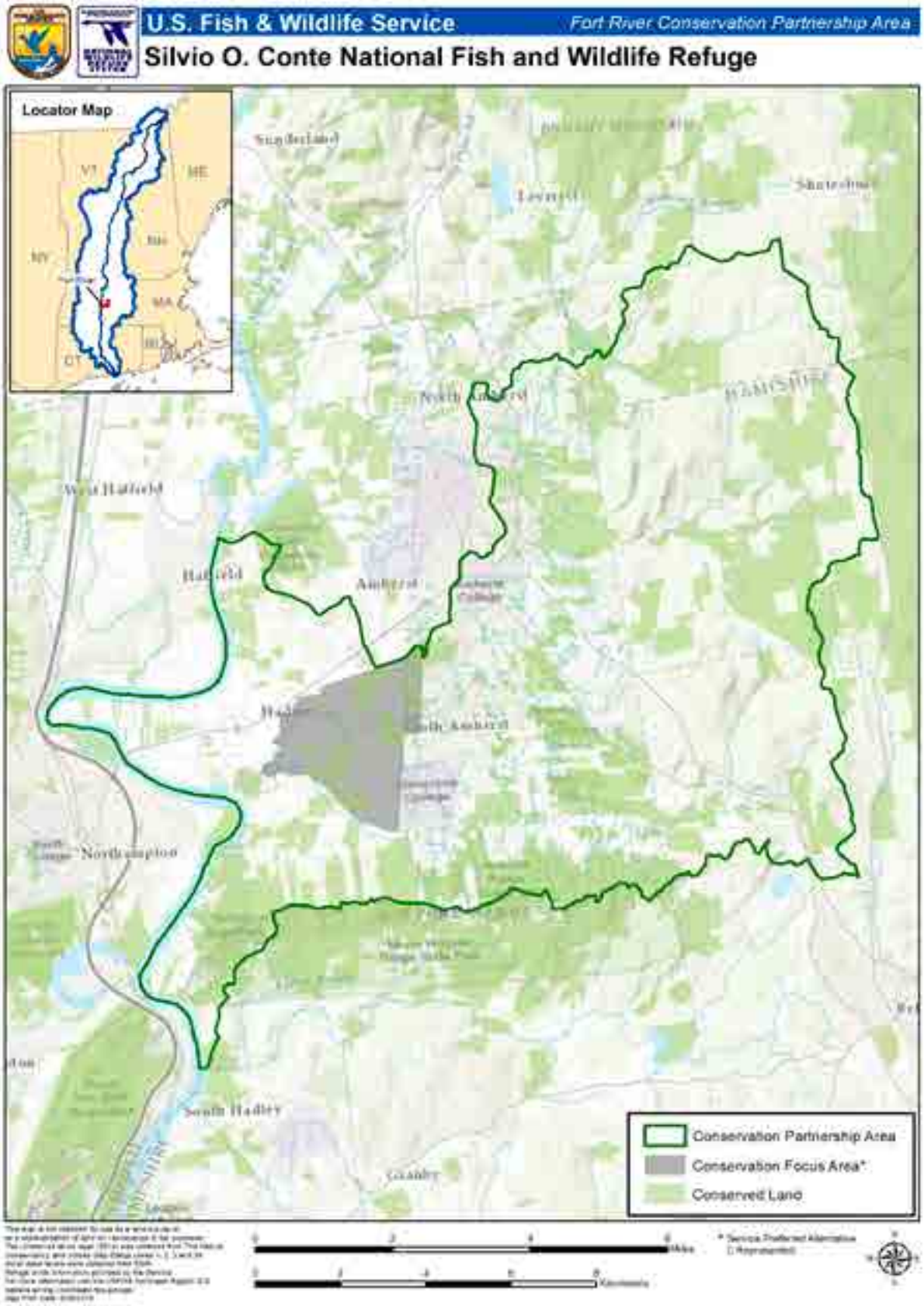


Map 4.7. Proposed Scantic River CPA, Connecticut

Map 4.8. Proposed Whalebone Cove CPA, Connecticut

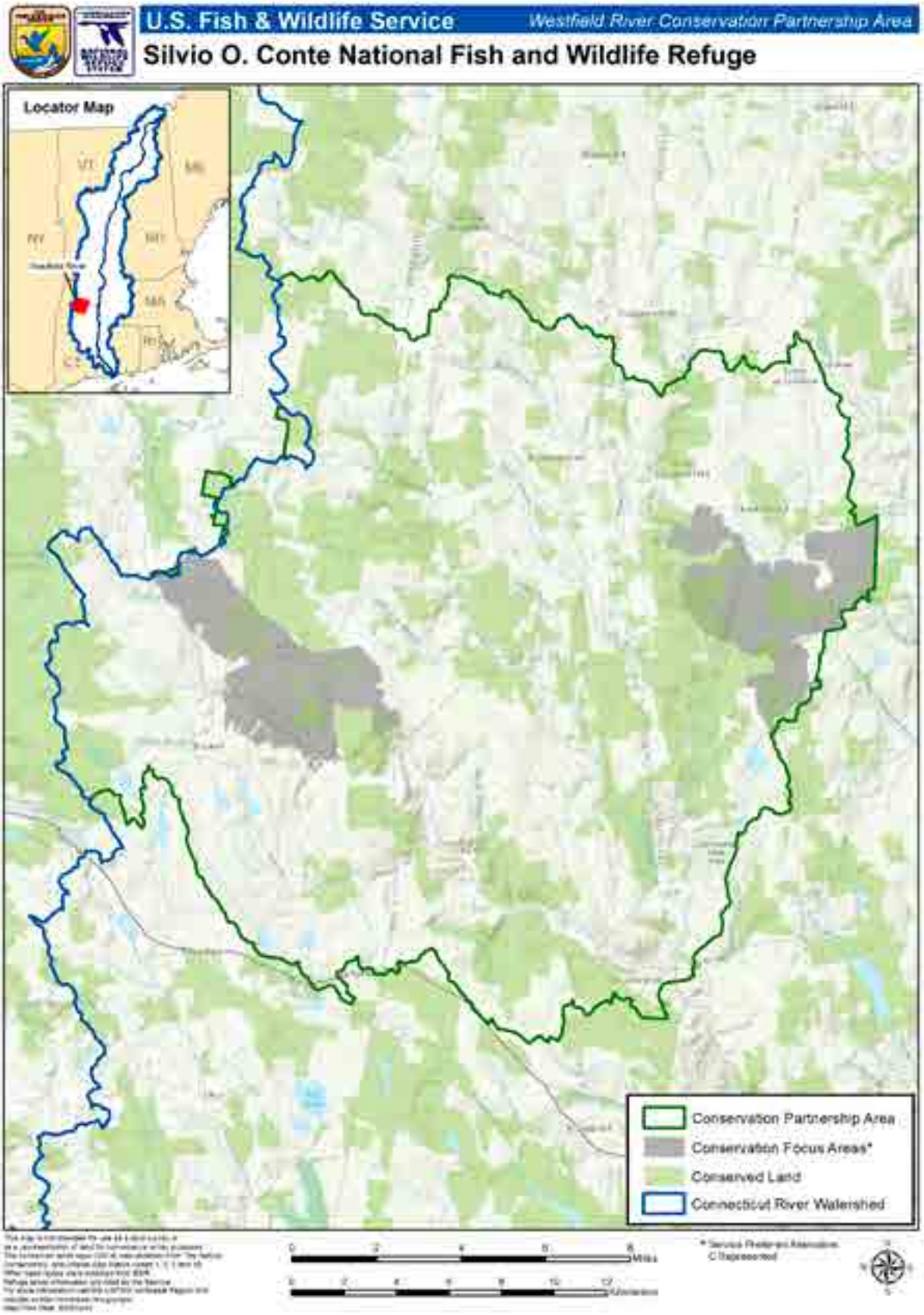


Map 4.9. Proposed Fort River CPA, Massachusetts

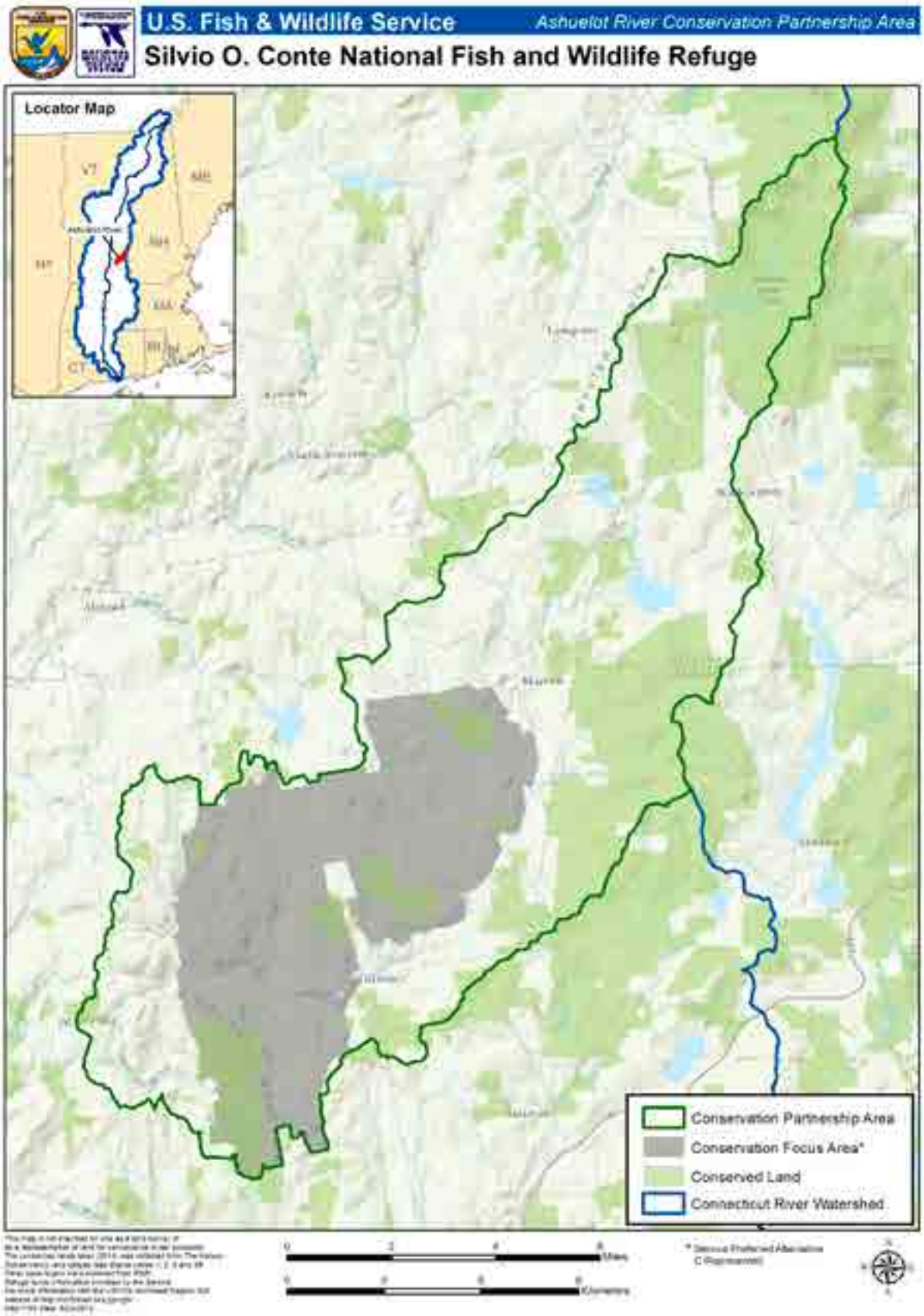


Map 4.10. Proposed Mill River CPA, Massachusetts

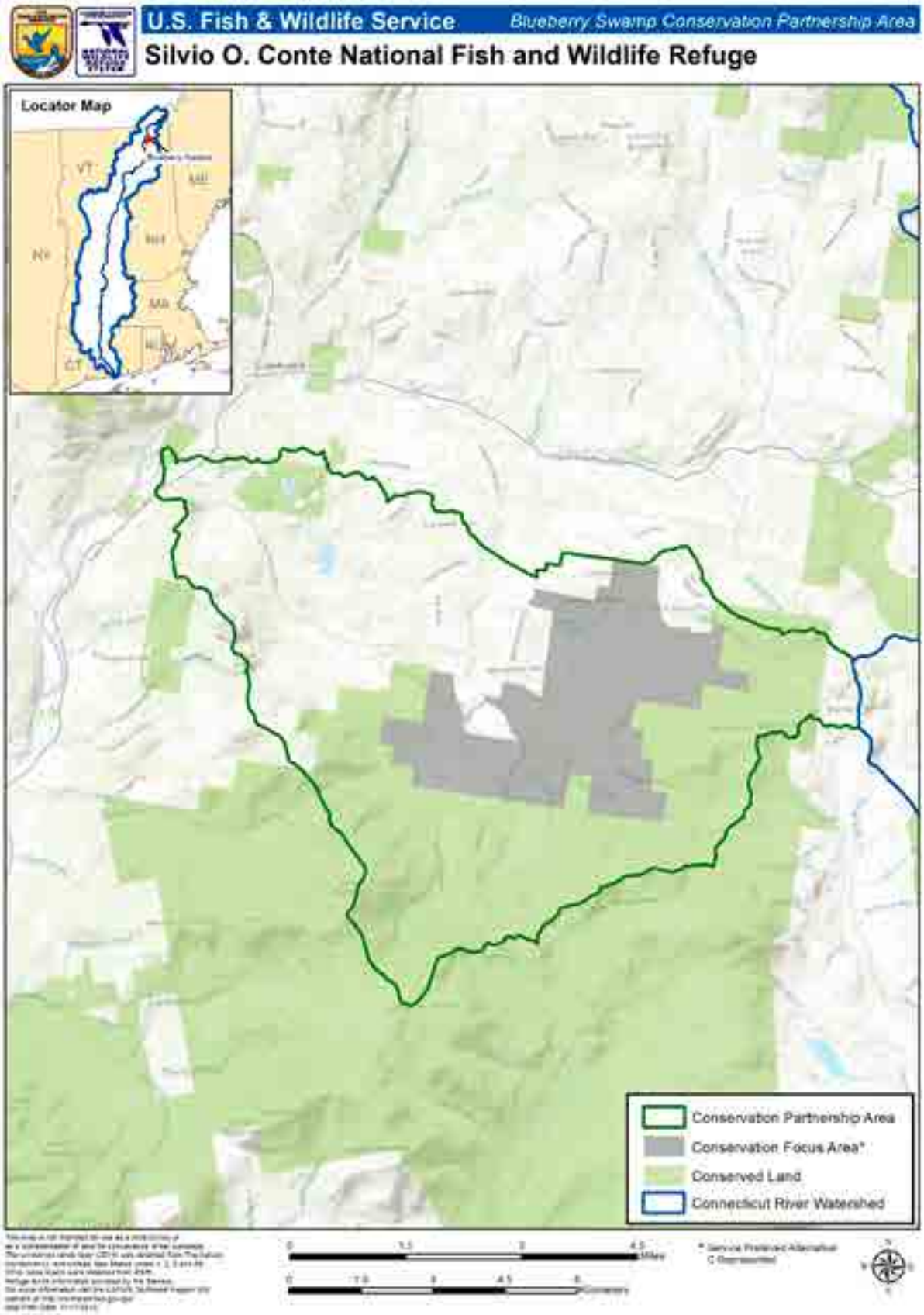
Map 4.11. Proposed Westfield River CPA, Massachusetts



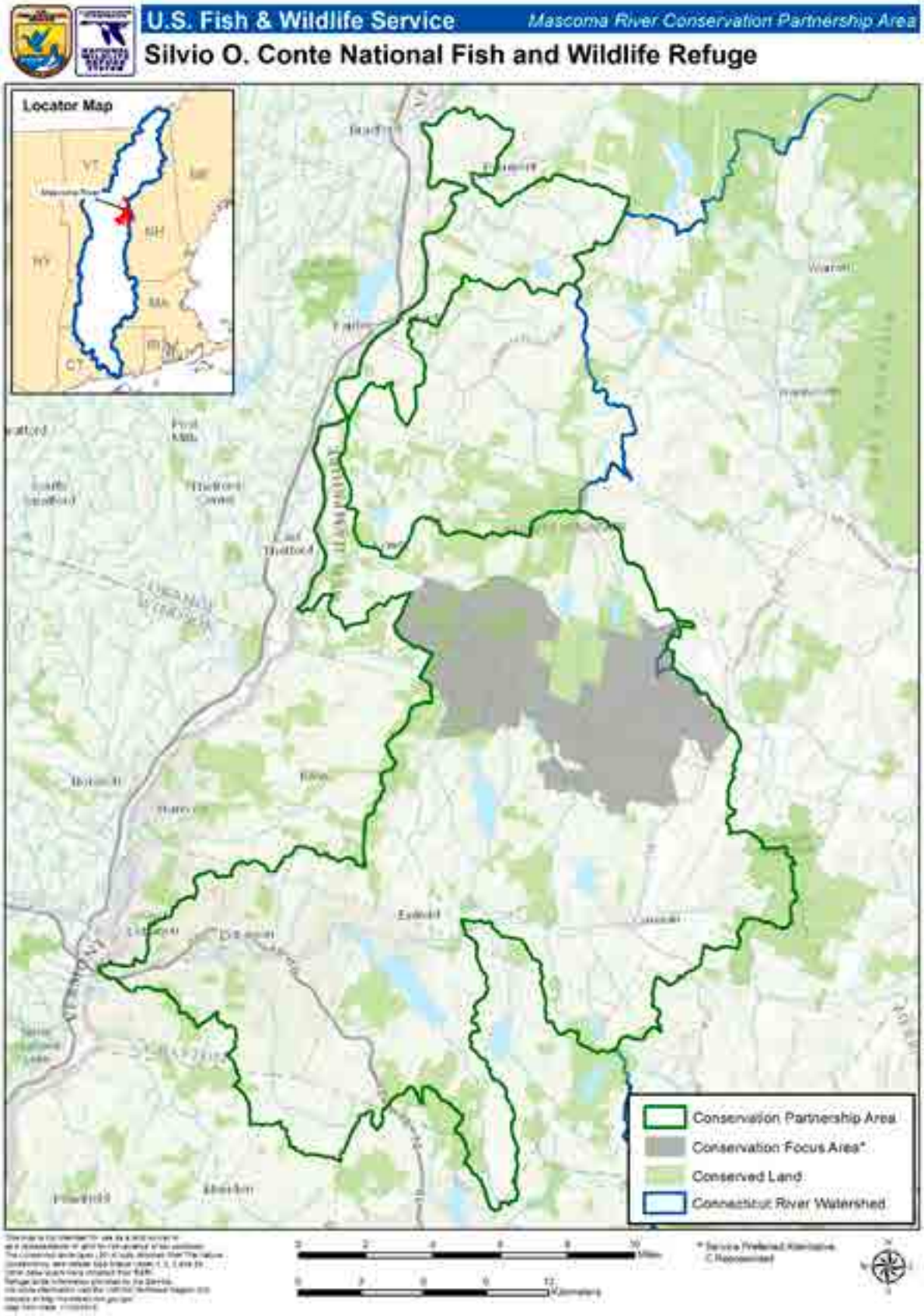
Map 4.12. Proposed Ashuelot River CPA, New Hampshire



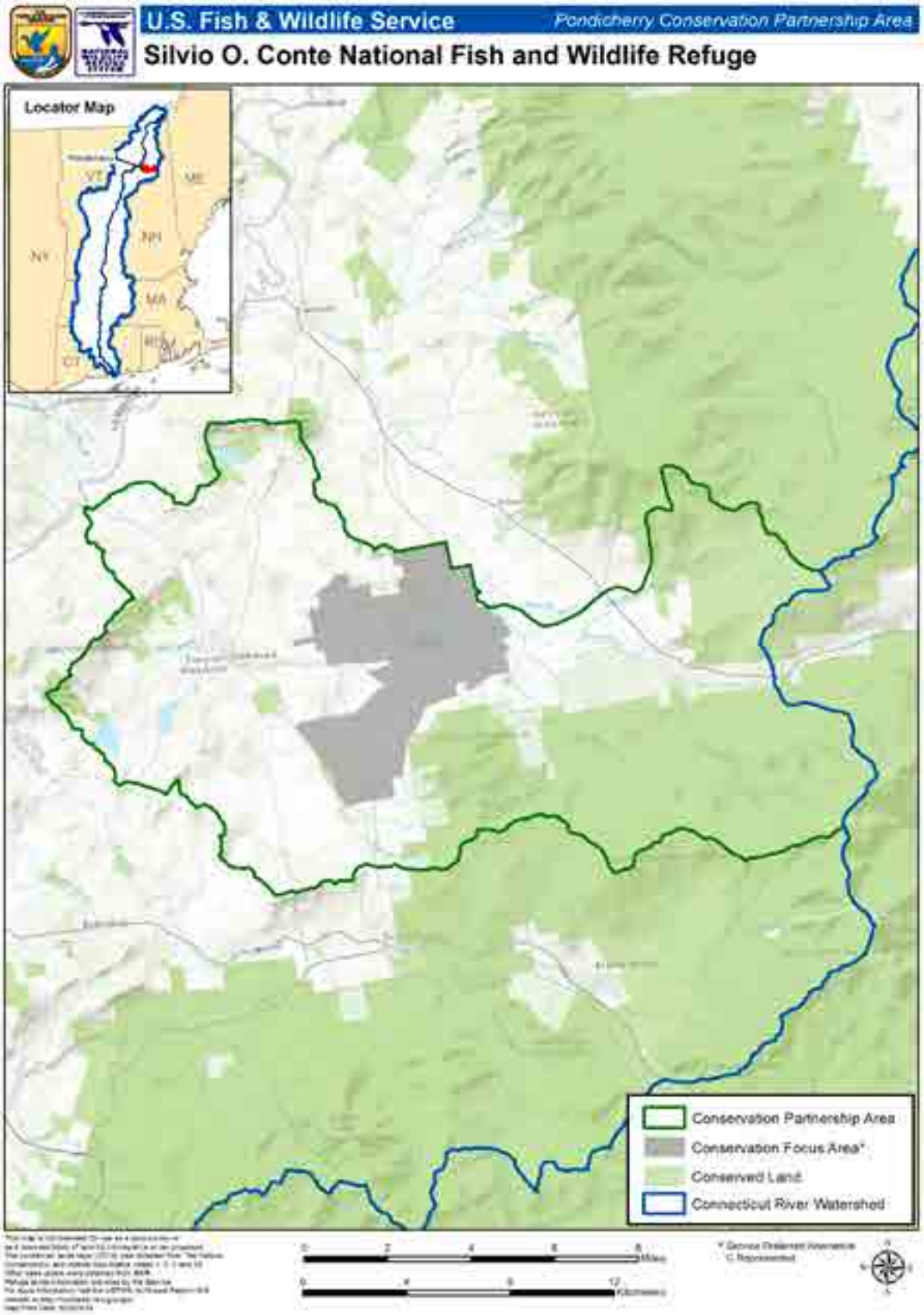
Map 4.13. Proposed Blueberry Swamp CPA, New Hampshire



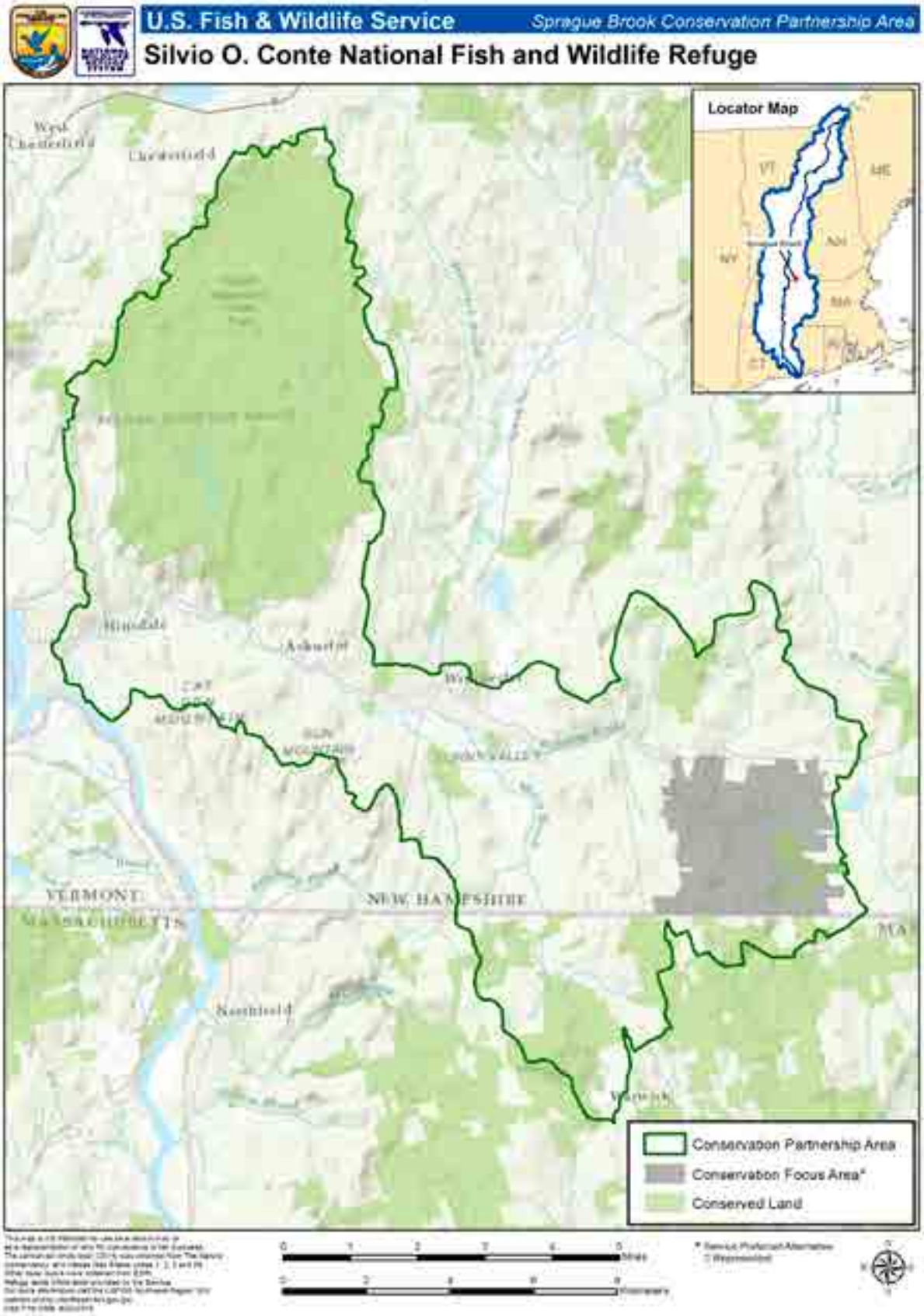
Map 4.14. Proposed Mascoma River CPA, New Hampshire



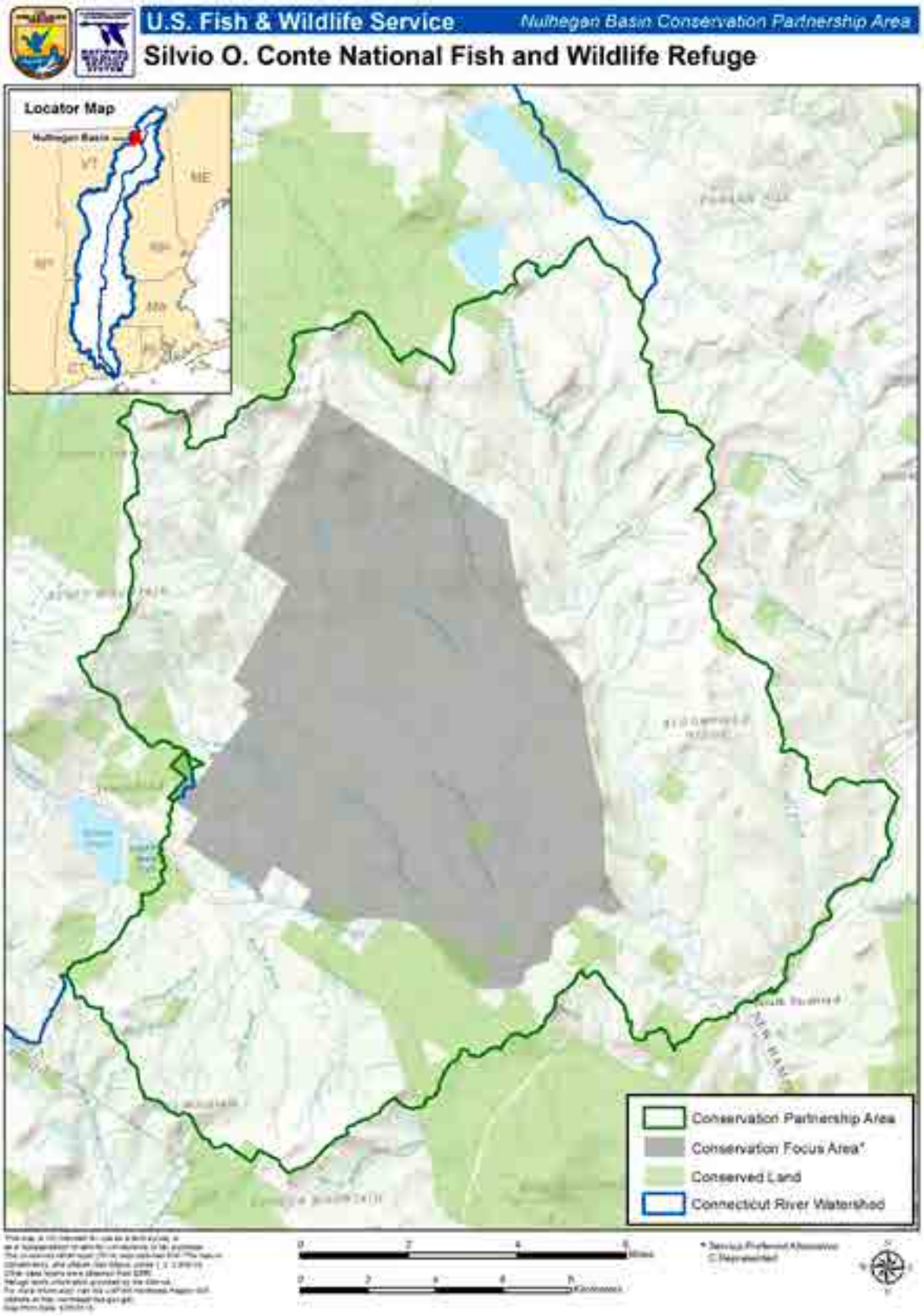
Map 4.15. Proposed Pondicherry CPA, New Hampshire



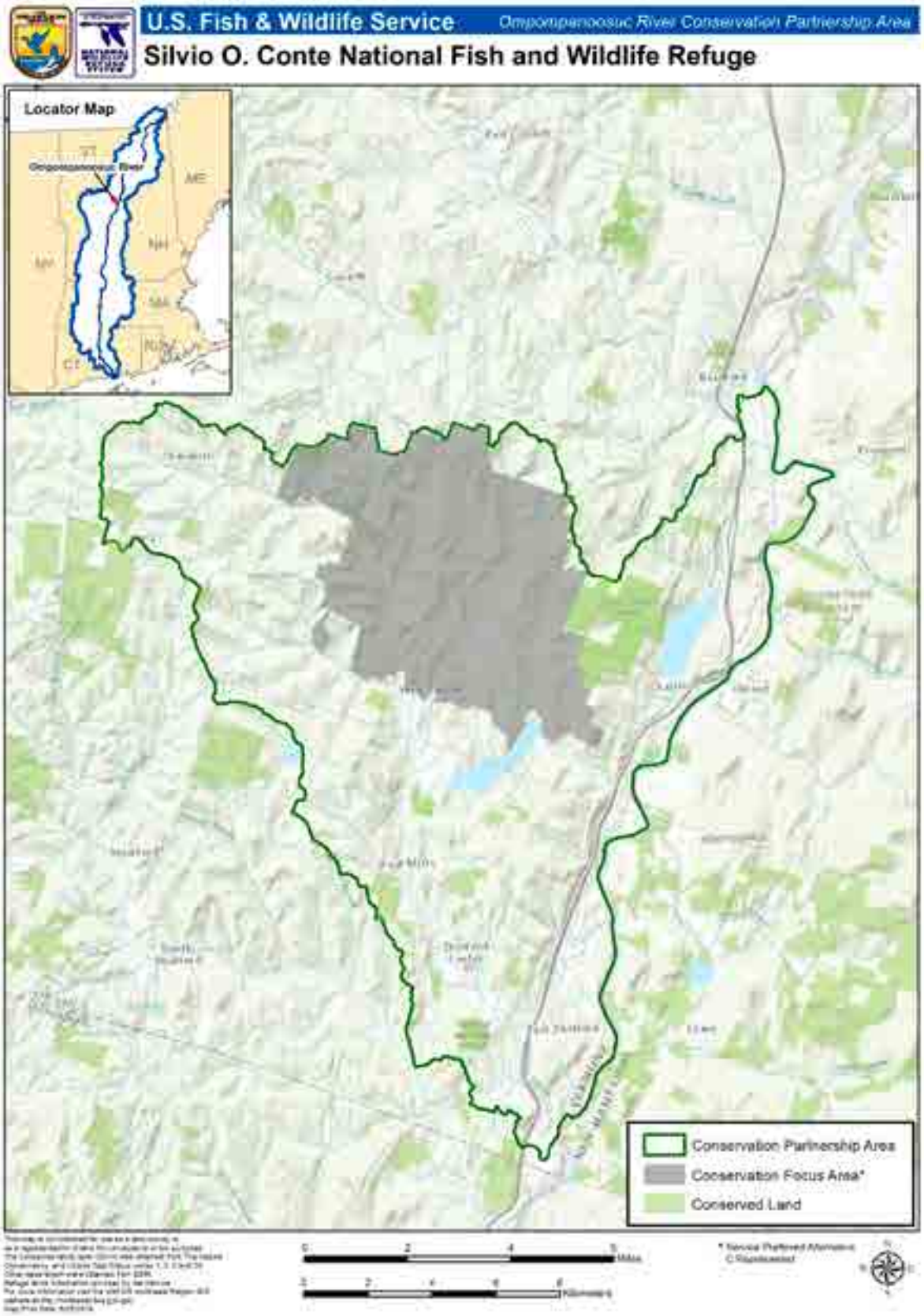
Map 4.16. Proposed Sprague Brook CPA, New Hampshire and Massachusetts



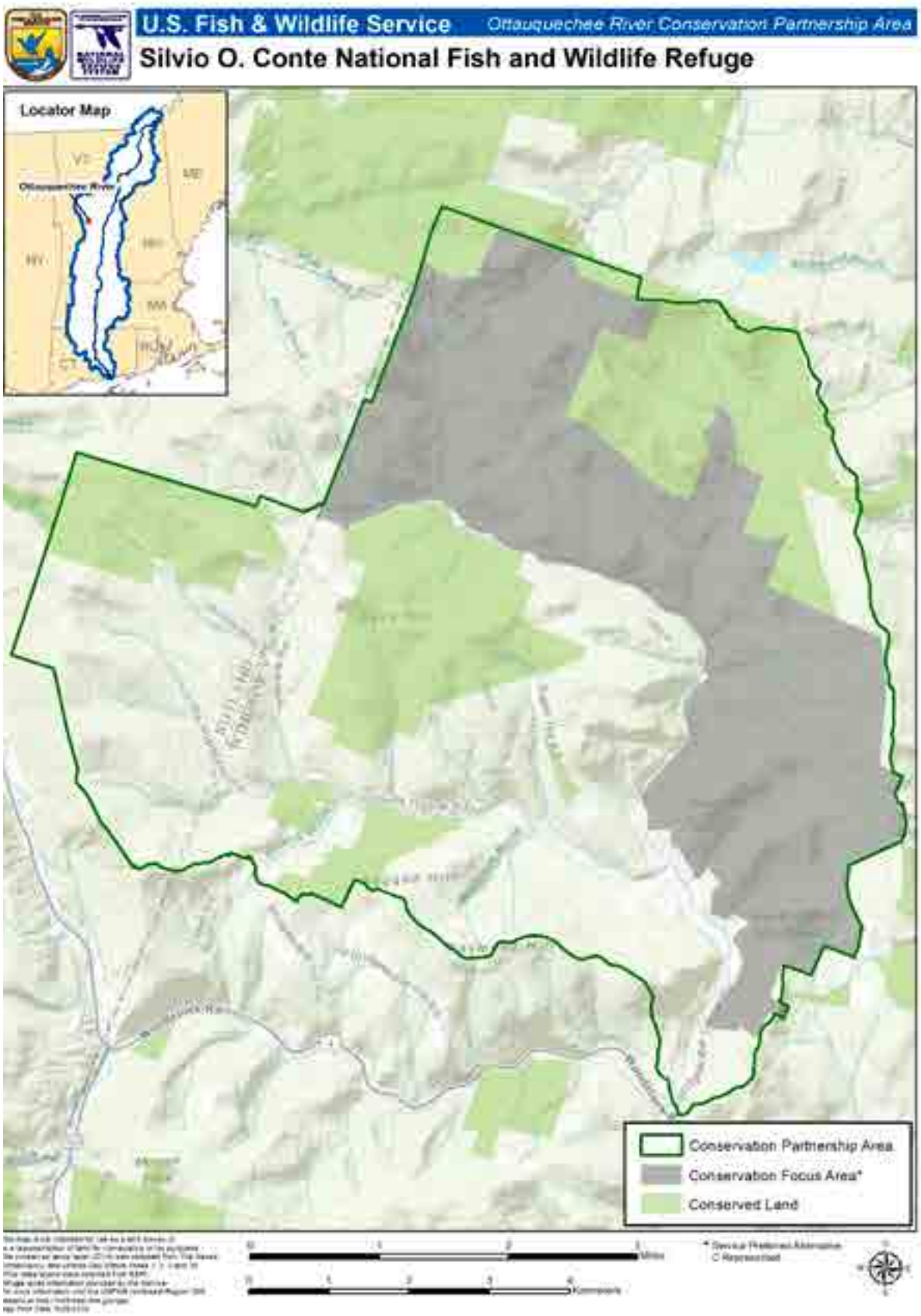
Map 4.17. Proposed Nulhegan Basin CPA, Vermont



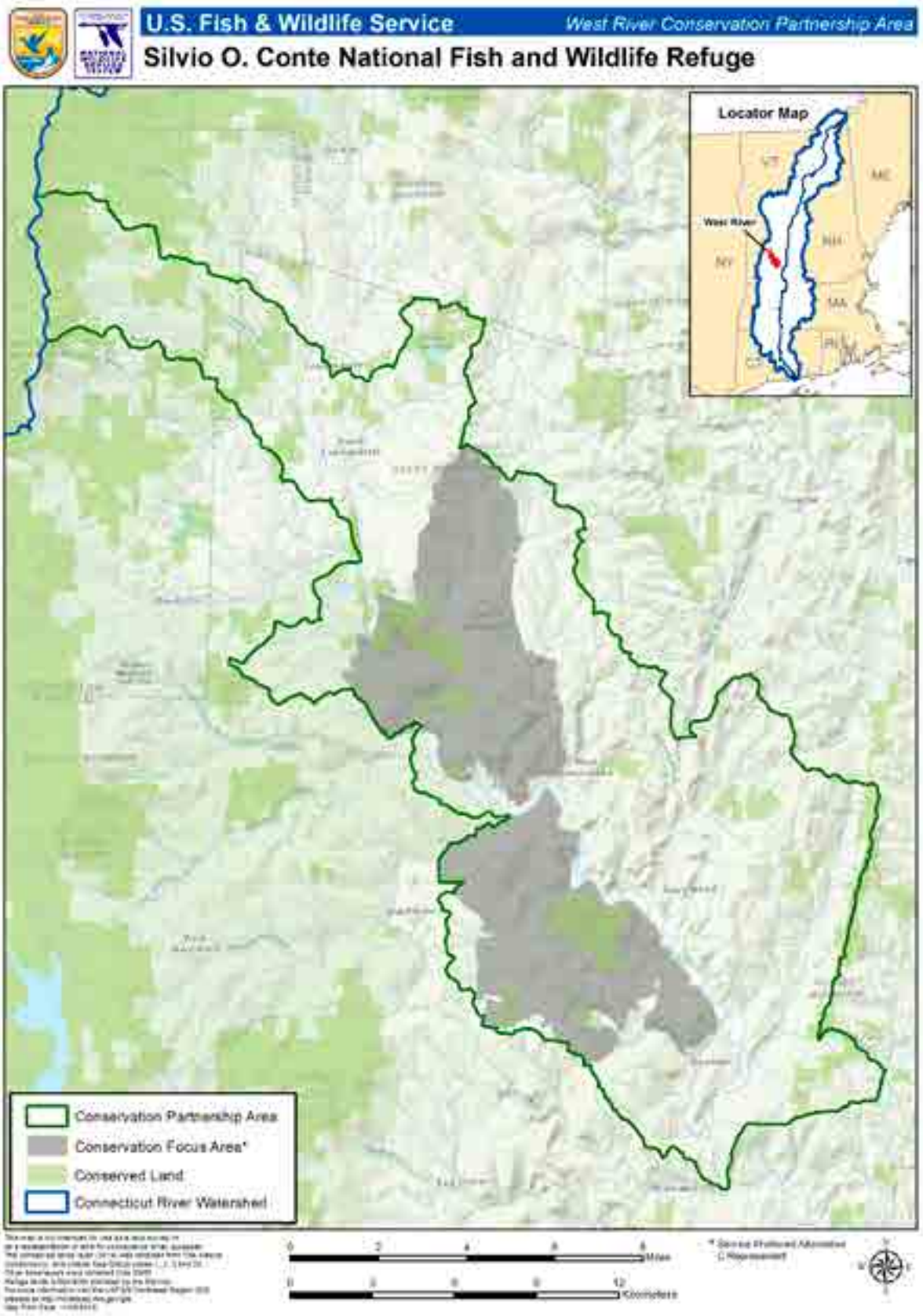
Map 4.18. Proposed Ompompanoosuc River CPA, Vermont



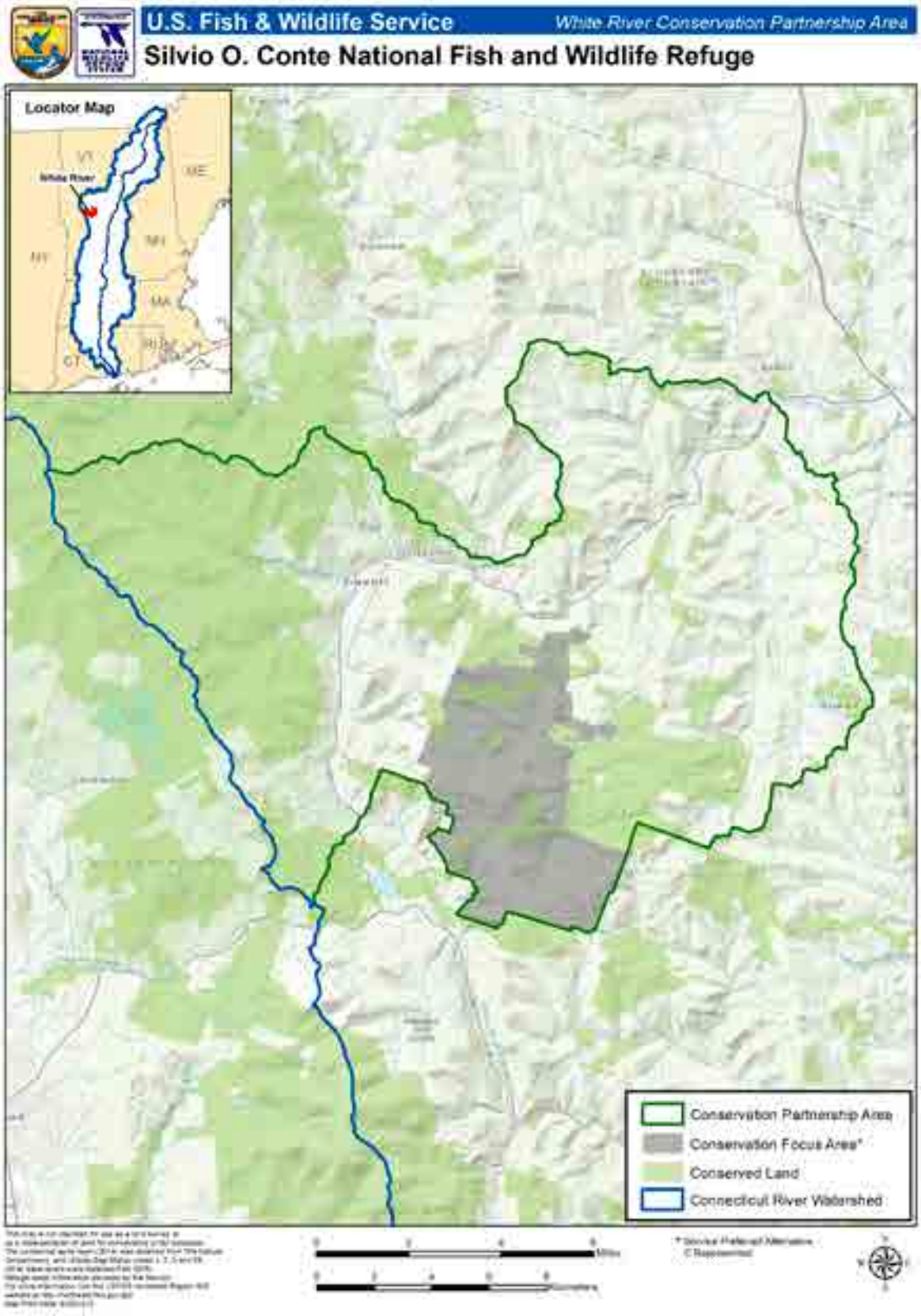
Map 4.19. Proposed Ottauquechee River CPA, Vermont



Map 4.20. Proposed West River CPA, Vermont



Map 4.21. Proposed White River CPA, Vermont



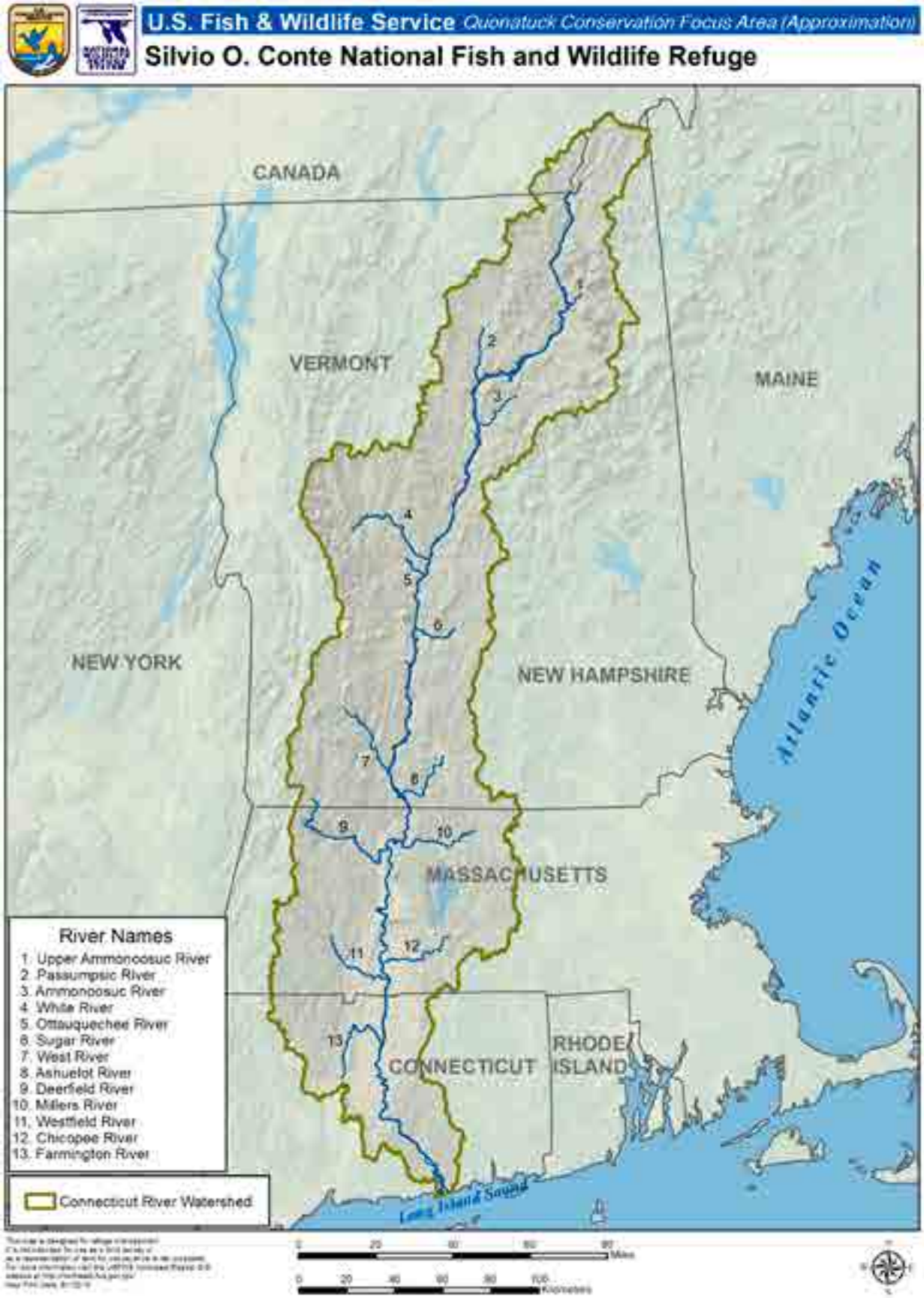
Maps of Proposed CFAs

The following maps show each of the individual CFAs under all the alternatives. CFAs are where we propose to acquire refuge lands for the refuge, either through fee or easement. The maps are organized alphabetically by state. Each CFA map shows:

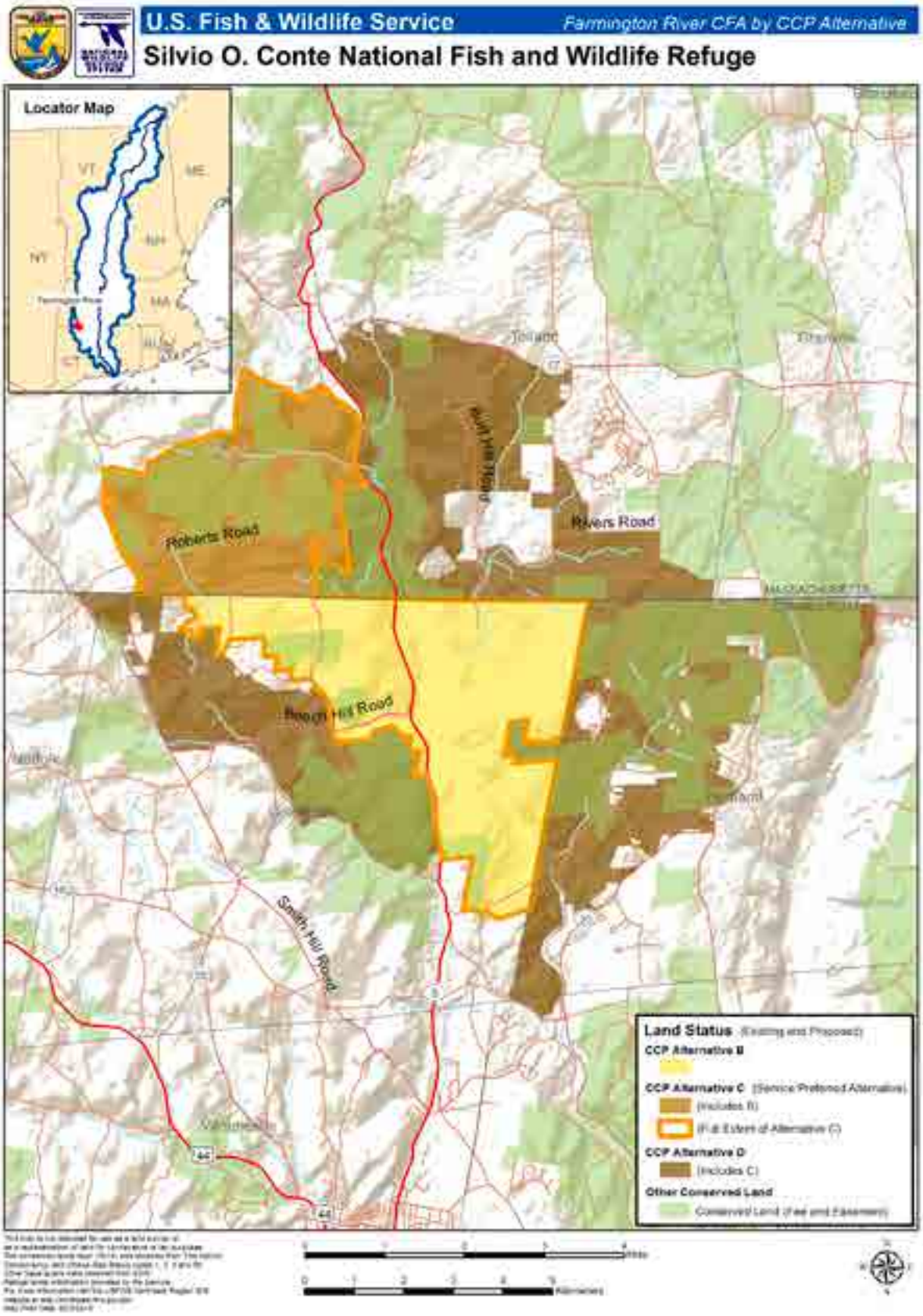
- Our proposed refuge boundary under alternatives B, C, and D (note: the proposed expansions are additive. For example, alternative C includes all of alternative B). The lands we propose for Service acquisition from willing sellers under alternatives B, C, and D are shown in yellow, tan, and dark brown, respectively.
- The current refuge ownership in that CFA, if any (shown in dark blue).
- Any additional lands that are currently approved for refuge acquisition in fee or easement (shown in light blue).
- Conserved lands as defined by The Nature Conservancy's 2014 secured lands data using GAP status 1, 2, 3 and 39 definitions (*https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/secured/Pages/default.aspx*). The Service does not intend to pursue acquisition of existing conserved lands (shown in green).

The Quonatuck CFA is unique among these maps as it is depicted as a linear feature. This depiction approximates our proposal to acquire land from willing sellers within the 100-year floodplain of the Connecticut River mainstem and its major tributaries. The priorities within the Quonatuck CFA are to protect threatened and endangered species and their habitats, floodplain forest, and tidal wetlands.

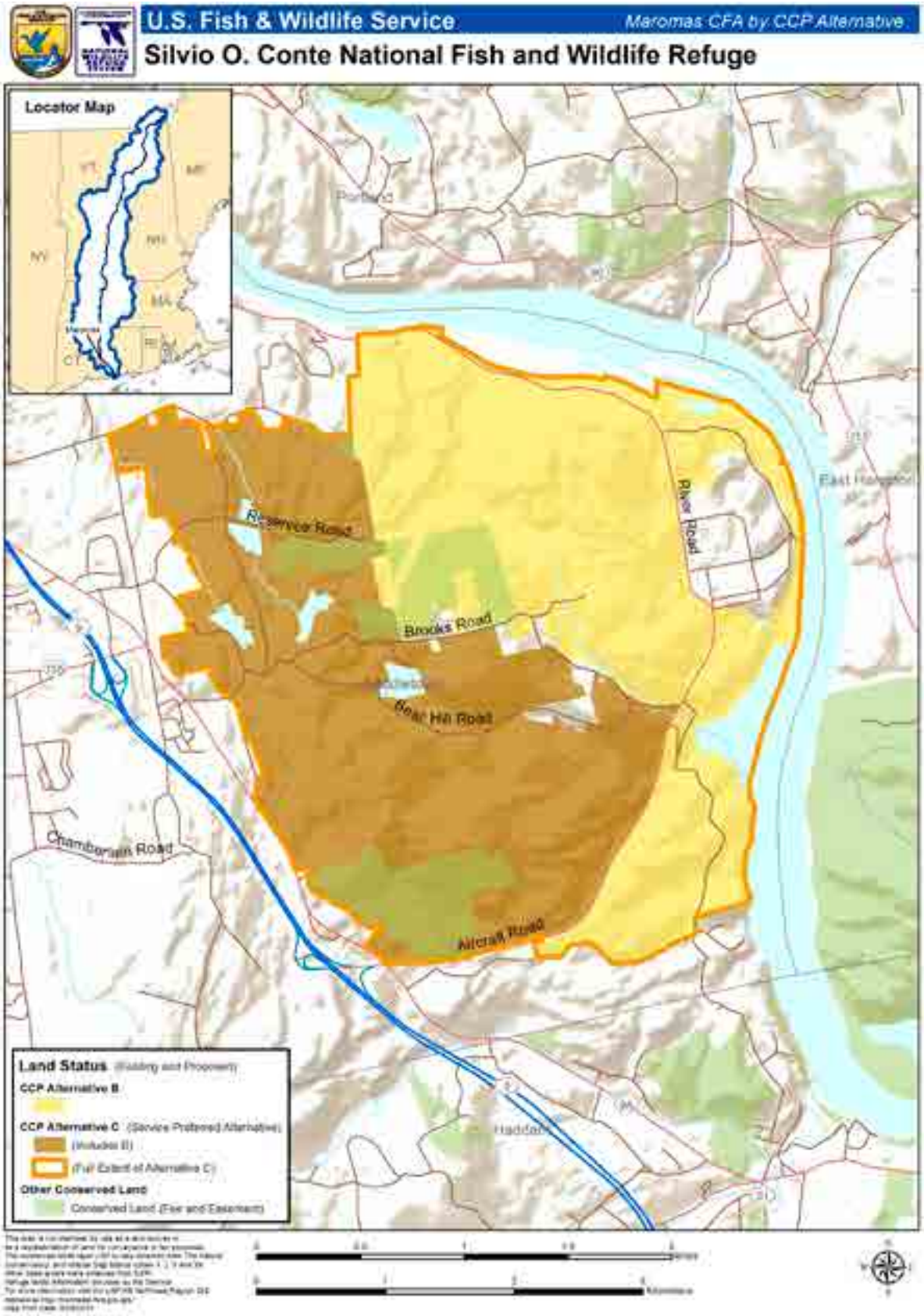
Map 4.22. The Quonatuck CFA (100-year Floodplain)



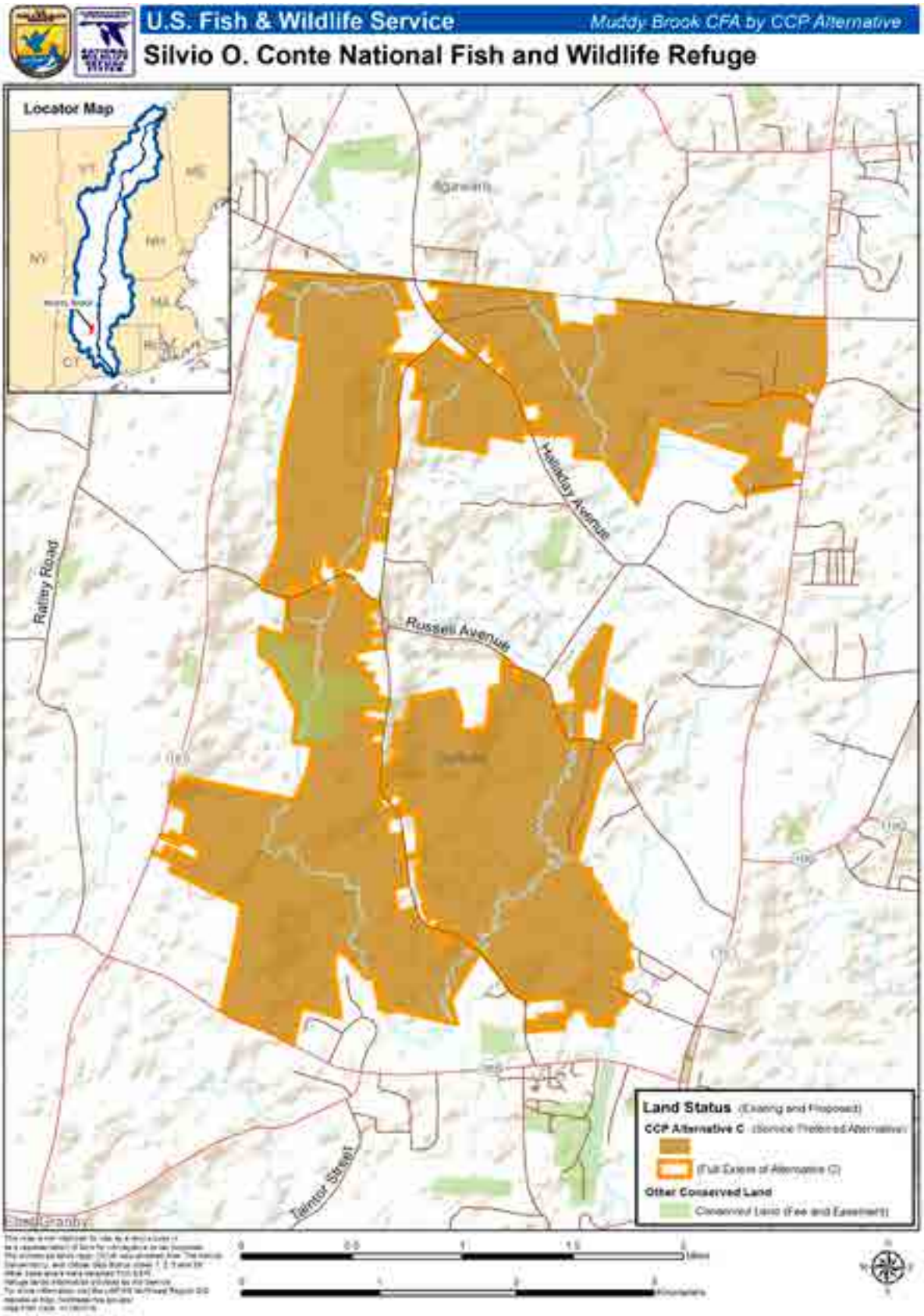
Map 4.23. Proposed Farmington River CFA under all Alternatives, Connecticut and Massachusetts



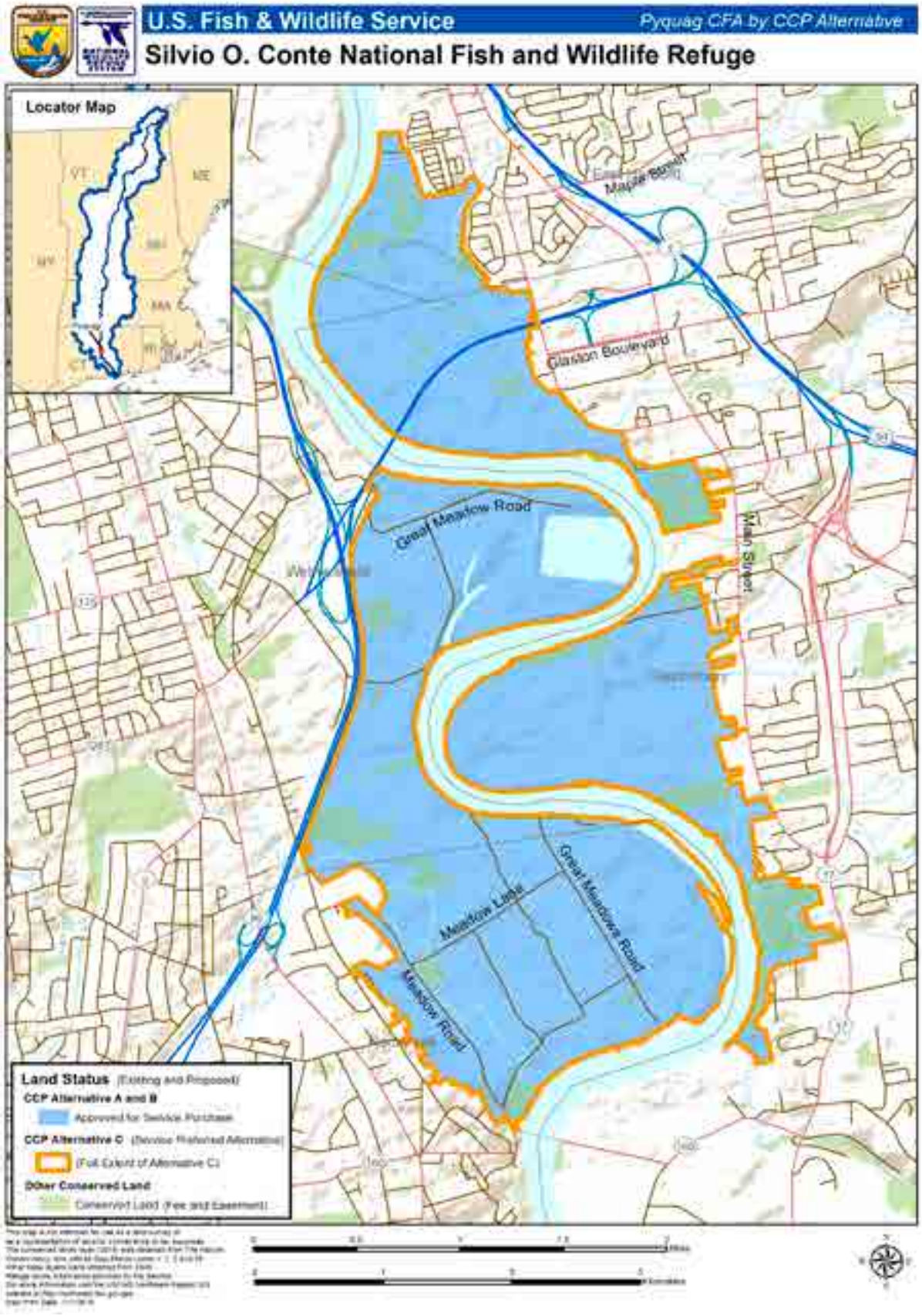
Map 4.24. Proposed Maromas CFA under all Alternatives, Connecticut



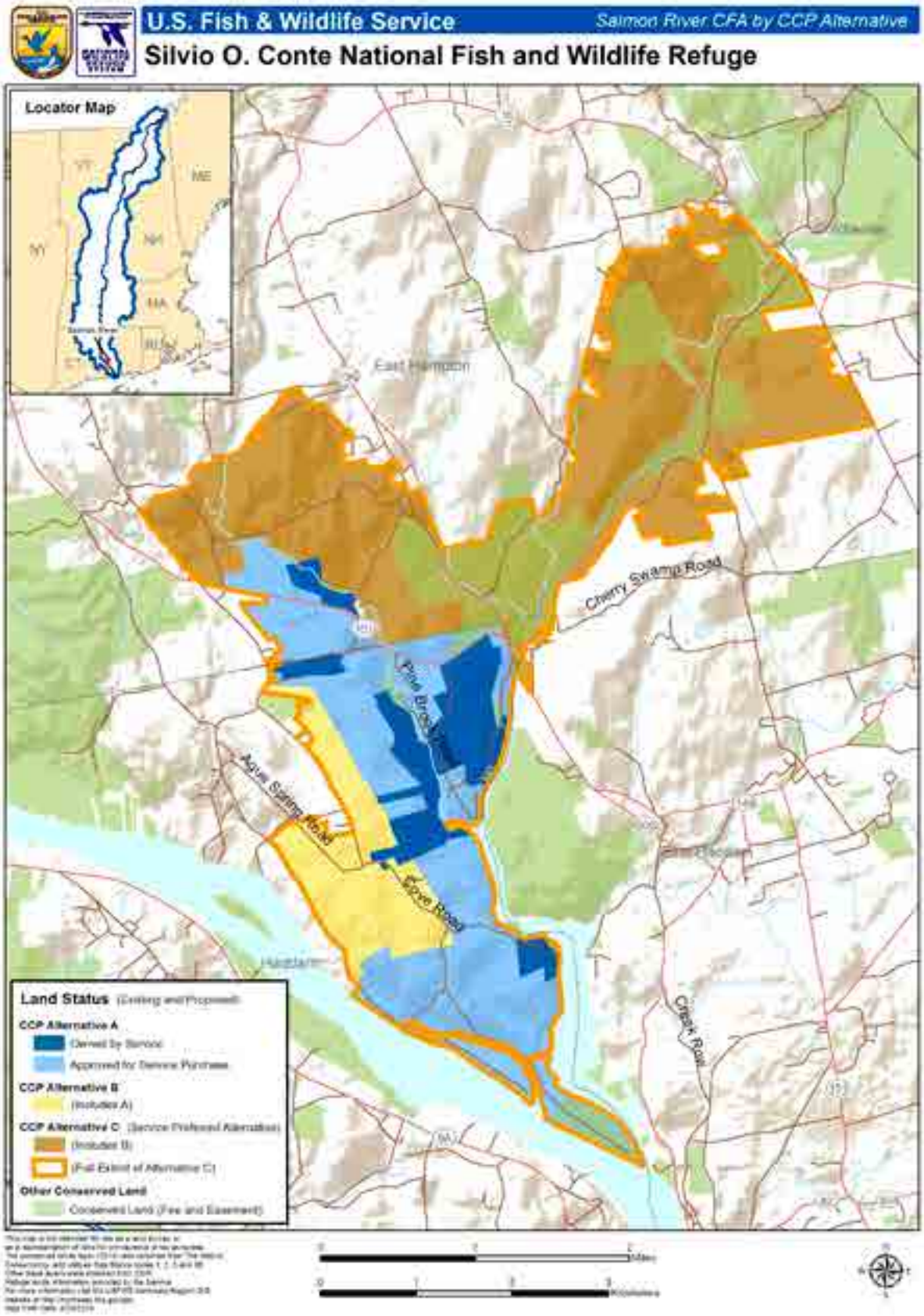
Map 4.25. Proposed Muddy Brook CFA under all Alternatives, Connecticut



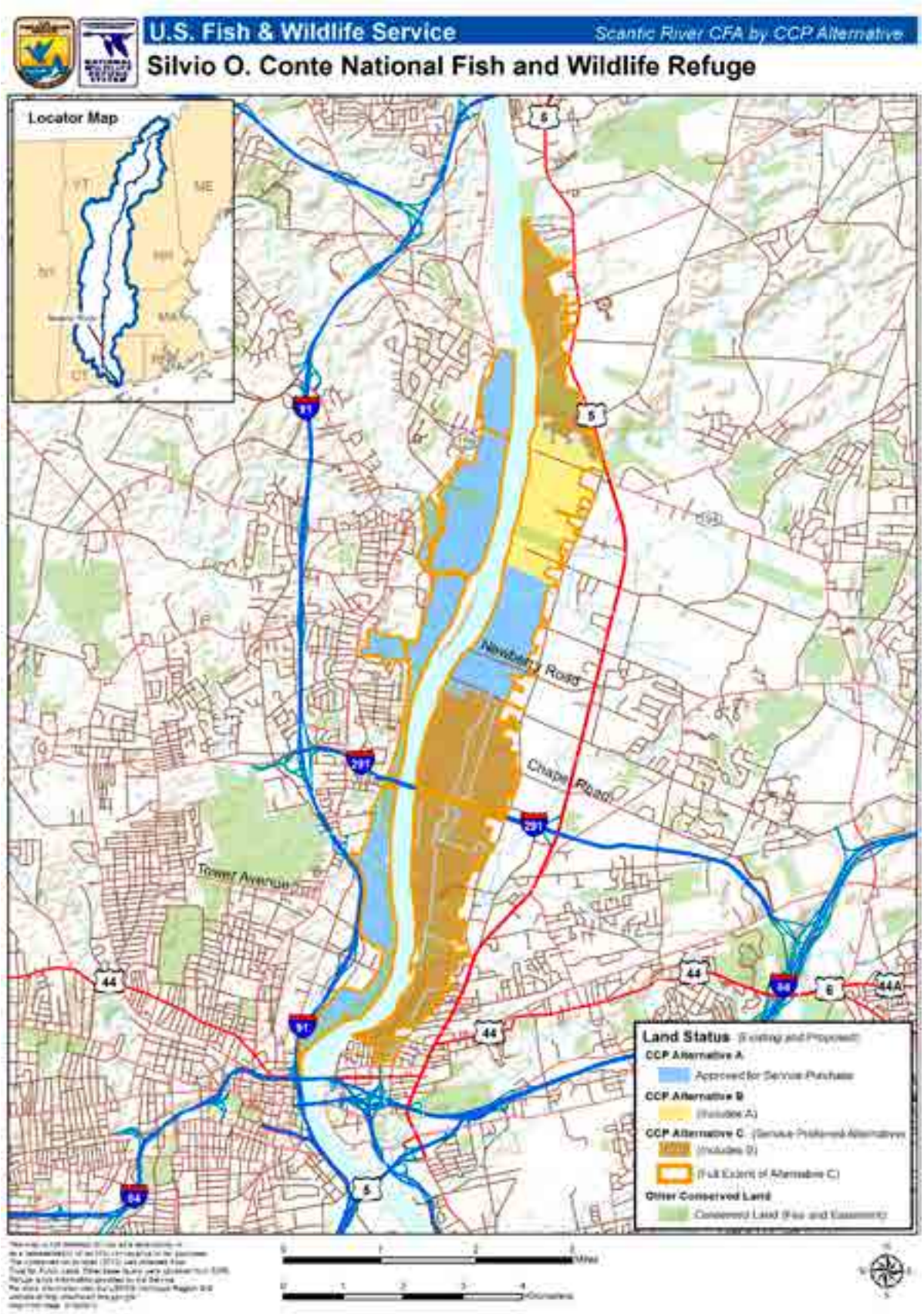
Map 4.26. Proposed Pyquag CFA under all Alternatives, Connecticut



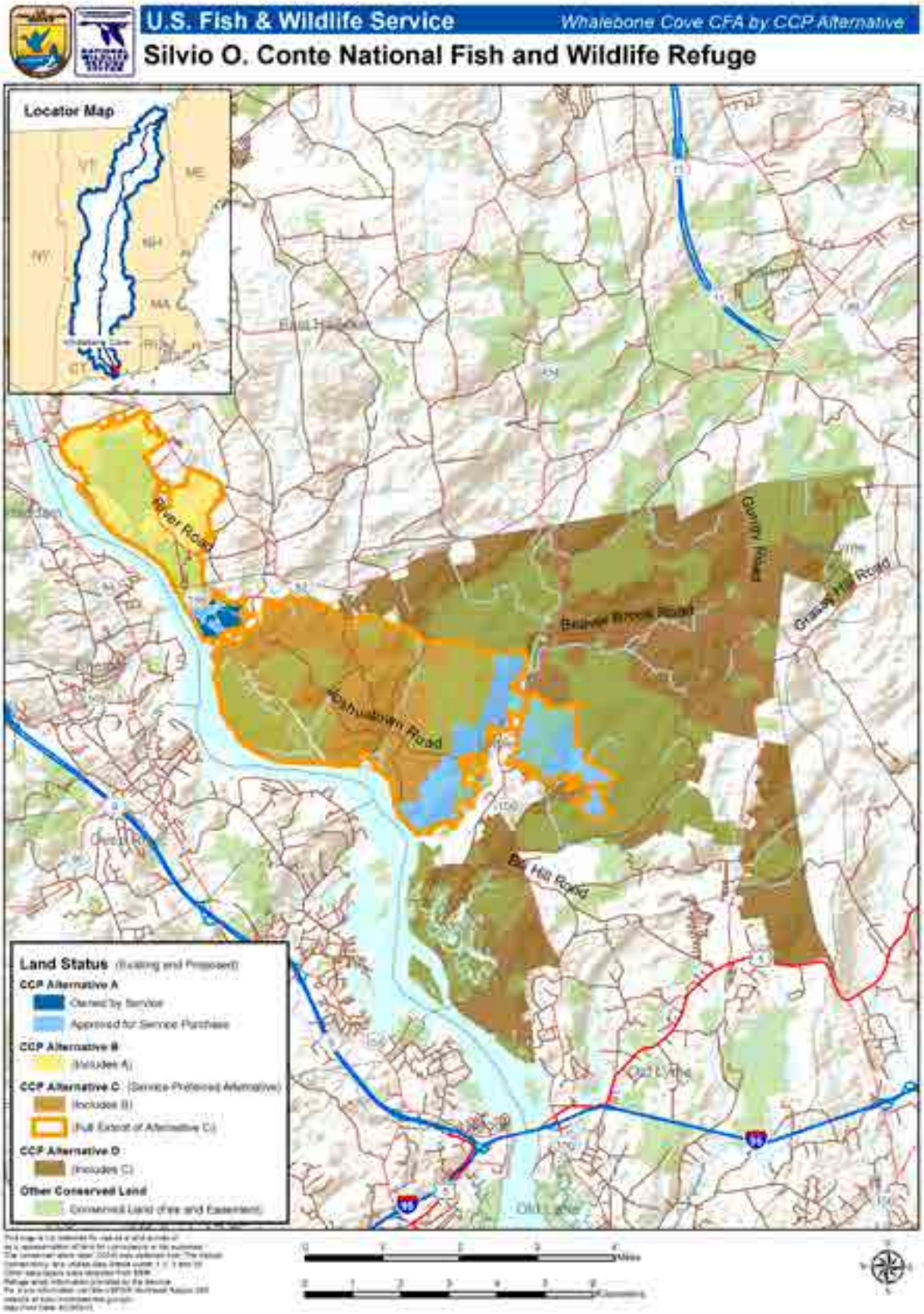
Map 4.27. Proposed Salmon River CFA under all Alternatives, Connecticut



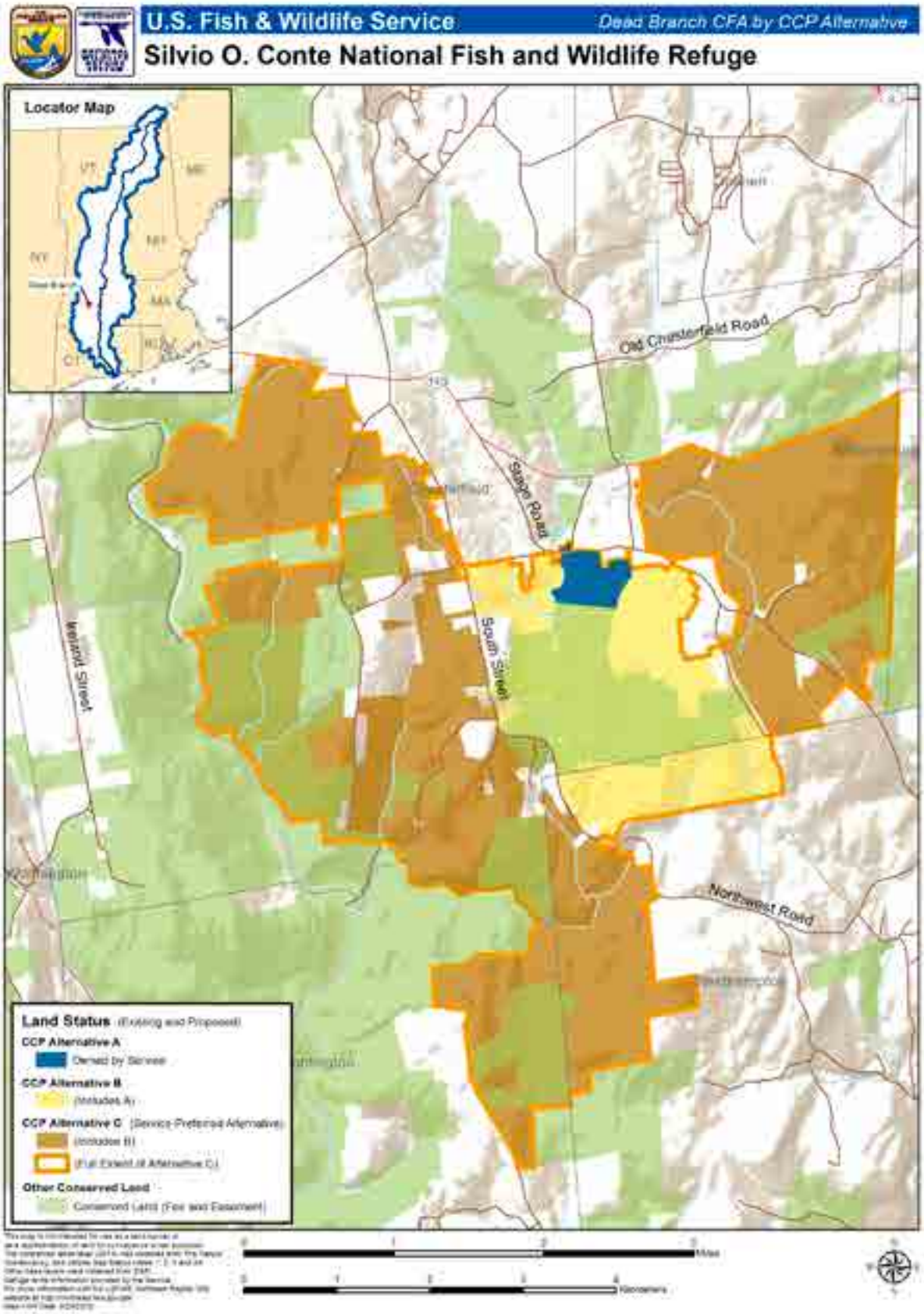
Map 4.28. Proposed Scantic CFA under all Alternatives, Connecticut



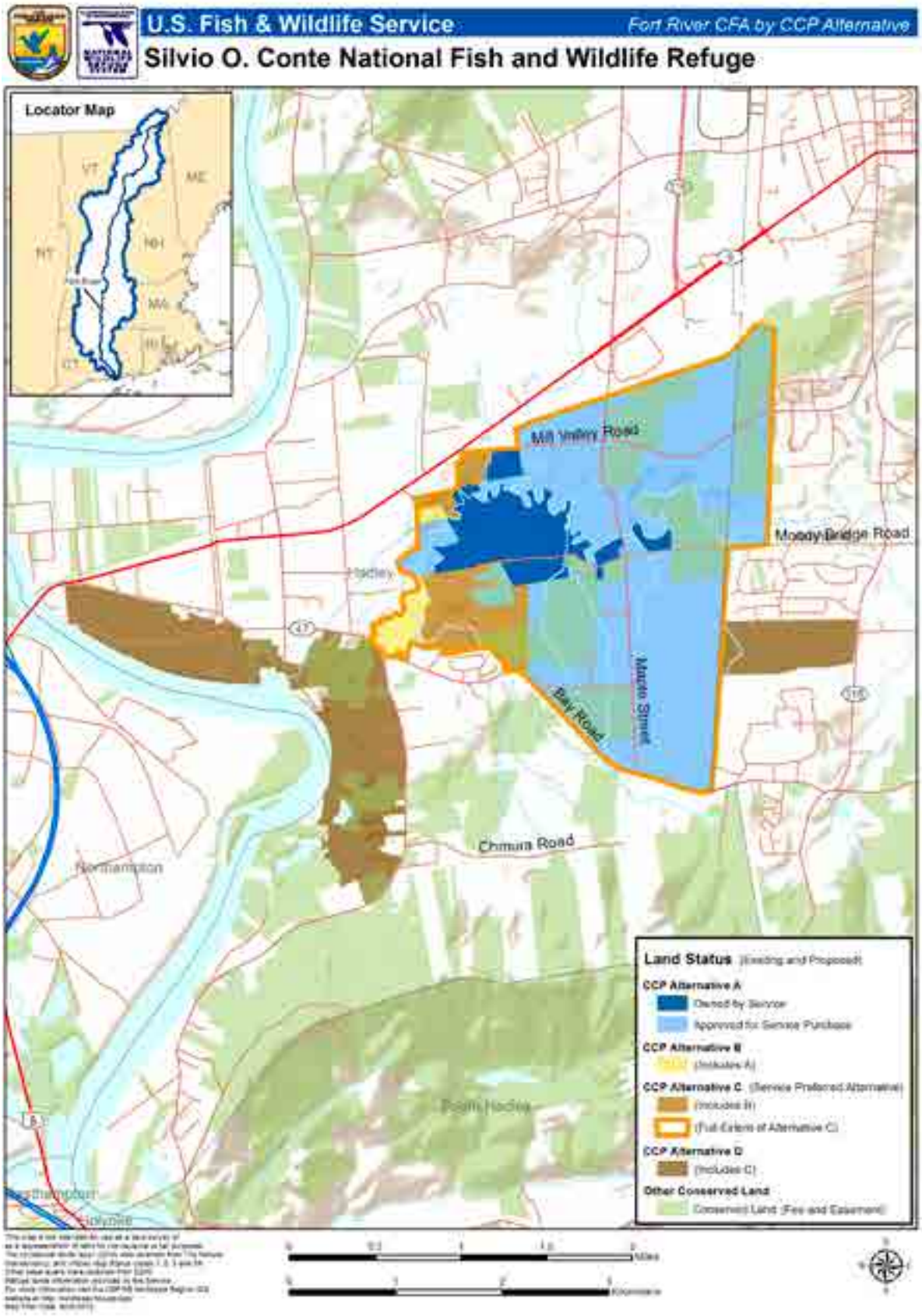
Map 4.29. Proposed Whalebone Cove CFA under all Alternatives, Connecticut



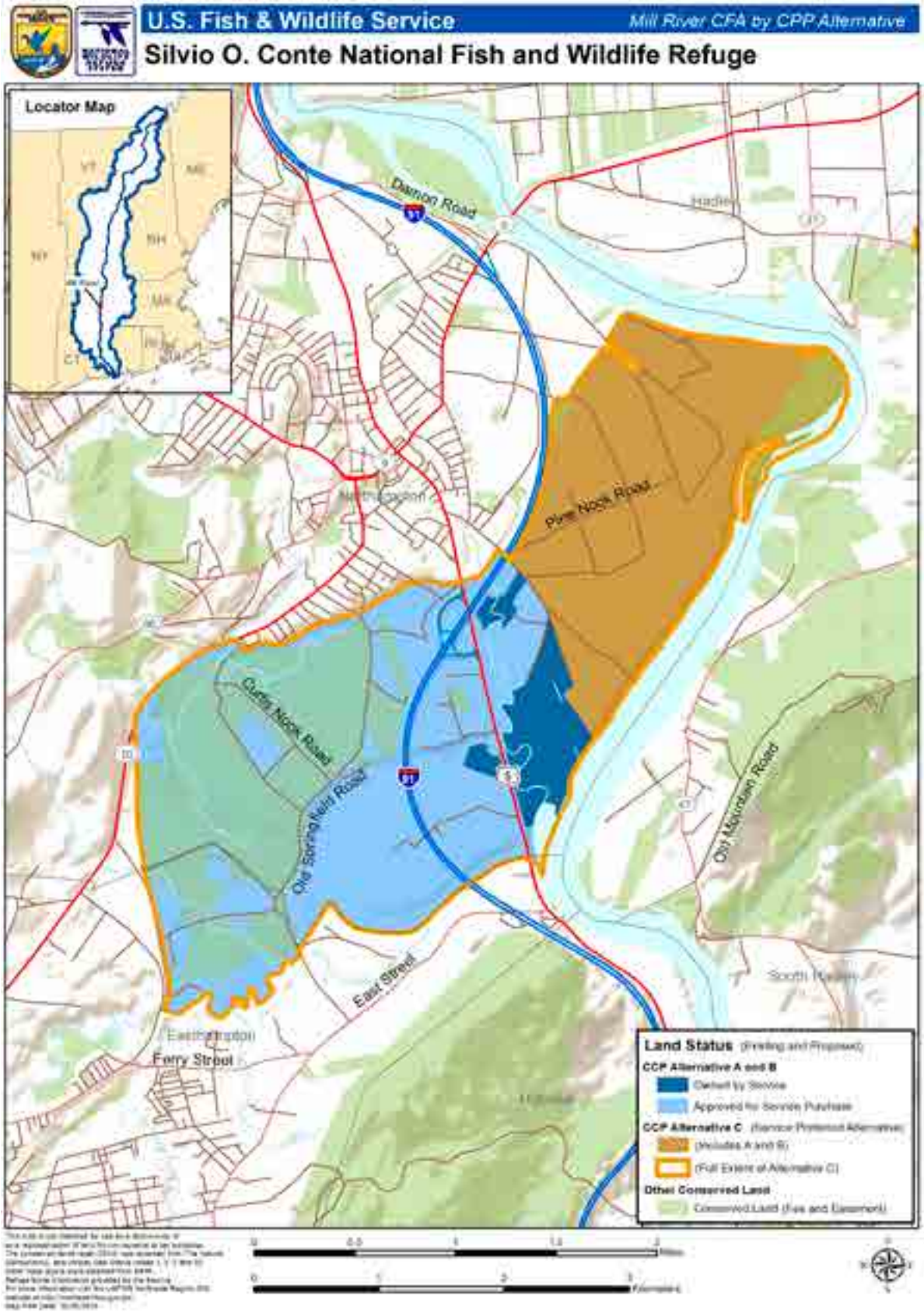
Map 4.30. Proposed Dead Branch CFA under all Alternatives, Massachusetts



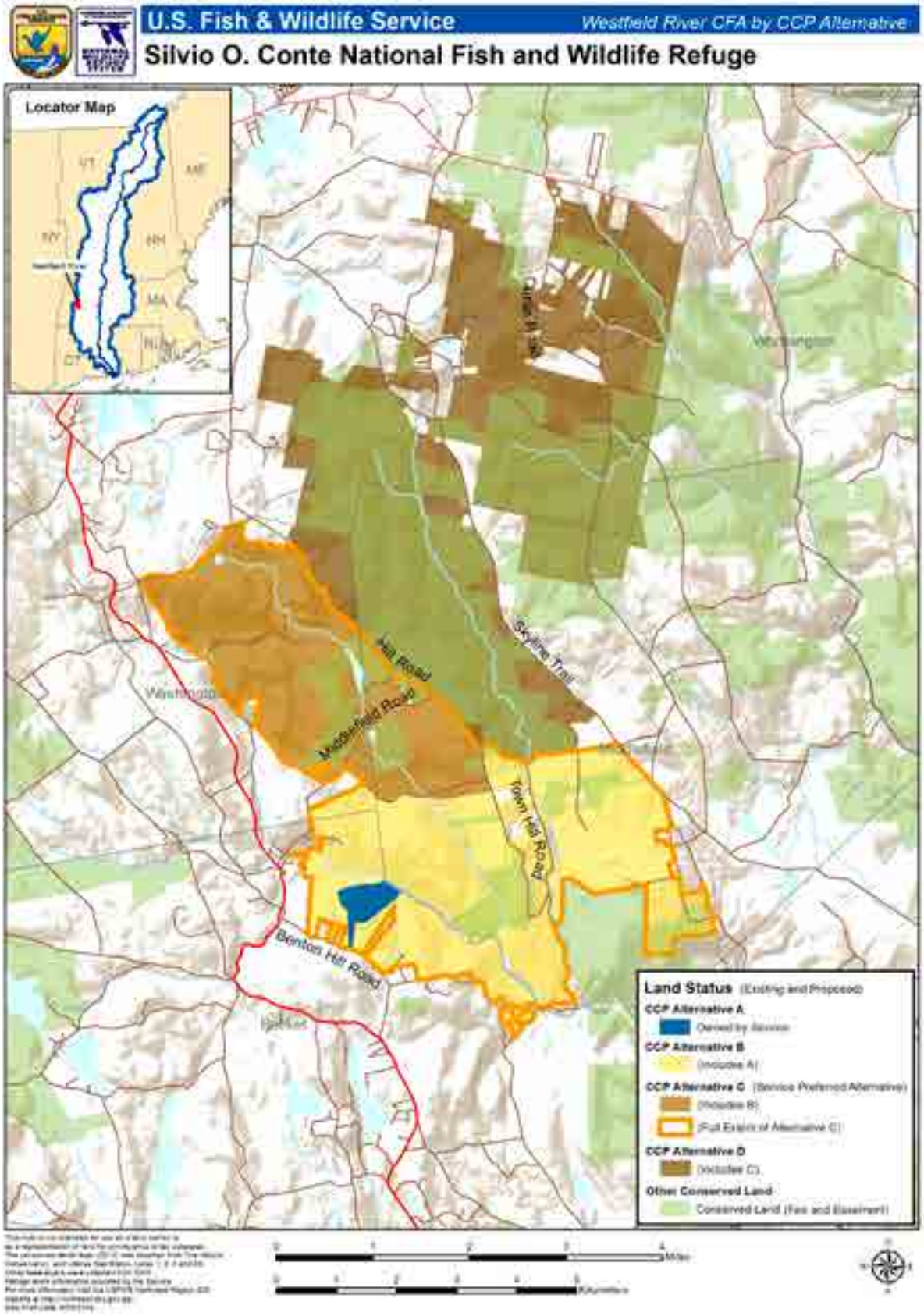
Map 4.31. Proposed Fort River CFA under all Alternatives, Massachusetts



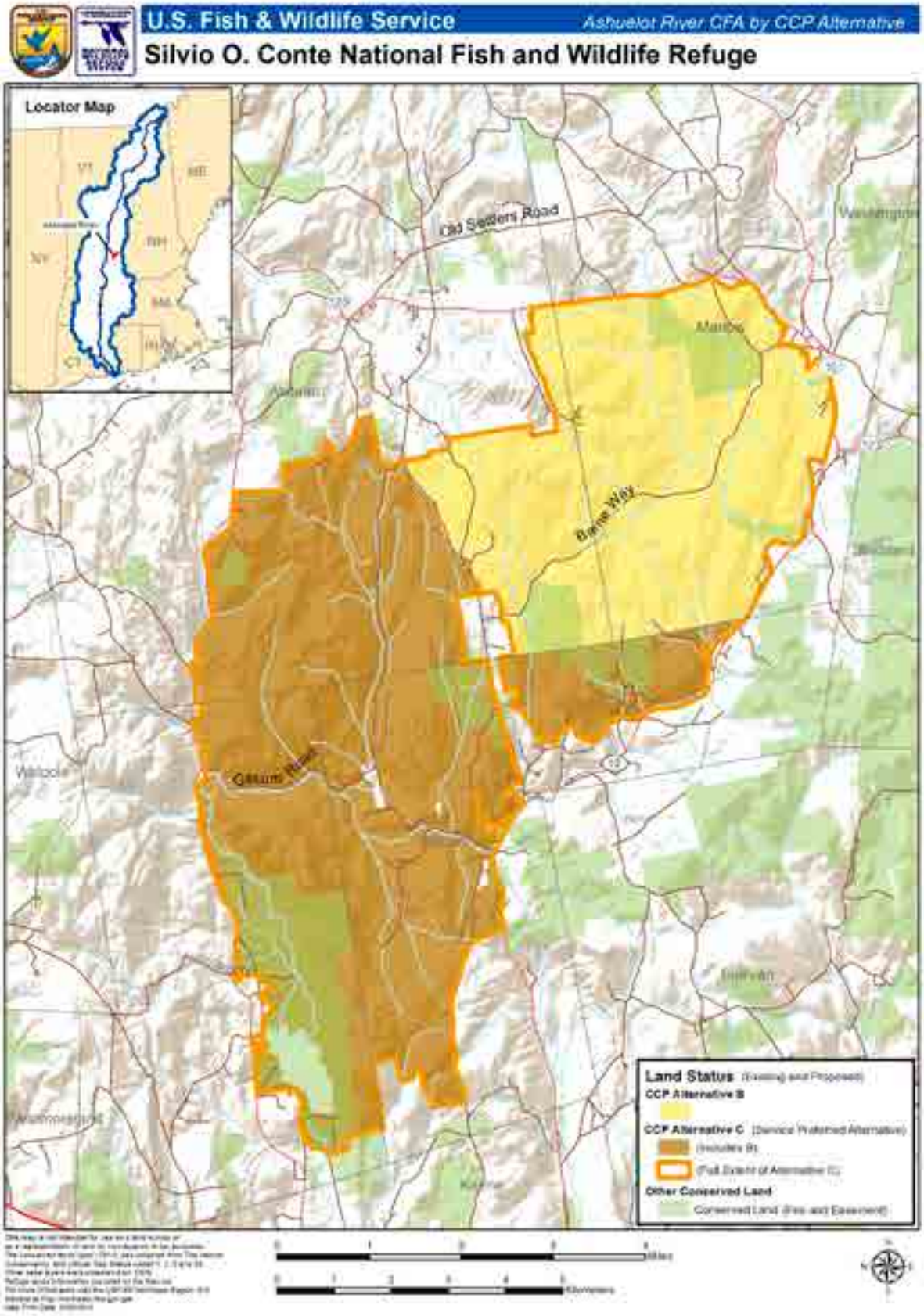
Map 4.32. Proposed Mill River CFA under all Alternatives, Massachusetts



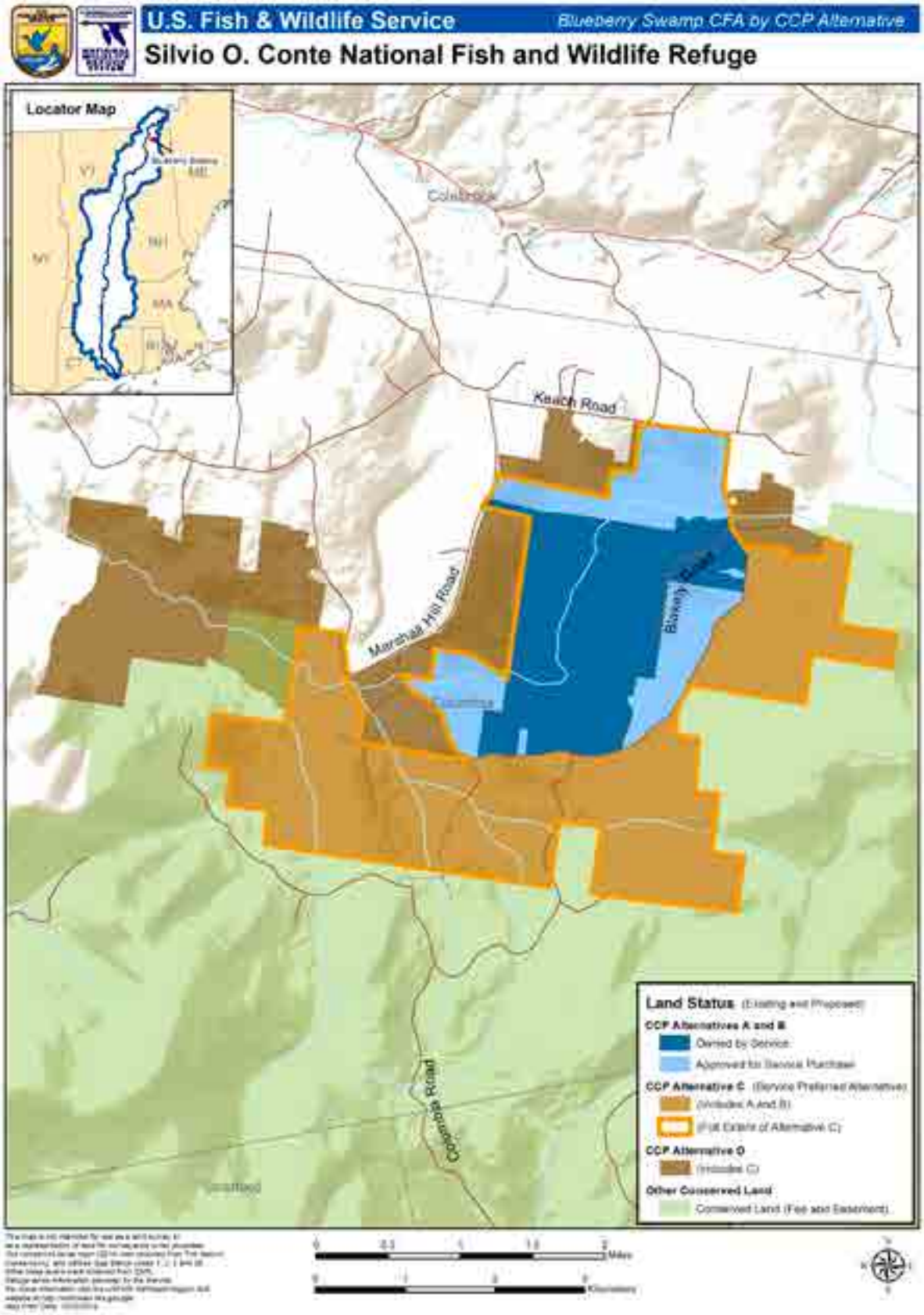
Map 4.33. Proposed Westfield River CFA under all Alternatives, Massachusetts



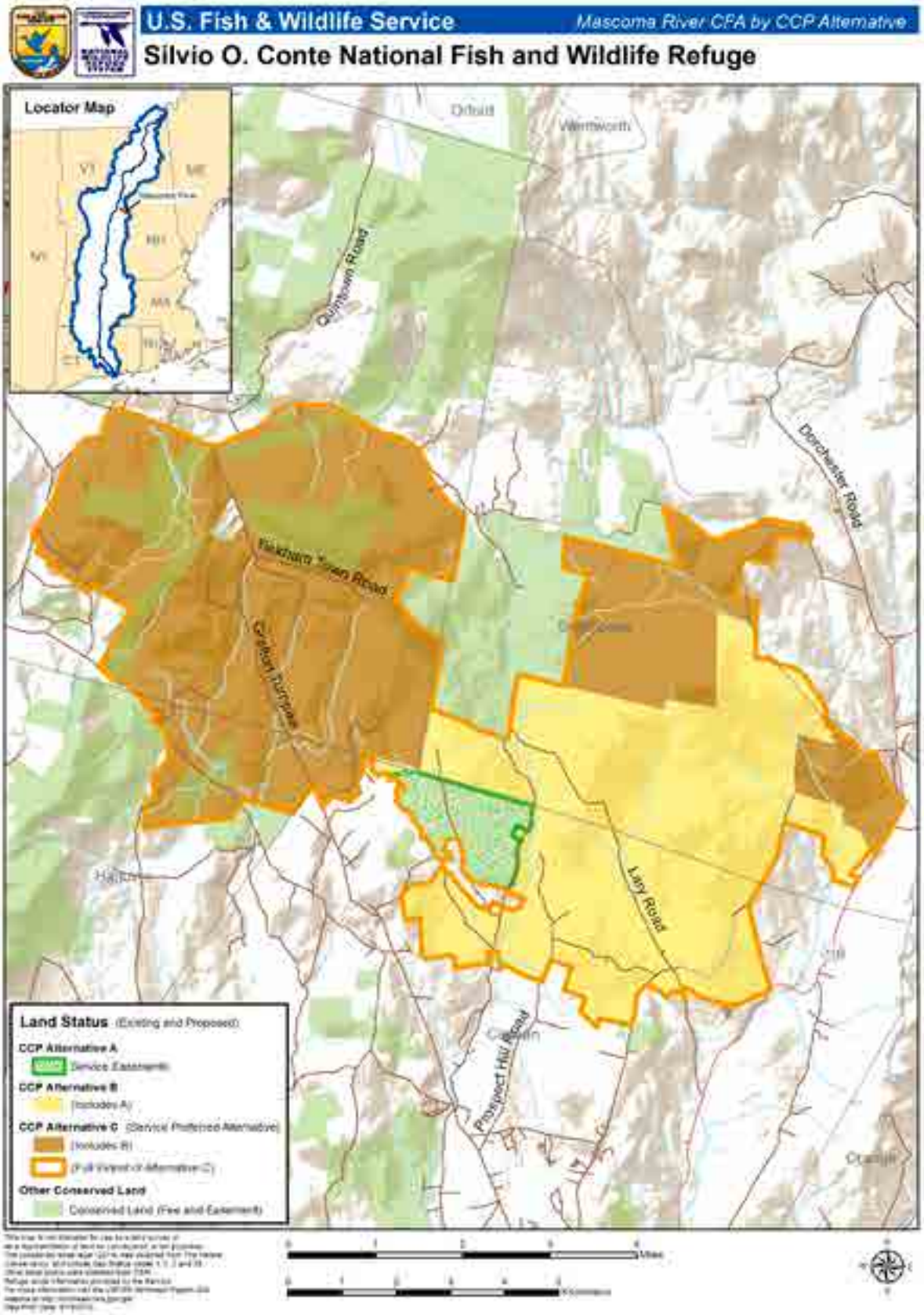
Map 4.34. Proposed Ashuelot River CFA under all Alternatives, New Hampshire



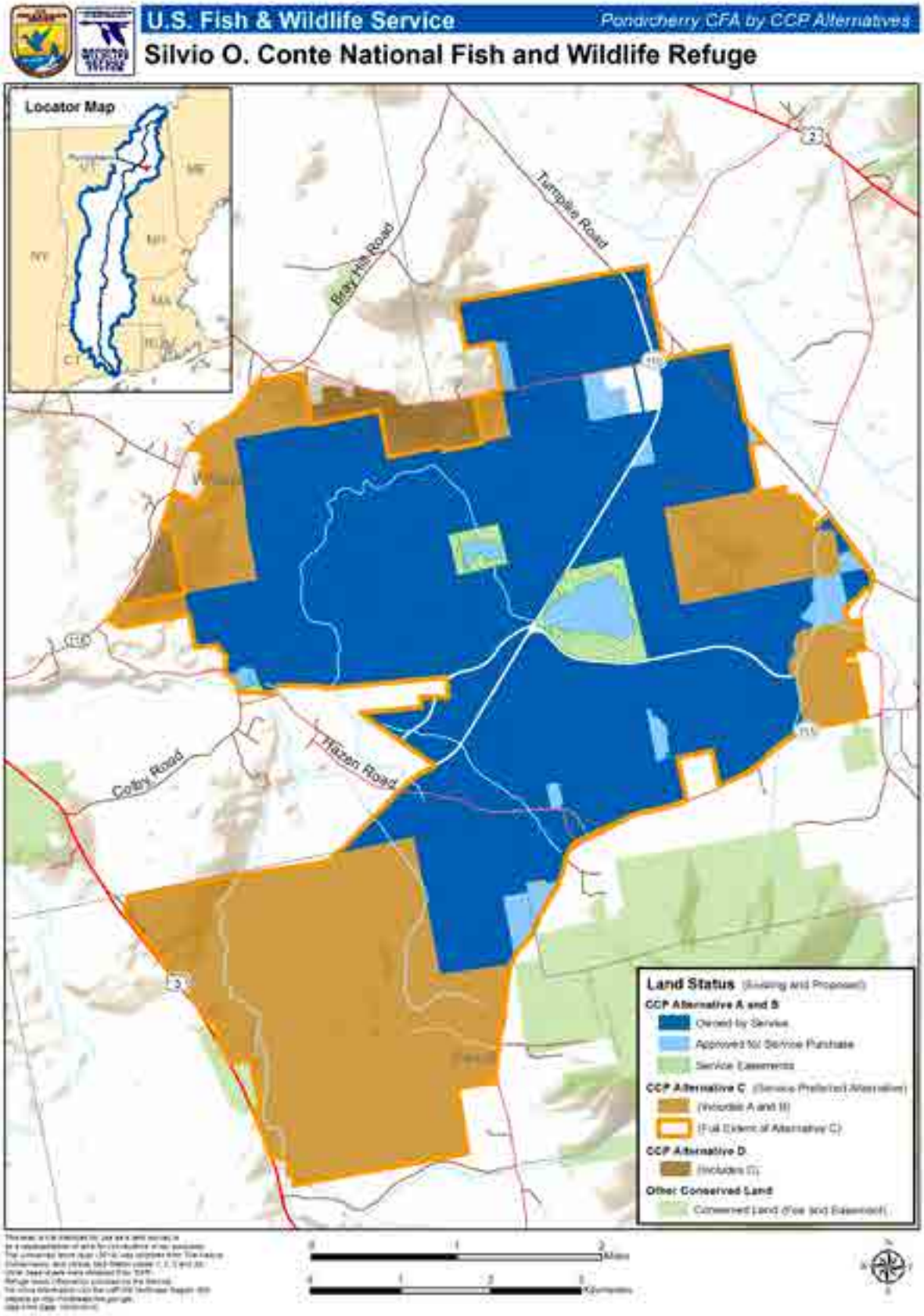
Map 4.35. Proposed Blueberry Swamp CFA under all Alternatives, New Hampshire



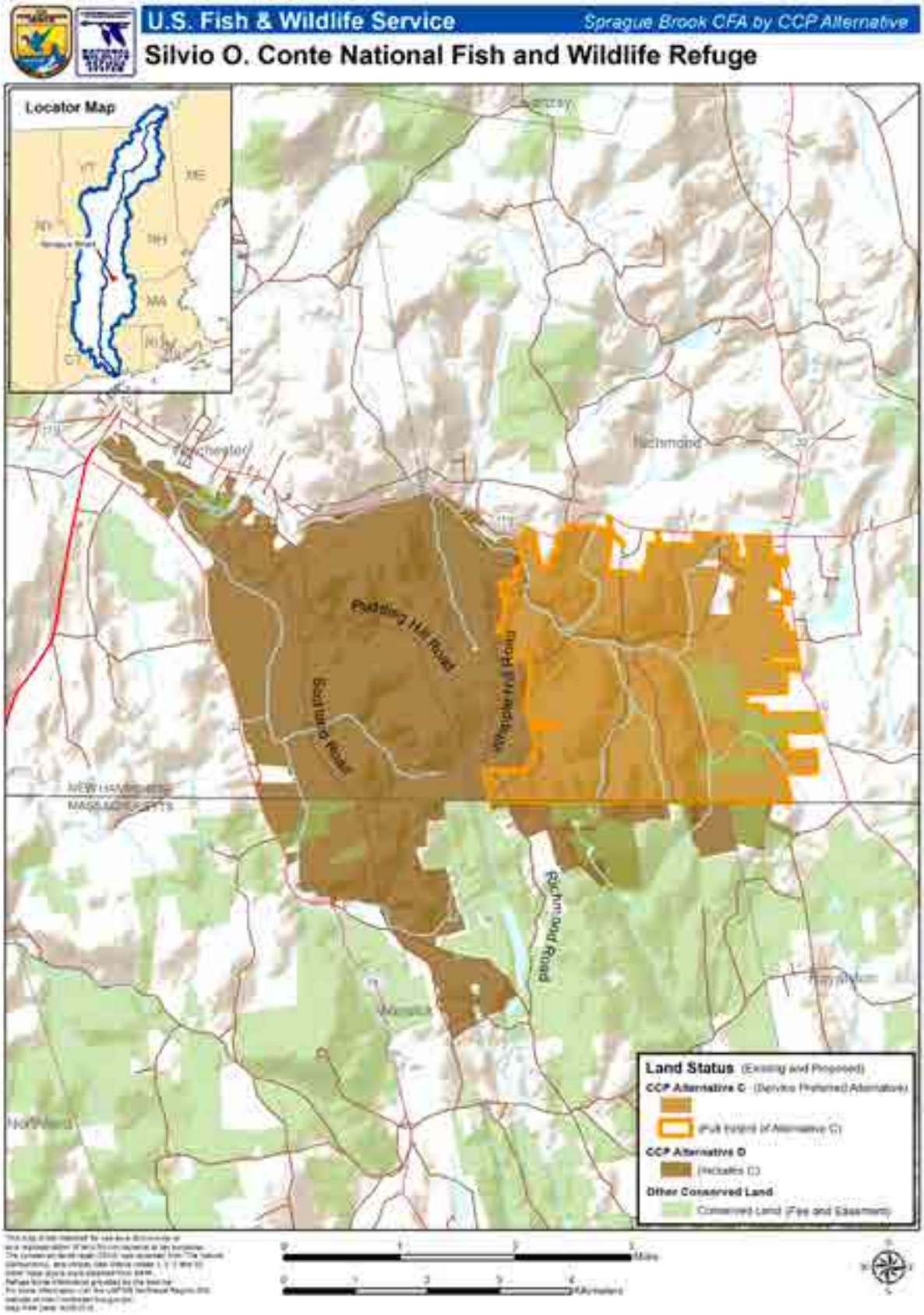
Map 4.36. Proposed Mascoma CFA under all Alternatives, New Hampshire



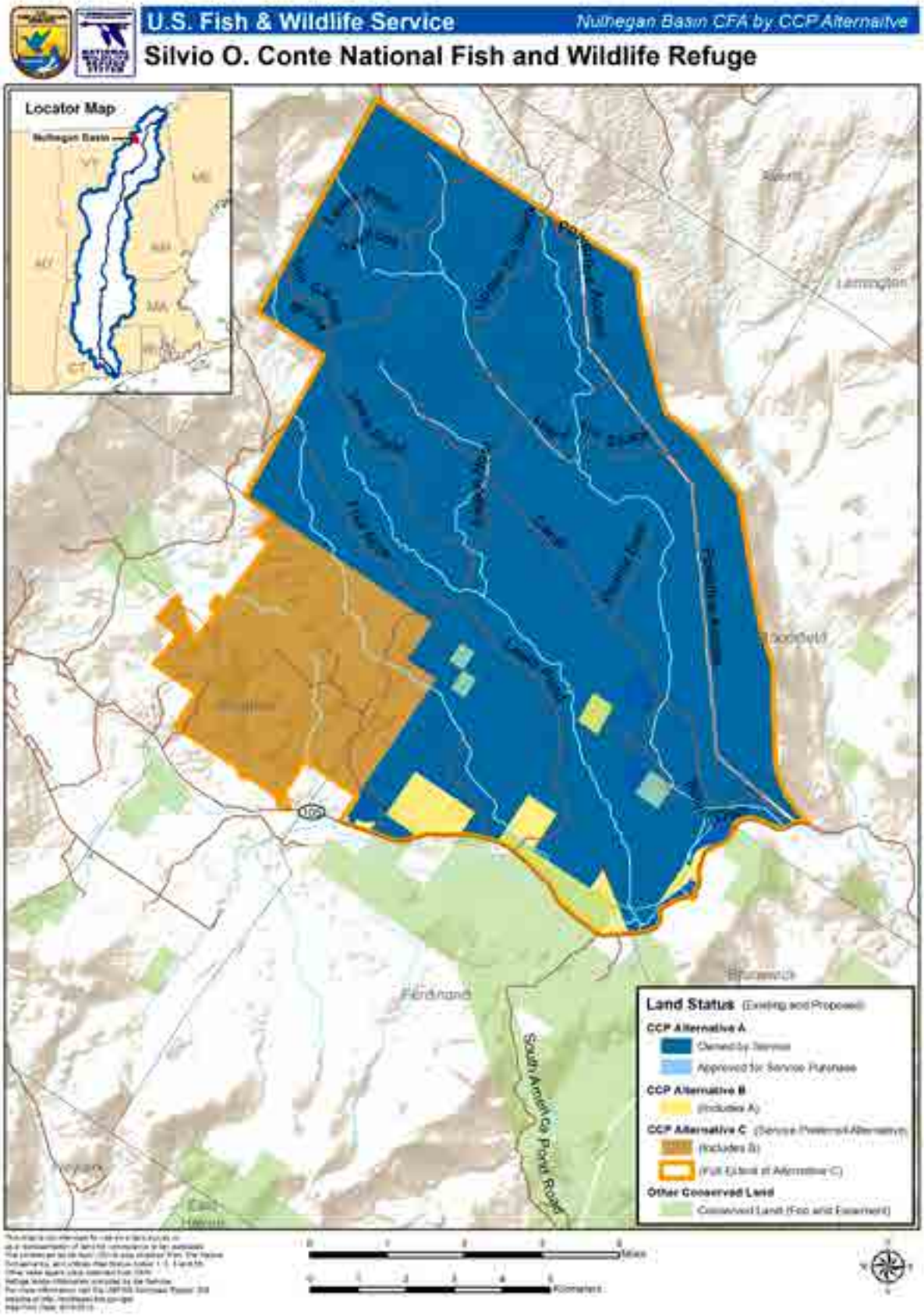
Map 4.37. Proposed Pondicherry CFA under all Alternatives, New Hampshire



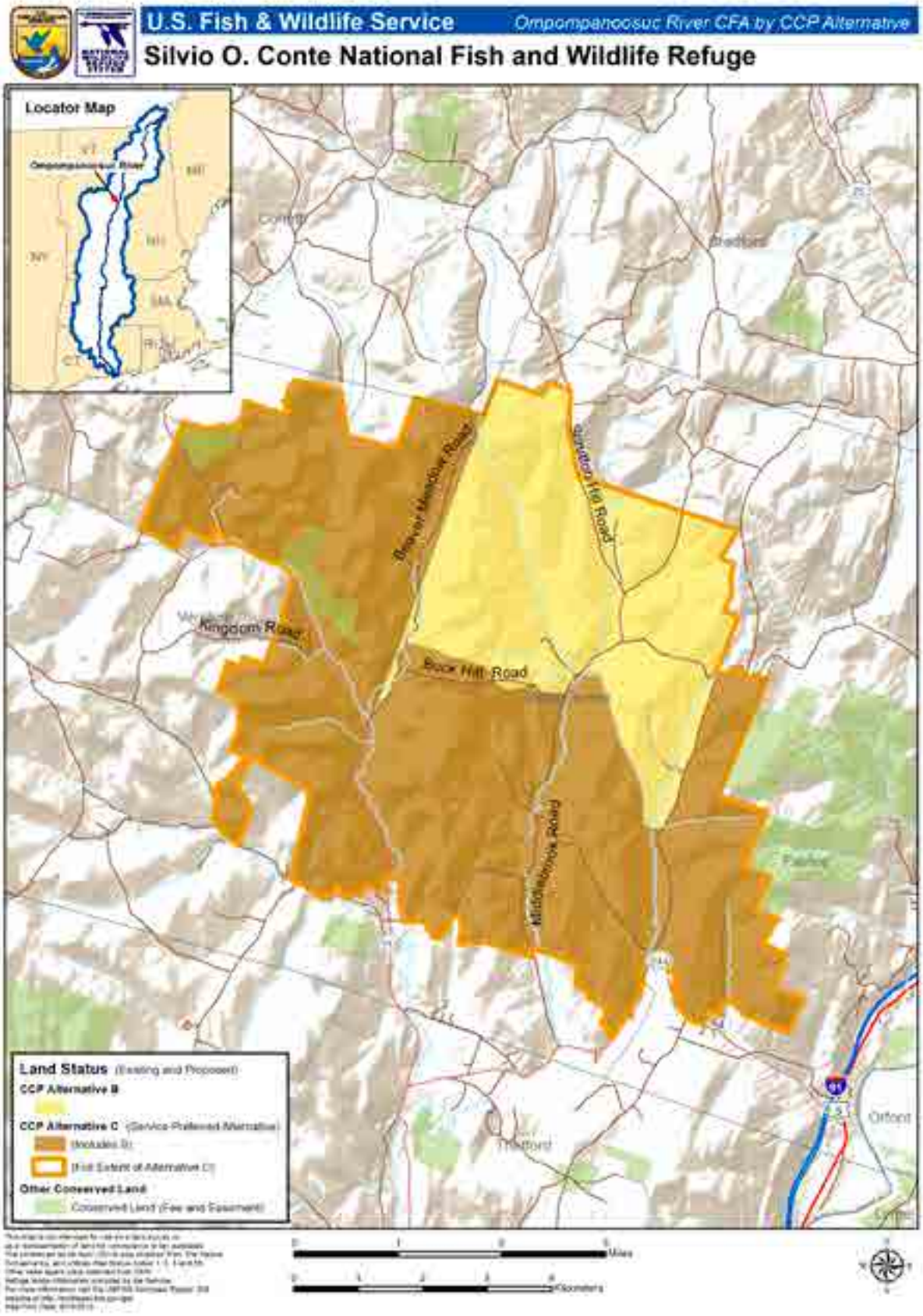
Map 4.38. Proposed Sprague Brook CFA under all Alternatives, New Hampshire and Massachusetts



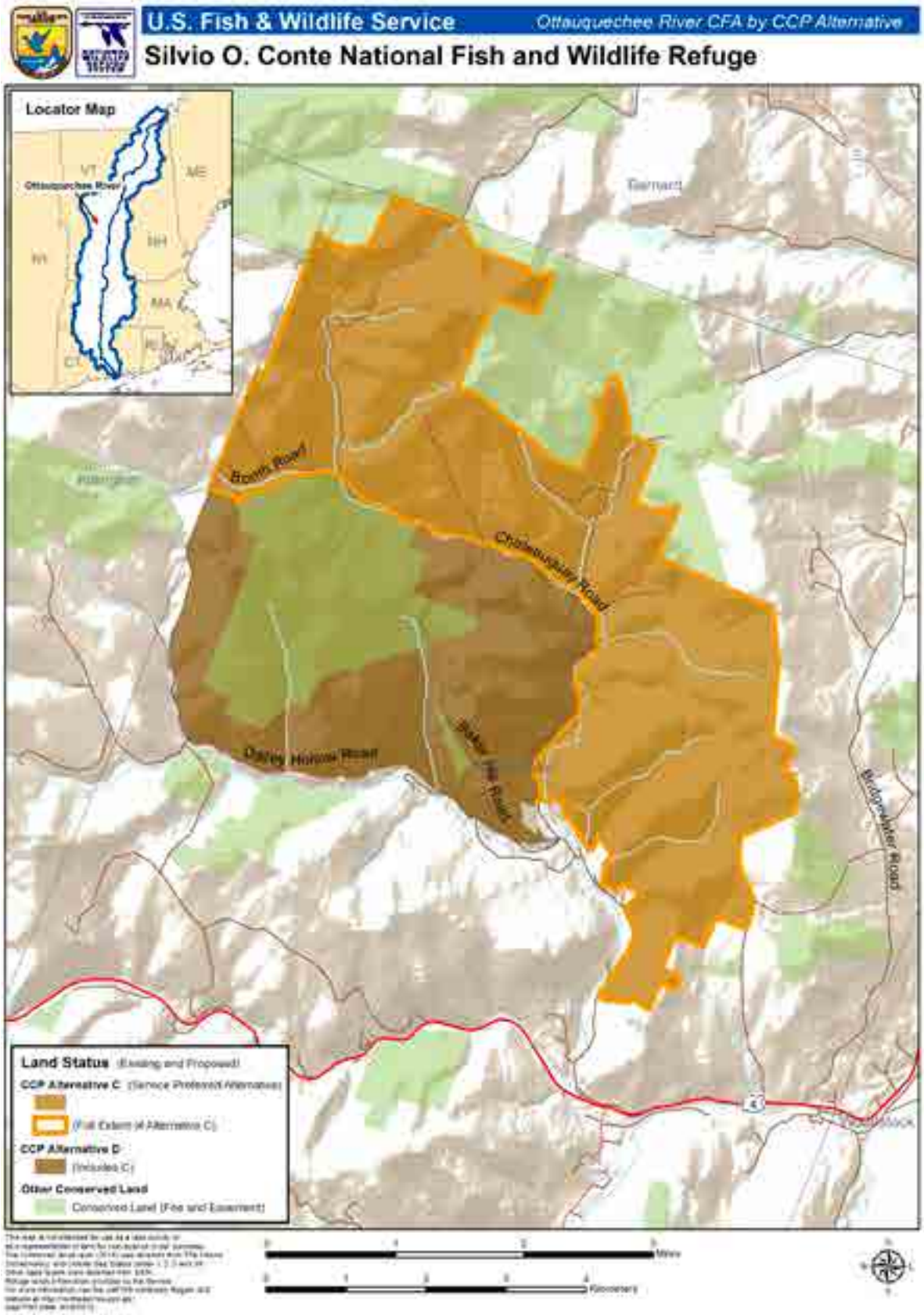
Map 4.39. Proposed Nulhegan Basin CFA under all Alternatives, Vermont



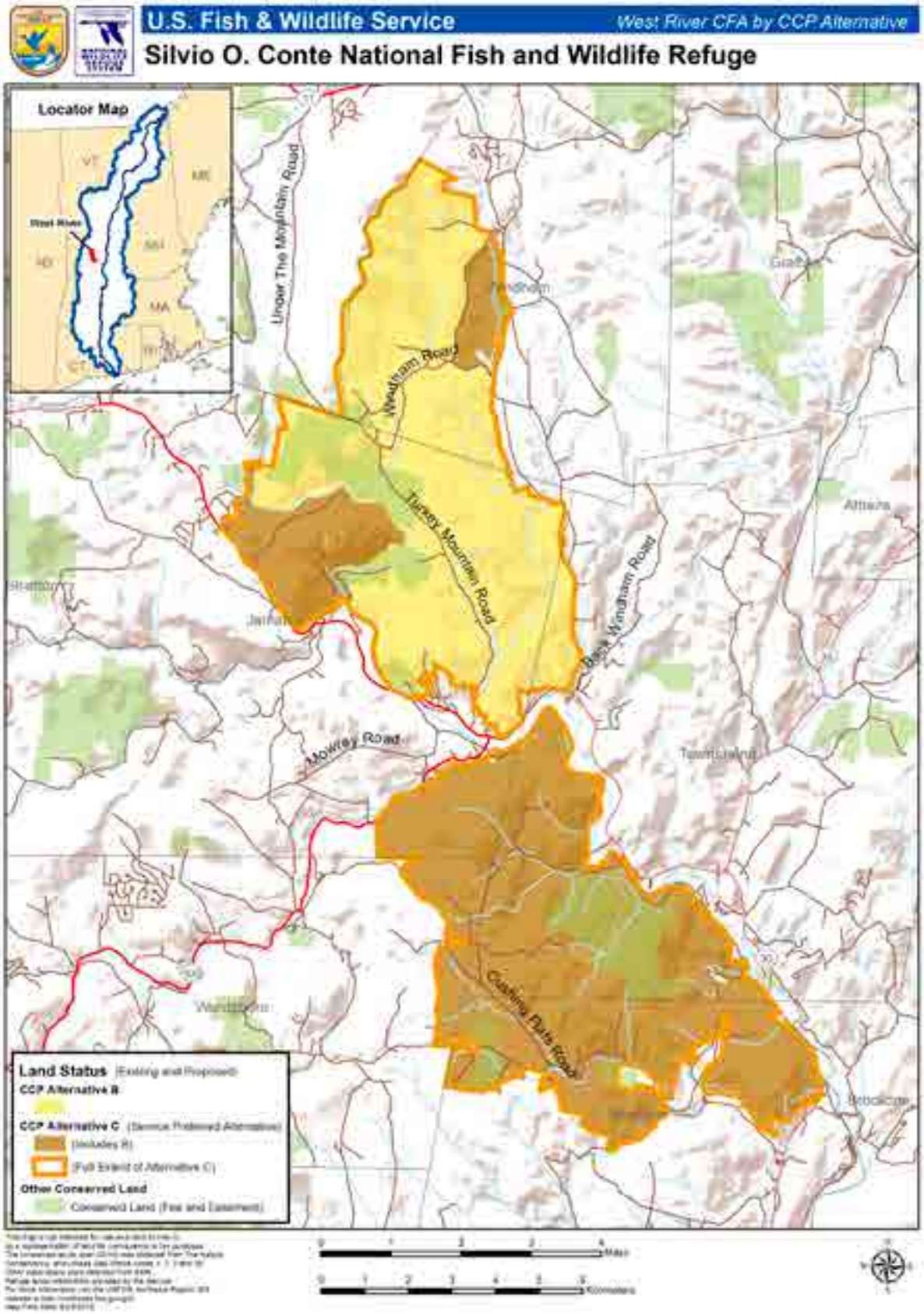
Map 4.40. Proposed Ompompanoosuc River CFA under all Alternatives, Vermont



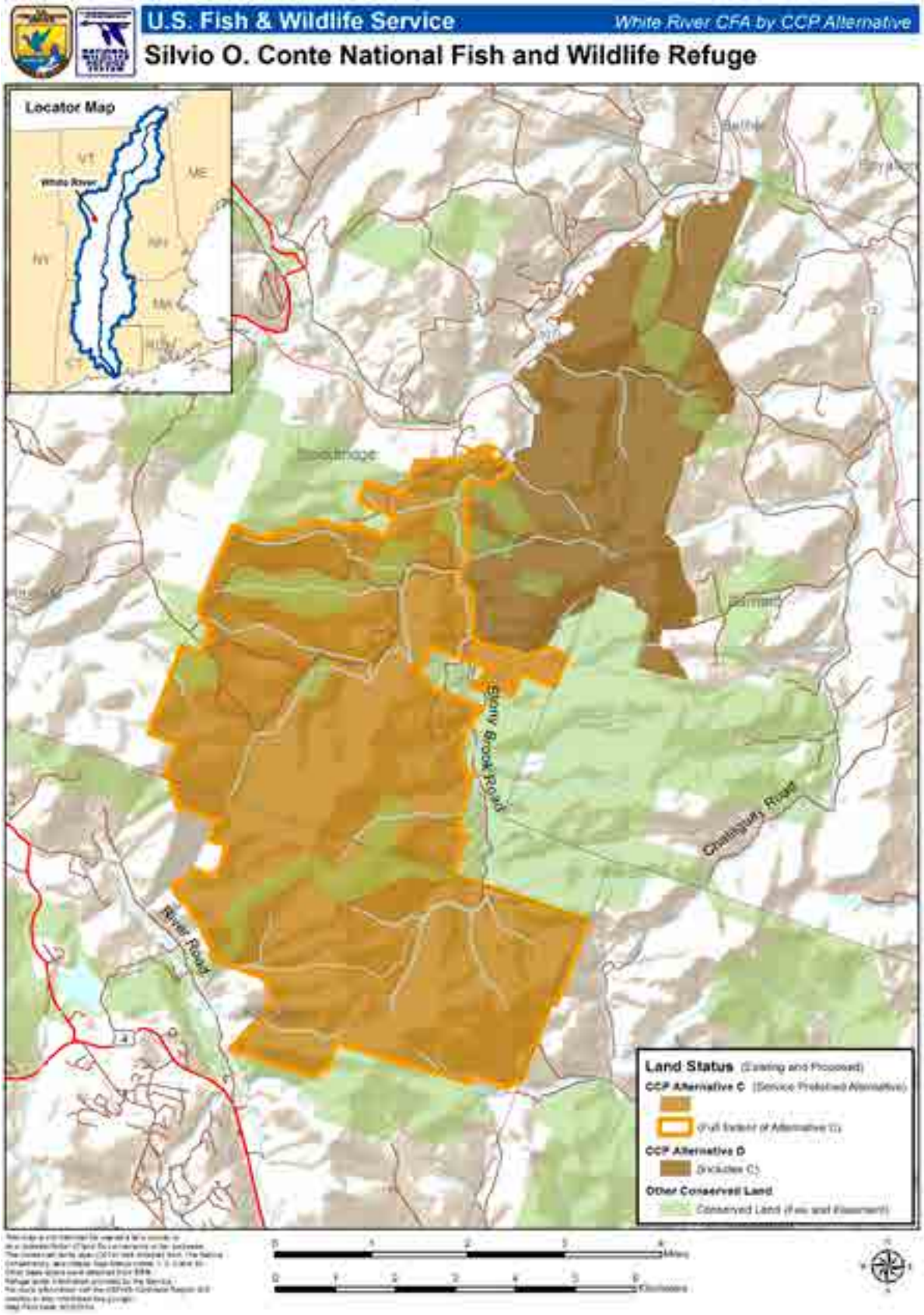
Map 4.41. Proposed Ottauquechee River CFA under all Alternatives, Vermont



Map 4.42. Proposed West River CFA under all Alternatives, Vermont



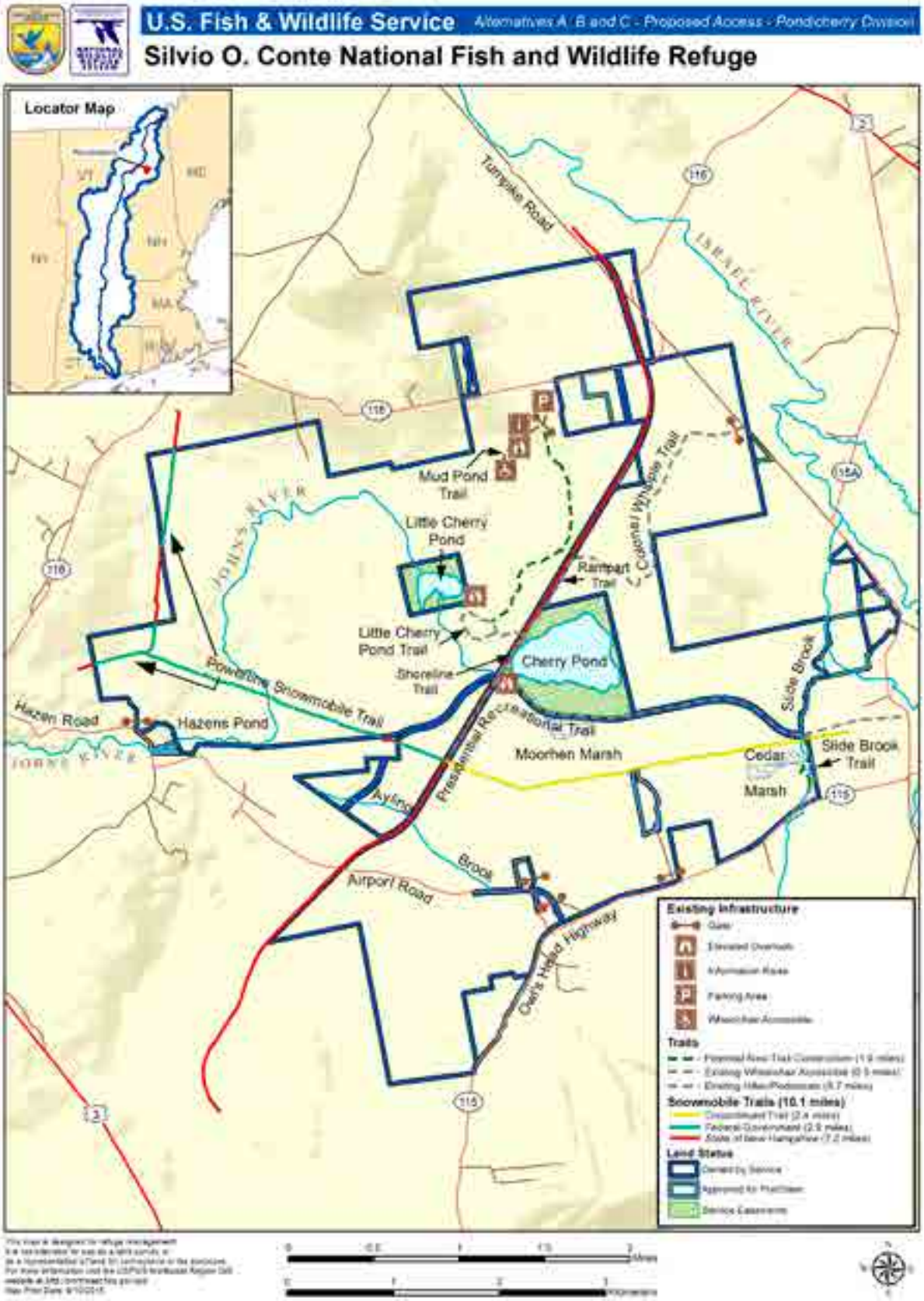
Map 4.43. Proposed White River CFA under all Alternatives, Vermont



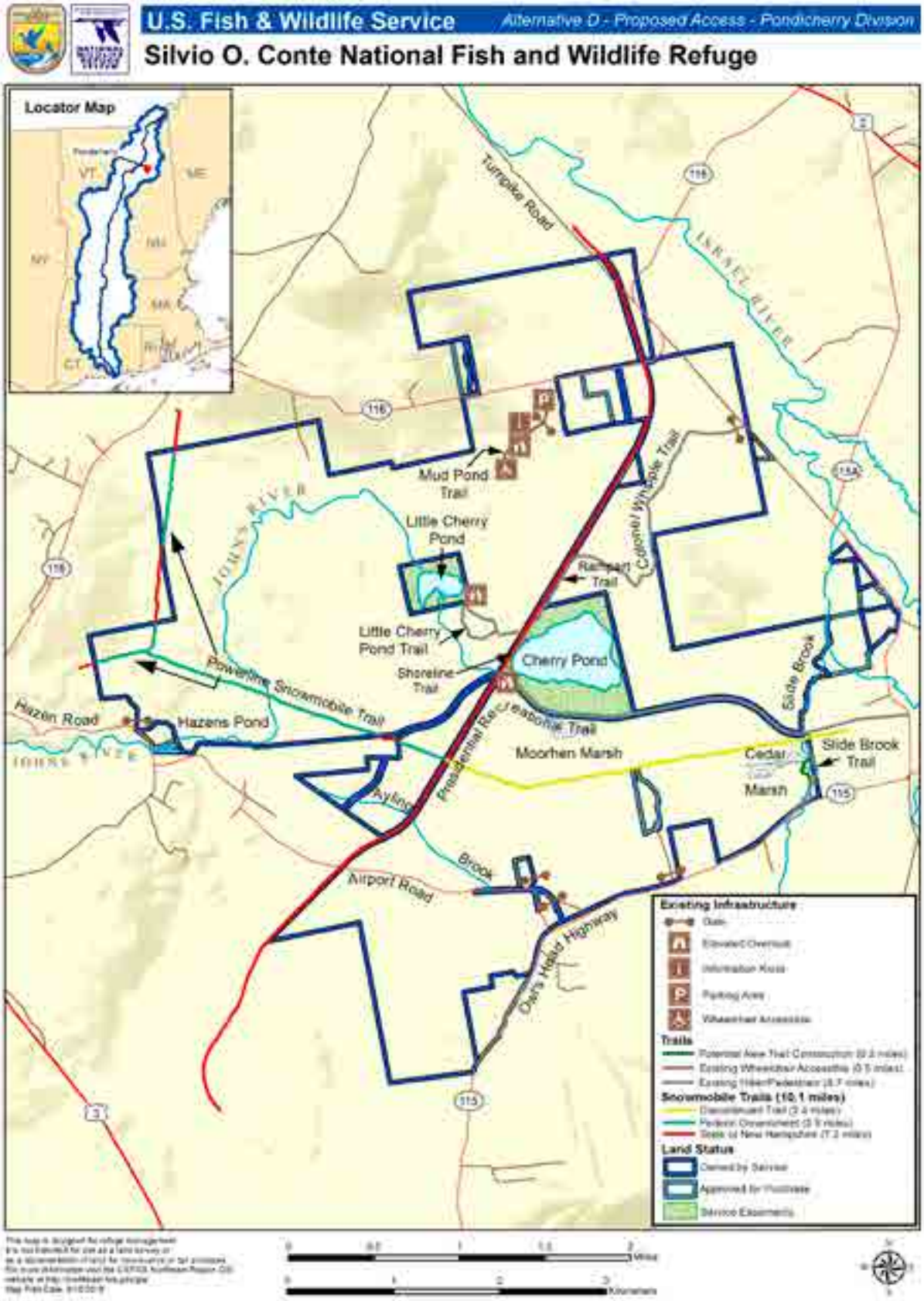
Maps of Proposed Recreational Access for the Nulhegan Basin and Pondicherry Divisions by Alternative

The following maps show the proposed public use access and facilities by alternative at the Pondicherry and Nulhegan Basin Divisions, the largest existing divisions. Other public use maps for other proposed and existing divisions are included in Appendix A, Conservation Focus Areas or Appendix D, Findings of Appropriateness and Compatibility Determinations.

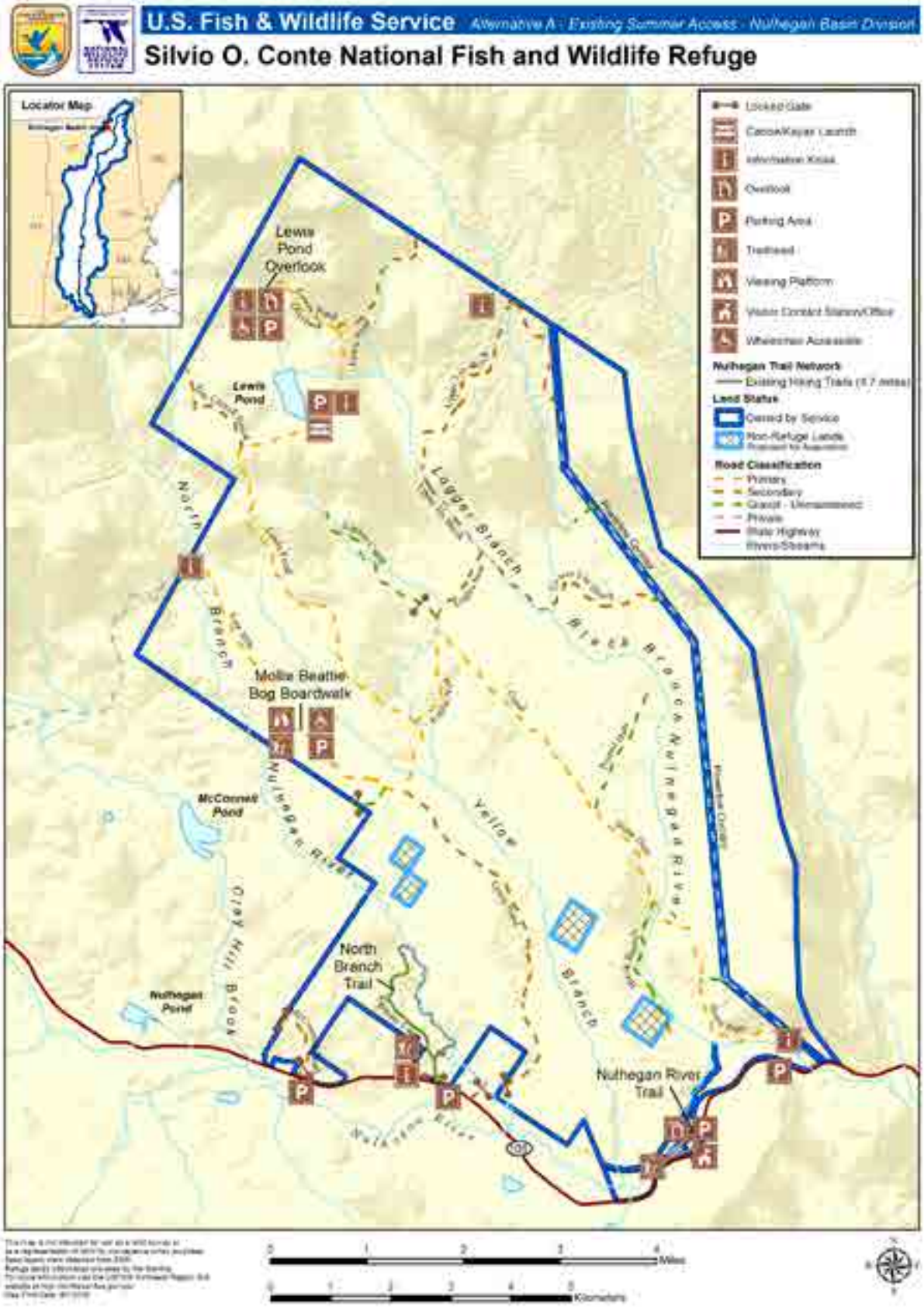
Map 4.44. Proposed Public Use Access at Pondicherry Division, Alternatives A, B, C



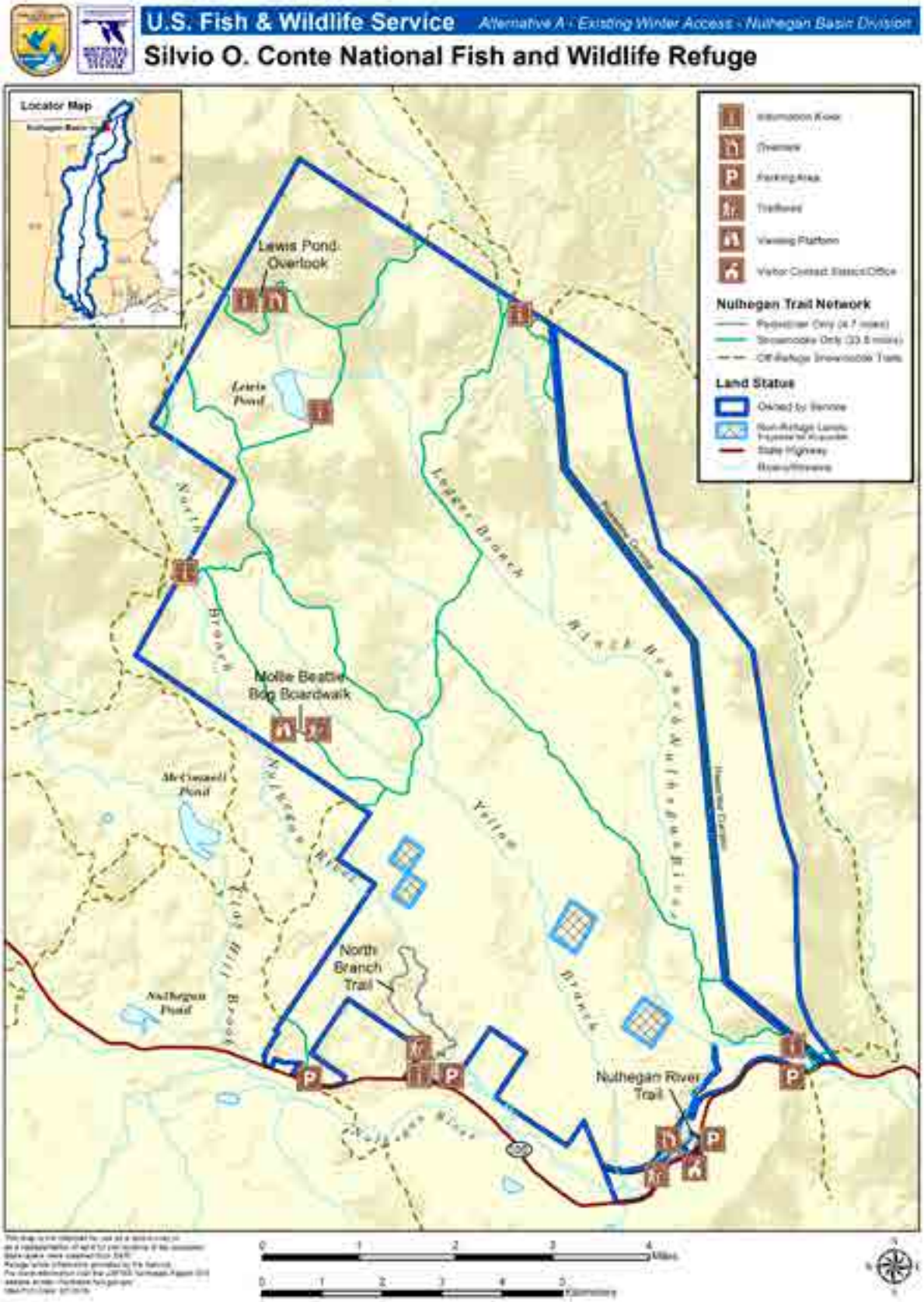
Map 4.45. Proposed Public Use Access at Pondicherry Division, Alternative D.



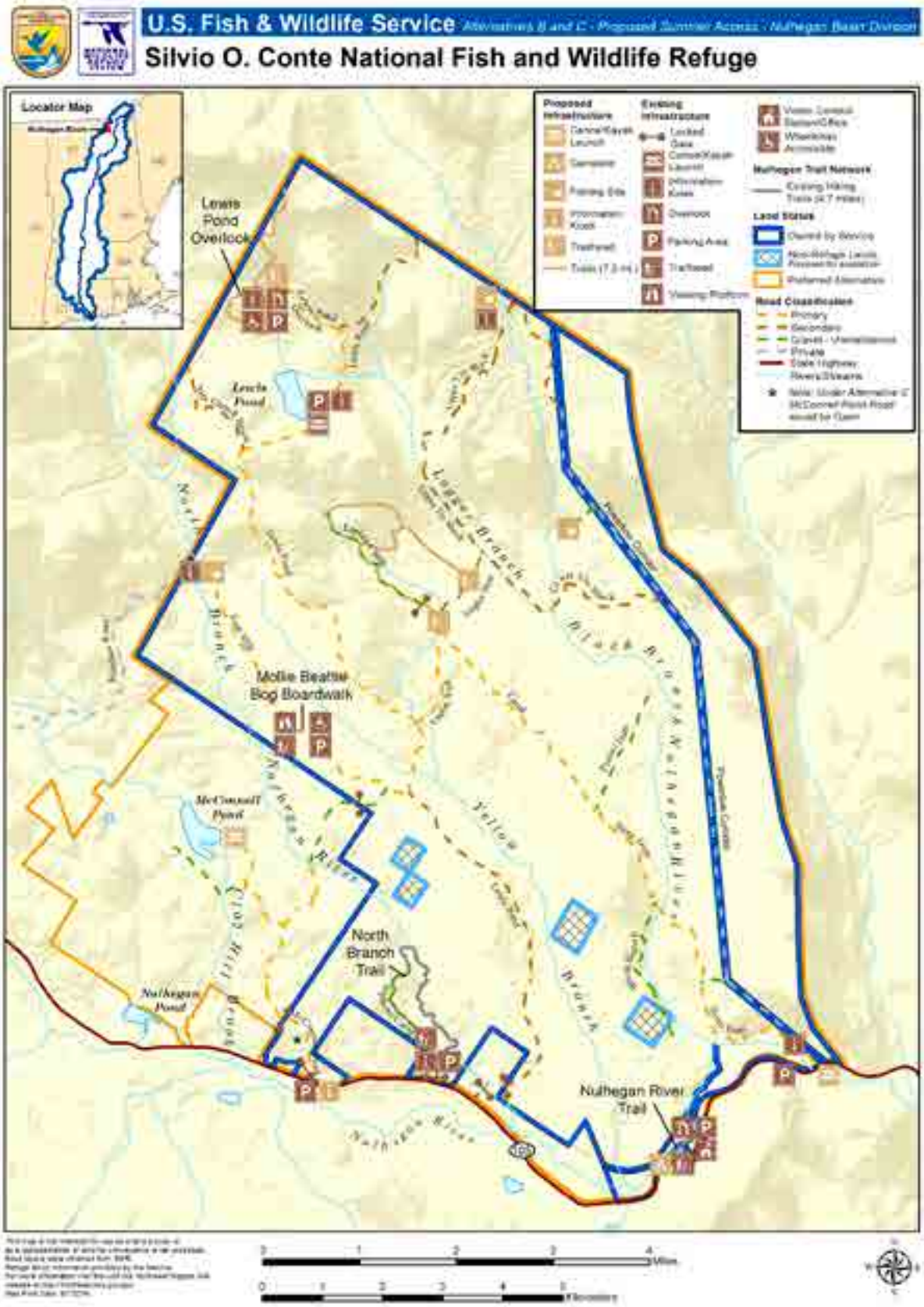
Map 4.46. Proposed Summer Public Use Access at Nulhegan Basin Division, Alternative A.



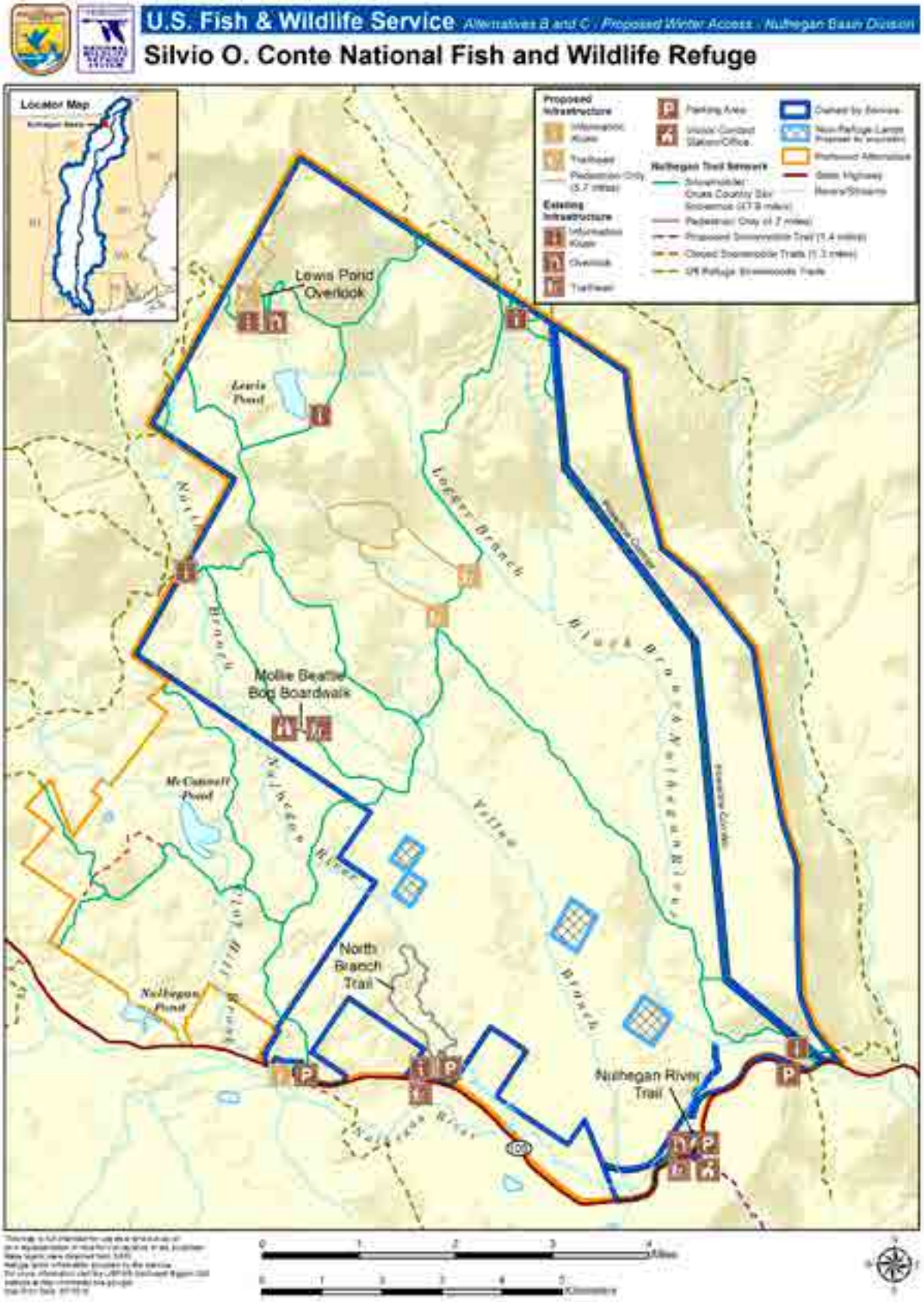
Map 4.47. Proposed Winter Public Use Access at Nulhegan Basin Division, Alternative A.



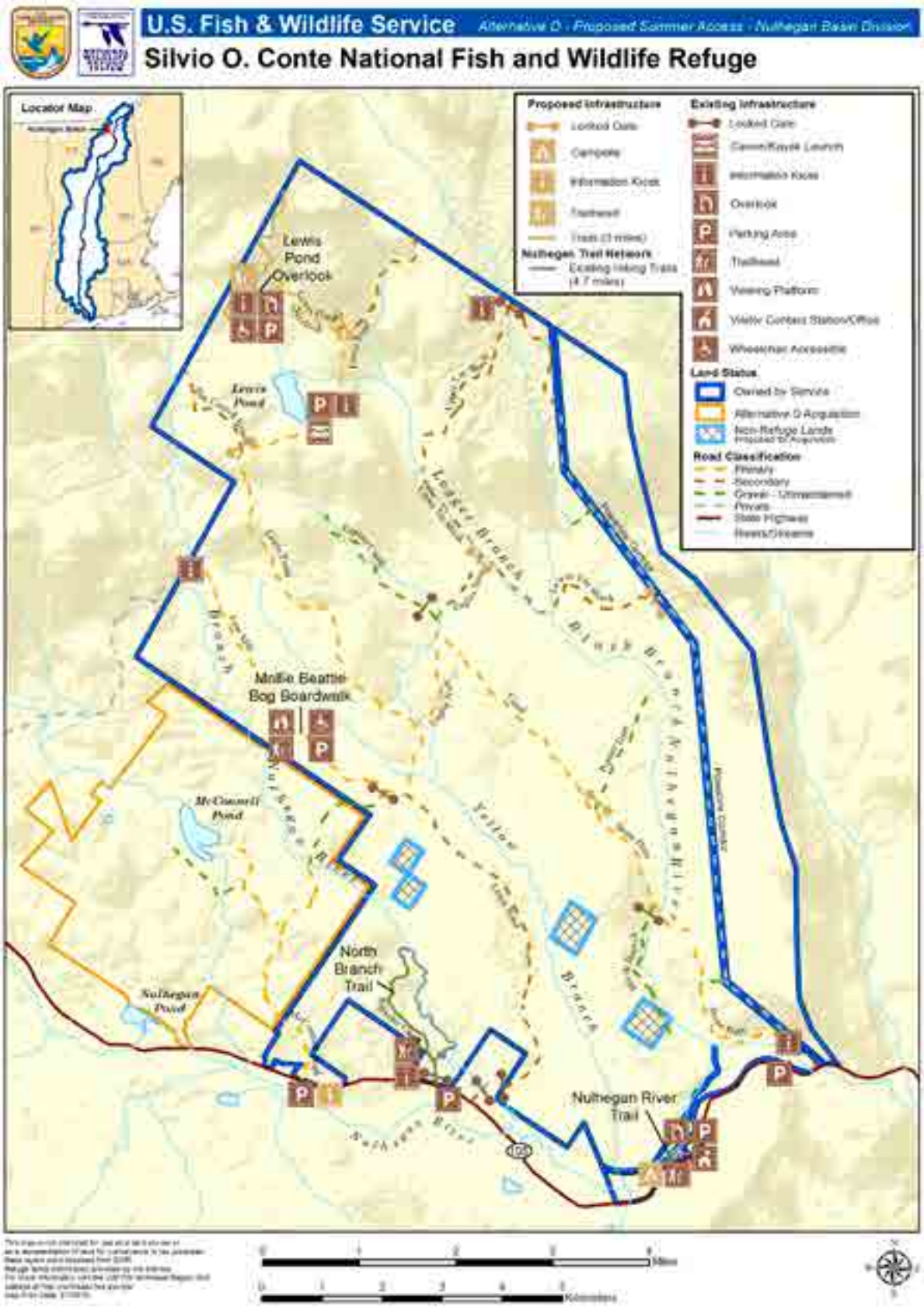
Map 4.48. Proposed Summer Public Use Access at Nulhegan Basin Division, Alternatives B and C.



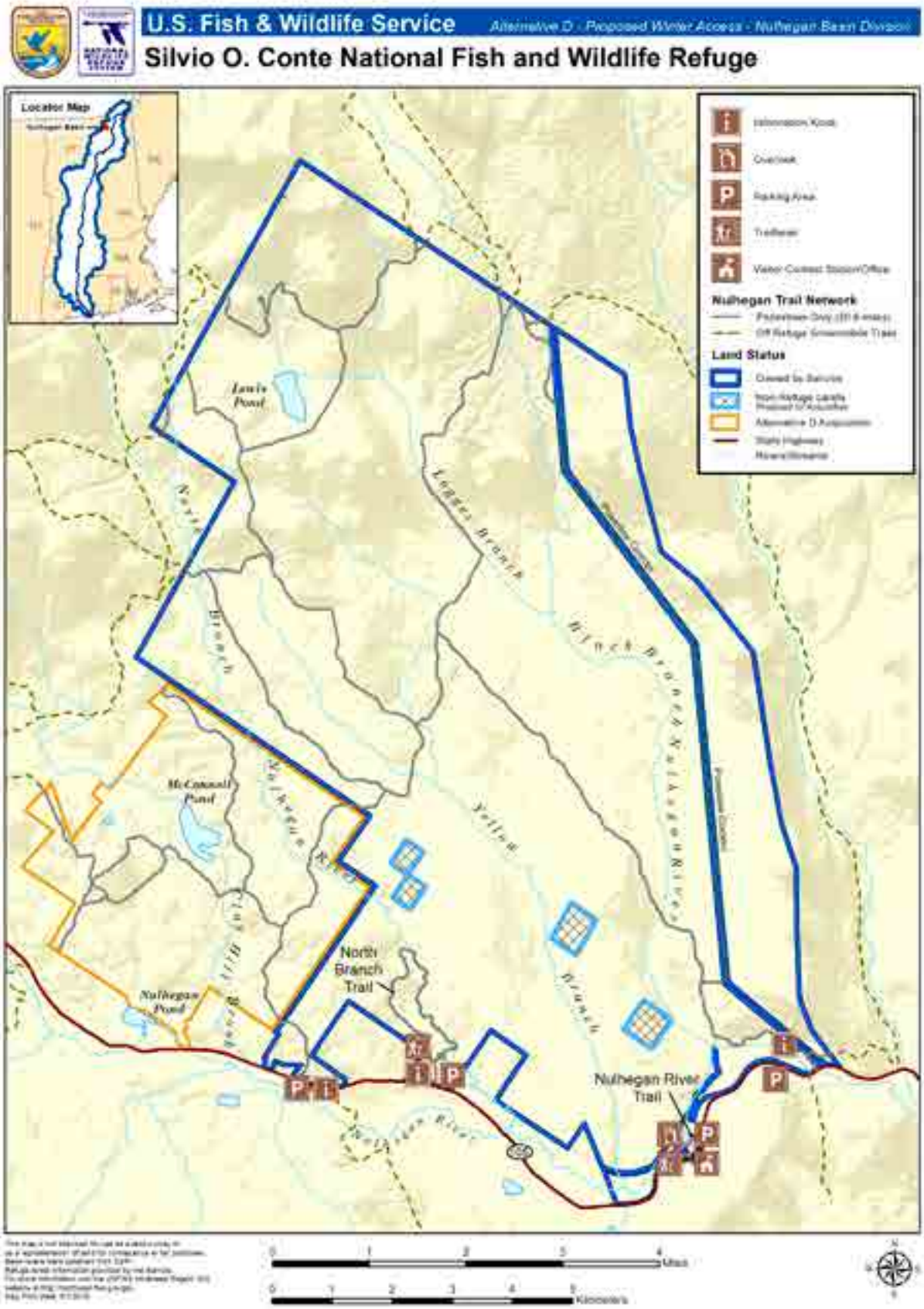
Map 4.49. Proposed Winter Public Use Access at Nulhegan Basin Division, Alternatives B and C.



Map 4.50. Proposed Summer Public Use Access at Nulhegan Basin Division, Alternative D.



Map 4.51. Proposed Winter Public Use Access at Nulhegan Basin Division, Alternative D.



Chapter 5

Sharon Lindsay

Stream habitat restoration at Nulhegan Basin Division

Environmental Consequences

- Introduction
- Impact Analysis and Relationship to Scale
- Regional-scale Impacts
- Refuge-scale Impacts
- Cumulative Impacts
- Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity
- Unavoidable Adverse Impacts
- Potential Irreversible and Irretrievable Commitments of Resources
- Environmental Justice Impacts
- Summary of the Impacts of the Alternatives

Introduction

This chapter summarizes and compares the potential impacts of the four management alternatives described in chapter 4 on the socioeconomic, physical, and biological environment of the refuge and larger Connecticut River watershed. The environment affected by the alternatives is described in Chapter 3–Affected Environment. This impact analysis is designed to inform the decision-making process to ensure the final CCP promotes management activities that avoid or minimize adverse environmental impacts, while promoting the human environment to the fullest extent possible.

As described in chapter 4, the CCP describes and analyzes four management alternatives for the refuge:

- Alternative A — Current Management (which serves as a baseline for comparing against the other three alternatives).
- Alternative B — Consolidated Stewardship.
- Alternative C — Enhanced Conservation Connections and Partnerships (the Service-preferred alternative).
- Alternative D — Expanded Ecosystem Restoration.

In this chapter, we estimate the beneficial and adverse impacts of implementing the management objectives and strategies for each of the alternatives. We attempt to describe the direct, indirect, short-term, and cumulative impacts likely to occur over the 15-year life span of this CCP. Beyond the 15-year planning horizon—which we define as long-term impacts—our estimates of environmental impacts contain greater uncertainty due to the difficulty in projecting impacts beyond the 15-year horizon. Where detailed information is available, we present an educated comparison of the alternatives and their anticipated impacts on the environment. When detailed information is not available, we base comparisons on professional judgment and experience. At the end of this chapter, we summarize the impacts predicted for each alternative in tabular format, providing a side-by-side comparison.

To meet our obligations under NEPA and to comply with Service policies, we assess the *significance* of impacts of all alternatives based on their context, magnitude, duration, and intensity. The context of our impact analysis ranges from site-specific to regional and landscape-scale, and is dependent on how widely the impact of an action can be observed over the affected environment (see chapter 3). Certain actions may have direct impacts in a very local context (e.g., removal of invasive plants), while others may have impacts in a broader context (e.g., participation in regional partnerships) (see table 4.1 in chapter 4). It is important to note that local 'minor' actions implemented by the refuge may have cumulative impacts when incrementally combined with other similar actions over time on a local or regional landscape. For example, invasive plant control on a local scale, when combined with other non-Service control efforts across the landscape could result in cumulative beneficial impacts. Although the refuge land base is a small portion of the Connecticut River watershed and larger ecoregion, our three action alternatives B, C, and D were developed in part to contribute toward regional conservation goals. Our proposed conservation objectives and strategies for species and habitats are generally consistent with regional, state, and Service landscape-level plans identified in Chapter 1, including the Wildlife Action Plans for the four watershed states and the Bird Conservation Region plans for the Northern Forest (BCR 14) and the New England/Mid-Atlantic Coast (BCR 30).

Table 5.1 provides context for the analysis, including the size of the refuge area, major habitat types and their acreages, lengths of existing and proposed ADA-compliant trails, length of existing roads, and amount of area that is predicted to be disturbed during any new construction.

Table 5.1. Context for Impacts Analysis at Silvio O. Conte National Fish and Wildlife Refuge.

Geographic Context	Size
BCRs: Atlantic Northern Forest (14) and New England/Mid-Atlantic (30)	111 million acres
Vermont, New Hampshire, Massachusetts, and Connecticut	20.6 million acres
Connecticut River Watershed	7.2 million acres
Existing Refuge Lands	37,216acres
Existing Refuge Divisions (9)	36,627 acres
Existing Refuge Units (8)	589 acres
Forested Uplands and Wetlands in Entire Watershed	5.6 million acres
Forested Uplands on Existing Refuge Lands	35,214acres
Non-forested Uplands and Wetlands in Entire Watershed	367,685 acres
Non-forested Uplands and Wetlands on Existing Refuge Lands	1,534 acres
Inland Aquatic Habitats in Entire Watershed	162,487 acres
Inland Aquatic Habitats on Existing Refuge Lands	179 acres
Coastal Non-forested Uplands in Entire Watershed	111acres
Coastal Non-forested Uplands on Existing Refuge Lands	0 acres
Coastal Wetlands and Aquatic Habitat in Entire Watershed	2,627 acres
Coastal Wetlands and Aquatic Habitat on Existing Refuge Lands	2 acres
Conserved Lands in Entire Watershed	1,924,620acres
Length of Existing Refuge Trails	51.3 miles
Length of Existing Refuge Roads	134 miles

Many impacts are not considered significant, but are described as negligible, minor, or moderate. The magnitude of such changes is defined as follows:

- **Negligible—**Management actions would result in impacts that would not be detectable or if detected, would have impacts that would be considered localized, and short-term.

- **Minor—**Management actions would result in a detectable change, but the change would be slight and have only a local impact on the biotic community, the resource, or ecological processes. The change would be discountable, insignificant, and of little consequence and short-term in nature.

- **Moderate—**Management actions would result in a clearly detectable change. This could include changes to a local biotic population or habitat sufficient to cause a change in the abundance, distribution, or composition, but not changes that would affect the viability of populations or habitats. Changes to local ecological processes would be of a limited extent.

- **Significant—**Management actions would result in a clearly detectable change. The impacts would be substantial and highly noticeable and could result in widespread change. This could include changes in the abundance, distribution, or composition of local or regional populations or habitats to the extent that it would not likely continue in its previous condition or size. Significant ecological processes would be altered, and changes throughout the ecosystem would be expected. Thus, the impact would be long-term if not permanent.

Impact significance is defined in terms of intensity, the type, quality, and sensitivity of the resource involved, the location of a proposed projects, the duration of its effect (short- or long-term), and other considerations of context. It is not a value judgment, as some impacts can be beneficial for one species and adverse for another, or have a positive impact on visitor use but a negative impact on migratory birds.

In addition to the magnitude of impact (negligible, minor, moderate, or significant), the impacts of the management action on environmental attributes are described as *beneficial, adverse*, or *no impact*. Generally, an impact will be described as *beneficial* if we estimate it helps to improve the quality or quantity of native habitat, increase or enhance native species populations, or enhances the sustainability of biological diversity, integrity, or environmental health. Refuge actions can also be beneficial or adverse to physical and socioeconomic environments. An *adverse* impact arises from an action that we estimate would be detrimental to any aspect of the physical, socioeconomic, or biological environment, and that potentially could impede the intent of the CCP and its goals. When we say that there is *no impact* we mean there is no recognized or discernible beneficial or adverse impact.

Often the impacts of a proposed action have trade-offs, and it can be difficult to describe them as either solely beneficial or adverse. For example, refuge habitat management may benefit certain suite of species (forest-interior dwelling migratory birds), but may have adverse impacts to other species (grassland-nesting migratory birds). Factors that reduce the population of a predator may be adverse for the predator and positive for the prey. Therefore, sometimes our impact analysis does not describe impacts as either beneficial or adverse.

The duration of identified impacts and their consequences varies from those occurring for a brief period in the 15-year life of this plan (e.g., direct impacts of new construction), to those occurring more frequently during the year like mowing or invasive plant control. The duration of identified impacts and their consequences varies from short-term—lasting a matter of days or weeks (e.g., construction noise)—to permanent such as the presence of new infrastructure.

Estimates of impacts—whether beneficial or adverse—were based upon the following criteria:

- The expected degree or percent of change from current conditions in the resource, assuming it is quantifiable.

- The frequency, duration, and magnitude of the impact.

- The sensitivity of the resource to such an impact, or its resiliency to recover from such an impact, or its ability to respond positively to a management action.

- The potential for implementing preventive or mitigating measures to avoid or lessen adverse impacts.

Nulhegan Basin Division visitor contact station

Mark Maghini/USFWS

Finally, we consider the following:

- Cumulative impacts, defined by CEQ (1997) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes the actions."

- The relationship between short-term uses of the human environment and the enhancement of long-term productivity. This relates to the balance or trade-off between the impacts from short-term (within the 15-year CCP timeframe) uses of the environment and the environment's long-term productivity (beyond the 15-year timeframe).

- The potential irreversible and irretrievable commitments of resources. Irreversible commitments are those that cannot be reversed. Irretrievable commitments are those that can be reversed, given sufficient time and resources, but that represent a loss for a period of time.

- Environmental justice impacts, including "identifying and addressing, as appropriate, any disproportionately high and adverse human health or environmental effects of the proposed action on minority populations and low-income populations (Executive Order 12898; 2/11/1994)."

For this discussion our baseline is the condition of the refuge as of mid-2013, represented by alternative A. At that time, the refuge was approximately 36,000 acres in size. Chapter 3 provides a description of the current refuge and watershed's socioeconomic, physical, and biological environments. It also describes current refuge staffing, administration, recreational offerings, and public use infrastructure.

There are certain classes of actions proposed in Chapter 4, "Alternatives, Including the Service-preferred Alternative," that do not require additional NEPA analysis because they are "categorically excluded" from further analysis or review. As such, their potential impacts are not analyzed in this chapter. These

include aspects of management that are both common to all alternatives, and are thought to have no significant impact either individually or when taken together (i.e., cumulatively), on the quality of the human environment. The following would qualify under the Service's list of categorical exclusions (as listed in 516 DM 8.5A), if individually proposed:

- Environmental education and interpretive programs (unless major construction is involved or significant increase in visitation is expected).
- Research, resource inventories, monitoring, and other resource information collection.
- Operations and maintenance of existing infrastructure and facilities (unless major renovation is involved).
- Certain minor, routine, recurring management activities and improvements.
- Small construction projects (e.g., kiosks and interpretive signs).
- Native vegetation planting.
- Minor changes in amounts and types of public use.
- Issuance of new or revised management plans when only minor changes are planned.
- Law enforcement activities.

We recognize that we cannot fully address all the potential impacts associated with the alternatives through this planning process. We describe in chapter 4 under the section "Actions Common to All Alternatives; Additional NEPA Analysis" section, those future management decisions that may require more detailed analysis before they are implemented. We attempt to analyze the impacts of some of the available options in this document to the extent possible, but a more detailed analysis will be required to inform the final decision. For specific projects evaluated in the future, NEPA documents would be prepared that address and fully analyze the potential adverse and beneficial impacts. Our goal is to develop and implement all future plans to minimize adverse impacts while maximizing the long-term benefits to each resource. Each additional NEPA analysis will include compliance with applicable Federal laws and mandates including the Endangered Species Act, the National Historic Preservation Act, and the Coastal Zone Management Act, as appropriate. Although not a comprehensive list, we recognize that further analysis would be required for these projects:

- Habitat Management Plans (HMPs) for refuge divisions and units.
- Hunt Plans for refuge divisions and units by respective state (currently we have a completed hunt plan for existing refuge lands in Vermont—Nulhegan Basin Division and the Putney Mountain Unit—and for the Pondicherry Division). We will develop plans to cover all divisions/units in each of the remaining three watershed States Fishing Management Plans for refuge divisions and units by each watershed state.
- Fire Management Plan (following individual Division HMP completion).
- Visitor Services Plan.
- Integrated Pest Management Plan.

Impact Analysis and Relationship to Scale

We have organized this section by two major resource headings: "Regional-scale Impacts" and "Refuge-specific Impacts." Regional-scale analysis addresses impacts to several resources areas we felt were best addressed at the larger regional scale. This includes impacts to the socioeconomic environment and physical environment, such as air quality, hydrology and water quality, and climate change. As noted in the discussion of context for this impact analysis, the regional-scale context includes the Connecticut River watershed and portions of the four watershed states: Connecticut, Massachusetts, Vermont, and New Hampshire. Refuge-specific impacts encompass aspects of the physical, biological, and socioeconomic environment, but at a smaller scale (table 5.2).

Each section addresses the projected types of impacts, adverse and beneficial, potentially resulting from CCP management actions presented in the different alternatives. We also describe, when possible, how impacts differ across alternatives. In doing so, impacts can more clearly be compared and evaluated. Last, concluding summary statements about impacts are provided for each section analyzed.

Table 5.2. Format of Impact Analysis

Resource Impacted	Resource Aspect	Regional-scale	Refuge-specific
Physical	Air quality	✔	✔
	Hydrology and water quality	✔	✔
	Climate change	✔	
	Soils		✔
Biological	Freshwater wetlands		✔
	Upland habitats		✔
	Biological integrity, diversity, and environmental health		✔
	Federal and state threatened and endangered species		✔
	Birds		✔
	Mammals		✔
	Reptiles, amphibians, fish, and other aquatic species		✔
	Other native fauna and flora		✔
Socioeconomic	Refuge revenue sharing	✔	✔
	Refuge visitor expenditures in local economy	✔	✔
	Refuge administration	✔	✔
	Habitat management	✔	✔
	Land use	✔	✔
	Environmental justice	✔	✔
	Public use and access	✔	✔
	Archaeological, historical, and cultural	✔	✔

Hunter check

Brett Billings/USFWS

Background and Context for Alternatives

The following provides some context for our analysis by highlighting the major distinctions between the four alternatives. As of 2013, the refuge was 37,000 acres in size. Under alterative A, we would continue to acquire additional refuge lands as described in the refuge's 1995 EIS and subsequent NEPA documents (up to 97,830 acres). Under alternatives B, C, and D we also propose to acquire additional refuge lands. Under alternative D we propose the largest refuge expansion; followed by alternative C. Table 5.3 depicts the differences in the proposed refuge acquisition boundary by alternative. For the locations of the proposed CFAs by alternative, see maps 4.20 to 4.40 in chapter 4. Over the 15-year life of the CCP, we expect to acquire approximately the same number of acres regardless of the alternative chosen. We estimate that we will continue to acquire new refuge lands at approximately the same rate as we have previously. On average, we have acquired an average of 2,117 acres, annually, although the average for the past 5 years is 647 acres annually. It is only in the long term, far beyond 15 years, that we expect larger differences in the size of the refuge.

Alternative A is referred to as a 'no-action' alternative because it assumes no change in current habitat management, including continuing current habitat management on about 455 acres, encouraging floodplain and riparian restoration, and control of invasive plants. In contrast, the 'action' alternatives B, C, and D propose different habitat management scenarios. Each of the alternatives differs in the amount and intensity of proposed active habitat management activities (table 5.4), which will be discussed throughout this analysis. In order to reduce redundancy, throughout the chapter we refer the reader back to table 5.4 for a summary of proposed active habitat management. Readers can also refer to the following impact sections below where we provide more detailed information on active habitat management: air quality, upland habitats, wetland habitats, federally listed species, and all other wildlife sections. Also, appendix A provides much more detailed information on our proposed habitat management for each CFA under alternatives B and C.

Similarly, alternative A also continues existing public use programs. The three other alternatives differ in the types of recreational activities offered and the projected amount of refuge visitation (Table 5.5).

Table 5.3. Comparison of Refuge Acquisition Boundary Under Each Alternative.

Acres	Alternative A	Alternative B	Alternative C	Alternative D
Current Refuge Lands (As of February 1, 2016)	37,000			
Additional Acres Proposed for Acquisition	60,830	60,772	160,330	164,307
Total Acres	**97,830**	**97,772**	**197,337**	**231,307**

Table 5.4. Approximate Acres to Be Actively Managed by Alternative to Provide Habitat for Priority Refuge Resources of Concern*

Habitat Management Activity	Approximate number of acres to be actively managed *			
	Alternative A	Alternative B	Alternative C	Alternative D
Forest (Wetland or Upland)				
Even-aged management	195 acres (60 to 65 acres/5 years)	1,560 acres (520 acres/5 years)	1,950 (650 acres/5 years)	0
Uneven-aged management	45 acres (3 acres/year)	4,500 acres (250 to 300 acres/year)	7,500 acres (350-500 acres/year)	0
Tree planting	15 acres (1 acre/year)	1,600 acres (320 acres/2 to 3 years)	2,100 acres (420 acres/2-3 years)	0
Forest total	*255*	*7,660*	*11,550*	*0*
Grassland**				
Mowing or burning	200 acres (all acres treated at least once every 3 years)	422 acres (all acres treated at least once every 3 years)	548 acres (all acres treated at least once every 3 years)	0
Shrubland ***				
Brushhog or Brontosaurus	0	775 acres (all acres treated at least once each 15 years)	775 acres (all acres treated at least once each 15 years)	0
Total Managed Acres	**455 acres (less than 1 percent of potential refuge)**	**9,312 acres (about 9 percent of potential refuge)**	**12,873 acres (about 6.5 percent of potential refuge)**	**0 acres (0 percent of potential refuge)**

* *This* **approximation of acres** *to be managed for habitat assumes full implementation of the CCP (e.g. staffing, funding, and land acquisition) over the 15-year CCP timeframe and beyond, and is based on limited, available resource information on refuge lands yet to be acquired. As new lands are acquired, and we assess habitat conditions, we will likely need to adjust these acres. All subsequent habitat management actions will conform to a site-specific Habitat Management Plan (HMP) derived from the management objectives prescribed in the final CCP*

** *Grassland acres by alternative represents the full footprint of grassland habitat for the refuge*

** *Shrubland acres by alternative represents the full footprint of shrubland habitat for the refuge; the majority of this habitat type to be managed to benefit New England cottontail.*

Table 5.5. Estimated Annual Visits on Refuge Lands, Refuge Educational Venues, and Refuge Events by Alternative.

Current and Projected Visitor Use	Alternative A	Alternative B	Alternative C	Alternative D
Total Visitation	**206,677**	**252,995**	**318,199**	**257,826**
Change from alternative A	0	+46,318 (+22%)	+111,522 (+54%)	+51,149 (+25%)
Visitation per Refuge activity:				
Hunting	2,105	5,880	11,820	14,160
Fishing	210	565	1,149	1,306
Wildlife Observation & Photography	5,786	26,190	53,190	37,600
Environmental Education and Interpretation	11,576	31,360	63,040	37,760
Snowmobiling	20,000	22,000	22,000	0
Sub-total On-refuge Visitation	**39,677**	**85,995**	**151,199**	**90,826**
Great Falls Discovery Center	7,500	7,500	7,500	7,500
Montshire Museum of Science	117,000	117,000	117,000	117,000
Wildlife on Wheels	6,000	6,000	6,000	6,000
Cabela's Conte Corner	36,500	36,500	36,500	36,500
Springfield Museum Conte Corner*	–	–	–	–
Sub-total Off-Refuge Visitation	**167,000**	**167,000**	**167,000**	**167,000**

** no data for Conte Corner at Springfield Museum, MA*

Regional-scale Impacts

Socioeconomic Impacts

Economists from the U.S. Geological Survey (USGS) conducted an analysis of the anticipated socioeconomic impacts of actions proposed in the four alternatives. Their full report (appendix I) provides information on the socioeconomic setting in the Connecticut River watershed, and discusses the potential benefits and adverse socioeconomic impacts of the four management alternatives.

Because of the vastness of the watershed, we decided to focus USGS's analysis on six sub-regions of the watershed where the refuge may have the greatest effect. We selected these six subregions based upon existing refuge lands and proposed future acquisitions:

(1) Northern Sub-region: Essex County, Vermont and Coos County, New Hampshire.

(2) White River Junction Sub-region: Orange County, Vermont, Windsor County, Vermont, and Grafton County, New Hampshire.

(3) Tri-State Border Sub-region: Windham County, Vermont, Cheshire County, New Hampshire, and Franklin County, Massachusetts.

(4) Greater Amherst Sub-region: Hampshire County, Massachusetts.

(5) Greater Hartford Sub-region: Hartford County, Connecticut.

(6) Southern Connecticut Sub-region: Middlesex County, Connecticut.

USGS estimated and compared potential socioeconomic impacts to each of the sub-regions from the four alternatives using a modeling system developed by the U.S. Forest Service called "Impacts Analysis for Planning" or IMPLAN. They analyzed economic effects in the following five categories:

(7) Refuge's purchase of goods and services:
The refuge purchases a wide variety of supplies and services for operation and maintenance activities (i.e., non-salary expenditures), many of which are purchased within the local area of each sub-region. Service purchases made within each sub-region contribute to the local economic impacts associated with the refuge.

Currently, in the Northern Sub-region, the majority (approximately 80 percent) of current non-salary expenditures are spent on cooperative agreements to fund the YCC program, environmental education and interpretive programs, and the WoW Express mobile environmental education center. In both the Tri-State Border and Greater Amherst Sub-regions, the majority of non-salary expenditures are spent on overhead and administration costs, while in the Southern Connecticut Sub-region a majority of these expenditures is spent on habitat management and infrastructure maintenance. In 2012, annual non-salary refuge expenditures totaled approximately $248,000 in the Northern Sub-region, $95,000 in the Tri-State Border Sub-region, $27,000 in the Greater Amherst Sub-region, and $2,000 in the Southern Connecticut Sub-region.

(8) Refuge personnel salary spending:
Refuge employees reside and spend their salaries on daily living expenses in the communities within the sub-regions where they live and work, thereby generating impacts within the local economy. Household consumption expenditures consist of payments by individuals and households to industries for goods and services used for personal consumption. Salary expenditures made by refuge personnel contribute to the local economic impacts associated with the refuge.

Currently, refuge salaries total over $1.21 million per year across three sub-regions. The Greater Amherst Sub-region receives a majority of the funds, with an average of $550,500 spent annually in the region. Salary expenditures in the Northern Sub-region and Tri-State Border Sub-region total $266,500 and $397,100, respectively.

(9) Refuge revenue sharing payments:
Although, the Federal government does not pay property taxes on lands it manages, the Service does provide annual "refuge revenue sharing payments" to towns and/or counties where national wildlife refuges are located. The purpose of these refuge revenue sharing payments is to lessen economic hardship to communities from the loss of tax revenue. Congress has the discretion to appropriate funds for refuge revenue sharing.

In 2012, the refuge made over $53,000 in refuge revenue sharing payments to 18 different municipalities. For more information on recent refuge revenue sharing payments, see table 3.7 in chapter 3.

(10) Refuge visitor spending:
Refuge visitors often buy a wide range of goods and services while visiting the area, including expenditures such as lodging, restaurants, supplies, groceries, and recreational equipment rental.

Currently, approximately between 20,000 and 30,000 visits occur on the existing refuge divisions and units annually. Off-refuge visitation, including visits to the Great Falls Discovery Center, Montshire Museum of Science,

Wildlife on Wheels, Cabela's Conte Corner, and the Springfield Museum Conte Corner, reach an additional 150,000 to 200,000 people annually. In the Northern Sub-region, non-local visitation accounts for about three jobs and about $283,500. Non-local visitor spending in the Tri-State Border Sub-region accounts for one job and about $95,900. In the Greater Amherst Sub-region, the total economic impact of non-local visitor spending is less than one job and about $3,700. Finally, in the Southern Connecticut Sub-region, the total economic impact of non-local spending is less than one job and about $5,000.

(11) Economic contribution of habitat management on the refuge (e.g., timber harvesting and agriculture):
Some refuge management actions can produce merchantable products such as timber and hay. The sale of these products can contribute to local economies. Conversely, refuge acquisition can remove productive land from economic uses. In order to achieve refuge wildlife and habitat goals, these lands may no longer be actively managed to produce agricultural and wood products. The refuge may continue to harvest products from some of these lands, but it would likely be at a much smaller scale than previously. The loss of these working lands may affect local economies.

Under all alternatives, there are several factors that would potentially moderate the effects to local communities from the refuge's acquisition of commercial forest land. These factors make it difficult to accurately predict our exact contributions to the local economy from habitat management. These factors include:

a. The employment associated with forest-based recreation and tourism is likely to remain unchanged or increase as these activities will still be taking place on refuge managed lands and demand for these services and goods will continue at current levels, if not increase.

b. We will only acquire lands from willing sellers.

c. Sometimes private landowners harvest some of their forest lands prior to sale to the refuge. In those cases, some economic gains would be realized by the private owner prior to Service ownership.

d. Landowners are financially compensated when they enter into a purchase agreement with the Service. Though it is unknown how those dollars would be spent, it is likely that some of the money would be injected into the local economy through the purchase of equipment, goods, and services from local retailers or by the purchase of additional lands.

e. Where appropriate and compatible, the intention of the refuge is to actively manage forests and grasslands for wildlife habitat using commercial means as the preferred management technique.

f. As we actively manage refuge lands for wildlife habitat, we will continue to produce some products that will be purchased within local economies (e.g., forest products, hay, etc.).

g. The amount and location of commercial forestry land to be acquired is highly uncertain, and acquisition is expected to occur gradually over the next several decades. The rate of Federal acquisition would depend on willing sellers and available budgets.

Again, the acquisition of these lands is highly variable and as such, it is not appropriate to model the economic impacts due to the high level of speculation

on where these acquisitions may occur as well as the timeframe in which they will occur.

Here we summarize the USGS report findings. Most of their analysis focused on short-term impacts (over the next 15 years). For more detailed information, please refer to appendix I for their full report.

Under all alternatives, we predict off-refuge visits will remain the same as current numbers. As visitation increases, we expect a commensurate increase in visitor spending.

Under all alternatives the refuge will continue to pay refuge revenue sharing payments to towns and counties. Because Congress annually sets the formula for calculating refuge revenue sharing payments, we cannot accurately predict the amount we will pay to towns and counties in the future. Unfortunately, in recent years funds available and revenue sharing payments to towns and counties have been decreasing. We plan to use a combination of conservation easements and fee-title acquisition. This will help mitigate the refuge's impact to local tax revenues; lands where we acquire conservation easements will continue to stay on local tax rolls, although property taxes often are reduced based upon the terms of a conservation easement. Our target is to acquire an average of 65 percent of future acquisitions through fee-title and the remaining 35 percent through conservation easements. We cannot guarantee that actual percentage of fee-title versus conservation easement acquisition, which will depend on willing sellers' preferences. We predict that we will be more likely to acquire conservation easements in the more northern sub-regions as compared to the more southern sub-regions.

Artist at the Pondicherry Division

David Govatski

Socioeconomic Effects of Alternative A

Purchase of goods and services under Alternative A

As compared to current levels, we estimate that over the 15-year life of the CCP non-salary expenditures will decrease in some sub-regions, while increasing in others. We anticipate that non-salary annual expenditures will decrease in the Northern (-$8,500) and Tri-State Border (-$63,600) Sub-regions under alternative A. Non-salary expenditures are expected to increase across the remaining sub-regions. Within the Greater Amherst and Southern Connecticut Sub-regions, expenditures are expected to increase by nearly $30,000 and $26,000, respectively. Currently the refuge does not spend money in the White River Sub-region or the Greater Hartford Sub-region because we do not currently own any refuge lands in these areas. Under alternative A, as lands are acquired in these areas, the refuge may potentially spend up to approximately $4,000 annually in the White River Sub-region and up to $40,000 annually in the Greater Hartford Sub-region.

Refuge personnel salary spending under Alternative A

Under alternative A, staffing would remain the same as current levels across the refuge and, therefore, we would expect personnel salary spending to continue at similar levels.

Refuge revenue sharing payments under Alternative A

We will pay additional refuge revenue sharing payments as we acquire new lands under alternative A (up to a total of 97,830 acres).

Refuge visitor spending under Alternative A
Under alternative A, overall visitation (both on and off refuge) is projected to be about 206,677 visits. This is an increase to on-refuge visits over current numbers, and is the smallest projected total visitor use among the proposed alternatives.

We predict the increases in visitation will differ by economic sub-region. Visitation is expected to remain largely the same in the Northern, White River Junction, and Tri-State Border Sub-regions. In the Greater Amherst Sub-region, once we complete the Fort River accessible trail (anticipated formal opening is in fall 2014) we expect annual visitation to increase tenfold (to approximately 3,000 visits). In the Greater Hartford Sub-region, as we acquire lands, we expect to complete up to two universal access ADA-compliant trails, which would add approximately 12,000 annual visits. Current visitation is also expected to increase in the Southern Connecticut Sub-region as land acquisitions occur. The additional land purchased is expected to draw about 4,000 visitors annually to the sub-region.

Based on these visitation projections, we expect visitor spending will increase in the Greater Amherst Sub-region, Greater Hartford, and Southern Connecticut Sub-region. Visitor spending in the other sub-regions will likely be similar to existing spending.

Economic contribution of habitat management on the refuge under Alternative A
Under all alternatives, we may acquire up to an additional 32,000 acres of commercial forest lands across several sub-regions over the next 15 years. We predict that more than half of those newly acquired forest lands would be spread across the Northern, White River Junction, and Tri-State Border sub-regions. We would continue to manage the woodcock management demonstration units in the Northern Sub-region and up to 200 acres of grassland each year across the Northern and Greater Amherst Sub-regions for migratory birds and other wildlife. As part of this management we may generate some timber products and hay.

Socioeconomic Effects of Alternative B
Purchase of goods and services under Alternative B
Under alternative B, refuge staff expects total non-salary expenditures to remain the same as under alternative A, but expenditures across regions will shift. While it is anticipated that under alternative B fewer purchases of goods and services will occur in the Northern and Greater Amherst Sub-regions, additional expenditures are expected in the White River Junction, Tri-State Border, Greater Hartford, and Southern Connecticut Sub-regions.

Refuge personnel salary spending under Alternative B
Same as alternative A.

Refuge revenue sharing payments under Alternative B
We expect that over both the short term and long term that refuge revenue sharing payments under B would be similar to alternative A. This is because we are proposing to purchase similar amounts of land under alternatives A and B (up to a total of 97,830 acres under A and up to a total of 97,772 acres under B). We also anticipate acquiring a similar 65/35 percent ratio of fee-title acquisitions and conservation easements as under alternative A.

Refuge visitor spending under Alternative B
Under alternative B, overall visitation (both on and off refuge) is projected to be about 252,995 visits. This is a projected increase of 46,318 (22%) over alternative A. Under alternatives C and D, we would expect larger increases in visitation. As visitation increases, we expect a commensurate increase in visitor spending.

In the Northern Sub-region, it is estimated that visitation, and therefore visitor spending, will not change under alternative B. Visitation in the White River Junction Sub-region is expected to increase by an additional 4,500 visits annually as additional land is acquired and universal trail access is established at the Ompompanoosuc River Division. Similarly, visitation in the Tri-State Border Sub-region is expected to increase by 3,000 annual visits as additional lands are acquired and trail access improved. In the Greater Amherst Sub-region it is estimated that annual visitation will be 4,000 as universal trail access is established at the Dead Branch, Westfield River, and Mill River Divisions. In the Greater Hartford Sub-region, visitation is expected to increase by an estimated 1,500 visits annually as universal trail access is added to the Farmington River Division. Finally, visitation in the Southern Connecticut Sub-region under alternative B is predicted to be the same as under alternative A.

Economic contribution of habitat management on the refuge under Alternative B
In the short term, the economic contribution would be similar to alternative A. When fully implemented (i.e., the refuge acquires the total proposed 97,772 acreage), we would harvest an average of 60 to 65 acres of forest every 5 years in the 300 acre woodcock management unit in the Northern Sub-region. We will continue to maintain the existing 200 acres grassland acres on the refuge (Northern and Greater Amherst Sub-regions) by periodic mowing.

Socioeconomic Effects of Alternative C
Purchase of goods and services under Alternative C
Under alternative C, refuge staff expect an increase in total goods and services purchases of about $175,000 annually. Under alternative C, the purchase of goods and services is expected to increase across all sub-regions with the exception of the Northern Sub-region. The greatest increase in expected non-salary expenditures will occur in the Tri-State Border and White River Junction Sub-regions, with both regions having an expected increase of greater than $100,000, annually.

Refuge personnel salary spending under Alternative C
Under alternative C, an additional ten positions are projected for the Tri-State Border Sub-region and six additional positions are projected for the Northern Sub-region. Similar to alternatives A and B, under alternative C, new staff will not be hired in the White River or Greater Hartford Sub-regions. The hiring of new staff will be dependent on budgets and will vary depending on availability of funds. We cannot predict which sub-region new staff will live and subsequently spend their salaries and as a result, the economic impacts of new staff cannot be reasonably allocated to a specific region.

Refuge revenue sharing payments under Alternative C
In the short term (within the 15-year timeframe of the CCP), we expect refuge revenue sharing payments under alternative C to be similar to alternatives A and B. Over the longer term, we expect to pay a greater amount of refuge revenue sharing payments to a higher number of towns and counties under alternative C as compared to alternatives B and C. This is because we are proposing to acquire more lands in more sub-regions of the watershed under alternative C (up to 197,337 acres). We also anticipate acquiring a similar 65:35 ratio of fee-title acquisitions and conservation easements under alternative C as under alternatives A and B.

Refuge visitor spending under Alternative C
Under alternative C, overall visitation (both on and off refuge) is projected to be about 318,199 visits. This is a projected increase of 111,522 compared to alternative A, and the greatest increase compared to the other alternatives (54%). As visitation increases, we expect a commensurate increase in visitor spending.

Similar to alternative B, under alternative C visitation in the Northern Sub-region is not expected to change. Under alternative C, visitation in the White River Junction Sub-region is expected to increase similarly to alternative B, plus an additional 1,500 visitors due to the establishment of a trail at the Sprague Brook Division, for a total of 6,000 additional visitors to the sub-region over alternative A. Visitation to both the Greater Amherst and Greater Hartford Sub-regions is expected to increase similarly under alternative C as estimated for alternative B. Under alternative C, visitation to the Southern Connecticut Sub-region is expected to be the same as alternatives A and B.

Economic contribution of habitat management on the refuge under Alternative C
In the short-term, the impacts under alternative C would be similar to alternatives A and B. Compared to the other alternatives, alternative C would generate the greatest amount of commercial products from habitat management (such as timber products and hay) over the long term. When fully implemented (i.e., the refuge acquires the total proposed 197,337 acreage), we would harvest approximately 500 acres of forest per year (including those currently harvested for woodcock at the Nulhegan Basin Division). We also anticipate mowing or burning approximately 550 acres of grasslands. These 550 acres would be treated rotationally, either annually or every 2 or 3 years. Similar to alternative B, as we acquire new refuge lands that are in early-successional habitat, we will evaluate whether continue to maintain them as early-successional habitat through forest harvesting. We will also develop a HMP with more details on our proposed habitat management.

Socioeconomic Effects of Alternative D
Purchase of goods and services under Alternative D
The purchase of goods and services under alternative D is quite similar to those expected under alternative C. Again, it is expected that all sub-regions, with the exception of the Northern Sub-region, will experience an increase in the purchase of goods and services by the refuge. Under alternative D, the greatest increase will occur in the White River Sub-region, due to our proposed refuge expansions in that area. All non-salary expenditures will be highly dependent on the location of land acquisitions, which are unknown at this time; therefore, USGS did not model estimates of future expenditures.

Refuge personnel salary spending under Alternative D
Same as alternative C.

Refuge revenue sharing payments under Alternative D
In the short term (within the 15-year timeframe of this CCP), we expect refuge revenue sharing payments under alternative D to be similar to alternatives A, B, and C. Over the longer term, we expect to pay a greatest amount of refuge revenue sharing payments to a higher number of towns and counties under alternative D as compared to the other alternatives. This is because we are proposing the greatest refuge expansion under alternative D (up to 231,307 acres).

We also anticipate acquiring a similar 65:35 ratio of fee-title acquisitions and conservation easements as under alternative D as under alternatives A, B, and C.

Refuge visitor spending under Alternative D
Under alternative D, overall refuge visitation (both on and off refuge) is projected to be about 257,826 visits. This is a projected increase of 51,149 over alternative A. The total number of predicted annual visits is slightly higher under alternative D compared to alternative B, but is much less than under alternative C. As visitation increases, we expect a commensurate increase in visitor spending.

Under alternative D, visitation in the Northern Sub-region is expected to decrease by approximately 16,000 visitors as 35 miles of snowmobile trails will be eliminated. Total visitation is estimated to be about 6,000 visitors. Alternative D does not include the construction of developed trails, so visitation in the White River Junction and Greater Amherst Sub-regions, is expected to increase annually by only 2,000 visits and 1,500 visits, respectively. Although trail development in the Greater Hartford Sub-region is also not included under Alternative D, due to the region's close proximity to Hartford and its expanding population, visitation is expected to increase by 4,500 visitors. Finally, in the Southern Connecticut Sub-region, a trail development is planned once acquisition of the Whalebone Cove Division is completed. This is expected to result in an additional 1,500 visits, annually.

Economic contribution of habitat management on the refuge under Alternative D
Alternative D would generate the smallest economic contribution from habitat management. Under alternative D, we would not actively manage any refuge lands, except under extreme circumstances (e.g., to reduce dangerous fuel loads after catastrophic natural disturbances such as fires, pest outbreaks, hurricanes, or ice storms).

Impacts to Air Quality

Introduction to Air Quality Impacts
Chapter 3, "Affected Environment" presents the status of air quality in the surrounding refuge landscape and Connecticut River watershed. We evaluated the management actions proposed in each alternative for their impacts on air quality, including their potential to help improve local and regional air quality. In addition, gases that affect air quality from a health perspective also contribute to climate change. These gases include carbon dioxide, methane, nitrous oxides and ozone, and are addressed in this section. The changes in greenhouse gasses will be reflective of impacts to climate change. A discussion of how the effects of climate change will impact Conte Refuge's ability to execute the CCP and modify the impacts from CCP implementation is included in the section *Climate Change Impacts*, below.

The benefits we considered included:

- Improved air quality from habitat protection and management actions.
- Reduction in the refuge's contribution to emissions as a result of adopting energy efficient practices.

The potential adverse effects of the management alternatives that were evaluated included increases in:

- Poor air quality from certain habitat management actions.
- Emissions, including greenhouse gas emissions[1] from buildings, construction, equipment use, and from refuge staff and visitor vehicles.
- Particulates and greenhouse gases from prescribed burning for habitat management.

[1] Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide(NO_x), hydrofluorocarbons, perfluorocarbons, nitrogen triflouride, and sulfur hexafluoride, per Executive Order 13693.

Air Quality Impacts That Would Not Vary By Alternative
Beneficial Impacts on Air Quality from habitat protection and management
We expect refuge land conservation and management across all alternatives to help reduce any future direct and indirect adverse impacts by maintaining and enhancing natural vegetative cover. Air quality is enhanced by maintaining forests, wetlands, and grasslands in vegetative cover (Dwyer et al. 1992).

Our analysis of air quality impacts considered only how the Service's actions at the refuge might affect criteria air pollutants, visibility, and global warming, focusing on the potential for localized beneficial or adverse air quality impacts. Across all alternatives, our professional judgement is that these habitat conservation and management actions lead to lower levels of emissions in areas near the refuge and higher air quality due the air pollutant filtering function of vegetation on the existing 37,000-acre refuge (Daily et al. 1997(a)). We anticipate negligible beneficial air quality impacts from permanently protecting additional refuge lands. By preventing further development on these lands, we expect a reduction in local emission sources and pollution from industrial, commercial, and residential development (e.g., air-borne particulates, fossil fuel emissions). Based on past rates, land acquisition over the 15-year CCP timeframe is likely to be on the order of 9,000-32,000 acres, so the beneficial impacts on air quality over the next 15 years may be the same regardless of alternative selected.

Over the 15-year life of the CCP, we expect to acquire land under each alternative at a pace similar to our historical acquisition pattern. Therefore, beneficial impacts to air quality from land protection are expected to be the same across all alternatives. However, in the longer term, we anticipate that alternatives C and D will have greater benefits than alternatives A and B.

Beneficial Impacts on Air Quality from adopting energy efficient practices
Across all alternatives the refuge would seek to employ other alternative energy sources, such as solar panels and small-scale wind turbines, in order to reduce its direct and indirect contribution to greenhouse gas emissions. Additional beneficial impacts also would derive from energy efficiency and conservation at all refuge facilities, and in maintaining fuel efficient vehicles.

The Nulhegan Basin Division's headquarters/visitor contact station was the first in the Service to receive an ENERGY STAR designation, indicating that the facility performs better than at least 75 percent of similar buildings nationwide. Other existing buildings used by the refuge have not earned this designation, including quarters and maintenance buildings. The refuge has determined that these buildings are not suitable for upgrading to LEED or ENERGY STAR. No changes are proposed in the CCP; therefore impacts are not expected to vary among alternatives.

Adverse Impacts on Air Quality from emissions and pollution
There are no major stationary (e.g., power plant) or mobile (e.g., automobile) sources of air pollution present on refuge lands that would exceed EPA's New Source Performance Standards (NSPS), nor would any be created under any of the alternatives. Additionally, in the long term (beyond 15 years) there are no expectations that any major source of air pollution would be generated from the refuge.

There are three Class I airsheds located within the Connecticut River watershed: the Great Gulf Wilderness (5,552 acres) and Presidential Range-Dry River Wilderness (20,000 acres) areas in the White Mountain National Forest (New Hampshire) and the Lye Brook Wilderness area (12,430 acres) designated in the Green Mountain National Forest (Vermont). None of the proposed refuge activities (e.g., vehicle fleet use, forest harvesting, new trail construction) would

Snowmobilers at kiosk

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have any significant adverse impacts, either during the 15-year period covered by the CCP or the long term beyond it, on these airsheds.

The Service restricts human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses), and thus limits human-derived uses that may impair air quality. Alternative C projects the highest levels of visitation, followed by alternatives D, B, and A (Table 5.5). Across these alternatives, impacts from non-snowmobile visitation are expected to be similar and negligibly adverse, over both the 15-year CCP horizon and the long term. Refuge vehicles (eight trucks, four SUVs (one hybrid), one mini-van, two ATVs, six snowmobiles, and one farm tractor), as well as contract heavy equipment, are estimated to average 100,000 miles traveled together on an annual basis. Treating all vehicles as equivalent, the EPA estimate for total annual CO2 emissions is 411 metric tons (EPA 2016). Emissions from public vehicles driven by visitors and volunteers are also projected to be very small, based on past use. Across the four alternatives, we anticipate that visitation to off-refuge sites, such as the Great Falls Discovery Center, Montshire Museum of Science, and the Wildlife on Wheels (WoW), will continue at existing levels (about 167,000 visits per year, Table 5.5). The air quality impacts of maintaining these facilities is expected to be negligible. Current CEQ guidance indicates that annual CO2-equivalent emissions below 25,000 metric tons do not warrant a detailed quantitative analysis.

Although the alternatives differ in the total amount of land the refuge is allowed to acquire, the history of the refuge indicates that we would likely not acquire all proposed new lands within the 15-year timeframe of the CCP. Since the refuge's inception, we have acquired an average of 2,117 acres per year, and the average for the past 5 years is only 647 acres. Therefore, non-snowmobile refuge use and visitation would not vary dramatically across alternatives.

Adverse Impacts on Air Quality from fire and associated smoke
Wildfire is not a substantive concern on the existing refuge or proposed new refuge lands because of the natural fire frequency regimes of the major

vegetative and forest types within the Connecticut River watershed. The watershed is dominated by vegetation that falls within Fire Regime Groups III, IV, and V. FRG III, in the central and southern Connecticut River valley, indicates a regime characterized by low and mixed severity fire at return intervals between 35 and 200 years . FRG IV, in the foothills, is characterized by high severity fire at return intervals between 35 and 200 . FRG V, which includes the Berkshires, Green Mountains, and Northern Forest, is characterized by fires of any severity at return intervals greater than 200 years. Salt marsh within the watershed is classified as FRG II, indicating a regime characterized by high severity fires at return intervals of fewer than 35 years (Landfire 2012). Because wildfire emissions are so unlikely, none of the alternatives propose regular fuel-load management. Therefore there are no likely adverse impacts, and this holds for all alternatives.

Under all alternatives, there is the potential for negligible (short term, localized) adverse impacts from seasonal wood burning at 30 private cabins at the refuge's Nulhegan Basin Division. Although alternatives B, C, and D propose the acquisition of an additional eight cabins, these cabins are currently in use and are thus not expected to generate air pollution above current levels over both the 15-year period covered by the CCP and longer time frames.

Adverse Impacts on Air Quality from other habitat management
Forest management activities are performed by logging contractors under supervision of the refuge forester. Emissions from heavy equipment used during logging operations may present a negligible adverse impact to air quality. An analysis of the effect of vegetation treatments across multiple forests found that while prescribed fire had little impact on forest carbon budgets in eastern forests, mechanical or combination treatments converted the forests from net sinks to sources in the first years following treatment. The degree of the change depends on the forest structure and composition prior to treatment as well as the type of treatment used. As forests re-establish, they can again become sinks (Depro et al. 2008). There is high uncertainty associated with the effect of different management strategies to sequester carbon (McKinley et al. 2011).

Air Quality Impacts Common to Alternatives A, B, and C
Adverse Impacts on Air Quality from emissions
Currently, there are an estimated 20,000 snowmobile visits annually on the Nulhegan Basin, Pondicherry, and Dead Branch Divisions (Table 5.5), thus subjecting these divisions to some short-term and long-term adverse impacts due to the emission of exhaust hydrocarbons from snowmobiles. Under alternative A, we would expect snowmobiling to continue at these levels. Air pollution from snowmobiles is well documented and can result in a number of health problems. Two-stroke engines are highly polluting and can emit high levels of carbon monoxide (CO), unburned hydrocarbons (HC) and smoke (NPS 2000). Figures submitted to the California Air Resources Board by the snow machine industry show that one two-stroke snowmobile emits the same volume of hydrocarbons and nitrous oxides as 1,000 cars, and as much carbon monoxide as 250 to 500 automobiles (Gierzynski 2008). However, newer four-stroke snowmobile engines reduce the amount of emissions somewhat. Large numbers of snowmobiles in one area (such as parking lots), cold, stable weather conditions, and low wind speed all increase the accumulation of fossil fuel toxins and increase the risk of adverse health effects (NPS 2000). Additionally, riding in groups of snowmobiles exposes the rider to emissions from the snowmobiles in front of them (Janssen and Schettler 2003).

Snowmobile trails on new lands to be acquired under these alternatives may be maintained, and in select situations closed trails may be opened to promote

wildlife-dependent public uses. If we acquire any new refuge lands with existing snowmobile trails that are part of a regional or state trail network, we may decide to allow the trails to remain open to help promote access to the refuge and to support wildlife-dependent public uses. Prior to allowing snowmobiling on new refuge lands, we would first determine that snowmobiling is appropriate and compatible on those lands. Although snowmobiling can introduce petroleum hydrocarbons to wild lands, it is unlikely that the potential short-term and long-term adverse impacts would be more than negligible to minor. Current snowmobile emissions do not cause the area to exceed federal or state air quality standards. None of the alternatives include an expansion of the existing snowmobile trail system, and thus do not represent an additional environmental impact. For further information, see the compatibility determination for snowmobiling in Appendix D, "Findings of Appropriateness and Compatibility Determinations."

Air Quality Impacts under Alternative A

Alternative A would continue current active management of forest and grassland habitats on 455 acres of habitat (1% of current refuge lands, see table 5.4), including 255 acres forest, 200 acres of grassland, and 0 acres of shrubland.

Forested habitat management under alternative A would focus on creating habitat for American woodcock and other species with similar habitat needs, continuing to implement the existing habitat management plan. We would harvest approximately 60-65 acres of forest every 5 years to conduct even-aged management across at total of 195 acres. In addition, uneven-aged management will continue on 45 acres, and tree planting will occur on 15 acres (4 acres/year, total). Habitat management under alternative A is designed to improve habitat structure for woodcock and other priority refuge resources of concern.

A total of 200 acres of grassland habitat are mowed or brush-hogged using a diesel-powered tractor at least once every 3 years within three refuge divisions: the Fort River, Nulhegan Basin, and Pondicherry Divisions. Grassland management under alternative A would be maintained to provide for priority refuge resources of concern grassland birds (e.g., bobolink, upland sandpiper, and breeding woodcock).

The refuge currently manages 20 miles of trails (e.g., Mud Pond Trail at Pondicherry Division, an ADA-compliant trail at Fort River, and Mollie Beattie Trail at Nulhegan Basin Division), 42 miles of gravel road (40 public, 2 administrative), and two overlooks.

Neutral Impacts. We do not plan to expand the trail system on current refuge lands under alternative A. Prescribed burning is not practiced or employed to manage habitats (except for hazardous forest fuel reduction), thus eliminating any potential for emission release. Our current invasive plant control does not use prescribed burning, relying instead on cutting, pulling by hand, and approved herbicides.

Beneficial Impacts. Over the 15-year CCP timeframe and beyond, there may be additional negligible to minor beneficial air quality impacts from vegetation on further land acquisitions up to a total of 97,830 acres within the original Special Focus Areas (SFAs).

Timber harvesting under alternative A has negligible beneficial impacts on air quality from carbon sequestration in regrowing vegetation. The benefit of carbon storage in forests is offset by how the harvested timber is used (McKinley et al. 2011), which is not within the refuge's control.

Adverse Impacts. Alternative A would include few and minor ground disturbing activities that could cause increases in fugitive dust (e.g., mowing, haying, limited forest management operations, hiking disturbance, or trail maintenance), consistent with past management, and introduce few emission sources (e.g., diesel emission from heavy equipment).

Alternative A is thought to have the lowest potential for annual on-refuge visitor increase (Table 5.5), since no expansion of hiking trails and visitor use is proposed. Using heavy equipment to maintain the current 20-mile hiking trail system is expected to have negligible adverse impacts to air quality.

We expect there to only be minor adverse air quality impacts from refuge staff driving vehicles to additional lands acquired during the lifetime of the CCP; these effects will vary depending on the location and management needs of any parcels acquired in the future.

We do not plan to increase capacity for snowmobiling within alternative A; rather, we plan only to maintain existing use levels, thereby minimizing any potential adverse air quality impacts beyond those described in the section *Impacts Common to Alternatives A, B, and C.*

The scope of impacts from forest management is described in the section *Air Quality Impacts that would not vary across alternatives*. Under alternative A, we propose to manage approximately 60 to 65 acres of forest every 5 years to improve habitats across refuge lands. The emissions and fugitive dust from timber harvest and tree planting activities is expected to be negligible (short-term and localized). The contribution of managed lands to carbon sequestration is highly uncertain. In general, the effect of harvest and other vegetation management releases carbon, while unmanaged lands, which make up the majority of the refuge, are more likely to be a carbon sink (Depro et al. 2008).

Because grassland management occurs infrequently and the treatment occurs on relatively small tracts of land (Fort River being the largest at 105 acres), in our professional judgement it will not have a greater than negligible adverse impact to local or regional air quality, either during the 15-year timeframe for the CCP or beyond.

Air Quality Impacts under Alternative B

Over the 15-year CCP horizon, we propose to actively 9,312 acres of habitat (compared to 455 acres under alternative A, and totaling 26% of current refuge lands), including 7,660 acres forest, 422 acres grassland, and 775 acres shrubland (Table 5.4).

Forest habitat management for American woodcock under alternative B would occur on 1,560 acres, harvesting approximately 520 acres every 5 years to create patches of early-successional forest. Forest management for other priority refuge resources of concern would take place on the remaining 6,100 acres of forest.

A total of 422 acres of grassland habitat may be mowed using a diesel-powered tractor, of which up to 100 acres may be prescription burned, at least once every 3 years within three refuge divisions: the Fort River, Nulhegan Basin, and Pondicherry Divisions. 775 acres of shrubland habitat may be brushogged, also using diesel-powered equipment, at least once every 15 years in the same Divisions. Grassland management under alternative B is intended to provide for priority refuge resources of concern, especially grassland birds (e.g., bobolink, upland sandpiper, and breeding woodcock). Shrubland management is intended

to provide for priority refuge resources of concern, including shrubland birds and New England cottontail.

Under alternative B, we propose to construct an approximately 1-mile-long, ADA-compliant hiking trail at each of the 19 CFAs. This would equate to the clearing and grooming of about approximately 2 acres of land for each trail mile, given that the trails would be between 4 and 8 feet wide. The direct impact from this work would affect up to 38 acres. We also propose adding 19 miles of new hiking trails, for a total of 58 miles of trails (Table 5.5).

Beneficial Impacts. Similar to the other alternatives, there would be short-term negligible to minor benefits to air quality from continuing to maintain the refuge's existing 37,000 acres of vegetation. Over the 15-year CCP timeframe and beyond, there may be negligible to minor beneficial air quality impacts from vegetation on further land acquisitions up to a total of 96,703 acres within the new more consolidated and generally larger 19 CFAs. These would be similar in scope although varying in location compared to alternative A because the total acreage proposed for acquisition is almost identical.

Alternative B would actively manage more acres than alternative A. The increase in habitat restoration may have a negligible positive, long-term impact on local air quality by favoring young, fast growing trees capable of rapidly sequestering carbon (Birdsey 1992). Consequently, we conclude that difference in benficial impacts to air quality between alternatives A, B, and C are negligible to minor.

Adverse Impacts. The adverse impacts of alternative B would be similar in kind to those described for alternative A. Although there would be a modest increase in management activity and visitation within the 19 CFAs, none of the management actions (described below) or emissions related to visitor use would tip adverse air quality impacts into a detectable level, particularly since activities would be conducted over time and over a larger landscape.

Maintaining the trail system is expected to have negligible short-term and long-term adverse impacts to air quality. Trail construction may release small amounts of fugitive dust, particulates, and hydrocarbon emissions to the new trail environment (e.g., from chainsaw operation, etc.). These adverse impacts are viewed as extremely short-term and negligible, and would have no detectable adverse impact over the long term. Public use trails and vehicle parking lots are carefully placed and managed to avoid or minimize adverse impacts to the refuge's air quality and diverse habitats. Moreover, given future funding expectations, it is not likely that the full extent of trails proposed in alternative B would be achieved within the CCP 15-year period, in which case these adverse impacts would be reduced. Long term impacts beyond that horizon are likely to have negligible adverse impacts.

Under alternative B, there would be an estimated 22,000 snowmobile visits annually to the Nulhegan Basin, Pondicherry, and Dead Branch Divisions. This represents an estimated increase of 2,000 visits over alternative A (Table 5.5). Most of the increased visitation is projected to occur in the new, approximately 1.4-mile spur trail that accesses to the Nulhegan Basin Division visitor contact facility. Management of existing snowmobile trails on refuge lands, and lands subject to potential acquisition, would be managed as described in *Air Quality Impacts Common to Alternatives A, B, and C.* We do not expect a noticeable change from current levels in emissions from snowmobiling. Although we may close some existing snowmobile routes where appropriate, such restrictions may not necessarily reduce vehicular emissions within the local area. Users

are quick to adapt to alternate routes, some of which maybe be longer or are on lands adjacent to the refuge. Consequently, we believe the potential adverse impacts from snowmobiling under this alternative would be comparable to those described in alternatives A and C, but potentially much greater than in alternative D (which prohibits all snowmobiling).

Compared to alternative A, we expect increases in refuge visitation stemming from the acquisition of additional refuge lands and increased trail mileage (Table 5.5). However, the projected increases would not pose any detectable increase in air emissions and pollutants due to public vehicles used on the refuge, or in any of the off-refuge environmental education activities (e.g., WoW Express). Overall, impacts from public vehicles under alternative B would be larger than alternative A, comparable to alternative C, but larger than alternative D (which eliminates snowmobiling on refuge lands). Since this alternative proposes fewer, more consolidated CFAs (19), there would be less refuge vehicular use, and therefore emissions, from refuge staff traveling between refuge lands, as compared to alternative A (65 SFAs). Emissions levels would likely be similar to alternatives C (22 CFAs) and D (22 CFAs).

The scope of impacts from forest management is described in the section Air Quality Impacts that would not vary across alternatives. Under alternative B, we propose varying forest management strategies (see table 5.4) affecting several hundred acres per year on average, in order to improve habitats across refuge lands. The emissions and fugitive dust from timber harvest and tree planting activities is expected to be negligible (short-term and localized). The contribution of managed lands to carbon sequestration is highly uncertain. In general, the effect of harvest and other vegetation management releases carbon, while unmanaged lands, which make up the majority of the refuge, are more likely to be a carbon sink (Depro et al. 2008). These impacts to air quality from forest management would be greater under alternative B than alternatives A or D, but less than under alternative C.

Because grassland management occurs infrequently and the treatment occurs on relatively small tracts of land (Fort River being the largest at 105 acres), in our professional judgement it will not have a greater than negligible adverse impact to local or regional air quality, either during the 15-year timeframe for the CCP or beyond. Compare to the other alternatives, the impacts will be much greater than alternative D, twice as large as alternative A, and smaller than under alternative C.

Under alternative B, we would occasionally use prescribed burning to manage refuge habitats. We anticipate using prescribed burning on 100 or fewer acres per year. As we acquire additional refuge lands and develop HMPs, we will consider use of additional prescribed burning as necessary. Such burning would be conducted under conditions outlined in a Fire Management Plan (FMP) (to be developed under NEPA compliance after the CCP). Adverse short-term impacts to air quality from prescribed burning operations (e.g. particulates, CO, CO_2, hydrocarbons, and small quantities of NO_x) are expected to be direct and local, with an overall minor impact. The air quality impacts from prescription burning are similar to that of other habitat maintenance (e.g., emissions from vehicles, chainsaws, etc.). The primary additional impact from prescribed fire comes from the air pollution that results from combustion; if air quality in a given region is approaching the standard for particulate matter, prescribed burning could cause that region to exceed the daily limits (Monroe et al. 2013). Burning vegetation can result in the release of a variety of air pollutants including aerosols of organic acids and hydrocarbons, and particulate matter of various size fractions. The type of pollutants varies with the type of fuel, its moisture content, the

temperature of the fire, and the length of time materials continue to smolder after the fire. The long-term impacts to air quality will be negligible given the infrequency of burn applications. We would generally use prescribed burning in forest habitats in a way that mimics the historical fire regime (e.g., frequent low severity fires in pitch pine forests in Massachusetts and Connecticut). We would also use prescribed fire to maintain some patches of grasslands. Smoke and other particulates will be minimized through using BMPs and smoke dispersion models. We will use BMPs and follow prescribed burn plans, which consider smoke dispersion models and address smoke management and other environmental and geographical factors, to minimize adverse air quality and visibility impacts on surrounding communities. Alternative B proposes constructing an outdoor classroom at the Fort River Division. A separate NEPA analysis will be conducted prior to constructing any additional structures, which would consider air quality impacts associated with that activity.

Air Quality Impacts under Alternative C

Over the 15-year CCP horizon, we propose to actively manage approximately 12,873 acres of habitat to improve habitat for priority wildlife, fish, and plant species (compared to 455 acres under alternative A), including 11,550 acres forest, 548 acres grassland, and 775 acres shrubland (table 5.4).

Forest habitat management for American woodcock under alternative C would occur on 1,950 acres, harvesting approximately 650 acres every 5 years to create patches of early-successio*nal forest*. Forest management for other priority refuge resources of concern would take place on the remaining 9,600 acres of forest.

A total of 548 acres of grassland habitat may be mowed using a diesel-powered tractor, of which up to 100 acres may be prescription burned, at least once every 3 years within three refuge divisions: the Fort River, Nulhegan Basin, and Pondicherry Divisions. 775 acres of shrubland habitat may be brushogged, also using diesel-powered equipment, at least once every 15 years, in the same Divisions. Grassland management under alternative C is intended to provide for priority refuge resources of concern, especially grassland birds (e.g., bobolink, upland sandpiper, and breeding woodcock). Shrubland management is intended to provide for priority refuge resources of concern, including shrubland birds and New England cottontail.

Under alternative C, we propose to construct an approximately 1-mile-long, ADA-compliant hiking trail at each of the 19 CFAs. This would equate to the clearing and grooming of about approximately 2 acres of land for each trail mile, given that the trails would be between 4 and 8 feet wide. The direct impact from this work would affect up to 38 acres. We also propose adding 22 miles of new hiking trails, for a total of 61 miles of trails (Table 5.5).

Beneficial Impacts. Similar to the other alternatives, there would be negligible to minor benefits to air quality from continuing to maintain the refuge's existing 37,000 acres of vegetation. Over the 15-year CCP timeframe and beyond, there would be an additional benefit from acquiring up to 197,337 acres within the new more consolidated and generally larger 22 CFAs, compared to alternative A's 65 SFAs.

Alternative C would actively manage the most acres among the four alternatives. The types of beneficial impacts under alternative C would be similar to those described under alternatives A and B, particularly over the 15-year CCP timeframe, but they would be realized across a considerably larger land area and have twice the beneficial impacts over the long-term (greater than 15 years).

These beneficial impacts are negligible to minor, but would be greater under alternative C than the other alternatives.

Adverse Impacts. The adverse impacts of alternative C would be similar in kind to those described for alternatives A and B. Although a modest increase in management activity and visitation within the 22 CFAs is projected, none of the management actions (described below) or emissions related to visitor use would cause adverse air pollution to exceed state standards, particularly since activities would be conducted over time and over a larger landscape.

Maintaining the trail system is expected to have negligible short-term and long-term adverse impacts to air quality. Trail construction may release small amounts of fugitive dust, particulates, and hydrocarbon emissions to the new trail environment (e.g., from chainsaw operation, etc.). These adverse impacts are viewed as extremely short-term and negligible, and would have no detectable adverse impact over the long term. Public use trails and vehicle parking lots are carefully placed and managed to avoid or minimize adverse impacts to the refuge's air quality and diverse habitats. Moreover, given future funding expectations, it is not likely that the full extent of trails proposed in alternative C would be achieved within the CCP 15-year period, in which case these adverse impacts would be reduced. Long term impacts beyond that horizon are likely to have negligible adverse impacts.

Under alternative C, there would be an estimated 22,600 snowmobile visits annually to the Nulhegan Basin, Pondicherry, and Dead Branch Divisions, representing an increase of 2,600 visits over alternative A and 600 visits over alternative B (Table 5.5). Most of the increased visitation is projected to occur in the new, approximately 1.4-mile spur trail that will access to the Nulhegan Basin Division visitor contact facility. Management of existing snowmobile trails on refuge lands, and lands subject to potential acquisition, would be managed as described in *Air Quality Impacts Common to Alternatives A, B, and C.* We do not expect a noticeable change from current levels in emissions from snowmobiling. Although we may close some existing snowmobile routes where appropriate, such restrictions may not necessarily reduce vehicular emissions within the local area. Users are quick to adapt to alternate routes, some of which

Green winged teal

Donna Dewhurst/USFWS

maybe be longer or are on lands adjacent to the refuge. Consequently, we believe the potential adverse impacts from snowmobiling under this alternative would be nearly identical to those described in alternatives A and B, but much greater than in alternative D (which prohibits all snowmobiling).

We project the highest level of visitation under alternative C, due to the acquisition of additional refuge lands and increased trail mileage (Table 5.5). However, the projected increases would not pose any detectable increase in air emissions and pollutants due to public vehicles used on the refuge, or in any of the off-refuge environmental education activities (e.g., WoW Express). Overall, impacts from public vehicles under alternative C would much larger than under the other alternatives. Since this alternative proposes fewer, more consolidated CFAs (22), there would be less refuge vehicular use, and therefore emissions, from refuge staff traveling between refuge lands, as compared to alternative A (65 SFAs). Emissions levels would likely be similar to alternatives B (19 CFAs) and somewhat greater than D (22 CFAs).

The scope of impacts from forest management is described in the section *Air Quality Impacts that would not vary across alternatives*. Under alternative C, we propose varying forest management strategies (see table 5.4) affecting 600-800 acres per year on average, in order to improve habitats across refuge lands. This is the largest total acreage among the alternatives analyzed. The emissions and fugitive dust from timber harvest and tree planting activities is expected to be negligible (short-term and localized). The contribution of managed lands to carbon sequestration is highly uncertain. In general, the effect of harvest and other vegetation management releases carbon, while unmanaged lands, which make up the majority of the refuge, are more likely to be a carbon sink (Depro et al. 2008). These impacts to air quality from forest management would be greater under alternative C than alternatives A, B, or D.

Because grassland management occurs infrequently and the treatment occurs on relatively small tracts of land (Fort River being the largest at 105 acres), in our professional judgement it will not have a greater than negligible adverse impact to local or regional air quality, either during the 15-year timeframe for the CCP or beyond. Compare to the other alternatives, the impacts will be increasingly greater than under alternatives D, A, or B.

Under alternative C, we would occasionally use prescribed burning to manage refuge habitats. We anticipate using prescribed burning on 100 or fewer acres per year. As we acquire additional refuge lands and develop HMPs, we will consider use of additional prescribed burning as necessary. Such burning would be conducted under conditions outlined in a Fire Management Plan (FMP) (to be developed under NEPA compliance after the CCP). Adverse short-term impacts to air quality from prescribed burning operations (e.g. particulates, CO, CO_2, hydrocarbons, and small quantities of NO_x) are expected to be direct and local, with an overall minor impact. The air quality impacts from prescription burning are similar to that of other habitat maintenance (e.g., emissions from vehicles, chainsaws, etc.). The primary additional impact from prescribed fire comes from the air pollution that results from combustion; if air quality in a given region is approaching the standard for particulate matter, prescribed burning could cause that region to exceed the daily limits (Monroe et al. 2013). Burning vegetation can result in the release of a variety of air pollutants including aerosols of organic acids and hydrocarbons, and particulate matter of various size fractions. The type of pollutants varies with the type of fuel, its moisture content, the temperature of the fire, and the length of time materials continue to smolder after the fire. The long-term impacts to air quality will be negligible given the infrequency of burn applications. We would generally use prescribed burning

in forest habitats in a way that mimics the historical fire regime (e.g., frequent low severity fires in pitch pine forests in Massachusetts and Connecticut). We would also use prescribed fire to maintain some patches of grasslands. Smoke and other particulates will be minimized through using BMPs and smoke dispersion models. We will use BMPs and follow prescribed burn plans, which consider smoke dispersion models and address smoke management and other environmental and geographical factors, to minimize adverse air quality and visibility impacts on surrounding communities.

Air Quality Impacts under Alternative D

Over the 15-year CCP horizon, we propose to actively manage 0 acres of habitat for priority wildlife, fish, and plant species (compared to 455 acres under alternative A), including 0 acres forest, 0 acres grassland, and 0 acres shrubland (table 5.4).

Under alternative D, we would conduct limited construction of public access infrastructure within the CFAs. We would construct 1-mile-long native surface trails rather than ADA-compliant trails on each of the proposed 22 CFAs. This equates to the clearing and grooming of about 1 acre of land per one mile of trail, maximum, for each CFA. The direct impact of this work would affect up to 22 acres. The length of the road and trail network under this alternative is 42 miles. The refuge currently manages and would continue to manage 20 miles of trails (e.g., Mud Pond Trail at Pondicherry Division, an ADA-compliant trail at Fort River, and Mollie Beattie Trail at Nulhegan Basin Division), 42 miles of gravel road (40 public, 2 administrative), and two overlooks.

Beneficial Impacts. Similar to the other alternatives, there would be negligible to minor benefits to air quality from continuing to maintain the refuge's existing 37,000 acres of vegetation. Over the 15-year CCP timeframe and beyond, there would be an additional benefit from acquiring up to 231,307 acres within the new more consolidated and generally larger 22 CFAs, compared to alternative A's 65 SFAs. If the refuge acquires the maximum possible acreage, this alternative would have the largest relative beneficial impact on air quality that stems from the conservation of vegetated landscapes. Because this alternative includes no active forest management, there are no beneficial impacts to air quality from the regrowth of harvested timber, but there may be increased carbon sequestration as meadows and shrublands revert to forest.

This alternative would also eliminate snowmobiling on all refuge lands, eliminating refuge-derived snowmobile hydrocarbon exhaust, and the local air quality impacts from visitors accessing the refuge by private vehicle in order to snowmobile. This beneficial impact to refuge air quality would be negligible over the short and long term. It is unknown how large the reduction in pollution from this step would be at the watershed scale because the effect may be to displace snowmobile use elsewhere in the watershed.

Adverse Impacts. We anticipate the fewest adverse air quality impacts under alternative D because we would discontinue active habitat management and construct less developed public use trails. This alternative would promote a reduced human induced footprint, emphasizing low-density public use opportunities.

Maintaining the road, trail, and parking lot system is expected to have negligible short-term and long-term adverse impacts to air quality. Trail construction may release small amounts of fugitive dust, particulates, and hydrocarbon emissions to the new trail environment (e.g., from chainsaw operation, etc.). These adverse

impacts are viewed as short-term and negligible, and would have no detectable adverse impact over the long term. Public use trails and vehicle parking lots are carefully placed and managed to avoid or minimize adverse impacts to the refuge's air quality and diverse habitats. Moreover, given future funding expectations, it is not likely that the full extent of trails proposed in alternative D would be achieved within the CCP 15-year period, in which case these adverse impacts would be reduced. Long term impacts beyond that horizon are likely to have negligible adverse impacts. Adverse impacts to air quality from this maintenance would be greater than under alternative A, but less than under alternatives B and C.

Visitation under alternative D is projected to be comparable to B, but distributed differently (Table 5.5). Snowmobile use would be eliminated on refuge lands, but non-snowmobile recreation would increase sufficiently to more than make up for the decrease in visitation from snowmobilers. Thus there would be a significant decrease in adverse impacts to air quality from snowmobiles. An increase in emissions from private vehicles would not be equivalent to this, so we predict adverse impacts to air quality related to refuge visitation would be lower under alternative D than alternatives B or C, but potentially similar to alternative A overall. No detectable increase in air emissions and pollutants is expected from any of the off-refuge environmental education activities (e.g., WoW Express). Since this alternative proposes fewer, more consolidated CFAs (22), and little to no active management of refuge lands, there would be less refuge vehicular use, and therefore emissions, from refuge staff traveling between refuge lands, as compared to the other alternatives.

USFWS

Snowy egret

Summary

Each alternative proposes the acquisition and protection of lands beyond the current refuge acreage of 37,000 acres. Additional acres range from approximately 60,000 acres (alternative A) to almost 200,000 acres (alternative D). Proposed refuge management activities–forest management, prescribed burning, trail construction, and snowmobile use–may be allowed in one or more of the alternatives presented, but are predicted to have a negligible to minor impacts, both beneficial and adverse, on air quality at the local and regional scales. Management under each alternative will meet or exceed EPA standards and comply with the Clean Air Act. By acquiring additional lands and permanently protecting them from further development, it is assumed the filtering function of intact forests will prevent a reduction in air quality within the watershed.

Impacts to Regional Hydrology and Water Quality

Introduction to Water Quality and Hydrology Impacts

Chapter 3, "Affected Environment" presents the status of water quality in the Connecticut River watershed. Management actions under each alternative were compared and their impacts to water quality and hydrology are discussed below. This included assessing management actions in each alternative for their potential benefits to water quality and hydrology locally and regionally, as well as those actions that pose potential adverse impacts.:

The benefits we considered included:

- Provision of areas for groundwater recharge and maintenance of natural watershed functions, including purifying and filtering surface and ground water, from the conservation of lands as part of the refuge.
- Mitigating potential pollution sources into waterways (e.g., NO_x, SO_2).
- Benefits to priority species obtained from the promotion of free-flowing rivers, stemming from work with diverse partnerships (whose members include State Fish and Game agencies and Trout Unlimited).

The potential actions leading to adverse impacts of the management alternatives considered included:

- Improper maintenance and construction of buildings and infrastructure.
- Particulate deposition into surface water from vehicle and equipment emissions.
- Improper spill management or inappropriate burning.
- Soil erosion leading to sedimentation stemming from improper forest management activities, road construction, or trail construction.
- Pet waste along refuge trails.

Our analysis of water quality impacts considered how the Service's actions at the refuge (and potential new refuge lands) might affect water quality impairment criteria (biological, physical, and chemical) used by states and EPA to determine whether designated uses of water are being achieved. Collectively, these refuge habitat conservation and management actions proposed in the alternatives would preserve and promote hydrologic function and thus help reduce and minimize the potential for water quality impairments as defined by the EPA (*https://www.epa.gov/waterdata/assessing-and-reporting-water-quality-questions-and-answers*; accessed August 2016).

Current Conditions

Recent (2010) water quality assessments for New Hampshire, Vermont, Massachusetts, and Connecticut indicate a range of water quality within listed water bodies. A water body is considered 'good' if it meets all the criteria (i.e., supports aquatic life, safe drinking water, safe fish consumption) for which it was assessed. Impaired waters exist when any one of the criteria is not met. Pathogens were the most common impairment reported by Connecticut, Massachusetts, and Vermont. Waterbodies impaired by polychlorinated biphenyls (PCB) were reported by Vermont and Massachusetts. New Hampshire detected problems with mercury (Hg) and pH. All surface waters in New Hampshire (16,896 miles) are listed as impaired for fish/shellfish consumption due to elevated mercury levels (EPA 2014).

Water Quality Impacts That Would Not Vary By Alternative

We estimate that proposed refuge management activities would neither significantly benefit nor adversely impact local and regional water quality. Our management actions would not contribute to the impairment of streams or rivers within SFAs, CFAs, CPAs, or the broader watershed. We hope to work with States on projects with potential to benefit water quality, stream flow, and hydrologic functions.

Beneficial Impacts. We expect refuge land acquisition and management under all alternatives to maintain natural hydrologic functions that mitigate adverse water quality and hydrologic impacts. These include minimizing erosion and impervious surfaces; filtering of pesticide and herbicide applications, heavy metal and petrochemical runoff, and sewage; minimizing high water turbidity and lowered dissolved oxygen; preventing the filling of wetland; and reducing stream blockages, stream bank sloughing, and flooding. We expect that refuge management activities will maintain or improve the native vegetative and soil cover, allowing water and nutrient cycling, water infiltration, stream flow stability, soils integrity, temperature attenuation, habitat structure, waste assimilation, and microbial nutrient processing (Postel and Thompson 2005).

Under all alternatives, we expect these benefits to occur across all existing refuge lands. Also, in the short term (within 15 years), we would likely acquire similar amounts of land under all the alternatives, thus beneficial impacts would be similar across all alternatives in the short term.
Under all alternatives, the refuge would join partnerships to identify and remove barriers (e.g., dams, undersized culverts, etc.) in rivers and streams in the watershed to restore natural inflow regimes for improved spawning and foraging habitat for aquatic resources. Roads that remain open to provide public and management access will be maintained according to BMPs. Where appropriate, we would retire and restore unnecessary forest interior and secondary roads to promote watershed and resource conservation. Roads may be upgraded, reopened, or maintained to improve access for habitat management.

Regardless of alternative, management decisions about water quality concerns will be driven by scientific data. We will work with state agencies and other conservation partners to identify sources of point and non-point sediment and nutrient loading (e.g., trail erosion, stream blockages) influencing refuge habitats and address these sources where possible.

Adverse Impacts. Management of refuge lands under all alternatives would include monitoring routine activities to reduce the probability of chemical contamination of water. This includes use of motorized vehicles and equipment, control of weeds and insects near buildings, and pesticide use for invasive species control. Pouring or mixing of chemicals or petroleum products would be conducted no closer than 50 feet from surface water. All staff would be trained in spill prevention and spill response. Additionally, we will work with appropriate state agencies to minimize the risk of unintentionally mobilizing currently stable toxins.

Regardless of the alternative selected, pesticides, most often herbicides, may be part of an integrated pest management program. Pesticides will only be used if it is the most effective management technique, and will be combined with other management tools. Pesticides must be approved by the Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection. The refuge will also develop and implement an Integrated Pest Management Plan that addresses environmentally safe application procedures and requirements.

The Service carefully regulates human uses of the refuge to minimize potential anthropogenic sources of water quality impairment (e.g., trail erosion in steep terrain), or disruption of hydrologic processes (e.g., collapsed or perched culverts). All alternatives predict an increase in annual visitors (Table 5.5). Alternative A predicts the lowest annual increase, since no expansion of hiking trails and visitor use is proposed, while alternative C predicts the highest increase due to its large refuge expansion proposal with 22 miles of trails potentially modifying and disturbing up to 44 acres of habitat; similarly, alternative D proposes modification and disruption of up to 22 acres with the development of 22 miles of trails (1 acres disturbance per mile). We do not plan to increase opportunities for snowmobiling on existing refuge land under alternatives A, B, and C. Rather, we plan only to maintain existing use levels; under alternative D we would eliminate snowmobiling. Existing snowmobile trails on new lands to be acquired under alternatives A, B, and C may be maintained if they are part of a statewide or regional mapped and maintained snowmobile network, yet this is not viewed as an increase in snowmobile capacity for refuge lands since it would simply maintain existing local or regional levels. In select situations, newly acquired connector trails, or currently closed trails may be opened to promote wildlife-dependent public uses. However, we would not

propose to construct any new trails and therefore the number of users using the entire trail network would not increase.

Dogs are allowed on the refuge to facilitate hunting and as companion animals. Decaying pet waste consumes oxygen in waterbodies and sometimes releases ammonia. Pet waste carries bacteria, viruses, and parasites that can threaten the health of humans and wildlife (EPA 2001). There are no known dog waste problems on any refuge division or unit nor are any significant increases in pet use on the refuge expected; we will continue to monitor any potential adverse impacts. Also, under all alternatives, we require pet owners to pick up after their pets. Consequently, current pet activities on the refuge are considered of negligible adverse impacts to refuge water quality.

Air deposition and smoke particulates can contribute to water quality impairment, typically with uncontrolled wildfire. We would conduct prescribed burning in compliance with an approved burn plan that takes into account atmospheric conditions and smoke dispersal. Any prescribed burning activities, whether for habitat manipulation or hazardous fuel loads (alternatives B and C) or protection of life or property, including the wild land urban interface (all alternatives), would be addressed in the refuge Fire Management Plans (which will be completed following the CCP).

As a natural resource agency, the Service strives to serve as a model for water use conservation. The refuge is required, where feasible, to employ water-saving technologies. For example, the headquarters building at the Nulhegan Basin Division has employed low-flow fixtures and non-irrigated landscaping.

Water Quality Impacts under Alternative A

Beneficial Impacts. Over the short term (15 years), there would be negligible to minor benefits to regional and local water quality from maintaining vegetation and hydrological functioning on the refuge's existing 35,898 acres. Over the long term (greater than 15 years), we may conserve up to an additional 60,830 acres of habitat. Short-term and long-term beneficial impacts would be expected to extend beyond refuge boundaries and spread through the local and regional watershed.

Most of the lands the refuge proposes to acquire are currently undeveloped and therefore already providing these beneficial impacts to regional and local water quality. Some of these lands would continue to provide these benefits into the future, while others may be developed prior to potential acquisition by the refuge. However, any acquisition by the refuge (or conservation by another agency, organization, or individual) would ensure permanent protection from development and guarantee the continuation of these benefits over the long term. The permanent protection of habitat through the SFAs will directly benefit the long-term ability of nearby communities to maintain or improve water quality.

Adverse Impacts. Overall, alternative A would include few ground disturbing refuge management activities (e.g., mowing, haying, brush hogging, tree cutting, or road maintenance) and introduce few, if any, additional sources of water pollution.

We expect negligible impacts on water quality from continuing to maintain existing refuge buildings, trails, roads, and parking lots (e.g., from runoff, spills, and failed septic systems). The refuge maintains its refuge headquarters and parking lots in Sunderland, Massachusetts, and the Nulhegan Basin Division headquarters and visitor contact station. Both the Sunderland facility and the Nulhegan Basin facility maintain an approved septic system. We also would

continue to manage 20 miles of existing trails (Mud Pond at Pondicherry, Fort River Trail at Fort River, and Nulhegan River, Black Branch, and Mollie Beattie Trails at Nulhegan Basin) and 42 miles of existing gravel roads (40 public, 2 administrative), and two overlooks.

Woodcock habitat management at Nulhegan Basin Division

Mark Maghini/USFWS

Under alternative A, we proposed to manage active manage 455 acres, including 255 acres of forest and 200 acres of grassland (table 5.4). Forest management under Alternative A is driven by the decline in American woodcock populations (Askins 2001). Our management activities are designed to have beneficial impacts on our designated trust species over time and negligible impacts to water resources. Forest management could negligible adversely impact water quality by causing sedimentation into streams and rivers or from unintentional spills from equipment. However, we will follow best management practices for these activities to minimize impacts to water quality (e.g., leaving forested buffers along streams and river). Operations are performed by logging contractors under supervision of the refuge forester.

In general, forests produce the highest water quality and most stable streams of any land use (Myers et al. 1985). Whenever the structure of forest soils is disturbed, there is a chance for erosion along with subsequent sedimentation of nearby waterbodies. Disturbance of the forest floor may channelize water which increases its velocity and its ability to carry sediment. Improperly designed and installed stream crossings can be a source of sediment to streams. But the major cause of erosion and sediment is improperly designed landings and truck roads (Patric 1976, 1978). Woodcock management requires clearcutting forests in adjacent blocks to create a mosaic of size classes important to their breeding, roosting, and courtship (Sepik et al. 1981). It has long been known that clearcutting northern hardwood forests can lead to changes in the intrasystem hydrologic cycle (Bormann et al. 1968), discharges of dissolved nutrients (Likens et al. 1970), increased particulate matter output (Bormann et al. 1974), and increased stream flow (Bormann et al. 1968). Fortunately, most of the region's forest soils are not prone to erosion. Litter layers and organic horizons of the forest floor allow rain and snowmelt to rapidly infiltrate into the mineral soil, even under extreme rainfall intensities. Mineral soil horizons are mostly well-drained, coarse-textured, sandy loams with high infiltration capacities. As a result, erosion rates and sediment yields from undisturbed forests are among the lowest in the country (Patric 1976), and erosive overland flow seldom occurs (Patric et al. 1984; Pierce 1967). Forest research over the last 4 decades has produced guidelines to help loggers and foresters harvest timber without causing unacceptable erosion and degradation of water quality (Haussman 1960; Univ. N.H. Coop. Ext. Serv. 2010). This research will guide the refuge during the location of truck roads and skid trails, including specifications for grades, slopes, distances from streams, and stream crossings during management of the Woodcock Demonstration Areas. Studies also guide the retirement techniques used at the close of a sale including grooming, seeding and mulching of roads, trails, and landings (Kochenderfer 1970; Hartung and Kress 1977).

We would also continue to mow or brush-hog using a diesel-powered tractor approximately 200 acres of grasslands management for target grassland birds

(e.g., bobolink, upland sandpiper, and breeding woodcock). Such infrequency of treatment on relatively small tracks of land (Fort River being the largest at 105 acres) are not believed to be more than negligibly adverse in its impact to local or regional water quality, both in the short term and long term.

Periodic construction and trail maintenance projects would cause very short-term, negligible, and localized effects from construction vehicle and equipment exhausts that may precipitate into the local watershed. Visits to the refuge by motor vehicle, and use of the refuge for recreational snowmobiling, would cause a non-detectable to negligible increase in air emissions that may precipitate into the watershed. Our annual road maintenance often includes efforts to improve the handling of water within our road network. This may involve repair or construction of bridges, replacement of culverts, improvement of road-side ditches, etc. Replacing culverts, repairing ditch work, and maintenance of bridge abutments often lead to discharges of sediment into waterbodies. The refuge considers these discharges to be of negligible impact to ecosystem resources.

The use of off-road vehicles (e.g., motorized dirt bikes, motorized all-terrain vehicles (ATVs) and off-road bicycles) can contribute to soil erosion and consequent turbidity in nearby waterways (Foltz and Yanosek 2005). While the use of ATVs is not permitted on the refuge, we propose to allow bicycling on designated refuge roads (not trails), an activity that is expected to have negligible adverse impacts on water quality. Under alternatives A, B, and C we will continue to allow snowmobiling on several refuge divisions, which could have minor adverse impacts on refuge water quality. Under alternative D, we would eliminate all snowmobiling. To what extent the water bodies on the refuge are at risk of hydrocarbon pollution is unclear. A study of water quality impacts performed throughout locations in Vermont, including refuge study sites at the Nulhegan Basin Division did not document adverse impacts (VDEC 2011). A study in Yellowstone, where snowmobile use is much higher, found petroleum hydrocarbons in small shallow water bodies exposed to snowmobile exhaust (Arnold and Koel 2006). The concentration of hydrocarbons in snow is likely to be particularly high on trails where regular grooming constantly packs exposed snow (Ruzycki and Lutch 1999). Spring snowmelt may release those hydrocarbons into streams or other bodies of water. Adams (1975) found hydrocarbon levels and lead to be at high levels the week after ice out in a Maine pond where snowmobiles were driven over ice during the previous winter. However, lead, is no longer an additive in gasoline, and therefore, not a current concern. Most snowmobiles currently in use have two-stroke motors that pass 20 to 33percent of the fuel straight through the engine and out the tailpipe unburned. Standard two-stroke engines also require that lubricating oil be mixed with fuel, so lubricating oil makes up part of the exhaust. This creates most of the visible haze that snowmobiles produce in the form of particulate matter, which itself is composed primarily of volatile organic compounds and hydrocarbons (CO, hydrocarbons HC, and particulates) (*http://serc.carleton.edu/research_education/yellowstone/snowmobiles.html*, accessed August 2016). Yet, during the course of a study in Yellowstone National Park, volatile organic compound (VOC) concentrations of snowmelt runoff were below levels that would adversely impact aquatic systems (Arnold and Koel 2006). Also, some newer snowmobile models are being designed to reduce emissions, pollutants, and noise. The compatibility determinations for snowmobiling in appendix D "Appropriateness and Compatibility Determinations," provides additional references on snowmobiling impacts.

Water Quality Impacts under Alternative B

Beneficial Impacts. Water quality benefits under Alternative B would be very similar to those discussed under alternative A in both the short term and long term.

As new refuge lands are acquired, we would take all necessary efforts to correct or mitigate any water quality or hydrologic impairments on newly acquired lands (e.g., collapsed culverts, road erosion, etc.). The protection of habitat through the CFAs has the potential to directly benefit the long term ability of the immediate watershed to maintain clean water quality, or mitigate impaired water quality.

Over the 15-year CCP horizon, alternative B proposed to actively manage approximately 9,312 acres of habitat compared to 455 acres under alternative A (table 5.4). The beneficial impact of ecologically-based forest and grassland management to water quality is generally expected to occur over the long term as structural diversity and ecological integrity of currently degraded forests or grasslands (including future lands to be acquired) are improved. We assume the restoration of forests using ecological forestry techniques will enhance hydrologic functions and water quality on some refuge lands over the long term. These beneficial impacts are likely to be negligible in the short term and minor over the long term time within the refuge and region.

Adverse Impacts. The short-term and long-term adverse impacts of alternative B would be negligible to minor and similar to those described under alternative A. However, we expect slightly less adverse impacts to water quality under alternative B because we propose to protect larger, more connected blocks of habitat than under alternative A. Although there would be relatively minor increases in land disturbing management actions over time due to the proposed change from the 65 SFAs to 19 CFAs, none of the management actions (e.g., potential new trails, greater habitat management) would result in greater than negligible to minor adverse impact in the short and long term.

Alternative B proposes to create approximately 1 mile of new trail on each of the proposed 19 CFAs equating to the clearing and grooming of about 2 acres of land per mile of trail, maximum, for each CFA. All new trails would be constructed using best management practices designed to minimize adverse impacts to vegetation, soil, and drainage patterns (e.g., using gentle slopes and switchbacks, following ridgelines, avoiding wet areas, constructing boardwalks where necessary; *http://www.americantrails.org/resources/trailbuilding;* accessed August 2016). The full impact of trail-building (e.g., erosion and sedimentation) would not occur in the short term since trail construction would occur over time, and the full length of trails almost certainly would be completed beyond the 15 year horizon of the CCP. Ultimately, it could affect up to 38 acres of the potential 97,830 acre refuge (less than one-tenth of one percent). Any adverse impacts would be considered localized and negligible. Considering visitor use, one study suggests that 70 percent of hikers veer off-trail (Hockett et al. 2010), and the refuge would take corrective actions to mitigate any resulting water quality impairment with placement of natural obstructions. Under alternative B, we expect fewer hikers and associated adverse impacts than under alternatives C or D, but more than under alternative A.

Alternative B also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Under alternative B, we propose to actively manage approximately 9,312 acres of forest, grassland, and shrublands (table 5.4). The potential adverse impacts to water quality due to habitat management activities would be similar to those described under alternative A, although the level of impact is expected to be relatively larger due to the greater amount of habitat to be managed over time. Unlike alternative A the majority of forest management under Alternative B will not involve clearcuts, but rather use ecological forestry techniques (Flatebo et al. 1999, Seymour et al. 2002, Franklin et al. 2007) including un-even aged management. This approach leaves more downed woody debris, standing trees,

and a higher canopy closure reducing the risk of increased run-off, nutrient leaching, and erosion. Activities would include, as noted under alternative A, use of heavy machinery and other fossil-fuel powered equipment to conduct annual habitat management. Such activities would be conducted in areas scattered across the refuge CFA landscape. We expect these activities to have negligible to minor short-term adverse impacts on local water quality at scattered locations across the 19 CFAs, and they are not expected to have any long term or larger scale impacts.

Under alternative B, we would employ limited use prescribed burning to manage refuge habitats (e.g., pitch pine communities, grassland communities) and to reduce hazardous fuels. We estimate this to be about 100 acres annually on average. Such burning would be conducted under conditions outlined in a Fire Management Plan (FMP) (to be developed under NEPA compliance following the CCP). Fires can affect water quality and water cycle processes to a greater or lesser extent depending on fire severity, and changes in water quality are primarily the result of soil erosion but also include elevated stream flow temperatures, increased pH, and changes in chemical concentrations and aquatic organism populations. Severe wildfire can produce substantial effects on the stream flow regime of small streams and rivers; however, the effects of low severity fires on water resources are generally minimal and short-lived (Neary et al. 2005). As discussed under the 'Air Quality' section, wildfire is not a substantive concern on the existing refuge or proposed new refuge lands because of the natural fire frequency regimes of the major vegetative and forest types within the Connecticut River watershed. Any potential for water quality impairment from refuge prescribed fire activities should be short term and adversely negligible, both short term and long term.

Under alternative B, we estimate that there will be an increase in on-refuge visitation (about 45,000 additional visitors, Table 5.5). However, such projected use would not pose any detectable increase in water pollution (e.g., erosion and sedimentation) due to visitor activities.

Water Quality Impacts under Alternative C

Beneficial Impacts. Alternative C would increase the acquisition authority of the refuge to 197,337 acres across 22 CFAs representing well over double the acres described in alternatives A and B. The beneficial impacts of alternative C to hydrology and water quality would be similar if not identical to alternatives A and B in nature and substance; however, due to the proposed increase in refuge acres and related expanded opportunities for habitat management and restoration over the long term, the magnitude of benefit likely would be nearly twice that of the former alternatives. Within the watershed as a whole, there would be no measurably significant change in water quality and no violation of any state water quality standards. The refuge would take all necessary efforts to mitigate any water quality impairments on newly acquired lands.

With alternative C and its potentially larger, permanently protected habitat land base, it is apparent that, over the long term horizon, water quality impact benefits would be modest, encompassing a meaningful portion of the Connecticut River watershed (greater than 2 percent of watershed). The average size of an intact CFA under alternative C is 8,986 acres while the average SFA under alternative A is 1,346 acres (and the average CFA in alternative B is 4,288 acres), thus illustrating the potential to protect larger intact portions of the watershed and their hydrologic functions. Absent unforeseen exigencies, the protection of habitat through the CFAs has the potential to directly benefit the long term ability of the immediate watershed to maintain clean water quality, or mitigate impaired water quality. Since the refuge was founded, annual additions to the refuge average 2,117, although the average for the past five years is 647 acres.

Adverse Impacts. The adverse impacts of alternative C would be very similar in substance to the adverse impacts described in alternative A. Although there would be differences in management actions due to the proposed change from alternative A's 65 SFAs to 22 CFAs, none of the management actions (e.g., potential new trails, existing road maintenance, habitat management) would tip adverse impacts to water quality into a detectable impairment level. Alternative C proposes to create approximately one mile of new trail for each of the 22 CFAs equating to the clearing and grooming of about two acres of land, maximum, for each CFA. That adverse impact (i.e., habitat disruption, possible erosion) could affect up to 44 acres of the potential 197,337 acre refuge, a negligible amount, especially considering such activity would be done incrementally over time. Considering visitor use, one study suggests that 70 percent of hikers veer off-trail (Hockett et al. 2010), and the refuge would take corrective actions to mitigate any resulting water quality impairment with placement of natural obstructions. Under alternative C, we expect the most hikers and associated adverse impacts.

Over the 15 year CCP horizon, alternative C encompasses management of a minimum of 12,873 acres of habitat compared to 455 acres under alternative A: 11,550 acres forest, 548 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (table 5.4). Similar to the previous alternatives, this would include implementation of the woodcock habitat management plan at the Nulhegan Basin Division. We would actively manage much more forest under alternative C than under alternative A (255 acres), and 50 percent more than under alternative B. Similarly, over the lifespan of the CCP, alternative C would facilitate active management of a minimum of 548 acres of grassland, well over twice that of alternative A (and 126 acres over alternative B), and would enable active management of at least 775 acres of shrubland within the 15 year horizon of the CCP, mainly to benefit the New England cottontail. Under alternative C, we propose annually to manage approximately 350-500 acres of forest every 5 years to improve habitats across refuge lands. The amount of the refuge that would potentially be actively managed under alternative C would represent at least six percent of a much expanded refuge when fully acquired, and over time additional acres could become subject to active management if determined necessary through development of future HMPs. We would employ the same types of habitat management under alternative C as described in alternative B, including select use of prescribed burning as previously described (~100 acres annually).

As described under alternative A, the use of heavy machinery and other fossil-fuel powered equipment to conduct annual habitat management under this alternative C over a larger refuge landscape is likely to have minor to negligible, short-term impact on local water quality at scattered locations across 22 CFAs. Over the long term, we presume an increase in fossil fuel particulates and potential adverse water quality impacts under alternative C simply because we propose to actively manage considerably more habitat than currently done under alternative A (and moderately more than alternative B, table 5.4) Additionally, any potential for air-borne particulates and water quality impairment from prescribed fire smoke should be extremely short term and adversely negligible. These potential adverse water quality impacts would be limited to a non-detectable, negligible short and long term level because such active management would be done over time and over widely scattered CFAs.

Water Quality Impacts under Alternative D

Beneficial Impacts. Alternative D would increase the acquisition authority of the refuge to 231,307 acres across 22 CFAs and lands that would serve to connect CFAs, either directly or by closing important gaps in unprotected habitat lying between CFAs. The 231,307 acre level of acquisition authority represents well over double the acres described in alternatives A (and B), and would serve to provide for a more integrated and functional habitat system

within the watershed. Across the 22 CFAs, alternative D would employ no active habitat management (except for threatened or endangered species where refuge habitats are identified in a species recovery plan) and only limited construction of public access infrastructure within the CFAs so that natural habitat functions and processes would be allowed to occur with a bare minimum of refuge-related adverse impacts. The beneficial impacts to water quality of alternative D would be similar if not identical to the other alternatives in nature and substance; however, the level of benefit would be greater than any of the former alternatives due to insignificant land disturbance activities imposed by the refuge. Within the watershed as a whole, there would be no measurably significant change in water quality and no violation of any state water quality standards.

Alternative D represents 3 percent of the watershed, a meaningful contribution to habitat protection within the watershed. With that even larger, permanently protected land base, it is apparent that water quality impact benefits from alternative D are minor to modest over the long term. The average size of an intact CFA under alternative D is 10,819 acres while the average SFA under alternative A is 1,346 acres (and alternative C is 8,986 acres), thus further illustrating the potential to protect larger intact portions of the watershed and their hydrologic functions. As with alternatives B and C, and absent unforeseen exigencies, the protection of habitat through the CFAs has the potential to directly benefit the long term ability of the immediate watershed to maintain clean water quality, or mitigate impaired water quality. It is recognized, however, that acquisition of the 'yet-to-be-acquired' acres within this alternative (164,307 acres) would take many years, likely well beyond the 15 year horizon of this CCP. Given the acquisition history at the refuge, acres acquired annually average 2,117 although the average for the past five years is a modest 647 acres. As with the former alternatives, additional short and long term beneficial impacts also would derive from water conservation at all refuge facilities, and in managing a fleet of well maintained, fuel efficient vehicles.

The passive management approach is expected to have a minor beneficial impact to the Nulhegan Basin and Pondicherry Divisions due to the proposed elimination of snowmobiling and its suspected hydrocarbon pollution into refuge waterways. The beneficial impacts to the refuge cannot clearly be estimated, although it is likely that the elimination of direct hydrocarbon emissions on the refuge will promote cleaner trail-side and road-side habitats for native fish and wildlife.

Adverse Impacts. Alternative D would employ no active habitat management, and construction of public access infrastructure within its 22 CFAs so that habitat functions and processes would be allowed to occur more naturally and with a minimum of adverse impact, both short term and long term. This alternative would promote a reduced human induced footprint, emphasizing low-density, undeveloped public use. Under alternative D there would be no active habitat management (except for threatened or endangered species where refuge habitats are identified in a species recovery plan). Management steps would be taken to mitigate unexpected events that may pose safety hazards (e.g., repair of collapsed culvert causing flooding, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming on 42 miles of refuge roads).

Water quality adverse impacts due to a passive management approach would be greatly minimized and negligible in impact, both in the short term and long term. Visitor use under alternative D would be higher for non-snowmobile use than alternatives A and B, though much less than under alternative C (Table 5.5). It

is presumed adverse impacts would be mitigated due to decreased visitor use. Eliminating snowmobile access may lead snowmobilers to create longer alternate connector routes, potentially affecting water quality on adjoining lands.

The adverse impacts of alternative D management activities to water quality would be negligible, and nearly undetectable in both the short and long term. Select management actions (e.g., potential new trails, existing road maintenance) would not tip adverse impacts into a detectable level. Alternative D proposes to do limited clearing on existing old roads for use as trails, or create short primitive trails of less than 1 mile for each of the 22 CFAs. This activity coupled with limited clearings for small parking areas and information signs are expected to result in the clearing and grooming of about one acre of land, maximum, for each CFA. That impact could affect up to 22 acres of the potential 231,307 acre refuge, a negligibly adverse amount.

Summary

In summary, our management activities across alternatives would not significantly impact (either adversely or beneficially) refuge or regional hydrology and water quality; none of the alternatives would violate EPA or state water quality standards, and all would comply with the Federal Clean Water Act. All alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres. Additional acres range from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). With those potential additions of habitat to the refuge, there is an expectation on the maintenance of good to excellent water quality due to the land-filtering and nutrient processing functions of intact forests and wetlands. We note that acquisition of additional acres to full acquisition levels proposed in the alternatives will not occur within the short term framework of this CCP (15 years) but will continue in the long term well beyond the 15 year CCP cycle, thereby ameliorating all possible immediate short term impacts over time. Proposed refuge management activities–forest management, prescribed burning, trail construction–may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact and in select cases minor adverse impact.

Introduction to Climate Change Impacts

Introduction to Climate Change Impacts

Climate change has been identified by the Service as a serious management concern, as detailed in chapter 3. Across the United States, we are already seeing a range of changes, from higher average air and water temperatures and greater extremes in precipitation events to accelerating sea level rise and an increase in storm intensity. Furthermore, these and other physical changes associated with climate change are having a significant biological impact across a broad range of natural systems (Frumhoff et al. 2007, Hayhoe et al. 2006). For managers at Conte NFWR and throughout the Refuge System, this means finding ways to address climate change by implementing conservation measures through a true adaptive management process. Developing a meaningful adaptation strategy for the refuge requires understanding the impacts, risks, and uncertainties associated with climate change and the vulnerability of the different features of relevant natural and human communities to those changes (Glick et al. 2011). Adding to this challenge is the fact that the ecological impacts associated with climate change do not exist in isolation, but combine with and exacerbate other stresses on the region's natural systems.

Over the 15 year timeframe of the CCP, the refuge will implement departmental and bureau policies about climate change including biological planning, landscape conservation, monitoring and research, becoming more carbon neutral in day-to-day refuge operations, collaborating with others on climate change, and educating the public. Step-down plans will include specific objectives and strategies for habitat management and public use. To reduce the adverse impacts of climate change stressors, the refuge intends to protect the structural

and functional dynamics of defined refuge habitats, promote diversity of species, promote landscape connectivity and corridors to facilitate migration, strengthen partnership support to address climate change, and promote effective environmental education and interpretation. In addition, the refuge will pursue carbon sequestration through habitat protection efforts and best management practices, which would benefit the ecosystems of the refuge and the Connecticut River watershed as a whole.

The refuge is continuing long-term monitoring of climate change and has goals in place for reducing greenhouse gas emissions from both refuge operations and visitors by 2020. Several inventory and monitoring projects occurring on the refuge would benefit our understanding of climate change impacts. Example projects include bird phenology monitoring, aerial photography analysis to detect forest compositional changes, and the Monitoring Avian Productivity and Survivorship (MAPS) program. These projects take place both on and off refuge lands in the watershed. The information collected will improve our ability to manage the threats of climate change and maintain flexibility in our management. Our continued efforts to reduce human-induced stressors are becoming more important in the face of climate change. Our early detection and rapid response approach for invasive species benefits refuge habitats and watershed-level control efforts. We will continue to work with federal, state, and NGO partners to implement monitoring of climate change impacts and develop strategies for mitigation and adaptation.

Impacts from Climate Change That Would Not Vary by Alternative
As discussed in Chapter 3, climate change manifests as alterations to the physical environment, which then have cascading effects on the biological environment. These changes have the potential to both beneficially and adversely impact the capacity of the refuge to implement the goals and objectives outlined in the CCP. Climate change may alter Conte Refuge's ecosystems, changing vegetation communities, habitats available for species, and the experience of refuge visitors. Because any adaptative management will need to respond to observed conditions on the ground, we refrain from speculating in great detail about methodological shifts in refuge management. Instead we highlight here relationships between projected changes to climate and the management goals and objectives that might be affected.

Changes to air temperature and CO_2 concentrations

- Higher average air temperatures, particularly in winter months.
- Increased levels of CO2 in the atmosphere
- A lengthening of the frost-free season and earlier date of last-spring freeze.

Beneficial Impacts: For some species, currently at the northern extent of their range, warmer temperatures and greater CO2 availability and may increase their growth rates and vigor. If those species, such as American Elm, are used in restoration projects, the success of restoration may be enhanced. Faster-growing plants may accelerate refuge-managed restoration efforts (Horton 2014, Manomet 2010b). Some species may experience range expansion, facilitating restoration and recovery efforts by Conte Refuge.

Adverse Impacts: However, invasive species such as kudzu, now confined to the southern United States, may also be able to move north and establish populations within the refuge. If native plant populations are excluded by the establishment of kudzu or other invasive plant species, there could be cascading effects throughout the food web. Many of the most aggressive weeds, such as kudzu, benefit from higher atmospheric carbon dioxide, and become more resistant to herbicide control. Research also suggests that glyphosate (for example, Roundup), the most widely-used herbicide in the United States, loses its efficacy on weeds grown at

the increased carbon dioxide levels likely to occur in the coming decades. Warmer winters and less snow cover in recent years have contributed to increased deer populations that degrade forest understory vegetation (Horton et al. 2014, CT DEEP 2015, NH FGD 2015.

Other pests, pathogens, and parasites currently excluded by cold weather, especially cold winters, may have an increasing impact on fish, wildlife, and plants. Higher winter temperatures may also increase susceptibility to cold damage just prior to a subsequent hard freeze, as plants may become less likely to develop cold weather protections. Another avenue for cold damage, even in a relatively warm winter, is when there is an extended warm period in late winter or early spring causing premature leaf-out or bloom, followed by a damaging frost event, as occurred throughout the Northeast in 2007 and again in 2012 (Horton et al. 2014, CT DEEP 2015, NH FGD 2015). To the extent that these susceptible plants are priority resources of concern, or provide habitat or food for priority resources of concern, warmer air temperatures may compromise and present new challenges to Conte Refuge's ability to fulfill Goal 1 – Wildlife and Habitat Conservation. In addition, in order to maintain early-successional forest, shrubland, and grassland habitats, more frequent forest management may be required, with the associated physical, biological, and socioeconomic impacts as described in other sections.

Changes in species distribution by elevation are occurring: a Vermont study found upslope shifts in the boundary between northern hardwoods and boreal forest on the Green Mountains between 1964 and 2004. Wildflowers and woody perennials are blooming earlier and migratory birds are arriving sooner. Because species differ in their ability to adjust, asynchronies (like a mismatch between key food source availability and migration patterns) can develop, increasing species and ecosystem vulnerability. Several bird species have expanded their ranges northward. (Horton et al. 2014, NH FGD 2015). These changes, already ongoing, are expected to accelerate in the coming decades, likely leading to large changes in the mix of plants and animals present in the local ecosystem, resulting in new communities that bear little resemblance to those of today (Joyce et al. 2014, VT FWD 2015). Forest, shrub, and grassland management practices proposed in the CCP are based on models of tree and other plant development that assume relative climate stability, and their accuracy and utility may be reduced as climate change proceeds, necessitating the development of new models under an adaptive management framework. Changes in species distributions, ideal species ranges, and the local competitive dynamics among birds and across taxa will complicate restoration and habitat management efforts.

The effect of climate change on phenology – the pattern of seasonal life cycle events in plants and animals, such as timing of leaf-out, blooming, hibernation, and migration – has been called a "globally coherent fingerprint of climate change impacts" on plants and animals. Observed long-term trends towards shorter, milder winters and earlier spring thaws are altering the timing of critical spring events such as bud burst and emergence from overwintering. This can cause plants and animals to be so out of phase with their natural phenology that outbreaks of pests occur, or species cannot find food at the time they emerge. Changes in the timing of springtime bird migrations are well-recognized biological responses to warming, and have been documented in the eastern United States. Some migratory birds now arrive too late for the peak of food resources at breeding grounds because temperatures at wintering grounds are changing more slowly than at spring breeding grounds (Joyce et al. 2014, CT DEEP 2015, VT FWD 2015). Where management activities on refuges are tied to phenological events, climate change may confound efforts to provide consistent management that has the effects intended by refuge staff.

James Welver/USFWS

Canada lynx kittens

Changes to water temperatures in both saltwater and freshwater systems.
Beneficial Impacts: Warmwater fish like eastern silvery minnow, pumpkinseed, and brown bullhead are likely to increase as water temperatures warm (Horton et al. 2014, NH FGD 2015, Manomet 2010b), and could provide an expanded food source for and contribute to population increases of predators of species like them.

Adverse Impacts: Suitable habitats will be shrinking for species such as coldwater fish like brook trout. It is difficult to predict what proportion of species will be able to move or adapt as their optimum climate zones shift (Horton et al. 2014, NH FGD 2015, CT DEEP 2015, Manomet 2010b). Some of the fish hosts endangered freshwater mussel species (e.g., dwarf wedgemussel and brook floater) are coldwater fish whose thermal habitat will likely diminish as climate warms, ultimately affecting the reproductive success of the mussels. Changes to lake ice duration and surface water temperatures will strongly affect primary productivity, dissolved oxygen, thermal habitat, and invertebrate and fish communities (NH FGD 2015). This makes the maintenance and restoration of habitat for coldwater species more challenging.

Changes in frequency, timing, and amount of annual precipitation

- More frequent heat waves and drought events
- An increase in the number and intensity of heavy rainfall events.
- Reduced snowpack and earlier peak snowmelt and spring peak flows.
- An increase in the intensity, duration, and destructiveness of hurricanes and winter storm events such as nor'easters

Beneficial Impacts: Less snow on Conte Refuge roads may lead to a decline in snowmobile use, resulting in positive impacts to air quality (as detailed in the Air Quality Impacts section above).

Adverse Impacts: Under projected climate conditions, rising temperatures could work together with forest stand characteristics and these other stressors to increase mortality. Recent die-offs have been more severe than projected. As temperatures increase to levels projected for mid-century and beyond, eastern forests may be at risk of die-off. New evidence indicates that most tree species can endure only limited abnormal water stress, reinforcing the idea that trees in wetter as well as semiarid forests are vulnerable to drought-induced mortality under warming climates (Joyce et al. 2014).

Across the entire U.S., precipitation amounts and intensity and associated river discharge are major drivers of water pollution in the form of excess nutrients, sediment, and dissolved organic carbon. At high concentrations, nutrients such as nitrogen and phosphorus can become pollutants and can promote excessive phytoplankton growth – a process known as eutrophication. Currently, many U.S. lakes and rivers are polluted (have concentrations above government standards) by excessive nitrogen, phosphorus, or sediment. There are well-established links among fertilizer use, nutrient pollution, and river discharge, and studies show that recent increases in rainfall in the northeastern United States have led to higher nitrogen amounts carried by rivers. Many important fish species such as

salmon and trout that lay their eggs in the gravel at the edges of streams are especially sensitive to elevated sediment fluxes in rivers. Sediment loading in lakes has been shown to have substantial detrimental effects on fish population sizes, community composition, and biodiversity (Joyce et al. 2014, EEA 2011).

Relatively small changes in the timing and amount of annual precipitation will influence the suitability and distribution of wetlands systems, particularly vernal pools and wet meadows, for many wetland-dependent amphibians, birds, and plants. Extended droughts that occur earlier in the breeding season along with elevated temperatures and lower groundwater tables may reduce the distribution and condition of wetlands statewide. These changes will mean that wetland-dependent species must either relocate via available corridors to other wetland systems or perish (CT DEEP 2015, VT FWD 2015, Manomet 2010c).

Some species, such as lynx and snowshoe hare, evolved traits that make them adapted for snowy winters. Decreased length of snow-covered ground and less snow is likely to be a competitive disadvantage for these species and others that are similarly adapted (VT FWD 2015).

The consequences of changing precipitation regimes may impact the Conte Refuge's ability to fulfill Goal 1 – Wildlife and Habitat Conservation because the effects of this pollution may harm both terrestrial and aquatic resources under refuge stewardship.

If roads are open to vehicular traffic other than snowmobiles for longer parts of the year, the potential exists to magnify the impacts of motorized vehicle use on refuge wildlife, habitat, and air quality. A longer season of road use may lead to increased sedimentation and increased need to maintain road networks, with all their associated impacts.

Ecosystems such as saltmarsh provide a buffering service to broader coastal ecosystems during storm events. Increased storm intensity, especially coupled with sea level rise and a decline in salt marsh, may overwhelm the capacity of such systems to protect the coast. Extreme weather events that produce sudden increases in water flow and the materials it carries can decrease the natural capacity of ecosystems to process pollutants, both by reducing the amount of time water is in contact with reactive sites and by removing or harming the plants and microbes that filter the pollutants (Joyce et al. 2014, CT DEEP 2015).

Extreme storm events also cause flooding inland, and interactions with human infrastructure can exacerbate damage to ecosystems. Over the last decade, there have been several storm events which have met the standards for 100-year flood state. Damage to culverts, roads, and stream banks (erosion) result in sediment and debris entering streams, rivers, lakes, and ponds, changing habitat structure and function (NH FGD 2015). Depending on how precipitation regimes change, it may be necessary to close, reroute, or construct new trails and roads on refuge-managed properties, which has its own additional impacts on fish, wildlife, and habitats, as described elsewhere in this chapter. Erosion increases sedimentation, washes away or covers spawning habitat, and can sweep animals downstream or kill them. Mussels are particularly sensitive to sedimentation, and can be buried under the load, which also clogs their filter feeding mechanisms, killing them. Stormwater also floods nest sites along the banks of rivers and ponds or in the saltmarshes downstream, affecting loons, wood turtles and others (NH FGD 2015).

Because storm events cannot be predicted at the very fine scale, there is no way to prioritize or amend restoration or habitat management efforts in advance of

highly intense storms, increasing the challenge for Conte Refuge staff to direct funding and staff to best achieve Goal 1 – Wildlife and Habitat Conservation. In addition, storms can damage management sites that are more vulnerable during active management, increasing the time needed for the systems in question to benefit from restoration as well as the impacts associated with the work itself (as described in other sections of this chapter).

Accelerating rate of sea level rise
Adverse Impacts: Beach and dune erosion, both a cause and effect of coastal flooding, is also a major issue in the Northeast. Since the early 1800s, there has been an estimated 39% decrease in marsh coverage in coastal New England. Impervious urban surfaces and coastal barriers such as seawalls limit the ability of marshes to expand inland as sea levels rise (Horton et al. 2014, CT DEEP 2015).

One of the most dramatic predicted effects of climate change in coastal habitats will be sea level rise. The predicted high water levels will inundate salt marshes, deepen estuaries, and convert marsh grass to mudflat and mudflats to subtidal zones. If the rate of sea level rise is rapid, affected habitats will be inundated more frequently, putting their associated species at high risk. Total habitat and species losses are particularly likely in developed areas where there are no natural habitat retreat areas to allow for salt marsh migration (NH FDG 2015, Manomet 2010a).

Dune and beach habitats are important for nesting and loafing seabirds, including Roseate terns, common terns, and marine mammals. Sea level rise may affect habitat availability and the timing of nesting and migration for seabirds. The sand and sediment making up coastal dunes will be driven inland by high tides and storm surges, with the lack of natural sediment movement and coastal development meaning that in many places dunes will be lost altogether. The degradation and loss of dunes will increase the impacts of storms and high tides further inland (NH FGD 2015).

As well as being inundated, salt marsh habitats may also lose pioneer species and salt pannes due to reduced incidence of ice scour. This habitat is also sensitive to changes in salinity from freshwater inputs. Rocky shores and islands will not be as affected except in low lying areas. Most intertidal species may shift to higher elevations but will be subject to more heavy surf during storms. Island-nesting birds may lose habitat or experience reduced productivity as a result of changes to available prey (NH FGD 2015).

Alterations to the health and total area occupied by salt marsh could affect the ecological justification for land acquisition in some CFAs, as well as impair Conte Refuge's ability to management for priority resources of concern associated with beach, salt marsh, and other coastal habitat.

Impacts from Climate Change That Would Vary by Alternative
The variation in how climate change is likely to impact the Service's ability to meet its goals and objectives under each alternative is influenced most by the spatial extent and configuration of lands owned and managed by Conte Refuge. Climate change adaptation and resilience strategies typically emphasize the conservation and protection of larger and more connected ecosystems whenever possible in order to provide the greatest potential climate resilience (MA DFG 2015). Based on this reasoning and the total acres proposed for acquisition within a certain number of CFAs, alternative A, is likely to face the greatest obstacles to effective fish, wildlife, and habitat conservation. Its relatively dispersed 65 SFAs are smaller, less contiguous, and less connected than the CFAs in the other

alternatives. The fragmented ownership under alternative A will have this effect both during the 15-year CCP plan horizon and over the longer term. The other three alternatives (B, C, D) propose similar CFAs, but vary in the total amount of land acquired. Over the 15-year planning horizon, assuming that similar amounts of land will be acquired, climate change impacts on the refuge's ability to achieve Goal 1 will be similar. However, over the long term, or in the event that acquisition rates increase dramatically, alternative D will experience the least impacts from climate change, followed by alternatives C and then D.

Under alternative B and C, prescribed burning would be used for habitat management where fire is needed to maintain target ecosystem composition, structure, and function. If significant changes to temperature and precipitation occur due to climate change, our ability to conduct prescribed burns, and the beneficial impact of prescribed burns on refuge ecosystems, may be inhibited.

Forested habitats on the refuge are managed to maintain and enhance the ecological resilience of these systems. Historically, three main factors, over-browsing by species such as white-tailed deer and moose, nonnative plant infestations, and damaging outbreaks of invertebrate pests, have been some of the most important stressors reducing forest resilience. Existing management approaches are likely to be important tools under climate change. These include adjusting the age structure of forest patches, managing deer densities, and intervening to eliminate invasive species and pests. The four alternatives propose differing levels of forest management to encourage resilience. The management methods proposed include promoting strucuturally diverse and species-rich areas of mature forest for retention and regenerating more homogeneous areas of second-growth trees to young forest habitat. This has the effect of establishing a mosaic of forest age classes and conditions on the landscape and could well be an important adaptation response to climate change. Diversifying the age structure and species composition of the forested landscape in advance of climate change could increase resilience of forested ecosystems and overall resistance to the impacts of a changing climate (Manomet 2010c). If so, alternative C, which includes the most active management, best positions the refuge to create resilient landscapes and adapt to a changing climate. Alternatives B and A follow. Under alternative D, which eliminates active management, the refuge is likely to be the most impacted by climate change, since none of the resilience-enhancing forest management will occur.

Summary

In summary, climate change is likely to significantly impact Conte Refuge's ability to achieve the goals and objectives outlined in the CCP. In some cases, these impacts will be beneficial, but based on current available scientific analysis, most impacts are projected to be adverse. Changes in air and water temperatures, precipitation frequency, amount and type, and sea level rise change may alter Conte Refuge's ecosystems, changing vegetation communities, habitats available for species, and the experience of refuge visitors. These impacts will affect Conte Refuge regardless of the alternative selected. Alternatives with more consolidated and larger acquired lands are likely to be more resilient and thus less impacted by climate change, as are alternatives that allow for active management across greater extents of the refuge.

Refuge-scale Impacts

Impacts to Soils

Introduction to Impacts on Soils

Soil is a living and life-giving substance essential to plants, wildlife, fish, and humans. Soils play key roles in regulating elements and nutrient cycles (carbon, nitrogen, and sulfur), seed protection, and serve as a fundamental basis of

the physical environment of all habitats on the refuge. Soil biotic communities consume wastes and the remains of dead organisms and recycle these into forms usable by plants. The amount of carbon and nitrogen stored in soils dwarfs that in vegetation. Carbon in soils is nearly double that in plant matter, and nitrogen in soils is about 18 times greater (Schlesinger 1991, Daily et al. 1997(b)). Soils are the structural matrix and nutrient source for plant productivity at the refuge and must be protected to sustain the variety of diverse habitats within the watershed that would meet our habitat and species management goals.

We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely affect refuge soils and soils of the refuge's general habitat types.

We compared the benefits of the alternatives from actions that would protect soils from erosion, compaction, or contamination or that would restore eroded, compacted, or contaminated soils, including the:

- Extent to which refuge land acquisition and conservation under the alternatives would limit the growth of nearby development or recreational use thereby reducing loss of forest vegetation and human disturbance and their potential soil impacts.
- Potential for restoration of degraded habitats, access roads, trails, and associated structures to provide opportunities to restore soils.

The potential adverse soil impacts of the refuge management alternatives that were evaluated included impacts from:

- Habitat management activities (e.g., mowing and haying grasslands, forest sivicultural actions).
- Construction of buildings, parking facilities, access roads, and interpretive trails.
- Road maintenance (grading, ditch maintenance, spreading gravel, removing boulders, roadside mowing/debrushing).
- Visitor use impacts on refuge trails and roads.
- Prescribed burning to manage habitats and/or reduce hazardous fuels.

Impacts to Soils That Would Not Vary by Alternative
Proposed refuge management activities would neither significantly benefit nor adversely impact current local and regional soil conditions. We expect refuge land conservation and management under all alternatives to help maintain undisturbed and natural beneficial soil functions that include nutrient cycling through healthy soil mycorrhizal fungi and microbial populations, plant stability and support, filtering water runoff, mitigating pesticide and herbicide applications, ameliorating heavy metal and petrochemical non-point runoff, reducing high water turbidity, recycling sewage (e.g., septic tank outflows), reducing outwash into wetlands and streams, and preventing flooding (*http://soilquality.org/basics/value.html*, accessed August 2016). Beneficial impacts are performed by natural soil functioning as noted. Under all alternatives, these functions would be protected on the refuge's existing 37,000 acres. Also, in the short term (within 15 years), we would likely acquire similar amounts of additional refuge lands under all the alternatives, thus beneficial

soil impacts would be similar across all alternatives in the short term. Over the longer term, we estimate differing amounts of beneficial soil impacts.

Across all alternatives, our management actions would not contribute to the permanent impairment of any lands and soils except for localized places where we plan to construct public use facilities (e.g., footbridges, kiosks, interpretative signage posts, occasional soil augmentation) or additional refuge administrative building. Therefore, we expect adverse impacts would be negligible. There are no plans for major facilities or new road construction, although there is a potential for an outdoor classroom at the Fort River Division under alternatives B, C, and D. Regardless of which alternative is selected, we would continue to use best management practices in all management activities that might impact refuge soils to ensure that we maintain refuge soil stability and productivity.

Bill Buchanan/USFWS

Gray squirrel

As we acquire additional refuge acres under each alternative, we would restore developed sites with unnecessary buildings or other infrastructure to natural topography and soil constituency and return to native vegetation. This would have negligible to minor impact benefit due to small dwelling site footprints.

As staffing and funding allow, we would repair and maintain roads to limit the potential for them to contribute sediment to waterways. Pending a positive compatibility finding, we expect to retain snowmobile trails that may exist on newly acquired lands if they serve are part of a statewide or regional trail network maintained by partners. If necessary for public access and a compatible use, we may provide additional and appropriate motorized access in proposed CFA expansion areas once an adequate land base is acquired. The compatibility determinations for snowmobiling in appendix D "Appropriateness and Compatibility Determinations," provide additional references on snowmobiling impacts.

The proposed forest management activities across alternatives are negligibly adverse to refuge soils in the short term and beneficial in the long term. These activities would be conducted using established best management practices to avoid soil compaction, soil displacement, rutting, erosion, and loss of soil productivity. All alternatives embrace a sizeable refuge land base, when fully acquired over the long term. Forest management will occur on an approximate annual average of approximately 60 to 65 acres (alternative A), approximately 250 to 300 acres for alternative B, approximately 350 to 500 acres for alternative C, and no managed acres for alternative D.

To minimize adverse impact to soils, we would closely monitor all routine activities that have the potential to result in chemical contamination from leaks or spills. These include use of motorized vehicles and equipment, herbicide control of weeds and insects around structures, use of chemicals for de-icing parking lots and walkways. Pouring or mixing of chemicals or petroleum products would be conducted carefully, and all staff would be trained in spill prevention and spill response. Management of pesticides for invasive species control would be conducted carefully as described in water quality impacts. As discussed in water quality impacts, there is some probability, although adversely minimal, that snowmobile hydrocarbon emissions may settle into roadside soils during spring melt.

The Service carefully considers public uses of the refuge, and we will only permit appropriate and compatible uses, such as wildlife-dependent recreational opportunities (fishing, hunting, hiking, environmental education, etc.). None of the uses allowed would be considered more than negligibly adverse to soil in the short and long term. At current levels and estimated future levels of visitation

(Table 5.5), we expect only negligible impacts to refuge soils (e.g., compaction and erosion on and along trails). We recognize, however, that there may off-trail impacts due to individuals veering off-trail for a variety of reasons (e.g., seek better views), and we would take known corrective actions to mitigate such activity such as placement of natural obstructions (Hockett et al. 2010). All of these trails are subject to soil compaction and minor soil disturbance, yet of short-term and long-term negligible adverse impact. Bicycling off of roads and all-terrain vehicles contribute to trail erosion. Neither of these activities are permitted on refuge lands, nor will they be on future acquisitions. Pets under control are permitted on refuge trails, yet their unchecked waste can cause negative adverse impacts to soils, similar to impacts discussed in water quality impacts. There are no known pet waste problems on any refuge division or unit, and future acquisitions will require pet waste removal by pet walkers. Pet waste across all alternatives would be considered a negligible adverse impact to soils in the short and long term.

Regardless of which alternative we select, we would take a number of steps to ensure that we have sufficient scientific data to support management decisions regarding refuge soil management and protection. We would work with the USDA Natural Resources Conservation Service, respective state agencies, and other conservation partners to help identify and correct any sources of soil erosion, compaction, or other impairment impacting refuge habitats and public visitation. Recognized best management practices would always be employed in any land disturbance activity.

Soil Impacts under Alternative A

Beneficial Impacts. In the short term, alternative A would continue to provide negligible to minor benefits from conserving soils on the refuge's existing 37,000 acres. Over the long term, we expect these benefits to increase as we protect up to 97,830 acres total. Most of the lands the refuge proposes to acquire are currently undeveloped and therefore already providing these local and regional beneficial soil stabilizing impacts (Daily et al. 1997(b)). Some of these lands would continue to provide these benefits well into the future, although others may be developed prior to potential acquisition by the refuge. However, any acquisition by the refuge (or conservation by another agency, organization, or individual) would ensure permanent protection of soils from development and guarantee its ecological functioning over the short and long term.

Alternative A would continue current habitat management on up to 455 acres (table 5.4). Habitat management measures under alternative A are generally expected to have negligible to minor beneficial impacts to soils of the refuge, principally over the long term. Harmon et al. (1986) note the importance of replenishing soil attributes and integrity by leaving large woody debris (tree stems, etc.) following active forest management operations. Under alternative A, prescribed burning is not used to manage habitats or reduce forest fuel loads, and therefore will not have any impact on refuge soils.

Adverse Impacts. Alternative A would include relatively few ground disturbing activities that might adversely impact refuge soils. These include road maintenance (40 miles public, 2 miles administrative), and visitor use impacts (e.g., 20 miles of trails). Both regionally and refuge-specific, these activities are of negligible adverse impact, both in the short and long term. Best management practices are implemented in all ground disturbing activities. Visitation under alternative A would not appreciably change over current levels and is expected to be lower than any of the other alternatives except alternative D (which eliminates snowmobiling) (Table 5.5). Current snowmobile use is not expected to have more than negligible adverse impact in the short term and long term. During the time

that snowmobiles and trail groomers operate, the trails are covered with several inches to a foot or more of snow, thus protecting soils. One study indicated that compaction of snow cover had little effect on average soil temperature and frost penetration (Wentworth 1972). Snowmobile trail maintenance occurs in summer and fall, and includes mowing, culvert replacement, and bridge re-decking, as necessary. Because more than 98 percent of the snowmobile trail network overlays gravel roads, the majority of these maintenance activities likewise occur on or along roads. Consequently, any impacts to soils would be minimal and likely only involve previously disturbed soils. We expect an increase in hiking trail use with the newly constructed trail/boardwalk at the Fort River Division, but expect little or no associated adverse soil impact. Visitor activities that impact soils, such as hiking off designated trails, and snowmobile emissions (re: air quality section) would pose the lowest concern of all alternatives except for alternative D due to projected visitor use (Table 5.5).

All of the active habitat management actions proposed under alternative A are designed to improve habitat structure for woodcock and other priority refuge resources of concern. All active management would be performed by contractors under supervision of the refuge forester. Soil quality is central to sustainable forest management because it defines the current and future productivity of the land and promotes the health of its plant and animal communities (Doran and Parkin 1994). A significant concern in the maintenance of forest soil quality and functioning is assuring the replenishment of surface and soil organic matter and avoiding compaction of the soil (Powers et al. 1990). Forest harvest methods differ in their impact to soils. Martin (1988) noted that mechanized whole-tree harvesting causes a greater proportion of soil disturbance than other harvesting systems and will adversely affect advanced and subsequent regeneration to a greater degree, and recommended winter logging, use of track vehicles, placement of skid trails along land contours, and minimization of any practice that expose infertile mineral soils. Martin et al. (1986) suggested that clear cutting of northern hardwood forests in New Hampshire accelerated the loss of nutrients when compared to reference forest stands. Brooks and Kyker-Snowman (2008), who note the importance of soil quality to forest amphibians, showed changes in forest floor temperature and soil moisture following timber harvest (compared to uncut forests) -- the impact varied with intensity of canopy openings and were short lived, concluding that harvesting has no lasting impact on forest floor temperature or soil moisture. Forest management activities conducted by the refuge would follow ecological principals designed to minimize or eliminate adverse soil impacts, while accelerating forest regeneration for priority refuge resources of concern species. Refuge forest management aims to improve the diversity of seral stages (where and when possible), restore historic composition and structure, and improve landscape connectivity of forested habitats. These forest management activities are believed to be of negligible adverse impact in the short term and long term, and ultimately will serve to the benefit of refuge forest health and function.

Under alternative A, we would continue to manage 200 acres of grassland to provide habitat for grassland-dependent birds (e.g., bobolink, upland sandpiper, and breeding woodcock). Such infrequency of treatment on relatively small tracks of land are not believed to be more than negligibly adverse in its impact to local or regional soil quality, both in the short term and long term.

Under alternative A, prescribed burning is not practiced or employed to manage habitats or reduce forest fuel loads (except in emergency situations to protect life or property), and no campfires are permitted, thus eliminating any potential for fire related adverse impacts to soils.

Our current invasive plant control involves no burning, relying instead on cutting, pulling by hand, and use of approved herbicides. Uprooting invasive plants temporarily disturbs the soil layer, but is considered of direct negligible adverse impact, with no long-term impacts. Further details on the number of upland forest acres to be managed by alternative, and how habitat management priorities will be made annually are presented in the section "Impacts to Upland Habitats and Vegetation."

Soil Impacts under Alternative B

Beneficial Impacts. The beneficial impacts to soils under alternative B is similar to those described under alternative A. In the short-term, we would continue to protect soils on the 37,000 acres of existing refuge land. In the long term, we would protect up to 97,772 acres. Compared to alternative A, we expect alternative B to have slightly greater benefit because we proposed to protect larger, more contiguous blocks of habitat under alternative A.

Under alternative B, we propose to manage approximately 9,312 acres of habitat compared to 455 acres under alternative A (table 5.4). While the amount of habitat managed increases substantially between alternatives A and B, there may be an associated increase in the beneficial impact of such management with forest harvesting since much of this management will occur on degraded forest habitats that are in need of ecologically based forest management intervention. Such management is expected to further enhance forest structure along with healthy soils, and is considered to be of minor beneficial impact in the short and long term both on the refuge and regionally.

Adverse Impacts. The adverse impacts of alternative B to soil quality would be similar in substance to the adverse impacts described for alternative A. Although there would be a modest increase in management activity within the 19 CFAs, none of the management actions (e.g., creating potential new trails, use of chainsaws, maintaining roads existing on newly acquired lands) would adversely degrade soils, particularly since activities would be conducted over time and over a larger landscape.

Alternative B proposes to create up to 1 mile of new hiking trail for each of the 19 CFAs equating to the clearing and grooming of about 2 acres of land for each trail mile, roughly 38 acres. Visitation under alternative B is project to increase 22 percent compared to alternative A (Table 5.5), but would offer greater visitor use opportunities. Visitor activities that might impact soils, such as hiking off designated trails, could pose local adverse impacts. Snowmobiling impacts would be essentially the same as described in alternative A. Hiking trail construction and use can adversely impact trail soils when inappropriately performed, especially where drainage is poor due to soil characteristics, slope, and trail location and configuration. The type of use (e.g., hikers, motorized vehicles, mountain bikes) impacts trail soils/surface in different ways, and use should be compatible with trail surface (e.g., smooth tread on easy trail, rough tread on back-country trails) (McPeake et al. undated).

Hikers and bicyclists can cause soil erosion along trails. Wilson and Seney (1994) found that hikers caused more sediment to be available on pre-wetted trails than bicyclist. Hikers and bicyclists can also cause soil compaction. To minimize the potential for adverse impacts, bicyclist are only permitted on refuge roads. Horses and all-terrain vehicles can also cause considerable erosion and compaction and are generally are not permitted on refuge lands; however, limited use may be authorized. Notably, all alternatives facilitate bicycling on refuge roads (not trails) and ATVs are prohibited altogether.

As new trails are constructed, we will use available trail planning methods and BMPs when constructing and maintaining hiking trails to minimize soil disturbance, erosion, and compaction. Given future funding expectations, it is not likely that the full extent of trails proposed in alternative B would be achieved within the CCP 15 year timeframe, thus short term direct impacts would be negligible. Long term impacts beyond that horizon also would be considered to be of negligible adverse impact. Overall, we estimate only about 38 acres of disturbance (about 2 acres per each 1-mile long, 8-foot wide ADA-accessible trail).

Alternative B also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Under alternative B, we propose to manage approximately 9,312 acres of habitat compared to 455 acres under alternative A (table 5.4). There may be some potential for management activities (e.g., use of heavy equipment) to cause soil erosion and compaction. To minimize the potential for adverse impacts, we will use best management practices (e.g., conducting some forest management during the winter when soils are frozen and covered with snow, avoiding areas with sensitive and/or highly erodible soils, such as wetlands, leaving forested buffers along riparian areas to prevent sedimentation into rivers and streams). Compared to alternative A, we expect slightly greater adverse impacts because we propose to manage additional acres. Overall, we expect the benefits from active management to wildlife, plants, and soils to outweigh adverse impacts.

We may use prescribed burning under this alternative to maintain fire regime habitat communities (e.g., pitch pine) and to treat hazardous fuels. Prescribed and wildfires can affect nutrient cycling and the physical, chemical, and biological properties of soils (DeBano 1990, Certini 2005). The magnitude of the impact depends on the severity of the fire, the topography of the area burned, and the resiliency of the soil. Prescribed fires are generally low to moderate in severity and do not result in long-term irreversible impacts (Certini 2005). If plants are able to quickly recolonize the burned area, soil properties are generally recovered and sometimes even enhanced (Certini 2005). We anticipate using prescribed burning on 100 or fewer acres per year and therefore expect only negligible to minor impacts to soils in very localized areas.

Soil Impacts under Alternative C

Beneficial Impacts. In the short term, the beneficial impacts of alternative C to refuge and regional soils would be very similar to those of alternative A and B. In the long term, alternative C would likely provide the second highest level of beneficial impacts to soils compared to other alternatives, because it would protect soils on up to 197,337 acres across 22 CFAs. Alternative C promotes protection of a considerably larger and more intact lands and soils configuration within the larger watershed landscape. Similar to the previous alternatives, such protection helps to maintain essential ecosystem functions provided by soils.

Under alternative C, we propose to actively management about 12,873 acres of habitat (table 5.4). In the short term, we expect similar impacts alternative B and C. However, in the long term, we expect the potential for an increase in the beneficial impact of such management with forest harvesting since much of this management will occur on degraded forest habitats that are in need of ecologically based forest management intervention. Such management is expected to further enhance forest structure along with healthy soils, and is considered to be of minor beneficial impact in the short term and particularly so over the long term, both refuge-specific and regionally.

USFWS

Yellow bellied sapsucker

Adverse Impacts. The adverse impacts to soils of alternative C is similar to alternative B, except there would be a slightly greater potential for adverse impacts from actively managing about 3,500 more acres of habitat (12,873 acres versus 9,312 acres; table 5.4) and constructing three additional 1-mile long, ADA-accessible trails (about an additional 6 acres of disturbance).

Soil Impacts under Alternative D

Beneficial Impacts. Alternative D is expected to provide the highest level of beneficial impacts to refuge soils in the long term because it would protect soils on up to 231,307 across 22 CFAs. Compared to alternative C, alternative D protects an even larger and more intact area within the larger watershed landscape.

Adverse Impacts. Compared to the other alternatives, the management activities proposed under Alternative D would have the least adverse impact on soils, promoting a low impact, passive management approach. Under alternative D there would be no active forest management designed for target priority refuge resources of concern wildlife that might periodically result in some soil disturbance. Management steps would be taken to mitigate unexpected events that may pose safety hazards and that may temporarily disturb soils (e.g., repair of collapsed culvert causing flooding, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that significantly impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment).

Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming). The low impact, or passive management, approach by this alternative would have both short- and long-term negligible adverse impacts on soil quality.

Also, alternative D is expected to have a very low impact on soils due to the absence of ground-disturbing habitat management. It has the second-highest level of visitor use among the alternatives (Table 5.5). As such, visitor activities that might impact soils, such as hiking off designated trails, would pose almost the lowest and negligible soil adverse threat of all alternatives. The refuge recognizes, however, that much of this reduced use is due to the elimination of snowmobiling, an activity that is not expected to have any more than negligible adverse impacts to refuge soils as discussed prior.

We do predict a slight increase in other forms of use from the eventual creation of 22 1-mile long “back country” trails (Table 5.5). We expect slightly less impacts to soils from constructing these “back country” trails compared to the ADA-accessible trails proposed under alternatives B and C because the trails would be narrower and less developed. We predict about 1 acre of disturbance per each trail mile (total of about 22 acres of disturbance).

Summary

In summary, our management activities across alternatives would not significantly impact (either adversely or beneficially) refuge or regional soils. All alternatives propose acquisition and protection of additional acres of refuge land (table 5.4). With those potential additions of habitat to the refuge, in concert with currently protected lands, there is an expectation on the maintenance of good to excellent soil quality due to soil protection and natural soil accretion, maintenance of the land-filtering and nutrient processing functions of the soil layer. We expect all proposed refuge management activities under all

alternatives—forest management, prescribed burning, trail construction, visitor use—to be of minor to negligible adverse impact.

Impacts to Freshwater Wetland Habitats and Vegetation

Generally, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et al. 1979). Freshwater wetlands are valuable natural resources that:

- Serve as important breeding, foraging, and migration habitats for wildlife.
- Contribute to nutrient recycling.
- Help purify drinking water supplies.
- Promote groundwater recharge.
- Mitigate flooding.
- Serve as important aquatic spawning areas.
- Offer unique recreational opportunities for the public.

These ecological functions are widely recognized. Activities that involve filling, excavating, or otherwise altering wetlands can impair wetland functions and values. For many years, these functions and values have been protected by Federal and state laws and regulations, and even town bylaws (e.g., Massachusetts). Overall, freshwater wetlands on the refuge are productive and in good condition.

The Service's Northeast Region has identified a number of important representative species and habitat types within their North Atlantic Land Conservation Cooperative (LCC). The LCC habitat types are used within this final CCP to define habitats to be acquired and actively or passively managed under the CCP, depending upon alternatives, to advance conservation of priority refuge resources of concern species associated with freshwater wetland habitat (Table 5.6) (derived from appendix A). This analysis on freshwater habitats and vegetation considers all wetland types found within the acquisition boundaries

Wood frog

Andrew MacLachlan/USFWS

of each alternative (see Table 3.4). Although freshwater wetlands encompass a vast majority of wetlands covered by this impact analysis, we also include consideration of the small amount of brackish and salt marsh that potentially could be acquired in the Whalebone Cove CFA. We evaluated and compared the management actions proposed for each of the refuge CCP alternatives based on their potential to benefit or adversely impact refuge freshwater wetlands.

Table 5.6. Comparison of Impacts to Freshwater Wetlands and Target Wildlife by Alternative

Major Freshwater Wetland Habitat	LLC Habitat[1]	PRRC Resources[2]	Acres of Freshwater Wetlands by Alternative			
			Alt. A	Alt. B	Alt. C	Alt. D
Forested Uplands and Wetlands	Conifer Swamps	Canada Warbler	undetermined	4,191	5,683	6,031
	Hardwood Swamps	Northern waterthrush Canada warbler	undetermined	2,008	2,639	5,993
	Shrub Swamp and Floodplain Forest	Laurentian-Acadian wet-meadow shrub swamp American woodcock American black Duck New England cottontail Little Brown bat Tri-colored bat Northern long-eared bat Eastern small-footed bat	undetermined	1,638	2,804	3,477
Non-forested Uplands and Wetlands	Freshwater Marsh	Laurentian-Acadian freshwater marsh American black duck Semi-palmated sandpiper	undetermined	962	2,053	2,401
	Peatlands	American black duck	undetermined	922	1,098	1,099
Inland Aquatic Habitats	Open Water[3]	American black duck Brook trout Atlantic salmon Alewife American eel Dwarf wedgemussel Brook floater	undetermined	2,155	2,972	3,783
Coastal Wetlands and Aquatic Habitats	Salt Marsh	Northern Atlantic coastal plain salt marsh.	undetermined	7	7	474
Total			**41,455**[4]	**11,883**[5]	**17,256**[5]	**23,258**[5]

[1] *LCC – Land Conservation Cooperative*

[2] *PRRC – Priority Refuge Resource of Concern*

[3] *Open water data likely to be under estimated.*

[4] *Estimate from 1995 Conte Final EIS-Action Plan, which is likely to be a high estimate.*

[5] *Figure does not include Quonatuck CFA acres and therefore is an underestimation*

The following management activities are most likely to impact the refuge's freshwater wetland habitats and vegetation:

Activities with the potential to benefit refuge freshwater wetlands include:

- Land acquisition and conservation that reduce loss of and impairment to freshwater wetlands by preventing further development.
- Wetland restoration, invasive plant control, and other management activities that improve wetland functions and values.

Activities with the potential to adversely impact refuge freshwater wetlands include:

- Forest management activities.
- Beaver and muskrat trapping.
- Moose and deer herbivory.
- Construction of buildings, parking facilities, access roads, and interpretive trails.
- Road maintenance (grading, ditch maintenance, roadside mowing).
- Visitor use impacts on wetlands adjacent to refuge trails and roads, or boardwalks through wetlands.

Impacts to Freshwater Wetlands That Would Not Vary by Alternative. Proposed refuge management activities would neither significantly benefit nor significantly adversely impact current local and regional freshwater wetlands. We expect the habitat conservation and management measures proposed in all alternatives would help protect and enhance natural beneficial functions, such as habitat for aquatic fish and wildlife, nutrient cycling, groundwater recharge, water filtration (in some cases ameliorating heavy metal and petrochemical non-point runoff), reduce high water turbidity, reducing high-flow outwash into streams and tributaries, and mitigate impacts due to storm flooding (*http://water.epa.gov/type/wetlands/;* accessed August 2016). All of these functions and values will be promoted on wetlands on existing and future refuge lands. In the short term (within 15 years), we would likely acquire similar amounts of land under all the alternatives, thus beneficial impacts would be similar across all alternatives in the short term. Greater beneficial freshwater wetland impacts would be expected to occur over the long term within alternatives C and D.

Across all alternatives, our management actions would not contribute to the long-term or permanent impairment of any freshwater wetlands, except when constructing structures for public use, use elevated boardwalks and observation platforms. These structures would be built to last beyond the 15-year timeframe of the CCP, but they could be dismantled when warranted. Direct impacts from these activities would be adverse, but negligible in the short term. There are no plans for major facilities or new road construction in or near wetland areas. Regardless of which alternative is selected, we would continue to use best management practices in all management activities that might impact refuge wetlands (e.g., maintaining appropriate wetland buffers, conducting habitat management actions on frozen soil).

As funding allows, we would strive to restore natural hydrology to impaired wetlands we acquire (e.g., replacing undersized culvers), to restore natural topographies, soils, and wetland vegetation. Restoration would include removing dwellings and other small infrastructure on property acquired by the refuge

in developed areas. We may also reduce the number of roads to minimize soil erosion into streams and rivers. Roads essential for management access may be improved, maintained, or re-opened. Skid trails created during forest habitat management operations would follow each state's best management practices.

Habitat management within the refuge's freshwater wetlands will be negligible, and would typically involve degraded lowland spruce-fir forest. Habitat management in any forested wetland area would follow appropriate best management practices, which include techniques that help to protect wetlands and their ecological functions. Unique wetlands, such as seeps and vernal pools, would be protected from adverse disturbance. We would take steps, as appropriate, to insure that our forest management practices, including passive management, do not contribute to the accumulation of hazardous fuel loads that may burn across wetland areas during dry seasons or droughts. Fortunately, the risk of catastrophic fire is fairly low in the forests of the watershed.

Logging may disturb refuge visitors, cause safety issues, or detract from visitors' aesthetic experience. When safety considerations warrant, areas of the refuge undergoing active management will be temporarily closed. Trails will either be closed or shared with logging trucks depending on the availability of feasible alternatives. Because small portions of the refuge's acreage will be actively harvested at any one time, disruptive adverse impacts to visitors will be minimal. Across all alternatives we will take appropriate management action to help recover any Threatened or Endangered species if new lands acquired are known habitat areas for these species, and such lands are identified as needing protection and management in an approved recovery plan. Such management actions would be taken after appropriate review and consultation with recognized experts and Service approval.

Circumstances may require the use of pesticides, such as herbicides to control invasive plants growing in freshwater wetlands. In these situations, the refuge management would follow an approved Integrated Pest Management Plan. A Pesticide Use Proposal (PUP) is required by the Service before application of a pesticide (including herbicides) on Service property. It is a protective measure to ensure the proper use of pesticides on Service lands. When required, the Regional Contaminants Specialist would review our Pesticide Use Proposals and approve chemical herbicide use.

The Service regulates human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses). We expect visitation to increase over time across all alternatives, as we acquire additional refuge lands and construct public use facilities, especially trails. The increase varies due to each alternative's respective refuge expansion level. Public use trails are constructed and managed to avoid or minimize adverse impacts to freshwater wetlands. Impacts to freshwater wetlands from the construction of new trails are expected be largest for alternatives B and C, which both propose constructing ADA-accessible trails. Impacts from alternative C will be slightly more than under alternative B. Impacts from alternative D follow, since this alternative still proposes the construction of many miles of new trails. Alternative A is associated with the fewest adverse impacts to wetlands from trail construction. Impacts from actual visitor use of these trails will likely track the impacts from construction, and will vary based on the popularity of each trail system. We expect trail construction and visitor hiking activity to have both short-term and long-term, negligible impacts to freshwater wetlands on the refuge.

Pets are allowed as companion animals and to facilitate hunting. Decaying pet waste consumes dissolved oxygen (DO) in water bodies and sometimes releases

ammonia (NH_3). Pet waste carries bacteria, viruses, and parasites that can threaten the health of humans and wildlife (EPA 2001). There are no known pet waste problems on any refuge division or unit, and future acquisitions will be carefully managed. Bicycling can contribute to soil erosion into wetlands; while the use of all-terrain vehicles (ATVs) is not permitted on refuge lands; we propose to allow bicycling on refuge roads (not trails).

Regardless of which alternative we select, we would take a number of steps to insure that we have sufficient scientific data to support management decisions regarding refuge freshwater wetland management and protection. We will work with Service's Division of Ecological Services, the USDA Natural Resources Conservation Service, respective state agencies, and other conservation partners to help identify and correct any impacts to freshwater wetlands.

Impacts to Freshwater Wetlands of Alternative A

Beneficial Impacts. Alternative A would provide short-term and long-term beneficial impacts from protecting freshwater wetlands on existing and future refuge lands. Table 5.6x estimates the total amount of wetlands protected under alternative A and lists the priority resources of refuge concern that would benefit from this conservation. The protection of these acres will provide benefits to wetlands from helping maintain essential wetland functions and values (e.g., fish and amphibian habitat, groundwater recharge, nutrient processing, and flood mitigation).

Overall, alternative A would continue current management of forest and grassland habitats on to 455 acres (table 5.4). Some forest management is expected to occur in forested wetlands (e.g., lowland spruce-fir) where habitat improvement is necessary, and is expected to have a number of beneficial impacts, both short-term and particularly long-term. Forest management can improve and accelerate development of historic forest structure and species composition (Seymour et al. 2002, Keeton 2006, Franklin et al. 2007, North and Keeton 2008, Raymond et al. 2009, Arseneault et al. 2011). In the absence of active management, the development of appropriate wildlife habitat may take longer or fail entirely, depending on site characteristics, prior management history, and natural disturbance frequency. An actively managed forest, where harvests act to mimic natural disturbances that create openings for new generations of trees while retaining some larger, older trees, will help maintain the appropriate forest structure and age or size classes important to focal species into the future, ensuring adequate habitat is available for priority refuge resources of concern species (for more detail, see appendices D and J).

Adverse Impacts. Under alternative A, we propose very few activities that would adversely impacts wetlands. Heavy equipment used for habitat management, trail and road maintenance, and other routine construction may cause some disturbance to wetlands (e.g., soil erosion and compaction of vegetation and soils). In general, we would avoid conducting these activities wetland areas, expect where necessary to enhance or restore wetland habitats for priority refuge resources of concern. However, some habitat management would occur in close proximity to wetland areas, or in forested wetlands such as the lowland spruce-fir forests at the Nulhegan Basin, Pondicherry, and Blueberry Divisions. We would follow best management practices to reduce the potential of these impacts, taking measures such as leaving forested buffers along wetlands and avoiding sensitive wetland areas.

In total, 200 grassland acres are managed within three CFA areas: Fort River, Nulhegan Basin, and Pondicherry. Management activities include periodic (2 to 3 years rotation) mowing, haying, and brush hogging with diesel fueled tractors, so

emission drift or fuel spills may enter nearby wetland areas and potentially could cause very localized, short-term adverse impacts. Such infrequency of treatment on relatively small tracks of land, and where such treatments are generally designed to be distant from known wetlands, are all refuge habitat management activities believed to be negligibly adverse in their impact to local or regional wetland integrity, both in the short term and long term.

Other management activities would include controlled herbicide use on about 60 acres, maintenance of six buildings, and trail and road maintenance with some tree cutting (about 20 miles of trails and 40 miles of public roads and 2 miles of administrative roads). We would also follow best management practices for these activities to minimize impacts to wetlands. In wetland areas, we would only use herbicides that are approved for use near wetlands and only where they are the most effective control for invasive species.

We are not currently using prescribed burning to manage refuge habitats and under alternative A we would only use prescribed burning to reduce hazardous fuels. Both regionally and refuge-specific, these activities would be of negligible adverse impact to freshwater wetlands. Best management practices to protect wetlands are implemented in all ground disturbing activities.

Visitation under alternative A would not appreciably change over current levels and is expected to be lower than any of the other alternatives. We note, however, there likely will be more visitation at the Fort River Division due to the new 1.2 mile (flat terrain) ADA-accessible trail and wetland boardwalk system, yet that potential increase would be modest and considered of negligible short-term and long-term adverse impact since most visitors will remain on the trail.

Alternative A would continue to allow managed furbearer trapping in freshwater wetlands at the Nulhegan Basin Division. This activity conducted from 2001 to 2012 resulted in a harvest of 65 beaver, 77 muskrat, 41 mink, and 13 river otter, averaging about 16 beaver, 8 muskrat, less than 4 mink, and 1 otter annually. The average number of annual trap-days spent by individuals in the wetland environment was 64. The impact of managing the populations of these species is considered negligible and the benefits beaver provide in creating and maintaining dynamic forested wetlands is maintained. Managed trapping helps to reduce damage by beaver and muskrats on refuge roads near freshwater wetlands. During five winter trapping seasons (2004/5 and 2007/8 to 2010/11), a total of 66 beaver and 46 muskrats were taken in the Moorehen Marsh vicinity of the Pondicherry CFA/Division by permitted trappers, thus averaging about 13 beaver and 9 muskrat in any one trapping season. This was a cooperative effort with the New Hampshire Bureau of Trails which manages the recreational rail-trail bordering Moorhen Marsh. Beavers and muskrats were plugging outlets under the rail-trail resulting in trail flooding which created sheet ice in winter, a safety hazard on this popular snowmobile trail. It is also likely that some of these recorded animals were actually taken off-refuge in the rail-trail ROW where the same trappers operated. Although over-browsing by ungulates has been documented at the Nulhegan Basin Division, there are currently no known over-browsing issues within forested wetlands at other refuge divisions.

As described prior, we do not plan to increase capacity for snowmobiling. Current trails do not impact wetlands. Snowmobile trails on new lands to be acquired under alternative A may be retained, and in select situations a closed trail may be opened to promote wildlife-dependent public uses, but these areas would not involve wetlands. Concerns have been voiced about the potential adverse impacts of snowmobile exhaust on aquatic systems: some suggest that fish can acquire and accumulate hydrocarbons, and repeated packing of snow during

grooming can accumulate pollutants on developed trails which are then released during snowmelt and spring runoff (Ruzycki and Lutch 1999, Oliff et al. 1999). A statewide 2010 study (VHB Pioneer 2010) evaluated snowpack chemistry to detail the presence or absence of impacts from snowmobile traffic on the chemical composition of snowpack, soil, and runoff in the proximity of heavily traveled snowmobile trails. Two of the sample sites were on Nulhegan Basin Division refuge trails. Snowmelt and runoff chemistry monitoring indicated no detectable levels of volatile organic compounds or total petroleum hydrocarbons in surface waters located immediately down-gradient of the snowmobile trails. Furthermore, snowpack chemistry monitoring indicated no detectable levels of volatile organic compounds or total petroleum hydrocarbons in background or on-trail snow sampling stations. Results showed no change in water chemistry for any of the sites sampled, including those on the refuge. Although this was a wide-ranging study, it only covered a single season. Therefore, additional replication would be useful to further assess the risk of hydrocarbon to refuge waters. However, based on the available data with a representative sampling of snowmobile use on the refuge, improvements in snowmobile technology to favor 4-stroke engines, and the substantial water volumes involved, the pollutant impacts to waters are expected to be negligible.

Impacts to Freshwater Wetlands of Alternative B

Beneficial Impacts. In the short term, the beneficial impacts of alternative B would be similar to those described under alternative A. Over the long term, we predict slightly greater benefits from protecting larger, more contiguous CFAs as opposed to protecting more scattered, smaller SFAs. By protecting larger, more contiguous CFAs, we expect to have a greater potential to protect natural wetland functioning and to ensure a wide buffer of undeveloped land surrounding wetlands.

Adverse Impacts. In the short term, adverse impacts to wetlands would be similar to those described under alternatives A and B. Over the long term, we expect a greater potential for adverse impacts to wetlands from expanded active habitat management (table 5.4). As described under alternative A, we will use best management practices to protect wetlands and to ultimately enhance habitat structure and functioning for priority refuge resources of concern. As we acquire new lands, we will develop HMPs that provide more detailed information on proposed active management and predicted impacts.

Visitation under alternative B would potentially increase by 22 percent over alternative A levels (Table 5.5), due in large part to an expanded 19-mile trail system. As such, increased visitor activities that might impact wetlands, such as hiking off designated trails would pose a minor concern, as visitors tend to spend most time in uplands, except when using existing wetland boardwalk trails. Boardwalk trails over wetlands would continue to be a potential management option, and all would be constructed using BMPs to avoid or minimize short-term and long-term adverse impacts to wetlands.

Alternative B also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to Freshwater Wetlands of Alternative C

Beneficial Impacts. In the short term, the beneficial impacts of alternative C would be similar to those described under alternatives A and B. Over the long term, we predict greater benefits from protecting more acres of wetland habitat.

Adverse Impacts. In the short term, adverse impacts to wetlands would be similar to those described under alternatives A and B. Over the long term, we expect a greater potential for adverse impacts to wetlands from expanded active habitat management (table 5.4). As we acquire new lands, we will develop HMPs that provide more detailed information on proposed active management and predicted impacts. As described under alternative A, we will use best management practices to protect wetlands and to ultimately enhance habitat structure and functioning for priority refuge resources of concern. These management impacts would be considered local and of negligible adverse impact in the short term and of no impact over the long term.

Visitation under alternative C would increase 54 percent (Table 5.5) compared to alternative A, offering greater visitor use opportunities over the short term and long term due to an expanded, accessible trail system. Potential adverse impacts would be similar in kind and slightly greater in total impact to those discussed under alternative B, due to a 22-mile trail system in alternative C compared to a 19-mile trail system in alternative B.

Similar to alternative B, alternative C proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Bill Buchanan/USFWS

Bullfrog

Impacts to Freshwater Wetlands of Alternative D

Beneficial Impacts. In the short term, the beneficial impacts of alternative D would be similar to those described under alternatives A, B, and C. Over the long term, we predict the greatest benefits under alternative D from protecting the greatest amount of habitat. Also, the CFAs under alternative D are the largest and most contiguous, so we expect the greatest potential to protect natural wetland functioning and process.

Adverse Impacts. In the short term, adverse impacts to wetlands would be similar to those described under alternatives A, B, and C. Over the long term, we expect the least potential for adverse impacts to wetlands because we propose no active habitat management, except for federally threatened and endangered species. We would continue to work with the Service's New England Field Office to determine whether active management is needed for federally listed species. We would also take management steps to mitigate unexpected events that may pose safety hazards (e.g., repair of collapsed culvert causing flooding, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that significantly impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment

Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming). In the absence of active management, the development of appropriate wildlife habitat may take longer or fail entirely, depending on site characteristics, prior management history, and natural disturbance frequency. In contrast to a passively managed forest, it is possible that an actively managed forest as described in other alternatives, where harvests act to mimic natural disturbances that create openings for new generations of trees while retaining some larger, older trees, may accelerate the improvement of natural forest structure and age or size classes important to focal species into the future.

Visitation under alternative D is projected to be lower than alternative C, but higher than under alternatives A or B. Its scope is different because snowmobile

use will be eliminated. Trails constructed under this alternative will be native-surface and thus less impactful on the surrounding vegetation. Trails will be designed to avoid wetlands, or to carefully incorporate trails and boardwalks into wetlands areas that promote environmental education and interpretation.

Visitor activities that might impact wetlands, such as hiking off designated trails or not removing pet waste, would pose negligible wetland adverse impacts in the short and long term. One study suggests 70 percent of hiking individuals veer off-trail (Hockett et al. 2010), and we would take known corrective actions to mitigate such activity such as placement of natural obstructions. Due to the passive management approach for alternative D, there would be no managed furbearer trapping at the Nulhegan Basin Division (CFA), which may adversely impact refuge habitats in the short and long term from not controlling species like beaver and muskrat, and their potential to adversely impact wetland habitats.

There is evidence that over-browsing in wetland systems has occurred in forests of the Nulhegan Basin Division, and Northeast Kingdom in general, although it is believed the current ungulate populations are at an acceptable level. Current refuge hunts (e.g., 350 annual hunt visits at Nulhegan Basin Division) are believed to help mitigate any potential problem, and the potential adverse impact from over-browsing in wetlands is considered negligible in the short term, yet the long-term impacts will have to be monitored.

Similar to alternatives B and C, alternative D proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Summary

In summary, our management activities across alternatives would not significantly adversely or beneficially impact refuge freshwater wetlands. As previously noted, all propose acquisition and protection of additional acres of refuge land. The continued conservation of existing refuge wetlands and the long-term potential to acquire and permanently protect more will be of direct and long-term beneficial impacts to wetland wildlife. Maintaining and protecting wetlands will help to guarantee their beneficial ecosystem functions that serve wildlife (e.g., habitat) and society at large (e.g., groundwater recharge, flood attenuation). We expect all proposed refuge management activities under all alternatives—forest management, prescribed burning, trail construction, visitor use—to be of minor to negligible adverse impact.

Impacts to Upland Habitats and Vegetation

Uplands typically are well-drained lands generally of higher elevation. Unlike wetlands, uplands do not have water as a defining feature determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Upland habitats and vegetation are the predominant plant communities in the Connecticut River watershed (Table 5.7). Like freshwater wetlands, uplands are valuable natural resources. They serve as important breeding, foraging, and migration habitats for a wide variety of plants and wildlife and are essential to the water and nutrient cycles. The Service's Northeast Region has identified a number of important representative species and habitat types within their North Atlantic Land Conservation Cooperative (LCC). The LCC habitat types are used within this final CCP to define habitats to be acquired and actively or passively managed under the CCP, depending upon alternative, to advance conservation of priority refuge resources of concern species (Table 5.5). This analysis on upland habitats and vegetation includes consideration of all LCC upland types that occur on the refuge, including spruce-fir forest, hardwood forest, woodlands, pasture, hay and grassland, old field and shrubland, cliff and talus, rocky outcrop, and rocky coast and islands.

We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely impact refuge upland habitat and vegetation. The following management activities are most likely to affect the refuge's upland habitat and vegetation:

Table 5.7. Comparison of Impacts to Upland LCC Habitats and Priority Refuge Resources of Concern Species by Alternative.

Major Upland Habitat	LCC Habitat	PRRC Wildlife	Alternative B: 19 CPAs	Alternative C: 22 CPAs	Alternative D: 22 CPAs
Forested Uplands and Wetlands	Spruce-fir Forest	Blackburnian warbler Rusty blackbird Canada warbler	18,231	22,707	23,784
	Hardwood Forest	American woodcock, Wood thrush Bald eagle Blackburnian warbler Chestnut-sided warbler Canada warbler Black-throated blue warbler Louisiana waterthrush New England cottontail Little brown bat Tri-colored bat, Northern long-eared bat, Eastern small-footed bat Osprey	61,212	150,927	195,578
	Woodlands	Woodland pine-oak community	221	476	649
Non-forested Uplands and Wetlands	Pasture, Hay and Grassland	American woodcock, New England cottontail	5,061	9,637	11,255
	Old Field and Shrubland	New England cottontail	37	52	99
	Cliff and Talus	Four unique plant communities Peregrine falcon	445	1,868	2,094
	Rocky Outcrop	Two unique plant communities	590	2,098	2,387
Coastal Non-forested Uplands	Rocky Coast and Islands	Acadian North Atlantic Rocky Coast	19	41	41
Total acres			**85,816**	**187,806**	**235,887**

The potential beneficial impacts to upland habitat and vegetation resulting from refuge management activities described in the alternatives include:

- Extent to which refuge land acquisition and conservation under the alternatives would reduce loss of or impairment to upland habitat and vegetation through development activities.
- Extent to which the potential refuge management actions on current and acquired upland habitats and vegetation would improve upland habitat functions and values to priority refuge resources of concern species.

The potential adverse upland habitat and vegetation impacts of the refuge management alternatives that were evaluated included impacts from:

- Habitat management activities designed to improve habitat structure for priority refuge resources of concern species.
- Impacts to non-priority wildlife due to management for priority species.
- Construction of buildings, parking facilities, access roads, and interpretive trails.
- Road maintenance (grading, ditch maintenance, spreading gravel, removing boulders, roadside mowing/debrushing).
- Visitor use impacts on uplands adjacent to refuge trails and roads.
- Prescribed burning in appropriate fire-regime habitats, or for habitat management and hazardous fuel reduction.

Estimated Acreage Subject to Habitat Management Activities
The acreage figures we propose for habitat management largely are to be conducted in upland habitats. The estimated acres to be managed are presented in table 5.4 above. We believe these estimates under each alternative offer reasonable estimates of average annual treatments, and provide the public, partners, and other stakeholders interested in this refuge management activity with a basis on which to evaluate and compare the proposed final CCP/EIS alternatives. These estimates assume full implementation of the CCP (e.g. staffing, funding, and land acquisition) over the 15-year CCP timeframe and beyond. They are based on limited, available resource information on refuge lands yet to be acquired. As new lands are acquired, and we assess habitat conditions, we will likely need to adjust these acres.

All subsequent habitat management actions will conform to a site-specific Habitat Management Plan (HMP) derived from the management objectives prescribed in the final CCP. Grassland acres by alternative (200, 422, 548, and 0 acres, respectively) represents the full footprint of grassland habitat to be managed by the refuge, and similarly, shrubland acres by alternative (0, 775, 775, and 0 acres, respectively) represents the full footprint of shrubland habitat to be managed by the refuge. We will initiate HMPs for each respective CFA/ refuge division once the Service has acquired a manageable land interest, and after we have conducted field inventories and assessments. Guided by an HMP, we will more specifically base our annual acreage estimates on potential habitat management opportunities and staff capabilities to oversee such actions that year. We will design and implement habitat management activities to achieve the respective HMP's objectives (and CCP Goal 1) while recognizing the need to accommodate unforeseen circumstances (e.g., difficult site topography, poor weather, constrained budgets, and staffing) that may result in annual variations in treatment acres. As such, we consider these annual estimates and not quotas or limitations. In addition, we expect that the average acres to be managed annually will be lower in the short-term (e.g. within the 15-year timeframe of the CCP), as compared to the long term when the refuge would potentially have reached its full authorized size encompassing a much larger land base.

Impacts to Upland Habitats That Would Not Vary by Alternative.
Proposed refuge management activities would benefit current local and regional upland habitats. We expect refuge land conservation and management within all alternatives over the long term to help maintain and promote regeneration

Bill Thompson

Snowy owl

of natural beneficial upland functions and values that include habitat for terrestrial fish and wildlife, nutrient cycling, groundwater recharge, filtering water, in some cases ameliorating heavy metal and petrochemical non-point runoff, retarding down-stream turbidity, reducing anthropogenically exacerbated high-flow outwash into streams and tributaries, and diminishing adverse weather impacts (e.g., storm winds, heavy precipitation). Priority refuge resources of concern will benefit from upland habitat protection.

All of these upland functions and values will be promoted on the existing 37,000 refuge acres, potential completion of its current authorized acquisition level (alternative A; 97,830 acres), reconfiguration of its current acquisition level (alternative B, 97,772 acres) into the proposed CFA structure, or any expansion of refuge size as proposed by alternatives C and D, the latter two which would authorize expansion to 197,337 and 231,307, respectively. Greater upland benefits would be derived from either of the refuge expansion alternatives (C and D) since they would permanently protect these often desirable building sites and preclude them from potential development projects. Since the refuge was founded, the average annual expansion has been 2,117 acres, although the average for the past five years is a modest 647 acres. Consequently, in the short term (within 15 years), we would likely acquire similar amounts of uplands under all the alternatives, thus beneficial upland habitat impacts would be similar and minor across all alternatives in the short term. Greater upland habitat beneficial impacts would be expected to be modest over the long term.

There are no explicit plans for major facilities or new road construction in upland habitats; however, action alternatives (B, C, and D) propose a potential outdoor classroom at the Fort River Division. Impacts to upland habitats from any outdoor classroom structures would be subject to separate NEPA analysis. Regardless of which alternative is selected, we would continue to use best management practices in all management activities.

Across all alternatives, we would restore natural slope and gradient to any impaired upland that may exist on acquired developed sites having unnecessary roads, buildings, or other infrastructure nearby thus promoting natural topography, soil constituency, and native upland vegetation. Restoration would include removing dwellings and other small infrastructure on property acquired by the refuge in developed areas. Reducing road use may eliminate air-borne dusts and minimize soil erosion into lower streams and rivers. As needed, roads will remain open to provide motorized and non-motorized access to visitors, and to benefit management access. Where appropriate, roads may be closed to visitor access. Roads no longer required for management activities and not suitable for public use may be closed to improve local soil and hydrology. Roads may be upgraded, re-opened, or maintained to improve access for active habitat management.

Within the regional and refuge specific upland landscape, habitat management impacts across alternatives are negligibly adverse in the short term and beneficial in the long term. Habitat management in any upland area would be conducted to create habitat structure to fulfill known needs of priority refuge resources of concern. The level of upland habitat management by acres changes considerably across alternatives (Table 5.4), but such management results in an altered and improved habitat structure, never permanent impairment. Impacts

from these activities (e.g., use of heavy equipment, chainsaw cutting, tractor mowing) would be negligibly adverse in the immediate short term (days to a few years) but beneficial in the longer term (one year or more). Operations performed by contractors will have oversight from the refuge staff.

Forest management is expected to have a number of beneficial impacts, both short-term and particularly long-term, by improving and accelerating growth of historic forest structure and species composition within currently degraded forests (Seymour et al. 2002, Keeton 2006, Franklin et al. 2007, North and Keeton 2008, Raymond et al. 2009, Arseneault et al. 2011). Although silviculture does not create forests that are ecologically identical to natural old-growth forests (Aber et al. 2000), we can mimic structures found in old-growth forest and conduct restoration. In the absence of active management, the development of wildlife habitat to serve the needs of priority refuge resources of concern in degraded forests may take longer or not occur, depending on site characteristics, prior management history, and natural disturbance frequency. An actively managed forest, where harvests act to mimic natural disturbances that create openings for new generations of trees while retaining some larger, older trees, will help maintain the appropriate forest structure and age or size classes important to focal species into the future, ensuring adequate habitat is available for priority refuge resources of concern species.

Ground-disturbing activities associated with forest management have some potential to adversely impact upland habitats, primarily in the immediate short term when heavy equipment is in use, particularly during forest harvest operations or grassland mowing/brushhogging. Forest habitat management under alternatives A, B, and C would continue implementation of the woodcock habitat management plan on 300 acres designated as woodcock demonstration areas at the Nulhegan Basin Division. Management techniques will include various forms of even-aged and uneven-aged management. Harvest operations will be performed by contractors under supervision of the refuge forester, and recognized BMPs will be employed throughout such operations to minimize short term adverse impacts to residual trees, soils, drainage patterns, streams, isolated wetlands, fuel/oil spills, etc.

The 15-year scope of the CCP falls far short of the decades we expect it will take to create a diverse and mature forest. Our expectation is that much of the forest structure and species composition deemed important to our refuge focal species will take a minimum of 100 years to develop under the implementation of our forest management goals and objectives. Generally, our management will move stands towards a more ecologically mature forest structure characterized by the inclusion of trees that extend above the canopy; a vertically and horizontally diverse canopy; increases in standing dead trees (snags) and downed woody debris - particularly larger size classes; increases in the softwood component of mixed species stands; and the maintenance of a generally closed canopy. These conditions favor refuge focal species, including but not limited to wood thrush, blackburnian and black-throated blue warblers. Where appropriate an even-aged management approach will benefit other focal species including Canada warbler, New England cottontail, and American woodcock.

Regardless of the alternative selected, pesticides, most often herbicides, will be part of management. The refuge will develop and implement an Integrated Pest Management Plan that addresses environmentally safe application procedures and requirements. Pesticides will only be used if it is the most effective management technique, and will be combined with other management tools. Pesticides must be approved by the Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection.

The Service carefully regulates human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses) and thus reduces anthropogenic impacts related to upland habitats. We expect visitation to increase over time across all alternatives, as we acquire additional refuge lands and construct public use facilities, especially trails. The increase varies due to each alternative's respective refuge expansion level. Visitation is highest under alternative C, followed by alternatives D, B, and A. Because alternative D proposes native-material trails rather than ADA-compliant trails, impacts from trail construction is likely to do more damage to upland habitats in alternative B, but impacts from trail use could potentially be greater under alternative D. Public use impacts are expected to be negligibly adverse in the short and long term. Public use trails are carefully placed and managed to avoid or minimize adverse impacts to upland habitats. Trails most commonly are sited in stable upland areas where potential habitat related impacts (e.g., habitat fragmentation, wetland impairment, soil erosion and compaction, disruption of sensitive communities, conduits for invasive plants and animals) can be avoided or minimized.

Pets under leash control are permitted on refuge trails, yet their waste can cause negative adverse impacts to the immediate upland environment and indirectly to nearby freshwater wetlands and streams (EPA 2011). There are no known pet waste problems on any refuge division or unit, and future acquisitions will be carefully managed to authorize any pet walking so that their wastes are removed from refuge lands. We recognize that visitors, and visitor use activities can be a source of introducing invasive plant seeds (e.g., muddy boots, pet hair), and seek to minimize these potential impacts by carefully designing new trails and implementing appropriate restricted use or public education and awareness.

Regardless of which alternative we select, we would take a number of steps to ensure that we have sufficient scientific data to support management decisions regarding refuge upland habitat management and protection. We would work with the our own Service Division of Ecological Services, the USDA Natural Resources Conservation Service, respective state agencies, and other conservation partners to help identify and correct any negative impacts to uplands.

Impacts to Upland Habitats of Alternative A

Beneficial Impacts. Alternative A would provide short- and long-term beneficial impacts to upland habitat because it would conserve uplands on a refuge landscape of up to 97,830 acres (37,000 currently acquired) across 65 widely separated, often small SFAs.

Overall, alternative A would continue current management of forest and grassland habitats encompassing up to 455 acres (255 acres forest and 200 acres grassland) (Table 5.4). No shrubland habitat would be actively managed to remain as shrubland. Forest habitat management under alternative A would continue implementation of the woodcock habitat management plan on 300 acres designated as woodcock demonstration areas at the Nulhegan Basin Division, harvesting approximately 60 to 65 acres every 5 years. Benefits to upland habitats from these activities would be greater under alternatives B and C than under alternative A. No active management is planned under alternative D.

Grassland management will be conducted under alternative A. Grassland management is defined as the set of actions taken to maintain the structure and persistence of grassland communities by preventing natural vegetation succession to forest. Active habitat management actions will include mowing, mechanical clearing, selective cutting, and selective use of herbicides to eliminate invasive plants. Without these intervention techniques and in the absence of disturbance, early-successional grasslands will succeed to another stage, likely young forest. The consequence of this is the elimination of a critical habitat type for the

refuge and the northeast in general (Oehler et al. 2006). These management interventions are intended to maintain and improve early-successional grassland habitat for priority refuge resources of concern target species (e.g., bobolink and upland sandpiper).

Alternative A would continue to permit managed furbearer trapping on uplands at the Nulhegan Basin Division. This activity conducted from 2001 to 2012 resulted in a harvest of 54 fisher, 31 coyote, 2 raccoon, and 8 weasel, and 1 bobcat, averaging about 5 fisher and less than 3 coyote annually with other recorded species being taken irregularly. The average number of annual trap-days spent by individuals in the upland environment was 25. The impact of trapping and managing the populations of these species in upland habitats is considered of minor benefit in the short and long term.

Adverse Impacts. Overall, alternative A would continue current management of forest and grassland habitats encompassing up to 455 acres (255 acres forest and 200 acres grassland) (Table 5.4). No shrubland habitat would be managed. Adverse impacts from ground-disturbing activities under alternative A would be greater than under alternative D, but probably less than under alternatives B and C.

Under this alternative A, prescribed burning is not employed to manage habitats or reduce forest fuel loads, and no campfires are permitted. Prescribed burning may be employed, however, to reduce hazardous fuels.

Upland habitat management under alternative A would be maintained to provide for target grassland birds (e.g., bobolink, upland sandpiper, and American woodcock). In total, 200 grassland acres are managed at three CFAs: Fort River, Nulhegan Basin, and Pondicherry Divisions. Management activities include mowing, haying, and brush hogging with diesel fueled tractors. Management activities include periodic (2-3 years rotation) mowing, haying, and brush hogging with diesel fueled tractors, so emission drift or fuel spills may enter upland habitats and potentially could cause very local adverse impacts. Frequency of management application usually skips one or more years (Table 5.4), although mowing and haying at Fort River is conducted annually. Such infrequency of treatment on relatively small tracks of land are all refuge activities believed to be negligibly adverse in their impact to local or regional wetland integrity, both in the short term and long term.

Active management to create or maintain shrublands is not planned under this alternative. This would have negligible to minor adverse impacts on shrubland-dependent species, including priority refuge resources of concern such as the New England cottontail. At the regional scale, there are few shrublands existing within the refuge acquisition boundary, so the impacts from a lack of management will be relatively small.

Habitat management activities under alternative A also includes controlled herbicide use to set back invasive plants, maintenance of six buildings, road maintenance with some tree cutting (40 miles public, 2 miles administrative), and visitor use impacts (e.g., 20 miles of trails). Both regionally and refuge-specific, these activities are of negligible impact, both in the short and long term.. Our current invasive plant control involves no burning, relying instead on cutting, pulling by hand, and approved herbicides.

Visitation under alternative A would not appreciably change over current levels and is expected to be lower than any of the other alternatives (Table 5.5). As such, visitor activities that might impact upland habitats, such as hiking off designated trails would pose minimal concern.

We do not plan to increase capacity for snowmobiling on existing or future refuge uplands regardless of alternative (and alternative D would eliminate snowmobiling); rather, we plan only to maintain existing use levels. Snowmobile trails on new uplands to be acquired under alternatives B and C may be maintained, and in select situations closed trails may be opened to promote wildlife-dependent public uses. The concentration of hydrocarbons in snow is likely to be particularly high on trails where regular grooming constantly packs exposed snow. Spring snowmelt from upland areas may release those hydrocarbons into streams or other bodies of water. To what extent the water bodies on the refuge are at risk of hydrocarbon pollution is unclear. While technological advances have produced cleaner four-stroke engines, the vast majority of snowmobiles still use inefficiently burning two-stroke engines, which can heavily pollute air and waters (CO, hydrocarbons HC, and particulates) (*http://www.epa.gov/oms/recveh.htm*, accessed August 2016). Yet, during the course of a study in Yellowstone National Park, volatile organic compound (VOC) concentrations of snowmelt runoff were below levels that would adversely impact aquatic systems (Arnold and Koel 2006).

The most common impacts to vegetation attributable to snowmobiles are physical damage like bending and breaking when hit or run over (Stangl 1999), however, given that all trails overlay roads, such impacts are not expected. Additionally, plants are impacted during trail maintenance when shrubs and sapling trees are trimmed back; however, similar impacts occur in the process of maintaining roadsides and would be completed regardless of a snowmobile trail network. Most trimming associated with the snowmobile trail is done by tractor-mounted brushcutters which sets back growth, but often does not kill the plants. Brush cutting only occurs when woody plants encroach within the road corridor or are tall enough to protrude above the snow surface. Plants in the snowmobile trail probably end winter dormancy later and are less productive than those that are unaffected (Stangl 1999). No federal or state listed plants are known from the area encompassing the snowmobile trail. The amount of habitat directly affected by snowmobile trails represents a small percentage of similar habitats within refuge lands.

There is evidence that deer and moose over-browsing has occurred in forests of the Nulhegan Basin Division and neighboring private forest lands, within the past decade, although it is believed the current moose population is at an acceptable level. Current refuge hunts at the Nulhegan Basin and Pondicherry Divisions (e.g., approximately two to six moose harvested annually at Nulhegan Basin Division) are believed to help decrease potential problems, and the potential adverse impact from over-browsing in upland forests is considered negligible in the short-term, yet the long-term impacts will have to be monitored.

Impacts to Upland Habitats of Alternative B

Beneficial Impacts. Alternative B would provide short- and long-term beneficial impacts to upland habitat because it would conserve upland habitats on up to 85,816 acres, across 19 consolidated CFAs as compared to the current 65 widely separated, often small, SFAs. Upland habitats that could be acquired under alternative B include: spruce-fir forest (18,231 acres), hardwood forest (61,212 acres), woodlands (221 acres), pasture, hay, and grasslands (5,061 acres), old field and shrublands (37 acres), cliff and talus (445 acres), rocky outcrop (590 acres), and rocky coast and islands (19 acres). It is recognized, however, that acquisition of lands comprising the full potential refuge would take many years, likely beyond the 15-year horizon of this CCP, indicating that potential beneficial impacts on uplands over the CCP 15 year horizon would be minor over the short-term, but may be modest over the long term.

Beneficial impacts from habitat management are projected to be greater under alternative B than alternatives A or D (no active management occurs under

alternative D), but less than under alternative C (Table 5.4). These benefits primarily revolve around supporting or improving the ecological structure and functions of currently degraded forests, or maintain or expand early-successional grassland and shrublands.

Grassland management will be conducted under alternative B to maintain the structure and persistence of grassland communities by preventing natural vegetation succession to forest. Active habitat management actions will include mowing, mechanical clearing, selective cutting, and selective use of herbicides to eliminate invasive plants. Beneficial impacts from grassland management will be greater under alternative B than under alternative A, but less than under alternative C, assuming the relative amount of grassland treated tracks the proposed plans.

Regarding public use, alternative B would continue to permit managed furbearer trapping and hunting on uplands at the Nulhegan Basin and Pondicherry Divisions as described in alternative A while also offering potential new hunting opportunities on future land acquisitions. Beneficial impacts from hunting and trapping are more dependent on participants than on total available acres, so there is considerable uncertainty around the relative level of impacts from this alternative compared to the others.

Adverse Impacts. Over the 15 year CCP horizon, alternative B encompasses management of a minimum of 9,312 acres of habitat compared to 455 acres under alternative A: 7,660 acres forest, 422 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (Table 5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs. Adverse impacts from ground-disturbing activities under alternative B would be greater than under alternatives A or D, but probably less than under alternative C, assuming that adverse impacts correlate with the number of acres management. These management impacts would be considered local and of negligible adverse impact in the short term and of no adverse impact over the long term.

Upland habitat management under alternative B would be maintained to provide for target grassland birds (e.g., bobolink, upland sandpiper, and American woodcock). Management activities include mowing, haying, and brush hogging with diesel fueled tractors. Management activities include periodic (2-3 years rotation) mowing, haying, and brush hogging with diesel fueled tractors, so emission drift or fuel spills may enter upland habitats and potentially could cause very local adverse impacts. Frequency of management application usually skips one or more years (Table 5.4), although mowing and haying at Fort River is conducted annually. Such infrequency of treatment on relatively small tracks of land are all refuge activities believed to be negligibly adverse in their impact to local or regional wetland integrity, both in the short term and long term.

Visitation under alternative B is expected to increase over time as refuges divisions are expanded and public access infrastructure is completed. Hiking off-trail may contribute to adverse impacts by degrading upland habitats. Assuming impacts are correlated with visitation, adverse impacts to upland habitats would be smaller under alternative B than alternatives C and D, but greater than under alternative A. Visitor activities that might impact uplands, such as hiking off designated trails and snowmobiling would pose a minor concern, as previously discussed, constituting a negligible adverse impact in the short and long term.

The most common impacts to vegetation attributable to snowmobiles are physical damage like bending and breaking when hit or run over (Stangl 1999), however,

given that all trails overlay roads, such impacts are not expected. Additionally, plants are impacted during trail maintenance when shrubs and sapling trees are trimmed back; however, similar impacts occur in the process of maintaining roadsides and would be completed regardless of a snowmobile trail network. Most trimming associated with the snowmobile trail is done by tractor-mounted brushcutters which sets back growth, but often does not kill the plants. Brush cutting only occurs when woody plants encroach within the road corridor or are tall enough to protrude above the snow surface. Plants in the snowmobile trail probably end winter dormancy later and are less productive than those that are unaffected (Stangl 1999). No federal or state listed plants are known from the area encompassing the snowmobile trail. The amount of habitat directly affected by snowmobile trails represents a small percentage of similar habitats within refuge lands.

Alternative B, like alternatives C and D, proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis .

Impacts to Upland Habitats of Alternative C

Beneficial Impacts. Alternative C would provide the second highest level of beneficial impacts to upland habitat compared to alternative A associated with conserving uplands on up to 197,337 across 22 CFAs, including the 19 CFAs proposed in alternative B that would be expanded in size within alternative C. Thus, alternative C promotes protection of a considerably larger and more intact and diverse upland configuration within the larger watershed landscape, encompassing 187,806 acres of upland habitat in total (Table 5.7). Priority refuge resources of concern wildlife benefitting from alternative B's upland habitat protection is illustrated in Table 5.7 above, and upland habitats subject to protection include: spruce-fir forest (22,707 acres), hardwood forest (150,927 acres), woodlands (476 acres), pasture, hay, and grasslands (9,637 acres), old field and shrublands (52 acres), cliff and talus (1,868 acres), rocky outcrop (2,098 acres), and rocky coast and islands (41 acres). These protected upland acres will also maintain essential upland habitat and ecosystem functions and values. It is recognized, however, that acquiring the full 187,806 upland habitat acres within this alternative would take many years, likely well beyond the 15 year horizon of this CCP, indicating that any potential upland gains over the CCP 15 year horizon would be minor in the short term, but may be modest over the long term.

Beneficial impacts from habitat management, including forest, shrubland, and grassland habitats, will be greatest under alternative C (Table 5.4), and is expected to benefit or improve the ecological structure and functions of currently degraded forests, or maintain or expand early-successional grassland and shrublands. Target priority refuge resources of concern species would receive some of these beneficial impacts.

Alternative C would continue to permit managed furbearer trapping and hunting on uplands at the Nulhegan Basin and Pondicherry Divisions as described in alternative A while also offering potential new hunting opportunities on future land acquisitions. . Beneficial impacts from hunting and trapping are more dependent on participants than on total available acres, so there is considerable uncertainty around the relative level of impacts from this alternative compared to the others.

Adverse Impacts. Over the 15 year CCP horizon, alternative C encompasses management of a minimum of 12,873 acres of habitat compared to 455 acres under alternative A: 11,550 acres of forest, 548 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant

USFWS

Wild turkey

species (Table 5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs..

We would conduct a greater amount (+11,295 ac) of forest management under alternative C over alternative A (255 acres), which also is an additional +3,890 acres over alternative B; over time additional acres could become subject to active management if determined necessary through development of future HMPs. We increase grassland management by 348 acres, and initiate management of shrubland habitat (775 acres) (similar to alternative B), largely intended to benefit New England cottontail. Most forest management is expected to occur on uplands, although some will occur in wetland habitat as noted in the prior section. Management would be conducted as noted in alternative A to protect upland resources, and ultimately to enhance their structure and function. Adverse impacts from ground-disturbing activities under alternative C would the largest among the alternatives, assuming that adverse impacts correlate with the number of acres management. These management impacts would be considered local and of negligible adverse impact in the short term and of no adverse impact over the long term.

Visitation under alternative C is expected to be the highest when compared to the other alternatives (Table 5.5). Potential adverse impacts would be similar to those discussed under alternative B. Visitor activities that might impact uplands, such as hiking off designated trails and snowmobiling would pose a minor concern, as previously discussed, constituting a negligible adverse impact in the short and long term.

The most common impacts to vegetation attributable to snowmobiles are physical damage like bending and breaking when hit or run over (Stangl 1999), however, given that all trails overlay roads, such impacts are not expected. Additionally, plants are impacted during trail maintenance when shrubs and sapling trees are trimmed back; however, similar impacts occur in the process of maintaining roadsides and would be completed regardless of a snowmobile trail network. Most trimming associated with the snowmobile trail is done by tractor-mounted brushcutters which sets back growth, but often does not kill the plants. Brush cutting only occurs when woody plants encroach within the road corridor or are tall enough to protrude above the snow surface. Plants in the snowmobile trail probably end winter dormancy later and are less productive than those that are unaffected (Stangl 1999). No federal or state listed plants are known from the area encompassing the snowmobile trail. The amount of habitat directly affected by snowmobile trails represents a small percentage of similar habitats within refuge lands.

Like alternatives B and D, alternative C also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to Upland Habitats of Alternative D

Beneficial Impacts. Refuge activities proposed in alternative D (passive management) are expected to have minor short-term and moderate long-term beneficial impacts. Alternative D would provide the highest level of beneficial impacts from protecting habitat compared to all other alternatives, because, over the long term, it would protect up to 235,887 acres of uplands across 22 CFAs (Table 5.7). This alternative proposes a low-impact nearly passive form

of management. It is recognized that acquisition of the full potential refuge is likely to take decades, well beyond the 15 year horizon of this CCP. This passive management approach results in permanent protection, unaltered forest succession, increase in late-succession forest, increased structural diversity (e.g. snags, coarse woody debris), and the lowest annual planned budget needed to perform management. Priority refuge resources of concern wildlife benefitting from alternative D's upland habitat protection is illustrated in Table 5.7 above, and upland habitats subject to protection include: spruce-fir forest (23,784 acres), hardwood forest (195,578 acres), woodlands (649 acres), pasture, hay, and grasslands (11,255 acres), old field and shrublands (99 acres), cliff and talus (2,094 acres), rocky outcrop (2,387 acres), and rocky coast and islands (41 acres).

Alternative D would also create the greatest amount of connections between CFAs and other public conservation lands. As noted prior, these protected upland acres will also maintain essential upland habitat and ecosystem functions and values (e.g., wildlife habitat, groundwater recharge, nutrient processing, and storm mitigation). This approach is expected to have the lowest impact threshold of all alternatives proposed. Benefits to priority refuge resources of concern wildlife under passive management likely would not fully be realized for decades into the future due to the pace of natural forest succession, and such benefits over the long term would be more likely to benefit forest priority refuge resources of concern species vs. early-successional species.

Some beneficial impacts to upland habitats would be realized by eliminating snowmobiling on refuge lands. The most common impacts to vegetation attributable to snowmobiles are physical damage like bending and breaking when hit or run over (Stangl 1999), however, given that all trails overlay roads, such impacts are not expected. Additionally, plants are impacted during trail maintenance when shrubs and sapling trees are trimmed back; however, similar impacts occur in the process of maintaining roadsides and would be completed regardless of a snowmobile trail network. Most trimming associated with the snowmobile trail is done by tractor-mounted brushcutters which sets back growth, but often does not kill the plants. Brush cutting only occurs when woody plants encroach within the road corridor or are tall enough to protrude above the snow surface. Plants in the snowmobile trail probably end winter dormancy later and are less productive than those that are unaffected (Stangl 1999). No federal or state listed plants are known from the area encompassing the snowmobile trail. The amount of habitat directly affected by snowmobile trails represents a small percentage of similar habitats within refuge lands, so the beneficial impacts are highly localized in space.

Adverse Impacts. Alternative D represents the least impacting management activities, promoting a low impact, passive approach. This approach would result in extremely negligible short- and long-term adverse impacts to refuge upland habitats, although other impacts through natural processes (e.g., storms, floods) would occur. Under this alternative, the refuge generally would not respond to these natural events. Under alternative D there would be no active habitat management designed for target priority refuge resources of concern wildlife. Thus, there will be no regularly prescribed silvicultural operations, mowing, burning, or active management activities on upland habitats.

Management steps would be taken to mitigate unexpected events that may pose safety hazards (e.g., repair of collapsed culvert causing flooding, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming). In the absence of active management,

desired wildlife habitat may develop more slowly or not at all, depending on site characteristics, prior management history, and natural disturbance frequency. This could have adverse impacts on the priority refuge resources of concern dependent upon upland habitats, although there is considerable uncertainty around the degree of these impacts related to uncertainty in future disturbance events and forest development.

Visitation under alternative D is projected to the second largest, 25 percent greater than alternative A despite the elimination of snowmobiling (Table 5.5) and furbearer trapping. Potential adverse impacts would be similar to those discussed under alternative B.

Like alternatives B and C, alternative D also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Due to the passive management approach for alternative D, there would be no managed furbearer trapping at the Nulhegan Basin Division (CFA), which may adversely impact refuge habitats and infrastructure. The most likely adverse impact is the loss of upland habtiats to freshwater wetland habitats as a result of beaver activity. There is evidence that over-browsing in wetland systems has occurred in forests of the Nulhegan Basin Division, and Northeast Kingdom in general although it is believed the current ungulate populations are at an acceptable level. Current refuge hunts (e.g., 350 annual hunt visits at Nulhegan Basin Division), which would continue under alternative D, are believed to help lessen potential problem, and the potential adverse impact from over-browsing in wetlands is considered negligible in the short term, yet the long-term impacts will have to be monitored.

Summary

In summary, our management activities across alternatives would not *significantly* adversely or beneficially impact refuge upland habitats. As previously noted, all alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). By continuing to protect and manage existing refuge uplands and proposing to acquire additional acres of habitat, we will have direct and long-term beneficial impacts on upland habitats and the species that rely on them. Maintaining and protecting uplands will help to guarantee their beneficial ecosystem functions that serve wildlife (e.g., habitat) and society at large (e.g., amelioration of climate change). We again note that acquisition of additional acres to full acquisition levels proposed in the alternatives will not occur within the short term framework of this CCP (15 years) but will continue in the long term well beyond the 15 year CCP cycle. Proposed refuge management activities–forest management, prescribed burning, trail construction, snowmobile use–may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact.

Impacts to Biological Integrity, Diversity, and Environmental Health (BIDEH)

One of the Refuge System's mandates is to maintain the integrity, diversity, and health of trust species and populations of wildlife, fish, and plants. This mandate is outlined in the Refuge System's biological integrity, diversity, and environmental health policy (BIDEH, *http://www.fws.gov/policy/601fw3.html*; accessed August 2016). Consequently, the refuge recognizes that it must promote management actions that provide for representative,

redundant, and resilient populations of priority refuge resources of concern trust species (*representation*: conserving the genetic diversity of a taxon; *redundancy*: sufficient populations to provide a margin of safety; *resilience*: the ability to withstand demographic and environmental variation). The maintenance and enhancement of habitat connectivity is critical for all units of the refuge. This is particularly important as the Service and Refuge System shift land management priorities to better enable species to adjust to climate change. Increasing the size of the refuge land base is a prime theme of this final CCP, and that effort is driven by the assumption that a greater conservation landscape will better mitigate for the impacts of climate change on fish and wildlife.

- We evaluated the proposed alternatives for their potential to beneficially or adversely impact the principals of BIDEH. Our proposed management actions include conservation actions targeting a wide range of priority refuge resources of concern, including species and habitat types that reflect the refuge's commitment to conserving BIDEH. CFAs with BIDEH sub-objectives corresponding to specific habitat types are described in Table 5.8.

  The potential beneficial impacts to BIDEH resulting from refuge management activities described in the alternatives include:

  - Extent to which refuge land acquisition and habitat conservation would protect essential habitats from potential development, thus promoting BIDEH.
  - Habitat management and restoration activities designed to improve habitat structure and integrity for priority refuge resources of concern and BIDEH.
  - Invasive plant, invasive insect, and pathogen control.
  - Habitat recovery through removal of unneeded buildings and roads.
  - Partnership support.
  - Effective visitor interpretation.

  The potential adverse impacts of refuge management actions within the alternatives that were evaluated included impacts from:

  - Habitat management activities.
  - Invasive plant control.
  - Prescribed burning in appropriate fire-regime habitats, or for hazardous fuel reduction.
  - Visitor use impacts on refuge lands, trails, and roads (e.g., hiking, snowmobiles, and introduction of invasive species).
  - Construction, maintenance, and removal of trails, parking facilities, buildings, and roads.

Table 5.8. CFAs Having BIDEH Sub-objectives for Major Habitat Types as Identified for Action Alternatives B, C, and D (derived from appendix A).

Conservation Focus Area	Forested Uplands and Wetlands	Non-forested Uplands and Wetlands	Inland Aquatic Habitats	Coastal Non-forested Uplands	Coastal Wetlands and Aquatic Habitats
Maromas CT	✔	✔			
Pyquag CT	✔	✔			
Muddy Brook CT	✔	✔			
Salmon River, CT	✔	✔			
Scantic River CT					
Whale-bone Cove	✔			✔	✔
Farmington River CT/MA	✔	✔			
Dead Branch MA	✔	✔			
Fort River MA					
Mill River MA					
Westfield River MA	✔	✔			
Sprague Brook NH/MA*	✔				
Ashuelot NH	✔	✔			
Blueberry Swamp NH		✔			
Mascoma River NH	✔				
Pondicherry NH					
Nulhegan Basin VT		✔			
Ompompanoosuc VT		✔			
Ottauquechee River VT *	✔				
West River VT*	✔	✔			
White River VT	✔	✔			
Quonatuck CT, MA, NH, VT	✔	✔	✔	✔	✔

**Sprague Brook, Ottauquechee River, and White River are not included in Alternative B but are included in alternatives C and D.*

Impacts to BIDEH That Would Not Vary by Alternative

Proposed refuge conservation and management activities would neither *significantly* benefit nor adversely impact the current BIDEH on undeveloped lands of the Connecticut River watershed, nor current or expanded refuge lands. We expect refuge land conservation and management under all alternatives to help maintain and even improve current BIDEH (e.g., restoring stream connectivity, floodplain forest, re-establishing vegetative corridors, etc.). All of these BIDEH functions and values will be promoted on the existing 37,000 refuge acres and on future lands the refuge acquires. It is recognized, however, that acquisition of lands comprising the full potential refuge would take many years, likely beyond the 15-year horizon of this CCP. In the short term (within 15 years), we would likely acquire similar amounts of habitat under all the alternatives, thus beneficial impacts would be similar across all alternatives in the short term. Over the long term, alternatives C and D would have greater BIDEH benefits because

they would permanently protect a greater amount of habitat in larger, more connected blocks, from development.

Across all alternatives, our management actions only contribute to the permanent impairment of BIDEH when constructing new trails, parking lots, elevated boardwalks and observation platforms. We believe impacts from these activities would be negligibly adverse in the short and long term. There are no explicit plans for major facilities or new road construction in upland habitats; however, action alternatives (B, C, D) propose a potential outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis. Regardless of which alternative is selected, we would continue to use BMPs in all management activities that might impact refuge habitats (e.g., approved herbicide use for invasive plant control, maintaining appropriate wetland buffers, implementation of forest management BMPs).

Across all alternatives, the refuge would restore and protect rare and exemplary habitats, reduce or eliminate invasive plants and, where appropriate, insect populations through partnerships with CISMAs on- and off-refuge lands. Regarding invasive plants in this chapter–treatment could include mechanical, prescribed fire, USDA-approved biological controls, and herbicides, either singly or in combination. As noted prior, the Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection, would review our Pesticide Use Proposals and approve any chemical herbicide use, although certain chemicals can be approved and used at the field station. All of these methods will eventually be incorporated in a refuge specific Integrated Pest Management plan.

Within the regional and refuge specific landscape, habitat management activities across alternatives are negligibly adverse in the short term and beneficial in the long term. Habitat management designed to improve habitat structure for priority refuge resources of concern would include recognized management techniques appropriate to the restoration of degraded habitat, or to the maintenance of early-successional habitats. Operations performed by contractors will be overseen by refuge staff.

The Service regulates human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses) and thus curtails anthropogenic impacts that may impair BIDEH functions and values. All alternatives predict some increase in annual visitor numbers over time (Table 5.5). Increases vary due to each alternative's respective refuge expansion level and impacts are expected to be negligibly adverse in the short and long term. Alternative A predicts the second lowest annual increase (Table 5.5), since no expansion of hiking trails and visitor use is proposed, while alternative C predicts the highest increase due to its large refuge expansion proposal with 22 miles of new conventional trails potentially modifying and disturbing up to 44 acres of habitat; similarly, alternative D proposes modification and disruption of up to 22 acres to create 22 miles of 'back-country' trails. All of these trails, however, would be situated to minimize BIDEH impacts while still providing for priority public uses.

Pets on leash are permitted on most refuge trails, yet their waste can cause negative adverse impacts to refuge habitats and natural water quality. There are no known dog waste problems on any refuge division or unit, and land acquired in the future will be carefully managed — requiring dog walkers to clean up pet waste.

Visitors and visitor use activities can be a source of introducing invasive plant seeds, and the refuge seeks to minimize these potential impacts by appropriately restricting use and conducting public education and awareness activities. The refuge has a full time Invasive Plant Control Initiative Coordinator who works on educational and other partnership projects full time. Refuge staff were

instrumental in forming, and coordinating the New England Invasive Plant Group (NIPGro). This organization networks the many individuals, organizations and agencies interested in controlling invasive plants in the region and is working toward the end goal of comprehensive prevention and control to protect natural communities and native species. Additionally, supported by a six-year grant from the U.S. Department of Agriculture, three major partners in NIPGro (the University of Connecticut; the New England Wild Flower Society; and the Silvio O. Conte National Fish and Wildlife Refuge) have begun developing an early warning/rapid response system. It is based on the Invasive Plant Atlas of New England, or IPANE. The project has trained 600 volunteers to recognize a broad array of invasive plants and has deployed these volunteers to natural areas all over New England.

Under all alternatives, management steps would be taken to mitigate unexpected events that may pose safety hazards (e.g., flooding due to collapsed culvert, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede desired natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing). Some short-term, negligible to minor adverse impacts on BIDEH may occur associated with such management steps.

Regardless of which alternative we select, we would take a number of steps to insure that we have sufficient scientific data to support management decisions regarding promotion of BIDEH. We would work with our own Service Division of Ecological Services and other appropriate partners to help identify and correct any impacts to BIDEH functions and values.

Impacts to BIDEH of Alternative A

Beneficial Impacts. Alternative A represents current management, building off the 1995 FEIS and Action Plan (USFWS 1995). Alternative A would provide short- and long-term beneficial impacts to the species and habitats outlined in the refuge purposes and the more recent BIDEH policy because it would protect up to 97,830 acres (37,000 acres currently acquired) across 65 widely separated, often small SFAs. The diversity of habitat types within the 65 SFAs are not quantified; however, species and habitat types benefitting are noted in appendix A of the FEIS. All of the habitat related management actions currently conducted under alternative A are essentially designed to promote refuge purposes and BIDEH. Forest management is designed achieve appropriate habitat structure for select priority refuge resources of concern species. Control of invasive plants promotes the establishment and persistence of native plants. Mowing and haying of grassland areas supports the existence of that special habitat. All of these activities, as noted in more detail in prior sections, are expected to have minor short- and long-term beneficial impacts on BIDEH at the refuge.

Adverse Impacts. Alternative A would include very few ground disturbing activities that might adversely impact the noted refuge purposes or BIDEH, both in the short and long term. These include management of the woodcock demonstration units at the Nulhegan Basin Division, the annual mowing and haying of grassland on the Fort River, Nulhegan Basin, and Pondicherry Divisions, controlled mechanical and herbicide use, maintenance of six buildings, roadside maintenance (40 miles public, 2 miles administrative), and visitor use impacts (e.g., 20 miles of trails). Both regionally and refuge-specific, these activities are of negligible short- and long-term adverse impact. Best management practices are implemented in all ground disturbing activities (e.g., habitat management, trail construction), as further described in prior sections. Over time, visitation under alternative A would not appreciably change over current levels and is expected to be lower than any of the other alternatives. As

such, visitor activities that might adversely impact BIDEH would pose negligible adverse impacts in the short and long term.

Promoting BIDEH would include removing unneeded infrastructure on property acquired by the refuge. Roads would remain open to provide motorized and non-motorized access by visitors, and to conduct habitat management actions. All road infrastructure will follow BMPs during their maintenance and use. We do not plan to increase capacity for snowmobiling regardless of alternative (and alternative D would eliminate snowmobiling); rather, we plan only to maintain existing use levels. Snowmobile trails on new lands to be acquired under alternatives B and C may be maintained, and in select situations closed trail may be opened to promote wildlife-dependent public uses. As noted under the Water Quality Impact section, snowmobiling can introduce petroleum hydrocarbons to wild lands; however, it is unlikely that the potential adverse impacts would be any more than minor, and in most locales negligible.

Impacts to BIDEH of Alternative B

Beneficial Impacts. Alternative B would likely result in short- and long-term beneficial impacts because it promotes BIDEH on up to 97,772 acres (37,000 currently acquired) but across 19 consolidated CFAs as compared to the current 65 widely separated, often small, and logistically difficult to manage SFAs. As noted in Rudnick et al. 2012, landscape connectivity, the extent to which a landscape facilitates the movements of organisms and their genes, faces critical threats from both fragmentation and habitat loss. Loss of connectivity can reduce the size and quality of available habitat, impede and disrupt movement (including dispersal) to new habitats, and affect seasonal migration patterns. These changes can lead, in turn, to detrimental effects for populations and species, including decreased carrying capacity, population declines, loss of genetic variation, and ultimately species extinction. Thus, alternative B promotes protection of a generally more intact and connected ecosystem. These beneficial ecosystem impacts would be considered minor in the short term and modest in the long term (assuming regular refuge expansion over time). Table 5.8 illustrates CFAs that have sub-objectives specifically addressing the BIDEH functions and values; these sub-objectives are derived from appendix A and, although designed specifically for alternative C (preferred alternative), would generally be applicable to alternative B.

Similar to alternative A, all of the habitat related management actions proposed in alternative B are designed to promote refuge purposes and BIDEH. All of these activities, as discussed in more detail in prior sections, are expected to have minor short-term and modest long-term beneficial impacts on the BIDEH of the refuge and its biological resources. Over the 15 year CCP horizon, alternative B encompasses management of a minimum of 9,312 acres of habitat (Table 5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs. Such management would be designed to improve and enhance habitat structure, thus its function and value. In doing such, we plan to benefit BIDEH, expecting the impact to be minor in the short term and modest in the long term. These benefits would be greater under alternative B than under alternative A or D, but less than under alternative C.

Adverse Impacts. Similar to alternative A, alternative B would include relatively few ground disturbing activities that might adversely impact refuge BIDEH. Over the 15 year CCP horizon, alternative B encompasses management of a maximum of 9,312 acres of habitat compared to 455 acres under alternative A: 7,660 acres forest, 422 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (Table 5.4). Additional management action would be subject to additional NEPA review. Adverse impacts from ground-disturbing activities under alternative B would be greater than under alternatives A or D, but probably less than under alternative

C, assuming that adverse impacts correlate with the number of acres managed. These management impacts would be considered local and of negligible adverse impact in the short term and of no adverse impact over the long term.

Visitation under alternative B would increase about 22 percent over alternative A, less than under alternatives C or D (Table 5.5). Increased visitor activities that might impact BIDEH, such as hiking off designated trails and snowmobiling would pose a minor concern. Visitor activities that might impact BIDEH include disruption of trail-side plants or low nesting migratory birds, potential introduction of invasive plant seeds. These pose short- and long-term impacts to BIDEH functions and values, but nevertheless would be considered of negligible to minor.

Alternative B also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to BIDEH of Alternative C

Beneficial Impacts. Alternative C would promote similar beneficial impacts as those described in alternative B, and would provide the second highest level of beneficial BIDEH impacts compared to alternative A and other alternatives because it would conserve habitat and ecosystem functions on up to 197,337 across 22, including the 19 CFAs proposed in alternative B that would be expanded in size within alternative C.

Over the 15 year CCP horizon, alternative C encompasses management of a minimum of 12,873 acres of habitat compared to 455 acres under alternative A: 11,550 acres. forest, 548 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (Table 5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs. Such management would be designed to improve and enhance habitat structure, thus its function and value. In doing such, we plan to benefit BIDEH, expecting the impact to be minor in the short term and modest in the long term. The beneficial impacts of alternative C would be identical in nature and substance to those discussed in alternative B but would be expected to be considerably higher due to the greater possibility of protecting diverse refuge and watershed habitats that are more ecologically intact due to the proposed CFA structure proposed in this alternative. These beneficial ecosystem impacts would be considered minor in the short term and modest in the long term.

Adverse Impacts. Similar to alternative A, alternative C would include relatively few ground disturbing activities that might adversely impact refuge BIDEH, particularly over the long term. Over the 15 year CCP horizon, alternative C encompasses management of a minimum of 12,873 acres of habitat compared to 455 acres under alternative A: 11,550 acres. forest, 548 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (Table 5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs. Management (e.g., forest silviculture, grassland mowing, control of invasive plants) would be conducted as noted in prior sections to restore degraded habitats or create early-successional habitat for priority refuge resources of concern species. Adverse impacts from ground-disturbing activities under alternative C would be greater than under the other alternatives, assuming that adverse impacts correlate with the number of acres management. These management impacts would be considered local and of negligible adverse impact in the short term and of no adverse impact over the long term.

Visitation under alternative C is expected to be the highest when compared to the other alternatives (Table 5.5). Potential adverse impacts would be similar to those

discussed under alternative B. Visitor activities that might impact BIDEH, such as hiking off designated trails and snowmobiling would pose a minor concern, as previously discussed, constituting a negligible adverse impact in the short and long term.

Like alternative B, alternative C also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to BIDEH of Alternative D

Beneficial Impacts. Alternative D would promote similar beneficial impacts as those described in alternative B, and provide the highest level of short- and long-term beneficial impacts to BIDEH compared to all other alternatives from permanently protecting up to 231,307 acres across 22 CFAs. Table 5.8 illustrates CFAs that have sub-objectives under goals and objectives (appendix A) specifically for advancing BIDEH functions and values within action alternative C; these sub-objectives would also be applicable to action alternative D. Thus, alternative D promotes BIDEH functions and values to the greatest extent of the alternatives due to the potential protection of a considerably larger, more intact and connected ecosystem within the larger watershed.

Eric Engbretson/USFWS

Brook trout

None of the active habitat management regimes noted for alternatives A, B, and C would be employed in alternative D. Benefits to priority refuge resources of concern wildlife under passive management likely would not fully be realized for many decades into the future due to the unfettered pace of natural forest succession, and without significant natural intervention of plant succession (e.g., extensive fires, local hurricane blowdowns) such benefits over the long term may be more likely to benefit interior forest priority refuge resources of concern species vs. early-successional species on current and future refuge lands).

Adverse Impacts. Alternative D would not employ active habitat manipulation but would rely upon a natural, passive approach to sustaining BIDEH on refuge lands, except under uncontrollable, extenuating circumstances (e.g., in response to a major natural disturbance or disaster). Under alternative D there would be no active forest management designed for target priority refuge resources of concern wildlife. Consequently, for priority refuge resources of concern early-successional species such as American woodcock, bobolink, upland sandpiper, and New England cottontail, natural events may not be adequate to sustain foraging or breeding habitat on current and future refuge lands, and this may be a minor adverse negligible impact to such species.

Visitation under alternative D is projected to be the second largest, 25 percent greater than alternative A despite the elimination of snowmobiling (Table 5.5) and furbearer trapping. Potential adverse impacts would be similar to those discussed under alternative B. As noted prior, visitor activities on back-country trails that might impact native plants, breeding birds, and soil stability would pose direct and indirect adverse impact to BIDEH functions and values compared to the other alternatives, but nevertheless would be considered of negligible impact, both in the short and long term.

Alternative D also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Summary

In summary, our management activities across alternatives would not *significantly* impact BIDEH adversely or beneficially on refuge habitats or future habitats. As previously noted, all alternatives facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). With the potential addition of habitat to the refuge, in combination with currently protected lands (37,000 acres), we anticipate better protection of BIDEH functions. The continued maintenance of existing refuge uplands and the potential to acquire and permanently protect more will be of direct and long-term beneficial impacts to promoting BIDEH over the short and long term. Maintaining and protecting the defined LCC subhabitats will help to guarantee their beneficial ecosystem functions that serve wildlife (e.g., habitat) and society at large (e.g., biological diversity and ecosystem stability). Proposed refuge management activities — forest management, prescribed burning, trail construction, snowmobile use — may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact to BIDEH.

Impacts to Federally Threatened and Endangered Species

The watershed hosts fourteen federally listed threatened and endangered species, and seven species proposed for federal listing (Table 5.9). All of these species could potentially benefit directly from land protection outlined in this proposal, although not all of these species' recovery plans specifically call for refuge land protection. Some recovery plans are over 20 years old, are in need of updating, and were developed at times where proposing additional Federal land protection was not a preferred option. Therefore, land protection was not considered in some of these recovery plans as a potential alternative or recovery strategy. However, as is the case with other priority species of conservation concern, where habitat loss or degradation is impacting population levels, Service protection of additional key habitat areas in the watershed will help temper those losses.

Table 5.9. Federally listed species and species proposed for listing

Species	Listing Status
Species with recovery or 5-year plans that specifically mention land protection	
Dwarf wedgemussel	Endangered
Jesup's milk-vetch	Endangered
Northeastern bulrush	Endangered
Puritan tiger beetle	Threatened
Other federally listed species	
Atlantic sturgeon	Endangered
Indiana bat	Endangered
Red knot	Endangered
Roseate tern	Endangered
Shortnose sturgeon	Endangered
Canada lynx	Threatened
Northern bog turtle	Threatened
Northern long-eared bat	Threatened
Piping plover	Threatened

Species	Listing Status
Small whorled pogonia	Threatened
Species proposed for listing	
Bicknell's thrush	Proposed
Brook floater	Proposed
Cobblestone tiger beetle	Proposed
Monarch butterfly	Proposed
Regal fritillary	Proposed
Tri-colored bat	Proposed
Yellow banded bumble bee	Proposed

There are numerous state-listed species that also exist within existing and proposed refuge lands. Appendix A presents tables of species of conservation concern for each CFA, which includes both federally and state-listed species.

We evaluated the proposed habitat management actions and strategies of all alternatives for their potential to impact, beneficially or adversely, the above species and their breeding, migration, and wintering habitats or where they may seasonally concentrate. Our proposed management actions include conservation targeting Federal and state endangered species, such as reducing forest fragmentation, restricting or minimizing public use in sensitive habitats, or enhancing early-successional shrub habitat.

We compared the benefits of the alternatives from actions that would protect federally threatened and endangered wildlife including:

- Refuge land acquisition and habitat conservation.
- Invasive plant and insect control.
- Refuge habitat management activities.
- Partnership support and collaboration in restoration activities.
- Effective visitor interpretation.
- The potential adverse impacts of refuge management actions within the alternatives that were evaluated included impacts from:
- Habitat management activities.
- Mowing and haying grasslands, and managing early-successional shrublands.
- Refuge construction activities or demolition of infrastructure.
- Road maintenance.
- Visitor use of refuge trails and roads
- Prescribed burning.

Under all alternatives we will monitor populations of listed and proposed species as appropriate and work with the Service's New England Field Office to

determine whether habitat management activities or modifications are warranted to benefit the species. Such activities would be documented in an HMP, and go through the NEPA process and Section 7 consultation. We will manage habitats specifically for listed and proposed species only after landscape conservation measures have been identified and the importance of refuge habitats has been determined.

Impacts to Listed and Proposed Species That Would Not Vary by Alternative
Within the watershed and regionally, there would be negligible to moderate beneficial impacts to listed and proposed species over the short and long term from the conservation of habitats within existing 37,000 acre refuge.

The refuge proposes no management action that would directly impact, adversely or beneficially, any of the listed or proposed species (Table 5.9). However, the refuge will be active in coordination with Federal and state partners and the Connecticut River Coordinator's Office to contribute to species conservation and recovery. Whenever new lands are acquired by the refuge that include known habitat for these species or could be managed to provide habitat, the refuge will take appropriate management action to help recover or sustain those species. Such management actions would be taken after appropriate review and consultation with recognized experts and Service approval, including Section 7 consultation where appropriate.

Disturbance resulting from public use could impact listed and proposed species. Across all alternatives, the refuge will prevent any direct impacts to federally listed beetles (Puritan tiger beetles, cobblestone tiger beetle) or plants (Jesup's milk-vetch, northeastern bulrush, small whorled pogonia) on any lands owned by the refuge by closing occupied areas to public use, monitoring known populations, and controlling vegetation where appropriate. For example, the Putney Mountain Unit in Vermont was purchased to protect a known population of the endangered Northeastern bulrush. The existing trail network is scheduled for expansion and efforts will be made to minimize impacts to the northeastern bulrush (USFWS 1993). There are no known current impacts to the species due to these activities, although the refuge will continue to monitor for any impacts, working with the Service's New England Field Office as needed.

The refuge manages 20 miles of trails, not including snowmobile trails, (e.g., Mud Pond at Pondicherry, the trail at Fort River, and the Nulhegan River Trail, the North Branch Trail, and the Mollie Beattie Bog Trail at Nulhegan Basin Division) and 42 miles of gravel road (40 public, 2 administrative); however, none of these public uses would infringe on any listed or proposed species. We do not predict adverse impacts on Canada lynx as a result of winter maintenance of roads and trails, along with snowmobiling and skiing. Although some have suggested that the packed snow trails created by these activities could allow coyotes access to traditional Canada lynx winter habitat and that this could reduce lynx population viability, a study to test this found no evidence that snowmobile trails significantly expanded coyote ranges, or that competition with coyotes, or other potential competitors such as bobcats, is negatively affecting Canada lynx populations (Kolbe et al. 2007).

The quantity of pesticides used during invasive plant control is minimal and varies from year to year, but would not be used where it could harm any of the listed or proposed species. Like other management actions, additional consultation and evaluation would be performed before implementing pesticide use in areas used by listed or proposed species.

The refuge is required to identify potential impacts to federally endangered species in a section 7 interagency endangered species consultation as an integral

part of the Service's annual pesticide use proposal program. These reviews assure that impacts are considered case-by-case and are avoided or minimized.

Impacts to Threatened and Endangered Species from Alternative A
Beneficial Impacts. There are additional yet negligible beneficial impacts from expanding the refuge up to a total of 97,830 acres within the original SFAs. Benefits to individual species could vary significantly over the short-term, depending on where additional refuge lands are acquired. The precise list of federally threatened, endangered, and candidate species that will benefit from lands and habitats protected in alternative A cannot be identified because of the lack of detailed descriptions of SFA boundaries. However, nearly all of the species listed in Table 5.9 would negligibly benefit under alternative A from proposed land protection and from refuge staff working with partners on larger conservation measures. Some of the proposed management actions (e.g., creating and maintaining early successional forest habitat) may promote habitat or benefit other species, leading to both indirect and direct benefits to listed or proposed species by improving their prey base or reducing intraspecific competition. Compared to the other alternatives, alternative A would likely have the least benefit to these federally threatened and endangered species as a group.

Adverse Impacts. Adverse impacts on listed or proposed species from the acquisition of additional acreage to bring the total within the refuge to 97,830 are expected to be minimal to non-existent (determined to either have no impact or unlikely to adversely impact).

None of the management activities are expected to have more than a short- and long-term negligible impact on listed species. Forest management under alternative A would be limited to promoting early successional vegetation in the woodcock habitat demonstration units at the Nulhegan Basin Division. Grassland management is also limited in scale and scope and is unlikely to adversely impact federally listed species. Grassland management already follows best management practices such as mowing only after July 15, in order to mitigate any threat posted to nesting birds. Grassland management is done with an understanding of the tradeoffs between disturbing the ground and maintaining adequate habitat for species dependent on grassland ecosystems (Wadsack and Tillmann 2011, Erb and Jones 2011).

Any changes or expansions to existing management activities will go through an HMP and/or Section 7 process to avoid adversely impacting any proposed or listed species. Our current understanding is that existing populations of proposed or listed species, such as Canada lynx and dwarf wedge mussel, are not being impacted by ongoing management. While some refuge activities, such as construction, traffic, and invasive plant control, could affect these species, we currently do not conduct such activities in areas listed species are known to occupy.

Compared to the other alternatives, alternative A has a lower likelihood of adversely affecting listed and proposed species than alternatives B and C, but greater than in alternative D, if one assumes that there is a linear relationship between active management and impact. If we accomplish our goal of having no impact on listed or proposed species from management, then adverse impacts from management will be the same for all alternatives. The same pattern would hold for adverse impacts stemming from visitor use.

Impacts to Threatened and Endangered Species from Alternative B
Beneficial Impacts. Regionally and within the watershed, the benefits to listed species of alternative B would generally follow those in alternative A. Benefits to individual species could vary significantly over the short-term, depending on

where additional refuge lands are acquired. The species listed in Table 5.9 would negligibly benefit under alternative B from proposed land protection and from refuge staff working with partners on larger conservation measures. Some of the proposed management actions (e.g., creating and maintaining early successional forest habitat) may promote habitat or benefit other species, leading to both indirect and direct benefits to listed or proposed species by improving their prey base or reducing intraspecific competition.

Compared to alternative A, alternative B offers several additional areas that contain habitat for the shortnose sturgeon (Maromas CFA), Atlantic salmon (Maromas, Ompompanoosuc, and West River CFAs), and dwarf wedgemussel (Ashuelot CFA). Alternative B consolidates lands across 19 CFAs, as compared to the current 65 widely separated, often small, SFAs. Compared to scattered SFAs under alternative A, the CFAs proposed under alternative B promote protection of a generally more intact and connected landscape. Although alternatives B and A protect similar amounts of acres of habitat, we predict that alternative B will provide better protection for listed and proposed species because it would protect larger blocks of habitat compared to alternative A. However, alternative B would protect less habitat than alternatives C and D.

Adverse Impacts. None of the management activities are expected to have more than a short- and long-term negligible impact on listed species. Forest management under alternative B would include forest management and potentially fuels reduction across more acres than under alternative A, although the focus would be continue to be on promoting early successional vegetation in the woodcock habitat demonstration units at the Nulhegan Basin Division. Grassland management is also limited in scale and scope and is unlikely to adversely impact federally listed species. Grassland management already follows best management practices such as mowing only after July 15, in order to mitigate any threat posted to nesting birds. Grassland management is done with an understanding of the tradeoffs between disturbing the ground and maintaining adequate habitat for species dependent on grassland ecosystems (Wadsack and Tillmann 2011, Erb and Jones 2011). Potential impacts from increased visitor use under this alternative include those from trail construction as well as from visitors themselves, but these will be designed to avoid impacts on any listed or proposed species.

Any changes or expansions to existing management activities will go through an HMP and/or Section 7 process to avoid adversely impacting any proposed or listed species. Our current understanding is that existing populations of proposed or listed species, such as Canada lynx and dwarf wedge mussel, are not being impacted by ongoing management. While some refuge activities, such as construction, traffic, and invasive plant control, could affect these species, we currently do not conduct such activities in areas listed species are known to occupy.

Compared to the other alternatives, alternative B has a lower likelihood of adversely affecting listed and proposed species than alternative C, but greater than in alternatives A and D, if one assumes that there is a linear relationship between active management and impact. If we accomplish our goal of having no impact on listed or proposed species from management, then adverse impacts from management will be the same for all alternatives. The same pattern would hold for adverse impacts stemming from visitor use.

Impacts to Threatened and Endangered Species from Alternative C

Beneficial Impacts. Regionally and within the watershed, the short- and long-term beneficial impacts to listed species of alternative C would be similar to alternative A, and almost identical to alternative B. Benefits to individual species could vary significantly over the short-term, depending on where additional

refuge lands are acquired. The species listed in Table 5.9 would negligibly benefit under alternative C from proposed land protection and from refuge staff working with partners on larger conservation measures. Some of the proposed management actions (e.g., creating and maintaining early successional forest habitat) may promote habitat or benefit other species, leading to both indirect and direct benefits to listed or proposed species by improving their prey base or reducing intraspecific competition.

Compared to alternative A, alternative C would offer several additional areas that contain habitat for the shortnose sturgeon (Maromas CFA), Atlantic salmon (Maromas, Ompompanoosuc, and West River CFAs), and dwarf wedgemussel (Ashuelot CFA). Alternative C consolidates lands across 22 CFAs, as compared to the current 65 widely separated, often small, SFAs. Compared to scattered SFAs under alternative A, the CFAs proposed under alternative C promote protection of a generally more intact and connected landscape. Though similar in the use of CFAs, alternative C would protect more habitat than alternative B and less habitat than alternatives D.

Adverse Impacts. None of the management activities are expected to have more than a short- and long-term negligible impact on listed species. Forest management under alternative C would include forest management and potentially fuels reduction across more acres than under the other alternatives, although the focus would be continue to be on promoting early successional vegetation in the woodcock habitat demonstration units at the Nulhegan Basin Division. Grassland management is also limited in scale and scope and is unlikely to adversely impact federally listed species. Grassland management already follows best management practices such as mowing only after July 15, in order to mitigate any threat posted to nesting birds. All habitat management is done with an understanding of the tradeoffs between disturbing the ground and maintaining adequate habitat for species dependent on grassland ecosystems (Wadsack and Tillmann 2011, Erb and Jones 2011). Potential impacts from increased visitor use under this alternative include those from trail construction as well as from visitors themselves, but these will be designed to avoid impacts on any listed or proposed species.

Any changes or expansions to existing management activities will go through an HMP and/or Section 7 process to avoid adversely impacting any proposed or listed species. Our current understanding is that existing populations of proposed or listed species, such as Canada lynx and dwarf wedge mussel, are not being impacted by ongoing management. While some refuge activities, such as construction, traffic, and invasive plant control, could affect these species, we currently do not conduct such activities in areas listed species are known to occupy.

Compared to the other alternatives, alternative C has a lower likelihood of adversely affecting listed and proposed species than the other alternatives if one assumes that there is a linear relationship between active management and impact. If we accomplish our goal of having no impact on listed or proposed species from management, then adverse impacts from management will be the same for all alternatives. The same pattern would hold for adverse impacts stemming from visitor use.

Impacts to Threatened and Endangered Species from Alternative D

Beneficial Impacts. Regionally and within the watershed, the benefits to listed species of alternative D would generally follow those in the other alternatives. Benefits to individual species could vary significantly over the short-term, depending on where additional refuge lands are acquired. The species listed in Table 5.9 would negligibly benefit under alternative D from

proposed land protection and from refuge staff working with partners on larger conservation measures.

Like alternatives B and C, this alternative would offer several areas that contain habitat for the shortnose sturgeon (Maromas CFA), Atlantic salmon (Maromas, Ompompanoosuc, and West River CFAs), and dwarf wedgemussel (Ashuelot CFA). Alternative D consolidates lands across 22 CFAs, as compared to the current 65 widely separated, often small, SFAs. Compared to scattered SFAs under alternative A, the CFAs proposed under alternative D promote protection of a generally more intact and connected landscape. Also, alternative D could potentially protect the greatest amount of habitat of all the alternatives.

In this alternative the refuge would still take steps to mitigate unexpected events that may pose safety hazards (e.g., flooding due to collapsed culvert, clear trail blockages due to storm damage or dead fall trees, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of significantly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required trail, road, and parking lot maintenance would continue (e.g., roadside mowing, tree trimming on less than 25 acres, use of heavy equipment). When such actions are necessary, the refuge would choose actions that not only address these issues, but also improve habitat conditions for proposed and listed species, where possible. For example, when culverts need to be repaired, the needs of Atlantic sturgeon, Shortnose sturgeon, Northern bog turtle, and brook floaters would be taken into account. Invasive plant control measures would be selected and prioritized to benefit listed and proposed species. Maintenance activities would also be designed to benefit these species wherever possible. Overall, there would be a negligible beneficial impact to listed and proposed species from such activities.

This alternative would eliminate snowmobiling. While the impact of snowmobiling on Canada lynx and other species has not been quantified on the Conte Refuge, it is unlikely that snowmobiling benefits these speices. Therefore the elimination of snowmobiling could have either no impact or negligible to minor beneficial impacts.

Adverse Impacts. Because alternative D is based on a passive management approach, it lacks the short- and long-term negligible adverse impact on listed species identified for the other three alternatives that is associated with active management. Such impacts include those stemming from travel through managed areas, the use of heavy equipment, prescribed burning, and the effects of the habitat alterations themselves.

Instead, the lack of active management could have a negligible adverse impact on listed species in cases where active management is the only way to ensure key habitat types exist. For example, Canada lynx need a mosaic of forest successional classes that includes early successional states, while the tri-colored bat and insect species proposed for listing need open habitat like grasslands or shrublands. Natural disturbances such as hurricanes or wildfires that would reset successional pathways are unpredictable. In the case of wildfire, disturbance is usually prevented to protect human life and property. As a result there is a high degree of uncertainty as to the likelihood that natural disturbance would be able to substitute for active management, and so we predict a negligible adverse impact due to ceasing active management that could increase if no natural disturbance occurs.

In this alternative the refuge would still take steps to mitigate unexpected events that may pose safety hazards (e.g., flooding due to collapsed culvert, clear trail blockages due to storm damage or dead fall trees, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of significantly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required trail, road, and parking lot maintenance would continue (e.g., roadside mowing, tree trimming on less than 25 acres, use of heavy equipment). We expect the infrequency of these activities, coupled with the use of best management practices to mitigate adverse impacts, to result in negligible adverse impacts to listed and proposed species over both the short and long term.

Visitation under alternative D is projected the second highest (after alternative C), as the elimination is snowmobiling is balanced by increased recreation on the much larger refuge (Table 5.5). Nevertheless, visitation under alternative D for other activities would be somewhat similar to that under the other alternatives. The 22-mile native material trail system would theoretically incur fewer adverse impacts to proposed and listed species in its construction and management than alternatives B and C. However, in all cases Section 7 consultation would be completed in order to eliminate adverse impacts, so the most likely scenario is that the impacts would not vary by alternative.

Compared to the other alternatives, alternative D has a lower likelihood of adversely affecting listed and proposed species than the other alternatives due to actions taken, but a higher likelihood that the outcome of not actively managing habitat would lead to adverse impacts. We currently lack a mathematical model to define an overall risk of adverse impacts from not conducting current management activities that can be directly compared to the other alternatives. However, if we accomplish our goal of having no impact on listed or proposed species from management, then adverse impacts from no management could be greater than from the alternatives utilizing active management.

Summary

The refuge proposes no management action that would directly impact, adversely or beneficially, any of the listed or proposed species (Table 5.9). Other refuge management-related activities could have negligible impacts on proposed or listed species, but no action would be taken that would knowingly adversely impact these species without first completing appropriate environmental review and acquiring necessary permits.

With increasing levels of habitat added to the refuge, we expect strengthened protections and management capability for listed and proposed species, notably where early-successional habitat would be actively managed. Continued management of existing refuge uplands, and the potential to acquire and permanently protect more will directly benefit these species over the short and long term. We will take appropriate management actions to aid recovery of these species if new lands acquired are known habitat areas for these species and are noted in recovery plans. Again, such management actions would be taken after appropriate review and consultation with recognized experts and Service approval. Habitat Management Plans subject to NEPA review and Section 7 consultations as required by the Endangered Species Act would be completed before engaging in any management that could harm listed or proposed species, or that takes place in areas where those species are known to occur.

Impacts to Bird Species

The diverse habitats within the expansive Connecticut River watershed provide breeding, migratory, wintering, and foraging areas for hundreds of resident and migratory bird species. The watershed is contained within two Bird Conservation Regions (BCRs) of the North American Bird Conservation Initiative, which have identified priority bird species needing conservation attention. Numerous state-listed bird species inhabit the defined CCP habitats. Table 5.10 identifies the priority refuge resources of concern birds and their LCC habitat types that may be impacted by activities described in the alternatives.

Table 5.10. Priority Refuge Resources of Concern Birds and the Associated Birds Known to use North Atlantic LCC General Habitat Types on Existing and Proposed Refuge Lands.

Major Habitat	LCC* General Habitat Types in CFAs	PRRC** Birds	Associated Birds ***
Forested Uplands and Wetlands	Spruce-fir Forest	Blackburnian warbler Rusty blackbird Canada warbler	Cape May warbler, boreal chickadee, purple finch, black-throated green warbler, spruce grouse, gray jay, black-backed woodpecker, bay-breasted warbler, white-throated sparrow, blackpoll warbler, brown creeper, Northern saw-whet owl, olive-sided flycatcher, palm warbler, pine grosbeak, sharp-shinned hawk, yellow-bellied flycatcher, Northern parula warbler
	Conifer Swamps	Canada Warbler	Blackburnian warbler, black-throated green warbler, Northern waterthrush, red-shouldered hawk, rose-breasted grosbeak, purple finch, veery, white-eyed vireo, willow flycatcher, wood duck, Northern parula
	Hardwood Forest	American woodcock Wood thrush Bald eagle Blackburnian warbler Chestnut-sided warbler Canada Warbler Black-throated blue warbler Louisiana waterthrush Osprey	Red-shouldered hawk, ovenbird, Eastern wood pewee, Northern flicker, yellow-bellied sapsucker, rose-breasted grosbeak, black-throated green warbler, American redstart, Baltimore Oriole, black and white warbler, prairie warbler, worm-eating warbler, blue-winged warbler, hooded warbler, cerulean warbler, black-billed cuckoo, broad-winged hawk, whip-poor-will, great-crested flycatcher, Acadian flycatcher, Northern goshawk, scarlet tanager, sharp-shinned hawk, Cooper's hawk, ruffed grouse, yellow-throated vireo, blue-headed vireo, barred owl, Eastern towhee, gray catbird, brown thrasher,
	Hardwood Swamps	Canada warbler	Red-shouldered hawk, black-throated green warbler, blackburnian warbler, rose-breasted grosbeak, purple finch, veery, white-eyes vireo, Northern parula warbler, wood duck Northern waterthrush,
	Shrub Swamp and Floodplain Forest	American woodcock, black duck	American woodcock, American bittern, warbling vireo, willow flycatcher, ruffed grouse, chestnut-sided warbler, American redstart, Canada goose, mallard, Eastern kingbird, gray catbird, Northern harrier, Eastern towhee, brown thrasher, alder flycatcher, green-winged teal, snowy egret, white-throated sparrow, rusty blackbird, common merganser, bufflehead, Canada goose, marsh wren, Virginia rail

Major Habitat	LCC* General Habitat Types in CFAs	PRRC** Birds	Associated Birds ***
Non-forested Uplands and Wetlands	Pasture, Hay and Grassland	American woodcock	Upland sandpiper, American kestrel, field sparrow, chestnut-sided warbler, bobolink, grasshopper sparrow, Eastern meadowlark, common night hawk, Eastern towhee, gray catbird, blue-winged warbler, prairie warbler, brown thrasher, Eastern kingbird, chimney swift, Northern harrier, indigo bunting, white-throated sparrow
	Freshwater Marsh	black duck, semi-palmated sandpiper	American bittern, marsh wren, Northern harrier, Virginia rail, great blue heron, snowy egret, short-billed dowitcher, lesser yellowlegs, wood duck, Canada goose, bufflehead, common loon, mallard, green-winged teal, gray catbird, willow flycatcher, warbling vireo, Eastern kingbird
	Old Field and Shrubland	American woodcock	Eastern towhee, gray catbird, bobolink, Eastern meadowlark, blue-winged warbler, prairie warbler, brown thrasher, field sparrow, Eastern kingbird, chimney swift, Northern harrier, indigo bunting
	Peatlands	black duck	Olive-sided flycatcher, palm warbler, black-backed woodpecker, Eastern kingbird, Northern harrier
	Cliff and Talus	peregrine falcon	
Inland Aquatic Habitats	Open Water	black duck	Canada goose, bufflehead, mallard, snowy egret, bald eagle, wood duck, green-winged teal

**LCC – Landscape Conservation Cooperative;*

***PRRC – Priority Refuge Resources of Concern (PRRC): species needing management attention that occupy habitats used by many associated birds; identified in Appendix A;*

****Associated Bird Species: species who habitat generally is similar to PRRC bird species and will benefit from any management activities for PRRC species.*

We compared the benefits of the alternatives from actions that would enhance the conservation of priority refuge resources of concern bird species:

- Refuge land acquisition and conservation for migratory birds
- Habitat management and restoration actions designed to promote birds considered priority refuge resources of concern.
- Invasive plant and insect control.
- Removal of surplus buildings and roads.
- Partnership support.
- Effective visitor interpretation.

The potential adverse impacts of refuge management actions within the alternatives that were evaluated included impacts from:

- Habitat management activities.
- Construction of buildings, parking facilities, access roads, and interpretive trails, or demolition of infrastructure.
- Road maintenance.

- Visitor use impacts.
- Prescribed burning.
- Conducting bird field research.
- Public use, including migratory bird hunting.

Impacts to Birds Common to All Alternatives.
Proposed refuge conservation and management activities would neither significantly benefit nor adversely impact the birds on undeveloped lands of the Connecticut River watershed, nor current or expanded refuge lands. We expect refuge land conservation and management within all alternatives to help maintain and improve current habitat conditions for the priority refuge resources of concern birds and their associated bird species. Bird habitat benefits will be promoted to varying degrees in the four alternatives under consideration. Greater bird habitat benefits would be derived from either of the refuge expansion alternatives (C and D) since they would permanently protect these larger habitat areas and preclude them from potential development projects. However, in the short term (within 15 years), beneficial impacts are expected to be similar across all alternatives in the short because we would likely acquire similar amounts of land under all the alternatives. Greater beneficial impacts to birds would be expected to accure under the different alternative scenarios over the long term, in proportion to the total land conserved as refuge lands.

While the bald eagle is no longer a federally listed species, the refuge uses the national bald eagle management guidelines for bald eagle management to implement time-of-year restrictions for nesting eagles. The guidelines do not permit any activity within 330 feet of an active nest during the breeding season, particularly where eagles are unaccustomed to such activity (USFWS 2007).

Impacts from protecting and restoring habitat
The positive impacts associated with all alternatives involve the value of protecting and restoring migrating birds habitat, and preventing habitat displacement through development. Strategic habitat protection of stopover neotropical migrant habitat (especially forest and shrub wetlands along the main stem of the river) within the Connecticut River watershed will significantly benefits these species during the spring migratory period.

Table 5.11. Comparison of LCC General Habitat Types that Could Support Priority Refuge Resources of Concern Birds By Alternative.

	Alternative B	Alternative C		Alternative D	
LCC Habitat	Acres	Acres	Percent increase over Alt. B	Acres	Percent increase over Alt. C
Conifer swamp/Spruce-fir	22,422	28,390	27%	29,815	5%
Hardwood Forest	61,212	150,927	147%	195,578	30%
Hardwood swamp	2,008	3,946	97%	5,993	52%
Shrub swamp/ Floodplain Forest	1,638	2,804	71%	3,477	24%
Cliff and Talus	445	1,868	320%	2,094	12%
Freshwater marshes	962	2,054	114%	2,401	17%
Old field and shrubland	37	52	41%	99	90%

LCC Habitat	Alternative B	Alternative C		Alternative D	
	Acres	Acres	Percent increase over Alt. B	Acres	Percent increase over Alt. C
Pasture/Hay/ Grassland	5,061	9,637	90%	11,255	17%
Peatland	922	1,098	19%	1,099	less than 1%
Open water	2,155	2,972	38%	3,783	27%

** LCC defined habitat acres are not available for SFA lands described in alternative A*

By protecting additional freshwater wetlands and saltmarsh, all alternatives may contribute over the long term toward waterfowl habitat objectives within the ACJV Waterfowl Focus Areas, and toward supporting breeding populations of waterfowl (Table 5.12).

Table 5.12. Potential Waterfowl Habitat Protection Contribution to Atlantic Coast Joint Venture Habitat Objectives Under Alternative C.

ACJV Waterfowl Focus Area	ACJV Waterfowl Habitat Objective (acres)	Acres of wetland habitat in CFAs (Percent of objective)		
		Alternative B	Alternative C	Alternative D
Connecticut River and Tidal Wetlands Complex – in CT	1,157	436 (38%)	878 (76%)	1,877 (162%)
Connecticut River – in NH	3,200	1 (<1%)	1 (<1%)	2 (<1%)
Connecticut River – in VT	250	2 (1%)	41 (16%)	41 (16%)
Lake Memphremagog – in VT	5,101	3,043 (60%)	3,913 (77%)	3,913 (77%)
Total for entire Atlantic Flyway	**1,577,594**	**11,884 (1%)**	**18,563 (1%)**	**23,257 (2%)**

** Acres of wetland habitat compared to waterfowl focus areas are not available for SFA lands described in alternative A.*

The refuge recognizes that management designed to benefit a priority refuge resources of concern species may represent a trade-off with habitat conditions for other species. For example, active management designed to benefit a priority refuge resources of concern birds by retarding natural successional forest growth (e.g., maintaining 422 acres of grasslands by mowing for bobolink and upland sandpipers, Table 5.4) may result in less habitat for mature forest associates (e.g., wood thrush, blackburnian warbler). Such trade-offs are common to any ecosystem management regime, and the refuge considers their impacts to non-priority refuge resources of concern species to be negligible.

Such management activities generally include management of the woodcock demonstration units at the Nulhegan Basin Division, which incorporate recognized silvicultural techniques designed to complement bird habitat objectives (Hagenbuch et al. 2011). They also include restoration of wetlands, mowing and haying of grassland on the Fort River Division, and controlled mechanical and herbicide use to treat invasive species. The refuge uses and employs best management practices in all habitat management operations that might impact refuge upland and wetland habitats (e.g., approved herbicide use for invasive plant control, mowing or cutting after July 15 to avoid the first nesting season, conducting forest management when ground is frozen).

Across all alternatives, we would restore and protect rare and exemplary habitats of high value to priority refuge resources of concern birds, and would selectively reduce or eliminate problematic invasive species. Pesticides, most often herbicides, may be used for restoration, in accordance with an Integrated Pest Management plan and Pesticide Use Proposal. The refuge will also develop and implement an Integrated Pest Management Plan that addresses

environmentally safe application procedures and requirements. We expect negligible adverse impacts on birds from pesticide use, and positive benefits from habitat restoration as a result of invasive plant reduction.

Within the regional and refuge specific landscape, forest management activities across alternatives are designed to improve habitat structure for priority refuge resources of concern birds, which should be negligibly adverse in the short term and beneficial in the long term. Silvicultural activities will be prescribed by the refuge forester, and will be designed to improve or create the habitat conditions required by priority refuge resources of concern species as described in an HMP, resulting in a beneficial impact. Adverse impacts will be limited due to the incorporation of best management practices, such as designing site-specific silvicultural treatments. Any areas proposed for burning would be done under an HMP and Fire Management Plan that would prescribe burns designed to enhance habitat over the long term.

Impacts from construction and maintenance of infrastructure
Across all alternatives, most management actions would not permanently impair habitat for priority refuge resources of concern birds. An exception is the construction of new infrastructure. Potential infrastructure includes trails, parking lots, stilted boardwalks and observation platforms for outdoor environmental education and interpretation. There are no plans for major facilities or new road or snowmobile trail construction on refuge lands. Building demolition could impact birds nesting in a building, but appropriate steps would be taken to avoid disturbing or taking individual birds. Maintening six buildings and continuing refuge road maintenance (grading, ditch maintenance, spreading gravel, removing boulders, roadside mowing/debrushing) with some tree cutting and mowing, is expected to have a negligible to minor adverse impact on birds.

We anticipate only negligible adverse short-term and long-term impacts to birds from the construction ADA-accessible trails under alternative B and C, or "backcountry" trails under alternative D. The trails will only disturb a small, concentrated amount of the habitat we proposed to acquire. Construction activities would be restricted to the non-breeding season.

Impacts from human presence on and use of the refuge
Human intrusion can affect bird behavior, distribution, habitat use, reproduction and survival (Knight and Gutzwiller 1995). Habitat loss and fragmentation are the major factors affecting bird populations at landscape scales, but human activity is a primary stressor of bird populations at local scales (Schlesinger 2008). The Service limits human uses of the refuge to those that are appropriate and compatible (usually wildlife-dependent uses) and thus curtails anthropogenic impacts that may impair bird use of available refuge habitats. Hunting migratory and resident game birds is currently allowed under state regulations on several divisions and units (e.g., Nulhegan Basin Division, Putney Mountain Unit), and this would be expanded to additional divisions (e.g., Honeypot Wetlands), CFAs, and units in the action alternatives following development of Hunt Plans for each watershed state (including NEPA review). We anticipate impacts to migratory birds from hunting to be negligible because our programs would adhere to state seasons and regulations and follow Federal and state harvest levels. These harvest levels are species-specific and are set annually to ensure that populations are sustained. Current and anticipated future hunting levels are also low.

All alternatives predict some increase in annual visitor numbers over time; however, the increase varies due to each alternative's respective refuge boundary configuration or expansion level. Impacts are expected to be negligibly adverse overall, although impacts will be greater as the number of actual visitors increases. Of the alternatives, A has the lowest projected impact, followed by

B, D, and C (see Table 5.5) The adverse impact will be negligible due to the refuge's efforts to mitigate impacts. For example, public use trails are placed and managed to avoid or minimize adverse impacts to birds relying upon the refuge's diverse habitats, for migration or breeding, especially ground nesting or under-story nesters. No impacts will occur from off-road bicycling and all-terrain vehicles as such activity is not permitted. In limited cases, potentially disturbing activities may be authorized.

For example, the public is allowed to drive on refuge roads. Bicycling may be permitted on refuge roads under alternatives B, C, & D, although the impacts are tiny compared to those of vehicles. ATV use may be authorized to assist disabled hunters access refuge lands. Use of these modes of transit would be authorized with appropriate conditions and safeguards (e.g., seasonal restriction) to avoid adverse impacts such as nest abandonment.

Pet-walking activities that might impact migratory bird habitats would pose negligible to minor impacts over the short term and long-term management of refuge migratory birds. Because dogs can contribute to breeding bird disturbance, especially for ground nesting and shrub and understory nesting birds (e.g., ovenbird, American woodcock, chestnut-sided warbler, black-billed cuckoo), dogs will be required to be on leash while on the refuge (UNSW 2007).

An indirect impact from hunters and hunting is lead exposure. For example, potential sources of lead exposure in woodcock include ingestion of lead-contaminated soil, and/or ingestion of lead-contaminated earthworms, most likely to occur in forage areas near roads (Scheuhammer et al. 1999).

Impacts from use of the refuge by researchers
Through the issuance of special use permits, all alternatives would promote bird monitoring and research on resident and migratory birds. A number of important projects and surveys already have been conducted or are ongoing: breeding bird surveys at Nulhegan Basin and Pondicherry, nest box use by American kestrel, American woodcock habitat preference, identification of stopover sites for migrating neotropical birds, breeding bird response to silvicultural treatments, mercury levels in Rusty blackbirds, Canada warbler habitat use in Northern forest, and others. These studies contributed to the refuge's knowledge base and provided information used to improve management. The refuge recognizes that field monitoring and research may adversely impact birds being studied largely due to the presence of humans, and sometimes direct contacts (e.g., banding, radio telemetry). In our judgement, there is a direct, negligible adverse impact on birds from research conducted on the refuge, and an indirect, beneficial impact on birds from improved understanding and management strategies that emerge from such research.

Impacts common to alternatives A, B, and C
We do not plan to increase capacity for snowmobiling in any of these alternatives. Snowmobile trails on new lands to be acquired under proposed alternatives B and C may be maintained, especially if they are connector trails, and in select situations closed trails may be opened to promote wildlife-dependent public uses. We do not anticipate habitat impacts related to snowmobiling on resident and over-wintering bird species. Because this activity is a pre-existing use, we do not expect a significant change in the use of habitats related to snowmobiling, and therefore do not expect impacts over either the short or long-term.

As noted under the water quality section, snowmobiling can introduce petroleum hydrocarbons to wild lands; however, it is unlikely that there would be any potential measurable adverse impacts to priority refuge resources of concern

birds and their associates, and none are known on refuge lands or potential refuge lands. The compatibility determinations for snowmobiling in appendix D 'Appropriateness and Compatibility Determinations,' provides additional impact analysis and references on snowmobiling impacts.

Impacts common to alternatives B, C, and D
Under these alternatives, the SFA structure put in place in the first Conte Refuge CCP would be eliminated. While the majority of the SFAs and their acreage would be retained in the new CFAs, Nineteen of 65 SFAs would not be included within the CFA structure, representing 36,915 acres of potential habitat that would not be available for inclusion into the refuge. The refuge recognizes that these SFAs continue to hold valuable habitat, and in some cases, important habitat for birds. Some of these areas have already been protected by other partners, and we would continue to encourage partners to pursue protection of these lands from willing sellers. Further details on wildlife benefits by the SFAs are provided by Appendices 3-10 of the 1995 FEIS (USFWS 1995).

The consolidation of SFAs into CFAs will promote the protection of large contiguous forest tracts that are connected (i.e., may function as corridors) to other tracts, have diverse and complex forest structure and composition, and support the structural integrity of forested wetlands.

Each of these alternatives proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to Birds of Alternative A
Beneficial Impacts. Beneficial impacts from Alternative A are outlined in the section "Impacts to birds common to all alternatives," above. While habitat diversity is represented within the SFA structure, the extent and distributions in overall habitat representation, resiliency, redundancy, connectivity, and protection of ecosystem processes in likely to be somewhat less than other alternatives simply due to the scattered nature and greater disconnection among the many SFAs.

Adverse Impacts. Many adverse impacts from Alternative A are outlined in the section "Impacts to birds common to all alternatives," above. This alternative encompasses 65 widely separated, often small, and logistically difficult to manage SFAs. This difficulty could have a negligible to minor impact on birds, including those from Table 5.10, over all time scales.

Impacts to Birds of Alternative B
Beneficial Impacts. Many of the beneficial impacts from Alternative B are outlined in the section "Impacts to birds common to all alternatives," above. Alternative B consolidates most of alternative A's current 97,830 acre acquisition boundary into 19 CFAs, thus promoting larger, more diverse, and connected habitat system within the larger watershed landscape.

Alternative B offers considerable protection and management potential of spruce-fir/conifer swamp and hardwood forests (83,634 acres, table 5.11). With alternative B proposing considerable acquisition of spruce-fir/conifer swamp and hardwood forests, many priority refuge resources of concern species and their associates would be likely to benefit from protection of their habitat (Table 5.10).

Because it is smaller in total area than alternatives C and D, beneficial impacts from alternative B would be smaller than for C and D over the long term.

Adverse Impacts. Alternative B includes very few habitat and ground disturbing activities that might adversely impact migratory bird habitat, and none would be of any permanent adverse impact. Visitation under alternative B would potentially increase by 22 percent over alternative A levels (Table 5.5), due in large part to an expanded 19-mile trail system. The impacts from trail construction in alternative B are smaller than from alternative C, but probably larger than from alternative D.

The essential difference from alternative A is the potential for increased active management. This includes mowing and haying on newly acquired lands (422 acres or more), an expectation to initiate substantial management of shrubland acres (e.g., 775 acres, Table 5.4), and management of approximately 7,660 acres of forested acres over the 15 year time period of the CCP (annual average of 250 to 300 acres, Table 5.4). Adverse impacts from these activities will be lower under alternative B than alternatives C and D because the total area managed will be smaller. Prescribed burning would be used under this alternative to maintain fire regime communities (e.g., pitch pine) and to facilitate treatment of less than 100 acres annually. Best management practices are implemented in all habitat management activities, as noted in 'Impacts to birds common to all alternatives.'

Impacts to Birds of Alternative C

Beneficial Impacts. Many of the beneficial impacts from Alternative C are outlined in the section "Impacts to birds common to all alternatives," above. Alternative C consolidates most of alternative A's current 97,830 acre acquisition boundary into 22 CFAs, thus promoting larger, more diverse, and connected habitat system within the larger watershed landscape. Under this alternative, up to 197,337 acres of habitat (more than A and B, but fewer than D) would be protected. The alternative C land base further develops and expands the intent of alternative B CFAs to enhance and enrich components of strategic habitat conservation design and climate change adaptation. Habitat diversity, resiliency, redundancy, connectivity, and protection of ecosystem processes are dramatically increased.

As with alternative B, the full implementation of alternative C would likely have beneficial impacts on spruce-fir/conifer swamp and hardwood forests (179,317 acres, a >100% increase over alternative B, Table 5.11) and the wildlife species associated with such habitat. It also represents a commitment to protect sizeable increases of hardwood swamps, shrub swamp/floodplain forests, freshwater marshes, cliff and talus, pasture/hay/grassland, and rocky outcrop. Priority refuge resources of concern bird species and their associates that will benefit from all the lands and habitats protected in alternative C are listed in Table 5.10.

To assess the contribution of the proposed land acquisition in alternative C to population and habitat objectives for migratory birds, we estimated the potential suitable habitat for six of breeding birds. We used this value to estimate the population that could be supported within the proposed CFAs (Table 5.13y). Population estimates are derived from GIS data on coarse-scale and forest type; it is assumed the condition of the forest is suitable for the species listed, and therefore the estimate should be considered generous. The species analyzed are neotropical migrant species that are identified as priority refuge resources of concern species, representative species by the North Atlantic LCC, priority species within Atlantic Northern Forest (BCR 14), and New England/Mid-Atlantic Coasts (BCR 30) plans, and whose habitat requirements represent the range of upland and wetland habitat types within the CFAs.

We also considered contributions to waterfowl habitat, wood duck populations, and neotropical migrant stopover habitat. Details on the habitat and population

estimates for these species is presented in Appendix C. Population estimates for existing conserved lands within the Connecticut River watershed are included to provide contexton any additional benefits that would be provided to migratory birds by acquiring the proposed lands within the CFAs.

Table 5.13. Estimated Contribution of Alternative C to Select Priority Refuge Resources of Concern in a Range of LCC Upland and Wetland Habitat Types

Priority Refuge Resources of Concern Species	Approximate CFA Habitat Acres Suitable for Species	Estimated Population in proposed CFAs (Approximate number of Individuals)	Estimated Population in all Connecticut River Watershed Conserved Lands
Wood thrush	155,500	31,200	273,000
Canada warbler	210,000	4,800	42,000
Blackburnian warbler	180,000	26,600	224,000
Black-throated Blue Warbler	180,000	25,400	216,000
American woodcock	140,000	4,600	38,000
Bobolink	4,100	1,000	10,000

Assuming they are protected and managed appropriately for the species listed in Table 5.13, the acres proposed for protection under alternative C have the potential to contribute habitat to approximately 11 percent of the total population that the Connecticut River watershed may be able to support for each of these select priority refuge resources of concern species. We assume that other priority refuge resources of concern bird species and other species associated with the priority refuge resources of concern birds will benefit. However, over the 15-year lifetime of the CCP, we would likely acquire similar amounts of land under all of the alternatives. Consequently, we expect similar levels of short-term beneficial impacts among the alternatives A, B, and C, but potentially twice the long-term beneficial impacts under alternative C.

Alternative C's protections of freshwater wetlands and saltmarsh may contribute over the long term toward waterfowl habitat objectives within the ACJV Waterfowl Focus Areas, and toward supporting breeding populations of waterfowl. The beneficial impacts for waterfowl are greater under alternative C than under alternative B, but less than under alternative D.

Wood Duck is identified as a high priority species for the Federal-state Atlantic Flyway Council and as a continentally high priority species for the North American Waterfowl Management Plan (NAWMP). The Atlantic Northern Forest BCR 14 is recognized by the NAWMP as a high priority region for breeding need and the New England/Mid-Atlantic Coasts BCR 30 is considered a moderate priority region for breeding need for wood duck. While no regional population objectives have been established for wood duck, the regional priority rankings suggest that the Connecticut River watershed can make significant contributions to sustaining the Atlantic Flyway population at or above target levels for harvest management purposes (Table 5.14).

Table 5.14. Approximate Wood Duck Breeding Potential in all CFAs Proposed in Alternative C*.

State	Acres of Potential Wood Duck Breeding Habitat in all CFAs**	Potential Breeding Wood Duck Population Supported within CFAs***
CT	3,951	988
MA	1,613	403
NH	2,327	582
VT	909	227
Total	**8,800**	**2,200**

** Based on estimates of cavity densities presented in Dugger and Fredrickson. 1992. Life History and Habitat Needs of the Wood Duck in The Waterfowl Management Handbook. Fish and Wildlife Leaflet 13. U.S. Fish and Wildlife Service, Washington, DC. (www.nwrc.usgs.gov/wdb/pub/wmh/13_1_6.pdf; accessed October 2013)*

***based on freshwater wetland and forested wetland types as defined within the LCC habitat types*

****Number of breeding pairs, estimated at 0.25 pairs/acre of potential habitat*

Adverse Impacts. Alternative C includes few habitat and ground disturbing activities that might adversely impact migratory bird habitat, and none would be of any permanent adverse impact.

Visitation under alternative C would increase 54 percent (Table 5.5) compared to alternative A, offering greater visitor use opportunities over the short term and long term due to an expanded, accessible trail system. Potential adverse impacts would be similar in kind and slightly greater in total impact to those discussed under alternative B, due to a 22-mile trail system in alternative C compared to a 19-mile trail system in alternative B. Nevertheless, with such visitation activities being established across a much larger refuge landscape, the refuge concludes that there would be negligible impacts over the short term and long term to migratory birds.

The essential difference from alternative A would be the potential for increased mowing and haying on newly acquired lands (548 acres or more), an expectation to initiate substantial management of shrubland acres (e.g., 775 acres, Table 5.4), and management of approximately 11,550 of forested acres over the 15 year time period of the CCP (~annual average of 350-500 acres, Table 5.4). Managed acres under this alternative may increase over time as needs arise, being determined by development of future HMPs. More acres are managed under alternative C than alternative B, so the adverse impacts are somewhat increased, although the overall impact is expected to be negligible. Prescribed burning would be used under this alternative to maintain habitats that depend on fire to persist over time (e.g., pitch pine). Less than 100 acres would be treated annually.

Impacts to Birds of Alternative D

Beneficial Impacts. Many of the beneficial impacts from Alternative D are outlined in the section "Impacts to birds common to all alternatives," above. Alternative D consolidates most of alternative A's current 97,830 acre acquisition boundary into 22 CFAs, thus promoting larger, more diverse, and connected habitat system within the larger watershed landscape. Under this alternative, up to 231,307 acres of habitat (more than any other alternative) would be protected. The alternative D land base further develops and expands the intent of

Bill Thompson

Eastern towhee

alternative B and C CFAs to enhance and enrich components of strategic habitat conservation design and climate change adaptation. Habitat diversity, resiliency, redundancy, connectivity, and protection of ecosystem processes are dramatically increased.

In contrast to all other alternatives, alternative D would employ a passive management approach. This passive approach is thought to allow natural ecological functions and processes to operate without influence from active management as proposed in the other alternatives. Although we will not be actively managing habitats under alternative D, we expect that natural events and disturbances (e.g., floods, fire, disease, hurricanes, microbursts, drought) will create some habitat complexity over the very long term (i.e., decades to centuries).This habitat complexity will likely serve some of the needs of priority refuge resources of concern species over the long term. It is recognized that such an approach would eliminate the ability of the refuge to implement selective habitat improvements necessary for certain priority refuge resources of concern birds (e.g., woodcock, grassland birds, New England cottontail). Such a 'hands-off' approach also eliminates the refuge's ability to apply adaptive management which embraces planning, implementation, and evaluation of management actions (e.g., timber harvest, prescribed burns).

Similar to alternative C, alternative D offers a high level of protection and management potential of spruce-fir/conifer swamp and hardwood forests, and it advances a notable increase in protection of hardwood swamps (52% over alternative C, Table 5.11). The priority refuge resource of concern birds and their associates that will benefit from lands and habitats protected in alternative D are noted in Table 5.10 above. With alternative D proposing considerable acquisition of spruce-fir/conifer swamp and hardwood forests, species likely to benefit include those noted in alternative B. The other habitats that would increase under this alternative are similar to alternative C, and the same species listed there would also benefit with alternative D.

Alternative D's protections of freshwater wetlands and saltmarsh may contribute over the long term toward waterfowl habitat objectives within the ACJV Waterfowl Focus Areas, and toward supporting breeding populations of waterfowl. The beneficial impacts for waterfowl based on habitat protection alone have the potential to be greater under alternative D than under the other alternatives under the long-term.

Adverse Impacts. The adverse impacts discussed in the other alternatives apply to a lesser degree under alternative D. Under alternative D there would be no active forest management. Management steps would be taken to mitigate unexpected events that may pose human safety hazards (e.g., repair of collapsed culvert causing flooding, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment).

Passive management means that natural processes would be allowed to alter the landscape unimpeded, creating habitat conditions that benefit some species likely at the expense of others. Allowing existing grasslands to revert to forest , for example, would eliminate habitat for grassland birds unless natural

processes opened new grassland areas. Forest interior nesting birds dependent upon complex forest structures may be adversely impacted without active management at CFAs that currently lack diverse multi-story structure due to past management activities (e.g., Nulhegan Basin and Pondicherry Divisions). However, forest structure within these CFAs may become more diverse over time depending on occurrence of natural disturbances that would alter forest structure or reset successional pathways. Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming).

Visitation under alternative D is projected to be lower than alternative C, but higher than under alternatives A or B. Its scope is different because snowmobile use will be eliminated. Trails constructed under this alternative will be native-surface and thus less impactful on the surrounding vegetation. Like other alternatives, impacts from visitors are expected to be negligible over the short- and long-term.

Summary

In summary, our management activities across alternatives would not significantly adversely or beneficially impact birds in the Connecticut River watershed. As previously noted, all alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). With those potential additions of habitat to the refuge, in concert with currently protected lands (37,000 acres), there is an expectation for strengthened protections and management capability for migratory and resident birds.

The continued maintenance of existing refuge uplands and the potential to acquire and permanently protect more will be of direct and long-term benefit to promoting listed species over the short and long term. We will take appropriate management action to help maintain and improve bird species known to be in decline (e.g., American woodcock, bobolink, blackburnian warbler, Canada warbler). Additionally, the refuge remains sensitive to contributing to the goals of the North American Waterfowl Management Plan and its associated Atlantic Coast Joint Venture, in the conservation of waterfowl. Maintaining and protecting the defined LCC subhabitats will help to guarantee their beneficial habitat functions for migratory and resident birds. We again note that acquisition of additional acres to full acquisition levels proposed in the alternatives will not occur within the short term framework of this CCP, but will continue in the long term well beyond the 15 year CCP cycle. Many of the impacts described here, especially the variance among alternatives, may not appear until beyond the 15 year CCP timeframe.

Proposed management activities — forest management, prescribed burning, trail construction, snowmobile use — may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact to promoting bird conservation.

Impacts to Mammals

The diverse habitats within the expansive Connecticut River watershed provide breeding and foraging areas for 61 species of mammals, an assemblage that includes 7 shrew species, 3 mole species, 9 bats species, 4 rabbit/hare species, 21 rodents species, 14 carnivore species, as well as the opossum, white-tailed deer, and moose (DeGraaf and Yamasaki 2001). The New England Cottontail, northern

long-eared bat, little brown bat, tri-colored bat, and eastern small-footed bat are priority refuge resources of concern mammals. A number of mammal species are also associated with habitat condition similar to priority refuge resources of concern species within 15 of the 22 CFAs (Table 5.15). Mammal species most common within represented CFAs include the Eastern red bat, black bear, and bobcat, all of which rely upon hardwood forest. Table 5.15 identifies for each CFA the priority refuge resources of concern, associated mammals, and their habitats.

Table 5.15. Priority Refuge Resources of Concern and Associated Mammal Species, and Their LCC Habitats That May Be Impacted by Activities Described in the Alternatives (derived from appendix A).

CFA	PRRC Mammal Species (LCC Habitats)	PRRC Associated Mammal Species for Each CFA Subject to Impacts (derived from Appendix A).
Maromas CT		
Pyquag CT*		
Muddy Brook CT†		
Salmon River CT*	New England cottontail (hardwood forest, grassland, shrub-swamp)	Eastern red bat (hardwood forest)
Scantic River CT*		
Whalebone Cove CT*	New England cottontail (hardwood forest, grassland, shrub-swamp, old Field)	Eastern red bat (hardwood forest)
Farmington River CT/MA	New England cottontail (hardwood forest, grassland, shrub-swamp)	Eastern red bat, black bear (hardwood forest)
Dead Branch MA*		Eastern red bat, black bear, bobcat, moose (hardwood Forest)
Fort River MA*		
Mill River MA*		
Westfield River MA*		Eastern red bat, black bear, bobcat, moose (hardwood Forest)
Sprague Brook NH/MA†		Eastern red bat, bobcat (hardwood forest)
Ashuelot NH		Eastern red bat, bobcat (hardwood forest)
Blueberry Swamp NH*		American marten, Canada lynx (spruce-fir forest)
Mascoma River NH		Eastern red bat, bobcat (hardwood forest)
Pondicherry NH*		Eastern red bat (hardwood forest); American marten, Canada lynx (spruce-fir forest)
Nulhegan Basin VT*		Eastern red bat (hardwood forest); American marten, Canada lynx (spruce-fir forest)
Ompompanoosuc VT	Little brown bat Northern long-eared bat Tri-colored bat Eastern small-footed bat	Eastern red bat, black bear, bobcat (hardwood forest); water shrew (freshwater marshes, shrub-swamps, forested floodplains)
Ottauquechee River VT†	Little brown bat Northern long-eared bat Tri-colored bat Eastern small-footed bat	Eastern red bat, black bear, long-tailed weasel, woodland vole (hardwood forest)

CFA	PRRC Mammal Species (LCC Habitats)	PRRC Associated Mammal Species for Each CFA Subject to Impacts (derived from Appendix A).
West River VT		Eastern red bat, black bear, bobcat, long- tailed weasel, woodland vole (hardwood forest); water shrew (freshwater marshes, shrub-swamps, forested floodplains)
White River VT†	Little brown bat Northern long-eared bat Tri-colored bat Eastern small-footed bat	Eastern red bat, black bear, bobcat, long-tailed weasel, woodland vole (hardwood forest)
Quonatuck*	8,000 acres of tidal (salt, brackish, and fresh) wetlands, floodplain forest, and riparian areas within the Quonatuck CFA , running through the main stem River, will be protected but specific habitats cannot be determined at this time but will be selected using detailed criteria (re: Appendix C: Land Protection Plan).	

** CFA contains a SFA, part of alternative A*
† CFA not proposed under alternative B, only proposed under alternatives C and D

Impacts to Mammals That Would Not Vary by Alternative
Proposed refuge conservation and management activities would neither significantly benefit nor adversely impact the mammals within the Connecticut River watershed, nor current or expanded refuge lands as proposed. We expect refuge land conservation and management within all alternatives, however, to help maintain and even improve current habitat conditions for the priority refuge resources of concern mammals and associated mammals (e.g., bat hibernacula, den trees, beaver ponds, deer winter yards). All of these mammal habitat benefits will be promoted to varying degrees 1) on the existing 37,000 refuge acres, and through potential completion of its current authorized acquisition level (97,830 acres), 2) by reconfiguration of just below its current acquisition level boundary per 19 CFAs (97,772 ac; alternative B), or 3) by any expansion of refuge size per 22 CFAs as proposed by alternatives C and D, the latter two which would authorize expansion from 97,830 acres to 197,337 acres and 231,307 acres, respectively. Greater habitat benefits to refuge mammals would be derived from either of the refuge expansion alternatives (C and D) since they would permanently protect these larger habitat areas and preclude them from potential development projects. However, in the short term (within 15 years), we would likely acquire similar amounts of land under all the alternatives, thus beneficial impacts to mammals would be similar across all alternatives in the short term. Greater beneficial impacts to mammals would be expected to occur over the long term.

Across all alternatives, our management actions would not contribute to the permanent impairment of habitat for priority refuge resources of concern mammals or associated mammals, except when constructing infrastructure for outdoor environmental education and interpretation, notably new trails, parking lots, stilted boardwalks and observation platforms; impacts from these activities would be negligibly adverse in the short and long term. As noted above, we would remove dwellings and other small infrastructure on property acquired by the refuge and carefully manage roads near sensitive habitat areas. There are no plans for major facilities or new road or snowmobile trail construction on refuge lands. As needed, roads will remain open to provide motorized and non-motorized access to visitors, and to benefit management access. Where appropriate, roads may be closed to visitor access. Roads no longer required for management activities may be closed permanently to restore habitat and improve local soil and hydrology. Roads also may be upgraded, re-opened, or maintained to improve access for habitat management.

As noted under the “Impacts to Birds” section above, regardless of which alternative is selected, we would continue to use recognized silvicultural BMP techniques designed to improve wildlife habitat, and recognize this benefits some species possibly at the expense of others. Little brown bat, northern long-eared

bat, tri-colored bat and eastern small-footed bat roost and raise young in cavities or loose bark of large trees or rocky outcrops within a forested landscape, often in the vicinity of hibernacula (caves used for hibernating in winter) (Degraaf et al, 2001, Darling Guidelines, unpublished). Eastern red bats, a migratory species, uses tree foliage to roost and rear their young, and often feed around forest edges and clearings (Davis and Lidicker 1956). New England cottontail require early-successional hardwood forests and shrublands. While Black bear and bobcat readily use a mix of deep hardwood forest, scattered fields, edges, and even dense regenerating forests. Similarly, Canada lynx and American marten rely upon a mosaic of deep mature spruce-fir forest and early-successional and maturing forests for shelter, den sites, and productive forage sites rich in snowshoe hare and rodents (DeGraaf and Yamasaki 2001). Forest management efforts under the CCP will provide a mosaic of habitat conditions within each CFA that will benefit priority refuge resources of concern species and associated mammals. Across all alternatives we will take appropriate management action to help recover any Threatened or Endangered species if new lands acquired are known habitat areas for these species, and such lands are identified as needing protection and management in an approved recovery plan. Such management actions would be taken after appropriate review and consultation with recognized experts and Service approval.

We would take steps, as appropriate, to insure that our forest management practices are not contributing to heavy fuel loads that may burn and damage refuge habitats; this would include potential fuel reduction activity under alternative D's passive management approach. As noted in previous sections above, and across all alternatives, we would selectively reduce or eliminate problematic invasive plant areas, on and off refuge, using mechanical and approved herbicidal treatment. The Regional Contaminants Specialist would review our proposals prior to field application, although certain routine chemicals can be approved and used at the field station.

The Service regulates human uses of the refuge to compatible uses (usually wildlife-dependent uses) and thus curtails anthropogenic impacts that may impair mammal use of available refuge habitats. By NWRS policy, hunting is a designated priority wildlife-dependent use (*http://www.fws.gov/policy/605fw2.html*; accessed August 2016). Hunting of game mammals would be permitted on all refuge lands where deemed compatible, and across all alternatives. The refuge generally believes alternative A's SFA structure may limit hunting opportunities compared to other alternatives since many SFAs are small and widely scattered. White-tailed deer, moose, black bear, coyote, and snowshoe hare, are the principal mammal species hunted, and gray squirrel and eastern cottontail are hunted further south in the watershed. Hunting has been a popular recreational activity across much of the watershed for generations. All hunting seasons and bag limits adhere to respective state regulations. Those regulations are set within each state based on what harvest levels can be sustained for a species without jeopardizing state populations. Measures are taken by each state to sustain populations of game mammals and avoid adverse impacts. Regulated hunting of white-tailed deer can be useful in attempting to maintain healthy populations. State wildlife management agencies and hosts of cooperators have achieved broad successes in managing deer populations at ecologically and socially acceptable levels, primarily through regulated hunting, but at high population densities deer can greatly alter the ecology of forest vegetation (McDonald et al., 2007, Winchcombe 1992), and can also spread invasive plant seed (Williams and Ward 2006). Today hunting has many social values, including recreation, subsistence, heritage, utilization of the harvestable surplus to benefit people, and control of overabundant wildlife populations. In addition, hunting regulated through licenses, stamps, permits, and taxes provides the major source of financing for habitat acquisition and improvement, research, and management

programs for all wildlife, both game and non-game (The Wildlife Society 2010). The compatibility determinations for hunting are contained in appendix D "Appropriateness and Compatibility Determinations," and provide additional references on snowmobiling impacts.

The refuge also employs certain restrictions to help sustain game population levels and assure for public safety. For example, the refuge prohibits bear baiting, nighttime hunting requires a special use permit, and all temporary blinds must be identified (name/address) when active and removed post season. "Hunter orange" is required at the Pondicherry CFA/Division, and snowshoe hare and coyote hunting end March 15 of each hunting year in advance of the State closure. Refuge restrictions at the Nulhegan Basin Division include no shooting from refuge roads. The refuge will determine whether additional restrictions are necessary at the Nulhegan Basin and Pondicherry CFAs/Divisions to prevent the accidental take of Canada lynx. By implementing state and refuge hunting regulations, hunting results in direct adverse impact due to individual losses. However, the projected total harvest would not adversely impact the viability of any harvested species' population, but would over the long term promote healthy and self-sustaining populations. Some disturbance to nontarget wildlife species may occur while hunters are in the field; however, those impacts should be minimal because hunting pressure is light. Any adverse impacts due to hunting are considered negligible.

Under all alternatives except alternative D, the refuge would employ a furbearer management program that would include trapping as a management tool in addition to non-lethal control mechanisms (e.g., beaver barriers); there would be no furbearer management program under alternative D's passive management approach. The furbearer management program used in alternatives A, B, and C would not be designed to eliminate targeted furbearer species, but rather, remove individuals in those areas where a surplus exists or individual animals are causing problems. Our program would adhere to state trapping regulations, which are set to ensure sustainable population levels. Harvest of beaver and muskrat, for example, can be both positive and adverse. Muskrats dig bank dens into embankments, causing considerable damage and adding costs to the operations of the refuge. Beaver will sometimes plug culverts and water control structures, causing damage to infrastructure, limiting access, and compromising the capability of refuge staff to manage habitat. Conversely, muskrat and beaver can both enhance aquatic and wetlands habitats by creating openings and ponding water. Many species in this forested region favor beaver ponds and wetlands (e.g., great blue heron, wood frogs, and wood ducks). Beaver are a keystone species for cycling small wetlands systems from pond to meadow to scrub-shrub to forest, and back to pond. The refuge recognizes the dynamic value beaver and muskrat play within wetland ecosystems of the Connecticut River watershed. The removal of excess furbearers from those areas would maintain furbearer populations at levels compatible with the habitat and with refuge objectives, minimize furbearer damage to facilities and wildlife habitat, minimize competition with, or interaction among, wildlife populations and species that conflict with refuge objectives, and minimize threats of disease to wildlife and humans.

During five winter trapping seasons (2004/5 and 2007/8 to 2010/11), a total of 66 beaver and 46 muskrats were taken in the Moorehen Marsh vicinity of the Pondicherry CFA/Division by permitted trappers, thus averaging about 13 beaver and 9 muskrat in any one trapping season. This was a cooperative effort with the New Hampshire Bureau of Trails which manages the recreational rail-trail bordering Moorhen Marsh. Beavers and muskrats were plugging outlets under the rail-trail resulting in trail flooding which created sheet ice in winter, a safety hazard on this popular snowmobile trail. It is also likely that some of these recorded animals were actually taken off-refuge in the rail-trail ROW where the same trappers operated. At the Nulhegan Basin Division, furbearer management

activity conducted from 2001-2012 resulted in a harvest of 65 beaver, 77 muskrat, 41 mink, and 13 river otter, averaging about 16 beaver, 8 muskrat, less than 4 mink, and 1 otter annually. Average annual trap-days spent by individuals in the wetland environment was 64. The potential adverse impact of a furbearer management program is considered by the refuge to be negligible to minor, and in the long term of negligible adverse impact due to the fecundity of both beaver and muskrat. The impact of managing the populations of these species is also considered beneficial due to beaver providing and maintaining dynamic forested wetlands. The compatibility determination for furbearer management in appendix D "Appropriateness and Compatibility Determinations," provides additional references on furbearer management.

All alternatives predict some increase in annual visitor numbers over time (Table 5.5); however, the increase varies due to each alternative's respective refuge boundary configuration or expansion level, and impacts are expected to be negligibly adverse in the short and long term. Public use trails are placed and managed to avoid or minimize adverse impacts to the refuge's diverse mammal assemblage. For example, at Pondicherry's Mud Pond Trail boardwalk, the refuge elevated sections a couple of feet to allow passage of small animals while also having one section lowered to about 4 inches above the wetland to allow large animals to cross. At present, most use occurs at the Nulhegan Basin and Pondicherry CFAs/Divisions. Alternative A predicts the lowest annual increase in visitor use (Table 5.5), since no expansion of hiking trails and visitor use is proposed, while alternative C predicts the highest increase due to its large refuge expansion proposal with trails potentially modifying and disturbing up to 22 miles and 44 acres of habitat (2 acres disturbed/mile); similarly, alternative D proposes modification and disruption of up to 22 acres (1 acres disturbed/mile). All of these trails, however, would be appropriately situated to avoid or minimize adverse impacts to priority refuge resources of concern mammals and associated mammals.

Bicycling and pet walking can disturb breeding and foraging mammals. Generally, these potentially disturbing activities are not permitted on refuge lands; however, limited use may be authorized in appropriate places. For example, we only allow bicycling on refuge roads (we do not allow bicycles off-road or on refuge trails). Any of these compatible uses would be authorized with appropriate conditions and safeguards to avoid adverse impacts such as on-trail mountain biking or introduction of invasive plant seeds from pet fur. Pets under control are permitted on most existing refuge trails, and they would be allowed on new trails if determined compatible within the specific CFA. The refuge fully recognizes that pets off-leash can disrupt mammals nearby, typically small mammals (eastern chipmunk, red squirrels, cottontail rabbits), thus all pet-walking would be restricted to leash only. Authors of many wildlife disturbance studies concluded that dogs (off-leash with people, dogs on-leash, or loose dogs) provoked the most pronounced disturbance reactions from their study animals. In effect, dogs extend the zone of human influence especially when off-leash and can cause pronounced reactions by ungulates, including energy loss. Dogs are noted predators for various wildlife species in all seasons and can potentially introduce diseases (distemper, parvovirus, and rabies) and transport parasites into wildlife habitats. Adverse impacts can be direct to individual wildlife and to populations over the long term (Sime 1999).

Through the issuance of special use permits, all alternatives would promote monitoring and research of refuge mammals. Plans are in place to monitor Canada lynx to better understand their movements, abundance, and habitat preferences at the Nulhegan Basin CFA/Division, and work continues to document the impact of moose browse on forest regeneration. The refuge recognizes that field monitoring and research may adversely impact mammals being studied largely due to the presence of humans, and sometimes direct contacts (e.g., radio telemetry). The value of an improved knowledge base is

appreciated by the refuge, and there is no indication that previous projects, nor similar ones authorized in the future, would have any more than a negligible adverse impact on mammals.

Impacts to Mammals of Alternative A

Beneficial Impacts. Alternative A would provide beneficial impacts, principally because it would protect up to 97,830 acres (37,000 currently acquired). As noted before, however, this alternative encompasses 65 widely separated, often small, and logistically difficult to manage SFAs. The primary objective of land acquisition under alternative A is to protect habitat for species listed in the refuge's statutory purposes (re: chapter 1), including federally and state-listed threatened and endangered species and other native species of plants, fish, and wildlife. While habitat diversity is represented within this SFA structure, the amount and distributions is limited in overall habitat representation, resiliency, redundancy, connectivity, and protection of ecosystem processes. Mammals associated with the habitats of priority refuge resources of concern species (table 5.15) that will benefit from lands and habitats protected in alternative A cannot be clearly distinguished due to the lack of appropriate GIS files distinguishing habitat types. However, 46 of the SFAs are now included within the newly proposed, more consolidated CFAs, thus recognizing their habitat values to mammals and other wildlife. Most of the species noted in Table 5.15 would also benefit under alternative A, yet management capability would be somewhat impeded under this alternative A due to the scattered nature of the SFAs. Management of the woodcock habitat demonstration units on the Nulhegan Basin Division under alternative A will result in the maintenance of approximately 300 acres of early-successional forests. While these treatments are designed specifically to benefit woodcock, a priority refuge resources of concern species, the refuge recognizes some mammals use early-successional forests.

Adverse Impacts. Nineteen of the 65 SFAs would not be included within the CFA structure, representing 36,915 acres of potential habitat that would not be available for inclusion into the refuge. The refuge recognizes that these SFAs continue to hold valuable habitat for mammals such as the Southern bog lemming known to occur in the Victory Basin (SFA 42). Seven of the SFAs are contained within proposed CFAs having priority refuge resources of concern associated mammals (Table 5.15). As noted in "Impacts that Do Not Vary by Alternative" above, alternative A would permit hunting of game mammals but such potential adverse impact would be deemed negligible. Alternative A would include very few habitat and ground disturbing activities known to adversely impact priority refuge resources of concern associated mammals, and none would be of any permanent adverse impact. Adverse impacts to mammals under alternative A are considered negligible in the short term and long term given the small acreage of forest the refuge maintains in an early-successional condition. Small mammals are adversely impacted by mowing (Yeager and Brittingham 2008), as is done at the Fort River and Nulhegan Basin Divisions/CFAs. When done, mowing height is set to avoid contact with small mammals to ensure negligible short- and long-term term impacts.

White-tailed deer fawn

USFWS

Under alternative A, active management would include annually mowing and haying up to 200 acres of grassland on three refuge divisions: Fort River, Nulhegan Basin, and Pondicherry, 255 acres of forest management (Table 5.4), hazardous fuel treatments on less than 100 acres, controlled mechanical and herbicide use on approximately 60 acres, maintenance of six buildings, road maintenance with some tree cutting and mowing (40 miles public, 2 miles administrative), and visitor use impacts (e.g., 20 miles of trails); some of these activities potentially can adversely impact mammals, particularly small mammals (e.g., mowing and fuel treatment) but they are considered to be of negligible adverse

impact in the short and long term due to their small scale application over such a potentially large refuge landscape. Both watershed-wide and refuge-specific, these activities are of negligible adverse impact. As noted prior, best management practices are implemented in all forest management activities.

Visitation under alternative A would not appreciably change over current levels and is expected to be lower than any of the other alternatives (Table 5.5), although similar to alternative D. As such, alternative A visitor activities that might impact mammals, as described would pose the lowest concern.

As noted previously, we do not plan to increase capacity for snowmobiling regardless of alternative (and alternative D would eliminate snowmobiling); rather, we plan only to maintain existing use levels. Snowmobile trails on new lands potentially to be acquired under proposed alternatives C and D may be maintained, especially if they are connector trails. In rare situations closed trails may be opened to promote wildlife-dependent public uses. Snowmobiling can introduce petroleum hydrocarbons to wild lands, but potential adverse impacts are expected to be negligible. Some studies that indicate that snowmobile traffic can harass mammals, causing increased metabolic rates and stress responses, and increase susceptibility to disease and predation, especially during hard winters (Oliff et al. 1999, Picton 1999). The accumulations of snowmobile exposures over the course of a winter or several seasons can result in significant long-term wildlife displacement and expanded home ranges. Collescott and Gillingham (per Hammitt and Cole, eds. 1998) found that moose that bedded down within 1,000 feet of an active snowmobile trail, or fed within 500 feet of snowmobile traffic, were likely to change their behavior in response to snowmobile disturbance. These types of potential adverse behavioral and metabolic impacts are discussed in considerably more detail within the compatibility determinations for snowmobiling in appendix D "Appropriateness and Compatibility Determinations," (appendix D) which concludes, however, that much of the disturbances to wildlife noted in literature are from snowmobiles that are not on designated trails and are traveling across open range habitats in unpredictable ways. Restricting snowmobile traffic to designated road corridors helps to increase predictability and wildlife habituation. The existing snowmobile trails, and many of the existing trails that may be incorporated into the refuge with new land acquisition, have been in place for decades and predate the establishment of the refuge. The snowmobile use at the Nulhegan Basin Division is currently at manageable levels based on monitoring studies, which supports our assessment that adverse impacts associated with this activity are expected to remain low.

An indirect impact to mammals from cross country skiing and snowmobiling stems from snow compaction. Snow cover is important to the winter survival of many species because of the protection that the subnivian environment provides from the stresses of direct exposure to severe winter weather and predation (Formozov 1946, Pruitt 1957, Fuller 1969). Jarvinen and Schmid (1971) found that snowmobile-compacted snowfields increased the winter mortality of small mammals, indicating that compaction inhibited mammal movements beneath the snow and subjected subnivian organisms (animals that travel below snow) to greater temperature stress. We have not, however, recorded any notable adverse impacts due to cross country skiing or snowmobiling and believe such impacts that may occur will be of negligible to minor adverse impact in the short term and over the long term.

Impacts to Mammals of Alternative B

Beneficial Impacts. Alternative B would provide very similar beneficial impacts when compared to alternative A, principally because it would protect almost the same amount of habitat, of which 37,000 acres are currently acquired. However, in contrast to the 65 widely separated, often small, and logistically difficult to manage SFAs, alternative B consolidates most of alternative A's current

97,830 acre acquisition boundary into 19 CFAs, thus promoting a larger, more diverse, and connected habitat system within the larger watershed landscape. This consolidation is designed to allow the refuge to acquire large contiguous forest tracts that are connected (and thus able to serve as corridors) to other tracts, offer a diverse and complex forest structure and composition, provide for structural integrity of forested wetlands, and more readily accommodate the ability of refuge mammals to adapt to a warming climate.

Alternative B offers acquisition of lands that would provide habitat for New England Cottontail, a priority refuge resource of concern. Three CFAs provide much of this potential habitat: the Farmington River CFA (which does not include former SFAs), and the Salmon River and Whalebone Cove CFAs, which include eight of the original SFAs. (Table 5.16). The protection of additional acres of habitat is likely to have negligible to minor beneficial impacts on the cottontail, with the degree of impact relative to the quantity of habitat protected and managed for this species.

Table 5.16. Estimated Potential New England Cottontail Habitat Acres Proposed by Alternative.

LCC Habitat Type	Alternative B	Alternative C	Alternative D
Pasture/Hay/Grassland	5,059	,634	11,234
Hardwood forest	61,190	150,836	195,518
Shrub swamp and floodplain forest	1,635	2,797	3,479
Old fields and shrubland	37	50	100
Total	**67,921**	**163,317**	**210,331**
Total without hardwood forest	**6,731**	**12,482**	**14,813**
Alternative A includes approximately 6000 acres of habitat.			

Alternative B offers acquisition of a large expanse, and protection and management potential, of spruce-fir/conifer swamp and hardwood forests (76,561 acres), habitats that accommodate all priority refuge resources of concern associated mammals including wetland dependent water shrew that also uses non-forested wetlands.

Alternative B proposes the establishment and management of 775 acres of shrubland habitat principally for New England cottontail (Table 5.4). The full extent of these acres will be established over an estimated ten year period. The expected benefits of such habitat management is to restore adequate habitat areas for this species so that viable self-sustaining meta-populations can become established in and near currently recognized habitat areas for this mammal. In doing such management, the refuge will contribute directly to the goals of the Strategic Plan for New England Cottontail (Fuller and Tur 2012).

Adverse Impacts. As presented and discussed in alternative A above, 19 of the 65 SFAs would not be included within the proposed CFA structure, representing 36,915 acres of potential mammal habitat that would not be available for inclusion into the refuge. Over the 15 year CCP horizon, alternative B encompasses management of a minimum of 9,312 acres of habitat compared to 455 acres under alternative A: 7,660 acres forest, 422 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species (table

5.4), and over time additional acres could become subject to active management if determined necessary through development of future HMPs.

A prominent difference between alternative B and alternative between A would be the establishment and active management of 775 acres of shrubland habitat under alternative B to benefit New England cottontail (table 5.4). As noted in alternative A, negligible adverse impacts to small mammals may occur due to active management activities but are not expected to have any short- and long-term impacts. We recognize that there are tradeoffs with all habitat management decisions. If we manage a particular areas for species that require grasslands, that area will not have the greatest benefit for species that require late successional forests. However, we hope by protecting and managing a diversity of habitat types (e.g., different forest types, grasslands, and shrublands) we will benefit a wide range of mammals. Prescribed burning would be used under this alternative to maintain fire regime communities (e.g., pitch pine) and to facilitate treatment of less than 100 acres of hazardous fuels annually. Best management practices are implemented in all habitat management activities, as noted prior.

Visitation under alternative B would potentially increase by 22 percent over alternative A levels (Table 5.5), due in large part to an expanded 19-mile trail system. As such, visitor activities that might impact mammal habitats, such as occasional hiking off designated trails, illegal running of unleashed pets, and snowmobiling would pose negligible to minor impacts over the long-term management. Due to the expansive nature of largely forest habitats to be potentially acquired under alternative B (tables 5.6 and 5.7), the refuge considers these active management priorities of negligible adverse impacts to mammals. Alternative B would permit hunting of game mammals but such potential adverse impact would be deemed negligibly adverse at worse and more likely beneficial in impact to the hunted mammal population.

Alternative B also proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to Mammals of Alternative C

Beneficial Impacts. Alternative C would provide the second most beneficial impacts to priority refuge resources of concern mammals primarily because it would protect up to 197,337 acres of habitat. Other native mammals sensitive to development would be afforded this additional habitat protection as well. This level of protection represents a 48 percent increase in acres over alternative B. As noted in alternative B's discussion above, alternative C yields beneficial impacts due to employing a CFA structure. However, in contrast to alternative B, alternative C would establish 22 CFAs and their sizes would be larger. This even larger CFA consolidation will greatly promote principals outlined in the CCP Objective for Forested Uplands and Wetland (re: chapter 4, Obj.1.1), as discussed above in alternative B.

Similarly to alternative B above, alternative C proposes acquisition of lands that would provide habitat for New England Cottontail, a priority refuge resource of concern. Three CFAs provide much of this potential habitat: the Farmington River CFA (which does not include former SFAs), and the Salmon River and Whalebone Cove CFAs, which include eight of the original SFAs (Table 5.16). The protection of additional acres of habitat is likely to have negligible to minor beneficial impacts on the cottontail, with the degree of impact relative to the quantity of habitat protected and managed for this species. The same amount of acres (775) are planned to be managed between alternatives B and C (Table 5.4), with the same negligible to minor beneficial impacts on the cottontail for each. These beneficial impacts would not occur in alternative A.

Also similar to alternative B, alternative C offers a high level of protection and management potential of spruce-fir/conifer swamp and hardwood forests (162,427 acres), and it advances a marked increase in protection of hardwood forests. It also represents a commitment to protect sizeable increases of hardwood swamps, shrub swamp/floodplain forests, freshwater marshes, cliff and talus, pasture/hay/grassland, and rocky outcrop. Such habitat protections accommodate all priority refuge resources of concern and associated mammals (Table 5.15). Alternative C proposes 6,558 additional acres over alternative B for the three CFAs that contain habitat for the New England cottontail (Table 5.16).

Adverse Impacts. The adverse impacts discussed in alternative B above largely apply to alternative C. Over the 15 year CCP horizon, alternative C encompasses management of a minimum of 12,873 acres of habitat compared to 455 acres under alternative A: 11,550 acres. forest, 548 acres grassland, and 775 acres shrubland, all designed to improve habitat for priority wildlife, fish, and plant species including mammals (table 5.4). Over time additional acres could become subject to active management if determined necessary through development of future HMPs. As noted and discussed prior, 19 SFAs would not be included within alternative C's proposed CFA structure, including SFA 42 (Victory Basin) known to be inhabited by southern bog lemming. Potential adverse impacts would be considered negligible over the short and long term and would be similar to those discussed under alternative B.

Visitation under alternative C would likely increase over current alternative A levels (Table 5.5) and would potentially offer the highest level of visitor use opportunities of all alternatives. Nevertheless, with such visitation activities being established across a potentially much larger refuge landscape, the refuge concludes that there would be negligible to minor adverse impacts over the short term and long term.

Impacts to Mammals of Alternative D

Beneficial Impacts. Alternative D may provide the most beneficial impacts to priority refuge resources of concern mammals and associated mammals over the long term because it would protect up 231,307 acres of habitat, of which 37,000 acres are currently acquired. This represents a 59 percent increase over alternative A's 97,830 acres, 58 percent increase over alternative B's 97,772 acres and 16 percent increase over alternative C's 197,337 acres. As noted in alternative B's discussion above, alternative D yields benefits due to employing a CFA structure, and, like alternative C, would establish 22 CFAs. This even larger CFA consolidation will advance the best opportunity to promote principals outlined in the CCP Objective for Forested Uplands and Wetland (re: Chapter 4, Obj.1.1), as discussed above in alternative B.

In contrast to all other alternatives, alternative D would employ a very low impact or passive management approach. This approach would essentially allow all natural ecological functions and processes to operate without influence from active management as proposed in the other alternatives. Although we will not be actively managing habitats under alternative D, we expect that natural events and disturbances (e.g., floods, fire, disease, hurricanes, microbursts, drought) will create some habitat complexity over the very long term (i.e., decades to centuries).This habitat complexity will serve some of the needs of priority refuge resources of concern species over the long term. However, some habitats, such as those utilized by the New England cottontail, are relatively less likely to occur on the refuge without active human management. Alternative D provides for the largest amount of potential cottontail habitat (Table 5.16), but without active management there is more uncertainty about the beneficial impacts to cottontail from its acquisition. They are likely negligible to minor, depending on the quality and persistence of habitat over time.

It is also recognized that such an approach tends to eliminate the ability of the refuge to seek selective habitat improvements for the New England cottontail, and potentially for the Canada lynx once more certainty is gained about how the refuge can best contribute to its needs. Management results (or wildlife response to management activities), when monitored, can reveal valuable lessons in using effective and wildlife-responsive techniques.

Similar to alternatives B and C, alternative D offers a very high level of protection and management potential of spruce-fir/conifer swamp and hardwood forests (194,756 acres), and it advances a notable increase in protection of hardwood swamps (+1,475 acres). Alternative D proposes 15,653 additional acres over alternative C for the three CFAs that contain habitat for the New England cottontail (Table 5.16). With alternative D's proposing considerable acquisition of spruce-fir/conifer swamp and hardwood forests, species likely to benefit include those noted in Table 5.15. As noted and discussed in alternative B above, 19 SFAs would not be included within alternative D's proposed CFA structure.

Adverse Impacts. As noted in "Impacts that Do Not Vary by Alternative" above, alternative D would permit hunting of game mammals but such potential adverse impact would be deemed negligible, and it would include the slight modifications described in alternative C. Due to its large size, and a passive management approach by the refuge (i.e., minor accessibility improvements), the land base proposed by alternative D (231,307 acres) may result in fewer hunting opportunities for some of the proposed CFAs.

The adverse habitat impacts discussed in the other alternatives apply much less to alternative D since the 'passive' management approach would not employ the habitat alteration activities described for the other alternatives. Under alternative D there would be no active forest management designed for target priority refuge resources of concern wildlife. Thus, there will be no regularly prescribed sivicultural operations or use of heavy equipment. Management steps would be taken to mitigate unexpected events that may pose safety hazards (e.g., flooding due to collapsed culvert, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment). Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming). Effectively, this means that under passive management natural processes would be allowed unimpeded to alter the landscape, thus impacting a host of species in positive and negative ways. For example, allowing existing grasslands and old fields to revert to forest would eliminate habitat for New England cottontail unless natural processes opened new shrubland areas. The passive approach would compromise the refuge's ability to apply an adaptive management approach designed to clarify and strengthen assumptions about expected results from applied management techniques. Visitation under alternative D is projected to be lower than alternative C, but higher than under alternatives A or B. Its scope is different because snowmobile use will be eliminated. Thus, adverse impacts would be considerably less than those noted in alternatives B and C and other alternatives, but nevertheless would be viewed as negligible.

Linda Cullivan

New England cottontail

Summary

In summary, our management activities across alternatives would not *significantly* adversely or beneficially impact mammals in the Connecticut River

watershed. As previously noted, all alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). With those potential additions of habitat to the refuge, in concert with currently protected lands (37,000 acres), we expect benefits to watershed mammals. The continued maintenance of existing refuge uplands and the potential to acquire and permanently protect more will be of direct and long-term beneficial impacts to promoting mammals over the short and long term. We will take appropriate management action to help maintain and improve mammals known to be in decline (e.g., New England cottontail). Maintaining and protecting the defined LCC subhabitats (notably grassland and shrubland habitat for New England cottontail) will help to guarantee their beneficial habitat functions for watershed mammals. Because it is unlikely that acquisition of the full proposed level of refuge ownership will be reached within the 15-year lifetime of the CCP, we acknowledge that there are limits to both the adverse and beneficial impacts predicted in this analysis, and that over the short-term there is some reduction in variation among alternatives. Proposed management activities–forest management, mowing, prescribed burning, trail construction, and snowmobile use–may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact to promoting mammal conservation.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species

The diverse aquatic habitats, and adjacent upland areas, within the expansive Connecticut River watershed provide breeding, migratory, wintering, and foraging areas for a diversity of reptiles and amphibians, hundreds of species of migratory and resident fish, and other aquatic species (e.g., freshwater mussels). Table 5.17 lists the priority refuge resources of concern reptile, amphibian, fish, and other aquatic species that may be impacted by the four alternatives. Some of these species are described in more detail under the discussion on federally threatened and endangered species. Although most of these species are aquatic, some occur seasonally in terrestrial areas (mole salamanders), or have terrestrial life-cycle phases (e.g. red-spotted newt). Some of the reptiles discussed are obligate terrestrial species (e.g., eastern box turtle, eastern hog nose snake).

Table 5.17. Priority Refuge Resources of Concern Reptiles, Amphibians, Fish, and Other Aquatic Species for Conte Refuge

	PRRC Reptiles, Amphibians, Fish, and Other Aquatic Species	
CFA	PRRC Fish & Mussels	PRRC Associated Aquatic Species
Maromas CT	American Shad, shortnose sturgeon, American eel, Atlantic salmon, alewife, blueback herring	spotted turtle, smallmouth bass, striped bass, pumpkinseed, sea lamprey, longnose dace, yellow perch, rainbow smelt, banded sunfish
Pyquag CT*	American Shad, shortnose sturgeon, American eel, Atlantic salmon, alewife, blueback herring	smallmouth bass, striped bass, burbot, pumpkinseed, sea lamprey, longnose dace, yellow perch, rainbow smelt, banded sunfish
Muddy Brook CT†	Eastern brook trout, American eel	sea lamprey, longnose dace
Salmon River CT*	American eel, Atlantic salmon, alewife, blue-backed herring, brook floater	Eastern box turtle, Eastern hognose snake
Scantic River CT*	American shad, shortnose sturgeon, American eel, Atlantic salmon, alewife, blueback herring	spotted turtle, smallmouth bass, burbot, striped bass, pumpkinseed, sea lamprey, longnose dace, yellow perch, rainbow smelt, banded sunfish
Whalebone Cove CT*	American eel, Atlantic salmon, alewife, blueback herring, Eastern brook trout	Eastern box turtle, sotted turtle, sea lamprey, bridle shiner, pumpkinseed, striped bass, longnose dace, yellow perch, rainbow smelt, banded sunfish, white perch

	PRRC Reptiles, Amphibians, Fish, and Other Aquatic Species	
CFA	**PRRC Fish & Mussels**	**PRRC Associated Aquatic Species**
Farmington River CT/MA	Eastern brook trout, American eel	Eastern box turtle, Jefferson salamander, Eastern ribbon snake, spotted turtle, black racer, bridle shiner, burbot, Eastern silvery minnow, longnose dace, longnose sucker, creek chubsucker
Dead Branch MA*	Eastern brook trout, Atlantic salmon	black racer, Jefferson salamander, Eastern ribbon snake, spotted turtle, wood turtle, Spring salamander, bridle shiner, longnose sucker, slimy sculpin, creek chubsucker, longnose dace, lake chub
Fort River MA*	Eastern brook trout, American eel	wood turtle, Spring salamander, sea lamprey, fallfish, longnose dace
Mill River MA*	American shad, shortnose sturgeon, American eel, Atlantic salmon, blueback herring, dwarf wedge mussel	Spring salamander, sea lamprey, Eastern silvery minnow, burbot, black dace, longnose sucker, slimy sucker, creek chubsucker, longnose dace
Westfield River MA*	Eastern brook trout, American eel, Atlantic salmon	Spring salamander, Eastern box turtle, four-toed salamander, black racer, spotted turtle, Northern leopard frog, Eastern ribbon snake, longnose sucker, black dace, slimy sculpin, creek chubsucker, longnose dace, lake chub
Sprague Brook NH/MA†	Eastern brook trout, Atlantic salmon	Jefferson salamander, marbled salamander, black racer, Eastern ribbon snake, Northern leopard frog, Northern red-bellied dace, slimy sculpin, burbot, creek chubsucker, longnose dace
Ashuelot NH	Eastern brook trout, American eel, dwarf wedge mussel	wood turtle, black racer, slimy sculpin, tessellated darter
Blueberry Swamp NH*	Eastern brook trout	Northern leopard frog, wood turtle, slimy sculpin; Northern red-bellied dace and finescale dace [both suspected but unconfirmed]
Mascoma River NH	Eastern brook trout	black racer, wood turtle, spotted turtle, slimy sculpin
Pondicherry NH*	Eastern brook trout	smooth green snake, Northern leopard frog, mink frog, Northern red-bellied dace, slimy sculpin, tessellated darter
Nulhegan Basin VT*	Eastern brook trout, Atlantic salmon	smooth green snake, black racer, wood turtle, mink frog
Ompompanoosuc VT	Eastern brook trout, Atlantic salmon	Jeffereson salamander, black racer, Eastern ribbon snake
Ottauquechee River VT†	Eastern brook trout, Atlantic salmon	blackstone shiner
West River VT	Eastern brook trout, Atlantic salmon, American shad, American eel, brook floater	Eastern ribbon snake, wood turtle, Eastern pearlshell
White River VT†	Eastern brook trout, Atlantic salmon	blacknose shiner
Quonatuck CFA*	8,000 acres of tidal (salt, brackish, and fresh) wetlands, floodplain forest, and riparian areas within the Quonatuck CFA , running through the mainstem river, will be protected but specific LCC habitats cannot be determined at this time but will be selected using detailed criteria (see also Appendix C: Land Protection Plan).	

** CFA contains a SFA, part of alternative A*

† CFA not proposed under alternative B, only proposed under alternatives C and D

Note: See appendix B for a full description of how we identified priority refuge resources of concern species based on information from a variety of conservation plans. See appendix A on additional information on priority refuge resources of concern species and proposed management for each CFA.

We evaluated the benefits to these species from actions proposed under the four alternatives, including:

- The extent to which refuge land acquisition and habitat conservation under the alternatives would limit the growth of nearby land development activities and their impact to reptile, amphibian, fish, and other aquatic species.
- Managing and restoring habitat to improve habitat structure and integrity for reptile, amphibian, fish, and other aquatic species.
- Repairing and upgrading road culverts.
- Removing surplus buildings and roads.
- Supporting partnerships.
- Conducting effective visitor interpretation.

We evaluated the potential for negative impacts to these species from actions proposed under the four alternatives, including:

- Forest management activities, including use of logging roads and skid trails.
- Mowing and haying grasslands, and managing for early-successional shrublands.
- Invasive plant control.
- Prescribed burning in appropriate fire-regime habitats, or for hazardous fuel reduction.
- Visitor use impacts on refuge lands, trails and roads (e.g., hiking, snowmobiles, and introduction of invasive species).
- Construction of trails, access roads, and parking facilities.
- Construction and/or demolition of buildings.
- Road maintenance (grading, ditch maintenance, spreading gravel, removing boulders, roadside mowing/debrushing).

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species That Would Not Vary by Alternative

None of the refuge activities proposed under the four alternatives would significantly benefit or adversely impact reptiles, amphibians, fish, and aquatic species in the Connecticut River watershed. We expect refuge land conservation and management under all alternatives will help maintain and even improve habitat for these species.

Under all alternatives, we anticipate that proposed additional refuge land acquisition will permanently protect habitat for and benefit reptiles, amphibians, fish, and other aquatic species. Over the long term, we expect alternatives C and D to have the greatest benefit because they propose the largest refuge expansions. However, in the short term (within 15 years), we would likely acquire

similar amounts of land under all the alternatives, thus beneficial impacts would be similar across all alternatives in the short term.

Across all alternatives, none of our proposed management actions would permanently degrade habitat for these species, except when constructing minor infrastructure appropriate to outdoor environmental education and interpretation, such as new trails, parking lots, raised boardwalks, and observation platforms (e.g., incidental trampling of terrestrial "eft" phase of the aquatic adult red-spotted newt, temporary disruption of slimy sculpin stream habitat during culvert replacement). Impacts from these activities would be negligibly adverse in both the short and long term. There are no plans for major facilities or new road construction on refuge lands. Regardless of which alternative is selected, we would continue to use best management practices in all management activities that might impact refuge wetlands, streams, and rivers (e.g., approved herbicide use for invasive plant control, not mowing within 100' of wetland areas, appropriate buffering of streams and vernal pools during forest management activities).

Across all alternatives, we would restore and protect key spawning reaches for priority fish species, where feasible, and would participate with our partners in the Eastern Brook Trout Joint Venture and other partnerships to do so. We recognize, however, the imperative to work with others since refuge lands would not compose an adequate habitat base to independently influence a significant fish population response. There are no management activities that would pose any adverse impacts to either the dwarf wedgemussel or brook floater, yet protection of riverine habitats in select CFAs would have a beneficial impact on these PRCC species (i.e., Fort River, West River, Ashuelot River, and Salmon River). We would also pursue protection and restoration activities on rare and exemplary habitats (e.g., vernal pools), and would reduce or eliminate invasive plant areas through partnerships with Cooperative Invasive Plant Management Areas (CISMA) on and off refuge lands using mechanical and approved herbicidal treatment. As noted previously, regardless of the alternatives selected, use of pesticides, most often herbicides, will be conducted under an Integrated Pest Management plan that addresses environmentally safe application procedures and requirements. Pesticides will only be used if it is the most effective management technique (e.g., dense expansive stands of Japanese knotweed), and will be combined with other management tools. Pesticides must be approved by the Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection. Additionally, treatments would not occur during spring salamander migrations (March 15th to May 1st) in areas containing vernal pools, and most often conducted in mid to late summer dry periods.

Conserving habitat for these species would include improvements to the aquatic area's immediate watershed by removing dwellings and other small infrastructure on property acquired by the refuge, and carefully manage roads near sensitive habitat areas. As noted by Jochimsen et al. (2004), although relatively few studies address the population-level consequences of roads, population declines in several reptile and amphibian species have been shown to be associated with roads. Species with restricted distributions and/or small population sizes appear to be more vulnerable to extinction because of their sensitivity to random events and changes. Direct effects are considered to involve injury or mortality due to physical contact from vehicles or occurring during road construction. Indirect effects include habitat loss, fragmentation, and alteration of ecosystem processes at both fine and broad scales (physical, chemical, and biological). Research indicates that the combined ecological effects may extend outward from the road edge beyond 100 meters, delineating a "road-effect zone." Altered roadside habitats have been shown to modify amphibian and reptile

behavior and movement patterns. Increased mortality and barriers to movement may influence species demography and gene flow, consequently having an impact on overall population stability and persistence (Jochimsen et al. 2004). There are no plans for major facilities or new road or snowmobile trail construction on refuge lands. As needed, roads will remain open to provide motorized and non-motorized access to visitors, and to benefit management access. Where appropriate, roads may be closed to visitor access. Roads no longer required for management activities may be closed permanently to improve local soil and hydrology. Roads may be upgraded, re-opened, or maintained to improve access for habitat management. Roads created during management actions will follow applicable BMPs to avoid wetlands, vernal pools, and sensitive habitat areas to avoid reptile and amphibian migration barriers (although we recognize artificial depressions may seasonally function as vernal pools). Logging may be performed over snow pack during winter to minimize such adverse impacts.

Off road vehicle use, can directly kill migrating reptiles and amphibians and indirectly impact populations by creating migration barriers, destroying habitats, increasing sedimentation, and introducing chemical contamination (Cooper et al. 2005, Hels and Buchwald 2001, Haxton 2000, and Trombulak and Frissell 2000). The refuge, however, prohibits ATV use and, where permitted (e.g., Nulhegan Basin Division), bicycling is restricted to refuge roads (trail use prohibited).

Forest management operations can adversely impact reptiles and amphibians (Martin and McComb 2003, Ash 1996) but may also create a beneficial diversity of habitat and species response (Loehle et al. 2005). Within the regional and refuge specific landscape, forest management activities across alternatives are negligibly adverse in the short term and beneficial in the long term. As noted previously, all forest silvicultural activities would follow established best management practices, including measures such as established buffers when necessary or conducting operations in winter.

The Service regulates human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses) and thus curtails anthropogenic impacts that may impair aquatic and associated terrestrial habitats. All alternatives predict some increase in annual visitor numbers over time (Table 5.5); however, the increase varies due to each alternative's respective refuge expansion level and impacts are expected to be negligibly adverse. Public use trails are carefully placed and managed to avoid or minimize adverse impacts to the refuge's reptiles, amphibians, and fish in nearby streams. Alternative A predicts the lowest annual increase, since no expansion of hiking trails and visitor use is proposed, while alternative C predicts the highest increase due to its large refuge expansion proposal with 22 miles of ADA-compliant trails potentially modifying and disturbing up to 44 acres of habitat (2 acres displaced/mile); similarly, alternative D proposes modification and disruption of up to 22 acres (1 acre/mile). All of these trails, however, would be appropriately situated to avoid or minimize impacts to terrestrial phase amphibians and terrestrial reptiles without reducing visitor observation and appreciation for rare and unique 'wildlife-rich' habitat areas.

The refuge is not currently officially open to recreational fishing, but it may occur on refuge lands. Under all alternatives, we propose to complete the administrative steps necessary to open refuge lands, where compatible, to recreational fishing. Recreational fishing by the public can have negative impacts on fish populations if it occurs at high levels or is not managed properly. Potential impacts from fishing include direct mortality from harvest and catch and release; injury to fish caught and released, changes in age and size class distribution, changes in reproductive capacity and success, loss of genetic diversity, altered behavior, and changes in ecosystems and food webs (Lewin et al. 2006, Cline et al. 2007). Since fishing occurs along the shores of or in streams, rivers, and

lakes, it has the greatest potential to impact wildlife associated with riparian, wetland, and aquatic habitats. In particular, fishing has the potential to disturb nesting and brooding birds. Anglers can also affect the number, behavior, and temporal distribution of some species of birds, including bald eagles, common ravens, and American crows (Knight et al. 1991). Discarded fishing tackle may harm waterfowl, eagles, and other birds externally by catching and tearing skin. Fishing line may also become wrapped around body parts and hinder movement (legs, wings), impair feeding (bill), or cause constriction with subsequent reduction of blood flow and tissue damage. Pollutants from motorboats, human waste, and litter have the potential to have negative impacts on water quality, and bank and trail erosion from human activity (e.g. canoe/ kayak landings, foot traffic) may increase aquatic sediment loads of streams and rivers, and alter riparian or streamside habitat/ vegetation in ways harmful to fish or other wildlife. Accidental introduction of invasive plants, pathogens, or exotic invertebrates, attached to fishing boats may also impact native vegetation, wildlife, and habitats. None of the potential impacts noted above are known to cause anything more than negligible to minor adverse impacts to fish populations or aquatic habitats, nor to nearby wildlife in adjacent habitats. Our fishing program would adhere to state regulations for annual take levels and seasons by species. These regulations are set within each state based on what harvest levels can be sustained for a species without adversely affecting its overall population. Thus, fishing can result in individual losses, but the projected cumulative harvest would not jeopardize the viability of any harvested species populations. The compatibility determinations on fishing are contained in appendix D 'Appropriateness and Compatibility Determinations,' and provide additional discussion and references on fishing impacts.

Bicycling can directly and indirectly impact reptiles and amphibians (trampling, habitat disturbance). However, we would only allow bicycling seasonally on refuge roads that are open to other motor vehicles. Generally, these trampling type activities are not permitted on refuge lands; however, limited use may be authorized when determined that the use is appropriate and compatible. Leashed pets are permitted on most refuge trails, yet they can have direct adverse impacts on snakes and turtles especially when off-leash. Their waste can cause negative adverse impacts to refuge habitats and natural water quality critical to fish and reptiles and amphibians. There are no known pet waste problems on any refuge division or unit, and future acquisitions will be carefully managed to authorize any pet walking so that their wastes are removed from refuge lands. These potential adverse impacts are considered negligible, both in the short term and long term.

Through the issuance of special use permits, all alternatives would promote monitoring and research on fish and reptiles and amphibians. The refuge recognizes that field monitoring and research may adversely impact fish and reptiles and amphibians often due to both indirect methods (e.g., visually checking salamander egg masses in vernal pools) and direct methods (e.g., netting, electro-fishing during fish surveys, or collecting and measuring salamanders). Similarly, research on fish and reptiles and amphibians can include capture and marking or tagging, or even use of radio transmitter implants. The value of an improved knowledge base upon which management depends is appreciated by the refuge, and there is no indication that previous projects, nor similar ones authorized in the future, would have any more than a negligible adverse impact on aquatic fauna.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species common to Alternatives B, C, and D

Alternative A calls for habitat protection in several SFAs that would contribute to fish and reptiles and amphibians conservation. Some SFAs valuable to fish and reptiles and amphibians would not be included in the CFA structure proposed

by the action alternatives. The refuge recognizes that these SFAs continue to hold valuable habitat for fish and reptiles and amphibians. Further details on fish and reptiles and amphibians benefits in the SFAs are provided by Appendix 3-10 of the 1995 FEIS (USFWS 1995). The CFAs proposed under the other three alternatives contain valuable wetland and riverine habitats, which extend across a greater potential spatial extent than that proposed under alternative A. Due to the benefits conferred through consolidating into fewer, larger CFAs, the overall beneficial impacts to reptiles, amphibian, fish, and other aquatic species are predicted to be larger under the action alternatives than under alternative A.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species under Alternative A

Beneficial Impacts. Alternative A would provide some beneficial impacts to fish and reptiles and amphibians because it would protect up to 97,830 acres (37,000 currently acquired) across 65 widely separated, often small SFAs. As noted in chapter 3 and table 5.17, many species discussed therein will benefit from habitat protection afforded by this alternative: fish (43 species), reptiles and amphibians (30 species), and mussels/clams (14 species). Many of the SFAs were established because of the presence of valuable spawning habitat for migratory fish, notably Atlantic salmon, alewife, and blueback herring. Beneficial protection of aquatic habitats has occurred under this framework, including, for example:

- Nulhegan Basin Division: North, Yellow, and Black Branches of the Nulhegan River.
- Blueberry Swamp Division: East Branch of Simms Stream.
- Pondicherry Division: Slide Brook, Johns River, and Ayling Brook.
- Salmon River Division: Pine Brook.
- Fort River Division: portions of the Fort River
- Dead Branch Division: portions of the Dead Branch.

Adverse Impacts. Alternative A would include very few ground disturbing activities that might adversely impact fish and reptiles and amphibians. These generally include forest management of the woodcock management demonstration units at the Nulhegan Basin Division, annually mowing and haying up to 200 acres at three refuge divisions: Fort River Division, Nulhegan Basin, and Pondicherry. The refuge would employ use of controlled mechanical and herbicide use on approximately 60 acres, maintenance of six buildings, road maintenance with some tree cutting and mowing (40 miles public, 2 miles administrative), and visitor use impacts (e.g., 20 miles of trails). Both regionally and refuge-specific, these activities are of negligible adverse impact. Best management practices are implemented in all ground disturbing activities (re: section on Impacts to Soils, Impacts to Freshwater Wetlands, and Impacts to Upland Habitats).

Visitation under alternative A would not appreciably change over current levels and is expected to be the lowest of the alternatives. As such, visitor activities that might adversely impact fish and reptiles and amphibians would pose negligible impacts.

Snowmobile use is the principal off-road vehicle, a use restricted to winter and many of the snowmobile trails are in the same locations as refuge roads. We do not plan to increase capacity for snowmobiling under alternative A. As noted under the water quality section, snowmobiling can introduce petroleum hydrocarbons to wild lands; however, it is unlikely that the potential adverse

impacts would be more than minor, and in most locales negligible due to the low number of trails and users.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species under Alternative B

Beneficial Impacts. Alternative B would provide minor beneficial impacts to reptile, amphibian, fish, and other aquatic species because it proposes to acquire up to 97,830 acres (37,000 currently acquired) across 19 consolidated CFAs. Compared to scattered SFAs under alternative A, the CFAs proposed under alternative B promote protection of a generally more intact and connected landscape. Although alternatives B and A protect similar amounts of acres of habitat, we predict that alternative B will provide better protection for river and stream habitats because it would protect larger blocks of habitat compared to alternative A. However, alternative B would protect less habitat than alternatives C and D. We anticipate that alternative D will protect the greatest amount of river and stream miles over the long term, followed by alternative C.

Alternative B would recognize priority habitat areas as those identified within the Eastern Brook Trout Joint Venture (e.g., Farmington River, Dead Branch, Westfield River, Mascoma, Ashuelot, Nulhegan Basin, West River, and Ompompanoosuc. Under alternative B, we would better protect vernal pools by mapping their presence on refuge lands. This alternative would also facilitate reclamation of Lewis Pond, working in concert with the state of Vermont, and generally to promote fish passage and aquatic habitat assessments.

Adverse Impacts. Similar to alternative A, alternative B would include relatively few ground disturbing activities that might adversely affect refuge fish and reptiles and amphibians. The essential difference would be the potential for increased mowing and haying on newly acquired lands, an expectation to substantially increase management of shrubland acres (775 acres over 10 years), and annual forest management of approximately 7,660 acres (~250-300 acres annually). Prescribed burning would be used under this alternative to maintain fire regime communities (e.g., pitch pine) and to facilitate treatment of approximately 100 acres annually. All other activities would be the same as alternative A.

We would follow best management practices when conducting ground disturbing activities to minimize impacts to wetlands and streams. None of the management activities are expected to have more than a negligible impact over the short term and long term.

Visitation under alternative B would be expected to be the second lowest of all alternatives (Table 5.5) since public use is proposed to be expanded within this alternative, largely through an expanded, ADA-compliant 19-mile trail system (displacing 38 acres of habitat). As such, visitor activities that might trample or disturb reptiles and amphibians and their habitat, such as hiking off designated trails, and, similarly, snowmobiling would pose a potential indirect adverse impact to fish and reptiles and amphibians through possible water pollution from hydrocarbon emissions. Under alternatives B and C,

Adult male atlantic salmon

E. Peter Steenstra

we do not propose to greatly increase snowmobiling on the refuge over current levels. As we acquire new lands with existing state-recognized snowmobile trails, we will evaluate whether or not to continue to allow snowmobiling in these locations. We believe the adverse impacts from visitation would be negligible to minor over both the short and long term.

Alternative B proposes an outdoor classroom at the Fort River Division, which may involve some sort of structure and would require subsequent NEPA analysis.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species under Alternative C

Beneficial Impacts. Alternative C would provide the second highest level of beneficial impacts to fish and reptiles and amphibians because it would protect up to 197,337 acres across 22 CFAs. Table 5.17 lists the species that would benefit from alternative C. These consolidated and larger CFAs enable the protection of more intact, connected, and hierarchical ordered riverine system. We anticipate that alternative C would protect greater amounts of potential spawning habitat than alternative B. Alternative C, would recognize priority habitat areas as those identified within the Eastern Brook Trout Joint Venture (e.g., Farmington River, Dead Branch, Westfield River, Mascoma, Ashuelot, Nulhegan Basin, West River, and Ompompanoosuc, but would also include the Ottauquechee, Muddy Brook, and Sprague Brook. As described under alternative B, alternative C would also map the location of vernal pools to better protect them. This alternative would facilitate reclamation of Lewis Pond, working in concert with the state of Vermont, and generally to promote fish passage and aquatic habitat assessments.

Adverse Impacts. Alternative C would be nearly identical to alternative B regarding ground disturbing activities although they would be implemented across a larger landscape. The essential difference would be the potential for increased mowing and haying on newly acquired lands (548 acres), an expectation to substantially increase management of shrubland acres (775 acres), and annual forest management of approximately 11,550 over the 15 year CCP period (~350-500 acres annually). We would follow best management practices when conducting ground disturbing activities to minimize impacts to wetlands and streams. None of the management activities are expected to have more than a negligible impact over the short term and long term.

Visitation under alternative C would be expected to be the highest of all alternatives (Table 5.5) since public use is proposed to be expanded within this alternative, largely through an expanded, ADA-compliant 22-mile trail system (displacing 44 acres of habitat). Adverse impacts would be nearly the same as those discussed in alternative B. Nevertheless, we believe the adverse impacts would be considered of short- and long-term negligible to minor adverse impact.

Impacts to Reptiles, Amphibians, Fish, and Other Aquatic Species under Alternative D

Beneficial Impacts. Alternative D would provide the highest level of beneficial impacts to fish and reptiles and amphibians compared to all other alternatives because it would protect up to 231,307 acres across 22 CFAs. Table 5.17 illustrates the species that would benefit from alternative D. These consolidated and larger CFAs enable the protection of more intact, connected, and hierarchical ordered riverine system. We predict that alternative D will protect the greatest amount of stream and river habitat, which is important to fish, amphibians, and reptiles.

In contrast to all other alternatives, alternative D would employ a very low impact or passive management approach. This passive approach is thought to be more feasible on a large landscape, and may allow all natural ecological functions and processes to operate without influence from active management as

proposed in the other alternatives. As noted previously, although we will not be actively managing habitats under alternative D, we expect that natural events and disturbances (e.g., floods, fire, disease, hurricanes, microbursts, drought) will create some habitat complexity over the very long term (i.e., decades to centuries). This habitat complexity will likely serve some of the needs of priority refuge resources of concern species over the long term. However, a passive approach may limit the amount of active habitat improvements for spawning fish and migrating reptiles and amphibians (e.g., potential removal of small dams on newly acquired lands, or occasional prescribed burns in pitch-pine habitat used by Box turtle and Eastern hog-nosed snake). The passive approach could serve as a baseline for comparing impacts from applied management techniques on other lands. Management results (or wildlife response to management activities), when monitored, can reveal valuable lessons in using effective and wildlife-responsive techniques. The passive management approach is expected to have minor beneficial impacts over the short term and modest impacts over the long term.

Adverse Impacts. Alternative D will result in fewer adverse impacts from ground-disturbing activities than the other three alternatives. Under alternative D there would be no active forest management designed for target priority refuge resources of concern wildlife. Thus, there will be no regularly prescribed sivicultural operations or use of heavy equipment. Management steps would be taken to mitigate unexpected events that may pose safety hazards (e.g., flooding due to collapsed culvert, clear trail blockages due to storm damage, eliminate hazardous fuel loads) or that impede natural succession or restoration (e.g., control serious outbreaks of invasive plants, hands-on restoration of highly impaired habitats through planting or other habitat management that may require the use of heavy equipment). There would be no mowing or haying on any refuge land. Activities such as required road and parking lot maintenance would continue (e.g., roadside mowing, tree trimming).

Visitation under alternative D's potentially larger refuge landscape would be expected to the second-highest among the alternatives, after alternative C,. Up to 22 miles of trails would be constructed under this alternative but would not be ADA accessible. The trail construction impact may approach 22 acres (1 acres disturbance for each mile of trail in each CFA). As such, visitor activities that might trample or disturb reptiles and amphibians, such as hiking off designated trails, would pose low adverse impacts to fish and reptiles and amphibians habitat as noted in alternative C, and would be considered of negligible to minor impact. Under alternative D, we would eliminate snowmobiling, which should lessen potential impacts to these wildlife species.

Summary

In summary, our management activities across alternatives would not significantly adversely or beneficially impact reptiles, amphibians, fish, other aquatic species, or their habitats in the Connecticut River watershed. As previously noted, all alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 additional acres (alternative A) to nearly 200,000 additional acres (alternative D). The additional proposed refuge acquisitions contain extensive stream and wetland habitats. We anticipate these additional refuge lands will increase the amount of permanently conserved habitat for reptile, amphibian, fish, and other aquatic species. The continued maintenance of existing refuge riverine and wetland habitats, and the potential to acquire and permanently protect more, will be of direct and long-term beneficial impacts to promoting fish and reptiles and amphibians over the short and long term. We will

take appropriate management action to help maintain and improve fish, reptiles, and amphibians (table 5.17).

Maintaining and protecting suitable riverine and wetland habitats (notable along the Connecticut River mainstem and major tributaries) will help to benefit reptiles, amphibians, fish, and other aquatic species. It will also help fulfill goals set by the Eastern Brook Trout Joint Venture. Because it is unlikely that acquisition of the full proposed level of refuge ownership will be reached within the 15-year lifetime of the CCP, we acknowledge that there are limits to both the adverse and beneficial impacts predicted in this analysis, and that over the short-term there is some reduction in variation among alternatives. Proposed management activities—forest management, prescribed burning, trail construction, snowmobile use, and fishing—may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact to promoting fish, reptile and amphibian conservation.

Impacts to Other Native Plants and Invertebrates

Beyond the species already described above, a number of other native plant and invertebrate species occur on the proposed CFAs. Table 5.18 highlights some of these species, such as dragonflies, tiger beetles, and wetland plants, for each CFA. As noted in chapter 3, there is a serious concern about human influences that impact pollinators, especially wild pollinators such as the now very rare rusty-patched bumble bee.

Table 5.18. Native Plants and Invertebrate Species Associated with Proposed CFAs

CFA	LCC Habitat Type	Other Native Plants and Invertebrate Species Associated with Priority Refuge Resources of Concern
Maromas CT		
Pyquag CT*	Freshwater marsh	Davis' sedge, waputo arrowhead
Muddy Brook CT†	Open water/riverine	Riverine clubtail, skillet clubtail, cobra clubtail
Salmon River CT*		
Scantic River CT*	Freshwater Marsh	Davis' sedge, waputo arrowhead
Whalebone Cove CT*		
Farmington River CT/MA	Open water/riverine	Harpoon clubtail, riverine clubtail, rapids clubtail
Dead Branch MA*	Open water/riverine	Riffle snaketail
Fort River MA*	Open water/riverine	Harpoon clubtail, arrow clubtail, rapids clubtail
Mill River MA*	Open water/riverine	Puritan tiger beetle, brook snaketail, arrow clubtail
Westfield River MA*	Open water/riverine	Arrow clubtail, riffle snaketail
Sprague Brook NH/MA†	Open water/riverine	Arrow clubtail, rapids clubtail
Ashuelot NH		
Blueberry Swamp NH*		
Mascoma River NH		
Pondicherry NH*		
Nulhegan Basin VT*	Open water/riverine	Riffle snaketail, brook snaketail, Maine snaketail, zebra clubtail

CFA	LCC Habitat Type	Other Native Plants and Invertebrate Species Associated with Priority Refuge Resources of Concern
Ompompanoosuc VT	Open water/riverine	Riffle snaketail, brook snaketail, Maine snaketail, zebra clubtail
Ottauquechee River VT†	Open water/riverine	Riffle snaketail, brook snaketail, zebra clubtail
West River VT	Freshwater marsh	Greene's rush, clustered sedge, grass rush, arrowleaf tapering rush
	Open water/riverine	Cobblestone tiger beetle (priority refuge resources of concern), boulder-beach tiger beetle, riffle snaketail, brook snaketail, zebra clubtail
White River VT†	Open water/riverine	Riffle snaketail, brook snaketail, zebra clubtail
Quonatuck*	8,000 acres of tidal (salt, brackish, and fresh) wetlands, floodplain forest, and riparian areas within the Quonatuck CFA , running through the mainstem River, will be protected but specific LCC habitats cannot be determined at this time but will be selected using detailed criteria (Appendix C: Land Protection Plan).	

** CFA contains a SFA, part of alternative A*
† CFA not proposed under alternative B, only proposed under alternatives C and D

Note: See appendix B for a full description of how we identified priority refuge resources of concern species based on information from a variety of conservation plans. See appendix A on additional information on priority refuge resources of concern species and proposed management for each CFA.

We compared the benefits of the alternatives from actions that would enhance native fauna and flora including:

- Extent to which refuge land acquisition and habitat conservation under the alternatives would limit the growth of nearby land development activities and their impact to native fauna and flora.
- Habitat management and restoration activities designed to improve habitat structure and integrity for native fauna and flora (e.g., floodplain forests).
- Invasive plant control.
- Effective visitor interpretation.

The potential adverse impacts of refuge management actions within the alternatives that were evaluated included impacts from:

- Invasive plant control.
- Visitor use impacts on refuge lands, trails and roads (e.g., hiking, snowmobiles, introduction of invasive species, camping).

Impacts to Other Native Plants and Invertebrates That Would Not Vary by Alternative

None of the refuge activities proposed under the four alternatives would significantly benefit or adversely impact native plants and invertebrates in the Connecticut River watershed. We expect refuge land conservation and management under all alternatives will help maintain and even improve habitat for these species.

Under all alternatives, we anticipate that proposed additional refuge land acquisition will permanently protect habitat for and benefit these species. Over the long term, we expect alternatives C and D to have the greatest benefit because they propose the largest refuge expansions. However, in the short term (within 15 years), we would likely acquire similar amounts of land under all the

alternatives, thus beneficial impacts would be similar across all alternatives in the short term.

Many of the rare native plants and invertebrates rely heavily on two habitat types: freshwater marshes and open water/riverine habitats. Table 5.19 lists the amount of these habitat types proposed across the CFAs under alternatives B, C, and D. However, in the short term (within 15 years), we would likely acquire similar amounts of land under all the alternatives, thus beneficial impacts would be similar across all alternatives in the short term. Greater beneficial impacts to native plants and invertebrates would be expected to occur under alternatives C and D over the long term because they propose the greatest refuge expansion.

Table 5.19. Proposed Freshwater Marsh and Open Water Habitat Protection Under Alternatives B, C, and D

LCC Habitat	Alternative B	Alternative C	Alternative D
Freshwater Marsh	962 acres	2,054 acres	2,401 acres
Open Water/Riverine	2,155 acres	2,972 acres	3,783 acres

Across all alternatives, our management actions would not contribute to the permanent impairment of native rare plants and invertebrates. Regardless of which alternative is selected, we would continue to use best management practices in all management activities that might impact refuge wetlands, stream, and rivers. Few management activities would be conducted in or near these habitats. Open water/riverine habitat is used by tiger beetles and often invasive plants encroach upon their shoreline habitats. Invasive plant control would be taken across all alternatives to protect and enhance this habitat type.

As noted previously, we would reduce or eliminate invasive plant areas through partnerships at Cooperative Invasive Plant Management Areas (CISMAs) on and off refuge lands using mechanical and approved herbicidal treatment. Regardless of the alternatives selected, pesticides, most often herbicides, would be used under conditions of an Integrated Pest Management plan. Pesticides will only be used if it is the most effective management technique (e.g., extensive dense stands of Japanese knotweed), and will be combined with other management tools. Pesticides must be approved by the Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection. Dragonflies also rely upon openwater/riverine habitat and can be adversely impacted by poor water quality (e.g., siltation, road salts run-off), shoreline habitat destruction, and even boat wakes (MassWildlife 2015).

Promoting native rare plants and invertebrates would include improvements to aquatic and immediately adjacent areas by removing dwellings and other small infrastructure on property acquired by the refuge in developed areas, and careful and appropriate management of roads near sensitive habitat areas. Forest management operations on the refuge are unlikely to adversely impact native rare plants and invertebrates because we would use best management practices during any forestry operations (e.g., buffers around wetlands and vernal pools).

Adverse impacts in freshwater marshes may occur if there were ever plans to construct stilted boardwalks or observation platforms is freshwater marshes for outdoor environmental education and interpretation. Currently there are no immediate plans for such types of construction. Any future proposals would need additional NEPA analysis. We would try to avoid placing trails in sensitive areas and would use best management practices to design the least impactful trails.

The Service regulates human uses of the refuge to appropriate and compatible uses (usually wildlife-dependent uses) and thus curtails anthropogenic impacts

that may impair aquatic and associated terrestrial habitats. All alternatives predict some increase in annual visitation over time (Table 5.5); however, the increase varies due to each alternative's respective refuge expansion level and impacts are expected to be negligibly adverse. Public use trails are placed and managed to avoid or minimize adverse impacts to the refuge's native fauna and flora. Construction of trails has been discussed previously (re: Impacts to Soils section) but none of this activity across all alternatives is expected to impact native rare plants and invertebrates except to a very negligible adverse level. Leashed pets are permitted on most refuge trails, yet they can have indirect adverse impacts on native plants and invertebrates due to their waste, which can cause negative adverse impacts to refuge water quality, and from trampling. are no known pet waste problems on any refuge division or unit, and future acquisitions will be carefully managed to authorize any pet walking so that their wastes are prevented from being introduced to refuge lands. Overall, these potential adverse impacts are considered negligible, both in the short term and long term, because we require owners to remove solid pet waste and pets must be leashed at all times on refuge lands.

Through the issuance of special use permits, all alternatives would promote monitoring and research on rare plants and invertebrates. The refuge recognizes that field monitoring and research may adversely impact these resources largely due to potential collections. The value of an improved knowledge base upon which management depends is appreciated by the refuge, and there is no indication that previous projects, nor similar ones authorized in the future, would have any more than a negligible adverse impact on these resources.

Impacts to Native Rare Plants and Invertebrates common to Alternatives B, C, and D

Nineteen of 65 SFAs would not be included within the CFAs. The refuge recognizes that these SFAs continue to hold valuable habitat, and in some cases, important habitat for native rare plants and vegetation. The adverse impact from not acquiring these acres should be offset by the greater amount of habitat to be acquired under the action alternatives.

Impacts to Native Rare Plants and Invertebrates under Alternative A

Beneficial Impacts. Alternative A would provide beneficial impacts to native rare plants and invertebrates because it would protect up to 97,830 acres across 65 widely separated SFAs. Table 5.18 provides a partial list of the rare plants and invertebrates that would benefit from land conservation under the proposed CFAs, many of which overlap with the SFAs proposed in the 1995 FEIS. Of the 65 SFAS, 46 occur within CFAs. Within these 46 SFAs, 22 contain rare plants, and some have a high diversity of rare plants: Colebrook Hill Farms (10 species) which is part of the Blueberry Swamp CFA and Mount Tom (30 species), which is part of the Mill River CFA. Most of the dragonfly species noted in Table 5.18 would also benefit under alternative A due to the number of riverine habitats included within the SFAs.

Adverse Impacts. Alternative A would include essentially no ground disturbing activities that might adversely impact rare plants and invertebrates species that rely upon open water/riverine and freshwater marsh habitat as these habitats generally need no land management manipulation. Control of invasive plants is one refuge activity that may adversely impact these habitat types if not properly implemented. As noted above, all precautions are taken to provide for minimal adverse impacts. Visitation under alternative A is not expected to impact native fauna and flora since their recreational activities (e.g., hiking, pet walking) do not enter freshwater marshes or open water/riverine habitats. Alternative A visitation levels would not appreciably change over current levels and are

expected to be lower than any of the other alternatives. Thus, visitor activities that might impact native fauna and flora would pose negligible adverse impacts over the short and long term.

Impacts to Other Native Plants and Invertebrates under Alternative B
Beneficial Impacts. Same as alternative A, because alternative B proposes to protect similar amounts of habitat.

Adverse Impacts. Similar to alternative A, except a slightly greater potential for adverse impacts from expanded habitat management activities (table 5.4) and from building additional hiking trails. However, as mentioned above, we would generally avoid these types of activities or use best management practices near wetland and open water habitats.

Impacts to Other Native Plants and Invertebrates under Alternative C
Beneficial Impacts. Similar to alternatives B and C, but we anticipate a slightly greater benefit to rare plants and invertebrates from protecting additional acres of habitats (table 5.18).

Adverse Impacts. Similar to alternative B, except a slightly greater potential for adverse impacts from expanded habitat management activities (table 5.4) and from building additional hiking trails. However, as mentioned above, we would generally avoid these types of activities or use best management practices near wetland and open water habitats.

Impacts to Other Native Plants and Invertebrates under Alternative D
Beneficial Impacts. Compared to the other alternatives, we predict the greatest benefits from native rare plants and invertebrates under alternative D because it proposes to protect the greatest amount of habitat (table 5.19).

Adverse Impacts. Compared to the other alternatives, we expect the fewest adverse impacts to rare plants and invertebrates under alternative D because we propose almost no active habitat management (except where necessary for threatened and endangered species).

Summary
In summary, our management activities across alternatives would not significantly adversely or beneficially impact the native rare plants and vegetation in the Connecticut River watershed. As previously noted, all alternatives would facilitate the acquisition and protection of additional acres of refuge land beyond the current refuge acreage of 37,000 acres, ranging from about 60,000 acres (alternative A) to nearly 200,000 acres (alternative D). With those potential additions of habitat to the refuge, in concert with currently protected lands (37,000 acres), we except benefits to fauna and flora. Maintaining and protecting these habitats will help to guarantee their beneficial habitat functions for these native species. Because it is unlikely that acquisition of the full proposed level of refuge ownership will be reached within the 15-year lifetime of the CCP, we acknowledge that there are limits to both the adverse and beneficial impacts predicted in this analysis, and that over the short-term there is some reduction in variation among alternatives. Proposed management activities–forest management, prescribed burning, trail construction, snowmobile use–may be allowed in one or more of the alternatives presented, but in all situations described above, we would expect all to be of negligible adverse impact on native plant or invertebrate conservation.

Archaeological, Historical, and Cultural Resources Impacts

Chapter 3–Affected Environment presents a description of historic and cultural resources in the surrounding refuge regional landscape and Connecticut River watershed. We evaluated and compared management actions that each

alternative proposes for their impacts, beneficial or adverse, on archaeological, historical, and cultural resources.

The following management activities are most likely to beneficially impact historic and cultural resources:

- Continued protection of valuable habitats, and potential for expanded acquisition of habitats, that prevents developments activities from exposing and damaging archaeological, historical, and cultural resources.
- Careful adherence to existing laws and policies designed to protect archaeological, historical, and cultural resources.

The following management activities are most likely to adversely impact historic and cultural resources:

- Habitat restoration activities involving excavation.
- Mechanized forest management activities.
- Improvements to existing buildings and trails.
- Demolition of existing/acquired structures.
- Building new infrastructure, to include: buildings, trails, trailhead parking lots, and signage installation.
- General public use.

Archaeological, Historical, and Other Cultural Resources Impacts that Would not Vary by Alternative

The refuge, through its Visitor Services efforts, ensures that significant cultural and historic resources are protected, experienced by visitors, and interpreted in accordance with authorizing legislation and policies. Activities outlined in each alternative, however, have some potential to adversely impact cultural resources, either by direct disturbance during a variety of habitat projects (e.g., logging), minor construction (e.g., interpretative sign installation), public use activities (e.g., hiking), and administration and operations activities (e.g., building and road construction and demolition). These actions may directly or indirectly expose cultural and historic artifacts. The presence of cultural resources including historic properties would not prevent a Federal undertaking or project, but any undertaking would be subject to Section 106 of the National Historic Preservation Act and other Federal laws protecting cultural resources. Potential adverse impacts to cultural resources would be identified, and options for minimizing adverse impacts would be discussed before any implementation of a refuge action.

Refuge staff would provide the Regional Office archaeologist a formal description and location of all projects, activities, routine maintenance, and operations that could disturb the ground or structures, details on requests for appropriate and compatible uses, and the options being considered. The archaeologist would analyze these undertakings for their potential to affect historic properties and enter into consultation with the State Historic Preservation Officer and other parties as appropriate. As necessary, the refuge would notify the public and local government officials. The Service would protect all known gravesites. Any collection of materials for tribal ceremonial purposes would be conducted under a special use permit.

USFWS

Northeastern bulrush

Under all alternatives, we would continue to identify areas with a high or moderate likelihood of having cultural resources, and actions could be taken to avoid or minimize adverse impacts on cultural resources. Visitors who are interested in the refuge's historical past would benefit from an increased emphasis on interpretation of the refuge's archaeological, historical, and cultural resources and the efforts to preserve its rich past.

Archaeological, Historical, and Other Cultural Resources Impacts of Alternatives A, B and C Compared to Alternative D

As discussed in prior sections, alternatives A, B, and C propose activities that would disturb land (e.g., forest management , kiosk construction, and trail construction). These activities would be employed over a wide landscape and are expected to have a negligible adverse impact to archaeological, historical, and cultural resources, especially given the required consultation review that is performed prior to work (as noted above). In contrast to the other three alternatives, alternative D proposes a passive management approach that would undertake very few land disturbance activities, other than minor work during establishment of trails, minor habitat management, and occasional maintenance. Because of this, we expect alternative D to have the least impact to cultural resources over the short and long term.

Summary

The Service would continue to follow all cultural resources laws for any project work on the refuge. Under alternatives B, C, and D, the Service would increase protection efforts largely through better planning, habitat assessments and related field survey work. These efforts would result in negligible to minor benefits to cultural resources.

Impacts to Public Use and Access

Each visitor's experiences on the refuge can be positively or adversely affected by the types of opportunities available, the refuge's setting, and other user groups (Manfredo 2008). The National Wildlife Improvement Act and Service policy emphasizes the need to provide for quality opportunities when providing for wildlife-dependent recreational activities. Wildlife-dependent recreation programs are evaluated based on the goal of providing for quality programs with the following elements: (1) safety and compliance with applicable laws; (2) minimized conflicts with wildlife and habitat goals and public uses; (3) accessibility for all; (4) resource stewardship, and (5) reliable and reasonable opportunities to experience wildlife (605 FW 1, *http://www.fws.gov/policy/605fw1.html;* accessed August 2016). This section addresses the priority public uses and the activities and facilities that support those uses and how visitors would be affected by the actions in chapter 3.

The following management activities are most likely to beneficially impact public use:

- Continued protection of valuable habitats, and potential for expanded acquisition of habitats, that will offer new and expanded wildlife-dependent recreational opportunities.
- Continuing to allow or expanding the existing range of public uses on properties acquired.
- Building new trails, trail heads, and parking lots.
- Improvements and/or new construction to visitor infrastructure.
- Increased distribution of refuge information.

- Increased partnerships with local, regional, and state recreational interests.
- Increased outreach and Service visibility to promote fish and wildlife stewardship.

The following management activities are most likely to adversely impact public use:

- Refuge acquisition may result in the elimination of non-wildlife dependent, non-priority activities that are presently allowed by the current owner (e.g., off-road vehicles).
- Increased conflict between user groups as visitation increases.
- Confusion over ownership boundaries and which rules apply.
- Short-term trail closures from forest management operations and other refuge management activities.

Many of the existing refuge divisions are currently open to the six priority wildlife-dependent public uses for the Refuge System: hunting, fishing, wildlife observation and photography, environmental education and interpretation. Divisions open to all six of these uses are: Nulhegan Basin, Pondicherry, Fort River, Mill River, Salmon River, Blueberry Swamp, and Dead Branch Divisions. In addition, wildlife observation and photography, environmental education and interpretation can be enjoyed at Third Island (Aug 1 thru Dec 31), Mt Toby, and Honey Pot Wetlands, all located in Massachusetts although these sites also have no improvements. Certain Units are closed for specific purposes: Wissatinnewag (presence of archaeological resources), Deadman's Swamp (presence of Puritan tiger beetle — federally threatened), and Mt Tom (presence near refuge land of unsafe buildings owned by Holyoke Boys and Girls Club needing repair). Two Units — Westfield River and Peterson — have no existing wildlife-dependent recreational public uses that have been determined to be compatible; consequently, no public uses are as yet authorized but may be in the future. Other popular activities allowed on the refuge include hiking, snowmobiling on designated trails, and cross-country skiing. Some regionally popular activities are currently not allowed on the refuge. These include: sled dog mushing, geocaching, ski-joring, biking in certain designated areas, and ATV or other motorized ORV use.

Table 5.2 provides a summary of projected annual visitation by the major activities allowed for each alternative. We evaluated the beneficial and adverse impacts of the following management actions with the potential to affect the level of opportunity or visitor experience.

Public Use Impacts That Would Not Vary by Alternative.
Under all alternatives, we would continue to offer the existing hunt programs at the following refuge divisions and units Nulhegan Basin, Blueberry Swamp, Pondicherry, Dead Branch, Westfield River, Fort River, Mill River, and Salmon River Divisions and the Putney Mountain, Third Island, Mount Toby, and Honeypot Wetlands Units. These hunts are generally consistent with state regulations, however some refuge-specific regulations do apply to protect sensitive resources and to ensure public safety. Under all alternatives, we would evaluate opening new refuge lands to hunting where compatible and a huntable area exists.

By continuing to allow hunting, we would continue to provide an opportunity for people to engage in a wildlife-dependent recreational use on refuges. Public

hunting is a popular activity in portions of the watershed and allowing this use will benefit individuals interested in engaging in public hunting on refuge lands.

However, hunting can also lead to adverse conflicts among user groups. For example, the noise from shotguns may disturb some non-hunters experience on the refuge. Other individuals do not support hunting for a variety of reasons, such as concerns over public safety, animal welfare, and impacts on nontarget wildlife. For these individuals, continuing to offer refuge hunting programs may negatively impact their experience of the refuge. Although, there are some safety concerns with any hunting program, state, Federal, and refuge-specific regulations help ensure public safety, such as no-hunting buffers around occupied buildings and in several other high-traffic locations on the refuge. Also, at the Pondicherry Division (NH) and all areas of Massachusetts and Connecticut, hunters are required to wear blaze orange safety hunting apparel. Conversely, hunters in stands anticipating game species might be adversely impacted by trail users (and vice versa). Overall, under all alternatives, we expect impacts among users to be negligible to minor due to the current and anticipated low levels of hunting.

The refuge will evaluate ADA needs to accommodate hunters with disabilities regardless of alternative. Special use permits will continue to be made available, as appropriate, for a number of potential activities such as those authorizing commercial hunt outfitters at the Nulhegan Basin Division. The Nulhegan Basin Division is located in an area of Vermont that is particularly noteworthy for large white-tailed deer, high moose densities, 45 percent of the State black bear harvest, and some of the best ruffed grouse and American woodcock hunting. Snowshoe hare and coyote also support abundant hunting opportunities in this remote setting. With an abundance of game, and fewer roads and development than other areas, the 'Northeast Kingdom' of Vermont, where the Nulhegan Basin Division is located, offers some of the best hunting opportunities in Vermont.

The refuge will maintain its 20 miles of trails located at the Nulhegan Basin, Pondicherry, Blueberry Swamp, and Fort River Divisions, and also maintain its current 40 miles of public roads. Trails and roads are the principal means by which the refuge promotes wildlife observation and photography, and interpretation and environmental education. Currently there are 6 miles of hiking trails that also serve to facilitate bird-watching, photography, and winter cross-country skiing. Other continued uses will include berry picking, camping, pet-walking, and non-motorized boating.

Dogwalking would continue to be allowed under all alternatives. Visitors walking dogs on the refuge may have adverse impacts of other users (e.g., photographers), sometimes through aggressive pet behavior or simple distraction from the wildlife experience. To minimize these impacts, we require all pets to be leashed.

Environmental education field walks are common and will be encouraged at most Divisions and Units unless there are strict closures in place (e.g., Deadman's Swamp, Mt. Tom). Large "in-field" educational interpretive walks with young children may adversely impact individuals seeking quiet and solitude, or a chance to take that special photograph.

There may also be times when public use is adversely impacted by standard refuge management activities such as habitat management, commercial haying, and restricted research areas. We do not expect these impacts to be greater than negligible because these activities only occur on a very small percentage of refuge lands and occur seasonally or for short periods of time.

Public Use Impacts of Alternative A
Beneficial Impacts. The public use benefits are the same as those described under "Public Use Impacts That Would Not Vary by Alternative," except under alternative A we would continue to allow snowmobiling on designated trails on the Nulhegan Basin, Pondicherry, and Dead Branch Divisions. Continuing to allow snowmobiling at these divisions would benefit visitors that participate in this activity on refuge lands, including those engaged in priority wildlife-dependent recreational uses.

Adverse Impacts. The adverse public use impacts are the same as those described under "Public Use Impacts That Would Not Vary by Alternative," except under alternative A there would be the potential for conflicts between snowmobilers and other users (e.g., snowshoers and cross-country skiiers). Under alternative A, we would contine to not allow other uses on snowmobile trails. This could negeatively impact visitors who snowshoe or cross-country ski by preventing them from accessing these trails and by creating noise which could impact their experience on the refuge. However, we expect these impacts to be minor as there are other trails available for these users. Separating snowmobiles and other users may lessen the likelihood for direct conflicts among different user groups (e.g., visitor safety concerns).

Public Use Impacts of Alternative B
Beneficial Impacts. The benefits of alternative B are similar to those discussed for alternative A, except for the following.

Although some fishing likely occurs on existing refuge lands, we propose to officially open existing refuge lands to public fishing, consistent with state regulations, under alternatives B, C, D. This will require developing a fishing plan and compatibility determinations, as well as completing other administrative requirements. We would only open fishing in places where it is found feasible and compatible. Under all alternatives, we would evaluate opening new refuge lands to fishing where compatible and a fishable area exists. By allowing hunting, we would continue to provide an opportunity for people to engage in a wildlife-dependent recreational use on refuges. Public hunting is a popular activity in portions of the watershed and allowing this use will benefit individuals interested in engaging in public hunting on refuge lands.

Under alternative B, we also propose to establish new hiking trails at the 19 proposed CFAs, where feasible, compatible, and it would create desirable wildlife-dependent recreational opportunities. Whenever feasible, we would try to develop these trails to be ADA-compliant. The trails would be designed to provide high-quality opportunities for wildlife observation, photography, environmental education, and interpretation. The proposed trails would range from a half-mile to one mile in length and will displace up to 38 acres of habitat (2 acres per mile). These trails would provide opportunities for individuals with disabilities and other user groups that require or prefer developed, gradually graded trails, such as families with children in strollers, other limited mobility. This type of recreational experience is still rare in the watershed and these trails could fill an important gap in serving these groups.

We would also seek to enhance our existing environmental education and interpretive programs by working with partners throughout the watershed. We anticipate a minor increase in the quality and quantity of environmental education and interpretive materials and programs on the refuge.

Adverse Impacts. In addition to the impacts described under alternative A, there is slight increase in the likelihood of conflicts between user groups under

alternative B. For example, constructing 19 miles of new trails may increase the amount of trail use and therefore, conflicts between trail users. These potential adverse conflicts may be more prevalent in more urban CFAs only because we would expect higher visitation and an overall greater density of visitors on relatively smaller units. However, overall we expect conflicts would be negligible to minor because of the proposed level of use and stipulations on use (e.g., pets must be leashed). There is also the potential for greater conflicts between snowmobilers and other users at the Nulhegan Basin Division under alternative B because we would propose to open the existing designated snowmobile trails to multiple uses, such as cross-country skiers and snowshoers. As we open these trails up to these uses, we will monitor and address any conflicts or other issues that arise.

Public Use Impacts of Alternative C
Beneficial Impacts. The same as alternative B, except we propose to construct up to 22 new trails under alternative B. We expect a slightly greater benefit from providing approximately 3 additional trail opportunities.

Adverse Impacts. The same as alternative B, except we propose to construct up to 22 new trails on the proposed CFAs. We expect a slightly greater chance of user conflicts compared to alternative, but still expect this impact to be negligible.

Public Use Impacts of Alternative D
Beneficial Impacts. Similar to alternatives B and C, except that the 22 new trails proposed under alternative D would be less developed (e.g., narrower, native surface) and benefit user groups that prefer a more "back-country" experience. Also, we expect overall less visitation under alternative D and therefore expect fewer conflicts between user groups.

Adverse Impacts. Alternative D proposes to eliminate snowmobiling on the refuge, which would negatively impact a larger user group, particularly at the Nulhegan Basin Division. However, prohibiting snowmobiling may benefit other user groups by reducing conflicts between snowmobiles and snowshoers and skiiers and other user groups that are disturbed by snowmobiles.

Cumulative Impacts

As noted early in this chapter, according to the CEQ regulations on implementing NEPA (40 CFR 1508.7), "cumulative impacts" result from adding the incremental impacts of the proposed action to the impacts of other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. This cumulative impacts assessment includes other agencies' or organizations' actions if they are inter-related and influence the same environment. Thus, this analysis considers the interaction of activities at the refuge with other actions occurring over a larger spatial and temporal frame of reference.

Air Quality: Although any form of anthropogenic pollutant emission contributes to overall cumulative impacts to some extent, we believe none of the alternatives are expected to have significant incremental contributions to cumulative adverse impacts on air quality locally or watershed-wide, and almost certainly be of negligible adverse impact. None of the proposed refuge actions would have a significant cumulative impact on the three Class I Airsheds located within the Connecticut River watershed: Great Gulf Wilderness (5,552 acres) and Presidential Range-Dry River Wilderness (20,000 acres) designated within the White Mountain National Forest (New Hampshire) and the Lye Brook Wilderness (12,430 acres) designated within the Green Mountain National Forest (Vermont).

Some short-term, local, and immediate deterioration in air quality would be expected from air emissions of motor vehicles, heavy equipment, prescribed burning, and snowmobiles. These incremental sources of emissions potentially do contribute to a degradation of air quality of the local and regional environment, but such contributions are extremely minor and of very short duration. Visitors would access the refuge primarily by automobile and snowmobile, but there is no expectation for marked visitor increases over the short term or long term (table 5.2). Additionally, visitor use due to 'on-refuge' visits (e.g., hiking, hunting, bird watching) are considerably less than visits that are indirectly associated with the refuge and its land base (table 5.2). Much of visitor-associated air emissions would result from private vehicles destined to visit the "off-refuge" environmental education centers and events: Great Falls Discovery Center, MA; Montshire Museum of Science, Vermont, Wildlife on Wheels (mobile unit throughout the watershed), and the Conte Corners at Cabela's in Connecticut and at the Springfield Science Museum in Massachusetts. A fair amount of this vehicular use is in conjunction with other destination activities or purposes that the visitors have. Thus, the refuge associated visits to these centers and exhibits tend to be coupled, or sometimes secondary purpose, to trips. The refuge land generally is not expected to be a New England recreation destination where visitors are drawn from distant places. Most visitors would already be in the area or would be passing through the area on vacation and would seek out the refuge for a day trip. The "off-refuge" visits, however, may draw individuals from regionally distant areas such as Cabela's in Hartford, Connecticut. All snowmobile trails on the refuge would essentially be through trails only; we would not provide parking, warming huts, or other infrastructure on refuge lands. Therefore, the presence of the refuge alone would only account for a small percentage of vehicle emissions generated in the watershed.

Projected land/habitat acquisitions, and limited restoration, of native upland forest, shrublands, and wetland vegetation should generate beneficial impacts to air quality locally. All alternatives would facilitate continued and increased land protection ability, with alternative C and D facilitation more than twice the current ability of the refuge to protect valuable habitats. These beneficial habitat impacts will derive from the refuge's capacity to continue to filter out many air pollutants harmful to humans, wildlife, and the environment. We will also strive to reduce energy consumption with green infrastructure and products associated with refuge activities.

In addition, with the new Service goal of achieving carbon neutrality by 2020, the refuge will be undertaking aggressive efforts to reduce the energy use and carbon footprint of our buildings, facilities, vehicle fleet, and workforce to the maximum extent possible. We will also be exploring ways to offset our residual carbon footprint by increasing carbon sequestration through our habitat management activities, including some limited riparian, floodplain, and old field afforestation projects. Integrating carbon sequestration awareness into conservation actions for wildlife and other habitat management activities will also have cumulative beneficial impacts for the air quality and humans within the local environment.

With our partners, we would continue to contribute to improving air quality through cooperative land conservation and management of natural vegetation and wetlands. Protecting valuable fish and wildlife habitat from development and maintaining it in natural upland vegetation or wetlands, assures these areas would continue to filter out many air pollutants that, incrementally, may be harmful to humans and the environment.

Hydrology and Water Quality: There would be no significant adverse cumulative impacts to hydrology or water quality under any of the alternatives. BMPs and erosion and sediment control measures would be used on building, road, trail, and other recreation infrastructure construction sites to ensure impacts are minimized. Strict adherence to PUPs would also minimize impacts from use of those chemicals. These projects are few in number and located widely dispersed throughout the refuge so their local effects would not be additive. There would be cumulative benefits to hydrology and water quality from restoration of unnecessary buildings and structures (e.g. removing impermeable surfaces), other disturbed sites, and unused roads and trails on acquired lands. There would also be cumulative benefits from more intensive efforts to restore natural hydrology through such measures as culvert removal, upgrading, or resizing, which will be facilitated by all alternatives.

All alternatives will facilitate meaningful levels of land/habitat acquisition, potentially increasing the size of the refuge from the current 37,000 acres to 231,307 over time. All alternatives call for some active management (e.g., habitat management, invasive plant control), although alternative D is largely designed for passive management (re: chapter 4). In each instance, the attention to habitat protection, active management of approximately 60 to 500 acres annually, and (in alternative D) passive ecosystem development, may result in improved water quality, water chemistry, , reduced sediment inputs, and possible mitigation of contaminated run-off. Over time, it is thought those actions would improve the ability of refuge upland and wetland systems to process nutrients and store carbon and contribute to other state watershed regulation standards and initiatives that are designed to maintain and improve water quality in the Connecticut River watershed.

Refuge management will introduce herbicides into wetlands and streams, albeit in limited quantities and only when treating invasive plant populations. It is assumed that these limited management efforts will not contribute to larger local or regional discharges. Based on the relatively short half-life and the limited acreage treated (currently about 60 acres annually it is not expected that any discernible effects would occur to these water resources as a result of herbicide treatments.

Management actions will be adaptive, in an effort to respond to a changing climate. Protecting, managing, and restoring the defined LCC upland and wetland habitats in our defined CFAs will improve the health of refuge watercourses and aquatic resources. In slightly varying degrees, all the alternatives emphasize maintaining the biological integrity, diversity, and environmental health of lands within the refuge boundaries, which strengthens the ecological integrity of the watershed. It is our hope that actions taken to ensure the long-term health of freshwater wetlands and forested habitats, preserve and enhance rare native plant and animal communities, and conserve state and federally listed species, will serve as a model for conservation planning.

When the conservation actions on the refuge are combined with actions by state wildlife managers, non-profit organizations, private landowners, local communities, and the new Connecticut River National Blueway coalition, considerable progress in mitigating the urbanization and development changes that directly impact water quality and habitat productivity within the Connecticut River watershed will be realized.

Soils: There is the potential for cumulative beneficial impacts to soils under all alternatives due to the permanent protection of existing and future refuge lands. With the cessation of development or, in select situations, till agriculture,

watershed soils managed by the refuge should improve in natural fertility and productivity. We anticipate greater long-term cumulative impacts to soils with alternatives C and D since we propose expanded land/habitat protection under these two alternatives. All alternatives would employ best management practices to minimize impacts to soils.

Adverse cumulative impacts to refuge soils potentially are from timber management, hiking, road repair, and minor construction activities (e.g., conventional ADA trail construction and parking lots), activities described in previous sections. We would improve watershed soil conditions and minimize site-level soil impacts through acquisition and protection of new habitat areas in SFAs (alternative A) or proposed CFAs (alternatives B, C, D) that may currently be degraded but retain land and soil structural features indicative of having excellent potential for restoration. Restoration typically would involve soil stabilization through appropriate re-vegetation plantings often in combination with site grading.

We will minimize any potential for adverse cumulative impacts by continuing to use best management practices when improving forest stands, maintaining or setting back succession in native grassland and shrubland habitats, mowing, brush-hogging, or prescribed burning to ensure cumulative beneficial impacts for soils. Under all alternatives, we expect to reclaim problem areas dominated by invasive species and restore them to native plant communities, which should improve nutrient recycling, restore native soil biota and soil fertility, and return soils to natural productivity regimes.

We expect beneficial cumulative effects from increasing carbon sequestration by managing and protecting native vegetation and soils. Biological CO_2 sequestration can be enhanced in managing natural habitats that increase the natural absorption of atmospheric carbon in soils. The carbon storage potential of soils that support differing vegetation communities has been estimated by the Congressional Budget Office (2007). The long-term storage potential of soil and vegetation is limited by characteristics such as location, climate, soil type, and plant species. On land used for crops in the continental United States, the equilibrium level of carbon in an acre of soil varies from the equivalent of 56 metric tons of CO_2 to 120 metric tons, averaging about 80 metric tons (CBO, 2007). Pasture, rangeland, and agricultural land that is reserved for conservation purposes store carbon at higher equilibrium levels: those levels range from 73 to 159 metric tons per acre and average 113 metric tons. Mature, never-harvested forests have even higher equilibrium levels per acre, varying from 286 to 1,179 metric tons of $CO_2$and averaging 465 metric tons (Birdsey 1992). In contrast, the average stand of timber harvested on a 30-year rotation holds the equivalent of 203 metric tons of CO_2 per acre at the beginning of the rotation (that is, at the start of its regrowth) and 256 metric tons at the end of the rotation (Lubowski et al. 2006). The long-term cumulative potential is limited to how the land is used and managed, and the refuge would maintain and, where possible, enhance the ability of refuge habitats to sequester carbon.

As with many areas nationwide, the greatest cumulative impacts on soils and those of the Connecticut River valley are from land development. Non-Federal forest land is the dominant land type being developed. Combined, forest land and cultivated cropland have made up more than 60 percent of the total acreage developed since 1982, yet since then and through 1997, erosion on cropland and USDA Conservation Reserve Program land has been reduced by 38 percent. Among all farm production regions, combined water and wind erosion in 2007 was lowest in the Northeast (USDA 2007). Potential land and habitat protections afforded by all alternatives are expected to beneficially impacts overall soil conservation in the Connecticut River watershed.

Climate Change: Department of the Interior Secretarial Order 3226 states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making. This order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making." Additionally, it calls for the incorporation of climate change considerations into long-term planning documents, such as a CCP.

The Wildlife Society published an informative technical review report in 2004 titled Global Climate Change and Wildlife in North America (Inkley et al. 2004). It interprets results and details from publications such as the Intergovernmental Panel on Climate Change reports (1996 to 2002) and describes the potential impacts and implications on wildlife and habitats. It mentions that projecting the impacts of climate change is complex because it is important to predict changing precipitation and temperature patterns, their rate of change, and the exacerbated effects of other stressors on the ecosystems. Those stressors include loss of wildlife habitat to urban sprawl and other developed land uses, pollution, ozone depletion, exotic species, disease, and other factors. Projections over the next 100 years indicate major impacts such as extensive warming in most areas, changing patterns of precipitation, and significant acceleration of sea level rise. According to the Wildlife Society report, "…other likely components of ongoing climate change include changes in season lengths, decreasing range of nighttime versus daytime temperatures, declining snowpack, and increasing frequency and intensity of severe weather events" (Inkley et al. 2004). The Wildlife Society report details known and possible influences on habitat and wildlife, including changes in primary productivity, changes in plant chemical and nutrient composition, changes in seasonality, sea level rise, snow, permafrost, and sea ice decline, increased invasive species, pests and pathogens, and impacts on major vertebrate groups.

The effects of climate change on populations and range distributions of wildlife are expected to be species specific and highly variable, with negative and positive effects. Generally, the prediction in North America is that the ranges of habitats and wildlife will generally move upwards in elevation and northward as temperatures rise. Species with small or isolated populations and low genetic variability will be least likely to withstand impacts of climate change. Species with broader habitat ranges, wider niches, and greater genetic diversity should fare better or may even benefit. This will vary depending on specific local conditions, changing precipitation patterns, and the particular response of individual species to the different components of climate change (Inkley et al. 2004). The report notes that developing precise predictions for local areas is not possible due to the scale and accuracy of current climate models, which is further confounded by the lack of information concerning species-level responses to ecosystem changes, their interactions with other species, and the impacts from other stressors in the environment. In other words, only imprecise generalizations can be made about the implications of our refuge management on regional climate change.

Our evaluation of the proposed action concludes that the activities that may contribute negligibly, but incrementally, to stressors regionally affecting climate change: our prescribed burning program, our use of vehicles and equipment to administer the refuge, and visitor use of motorized vehicles. We discuss the direct and indirect impacts of those activities elsewhere in this chapter. We also discuss measures to minimize the impacts of both. For example, with regard to prescribed burning, we follow detailed burn plans operating only under conditions that minimize air quality concerns. In addition, many climate change experts advocate prescribed burning to manage the risk of catastrophic fires (Inkley et al. 2004). Federal mandates require all Federal agencies to reduce petroleum fuel use by two percent annually based upon 2005 fuel use, having a

goal of reducing petroleum fuel use by 30 percent. More than any other factor, this mandate will drive fleet management practices through 2020, and the refuge will attempt to replace older, inefficient vehicles, with more fuel efficient models. With regard to our equipment and facilities, we are trying to reduce our carbon footprint wherever possible by using alternative energy sources and energy-saving appliances, and using recycled or recyclable materials, along with reduced travel and other conservation measures.

In our professional judgment, the majority of management actions we propose would not exacerbate climate change in the region or project area, and some might incrementally prevent or slow local impacts. We discuss our actions relative to the 18 recommendations in The Wildlife Society (TWS) report to assist land and resource managers in meeting the challenges of climate change when working to conserve wildlife resources (Inkley et al. 2004). We make specific reference below to where the TWS recommendations are addressed by the goals of the Service's *Rising to the Urgent Challenge*.

- ***Recommendation #1—*** Recognize global climate change as a factor in wildlife conservation: This recommendation relates to land managers and planners becoming better informed about the consequences of climate change and the variability in the resources they work with. The Service and Refuge System are addressing this factor in three complimentary plans:

- Rising to the Urgent Challenge

- National Fish, Wildlife and Plants Climate Adaptation Strategy

- Planning for Climate Change on the National Wildlife Refuge System (draft).

The Service is taking a major role among Federal agencies in distributing and interpreting information on climate change. *Rising to the Urgent Challenge* is the FWS strategic plan for responding to climate change, and much of what is recommended by The Wildlife Society (TWS) in its technical report (Inkley et al. 2004) noted above is covered by the Service's *Rising to the Urgent Challenge*. The key principles of this plan are setting priorities in the context of climate change, vigorous partnership and interdependence with others, use of the best available science, landscape-level conservation, using state-of-the-art technology, and taking a global approach in addressing climate change (USFWS 2010). These principles are woven through three strategic themes: adaptation, mitigation, and engagement, and eight goals are allocated among these themes as follows:

Adaptation
Goal 1: We will work with partners to develop and implement a National Fish and Wildlife Climate Adaptation Strategy.

Goal 2: We will develop long-term capacity for biological planning and conservation design and apply it to drive conservation at broad, landscape scales.

Goal 3: We will deliver landscape conservation actions that support climate change adaptations by fish and wildlife of ecological and societal significance.

Goal 4: We will develop monitoring and research partnerships that make available complete and objective information to plan, deliver, evaluate, and improve actions that facilitate fish and wildlife adaptation to accelerating climate change.

Mitigation
Goal 5: We will change our business practices to achieve carbon neutrality by the Year 2020.

Goal 6: To conserve and restore fish and wildlife habitats at landscape scales while simultaneously sequestering atmospheric greenhouse gases, we will build our capacity to understand, apply, and share biological carbon sequestration science; and we will work with partners to implement carbon sequestration projects in strategic locations.

Engagement
Goal 7: We will engage FWS employees; our local, state, Tribal, national, and international partners in the public and private sectors; our key constituencies and stakeholders; and everyday citizens in a new era of collaborative conservation in which, together, we seek solutions to the impacts of climate change and other 21st century stressors of fish and wildlife.

In 2009, Congress directed the Secretary of the Interior "to develop a national strategy to assist fish, wildlife, plants, and associated ecological processes in becoming more resilient, adapting to, and surviving the impacts of climate change" (U.S. House of Representatives 2010:77). Working closely with the Council on Environmental Quality, FWS (representing DOI) assembled Federal, state, and Tribal partners, and with input from numerous scholars the *National Fish, Wildlife and Plants Climate Adaptation Strategy* was developed. The collection of participants was called the "NFWPCAS Partnership." The national strategy was reviewed by the public and published (NFWPCAS Partnership 2012). The seven goals of the NFWPCAS, very similar to the Service's *Rising to the Urgent Challenge* goals, are to "to inspire and enable natural resource professionals and other decision makers to take action to conserve the nation's fish, wildlife, plants, and ecosystem functions, as well as the human uses and values these natural systems provide, in a changing climate" (NFWPCAS Partnership 2012:16). And last, the Service's Northeast Region co-hosted a workshop in June 2008 titled Climate Change in the Northeast: Preparing for the Future. The goal of the workshop was "to develop a common understanding of natural and cultural resource issues and to explore management approaches related to climate change in the Northeast." Its primary target audience was land managers. Experts in climate change gave presentations and facilitated discussion. The stated outcomes were to have participants more fully understand the present and anticipated impacts from climate change on forested, ocean and coastal ecosystems, and to be able to identify effective management approaches that include collaboration with other local, state and Federal agencies. All of the Northeast Region refuge supervisors and planners attended, as did more than 20 refuge field staff. In addition, in response to Executive Order 134*22*, Strengthening Federal Environmental, Energy, and Transportation Management, and the Service goal of becoming a carbon neutral agency, the Service and refuge will assess its energy use and opportunities for investments to boost energy efficiency and implement renewable energy sources, on-refuge and in most of the Service's locations. Energy audits will help us identify needed actions and performance measurements such as return on investment, reduced O&M costs, and reduced energy intensity.

USFWS

YCC crew at work at North Branch Trail, Nulhegan Basin Division

Conserving the Future is a broad vision document of the Refuge System. *Planning for Climate Change on the National Wildlife Refuge System* is a *Conserving the Future* deliverable, and is designed to help refuge planners and managers to incorporate the themes of the various mandates in a philosophically coherent manner while providing practical guidance for incorporating climate change into planning documents. At the same time, Refuge System planning documents must function within the already existing cycle of strategic habitat conservation (SHC) (FWS 2008). The basic SHC components are planning, implementation, and evaluation, which is discussed in Chapter 1—Purpose and Need for Action.

- ***Recommendation #2***—Manage for diverse conditions (re: FWS Goal 3): This recommendation relates to developing sound wildlife management strategies under current conditions, anticipating unusual and variable weather conditions, such as warming, droughts, and flooding. Our proposed habitat management actions described in chapter 3 promote healthy, functioning forested uplands and wetlands, non-forested uplands and wetlands, inland aquatic habitats, coastal non-forested uplands, and coastal wetlands and aquatic habitats. Protecting the integrity of wetlands and managing for fully functioning riparian areas is also a priority. We have identified monitoring elements, which will be fully developed in the inventory and monitoring step-down plan, to evaluate whether we are meeting our objectives and to assess changing conditions. We will implement an adaptive management approach as new information becomes available.

- ***Recommendation #3***—Do not rely solely on historical weather and species data for future projections without taking into account climate change (re: FWS Goals 4 and 6). This recommendation relates to the point that historical climate, habitat and wildlife conditions are less reliable predictors of climate changes. For example, there may be a need to adjust breeding bird survey dates if migratory birds are returning earlier to breed than occurred historically. A 3-week difference in timing has already been documented by some bird researchers. We are aware of these implications and plan to build these considerations into our inventory and monitoring plan, habitat management plans, and annual habitat work plans so that we can make adjustments accordingly. Our results and reports, and those of other researchers on the refuge, will be shared within the conservation community.

- ***Recommendation #4***—Expect surprises, including extreme events (re: FWS Goals 2, 4, and 6). This recommendation relates to remaining flexible in management capability and administrative processes to deal with ecological surprises such as floods or pest outbreaks. Refuge managers have flexibility within their operations funds to deal with emergencies. Other regional operations funds would also be redirected as needed to deal with an emergency.

- ***Recommendation #5***—Reduce non-climate stressors on the ecosystem (re: FWS Goal 3). This recommendation relates to reducing human influences that adversely affect resilience of habitats and species (e.g., invasive species, contaminants, diseases). The objectives of our habitat management program are to maintain and enhance the biological integrity, diversity, and health of refuge lands. Objectives to enhance upland, wetland, and riverine habitats (interior and coastal) for watershed protection, to establish 25,000 acre habitat blocks with partners, and to establish healthy, diverse native forests in large tracts (greater than 500 acres) will help offset the local impacts of climate change.

- ***Recommendation #6—*** Maintain healthy, connected, genetically diverse populations (re: FWS Goal 3). This recommendation relates to the fact that small isolated populations are more prone to extirpations than larger, healthy, more widespread populations. Large tracts of protected land facilitate more robust populations and can offer better habitat quality in core areas. We will continue to work with our many conservation partners at the state and regional levels to support and complement restoration and protection efforts.

- ***Recommendation #7:—*** Translocate individuals (re: FWS Goal 4). This recommendation suggests that it may sometimes be necessary to physically move wildlife from one area to another to maintain species viability, or even transplant captive-raised individuals. However, it is recognized that this is an extreme conservation strategy, one currently not needed within this CCP's 15 year horizon. Our action alternatives (alternatives B, C, and D) are designed to protect and manage habitats in a manner that facilitates species adaptation to climate change. An example has been the limited or short-term success in translocating Puritan tiger beetles, achieved using larval beetles in both New England and the Chesapeake Bay area. To date, the attempted translocations of Puritan tiger beetles have not led to a secure beetle populations, likely a result several factors. Successful propagation of Puritan tiger beetles has been developed through research at the University of Massachusetts and Randolph Macon College. Translocation of propagated Puritan tiger beetle larvae has been attempted at cliffs along the Chesapeake Bay, but was not successful. Nonetheless, the Service believes that additional efforts, using existing and new techniques, should be pursued in appropriate habitats to support the recovery of these species, and the refuge will participate in this effort if called upon (*http://www.fws.gov/chesapeakebay/EndSppWeb/BEETLE/TigerBeetle.html*; accessed August 2016).

- ***Recommendation #8—*** Protect coastal wetlands and accommodate sea level rise (re: FWS Goal 3): This recommendation relates to actions that could ameliorate wetland loss and sea level rise, such as purchasing wetlands easements, establishing riparian and coastal buffers, restoring natural hydrology, and refraining from developments or impacts in sensitive wetlands and coastal areas. Our habitat goal and associated objectives proposes the acquisition and protection of diverse coastal habitat in Connecticut including salt marsh (e.g., Whalebone Cove CFA), which would be managed under a future Habitat Management Plan that incorporates the influence of climate change stressors.

- ***Recommendation #9—*** Reduce the risk of catastrophic fire (re: FWS Goal 3). This recommendation acknowledges that fire can be a natural part of the ecosystem, but that climate change could lead to more frequent fires or greater likelihood of a catastrophic fire. There are no alternatives with management actions calling for annual prescribed burning to maintain large areas of forest habitat, although selective use likely will occur under HMPs for pitch-pine dominated forest and similar fire-regime systems; controlled burning to reduce fuel loads may be conducted under emergency fire threat situations. Fuel load management will be done through prescribed burning and mechanically within the context of a Forest Management Plan.

- ***Recommendation #10—*** Reduce likelihood of catastrophic events affecting populations (re: FWS Goal 3). This recommendation states that increased intensity of severe weather can put wildlife at risk. While the severe weather cannot be controlled, the refuge's preferred alternative calls for an expanded acquisition boundary that will, over the long term horizon of this CCP enable

the protection and management of greater habitat areas, thus offering a form of safe harbor to a number of species during severe weather events.

- ***Recommendation #11—*** Prevent and control invasive species (re: Goals 3). This recommendation emphasizes the increased opportunities for invasive species to spread because of their adaptability to disturbance. Invasive species control will be essential, including extensive monitoring and control to preclude larger impacts. Invasive species control is a major initiative within the Service. The refuge and Northeast Region, in particular, has taken a very active stand. In chapter 3, we provide descriptions of our current and future plans on the refuge to control existing invasive plant infestations. We also describe monitoring and inventorying strategies to protect against any new infestations.

- ***Recommendation #12—*** Adjust yield and harvest models (re: FWS Goal 3 and 4). This recommendation suggests that managers may have to adapt yield and harvest regulations for game species in response to climate variability and change to reduce the impact on species and habitats. Hunting is permitted under state law at several refuge divisions and units (i.e., Nulhegan Basin, Blueberry Swamp, Putney Mountain Unit, Pondicherry, Fort River, and Salmon River). Species hunted include deer, moose, black bear, ruffed grouse, woodcock, wild turkey, coyote, and snowshoe hare. There is no indication of harvest stress on any of these species, yet we will ensure harvest compatibility within our developing hunt plans. The refuge does not have authority to set harvest regulations but can restrict time and location. For resident wildlife, regulations are established at the state level. For Federal migratory game birds, the harvest framework is established by the Service at the national level while being further refined at the state level.

- ***Recommendation #13—*** Account for known climatic conditions (re: FWS Goal 2 and 4). This recommendation states we should monitor key resources through predictable short-term periodic weather phenomena, such as El Nino, to aid us in future management efforts. We will develop an Inventory and Monitoring Plan that will help us set and evaluate our hypotheses, assumptions, and management actions in achieving objectives, as well as enable us to refine and adjust future management decisions.

- ***Recommendation #14—*** Conduct medium- and long-range planning (re: FWS Goal 2). This recommendation states that plans longer than 10 years should take into account potential climate change and variability as part of the planning process. This intent and statutory purpose of this 15-year CCP is to achieve the purposes, goals, and vision of the refuge, to contribute to the mission of the Refuge System, and to advance the policies and directives of the Service and Department of the Interior. Notably, this CCP addresses the Department's Secretarial Order 3226 (January 19, 2001) calling for long-term planning on climate change. The refuge's CCP addresses climate change with an emphasis on protecting and managing spatially diverse, contiguous, structurally sound native habitat areas. It advances the mitigation of non-climate human stressors on refuge lands, while also promoting education and interpretation about climate change. Our monitoring program and adaptive management strategies will also facilitate our ability to respond to climate change.

- ***Recommendation #15—*** Select and manage conservation areas appropriately (re: FWS Goal 3). This recommendation states that establishment of refuges, parks, and reserves is a conservation strategy needed to minimize the decline of wildlife and habitats in North America. Decisions on locating future conservation areas should take into account potential climate change and variability. This CCP specifically meets this recommendation by its preferred

'alternative C' proposal (and similarly with alternative D) to expand the acquisition boundary of the refuge across a wide range of essential habitat types throughout the north-south alignment of the 7.2 million acre watershed. Having been established as a unique watershed-oriented refuge, there is an acute recognition of the refuge's role in promoting an integrally connected landscape that facilitates movement and adaptation of fish and wildlife in an ever warming climate environment. Our watershed-level partnerships with state agencies, numerous conservation organizations, private and other public landowners, coupled with our refuge expansion proposals, would result in more stable, resilient habitats across the landscape, and help reduce other non-climate stressors. Conserving and connecting protected lands provides wildlife migration corridors, maintains a refugium for species on the edge of their range, removes dispersal barriers and establishes dispersal bridges, protects hydrology, and increases the ecological, genetic, and geographic variation in species. Our plans to control invasive plants, maintain the integrity and function of forest floodplains and wetlands, and promote forest health and diversity, could also minimize climate change impacts.

- ***Recommendation #16***— Ensure ecosystem processes (re: FWS Goals 2, 3, and 4). This recommendation suggests that managers may need to enhance or replace diminished or lost ecosystem processes. Manually dispersing seed, reintroducing pollinators, and treating invasive plants and pests, are examples. We plan to take an aggressive approach to treating invasive plants, and our acquisition boundary expansion will greatly enable the refuge to enhance ecosystem processes. None of our proposed management actions will diminish existing natural ecosystems processes. We will rely upon our forthcoming Inventory and Monitoring Plan implementation to guide adjustments to management actions aimed at a more active role in enhancing ecosystem processes.

- ***Recommendation #17***— Look for new opportunities (re: FWS Goals 2, 4, and 7): This recommendation states that managers must be continually alert to anticipate and take advantage of new opportunities that arise. Creating wildlife conservation areas from abandoned or unusable agricultural land, and participating with industry investment in carbon sequestration or restoration programs are two examples. This CCP specifically meets this recommendation by its preferred 'alternative C' proposal (and similarly with alternative D) to expand the acquisition boundary of the refuge across a wide range of essential habitat types. Additionally, refuge staff members have many conservation partners in the watershed who, in turn, are networked throughout the larger region. Our land protection expansion proposal was largely borne from this extensive partnership. Our 13-state Northeast Region has field offices and a regional office that integrates the other Service program areas, including those that work with private entities. We also coordinate across Service regions on essential climate related issues such as sea level rise and invasive species, and frequently benefit from national guidance and technical information transfer. We have developed outreach materials and make ourselves available to interested organizations and groups to provide more detailed information on the Service and Refuge System missions, refuge goals and objectives, and partnership opportunities.

- ***Recommendation #18***— Employ monitoring and adaptive management (re: FWS Goals 2, 3, and4). This recommendation states that we should monitor climate and its effects on wildlife and their habitats and use this information to adjust management techniques and strategies. Given the uncertainty with climate change and its impacts on the environment, relying on traditional methods of management may become less effective. We agree that an effective

and well-planned monitoring program, coupled with an adaptive management approach, will be essential to dealing with the future uncertainty of climate change. We have built both aspects into our CCP. We will develop a detailed step-down Inventory and Monitoring Plan designed to test our assumptions and management effectiveness in light of on-going changes. With that information in hand, we will either adapt our management techniques or reevaluate or refine our objectives and techniques as appropriate. This plan will address broad aspects of refuge habitat change and species that are known to be sensitive to climate change such as Piping plover (sea level rise), Canada lynx (snowpack), brook trout and juvenile Atlantic salmon (stream flow), and Bicknell's thrush (breeding habitat displacement and increased egg predation by red squirrels).

Biological Resources — Conserved Habitats, Fish, and Wildlife: All of the alternatives would maintain or improve native biological resources on the refuge, in the Connecticut River watershed, and New England in general. The combination of our management actions with those of other conservation partners, organizations, and landowners would result in beneficial cumulative impacts on the biological environment by:

- Improving the protection and management of refuge Priority Refuge Resources of Concern (e.g., Federal trust species, state-listed species, and migratory birds), and associated species.
- Protecting and improving major wetland and upland habitat types defined in this final CCP and their associated LCC subhabitat types, though habitat acquisition and protection proposed in each of the alternatives.
- Actively managing select habitats to promote habitat structure and diversity needed for priority refuge resources of concern species (e.g., wood thrush, blackburnian warbler, New England cottontail, Eastern brook trout).
- Controlling invasive plants and insects.
- Restoring and conserving native flora, pollinators, and other wildlife.
- Enhancing and restoring biological integrity, diversity, and environmental health of refuge lands and new lands to be acquired.

There would be no significant cumulative adverse effects to biological resources under any of the alternatives because the changes in habitat components that we would manage for directly or expect to realize through natural succession would on balance be beneficial. Biological resources that we would manage to prevent their introduction, limit, or eliminate, such as invasive plants, are not natural components of the Connecticut River watershed and refuge ecosystems.

In general, native habitat protection and varying levels of management (including both active and passive management) as described in the alternatives will have cumulative beneficial impacts on the biological environment. We expect to increase select species populations in targeted situations (e.g., Eastern brook trout, wood thrush) through habitat protection and active management (e.g., stream restoration, silviculture operations). Native habitat protection and management cumulatively benefits the biological environment by increasing and enhancing healthy soil biota, restoring and enhancing native plant resources, potentially increasing resident wildlife populations of mammals, fish, reptiles, and amphibians, and enhancing invertebrate populations such as dragonflies and pollinators. Cumulative beneficial impacts on the refuge's biological environment will also accrue from reducing habitat fragmentation across the watershed landscape through refuge land protection activities.

A 2006 survey of New England's aging forest owners revealed that 41,000 owners of 1.72 million acres claimed they planned to sell some or all of their land in the 5 five years, and a group of 28,000 owners managing another 560,000 acres planned to subdivide their land over the same period (Butler et al. 2008). Cumulatively, the habitat protection efforts of the refuge will tie well with activities of other land protection organizations, public and private, thus will offer beneficial cumulative impacts. For example, the Trust for Public Lands has protected over 170,000 acres in the watershed and The Nature Conservancy has protected nearly a quarter million acres (*www.tpl.org/what-we-do/where-we-work/massachusetts/connecticut-river.html*; accessed October 2013) and *www.nature.org/ourinitiatives/regions/northamerica/unitedstates/connecticut/connecticutriver/index.htm*; accessed October 2013). Under the USDA Forest Legacy Program, a grant program to protect forestlands from conversion to non-forest uses, well over 321,000 forestland acres have been protected in the four watershed states while retaining such land in private ownership, although it is unknown how many acres fall within the watershed. A number of priority areas in the watershed are identified for potential future Forest Legacy protections: Connecticut—Roaring Brook ; Massachusetts—Quabbin to Wachusett ; New Hampshire— Mahoosuc Gateway/Success, Oliverian Valley; and Vermont—Northern Green Mountains, Windham Working Forest.

A number of other forest and forest related conservation programs and initiatives are actively underway in New England and the Connecticut River watershed and, along with the refuge's efforts, will serve to promote cumulative beneficial impacts to the region's forestlands: Community Forest and Open Space Conservation Program (USDA) , Urban and Community Forestry (USDA), Land and Water Conservation Fund (LWCF), Wildlife Habitat Incentives Program (USDA), Wetlands Reserve Program (USDA), Conservation Stewardship Program (USDA), Environmental Quality Incentives Program (USDA), Farm and Ranch Lands Protection Program (USDA), Healthy Forest Reserve Program (USDA), the Cooperative Conservation Partnership Initiative (USDA), and Conservation Innovation Grants (USDA). Notably, New England has pioneered the movement to conserve and restore large interstate landscapes such as the Northern Forest and the Connecticut River watershed. Both of these landscapes were named as priorities in the President's FY 2012 Budget and the America's Great Outdoors report (New England Forest Partners 2013). Additionally, watershed states also have forest protection programs (e.g., Massachusetts Chapter 61 Laws, Vermont Forest Stewardship Program).

Proposed habitat enhancement and restoration activities (e.g., increase forest structural diversity, floodplain restoration) under alternatives A, B, and C will limit any potential adverse cumulative impacts effects on the biological environment by careful employment of best management practices, as noted earlier. Refuge timber harvests will be driven by habitat considerations, not economic concerns, and will enhance the diversity of the forest landscape for target priority refuge resources of concern wildlife. Within much of the watershed, forests are younger and support more simplified species and age mixtures than their pre-European cohorts (Foster and Aber 2004, Irland 1999, Elliot 1999). Changing economic pressures to maximize short-term profits have led to shorter rotations and more aggressive harvesting practices (Lansky 1992), and erosion from improperly constructed roads can contribute tons of sediment to streams each year. Rising pressures for wood-based bioenergy to meet alternative fuel targets of New England states may intensify adverse harvesting practices (Evans and Perschel 2009, Damery et al. 2009, Benjamin et al. 2009, Cronan et al. 2010). Timber harvests occur on lands surrounding the Nulhegan Basin Division: Plum Creek Timber Company (3,604 acres treated in 2013; 84,000 acres ownership) and West Mountain Wildlife Management Area (50 acres treated annually; 22,000 acres ownership by state of Vermont).

Forest management proposed by the refuge, ranges from no cutting (alternative D), to approximate annual harvest of 500 acres. Refuge forests subject to will contribute to the overall health of the watershed's forest ecosystem. In select situations, where forest regeneration is inhibited by invasive species, over browsing by ungulates, or human disturbances, native tree species will be planted to speed forest establishment.

Similar to habitat management to improve certain forest habitat areas for target wildlife, maintenance of grassland and shrubland areas as described earlier will help to provide for these otherwise declining habitats well recognized for their value to target wildlife (e.g., upland sandpiper, bobolink). Westover Air Reserve Base in Chicopee, Massachusetts hosts the most important populations of grasshopper sparrows and upland sandpipers in the watershed, an area previously designated as an SFA but currently protected and managed through an agreement between the U.S. Air Force and Mass Wildlife. The Connecticut River valley in Massachusetts provides the greatest potential for grassland habitat restoration in the watershed, indicating the importance of the refuge's proposed CFAs such as the Fort River, and Mill River. As New England becomes increasingly forested and urbanized these grassland species will be increasingly limited by available habitat. Refuge management of these lands (164 acres) will cumulatively have very negligible impacts to the forest environment that typically would successionally replace the grasslands, due to the expansive forests in the watershed. Additionally, the refuge will use all available best management practices when mowing and brush-hogging these habitat areas to minimize immediate and potential adverse impacts, recognizing that the long-term impacts are expected to be cumulatively beneficial.

Certain biological resources that we would work to control, principally invasive plants, are not natural components of our managed wildland areas or the Connecticut River watershed. We do not consider the loss of these biotic elements to be an adverse impact, and in fact, our control efforts along with those of others (e.g., USDA-NRCS) cumulatively should help maintain a broader, more resilient array of native habitats. In contrast, not controlling invasive species would contribute to adverse cumulative impacts to the biological environment. All alternatives facilitate control of invasive species. Controlling invasive plants will involve the use of chemical herbicides and mechanical treatments. The selective use of herbicides will be based upon an integrated pest management strategy that incorporates pest ecology, the size and distribution of the population, site-specific conditions, and known efficacy under similar site conditions. Best management practices will reduce potential effects to non-target species, sensitive habitats, and quality of surface and groundwater. Herbicide applications will be targeted to control discreet plant, and potentially insect, populations in localized areas. A 'minimal' approach is generally used (e.g., 'cut and drip' herbicide application on individual plants) contrasted, when appropriate, with broadcast applications in larger invasive plant areas. Herbicides applied on the refuge would be short-lived, resulting from environmental and microbial breakdown to less or non-hazardous degradation products.

Beaver and muskrats are native aquatic rodents that are a natural component of the refuge ecosystem. However, on occasion individual animals or small colonies will damage valuable refuge infrastructure, burrow into dikes or cause flooding conditions on neighboring private land. Beaver damming and flooding of refuge managed habitats may impact the refuge's ability to achieve an optimal management regime for Federal trust resources. Cumulatively, managing these furbearers over the long term and in concert with those harvested through regulatory programs of the state Fish and Wildlife agencies in the watershed should pose negligible adverse impact and, beneficial impacts over time as their population levels will be expected to be more in balance with the wetland environment. Similarly, refuge management of other more terrestrial furbearers (e.g., coyote, bobcat) is conducted through special use permits in a manner that

is consistent with population objectives of the respective watershed states, while also playing a role to minimize undue predator pressure on other species such as ground nesting birds and interspecific competition between bobcat and Canada lynx. The cumulative adverse impacts of these trapping activities are expected to be of adverse and immediate negligible impact (on individual animals), and over the long term to be of beneficial cumulative impact to the furbearer population.

Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity

In this section, we examine the relationship between local, short-term uses of the human environment and maintaining the long-term productivity of the environment. By long-term, we mean that the impact would extend beyond the 15-year period of this CCP. Under all alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, including migratory birds, inter-jurisdictional fish, and other far-ranging wildlife species. Habitat protection and restoration actions across all alternatives may entail short-term negative impacts to ensure the long-term productivity of the refuge. Many of the cyclic management actions in the alternatives, namely, actively managing forests, shrublands, and grasslands, controlling invasive plants and animals, and grasslands, and restoring native plant communities can have dramatic short-term impacts. These include direct mortality of some plants and animals, displacement of species, and temporary displacement or cessation of certain types of public use. However, the long-term benefits of those actions generally offset their short-term impacts. Habitat management practices that mimic ecological and sustainable processes optimize the maintenance and enhancement of the biological diversity, integrity, and environmental health of those habitats for the long term. Long-term productivity is especially enhanced when the ecological and sustainable management actions that are proposed in the preferred alternative would best support and improve links between nutrient cycling, ecological processes, and ecosystem function.

Diverse and wide-ranging wildlife recreational opportunities for public use should provide the best long-term positive economic impacts to local communities. That mirrors the widely accepted premise that maintaining biological diversity in natural ecosystems helps ensure their long-term resiliency. We would design our proposed public use programs to heavily rely on outreach and environmental education to explain all of our management actions to visitors and the public that would encourage everyone to be better stewards of our natural environment.

In summary, we predict that the alternatives would contribute positively to maintaining and enhancing the long-term productivity of the refuge's natural resources, with sustainable beneficial cumulative and long-term benefits to the environment surrounding the refuge, while necessitating only minimal inconvenience or loss of opportunity for the American public.

Unavoidable Adverse Impacts

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and cannot be avoided, even with mitigation measures. All the alternatives would result in some minor, localized, unavoidable adverse impacts. For example, any minor construction, burning or prescribed fires, control of invasive plant species, or upgrading a trailhead parking lot to be ADA compliant would produce minor short-term, localized adverse impacts. Some habitat types on the refuge will be adversely impacted as previously noted (e.g., Impacts to Mammals) following direct habitat management applications (e.g., logging or haying). There will be adverse but negligible impacts to species whose preferred habitat has been altered; however, the altered habitat will be of beneficial impact to the priority refuge resources of concern species being managed. Furthermore, all of those impacts would be mitigated with best management practices, so none of the alternatives would cause significant, unavoidable cumulative impacts. There would be property tax losses to towns and increased visitation that could have unavoidable effects. These impacts are minimally offset by refuge revenue sharing payments. All the alternatives, in

varying degrees, will have adverse impacts to a certain segment of the public that does not desire any change in current habitat management or public use programs. Some may be concerned about increased visitation to the refuge, or others may not like us to open new tracts for public use adjacent to their residences. Some of these impacts on certain individuals or neighbors are unavoidable. Our responsibility is to provide equal opportunities to the American public. We believe we have sought a fair balance in minimizing and mitigating adverse impacts while optimizing wildlife conservation and providing excellent recreational opportunities to the public. Nevertheless, none of these unavoidable impacts rises to the level of significance under any of the alternatives. All these unavoidable adverse effects on the physical and biological environment will be relatively local and more than offset by the long-term benefits of cleaner air, cleaner water, and making rare wildlife species more common across the landscape, while providing quality wildlife-dependent recreation.

Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those commitments that cannot be reversed, except perhaps in the extreme long-term or under unpredictable circumstances. One extreme example is an action that contributes to a species' extinction. Once extinct, it can never be replaced. By comparison, irretrievable commitments of resources are those that can be reversed, given sufficient time and resources, but represent a loss in production or use for a time. An example of an irretrievable commitment for the refuge is maintaining early-successional shrubland, old fields, and young forest for breeding American woodcock, a management action common to all alternatives. If for justifiable reason, American woodcock breeding habitat at the Nulhegan Basin Division was no longer considered by the refuge and conservation partners as necessary, those managed acres would revert gradually to mature forest and would be valuable to another suite of birds. Another example would be a management action that calls for building a large permanent visitor education center. We have not proposed any management action that poses a Potential Irreversible and Irretrievable Commitments of Resources, and we do not consider small visitor facilities, such as photo blinds and information kiosks, or new trails, to be irretrievable commitments of resources. We can dismantle those facilities and restore the sites if resource damage is occurring or priorities have shifted.

A prominent irreversible commitment proposed in this final CCP impacting local communities is Service land acquisition. All alternatives enable the Service to acquire new lands, and alternatives C and D expand current land acquisition authorization, as previously described herein and Chapter 4 — Alternatives. Once these lands become part of the refuge, they would not revert back to private ownership. There are provisions for exchanges of land parcels when such exchanges are determined to be in the best interest of the refuge; however, an exchange is not a reversion. The commitment of resources to maintain newly acquired lands is small compared to the benefits derived from the increased habitat areas for fish and wildlife, biodiversity, and the potential benefit to refuge visitors by providing a variety of wildlife-oriented recreational opportunities.

Environmental Justice Impacts

President Clinton signed Executive Order no. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities.

The order directs Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high adverse human

health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment.

The United States EPA Office of Environmental Justice defines it as follows:

> *"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental law, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work."*

Overall, we expect none of the alternatives to place disproportionately high, adverse environmental, economic, social, or health effects on minority or low income persons. All of the alternatives maintain or establish refuge CFAs (later to be refuge Divisions) throughout the watershed, in both rural and urban settings. Opportunities will be created to have all people visit and enjoy the refuge. Before we make any decisions to change habitat management or the environment we inform the public. Our programs and lands are equally open to all users who follow refuge rules and regulations. We do not discriminate in our responses for technical or practical information on conservation issues or when providing technical assistance in managing private lands.

It's estimated that both urban and rural communities within the Connecticut River watershed may benefit economically under all management alternatives if increased visitor expenditures offset property tax losses on acquired lands. This benefit would vary widely from urban to rural communities, and is dependent on respective communities' reliance on property tax revenues and tourism. We estimate that no community will be adversely affected over the long term by loss of access to game or fish for those who use them to supplement their annual diet, because both hunting and fishing are likely to remain a compatible use of the refuge. Many refuge areas may promote outdoor recreational activities (e.g., hiking, birding, hunting, and fishing) that may stimulate local jobs and revenue sources. Certain areas may restrict particular recreation activities known to be an important source of income for local communities (e.g. snowmobiling), but efforts will be made to provide sufficient access to support this revenue base.

Summary of the Impacts of the Alternatives

The following table summarizes and compares the benefits and adverse impacts we described above in chapter 5 for each of the four alternatives. For our discussion on cumulative impacts, the relationship between short-term uses of the human environment and enhancement of long-term productivity, unavoidable adverse impacts, potential irreversible and irretrievable commitments of resources, and environmental justice, please refer to the chapter 5 narratives above.

Table 5.20. Summary of the impacts of the alternatives.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO REGIONAL AND LOCAL SOCIOECONOMICS			
Socioeconomic impacts that do not vary between the alternatives: Under all alternatives, we would continue to pay refuge revenue sharing payments to municipalities where refuge lands are located. Regardless of the alternative selected, refuge jobs, refuge expenditures, and visitor spending would negligibly contribute to the local economy.			
Refuge purchase of goods and services and Refuge personnel salary spending			
As additional refuge lands are acquired, non-salary expenditures will shift from occurring most frequently in the north to greater spending in the south of the watershed. We would continue to maintain our current level of staffing and, therefore, we would expect personnel salary spending to continue at similar levels.	Similar to alternative A.	Compared to alternatives A and B, we predict an increase in spending of about $175,000, particularly in the Tri-State Border and White River Junction subregions. Over the long term, we would add up to 16 new staff positions (dependent upon funding), particularly in the Northern and Tri-State Border subregions.	Similar to alternative C
Refuge visitor spending in the local economy			
In general, as with the other alternatives, visitation (and therefore visitor spending) would continue at current levels at existing divisions and units. Over the long term, as we acquire additional lands in other areas in the southern watershed, we expect visitation and visitor spending to increase in these areas.	As with the other alternatives, we expect current levels of visitation (and therefore visitor spending) to continue at existing divisions and units. As new lands are acquired and additional ADA-accessible trails are built, we expect visitation to increase (estimate about 22 percent above current visitation levels).	As with the other alternatives, we expect current levels of visitation (and therefore visitor spending) to continue at existing divisions and units. As new lands are acquired and additional ADA-accessible trails are built, we expect visitation to increase (estimate about 54 percent above current visitation levels).	As with the other alternatives, we expect current levels of visitation (and therefore visitor spending) to continue at existing divisions and units. As new lands are acquired and "backcountry" trails are built, we expect visitation to increase (estimate about 25 percent above current visitation levels). This increase will occur despite a large decrease in visitation due to the elimination of snowmobiling. Impact on local economies due to eliminating snowmobiling is likely minor as many other snowmobile trails exist in area.
Economic contributions from habitat management			
We may acquire additional acres of commercial forest lands across the watershed, particularly in the Northern, White River Junction, and Tri-State Border Subregions. We would continue to manage approximately 225 acres of forest in the Northern Subregion and up to 200 acres of grassland each year across the Northern and Greater Amherst Subregions for migratory birds and other wildlife, generating negligible amounts of timber products and hay.	Short-term impacts similar to alternative A. Over the long term, as we acquire new refuge lands, we would actively manage approximately 7,660 acres of forest. We would also manage approximately 422 acres of grassland and 775 acres of shrubland on the refuge. Similar to A, as part of this management, we may generate some negligible to minor amounts of timber products and hay.	Short-term impacts similar to alternative A. Over the long term, as we acquire new refuge lands, we would actively manage up to 11,500 acres. We would also manage approximately 548 acres of grassland and 775 acres of shrubland on the refuge. Similar to A and B, As part of this management, we may generate some negligible to minor amounts of timber products and hay.	Alternative D would generate the smallest economic contribution from habitat management. Under alternative D, we would passively manage all refuge habitats, except in rare circumstances (e.g., major disturbance such as fire, hurricane, or ice storm, to restore degraded habitats, for threatened and endangered species).

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO REGIONAL AIR QUALITY			
Air quality impacts that do not vary between the al**ternatives**: None of the alternatives would significantly benefit or adversely affect local or regional air quality. None of the alternatives would violate EPA standards for air pollutants and all would comply with the Clean Air Act. There are no major stationary or mobile sources of air pollution present on Service-owned lands nor would any be created under any of the alternatives. No Class I air quality areas would be affected. All of the alternatives would have short- and long-term negligible adverse impacts (e.g., emissions from vehicles, equipment, and buildings) and negligible to minor long-term beneficial impacts (e.g., preventing further development, sequestrating carbon, and filtering air from permanently protecting native habitats) on regional air quality. To reduce the amount of refuge emissions, we would replace or upgrade, as necessary, refuge equipment, vehicles, and facilities with more efficient models and look for alternative energy sources. Over the short-term, we expect similar minor beneficial impacts to air quality as habitat conservation and management actions lead to lower levels of emissions in areas near the refuge, and the air pollutant filtering function of vegetation on refuge-protected lands continues.			
Within the next 15 years: Negligible, short-term adverse impacts from: • Maintaining and using existing refuge administrative and public use facilities (e.g., trails, roads, buildings). Lowest among the alternatives. • Emissions from refuge staff and visitor vehicles. • Emissions from snowmobiles. • Emissions from equipment for continuing existing habitat management projects (up to 445 acres). *Beyond the next 15 years:* Minor long-term beneficial impacts to regional air quality from protecting up to 97,830 acres of habitat from further development (e.g., continued carbon sequestration, decreased likelihood of emissions from development). Lowest among the alternatives.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Up to and beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality from protecting up to 97,772 acres of habitat. Potential for adverse, short-term impacts from: • Emissions from managing greater amounts of habitat (approximately 9,312 acres). • Emissions and fugitive dust from constructing new trails (up to 19 1-mile long ADA-accessible trails). • An increase in refuge visitation, and related increase in vehicle emissions. • Emissions from snowmobiles.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Up to and beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality from protecting up to 197,337 acres of habitat. Potential for adverse, short-term impacts from: • Emissions from managing the greatest amounts of habitat (approximately 12,873 acres). Highest among the alternatives. • Emissions and fugitive dust from constructing new trails (up to 22, 1-mile long ADA-accessible trails). Highest among the alternatives. • Large projected increase in refuge visitation and related increase in vehicle emissions. Highest among the alternatives. • Emissions from snowmobiles. Highest among the alternatives.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Up to and beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality from protecting up to 231,307 acres of habitat, and from eliminating snowmobiling on refuge lands. Potential for adverse, short-term impacts from: • Emissions from managing habitat intermittently. Lowest among the alternatives. • An increase in refuge visitation, and related increase in vehicle emissions. • Emissions and fugitive dust from constructing new trails (up to 22 1-mile long native-material trails). Lowest among the alternatives.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO REGIONAL HYDROLOGY AND WATER QUALITY			
Hydrology and water quality impacts that do not vary between the alternatives: None of our proposed management activities would significantly benefit or adversely affect local or regional hydrology and water quality. None of our proposed management activities would violate Federal or state standards for contributing pollutants to water sources; all four would comply with the Clean Water Act. Under all alternatives, we would use best management practices to prevent spills and protect hydrology and water quality during management (e.g., only using approved herbicides to remove invasive plants, leaving a forested buffer along riparian areas) and construction (e.g., using elevated boardwalks and installing appropriately sized culverts) activities. We would also encourage refuge visitors to stay on trails and in other designated areas to limit potential to disrupt hydrology or adversely affect water quality (e.g., trail erosion into streams). We also require that pet owners remove solid pet wastes to reduce the potential to affect water quality.			
Within the next 15 years: Negligible adverse short-term, localized impacts from refuge visitation (e.g., snowmobile emissions), road and trail maintenance, and invasive plant control (e.g., herbicide application). *Up to and beyond the next 15 years:* Negligible, long-term beneficial impacts to regional water quality and hydrology from protecting up to 97,830 acres of habitat from further development.	*Within the next 15 years*: Similar to alternative A—negligible, short-term, localized adverse impacts. *Up to and beyond the next 15 years:* Negligible long-term beneficial impacts to regional water quality and hydrology are similar to alternative A (protect up to 97,772 acres of native habitat). However, we would protect larger blocks of habitat under alternative B than alternative A, and therefore expect slightly greater benefits. Also, slightly greater potential for adverse, short-term impacts from: • Actively managing greater amounts of habitat (approximately 9,312 acres). • Constructing new trails (up to 19, 1-mile long ADA-accessible trails). • An increase in refuge visitation (i.e., increased vehicles emissions).	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Up to and beyond the next 15 years:* Compared to other alternatives, second greatest potential for long-term benefits to regional air quality from protecting up to 197,337 acres of native habitat. We expect these impacts to be minor to modest. However, compared to other alternatives, the greatest potential for adverse, short-term impacts from: • Equipment and vehicle emissions from actively managing the greatest amount of habitat (approximately 12,873 acres). • Constructing new trails (up to 22, 1-mile long ADA-accessible trails). • The greatest projected increase in refuge visitation (i.e., increased vehicle emissions).	*Within the next 15 years*: Negligible adverse short-term, localized impacts from refuge visitation, road, and trail maintenance, new construction (e.g., trails and trail heads) and invasive plant control (e.g., herbicide application). Compared to other alternatives, least potential for adverse short-term impacts because of emphasis on a "back-country" visitor experience, eliminating snowmobiling, and least amount of active habitat management. *Up to and beyond the the next 15 years:* Minor to modest long-term beneficial impacts to regional hydrology and water quality. Compared to other alternatives, greatest potential for benefits to regional hydrology and water quality by protecting the greatest amount of habitat (up to 231,307 acres) and allowing natural hydrological processes to occur across the refuge, with limited to no active management. We expect these impacts to be minor to modest.

Table 5.24. Summary of Environmental Consequences by Alternatives.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
CLIMATE CHANGE IMPACTS			
Climate change impacts that do not vary between the alternatives: Under all alternatives, changes in temperature, precipitation, sea level rise, storm intensity, and other physical changes are having a significant biological impact across a broad range of natural systems. This includes increased uncertainty related to the outcomes of management actions. To reduce the adverse impacts of climate change stressors, the refuge intends to protect the structural and functional dynamics of defined refuge habitats, diversity of species, promote landscape connectivity and corridors to facilitate migration, strengthen partnership support to address climate change, and promote effective environmental education and interpretation.			
Given climate change impacts, under this management strategy the refuge could see negligible adverse impacts from managing 97,830 acres of habitat across dispersed SFAs that are smaller, less contiguous, and less connected than SFAs, and have a higher likelihood of becoming ecological sinks. Negligible to minor long-term adverse impacts to forest resilience are possible, given that active management can only occur on a small portion of the refuge.	Given climate change impacts, under this management strategy the refuge could see minor beneficial impacts from protecting larger and more connected ecosystems across up to 97,772. Less benefit than alternatives B and C. Negligible to minor long-term adverse impacts to forest resilience are possible, given that active management can only occur on a small portion of the refuge. This alternative better positions the refuge to adapt to climate change than alternatives A or D, but offers fewer opportunities than under alternative B.	Given climate change impacts, under this management strategy the refuge could see minor beneficial impacts from protecting larger and more connected ecosystems across up to 197,337. These benefits would be greater than alternatives A and B, and lesser than under alternative D. Negligible to minor long-term adverse impacts to forest resilience are possible, given that active management can only occur on a small portion of the refuge. This alternative better positions the refuge to adapt to climate change than alternatives A, B or D.	Given climate change impacts, under this management strategy the refuge could see minor to moderate beneficial impacts from protecting larger and more connected ecosystems across up to 231,307. These benefits would be greater than alternatives A, B and C. Negligible to moderate long-term adverse impacts to forest resilience are possible, given that active management can only occur in rare circumstances. Under this alternative, the refuge is likely to be the most impacted by climate change, since resilience-enhancing active forest management may not occur.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO SOILS			
Soil impacts that do not vary between the alternatives: None of our proposed management activities would significantly benefit or adversely affect local or regional soils. Under all alternatives, we would use best management practices to conserve soils during management (e.g., forest management to improve habitat), maintenance, and construction (e.g., new trail construction) activities. We would also encourage refuge visitors to stay on trails and in other designated areas to limit potential for soil erosion and compaction.			
Within the next 15 years: Negligible adverse short-term, localized impacts from: • Visitor use impacts (e.g., soil compaction and erosion alongside trails). • Road and trail maintenance. • Invasive plant control (e.g., herbicide application). • Continuing to manage up to 455 acres of habitat. *Up to and beyond the next 15 years:* Negligible minor long-term beneficial impacts to soils from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. *Up to and beyond the next 15 years:* Similar to alternative A, minor beneficial impacts to soils from permanently protecting up to 97,772 acres of habitat. We expect slightly greater benefits from protecting larger blocks of habitat under alternative B. However, we also expect a slightly greater potential for adverse impacts to soils from managing additional acres of habitat (approximately 9,312 acres). Also, from constructing up to 19 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to alternatives A and B. *Up to and beyond the next 15 years:* Compared to other alternatives, the second greatest potential to benefit soils from permanently protecting up to 197,337 acres of habitat. However, compared to other alternatives, the greatest potential for adverse impacts to soils from actively managing additional acres of habitat (approximately 12,873 acres) and from constructing up to 22 1-mile-long, ADA-accessible trails. We also expect the highest visitation under alternative C.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to soils because of very little to no active habitat management. *Up to and beyond the next 15 years:* Alternative D would have the greatest potential to benefit soils from protecting the greatest amount of habitat and allowing soil processes to occur, with no to limited active management. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails. However some potential for adverse impacts to soils from occasional habitat management and from constructing up to 22 1-mile-long, native-surface trails. We also expect the second-highest visitation under alternative D.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO FRESHWATER WETLANDS			
Freshwater wetland impacts that do not vary between the alternatives: None of alternatives would have a significant adverse effect on any freshwater wetland habitats on the refuge. Under all alternatives, we predict negligible to minor long-term benefits from protecting and/or restoring wetland habitats on the refuge. We would also use best management practices to minimize adverse impacts to wetlands from new construction (e.g., building outside of wetland areas), trail and road maintenance, invasive species control (e.g. only using approved herbicides and/or using other non-chemical controls), and habitat management (e.g., buffering wetlands). The majority of habitat management will occur in upland areas, away from freshwater wetlands. We would also encourage visits to stay on trails to minimize the potential for impacts to wetland vegetation and wildlife.			
Within the next 15 years: Negligible adverse short-term, localized impacts from: • Visitor use (e.g., sedimentation from small amounts of off trail use). • Road and trail maintenance. • Invasive plant control (e.g., herbicide application). • Continuing to manage upland habitats following best management practices (up to 455 acres). *Up to and beyond the next 15 years:* Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. *Up to and beyond the next 15 years:* Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,772 acres of habitat. Potential negligible to minor adverse impacts to freshwater wetlands from managing additional acres of habitat (approximately 9,312 acres). Negligible to minor adverse impacts from constructing up to 19 1-mile-long, ADA-accessible hiking trails. Most of the management and trail construction will occur in uplands, but we will follow best management practice to reduce impacts where activities occur near wetlands.	*Within the next 15 years*: Similar to alternatives A and B. *Up to and beyond the next 15 years:* Compared to other alternatives, the second greatest potential to benefit wetlands by permanently protecting up to 197,337 acres of habitat. However, we also expect the greatest potential for adverse impacts to freshwater wetlands from managing additional acres of habitat (approximately 12,873 acres). Negligible to minor adverse impacts from constructing up to 22 1-mile-long, ADA-accessible hiking trails. Most of the management and trail construction will occur in uplands, but we will follow best management practice to reduce impacts where activities occur near wetlands.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to wetlands because of very little to no active habitat management. *Up to and beyond the next 15 years:* Alternative D would have the greatest potential to benefit wetlands by from protecting the greatest amount of habitat with no to limited active management. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails. Negligible to minor adverse impacts from constructing up to 22 1-mile-long, native-material hiking trails. Most of the management and trail construction will occur in uplands, but we will follow best management practice to reduce impacts where activities occur near wetlands.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO UPLAND HABITATS AND VEGETATION			
Upland habitat and vegetation impacts that do not vary between the alternatives: None of alternatives would have a significant adverse effect on any upland habitats on the refuge. Under all alternatives, we predict negligible to minor long-term benefits from protecting, managing, and/or restoring upland habitats on the refuge. Under all alternatives, there is the potential for short-term adverse impacts to habitats from habitat management (e.g., herbicide application), new construction (e.g., trails, boardwalks, etc.), and refuge visitation; however, we would minimize these impacts by using best management practices and encouraging visitors to stay on trails.			
Within the next 15 years: Negligible adverse, short-term impacts from: • Visitor use (e.g., trampling of vegetation from small amount of off-trail use). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., compaction and trampling from heavy equipment, use of herbicides and prescribed burning). *Up to and beyond the next 15 years:* Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. *Up to and beyond the next 15 years:* Negligible to minor long-term beneficial impacts to uplands habitats and vegetation from permanently protecting up to 97,772 acres of habitat. Negligible to minor beneficial impacts to vegetation from managing additional acres of habitat (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland). Negligible to minor adverse impacts from constructing up to 19 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to alternatives A and B. *Up to and beyond the next 15 years:* Compared to other alternatives, the second greatest potential to benefit upland habitats and vegetation by permanently protecting up to 197,337 acres of habitat. Negligible to minor beneficial impacts to vegetation from managing additional acres of habitat (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland). Negligible to minor adverse impacts from constructing up to 22 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to vegetation because of very little to no active habitat management. *Up to and beyond the next 15 years:* Alternative D would have the greatest potential to benefit uplands and vegetation by protecting the greatest amount of habitat. No beneficial impacts from active habitat management. Negligible to minor adverse impacts from constructing up to 22 1-mile-long, native-material hiking trails. Least potential for adverse imapacts among alternatives. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO BIOLOGICAL INTEGRITY, DIVERSITY AND ENVIRONMENTAL HEALTH			
Biological integrity, diversity, and environmental health impacts that do not vary between the al**ternatives**: None of the alternatives would have significant adverse effects on biological integrity, diversity, or environmental health (BIDEH), either regionally or on the refuge. Under all alternatives, we predict negligible to minor long-term benefits to BIDEH from protecting, managing, and restoring native habitats, conserving native wildlife, and controlling invasive plants and animals. There is the potential for short-term, adverse impacts on some native wildlife and habitats from habitat management (e.g., herbicide application, timber harvesting), trail construction and facilities maintenance; however, we would minimize these impacts by using best management practices. Under all alternatives, there is also the potential for refuge visitors to adversely impact wildlife and habitats, but we would reduce these impacts by only allowing appropriate and compatible uses, encouraging visitors to stay on trails, and closing sensitive areas to public use, if necessary. Under all alternatives, we would actively manage habitats to mitigate threats to environmental health.			
Within the next 15 years: Negligible adverse, short-term impacts to BIDEH from: • Visitor use (e.g., trampling of vegetation from small amount of off-trail use). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., compaction and trampling from heavy equipment, use of herbicides and prescribed burning). Beyond next 15 years: Negligible to minor long-term beneficial impacts to biological integrity from permanently protecting up to 97,830 acres of habitat. Negligible benefits to biological diversity from actively managing habitats to provide a diversity of age/size classes, successional stages, and structural diversity.	*Within the next 15 years*: Similar to alternative A. *Up to and beyond the next 15 years:* Minor to modest long-term beneficial impacts to biological integrity from permanently protecting up to 97,772 acres of habitat. The second greatest potential to benefit biological diversity by actively managing habitats (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland) to provide a diversity of age/size classes, successional stages, and structural diversity. However, we also expect the greatest potential for adverse impacts to biological integrity from actively managing habitats and constructing up to 19 1-mile-long ADA-accessible hiking trails (e.g., trampling/removal of native vegetation and soil compaction). Our habitat management is designed to promote BIDEH by enhancing the diversity of refuge habitats and mimicking or restoring natural processes.	*Within the next 15 years*: Similar to alternatives A and B. *Up to and beyond the next 15 years:* Compared to other alternatives, the second greatest potential for beneficial impacts to biological integrity from permanently protecting up to 197,337 acres of habitat. The greatest potential to benefit biological diversity by actively managing the most acres of habitat (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland) to provide a diversity of age/size classes, successional stages, and structural diversity. However, we also expect the greatest potential for adverse impacts to biological integrity from actively managing habitats and constructing up to 22 1-mile-long ADA-accessible hiking trails. Our habitat management is designed to promote BIDEH by enhancing the diversity of refuge habitats and mimicking or restoring natural processes.	*Within the next 15 years*: Similar to other alternatives. *Up to and beyond the next 15 years:* Compared to the other alternatives the greatest potential for benefits to biological integrity from permanently protecting and allowing natural processes on up to 231,307 acres of habitat. Also, from discontinuing snowmobiling and creating less developed trails and public use facilities. Slightly less potential for positive benefits to biological diversity because we will not actively manage refuge habitats (e.g., less structural diversity in forests, more homogenous age/size classes, fewer grasslands and shrublands). Benefits to ecological health would be similar to alternatives A, B, and C as we would use active management in the case of significant outbreaks of forest pests and other ecological disturbances.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES			
Listed species impacts that do not vary between the alte**rnatives**: None of the activities proposed in any of the alternatives should adversely affect any federally listed or Federal candidate species and we will continue to consult on proposed actions with Service Endangered Species staff under Section 7 of the Endangered Species Act. Under all alternatives, we will continue to work with partners to help conserve federally listed and Federal candidate species in the Connecticut River watershed. In particular, we will work with the Connecticut River Coordinator's office to conserve federally listed aquatic species that occur in the Connecticut River main stem and its tributaries. Under all alternatives, we will continue to protect federally listed species that occur on existing refuge lands. We will continue to manage habitat and prohibit public access to protect listed or proposed plant and beetle species. We will monitor known populations of listed or proposed species and work with the Service's New England Field Office to determine if any active habitat management on the refuge is warranted. We expect only negligible impacts to listed or proposed species from refuge visitors and from active habitat management. Visitors are encouraged to stay on trails and we will close sensitive areas to the public (e.g., Deadman's Swamp). Habitat management in areas where listed species occur is designed to improve these areas for those species and will result in long-term benefits for listed or proposed species. Under all alternatives, we may acquire additional lands that support or protect water quality for federally listed threatened and endangered and candidate species, including northern long-eared bat, dwarf wedgemussel, and shortnose sturgeon.			
Up to and beyond the next 15 years: Negligible to minor long-term beneficial impacts to listed and proposed species from permanently protecting up to 97,830 acres of habitat. Negligible to minor beneficial impacts from active forest, shrubland, and grassland management. Negligible adverse impacts from visitation.	*Up to and beyond the next 15 years:* Minor to modest long-term beneficial impacts to listed and proposed species from permanently protecting up to 97,772 acres of habitat. Negligible to minor beneficial impacts from active forest, shrubland, and grassland management. Negligible adverse impacts from trail construction or water quality. Negligible impacts from visitation.	*Up to and beyond the next 15 years:* Compared to other alternatives, the second greatest potential for beneficial impacts to listed and proposed species from permanently protecting up to 197,337 acres of habitat. Negligible to minor beneficial impacts from active forest, shrubland, and grassland management. Greatest potential for negligible adverse impacts from trail construction or water quality. Greatest potential for negligible adverse impacts from visitation.	*Up to and beyond the next 15 years:* Compared to the other alternatives the greatest potential for benefits to listed and proposed species from permanently protecting and allowing natural processes on up to 231,307 acres of habitat. Negligible to minor beneficial impacts from active forest, shrubland, and grassland management. Negligible adverse impacts from trail construction or water quality. Negligible adverse impacts from visitation.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
Impacts to Native Wildlife and Plants ** Covers the following sections: Impacts to Birds; Impacts to Mammals; Impacts to Fish, Aquatic Fauna, Reptiles, and Amphibians; Impacts to Rare Plants and Invertebrates **			
Native wildlife and plant impacts that do not vary between the alternatives: None of the activities proposed in any of the alternatives would significantly benefit or adversely affect terrestrial wildlife species at the watershed scale. All alternatives would permanently protect habitat for a wide-range of bird species across the watershed. Under all alternatives, there is the potential for negligible, short-term impacts to wildlife and rare plants species from habitat management, public use, and facilities maintenance and construction. However, we will minimize these impacts by using best management practices (e.g., delaying grassland mowing until after breeding) and encouraging visitors to stay on trails and closing sensitive areas to public use. Any active habitat management would be designed to enhance refuge habitats, and therefore, is expected to have long-term benefits to certain species. None of the activities proposed in any of the alternatives would significantly benefit or adversely impact aquatic species at the watershed scale. We would continue to work with partners (e.g., Connecticut River Coordinator's Office, Eastern Brook Trout Joint Venture, etc.) to conserve, restore and enhance aquatic species and habitat in the Connecticut River main stem and its tributaries (e.g., land conservation, removing barriers to aquatic organism passage, improving water quality). Under all alternatives, there is the potential for negligible, short-term impacts to aquatic species from habitat management (e.g., mowing, forest management, and invasive plant control), public use, and facilities maintenance and construction. However, we will minimize these impacts by using best management practices (e.g., approved herbicide use for invasive plant control, not mowing within 100 feet of wetland areas, appropriate buffering of streams and vernal pools during forest management activities) and encouraging visitors to stay on trails and closing sensitive areas to public use.			
Within the next 15 years: Negligible adverse, short-term impacts from: • Visitor use (e.g., disturbance along trails, trampling of plants and small animals, road kill from vehicles, disturbance from snowmobiles, siltation into streams from trail use, impacts from hunting and fishing following state regulations). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., short-term displacement or disturbance, compaction and trampling from heavy equipment, use of herbicides and prescribed burning). Beyond next 15 years: Negligible to minor long-term beneficial impacts from permanently protecting up to 97,830 acres of habitat. Negligible to minor benefits to species requiring actively management habitats. We would continue to manage approximately 255 acres of early successional forest and 200 acres of grasslands.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Similar to alternative A, over the long term alternative B will protect up to 97,772 acres of habitat. Compared to alternative A, alternative B will protect larger, more contiguous tracts of habitat. The second greatest benefit to species that require actively managed habitats, such as grasslands, shrublands, or young forests (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland). Compared to alternative A, slightly greater potential for adverse, short-term impacts from: • Actively managing greater amounts of habitat (approximately 9,312 acres). • Constructing new trails (up to 19, 1-mile long ADA-accessible trails). • An increase in refuge visitation (e.g., disturbance along trails).	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Over the long term, alternative C will protect the second greatest amount of habitat (up to 197,337 acres). The second greatest benefit to species that require large, contiguous, relatively undisturbed blocks of mature forest. The greatest benefit to species that require actively managed habitats, such as grasslands, shrublands, or young forests (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland). However, compared to other alternatives, the greatest potential for adverse, short-term impacts from: • Disturbance from actively managing the greatest amount of habitat (approximately 12,873 acres). • Constructing new trails (up to 22, 1-mile long ADA-accessible trails). • The greatest projected increase in refuge visitation.	*Within the next 15 years*: Similar to other alternatives, except that snowmobiling would be eliminated and no active habitat management, except in rare circumstances (e.g., major disturbance such as fire, hurricane, or ice storm, to restore degraded habitats, for threatened and endangered species). Beyond next 15 years: Over the long term, alternative D will protect the greatest amount of habitat (up to 231,307 acres). The greatest benefit to species that require large, contiguous, relatively undisturbed blocks of mature forest. The greatest adverse impact to species that require actively managed habitats, such as grasslands, shrublands, or young forests. Fewest impacts from public use because we would eliminate snowmobiling and create less developed trails and public use facilities.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
Impacts to Archaeological, Historical, and Cultural Resources			
Archaeological, historical, and cultural resource impacts that do not vary between the alternatives: We expect negligible to minor benefits to cultural resources under all alternatives because we would continue to consult with Service archaeologists and state and Tribal historic preservation officers prior to ground-disturbing activities to limit disturbance to refuge's archaeological, historical, and cultural resources. Also, we would protect any known sites or resources on the refuge and incorporate information on these resources into refuge interpretive and educational programs. There is a small risk that our management activities would disturb unknown sites, as well as the risk that some visitors may inadvertently or intentionally damage known of undiscovered sites.			
Same as impacts that do not vary by alternative		Compared to alternative A, alternatives B and C would have a greater potential to benefit archaeological, historical, and cultural resources because they propose to increase protection efforts for these resources through better planning and more extensive survey work.	Similar to alternatives B and C, except alternative D has the least potential to disturb archaeological, historical, and cultural resources because it proposes the least amount of ground-disturbing activities.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO PUBLIC USE AND ACCESS			
Public use and access impacts that do not vary between the alte**rnatives**: Under all alternatives, we would continue to provide opportunities for six compatible, priority, wildlife-dependent public uses (wildlife observation and photography, environmental education, interpretation, fishing, and hunting). Under all alternatives, there is a small possibility of conflicts between users groups (e.g., between hunters and other users, pet walkers and bird watchers). Also, some sensitive areas of the refuge are closed to public use, but this mitigated by other public use opportunities on other parts of the refuge or other ownerships nearby.			
Negligible beneficial impacts from permanently protected public access on refuge lands. Continue to offer current level of public use and access on existing refuge divisions and units, including the six priority public uses. We would also allow these uses on newly acquired lands, if found compatible. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division. Based on current low levels of visitation, we anticipate negligible short-term, adverse impacts from conflicts between user groups.	Negligible beneficial impacts from permanently protected public access on refuge lands. Continue to offer current levels of public use and access, including the six priority uses. We would also allow these uses on newly acquired lands, if found compatible. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division. Compared to alternative A, we expect slightly greater benefits to visitors, especially those with limited mobility, from the construction of up to 19 miles of ADA-accessible trails. Compared to alternative A, slightly greater potential for conflicts between user groups as visitation increases (we anticipate a 22 percent increase in on refuge visits over current levels).	Similar to alternative B; however, expect greater beneficial impacts from permanently securing public access on additional acres. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division Compared to alternative B, we would construct up to 22 miles of ADA-accessible trails. Compared to alternatives A and B, slightly greater potential for conflicts between user groups as visitation increases (we anticipate a 54 percent increase in on refuge visits over current levels).	Continue to offer opportunities for the six priority public uses, focusing on providing a more backcountry experience (e.g., narrower, native surface trails; less motorized uses; less developed facilities; etc.). Adverse impacts to snowmobilers from closing all refuge snowmobile trails; however, we expect these impacts to be minor as extensive snowmobile trails are available on other ownerships nearby. Compared to alternative A, slightly greater potential for conflicts between user groups as visitation increases (we anticipate a 24 percent increase in on refuge visits over current levels). Reduced potential for some conflicts as snowmobiling is eliminated.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO REGIONAL AND LOCAL SOCIOECONOMICS			
Socioeconomic impacts that do not vary between the alternatives: Under all alternatives, we would continue to pay refuge revenue sharing payments to municipalities where refuge lands are located. Regardless of the alternative selected, refuge jobs, refuge expenditures, and visitor spending would negligibly contribute to the local economy.			
Refuge purchase of goods and services and Refuge personnel salary spending			
As additional refuge lands are acquired, non-salary expenditures will shift from occurring most frequently in the north to greater spending in the south of the watershed. We would continue to maintain our current level of staffing and, therefore, we would expect personnel salary spending to continue at similar levels.	Similar to alternative A	Compared to alternatives A and B, we predict an increase in spending of about $175,000, particularly in the Tri-State Border and White River Junction subregions. Over the long term, we would add up to 16 new staff positions (dependent upon funding), particularly in the Northern and Tri-State Border subregions.	Similar to alternative C
Refuge visitor spending in the local economy			
In general, visitation (and therefore visitor spending) would continue at current levels at existing divisions and units. Once the ADA-accessible trail at the Fort River Division is complete, we expect annual visitation there to increase. Over the long term, as we acquire additional lands in other areas in the southern watershed, we expect visitation and visitor spending to increase in these areas.	Similar to alternative A, we expect current levels of visitation (and therefore visitor spending) to continue at existing divisions and units. As new lands are acquired and additional ADA-accessible trails are built, we expect visitation to increase (estimate about 10 percent above current visitation levels).	Similar to alternative B, except we expect a slightly greater increase in visitation (estimate about 13 percent above current visitation levels).	Large decrease in visitation in the Northern subregion from eliminating snowmobiling. However impact on local economy likely minor as many other snowmobile trails exist in area. Over the long term, as new lands are acquired we anticipate that non-snowmobile visits will increase. However, we expect a smaller increase in visitation under alternative D than under alternatives B and C because we propose less developed trails.
Economic contributions from habitat management			
We may acquire additional acres of commercial forest lands across the watershed, particularly in the Northern, White River Junction, and Tri-State Border Subregions. We would continue to manage approximately 225 acres of forest in the Northern Subregion and up to 200 acres of grassland each year across the Northern and Greater Amherst Subregions for migratory birds and other wildlife, generating negligible amounts of timber products and hay.	Short-term impacts similar to alternative A. Over the long term, as we acquire new refuge lands, we would actively manage approximately 7,660 acres of forest. We would also manage approximately 422 acres of grassland and 775 acres of shrubland on the refuge. Similar to A, as part of this management, we may generate some negligible to minor amounts of timber products and hay.	Short-term impacts similar to alternative A. Over the long term, as we acquire new refuge lands, we would actively manage up to 11,500 acres. We would also manage approximately 548 acres of grassland and 775 acres of shrubland on the refuge. Similar to A and B, As part of this management, we may generate some negligible to minor amounts of timber products and hay.	Alternative D would generate the smallest economic contribution from habitat management. Under alternative D, we would passively manage all refuge habitats, except in rare circumstances (e.g., major disturbance such as fire, hurricane, or ice storm, to restore degraded habitats, for threatened and endangered species).

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO REGIONAL AIR QUALITY			
Air quality impacts that do not vary between the alternatives: None of the alternatives would significantly benefit or adversely affect local or regional air quality. None of the alternatives would violate EPA standards for air pollutants and all would comply with the Clean Air Act. There are no major stationary or mobile sources of air pollution present on Service-owned lands nor would any be created under any of the alternatives. No Class I air quality areas would be affected. All of the alternatives would have short- and long-term negligible adverse impacts (e.g., emissions from vehicles, equipment, and buildings) and negligible to minor long-term beneficial impacts (e.g., preventing further development, sequestrating carbon, and filtering air from permanently protecting native habitats) on regional air quality. To reduce the amount of refuge emissions, we would replace or upgrade, as necessary, refuge equipment, vehicles, and facilities with more efficient models and look for alternative energy sources.			
Within the next 15 years: Negligible, short-term adverse impacts from: • Maintaining existing refuge administrative and public use facilities (e.g., trails, roads, buildings). • Emissions from refuge facilities (e.g., heating/cooling buildings) and from refuge staff and visitor vehicles, including snowmobiles. • Emissions from equipment for continuing existing habitat management projects (up to 445 acres). *Beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality from protecting up to 97,830 acres of habitat from further development (e.g., continued carbon sequestration, decreased likelihood of emissions from development).	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Beyond the next 15 years:* Similar to alternative A, negligible long-term beneficial impacts to regional air quality from protecting up to 97,772 acres of habitat. However, slightly greater potential for adverse, short-term impacts from: • Emissions from managing greater amounts of habitat (approximately 9,312 acres). • Emissions and fugitive dust from constructing new trails (up to 19 1-mile long ADA-accessible trails). • An increase in refuge visitation, and related increase in vehicle emissions.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality. Compared to other alternatives, second greatest potential to benefit regional air quality from protecting up to 197,337 acres of habitat. However, compared to other alternatives, the greatest potential for adverse, short-term impacts from: • Emissions from managing the greatest amounts of habitat (approximately 12,873 acres). • Emissions and fugitive dust from constructing new trails (up to 22, 1-mile long ADA-accessible trails). • The greatest projected increase in refuge visitation and related increase in vehicle emissions.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. *Beyond the next 15 years:* Negligible long-term beneficial impacts to regional air quality. Compared to other alternatives, greatest potential to benefit regional air quality from: • Protecting the greatest amount of habitat and discontinuing active management (e.g., by permanently protecting 231,307 acres from development). • Allowing the least amount of motorized use (e.g., eliminating snowmobiling). • Proposing the fewest new construction projects (e.g., new hiking trails and other public use infrastructure).

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IMPACTS TO REGIONAL HYDROLOGY AND WATER QUALITY			
Hydrology and water quality impacts that do not vary between the alternatives: None of our proposed management activities would *significantly* benefit or adversely affect local or regional hydrology and water quality. None of our proposed management activities would violate Federal or state standards for contributing pollutants to water sources; all four would comply with the Clean Water Act. Under all alternatives, we would use best management practices to prevent spills and protect hydrology and water quality during management (e.g., only using approved herbicides to remove invasive plants, leaving a forested buffer along riparian areas) and construction (e.g., using elevated boardwalks and installing appropriately sized culverts) activities. We would also encourage refuge visitors to stay on trails and in other designated areas to limit potential to disrupt hydrology or adversely affect water quality (e.g., trail erosion into streams). We also require that pet owners remove solid pet wastes to reduce the potential to affect water quality.			
Within the next 15 years: Negligible adverse short-term, localized impacts from refuge visitation (e.g., snowmobile emissions), road and trail maintenance, and invasive plant control (e.g., herbicide application). Beyond next 15 years: Negligible, long-term beneficial impacts to regional water quality and hydrology from protecting up to 97,830 acres of habitat from further development.	*Within the next 15 years*: Similar to other alternatives—negligible, short-term adverse impacts. Beyond next 15 years: Compared to other alternatives, second greatest potential for long-term benefits to regional air quality from protecting up to 197,296 acres of native habitat. We expect these impacts to be minor to modest. However, compared to other alternatives, the greatest potential for adverse, short-term impacts from: • Equipment and vehicle emissions from actively managing the greatest amount of habitat (approximately 12,873 acres). • Constructing new trails (up to 22, 1-mile long ADA-accessible trails). • The greatest projected increase in refuge visitation (i.e., increased vehicle emissions).	*Within the next 15 years*: Negligible adverse short-term, localized impacts from refuge visitation, road, and trail maintenance, new construction (e.g., trails and trail heads) and invasive plant control (e.g., herbicide application). Compared to other alternatives, least potential for adverse short-term impacts because of emphasis on a "back-country" visitor experience, eliminating snowmobiling, and least amount of active habitat management. *Beyond the next 15 years:* Minor to modest long-term beneficial impacts to regional hydrology and water quality. Compared to other alternatives, greatest potential for benefits to regional hydrology and water quality by protecting the greatest amount of habitat (up to 231,307 acres) and allowing natural hydrological processes to occur across the refuge, with limited to no active management.	*Within the next 15 years*: Negligible adverse short-term, localized impacts from refuge visitation, road, and trail maintenance, new construction (e.g., trails and trail heads) and invasive plant control (e.g., herbicide application). Compared to other alternatives, least potential for adverse short-term impacts because of emphasis on a "back-country" visitor experience, eliminating snowmobiling, and least amount of active habitat management. *Beyond the next 15 years:* Minor to modest long-term beneficial impacts to regional hydrology and water quality. Compared to other alternatives, greatest potential for benefits to regional hydrology and water quality by protecting the greatest amount of habitat (up to 231,307 acres) and allowing natural hydrological processes to occur across the refuge, with limited to no active management.

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IMPACTS TO CLIMATE CHANGE			
Climate change impacts that do not vary between the alternatives: Under all alternatives, refuge operations and emissions from refuge and visitor vehicles would continue to contribute negligibly to climate change. However, under all alternatives we would continue to seek ways to limit the refuge's carbon emissions by adopting energy efficient practices.			
Negligible adverse impacts from: • Emissions from staff and visitor vehicles (including snowmobiles). • Refuge equipment and machinery used to maintain existing administrative and public use facilities and to actively manage habitats (up to 455 acres). Negligible to minor long-term benefits from permanently protecting up to 97,830 acres of habitat (e.g., carbon sequestration).	Negligible adverse impacts from emissions from staff and visitor vehicles (including snowmobiles). Compared to alternative A, we expect slightly higher visitation from completing up to 19, 1-mile ADA-accessible trails. Compared to alternative A, slightly greater potential for adverse impacts from actively managing greater amounts of habitat (approximately 9,312 acres). Negligible to minor long-term benefits from permanently protecting up to 97,772 acres of habitat.	Negligible adverse impacts from emissions from staff and visitor vehicles (including snowmobiles). Compared to alternatives A and B, we expect higher visitation from completing up to 22 1-mile ADA-accessible trails. Compared to alternatives A and B, slightly greater potential for adverse impacts from actively managing greater amounts of habitat (approximately 12,873 acres). Compared to other alternatives, second greatest potential for benefits from permanently protecting up to 197,337 acres of habitat.	Negligible adverse impacts from emissions from staff and visitor vehicles. Compared to other alternatives, the least potential for adverse impacts because we would eliminate snowmobiling. Compared to other alternatives, least potential for adverse impacts from active habitat management because we would passively manage all refuge habitats, except in rare circumstances (e.g., major disturbance such as fire, hurricane, or ice storm, to restore degraded habitats, for threatened and endangered species). Compared to other alternatives, greatest potential for benefits from permanently protecting up to 231,307 acres of habitat.
IMPACTS TO SOILS			
Soil impacts that do not vary between the alternatives: None of our proposed management activities would significantly benefit or adversely affect local or regional soils. Under all alternatives, we would use best management practices to conserve soils during management (e.g., forest management to improve habitat), maintenance, and construction (e.g., new trail construction) activities. We would also encourage refuge visitors to stay on trails and in other designated areas to limit potential for soil erosion and compaction.			
Within the next 15 years: Negligible adverse short-term, localized impacts from: • Visitor use impacts (e.g., soil compaction and erosion alongside trails). • Road and trail maintenance. • Invasive plant control (e.g., herbicide application). • Continuing to manage up to 455 acres of habitat. Beyond next 15 years: Negligible minor long-term beneficial impacts to soils from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Similar to alternative A, minor beneficial impacts to soils from permanently protecting up to 97,772 acres of habitat. We expect slightly greater benefits from protecting larger blocks of habitat under alternative B. However, we also expect a slightly greater potential for adverse impacts to soils from managing additional acres of habitat (approximately 9,312 acres). Also, from constructing up to 19 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Compared to other alternatives, the second greatest potential to benefit soils from permanently protecting up to 197,337 acres of habitat. However, compared to other alternatives, the greatest potential for adverse impacts to soils from actively managing additional acres of habitat (approximately 12,873 acres) and from constructing up to 22 1-mile-long, ADA-accessible trails. We also expect the highest visitation under alternative C.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to soils because of very little to no active habitat management. Beyond next 15 years: Alternative D would have the greatest potential to benefit soils from protecting the greatest amount of habitat and allowing soil processes to occur, with no to limited active management. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO FRESHWATER WETLANDS			
Freshwater wetland impacts that do not vary between the alternatives: None of alternatives would have a *significant* adverse effect on any freshwater wetland habitats on the refuge. Under all alternatives, we predict negligible to minor long-term benefits from protecting and/or restoring wetland habitats on the refuge. We would also use best management practices to minimize adverse impacts to wetlands from new construction (e.g., building outside of wetland areas), trail and road maintenance, invasive species control (e.g. only using approved herbicides and/or using other non-chemical controls), and habitat management (e.g., buffering wetlands). The majority of habitat management will occur in upland areas, away from freshwater wetlands. We would also encourage visits to stay on trails to minimize the potential for impacts to wetland vegetation and wildlife.			
Within the next 15 years: Negligible adverse short-term, localized impacts from: • Visitor use (e.g., sedimentation from small amounts of off trail use). • Road and trail maintenance. • Invasive plant control (e.g., herbicide application). • Continuing to manage upland habitats following best management practices (up to 455 acres). Beyond next 15 years: Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,772 acres of habitat. However, we also expect a slightly greater potential for adverse impacts to soils from managing additional acres of habitat (approximately 9,312 acres). Also, from constructing up to 19 1-mile-long, ADA-accessible hiking trails. Most of the management and trail construction will occur in uplands, but we will follow best management practice to reduce impacts where activities occur near wetlands.	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Compared to other alternatives, the second greatest potential to benefit wetlands by permanently protecting up to 197,337 acres of habitat. However, we also expect the greatest potential for adverse impacts to soils from managing additional acres of habitat (approximately 12,873 acres). Also, from constructing up to 22 1-mile-long, ADA-accessible hiking trails. Most of the management and trail construction will occur in uplands, but we will follow best management practice to reduce impacts where activities occur near wetlands.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to wetlands because of very little to no active habitat management. Beyond next 15 years: Alternative D would have the greatest potential to benefit wetlands by from protecting the greatest amount of habitat with no to limited active management. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO UPLAND HABITATS AND VEGETATION			
Upland habitat and vegetation impacts that do not vary between the alternatives: None of alternatives would have a *significant* adverse effect on any upland habitats on the refuge. Under all alternatives, we predict negligible to minor long-term benefits from protecting, managing, and/or restoring upland habitats on the refuge. Under all alternatives, there is the potential for short-term adverse impacts to habitats from habitat management (e.g., herbicide application), new construction (e.g., trails, boardwalks, etc.), and refuge visitation; however, we would minimize these impacts by using best management practices and encouraging visitors to stay on trails.			
Within the next 15 years: Negligible adverse, short-term impacts from: • Visitor use (e.g., trampling of vegetation from small amount of off-trail use). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., compaction and trampling from heavy equipment, use of herbicides and prescribed burning). Beyond next 15 years: Negligible to minor long-term beneficial impacts to wetlands from permanently protecting up to 97,830 acres of habitat.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Negligible to minor long-term beneficial impacts to uplands habitats and vegetation from permanently protecting up to 97,772 acres of habitat. However, we also expect a slightly greater potential for adverse impacts to vegetation from managing additional acres of habitat (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland) and from constructing up to 19 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Compared to other alternatives, the second greatest potential to benefit upland habitats and vegetation by permanently protecting up to 197,337 acres of habitat. However, we also expect the greatest potential for adverse impacts to vegetation from managing additional acres of habitat (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland). Also, from constructing up to 22 1-mile-long, ADA-accessible hiking trails and increased visitation.	*Within the next 15 years*: Similar to other alternatives, except slightly less impacts to vegetation because of very little to no active habitat management. Beyond next 15 years: Alternative D would have the greatest potential to benefit uplands and vegetation by protecting the greatest amount of habitat with no to limited active management. Also, we would construct the least amount of new infrastructure (e.g., backcountry trails, kiosks, trailheads, boardwalks) under alternative D and eliminate snowmobiling trails.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO BIOLOGICAL INTEGRITY, DIVERSITY AND ENVIRONMENTAL HEALTH			
Biological integrity, diversity, and environmental health impacts that do not vary between the alternatives: None of the alternatives would have *significant* adverse effects on biological integrity, diversity, or environmental health (BIDEH), either regionally or on the refuge. Under all alternatives, we predict negligible to minor long-term benefits to BIDEH from protecting, managing, and restoring native habitats, conserving native wildlife, and controlling invasive plants and animals. There is the potential for short-term, adverse impacts on some native wildlife and habitats from habitat management (e.g., herbicide application, timber harvesting), trail construction and facilities maintenance; however, we would minimize these impacts by using best management practices. Under all alternatives, there is also the potential for refuge visitors to adversely impact wildlife and habitats, but we would reduce these impacts by only allowing appropriate and compatible uses, encouraging visitors to stay on trails, and closing sensitive areas to public use, if necessary.			
Within the next 15 years: Negligible adverse, short-term impacts to BIDEH from: • Visitor use (e.g., trampling of vegetation from small amount of off-trail use). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., compaction and trampling from heavy equipment, use of herbicides and prescribed burning). Beyond next 15 years: Negligible to minor long-term beneficial impacts to biological integrity from permanently protecting up to 97,830 acres of habitat. Negligible benefits to biological diversity from actively managing habitats to provide a diversity of age/size classes, successional stages, and structural diversity. Similar to other alternatives, we would actively manage habitats in the case of threats to environmental health.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Minor to modest long-term beneficial impacts to biological integrity from permanently protecting up to 97,772 acres of habitat. The second greatest potential to benefit biological diversity by actively managing habitats (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland) to provide a diversity of age/size classes, successional stages, and structural diversity. Similar to other alternatives, we would actively manage habitats in the case of threats to environmental health. However, we also expect the greatest potential for adverse impacts to biological integrity from actively managing habitats and constructing up to 19 1-mile-long ADA-accessible hiking trails (e.g., trampling/removal of native vegetation and soil compaction). However, our habitat management is designed to promote BIDEH by enhancing the diversity of refuge habitats and mimicking or restoring natural processes.	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Compared to other alternatives, the second greatest potential for beneficial impacts to biological integrity from permanently protecting up to 197,337 acres of habitat. The greatest potential to benefit biological diversity by actively managing the most acres of habitat (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland) to provide a diversity of age/size classes, successional stages, and structural diversity. Similar to other alternatives, we would actively manage habitats in the case of threats to environmental health. However, we also expect the greatest potential for adverse impacts to biological integrity from actively managing habitats and constructing up to 22 1-mile-long ADA-accessible hiking trails. However, our habitat management is designed to promote BIDEH by enhancing the diversity of refuge habitats and mimicking or restoring natural processes.	*Within the next 15 years*: Similar to other alternatives. Beyond next 15 years: Compared to the other alternatives the greatest potential for benefits to biological integrity from permanently protecting and allowing natural processes on up to 231,307 acres of habitat. Also, from discontinuing snowmobiling and creating less developed trails and public use facilities. Slightly less potential for positive benefits to biological diversity because we will not actively manage refuge habitats (e.g., less structural diversity in forests, more homogenous age/size classes, fewer grasslands and shrublands). Benefits to ecological health would be similar to alternatives A, B, and C as we would use active management in the case of significant outbreaks of forest pests and other ecological disturbances.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES			
Listed species impacts that do not vary between the alternatives: None of the activities proposed in any of the alternatives should adversely affect any federally listed or Federal candidate species and we will continue to consult on proposed actions with Service Endangered Species staff under Section 7 of the Endangered Species Act. Under all alternatives, we will continue to work with partners to help conserve federally listed and Federal candidate species in the Connecticut River watershed. In particular, we will work with the Connecticut River Coordinator's office to conserve federally listed aquatic species that occur in the Connecticut River main stem and its tributaries. Under all alternatives, we will continue to protect federally listed species that occur on existing refuge lands. At the Deadman's Swamp Unit, we will continue to manage habitat (e.g., invasive plant control) and prohibit public access to protect the federally threatened Puritan tiger beetle. At the Putney Mountain Unit, we will continue to protect populations of the federally endangered northeastern bulrush and monitor the impacts to this plant from unauthorized public uses. At the Nulhegan Basin Division, we will continue to monitor federally threatened Canada lynx use of the refuge and work with the Service's New England Field Office to determine if any active habitat management on the refuge is warranted. We expect only negligible impacts to listed species from refuge visitors and from active habitat management. Visitors are encouraged to stay on trails and we will close sensitive areas to the public (e.g., Deadman's Swamp). Habitat management in areas where listed species occur is designed to improve these areas for those species and will result in long-term benefits for listed-species. Under all alternatives, we may acquire additional lands that support or protect water quality for federally listed threatened and endangered and candidate species, including northern long-eared bat, dwarf wedgemussel, and shortnose sturgeon.			
Same as those described under impacts that do not vary among the alternatives.	*Within the next 15 years*: Same as those described under impacts that do not vary among the alternatives.	*Within the next 15 years*: Same as those described under impacts that do not vary among the alternatives.	*Within the next 15 years*: Same as those described under impacts that do not vary among the alternatives.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
Impacts to Native Wildlife and Plants ** Covers the following sections: Impacts to Birds; Impacts to Mammals; Impacts to Fish, Aquatic Fauna, Reptiles, and Amphibians; Impacts to Rare Plants and Invertebrates **			
Native wildlife and plant impacts that do not vary between the alternatives: None of the activities proposed in any of the alternatives would significantly benefit or adversely affect terrestrial wildlife species at the watershed scale. All alternatives would permanently protect habitat for a wide-range of bird species across the watershed. Under all alternatives, there is the potential for negligible, short-term impacts to wildlife and rare plants species from habitat management, public use, and facilities maintenance and construction. However, we will minimize these impacts by using best management practices (e.g., delaying grassland mowing until after breeding) and encouraging visitors to stay on trails and closing sensitive areas to public use. Any active habitat management would be designed to enhance refuge habitats, and therefore, is expected to have long-term benefits to certain species. None of the activities proposed in any of the alternatives would *significantly* benefit or adversely impact aquatic species at the watershed scale. We would continue to work with partners (e.g., Connecticut River Coordinator's Office, Eastern Brook Trout Joint Venture, etc.) to conserve, restore and enhance aquatic species and habitat in the Connecticut River main stem and its tributaries (e.g., land conservation, removing barriers to aquatic organism passage, improving water quality). Under all alternatives, there is the potential for negligible, short-term impacts to aquatic species from habitat management (e.g., mowing, forest management, and invasive plant control), public use, and facilities maintenance and construction. However, we will minimize these impacts by using best management practices (e.g., approved herbicide use for invasive plant control, not mowing within 100 feet of wetland areas, appropriate buffering of streams and vernal pools during forest management activities) and encouraging visitors to stay on trails and closing sensitive areas to public use.			
Within the next 15 years: Negligible adverse, short-term impacts from: • Visitor use (e.g., disturbance along trails, trampling of plants and small animals, road kill from vehicles, disturbance from snowmobiles, siltation into streams from trail use, impacts from hunting and fishing following state regulations). • Continuing active habitat management on up to 255 acres of forest and 200 acres of grasslands (e.g., short-term displacement or disturbance, compaction and trampling from heavy equipment, use of herbicides and prescribed burning). Beyond next 15 years: Negligible to minor long-term beneficial impacts from permanently protecting up to 97,830 acres of habitat. Negligible to minor benefits to species requiring actively management habitats. We would continue to manage approximately 255 acres of early successional forest and 200 acres of grasslands.	*Within the next 15 years*: Similar to alternative A. Beyond next 15 years: Similar to alternative A, over the long term alternative B will protect up to 97,772 acres of habitat. Compared to alternative A, alternative B will protect larger, more contiguous tracts of habitat. The second greatest benefit to species that require actively managed habitats, such as grasslands, shrublands, or young forests (approximately 7,660 acres of forest, 422 acres of grassland, and 755 acres of shrubland). Compared to alternative A, slightly greater potential for adverse, short-term impacts from: • Actively managing greater amounts of habitat (approximately 9,312 acres). • Constructing new trails (up to 19, 1-mile long ADA-accessible trails). • An increase in refuge visitation (e.g., disturbance along trails).	*Within the next 15 years*: Similar to alternatives A and B. Beyond next 15 years: Over the long term, alternative C will protect the second greatest amount of habitat (up to 197,337 acres). The second greatest benefit to species that require large, contiguous, relatively undisturbed blocks of mature forest. The greatest benefit to species that require actively managed habitats, such as grasslands, shrublands, or young forests (approximately 11,550 acres of forest, 548 acres of grassland, and 755 acres of shrubland). However, compared to other alternatives, the greatest potential for adverse, short-term impacts from: • Disturbance from actively managing the greatest amount of habitat (approximately 12,873 acres). • Constructing new trails (up to 22, 1-mile long ADA-accessible trails). • The greatest projected increase in refuge visitation.	*Within the next 15 years*: Similar to other alternatives, except that snowmobiling would be eliminated and no active habitat management, except in rare circumstances (e.g., major disturbance such as fire, hurricane, or ice storm, to restore degraded habitats, for threatened and endangered species). Beyond next 15 years: Over the long term, alternative D will protect the greatest amount of habitat (up to 231,307 acres). The greatest benefit to species that require large, contiguous, relatively undisturbed blocks of mature forest. The greatest adverse impact to species that require actively managed habitats, such as grasslands, shrublands, or young forests. Fewest impacts from public use because we would eliminate snowmobiling and create less developed trails and public use facilities.

Alternative A Current Management	Alternative B Consolidated Stewardship	Alternative C (Service-preferred) Enhanced Conservation Connections and Partnerships	Alternative D Reduced Management with Emphasis on Backcountry Recreation
IMPACTS TO ARCHAEOLOGICAL, HISTORICAL, AND CULTURAL RESOURCES			
Archaeological, historical, and cultural resource impacts that do not vary between the alternatives: We expect negligible to minor benefits to cultural resources under all alternatives because we would continue to consult with Service archaeologists and state and Tribal historic preservation officers prior to ground-disturbing activities to limit disturbance to refuge's archaeological, historical, and cultural resources. Also, we would protect any known sites or resources on the refuge and incorporate information on these resources into refuge interpretive and educational programs. There is a small risk that our management activities would disturb unknown sites, as well as the risk that some visitors may inadvertently or intentionally damage known of undiscovered sites.			
Same as impacts that do not vary by alternative	Compared to alternative A, alternatives B and C would have a greater potential to benefit archaeological, historical, and cultural resources because they propose to increase protection efforts for these resources through better planning and more extensive survey work.		Similar to alternatives B and C, except alternative D has the least potential to disturb archaeological, historical, and cultural resources because it proposes the least amount of ground-disturbing activities.
IMPACTS TO PUBLIC USE AND ACCESS			
Public use and access impacts that do not vary between the alternatives: Under all alternatives, we would continue to provide opportunities for six compatible, priority, wildlife-dependent public uses (wildlife observation and photography, environmental education, interpretation, fishing, and hunting). Under all alternatives, there is a small possibility of conflicts between users groups (e.g., between hunters and other users, pet walkers and bird watchers). Also, some sensitive areas of the refuge are closed to public use, but this mitigated by other public use opportunities on other parts of the refuge or other ownerships nearby.			
Negligible beneficial impacts from permanently protected public access on refuge lands. Continue to offer current level of public use and access on existing refuge divisions and units, including the six priority public uses. We would also allow these uses on newly acquired lands, if found compatible. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division. Based on current low levels of visitation, we anticipate negligible short-term, adverse impacts from conflicts between user groups.	Negligible beneficial impacts from permanently protected public access on refuge lands. Continue to offer current levels of public use and access, including the six priority uses. We would also allow these uses on newly acquired lands, if found compatible. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division. Compared to alternative A, we expect slightly greater benefits to visitors, especially those with limited mobility, from the construction of up to 19 miles of ADA-accessible trails. Compared to alternative A, slightly greater potential for conflicts between user groups as visitation increases (we anticipate a 10 percent increase in on refuge visits over current levels).	Similar to alternative B; however, expect greater beneficial impacts from permanently securing public access on additional acres. Continue to allow snowmobiling on designated trails at the Pondicherry, Nulhegan Basin, and Deadbranch Division Compared to alternative B, we would construct up to 22 miles of ADA-accessible trails. Compared to alternatives A and B, slightly greater potential for conflicts between user groups as visitation increases (we anticipate a 13 percent increase in on refuge visits over current levels).	Continue to offer opportunities for the six priority public uses, focusing on providing a more backcountry experience (e.g., narrower, native surface trails; less motorized uses; less developed facilities; etc.). Adverse impacts to snowmobilers from closing all refuge snowmobile trails; however, we expect these impacts to be minor as extensive snowmobile trails are available on other ownerships nearby. Compared to other alternatives, slightly less potential for conflicts between user groups as snowmobiling is eliminated.

Chapter 6

USFWS

CCP Public Scoping Meeting, Island Pond, Vermont

Coordination and Consultation

- Introduction
- Public and Partner Involvement
- Public and Partner Meetings

Introduction

Effective conservation begins with effective community involvement. To ensure that our future management of the refuge considers the issues, concerns, and opportunities expressed by the public and our partners, we used a variety of public and partner involvement techniques in our planning process. What follows is the chronology of public outreach activities we conducted while preparing the draft CCP/EIS for Silvio O. Conte National Fish and Wildlife Refuge.

Public and Partner Involvement

We began the CCP process for Silvio O. Conte National Fish and Wildlife Refuge in 2006. We published our original Notice of Intent to prepare a CCP and EIS in the *Federal Register* on October 20, 2006 (71 FR 62006). This notice also announced a public scoping period and requested public and partner input into the planning process. During scoping, we solicited comments on the major issues that the public and others felt we should address in the CCP. We also held numerous public meetings throughout the Connecticut River watershed. In fall 2014, we distributed an internal review draft to over 50 individuals from at least 5 State conservation agencies, 6 federally recognized Tribes, and 5 Federal agencies, including numerous divisions of the U.S. Fish and Wildlife Service and the White and Green Mountain National Forests.

Public and Partner Meetings

Refuge staff attended the following meetings where aspects of the CCP planning process were discussed.

2007	5/17/2007	Friends of Silvio O. Conte National Fish and Wildlife Refuge—Norwich, Vermont
	5/22/2007	Friends of Silvio O. Conte National Fish and Wildlife Refuge—Longmeadow, Massachusetts
	12/10/2007	Public Scoping Meeting—Norwich, Vermont
	12/11/2007	Public Scoping Meeting—Winchester, New Hampshire
	12/12/2007	Public Scoping Meeting—Brattleboro, Vermont
	12/17/2007	Public Scoping Meeting—Colebrook, New Hampshire
	12/18/2007	Public Scoping Meeting—Island Pond, Vermont
	12/19/2007	Public Scoping Meeting—Jefferson, New Hampshire
2008	1/8/2008	Public Scoping Meeting—Hadley, Massachusetts
	1/10/2008	Public Scoping Meeting—Chesterfield, Massachusetts
	1/14/2008	Public Scoping Meeting—Middletown, Connecticut
	1/16/2008	Public Scoping Meeting—Burlington, Connecticut
	1/17/2008	Public Scoping Meeting—Old Lyme, Connecticut
	2/20/2008	Public Scoping Meeting—Richmond, New Hampshire
	3/27/2008	Quabbin to Cardigan Partnership—Hancock, New Hampshire
	4/9/2008	Connecticut River Joint Commission—Headwaters Subcommittee
	4/22/2008	Norton VT Planning Commission—Ecotourism Discussion

	4/28/2008	Friends of Silvio O. Conte National Fish and Wildlife Refuge "Experts" Workshop— Hanover, New Hampshire
	5/8/2008	Unified Towns and Gores Board of Governors—Island Pond, Vermont *(Discussed desire for recreational opportunities, including bicycling)*
	5/16/2008	NorthWoods Stewardship Center Annual Board Meeting—Brunswick, Vermont
	6/11/2008	Vermont Trappers Association Monthly Meeting—Barre, Vermont
	8/14/2008	Meeting with Island Pond Business Leaders and the Northeast Kingdom Travel and Tourism Association—Island Pond, Vermont
	8/26/2008	Friends of Maromas—Middletown, Connecticut
	9/27/2008	Champion Land Leaseholder and Traditional Interests Coalition—Ferdinand, Vermont
	10/7/2008	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	11/4/2008	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	12/11/2008	Unified Towns and Gores Board of Governors—Ferdinand, Vermont *(Discussed desire for recreational opportunities, including requesting snowmobile access)*
2009	2/17/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	3/11/2009	Brighton Snowmobile Club/Canaan Border Riders—Brunswick, Vermont *(Discussed trail sharing and access to Nulhegan Basin Division visitor contact station)*
	4/6/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	5/4/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	5/23/2009	Northeast Kingdom (NEK) Audubon Annual Meeting—Brunswick, Vermont
	6/19/2009	NorthWoods Stewardship Center—YCC Crew Leader Trainings—East Charleston, Vermont
	6/29/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont

	7/2/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	8/10/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	9/26/2009	Champion Land Leaseholder and Traditional Interests Coalition—Ferdinand, Vermont
	10/26/2009	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	10/27/2009	Northern Forest Canoe Trail Meeting—Island Pond, Vermont *(included site visit to discuss portage/campsite on the Nulhegan Basin Division)*
	11/9/2009	Nulhegan Gateway Association—Island Pond, Vermont
2010	1/28/2010	Friends of the Silvio O. Conte National Fish and Wildlife Refuge General Meeting
	4/10/2010	Northeast Kingdom (NEK) Audubon Annual Meeting—St. Johnsbury, Vermont
	9/14/2010	Vermont Bearhound Association—Barre, Vermont *(included discussion on potential changes to bearhound training season)*
2011	1/6/2011	Brunswick, Vermont Selectboard Meeting—Brunswick, Vermont *(included discussion on public use and land acquisition)*
	6/4/2011	Vermont Coverts: Woodland for Wildlife Meeting—Derby, Vermont
	9/11/2011	Vermont Trappers Association Annual Meeting—Barton, Vermont
	11/9/2011	Salmon River Division Friends Group—Haddam Neck, Connecticut
	11/16/2011	Mt Tom Partnership—Holyoke, Massachusetts
2012	3/30/2012	Friends of the Silvio O. Conte National Fish and Wildlife Refuge General Meeting
	9/9/2012	Nulhegan Gateway Association General Monthly Meeting—Island Pond, Vermont
	10/6/2012	Champion Land Leaseholder and Traditional Interests Coalition Meeting—Ferdinand, Vermont
	10/11/2012	NorthWoods Stewardship Center–Youth Conservation Corps Crew Leader Training—East Charleston, Vermont

2013	1/28/2013	Friends of the Silvio O. Conte National Fish and Wildlife Refuge General Meeting
2014	10/ to 12/2014	Meetings with State Fish and Wildlife Agencies to collect comments on the internal review draft of the CCP/EIS
	8/31/2015	Public Meeting—Columbia, New Hampshire
	9/1/2015	Public Meeting—Island Pond, Vermont
	9/2/2015	Public Meeting—Whitefield, New Hampshire
	9/9/2015	Public Meeting—Woodstock, Vermont
	9/10/2015	Public Meeting—Bradford, Vermont
	9/14/2015	Public Meeting—Beckett, Massachusetts
	9/15/2015	Public Meeting—Hadley, Massachusetts
	9/16/2015	Public Meeting—Townshend, Vermont
	9/17/2016	Public Meeting—Keene, New Hampshire
	9/21/2015	Public Meeting—Colebrook, Connecticut
	9/22/2015	Public Meeting—Glastonbury, Connecticut
	9/23/2015	Public Meeting—Chesterfield, Massachusetts
	9/24/2015	Public Meeting—Higganum, Connecticut
	10/3/2015	Champion Lands Leaseholder and Traditional Coalition Annual Meeting—Refuge staff provided an update on the status of the draft CCP/EIS and reminded attendees how they could provide comments. There were approximately 80 attendees.
2015	10/15/2015	Public Meeting—Lancaster, New Hampshire
	10/19/2015	Connecticut River Joint Commission—Lebanon, New Hampshire. Refuge staff provided an update on the status of the draft CCP/EIS and reminded attendees how they could provide comments.
	10/22/2015	Lower Connecticut River Gateway Commission—Essex, Connecticut. Refuge Manager provided an update on the status of the draft CCP/EIS and reminded attendees how they could provide comments.
	11/2/2015	Public Hearing—St. Johnsbury, Vermont
	11/5/2015	Public Hearing—Keene, New Hampshire
	11/9/2015	Public Hearing—Hadley, Massachusetts

	11/12/2015	Public Hearing—Burlington, Connecticut
	12/2/2015	Associated Industries of Vermont Forest Policy Task Force—Refuge staff provided an update on the status of the draft CCP/EIS and reminded attendees how they could provide comments. Additionally, information was provided on the role of habitat management within the Refuge System, and more specifically, the proposed use of commercial forest practices to achieve desired habitat conditions for our Federal trust wildlife species.
2016	5/3/2016	Information Meeting—West Lebanon, New Hampshire. This meeting was sponsored by Senator Shaheen and hosted by The Nature Conservancy of New Hampshire and the New Hampshire Timberland Owners Association. The meeting was open to all. Approximately 130 people attended the Q&A discussion session.
	6/29/2016	Columbia, New Hampshire. This meeting was hosted by Senator Ayotte. The meeting was open to all. Approximately 25 people attended the Q&A discussion session.

Chapter 7

USFWS

CCP scoping meeting

List of Preparers

- **Planning Team**
- **Other Service Program Involvement**
- **Partners Involved in Refuge Planning**

Planning Team

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Partners Involved in Refuge Planning

Refuge programs received a great deal of support and input from outside the Service during our planning process. Many of these partners help us with biological surveys, enhancing public use and refuge programs, restoring habitat, law enforcement, and protecting land. Our partnerships will continue to expand under the increasing interest in conserving refuge resources. During the development of the CCP, the following organizations provided input:

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- National Wildlife Refuge Association.
- Connecticut Department of Energy and Environmental Protection, Wildlife Division.
- Massachusetts Division of Fisheries and Wildlife.
- New Hampshire Fish and Game Department.
- Vermont Fish and Wildlife Department.
- Steve Funderburk, Gap Solutions, Inc.
- U.S. Geological Survey, Policy Analysis and Science Assistance, Fort Collins Science Center.

Patrick Comins

Nulhegan River

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Bill Thompson

Song sparrow

Glossary, Acronyms, and Species Scientific Names

- Glossary
- Acronym
- Species Scientific Names

Glossary

active adaptive management — Management that involves deliberately implementing and testing a range of management option or actions in order to learn which is most effective.

adaptive capacity — The ability of a conservation feature or human community to adjust to the impacts of climate change.

adaptive management — The process of "learning by doing" by taking either a singlular approach or intervention or a range of conservation interventions, monitoring the effectiveness of these approach(es), and using that feedback to make improvements in the management intervention(s).

abiotic — nonliving; a physical feature of the environment such as climate, temperature, geology, soils

alternative — a set of objectives and strategies needed to achieve refuge goals and the desired future condition.

ambient — of the surrounding area or outside environment

anadromous fish — fish that spend a large portion of their life cycle in the ocean and return to freshwater to breed.

anuran — relating to frogs and toads, any vertebrate of the order Anura

appropriate use — a proposed or existing use on a refuge that meets at least one of the following three conditions:

1. the use is a wildlife-dependent one;
2. the use contributes to fulfilling the refuge purpose(s), the System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act was signed into law; or
3. the use has been determined appropriate as specified in section 1.11 of that act.

approved acquisition boundary — a project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands that the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the System

aquatic — growing in, living in, or dependent upon water.

aquatic barrier — any obstruction to fish passage.

archaeology — the study of human cultures

avian of or having to do with birds

basin the surrounding land that drains into a water body.

beaver deceiver a fence that discourages beaver from damming areas.

best management practice land management practices that produce desired results (usually describing forestry or agricultural practices effective in reducing non-point source pollution.

bioaccumulation an increase in concentration of a chemical in an organism at a higher level than expected.

biological diversity the variety of life forms and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

biological integrity biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including natural biological processes that shape genomes, organisms, and communities.

biological planning The process of identifying priority conservation species and measurable targets such as population objectives, assessing the current status of populations (increasing, decreasing, static), identifying threats and limiting factors, and building models to describe the relationship of populations to habitat and other limiting factors.

biophysical region a geographic region described based on a broad pattern of geology, topography, climate, and species distribution.

bird conservation region ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.

birds of conservation concern A list we developed from the most current conservation assessments from three bird conservation plans: Partners in Flight, The United States Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. We developed rules to narrow these lists by focusing on species, subspecies, or populations that have declining trends, small population sizes, and are facing severe threats at some point in their annual cycle.

bog soggy, moist, spongy, or otherwise wet areas with peat soils—the partially or incompletely decomposed remains of dead plants and some animals. A type of peatland.

buffer lands bordering water bodies that reduce runoff and nonpoint source pollution

canopy the layer of foliage formed by the crowns of trees in a stand. For stands with trees of different heights, foresters often distinguish among the upper, middle and lower canopy layers. These represent foliage on tall, medium, and short trees. The uppermost layers are called the overstory.

catadromous refers to fish that migrate from freshwater to saltwater to spawn and reproduce.

categorical exclusion a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment.

clear-cutting method of timber harvesting in which all trees in a forested area are removed in a single cutting.

coarse filter Conservation features intended to compensate for our incomplete knowledge of all biodiversity by reflecting diversity at a higher level of ecological organization that can more readily observe, such as ecosystem types.

community (ecological) Relatively distinct assemblages of species that co-occur in space.

community a distinct assemblage of plants that develops on sites characterized by particular climates and soils, and the species and populations of wild animals that depend on the plants for food, cover and/or nesting.

compatible use a wildlife-dependent recreational use, or any other use on a refuge that will not materially interfere with or detract from the fulfillment of the mission of the Service or the purposes of the refuge.

compatibility determinations a required determination for wildlife-dependent recreational uses or any public uses of a refuge.

Comprehensive Conservation Plan a document that describes the desired future conditions of the refuge, and specifies management direction to achieve refuge goals and the mission of the National Wildlife Refuge System.

conceptual model A descriptive model of a system based on qualitative assumptions about its elements, their interrelationships, and system boundaries.

conservation design the application of scientific information, expert opinion, and spatial data that helps us to establish estimates of where and how to achieve our mission through landscape sustainability. It is the integration of multiple objectives and the determination of how to efficiently apportion objectives across the landscape and among Refuge System units.

conservation easement a legal agreement between a landowner and a land trust or governmental agency that permanently limits some uses of a property to protect its conservation values.

constraint A condition that restricts potential options in a conservation plan (e.g., total budget or actions that have already been committed to).

cool-season grass introduced grass for crop and pastureland that grows in spring and fall and is dormant during hot summer months.

Cooperative Agreement a usually long-term habitat protection action, which can be modified by either party, in which no property rights are acquired. Lands under a cooperative agreement do no necessarily become part of the National Wildlife Refuge System

cost The money, staff time, capital equipment, and other resources necessary to plan for and more broadly implement a strategy, action, or conservation plan.

cover-type the current vegetation of an area.

critical habitat according to U.S. Federal Law, the ecosystems upon which endangered and threatened species depend.

cultural resource those parts of the physical environment—natural and built—that have cultural values to some sociocultural group or institution. Cultural resources include historic sites, archaeological sites and associated artifacts, sacred sites, buildings, and structures.

culvert a tunnel carrying a stream or an open drain under a road, trail, or railroad

defoliate; defoliator remove a plant's leaves, something that removes a plants leaves

designated landscape Landscapes, seascapes, and watersheds whose configuration and function have been heavily influenced by people, generally for their benefit.

diameter at breast height (dbh)—the diameter of the stem of tree measure at breast height (usually 4.5 feet above the ground). The term is commonly used by foresters to describe tree size.

disturbance a disruption in the natural plant succession of a community or ecosystem resulting in a new community.

early successional habitat Succession is the gradual replacement of one plant community by another. In a forested ecosystem, tree cover can be temporarily displaced by natural or human disturbance (e.g., flooding by beaver, or logging). The open environments created by removal of tree cover are referred to as 'early-successional' habitats because as time passes, trees will return. The open conditions occur 'early' in the sequence of plant communities that follow disturbance. We define *early successional forest* in this CCP as*:* the shrub-sapling stage; 0-15 years old.

ecological integrity The condition or health of an ecosystem or habitat; in particular, how intact it is.

ecological succession the orderly progression of an area through time in the absence of disturbance from one vegetative community to another.

ecoregion a territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

ecosystem a dynamic and interrelated complex of plant and animal communities and their associated non-living environment.

ecosystem approach a strategy or plan to protect and restore the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.

ecosystem process a natural phenomenon in an ecosystem

ecosystem services the goods and services that natural ecosystems deliver to people.

effluent outflow of water from a structure, such as wastewater discharge from a sewage treatment plant or industrial facility.

emergent marsh wetlands dominated by erect, rooted, herbaceous plants.

endangered species any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the *Federal Register*.

Environmental Assessment a systematic analysis to determine if proposed actions would result in a significant effect on the quality of the environment.

environmental health the composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.

eutrophication the process by which a body of water acquires a high concentration of nutrients, particularly phosphates and nitrates, often leading to excessive algae growth. As the algae die and decompose, the amount of available oxygen decreases, causing the death of some aquatic organisms.

even-aged management a forest management technique in which all the trees in an area are harvested at once or in several cuttings over a short time period to create stands of trees all approximately the same age.

exotic species a species that is not native to an area and has been introduced intentionally or unintentionally by humans.

expert judgment The opinion of an expert about a matter of fact.

extinction the termination of existence of a lineage of organisms (e.g., a subspecies or species.

extirpation the localized extinction of a species that is no longer found in a locality or country, but still exists elsewhere in the world.

Federal-listed species a species listed either as endangered, threatened, or species at risk (formerly a "candidate" species) under the Endangered Species Act of 1973, as amended.

fee-title acquisition the acquisition of most or all of the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title.

fine filter Important aspects of biodiversity unlikely to be well represented with coarse filters, such as individual species.

flowage refers to an area along a stream or river periodically flooded by beaver.

flowage easement the right to control the flow of water from a source such as by impoundment, including the right to overflow, flood, and submerge lands affected.

fragmentation the process of reducing the size and connectivity of habitat patches. The disruption of extensive habitats into isolated and small patches.

fundamental objectives Those goals that we ultimately want our actions to achieve; they are statements about the things we value.

furbearer any mammal that traditionally has been hunted and trapped primarily for fur.

geographic information system a computer system capable of storing and manipulating spatial mapping data.

glacial fluvial-drift material transported, sorted, and deposited by flowing glacial meltwater.

glacial moraine a glacially formed accumulation of unconsolidated glacial debris (soil and rock)

glacial outwash glacial drift deposited by water flowing from a melting glacier.

glacial till a mixture of sand, silt, clay, and rock ground up by a glacier and dropped as it retreats.

glide an area of smooth, fast-moving water in a stream that often separates pools (deep, slow-moving water) from riffles (shallow, fast-moving water).

goals descriptive statements of desired future conditions.

habitat an ecosystem, often linked to particular species.

heathlands dwarf-shrub habitat, dominated by plants of the Ericaceae family, such as blueberry, cranberry, and azalea.

hectare equal to 2.47 acres

historic conditions the composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape.

hotspot locations that harbor unusually high concentrations of species.

hydro-axe a machinery attachment that mulches vegetation, including shrubs and trees up to 6 inches in diameter

impoundment a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, that is used to collect and hold water.

indicator In conservation, something that Is reported on as evidence of how well the plan objectives are being achieved.

interjurisdictional fish populations of fish that are managed by two or more State or national or tribal governments because of the scope of their geographic distributions or migrations.

interspersion refers to how different habitats occur (or are dispersed) across the landscape.

invasive species a nonnative species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

issue any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or in the presence of an undesirable resource condition.

juxtaposition the proximity (or arrangement) of distinctly different habitats to each other.

Landscape Conservation Cooperative (LCC) public-private partnerships that define shared conservation goals and provide the expertise needed to support conservation planning at landscape scales. LCCs generate the tools, methods, and data that managers need to design and deliver conservation using the Strategic Habitat Conservation approach.

landscape conservation design A partner-driven approach to achieve a sustainable, resilient socio-ecological landscape. It is an iterative, collaborative, and holistic process resulting in strategic and spatial products that provide information, analytical tools, maps, and strategies to achieve landscape goals collectively held among partners.

land trust Usually nonprofit organizations whose missions are to conserve land through acquisition, conservation easement legislation, and/or ecological management activities.

large saw timber a tree approximately 15 inches or greater diameter at breast height

late-succession forest mature and old growth stages; greater than 70 years old

likelihood of success The estimate that a project will deliver the desired outcomes. This analysis includes assessing the likelihood that the project will be implemented effectively, and, if implemented, will be successful. The estimate might be on a linguistic scale or as a probability.

limiting factor an environmental limitation that prevents further population growth

liquefied natural gas natural gas converted into a liquid form by cooling to a very low temperature

mast fruits and nuts that provide food for wildlife. Soft mast includes most fruits with fleshy coverings. Hard mast includes nuts such as acorns, beech nuts, and hickory nuts.

microhabitats a small, specific habitat, such as under a log or a hole in a tree.

midden a pile or mound of mussel shells and other debris indicating the site of a human settlement

mid-successional forest the pole-sawlog stage; 16-70 years old

millinery trade the use of bird feathers in women's hats and other clothing.

minimum variable population (MVP)_ The size at which a population's survival could be considered reasonably certain.

National Wildlife Refuge System all lands, waters, and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife and plant resources

Neotropical migratory bird a bird species that breeds north of the United States/Mexico border migrate and winters primarily south of the U.S. border in Mexico, the West Indies, or Central or South America.

Non-consumptive wildlife recreation wildlife observation, photography, hiking, environmental education and interpretation

nonpoint source pollution a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from a number of points that are spread out and difficult to identify and control.

nuisance species plants and animals (sometimes called nonnatives or exotics) that threaten the Lake Champlain Basin's native fish, wildlife, and plants and impede recreational activities.

objectives actions to be accomplished to achieve a desired outcome or goal.
Objectives are more specific, and generally more measurable, than goals.

option An alternative strategy or action under consideration in a plan.

overstory the upper canopy layer in a forest

paleontology the study of prehistoric life

parr the salmon life stage between fry and smolt; a young salmon distinguished by dark rounded patches evenly spaced along its side.

passive adaptive management Management in whichh only one management option or action is selected based on existing information, but results of that choice are monitored, and future management decisions are made based on this additional knowledge.

peatland a type of wetland with organic or peat soils--the partially or incompletely decomposed remains of dead plants and some animals.

physiographic area a bird conservation planning unit with relatively uniform vegetative communities, bird populations, and species assemblages, as well as land use and conservation issues, developed by Partners in Flight.

planning context The circumstances in which a conservation plan is developed. this usually involves considering the purpose of a plan, decisions to be made, decision makers, constraints on a planning process, level of investment in the plan, and audience for the plan.

point source pollution a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant.

pole timber a tree approximately 5 to 10 inches diameter at breast height

pool an area of relatively deep, slow-moving water is a stream or river; a body of water formed above a dam.

population objectives describe the desired outcomes. We express objectives as abundance, trend, change of distribution, vital rates, or by using other measurable indices of population status based on the best biological information. We use these objectives, which are dependent on the scale of the population measured, to assess how well we are performing our management actions.

preferred alternative the Service's selected alternative identified in the Draft Comprehensive Conservation Plan.

prehistoric refers to the period before written history

prescribed fire the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives.

priority conservation species those species requiring focused resource commitments due to legal status, management need, vulnerability, and geographic areas of importance.

priority public use a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.

project proposal a document recommending the creation of a new refuge or the expansion of the boundary of an existing refuge as identified within a conservation design.

quantitative An amount that can be measured and expressed numerically.

range the geographic area within which a particular species is found.

redd a nest of fish eggs covered by gravel.

relative abundance an estimate of actual or absolute abundance, usually stated as an index.

release (in forestry) freeing seedlings and saplings from competition with other trees, shrubs, and herbs. Techniques include removing mature trees in the canopy that are shading seedlings and saplings or thinning stands.

research natural area part of a national network of reserved areas intended to represent the full array of North American ecosystems; natural processes are allowed to predominate without human intervention.

resilience the capacity of a system to resist or recover quickly from a perturbation.

restoration management of a disturbed or degraded habitat that results in the recovery of its original state (e.g., restoration may involve planting native species, removing invasive shrubs, prescribed burning).

riffle a series of shallow rapids in a stream or river where the water flows quickly over completely or partially submerged rocks and other debris.

riparian relating the floodplains, banks, and terraces that line rivers.

riparian area habitat along the banks of a stream, river, or wetland.

risk An uncertainty that might negatively affect the ability to achieve a project's objectives.

riverine within the active channel of a river or stream.

sapling a young tree, approximately 1 to 5 inches diameter at breast height

scoping a process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are federal, state and local agencies; private organizations; and individuals.

secondary public use uses other than the six priority public uses-hunting, fishing, wildlife observation, photography, interpretation, and environmental education.

second-growth forest forest that has re-grown after a major disturbance such as a fire, timber harvest, windstorm, or insect infestation.

selective cutting the periodic removal of individual trees or groups of trees to improve or regenerate a stand.

shifting mosaic an interconnected patchwork of distinct vegetation types that may shift across the land surface as a result of dynamic ecosystem processes, such as periodic wildfire or flooding.

silviculture the science and practice of managing forests.

skid trail an unsurfaced, single lane trail used for removing harvested trees from the forest. It is usually narrower and steeper than ordinary truck roads.

slash tree tops, branches, bark, and other residue left on the ground after logging.

small saw timber a tree approximately 10 to 15 inches diameter at breast height

snag standing, dead trees. Snags provide important habitat characteristics for many wildlife species. For example, many birds and small mammals will create or use existing cavities in snags for nests and burrows.

spawn the act of reproduction of fishes--the mixing of the sperm from the male fish and the eggs of a female fish.

special use permit a permit authorized by the refuge manager for an activity that is not usually available to the general public.

species a distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. In taxonomy, a category of biological classification that refers to one or more populations of similar organisms that can reproduce with each other but is reproductively isolated from—that is, incapable of interbreeding with—all other kinds of organisms.

species richness a simple measure of species diversity calculated as the total number of species in a habitat or community.

staff gauge an instrument used to measure water levels

stakeholder An individual, group, or organization that is interested in some aspect of a conservation plan or project and may be affected by, or will potentially affect, project activities.

stand an easily defined area of the forest that is relatively uniform in species composition or age and can be managed as a single unit.

stand-replacing fire a fire that kills all or most living overstory trees in a forest and initiates regrowth. This type of fire can be a ground fire, surface fire, or crown fire, but is usually a combination of two or more types.

stocking refers to releasing hatchery raised fish into streams and lakes

stopover habitat habitat where birds rest and feed during migration. Also called staging area.

Strategic Habitat Conservation (SHC) the adaptive management framework for making management decisions about where and how to deliver conservation efficiently to achieve specific biological outcomes. It requires us to set goals, make strategic decisions about our actions, and constantly reassess and improve our approaches-all critical steps in dealing with a range of landscape-scale resource issues.

strategies a general approach or specific actions to achieve objectives.

structure the horizontal and vertical arrangement of trees and other vegetation having different sizes, resulting in different degrees of canopy layering, tree heights, and diameters within a stand.

succession the natural, sequential change of species composition of a community in a given area

surrogate A conservation feature used to represent another feature(s) and generally easier to observe, map, or measure than those features it is representing.

surrogate species Used to define measurable targets and guide conservation design. Represent multiple species and habitats within a defined landscape, geographic area, or specific national wildlife refuge.

swale a low place, especially a marshy depression.

target quantitative statements of the outcomes planners want to achieve for each objective.

taxon, *pl.* taxa in biology, a classification or group, such as a phylum, family, genus, or species

terrestrial living on land.

territory an area occupied by a single animal, mated pair, or group that is defended against intruders, especially others of the same species.

threatened species those plant or animal species likely to become endangered species throughout all of or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the *Federal Register*.

trade-off A situation where achievement of one objectives comes at the expense of achieving another objective.

trust resources national resources entrusted by Congress to the U.S. Fish and Wildlife Service for conservation and protection. These "trust resources" include migratory birds, federal-listed endangered and threatened species, inter-jurisdictional fishes, wetlands, and certain marine mammals.

turbidity a measure of water clarity that measures the amount of material suspended in water, such as clay, silt, sand, algae, plankton, microbes, etc. The more turbid water is, the cloudy or hazier it is. High turbidity is a water quality concern because suspended particles absorb more heat, leading to higher water temperatures, and subsequent reduced dissolved water concentrations that reduce photosynthesis rates. Also, suspended particles can clog fish gills and smoother fish eggs and organisms that live along the bottom of streams.

uncertainty A situation characterized by imperfect and/or unknown information.

understory the lower layer of vegetation in a stand, which may include short trees, shrubs, and herbaceous plants

uneven-aged management a forest management technique that removes some trees in each age or size class, either singly, in groups, or in strips, to maintain a multi-aged stand.

vernal pool depressions holding water for a temporary period in spring and other high water periods, and in which several species of amphibians lay eggs.

vision statement A brief and inspirational statement about what the future of a conservation project, initiative, program, or area might look like.

warm-season grass native prairie grass that grows the most during the summer, when cool-season grasses are dormant.

warm-water fishery a water system that supports fish that are able to tolerate water temperatures above 80 degrees Fahrenheit. Examples of warm-water species are sunfish, yellow perch, catfish, and small and largemouth bass.

water rights the right of a user to use water from a source such as a river, stream, pond, or groundwater source.

watershed the geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the land drains.

Wilderness Area An area designated by Congress as part of the National Wilderness Preservation System

wilderness study area Lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation that they be included in the Wilderness System.

wildlands reserve large landscape reserves subject to minimal human impact (largerly free from active management) and shaped by natural processes, the ambient environment, and legacies of prior history. They strive to accomplish four objectives: 1) slow the pace of climate change by supporting complex, aging forests that can store twice as much carbon as young forests; 2) provide rare habitats for a diverse array of plants, animals, and micro-organisms; 3) safeguard lands of natural, cultural, and spiritual significance; and 4) serve as unique scientific reference points for evaluation and improvement of management practices elsewhere (Foster et al. 2010).

wildlife-dependent recreation A use of a Refuge involving hunting, fishing, wildlife observation, wildlife photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the National Wildlife Refuge System.

windthrow the uprooting of and knocking over trees by wind.

woody debris any pieces of dead woody material on the ground in forests or in streams, such as trunks, branches, and roots.

Acronym

Acronym	Full Name
ACJV	Atlantic Coast Joint Venture
ADA	Americans with Disabilities Act
AGO	America's Great Outdoors Initiative
AHPA	Archaeological and Historic Preservation Act
AHWP	Annual Habitat Work Plan
AMC	Appalachian Mountain Club
AQI	Air Quality Index
ARPA	Archaeological Resources Protection Act
ASMFC	Atlantic States Marine Fisheries Commission
ATV	All-terrain vehicle
BAT	Biological Assessment Trailer
BBD	Beech bark disease
BCR	Bird Conservation Region
BIDEH	Biological Integrity, Diversity, and Environmental Health
BLM	Bureau of Land Management
BMP	Best management practices
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CCP	Comprehensive Conservation Plan
CCS	Challenge Cost-share
CD	Compatibility determination
CDIP	Career Discovery Internship Program
CE	Categorical exclusion
CEQ	Council of Environmental Quality
CFA	Conservation Focus Area
CFR	Code of Federal Regulations

Acronym	Full Name
cfs	Cubic feet per second
CISA	Community Involved in Sustaining Agriculture
CISMA	Cooperative Invasive Species Management Areas
Conte Act	Silvio O. Conte National Fish and Wildlife Refuge Act of 1991
Conte Refuge	Silvio O. Conte National Fish and Wildlife Refuge
CPA	Conservation Partnership Area
CRASC	Connecticut River Atlantic Salmon Commission
CRCO	Connecticut River Coordinator's Office
CSA	Community Supported Agriculture
CT	Connecticut
CTDEEP	Connecticut Department of Energy and Environmental Protection
dbh	diameter at breast height
DCR	Massachusetts Department of Conservation and Recreation
DDE	dichloro-diphenyl-dichloroethylene
DDT	dichloro-diphenyl-trichloroethane
DED	Dutch elm disease
DO	Dissolved oxygen
DOI	Department of the Interior
DOT	Department of Transportation
DWA	Deer wintering area
EA	Environmental Assessment
EAB	Emerald ash borer
EBTJV	Eastern Brook Trout Joint Venture
EE	Environmental Education
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FEIS	1995 Final Environmental Impact Statement for Silvio O. Conte National Fish and Wildlife Refuge

Acronym	Full Name
FERC	Federal Energy Regulatory Commission
FMP	Fire Management Plan
FOA	Finding of Appropriateness
FR	Federal Register
Friends of Conte	Friends of Silvio O. Conte National Fish and Wildlife Refuge
GCN	Greatest Conservation Need
GFDC	Great Falls Discovery Center
HMP	Habitat Management Plan
HRI	Habitat Restoration Initiative
HUC	Hydrological Unit Code
HWA	Hemlock wooly adelgid
IBA	Important Bird Area
IMP	Inventory and Monitoring Plan
IPANE	Invasive Plant Atlas of New England
IPCC	Intergovernmental Panel of Climate Change
IUCN	International Union for the Conservation of Nature
LCC	Landscape Conservation Cooperatives
LCHIP	New Hampshire's Land and Community Heritage Investment Program
LISS	Long Island Sound Study
LMRD	Land Management Research Demonstration
LPP	Land Protection Plan
LRTP	Long-range Transportation Plan
LWCF	Land and Water Conservation Fund
MA	Massachusetts
MBCF	Migratory Bird Conservation Fund
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding

Acronym	Full Name
NAAEE	North American Association of Environmental Education
NAAQS	National Ambient Air Quality Standard
NAI	National Association for Interpretation
NALCC	North Atlantic Landscape Conservation Cooperative
National Register	National Register of Historic Places
NAWMP	North American Waterfowl Management Plan
NBS	National Blueway System
NEC	New England cottontail
NECIA	Northeast Climate Impacts Assessment
NEK	Northeast Kingdom (Region of Northern Vermont)
NEPA	National Environmental Policy Act of 1969
NEPCoP	New England Plant Conservation Program
NETHC	Northeast Terrestrial Habitat Classification System
NFWPCAS	National Fish, Wildlife and Plants Climate Adaptation Strategy
NGO	Non-governmental organization
NH	New Hampshire
NHFG	New Hampshire Fish and Game Department
NHPA	National Historic Preservation Act
NIPGro	New England Invasive Plant Group
NNL	National Natural Landmark
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standards
NWPS	National Wilderness Preservation System
NWRS	National Wildlife Refuge System
OHVs	Off-highway vehicles

Acronym	Full Name
ORV	Off-road vehicles
Partners	Partners for Fish and Wildlife
PCB	polychlorinated biphenyl
ppm	parts per million
PRRC	Priority Refuge Resources of Concern
PUP	Pesticide Use Proposal
QR Code	Quick Response Code
RAPP	Refuge Annual Performance Plans
Refuge System	National Wildlife Refuge System
RGGI	Regional Greenhouse Gas Initiative
RHPO	Regional Historic Preservation Officer
RNA	Research Natural Area
ROD	Record of Decision
RONS	Refuge Operations Need System
SAMMS	Service Asset Management and Maintenance System
SCA	Student Conservation Association
Service	United States Fish and Wildlife Service
SFA	Special Focus Area
SGCN	Species of greatest conservation concern
SHC	Strategic Habitat Conservation
SHPO	State Historic Preservation Officer
SLAMM	Sea Level Affecting Marshes Model
STEM	Science, Engineering, and Math
SUV	Sport Utility Vehicle
THPO	Tribal Historic Preservation Officer
TNC	The Nature Conservancy
TPL	Trust for Public Land

Acronym	Full Name
TU	Trout Unlimited
TWS	The Wildlife Society
UCS	Union of Concerned Scientists
USACE	United States Army Corps of Engineers
USCB	United States Census Bureau
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VAST	Vermont Association of Snow Travelers
VFWD	Vermont Fish and Wildlife Department
VINS	Vermont Institute of Natural Science
VOC	Volatile organic compounds
VT	Vermont
WAP	State Wildlife Action Plan
watershed	Connecticut River watershed
WDMU	Woodcock Demonstration Management Units
WMA	Wildlife Management Area
WoW Express	Watershed-on-Wheels Express Mobile Visitor Center
WRDA	Water Resources Development Act
WSA	Wilderness Study Area
WUI	Wildland-urban interface
YCC	Youth Conservation Corps

Species Scientific Names

Common Name	Scientific Name
Alder species	*Alnus* spp.
Alewife	*Alosa pseudoharengus*
Alewife floater	*Anodonta implicata*
American beach grass	*Ammophila breviligulata*
American beaver	*Castor canadensis*
American beech	*Fagus grandifolia*
American bittern	*Botaurus lentiginosus*
American black duck	*Anas rubripes*
American chestnut	*Castanea dentata*
American clam shrimp	*Limnadia lenticularis*
American crow	*Corvus brachyrhynchos*
American eel	*Anguilla rostrata*
American elm	*Ulmus americana*
American goldfinch	*Carduelis tristis*
American hornbeam	*Carpinus caroliniana*
American kestrel	*Falco sparverius*
American marten	*Martes americana*
American oystercatcher	*Haematopus palliatus*
American pipit	*Anthus rubescens*
American redstart	*Setophaga ruticilla*
American robin	*Turdus migratorius*
American shad	*Alosa sapidissima*
American wigeon	*Anas americana*
American woodcock	*Scolopax minor*
Amur corktree	*Phellodendron amurense*
Apple species	*Malus* spp.
Arrow arum	*Peltandra virginica*
Ash species	*Fraxinus* spp.
Asian longhorn beetle	*Anoplophora glabripennis*

Common Name	Scientific Name
Asiatic clam	*Coribicula fluminea*
Atlantic salmon	*Salmo salar*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Atlantic white cedar	*Chamaecyparis thyoides*
Auricled twayblade	*Listera auriculata*
Autumn olive	*Elaeagnus umbellata*
Bald eagle	*Haliaeetus leucocephalus*
Balsam fir	*Abies balsamea*
Balsam poplar	*Populus balsamifera*
Baltimore oriole	*Icterus galbula*
Banded sunfish	*Enneacanthus obesus*
Barn owl	*Tyto alba*
Barred owl	*Strix varia*
Basswood	*Tilia americana*
Bayberry	*Myrica pensylvanica*
Bay-breasted warbler	*Dendroica castanea*
Beach heather	*Hudsonia tomentosa*
Beach plum	*Prunus maritima*
Beaked-rush	*Rhynchospora capillacea*
Bearberry	*Arctostaphylos alpina*
Bicknell's thrush	*Catharus bicknelli*
Big brown bat	*Eptesicus fuscus*
Bigtooth aspen	*Populus grandidentata*
Birch species	*Betula* spp.
Bitternut hickory	*Carya cordiformis*
Black ash	*Fraxinus nigra*
Black bear	*Ursus americanus*
Black cherry	*Prunus serotina*
Black fly	Family Simuliidae

Common Name	Scientific Name
Black grass (salt meadow rush)	*Juncus gerardii*
Black gum	*Nyssa sylvatica*
Black huckleberry	*Gaylussacia baccata*
Black locust	*Robinia pseudoacacia*
Black oak	*Quercus velutina*
Black rail	*Laterallus jamaicensis*
Black rat snake	*Pantherophis alleghaniensis*
Black spruce	*Picea mariana*
Black willow	*Salix nigra*
Black-and-white warbler	*Mniotilta varia*
Black-backed woodpecker	*Picoides arcticus*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Blackburnian warbler	*Setophaga fusca*
Black-crowned night heron	*Nyctanassa nycticorax*
Blacknose dace	*Rhinichthys atratulus*
Blackpoll warbler	*Setophaga striata*
Black-throated blue warbler	*Dendroica caerulescens*
Black-throated green warbler	*Setophaga virens*
Blueback herring	*Alosa aestivalis*
Blueberry species	*Vaccinium* spp.
Bluefish	*Pomatomus saltatrix*
Bluegill	*Lepomis macrochirus*
Bluejoint	*Calamagrostis canadensis*
Blue-spotted salamander	*Ambystoma laterale*
Blue-winged teal	*Anas discors*
Blue-winged warbler	*Vermivora pinus*
Bobcat	*Lynx rufus*
Bobolink	*Dolichonyx oryzivorus*
Bog sedge	*Carex paupercula*

Common Name	Scientific Name
Boreal chickadee	*Poecile hudsonicus*
Boreal owl	*Aegolius funereus*
Boreal turret snail	*Valvata sincera*
Broad-winged hawk	*Buteo platypterus*
Brook floater	*Alasmindonta varicosa*
Brown bullhead (Horned pout)	*Ameiurus nebulosus*
Brown thrasher	*Toxostoma rufum*
Brown trout	*Salmo trutta*
Bufflehead	*Bucephala albeola*
Burdot (cusk)	*Lota lota*
Burning bush, winged euonymus	*Euonymus alata*
Buttonbush	*Cephalanthus occidentalis*
Caddisflies	Order: Trichoptera
Calmmyweed	*Polanisia dodecandra*
Canada geese	*Branta canadensis*
Canada lynx	*Lynx canadensis*
Canada thistle	*Cirsium arvense*
Canada warbler	*Wilsonia canadensis*
Canvasback	*Aythya valisineria*
Cape May warbler	*Setophaga tigrina*
Cedar waxwing	*Bombycilla cedrorum*
Cerulean warbler	*Setophaga cerulea*
Chain pickerel	*Esox niger*
Channel catfish	*Ictalurus punctatus*
Cherry species	*Prunus* spp.
Chestnut oak	*Quercus prinus*
Chestnut-colored sedge	*Carex lasiocarpa*
Chestnut-sided warbler	*Setophaga pensylvanica*
Chimney swift	*Chaetura pelagica*

Common Name	Scientific Name
Clapper rail	*Rallus longirostris*
Cocklebur	*Xanthium* spp.
Coltsfoot	*Tussilago farfara*
Common buckthorn	*Rhamnus cathartica*
Common carp	*Cyprinus carpio*
Common gallinue (Common moorhen)	*Gallinula galeata*
Common goldeneye	*Bucephala clangula*
Common loon	*Gavia immer*
Common merganser	*Mergus merganser*
Common mudpuppy	*Necturus maculosus*
Common reed *(Phragmites)*	*Phragmites australis*
Common shiner	*Luxilus cornutus*
Common snapping turtle	*Chelydra serpentina*
Common yellowthroat	*Geothlypis trichas*
Coontail	*Ceratophyllum demersum*
Cooper's hawk	*Accipiter cooperii*
Coyote	*Canis latrans*
Crappie	*Pomoxis* spp.
Creek chub	*Semotilus atromaculatus*
Creeper	*Strophitus undulatus*
Cuckoos	Family Cuculidae
Deer mouse	*Peromyscus maniculatus*
Double-crested cormorant	*Phalacrocorax carbo*
Dowitcher	*Limnodromus* spp.
Drooping bluegrass	*Poa saltuensis*
Dwarf chinkapin oak	*Quercus prinoides*
Dwarf wedgemussel	*Alasmindonta heterondon*
Eastern American toad	*Bufo americanus*
Eastern bluebird	*Sialia sialis*

Common Name	Scientific Name
Eastern box turtle	*Terrapene carolina*
Eastern brook trout	*Salvelinus fontinalis*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern cottonwood	*Populus deltoids*
Eastern cougar	*Puma concolor*
Eastern elk	*Cervus canadensis canadensis*
Eastern elliptio	*Elliptio complanata*
Eastern floater	*Pyganodon cataracta*
Eastern hemlock	*Tsuga canadensi*
Eastern hognose snake	*Heterodon platirhinos*
Eastern kingbird	*Tyrannus tyrannus*
Eastern lampmussel	*Lampsilis radiate radiata*
Eastern meadowlark	*Sturnella magna*
Eastern milksnake	*Lampropeltis triangulum*
Eastern pearlshell	*Margaritifera margaritifera*
Eastern phoebe	*Sayornis phoebe*
Eastern pipistrelle bat	*Pipistrellus subflavus*
Eastern pond mussel	*Ligumia nasuta*
Eastern red bat	*Lasiurus borealis*
Eastern red cedar	*Juniperus virginiana*
Eastern ribbon snake	*Thamnophis sauritus*
Eastern small-footed bat	*Myotis leibii*
Eastern spadefoot toad	*Scaphiopus holbrookii*
Eastern timber rattlesnake	*Crotalus horridus*
Eastern towhee	*Pipilo erythrophthalmus*
Eastern wild turkey	*Meleagris gallopavo silvestris*
Eastern wolf	*Canis lupus lycao*
Emerald ash borer	*Agrilus planipennis*

Common Name	Scientific Name
Ermine	*Mustela erminea*
Eurasisn milfoil	*Myriophyllum spicatum*
European honeybee	*Apis mellifera*
Fallfish	*Semotilus corporalis*
False nettle	*Boehmeria cylindrica*
Fanwort	*Cabomba* spp.
Faxon's clam shrimp	*Eulimnadia agassizii*
Field sparrow	*Spizella pusilla*
Finescale dace	*Phoxinus neogaeus*
Fir species	*Abies* spp.
Fisher	*Martes pennanti*
Flowering dogwood	*Cornus florida*
Fowler's toad	*Bufo fowleri*
Freshwater cordgrass	*Spartina pectinmata*
Fringed sedge	*Carex crinita*
Gadwall	*Anas strepera*
Garber's sedge	*Carex garberi*
Garlic-mustard	*Alliaria petiolata*
Gizzard shad	*Dorosoma cepedianum*
Glasswort	*Salicornia depressa*
Glossy buckthorn	*Frangula alnus*
Golden club	*Orontium aquaticum*
Golden-winged warbler	*Vermivora chrysoptera*
Grasshopper sparrow	*Ammodramus savannarum*
Gray birch	*Betula populifolia*
Gray catbird	*Dumetella carolinensis*
Gray fox	*Urocyon cinereo-argenteus*
Gray jay	*Perisoreus canadensis*
Gray squirrel	*Sciurus carolinensis*

Common Name	Scientific Name
Gray wolf	*Canis lupus*
Great blue heron	*Ardea herodias*
Great crested flycatcher	*Myiarchus crinitus*
Great egret	*Ardea albus*
Greater yellowlegs	*Tringa melanoleuca*
Green ash	*Fraxinus pennsylvanica*
Green dragon	*Arisaema dracontium*
Green-winged teal	*Anas carolinensis*
Grey-cheeked thrush	*Catharus minimus*
Gypsy moth	*Lymantria dispar*
Heath hen	*Tympanuchus cupido cupido*
Hemlock wooly adelgid	*Adelges tsugae*
Henslow's sparrow	*Ammodramus henslowii*
Hermit thrush	*Catharus guttatus*
Hickory species	*Carya* spp.
Hoary bat	*Lasiurus cinereus*
Hogchoker	*Trinectes maculatus*
Hooded merganser	*Lophodytes cucullatus*
Hooded warbler	*Setophaga citrina*
Horned lark	*Eremophila alpestris*
Huckleberry	*Vaccinium globulare*
Indiana bat	*Myotis sodalis*
Ipswich sparrow	*Passerculus sandwichensis princeps*
Japanese barberry	*Berberis thunbergii*
Japanese knotweed	*Fallopia japonica*
Japanese stiltgrass	*Microstegium vimineum*
Jefferson salamander	*Ambystoma jeffersonianum*
Jesup's milk-vetch	*Astragalus robbinsii*
Jewelweed	*Impatiens capensis*

Common Name	Scientific Name
Joe-pye weed	*Eutrochium purpureum*
Killifish	*Fundulus diaphanus*
King rail	*Rallus elegans*
Kudzu	*Pueraria montana*
Labrador tea	*Ledum groenlandicum*
Lake chub	*Couesius plumbeus*
Lake trout	*Salvelinus namaycush*
Largemouth bass	*Micropeterus salmoides*
Leafy spurge	*Euphorbia esula*
Least bitterns	*Ixobrychus exilis*
Least flycatcher	*Empidonax minimus*
Least tern	*Sterna antillarum*
Leatherleaf	*Chamaedaphne calyculata*
Lesser yellowlegs	*Tringa flavipes*
Lincoln's sparrow	*Melospiza lincolnii*
Lingonberry	*Vaccinium vitis-idaea*
Little blue heron	*Egrretta caerulea*
Little bluestem	*Schizachyrium scoparium*
Little brown bat	*Myotis lucifugus*
Longnose dace	*Rhinichthys cataractae*
Lousiana waterthrush	*Parkesia motacilla*
Lowbush blueberry	*Vaccinium* spp.
Mallard	*Anas platyrhynchos*
Many-fruited false-loosestrife	*Ludwigia polycarpa*
Maple species	*Acer* spp.
Marbled salamander	*Ambystoma opacum*
Marsh elder	*Iva annua*
Marsh fern	*Thelypteris palustris*
Mayflies	Order Ephemeroptera

Common Name	Scientific Name
Meadow beauty	*Rhexia virginica*
Meadow jumping mouse	*Zapus hudsonius*
Meadow vole	*Microtus pennsylvanicus*
Merlin	*Falco columbarius*
Midges	Family: Chironomidae
Mile-a-minute	*Persicaria perfoliata*
Mink	*Mustela vison*
Mole salamander	*Ambystoma talpoideum*
Moose	*Alces alces*
Morrow's honeysuckle	*Lonicera morrowii*
Mountain ash	*Fraxinus texensis*
Mountain maple	*Acer spicatum*
Mourning dove	*Zenaida macroura*
Mullet	*Mugil cephalus*
Multiflora rose	*Rosa multiflora*
Mummichog	*Fundulus heteroclitus*
Musk flower	*Mimulus moschatus*
Musk turtle	*Sternotherus oderatus*
Muskrat	*Ondatra zibethicus*
Mute swans	*Cygnus olor*
Naiad	*Najas marina*
Narrow-leaved cattail	*Typha angustifolia*
Nelson's sparrow	*Ammodramus nelsoni*
New England cottontail	*Sylvilagus transitionalis*
Nodding bur marigold	*Bidens cernua*
Northeastern bulrush	*Scirpus ancistrochaetus*
Northen dusky salamander	*Desmognathus fuscus*
Northern black racer snake	*Coluber constrictor*
Northern bog lemming	*Synaptomys borealis*

Common Name	Scientific Name
Northern copperhead	*Agkistrodon contortrix mokasen*
Northern diamondback terrapin	*Malaclemys terrapin*
Northern dusky salamander	*Desmognathus fuscus*
Northern goshawk	*Accipter gentilis*
Northern harrier	*Circus cyaneus*
Northern leopard frogs	*Rana pipiens*
Northern myotis	*Myotis septentrionalis*
Northern parula	*Setophaga americana*
Northern pike	*Esox lucius*
Northern pintail	*Anas acuta*
Northern red-bellied turtle	*Pseudemys rubriventris*
Northern redbelly dace	*Phoxinus eos*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Northern saw-whet owl	*Aegolius acadicus*
Northern shrike	*Lanius excubitor*
Northern spring peeper	*Pseudacris crucifer*
Northern two-lined salamander	*Eurycea bislineata*
Northern white cedar	*Thuja occidentalis*
Norway maple	*Acer platanoides*
Nuthatch species	*Sitta* spp.
Oak species	*Quercus* spp.
Olive-sided flycatcher	*Contopus cooperi*
Orchids	*Platanthera* spp.
Oriental bittersweet	*Celastrus orbiculatus*
Ornamental jewelweed	*Impatiens glandulifera*
Osprey	*Pandion haliaetus*
Ostrich fern	*Matteuccia struthiopteris*
Ovenbird	*Seiurus aurocapilla*
Painted turtle	*Chrysemys picta*

Common Name	Scientific Name
Pale swallow-wort	*Cynanchum rossicum*
Palm warbler	*Setophaga palmarum*
Paper birch	*Betula papyrifera*
Passenger pigeon	*Ectopistes migratorius*
Perch species	*Perca* spp.
Peregrine falcon	*Falco peregrinus*
Pickerel	*Esox* spp.
Pickerelweed	*Pontederia cordata*
Pied-billed grebe	*Podilymbus podiceps*
Pignut hickory	*Carya glabra*
Pigweed	*Chenopodium album*
Pileated woodpecker	*Dryocopus pileatus*
Pin oak	*Quercus palustris*
Pine shoot beetle	*Tomicus piniperda*
Pine warbler	*Dendroica pinus*
Piping plover	*Charadrius melodus*
Pitch pine	*Pinus rigida*
Porcupine	*Erethizon dorsatum*
Prairie warbler	*Dendroica discolor*
Precious underwing moth	*Catocala pretiosa pretiosa*
Puritan tiger beetle	*Cicindela puritana*
Purple finch	*Haemorhous purpureus*
Purple loosestrife	*Lythrum salicaria*
Pygmy shrew	*Sorex hoyi*
Quagga mussel	*Dreissena rostriformis*
Quaking aspen	*Populus tremuloides*
Raccoon	*Procyon lotor*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*

Common Name	Scientific Name
Red fox	*Vulpes vulpes*
Red knot	*Calidris canutus*
Red maple	*Acer rubrum*
Red oak	*Quercus rubra*
Red pine	*Pinus resinosa*
Red spruce	*Picea rubens*
Red squirrel	*Tamiasciurus hudsonicus*
Red-backed salamander	*Plethodon cinereus*
Red-bellied woodpecker	*Melanerpes carolinus*
Red-breasted merganser	*Mergus serrator*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Reed canary grass	*Phalaris arundinacea*
Ring-necked duck	*Aythya collaris*
River bulrush	*Scirpus fluviatilis*
River herring	*Alosa* spp.
River otter	*Lontra canadensis*
Riverweed	*Podostemum ceratophyllum*
Rock snot	*Didymosphenia geminata*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Round whitefish	*Prosopium cylindraceum*
Ruddy turnstone	*Arenaria interpres*
Ruffed grouse	*Bonasa umbellus*
Rusty blackbird	*Euphagus carolinus*
Rusty-patched bumble bee	*Bombus affinis*
Saltmarsh sparrow	*Ammodramus caudacutus*
Saltmeadow cordgrass	*Spartina patens*
Saltmeadow rush	*Juncus gerardii*

Common Name	Scientific Name
Sassafras	*Sassafras albidum*
Savannah sparrow	*Passerculus sandwichensis*
Scarlet tanager	*Piranga olivacea*
Scaup species	*Aythya* spp.
Scoter species	*Melanitta* spp.
Scrub oak	*Quercus ilicifolia*
Sea lamprey	*Petromyzon marinus*
Sea rocket	*Cakile edentula*
Sea-beach needlegrass	*Aristida tuberculosa*
Seaside goldenrod	*Solidago sempervirens*
Seaside sparrow	*Ammodramus maritimus*
Sedge wren	*Cistothorus platensis*
Semipalmated sandpiper	*Calidris pusilla*
Shagbark hickory	*Carya ovata*
Sharp-shinned hawk	*Accipter striatus*
Sheep laurel	*Kalmia angustifolia*
Shining rose	*Rosa nitida*
Short-billed dowitcher	*Limnodromus griseus*
Shortnose sturgeon	*Acipenser brevirostrum*
Silky dogwood	*Cornus anomum*
Silver maple	*Acer saccharinum*
Silverweed	*Argentina anserina*
Slimy sculpin	*Cottus cognatus*
Small sundrops	*Oenothera perennis*
Small whorled pogonia	*Isotria medeoloides*
Smallmouth bass	*Micropterus dolomieu*
Smelt	Family Osmeridae
Smooth cordgrass	*Spartina alterniflora*
Snaketail dragonfly	*Ophiogomphus* spp.

Common Name	Scientific Name
Snowshoe hare	*Lepus americanus*
Snowy egret	*Egretta thula*
Solitary sandpiper	*Tringa solitaria*
Sora rail	*Porzana carolina*
Southern bog lemming	*Synaptomys cooperi*
Southern red-backed vole	*Clethrionomys gapperi*
Speckled alder	*Alnus incana*
Sphagnum moss	*Sphagnum* spp.
Spikegrass (Salt grass)	*Distichlis spicata*
Spottail shinner	*Notropis hudsonius*
Spotted knapweed	*Centaurea stoebe*
Spotted sandpiper	*Actitis macularia*
Spotted turtle	*Clemmys guttata*
Spring salamander	*Ambystoma maculatum*
Spruce grouse	*Falcipennis canadensis*
Spruce species	*Picea* spp.
Star-nosed mole	*Condylura cristata*
Sticky false asphodel	*Tofieldia glutinosa*
Stoneflies	Order: Plecoptera
Striped bass	*Morone saxatillis*
Striped skunk	*Mephitis mephitis*
Suckers	*Catostomus* spp.
Sugar maple	*Acer saccharum*
Summer flounder	*Paralichthys dentatus*
Sunfish	*Lepomis* spp.
Swamp darter	*Etheostoma fusiforme*
Sweet fern	*Comptonia peregrine*
Sweet flag	*Acorus calamus*
Sweet gale	*Myrica gale*

Common Name	Scientific Name
Sweetgum	*Liquidambar styraciflua*
Switchgrass	*Panicum virgatum*
Tamarack	*Larix laricina*
Tapegrass	*Vallisneria spiralis*
Tennessee warbler	*Oreothlypis peregrina*
Tessellated darter	*Etheostoma olmstedi*
Three-square bulrush	*Scirpus americanus*
Tidewater mucket	*Leptodea ochracea*
Tiger beetles	Family: Carabidae
Toothcup	*Ammannia coccinea*
Tree swallow	*Tachycineta bicolor*
Triangle floater	*Alasmidonta undulata*
Tricolored bat	*Perimyotis subflavus*
Turkey vulture	*Cathartes aura*
Upland sandpiper	*Bartramia longicauda*
Veery	*Catharus fuscescens*
Vesper sparrow	*Pooecetes gramineus*
Viburnum spp.	*Viburnum* spp.
Virginia opossum	*Didelphis virginiana*
Virginia pine	*Pinus virginiana*
Virginia rail	*Rallus limicola*
Virginia rose	*Rosa virginiana*
Wall lettuce	*Lactuca muralis*
Walleye (Walleyed pike)	*Sander vitreus*
Warbling vireo	*Vireo gilvus*
Water chestnut	*Trapa natans*
Water lily	*Nymphaea* spp.
Water milfoil	*Myriophyllum* spp.
Water pipit	*Anthus spinoletta*

Common Name	Scientific Name
Water shrew	*Sorex palustris*
Waterweed	*Elodea canadensis*
Whimbrel	*Numenius phaeopus*
Whip-poor-will	*Caprimulgus vociferus*
White ash	*Fraxinus americana*
White meadowseet	*Spirea alba*
White oak	*Quercus alba*
White perch	*Morone americana*
White pine	*Pinus strobus*
White sucker	*Catostomus commersonii*
White walnut (Butternut)	*Juglans cinerea*
White-eyed vireo	*Vireo griseus*
White-fringed orchid	*Platanthera blephariglottis*
White-tailed deer	*Odocoileus virginianus*
White-throated sparrow	*Zonotrichia albicollis*
Widgeon grass	*Ruppia maritima*
Wild chervil	*Anthriscus sylvestris*
Wild rice	*Zizania aquatica*
Willet	*Catoptrophorus semipalmatus*
Willow flycatcher	*Empidonax traillii*
Willow species	*Salix* spp.
Winter flounder	*Pleuronectes americanus*
Wolverine	*Gulo gulo*
Woodchuck	*Marmota monax*
Wood duck	*Aix sponsa*
Wood frog	*Rana sylvatica*
Wood nettle	*Laportea canadensis*
Wood thrush	*Hylocichla mustelina*
Wood turtle	*Clemmys insculpta*

Common Name	Scientific Name
Woodland caribou	*Rangifer tarandus caribou*
Worm-eating warbler	*Helmitheros vermivorum*
Yarrow	*Achillea millefolium*
Yellow-bellied flycatcher	*Empidonax flaviventris*
Yellow birch	*Betula alleghaniensis*
Yellow corydalis	*Corydalis lutea*
Yellow lampmussel	*Lampsilis cariosa*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Yellow-crowned night heron	*Nyctanassa violacea*
Yellow-rumped warbler	*Setophaga coronata*
Yellow-throated vireo	*Vireo flavifrons*
Zebra mussel	*Dreissena polymorpha*

Silvio O. Conte National Fish and Wildlife Refuge
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Sunderland, MA 01375
413/548 8002
http://www.fws.gov/refuge/Silvio_O_Conte/

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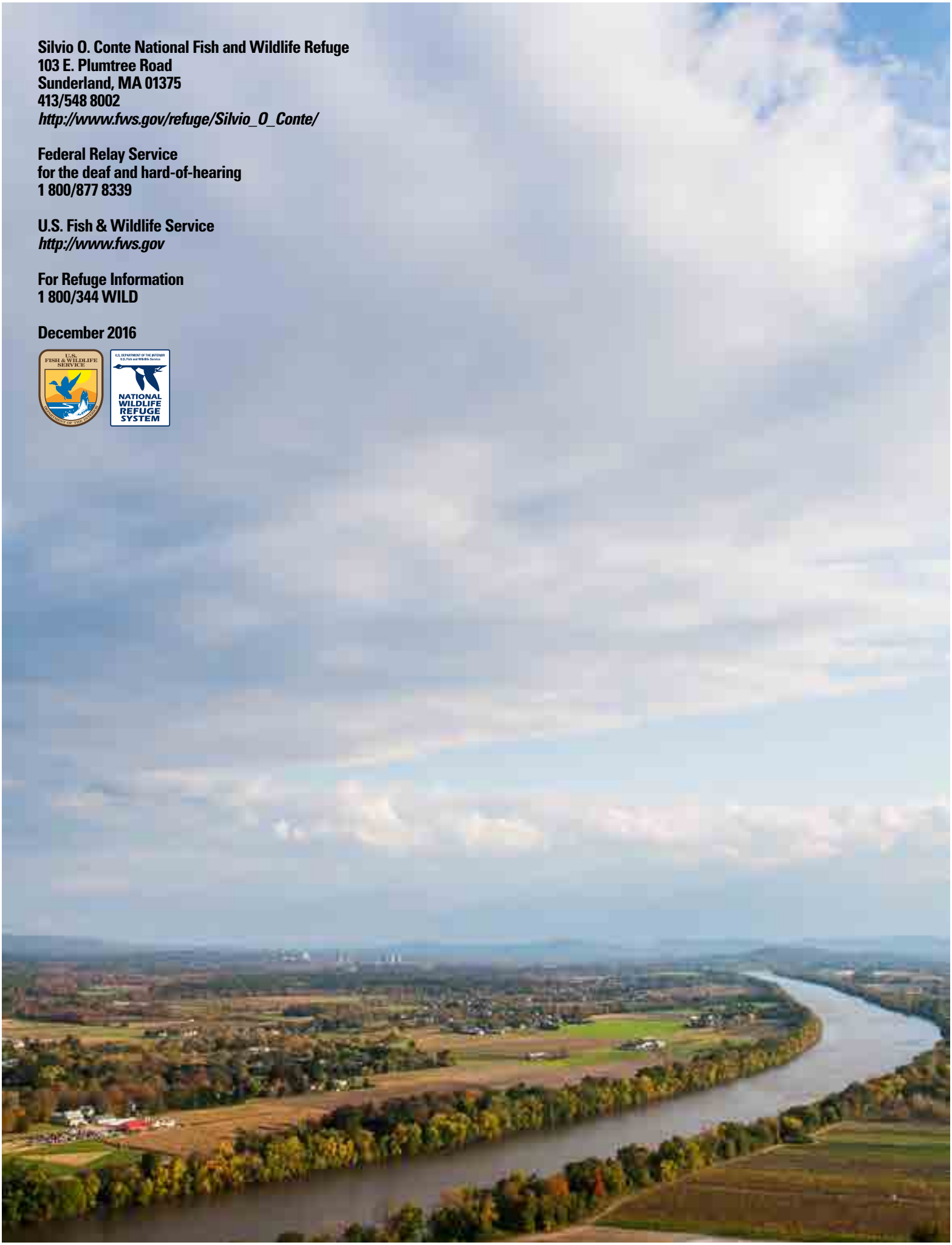
December 2016