U.S. Fish & Wildlife Service

John Heinz National Wildlife Refuge at Tinicum

Draft Comprehensive Conservation Plan and Environmental Assessment

March 2012

Front and back cover:

The Philadelphia skyline from John Heinz National Wildlife Refuge at Tinicum
Larry Woodward/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 555 national wildlife refuges and thousands of waterfowl production areas. The Service also operates 70 national fish hatcheries and 81 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.

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John Heinz National Wildlife Refuge at Tinicum Vision Statement

John Heinz National Wildlife Refuge at Tinicum is a green respite nestled within the urban setting of the city of Philadelphia. Refuge lands are a thriving sanctuary teeming with a rich diversity of fish, wildlife, and plants native to the Delaware Estuary. Healthy and productive expanses of freshwater tidal marsh, open waters, mudflats, and forests support the hundreds of species that breed, rear their young, rest during migration, and call the refuge home year-round.

With partners' support, the refuge leads by example in the restoration and conservation of freshwater tidal marsh within the Delaware Estuary. Also, given its accessibility and visibility to over 35 million Americans living within a 2-hour drive, the refuge serves as a prominent ambassador of the National Wildlife Refuge System. Its high quality programs promote natural and cultural resource stewardship, demonstrate the conservation of urban wildlife habitat, encourage compatible outdoor public use, and serve as a living classroom to connect people with nature and local history. Those who visit John Heinz NWR are inspired to take action to improve the quality of life for themselves and those around them.

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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: John Heinz National Wildlife Refuge at Tinicum
Philadelphia, PA

Administrative Headquarters: John Heinz National Wildlife Refuge at Tinicum
Philadelphia, PA

Responsible Official: Wendi Weber, Regional Director, Northeast Region

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This Draft Comprehensive Conservation Plan and Environmental Assessment analyzes three alternatives for managing the 1,200-acre John Heinz National Wildlife Refuge over the next 15 years. This document also contains 11 appendixes that provide additional information supporting our analysis. Following is a brief overview of each alternative:

Alternative A: This alternative is referred to as our "No Action" or "Current Management" alternative, as required by the National Environmental Policy Act. Under this alternative, no major changes to our biological, public use, or administrative management practices would occur.

Alternative B: This is the Service's preferred alternative. It represents the objectives and strategies recommended by the planning team for best achieving the refuge's purposes, vision, and goals, and responding to public issues. Under this alternative, we would focus on increased restoration of freshwater tidal marsh and providing environmental education programs for urban youth. We would also increase efforts to monitor for the effects of climate change.

Alternative C: This alternative also prioritizes protection of the refuge tidal marsh, but would focus upland habitat management on increasing the refuge's shrubland habitats. Restoration of freshwater tidal marsh would be delayed to gain further understanding of the potential implications of sea level rise. Our current public use program would be improved, with some expansions planned.

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

Chapters

Chapters (cont.)

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Chapter 1

Ron Holmes/USFWS

A bald eagle soars over the refuge with a fish.

The Purpose, of and Need for, Action

1.1 Introduction to John Heinz National Wildlife Refuge

John Heinz National Wildlife Refuge at Tinicum (NWR, refuge) currently includes 993 acres of the 1,200 acres within its approved acquisition boundary. The refuge protects over 200 acres of the last remaining freshwater tidal marsh in Pennsylvania. It is an important migratory stopover along the Atlantic Flyway, and provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migratory birds (Cohen 2004). The refuge is located in Philadelphia and Delaware Counties in the Commonwealth of Pennsylvania (map 1.1)

John Heinz NWR includes a variety of important resources and also provides a unique opportunity for education and outreach near the urban center of the city of Philadelphia, the nation's fifth largest metropolitan area (U.S. Census Bureau 2011). Sustaining and protecting these resources requires planning, active on-the-ground management, and partnerships with the surrounding communities of the Delaware Valley.

John Heinz NWR is managed by the U.S. Fish and Wildlife Service (USFWS, the Service, our, we) as part of the National Wildlife Refuge System (Refuge System). The Refuge System maintains the biological integrity, diversity, and environmental health of natural resources on lands within it for the benefit of present and future generations.

This draft comprehensive conservation plan (CCP) and environmental assessment (EA) for the refuge combines two documents required by Federal law into one document:

- A CCP, required by the National Wildlife Refuge System Administration Act (Refuge Improvement Act) of 1996, as amended by the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57; 111 Stat. 1253)
- An EA, required by the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*, 83 Stat. 852)

Following the public review of this draft CCP/EA, the Service's Northeast Regional Director will decide on the components of a final CCP to guide refuge management decisions over the next 15 years. The Service will use the final CCP to promote the understanding of, and support for, refuge management among State and Federal agencies, our conservation partners, Tribal governments, local communities, and the public.

This draft CCP/EA is organized in several chapters to outline the history, driving mandates, purposes, and conservation priorities guiding the proposed actions, as well as the affected environment of the refuge and alternatives reviewed in the course of plan development.

Chapter 1, "The Purpose of, and Need for, Action," explains the purpose of, and need for, preparing a CCP and EA, and introduces the 5 subsequent chapters and 11 appendixes.

Chapter 2, "Affected Environment," describes the biological and socioeconomic landscape context as well as the physical, biological, and human environments of the refuge.

Chapter 3, "Alternatives Considered, Including the Service-preferred Alternative" presents three management alternatives and their objectives and strategies for meeting refuge goals and addressing public issues. It also describes the activities that the Service expects to occur regardless of the alternative selected for the final CCP. The range of alternatives we analyzed include continuing our present management of the refuge unchanged, expanding visitor

services, restoring coastal plain habitats found on the refuge, and enhancing habitat management and visitor services with a wider, regional focus.

Chapter 4, "Environmental Consequences," assesses the environmental effects of implementing each of the three management alternatives. It predicts the foreseeable benefits and consequences affecting the socioeconomic, physical, cultural, and biological environments described in chapter 2.

Chapter 5, "Consultation and Coordination with Others," summarizes how the Service involved the public and our partners in the planning process. Their involvement is vital for the future management of this refuge and all national wildlife refuges.

Chapter 6, "List of Preparers," credits Service and non-Service contributors to the planning effort.

Eleven appendixes, a glossary with acronyms, and a bibliography section provide additional documentation and references to support our analysis summarized within the report.

1.2 Purpose of, and Need for, the Proposed Action

In 1997, Congress passed the Refuge Improvement Act establishing a unifying mission for the Refuge System. The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its "wildlife first" mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. The Refuge Improvement Act also requires that all refuges established prior to 1997 prepare a CCP by 2012.

The Service proposes to develop a CCP for the refuge that, in the Service's best professional judgment, best achieves the purposes, vision, and goals of the refuge; contributes to the mission of the Refuge System; adheres to Service policies and other mandates; addresses identified issues of significance; and, incorporates sound principles of fish and wildlife science.

NEPA regulations require our evaluation of a reasonable range of alternatives, including a no action and a proposed or preferred action. The no action alternative can be either (1) taking no management action, or (2) not changing current management. In this draft plan, alternative A is the latter. All alternatives will be evaluated and compared as to how well they meet the purpose of, and need for, a CCP.

The purpose of adopting a CCP for this refuge is to accomplish the following goals:

Goal 1. Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania coastal plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.

Goal 2. Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.

Goal 3. Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.

Goal 4. Ensure that visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.

Goal 5. Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.

Goal 6. Communicate and collaborate with local communities, Federal and State agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.

Several Service policies providing specific guidance on implementing the Refuge Improvement Act have been developed since the refuge was established. A CCP incorporates those policies, and develops strategic management direction for the refuge for 15 years, by

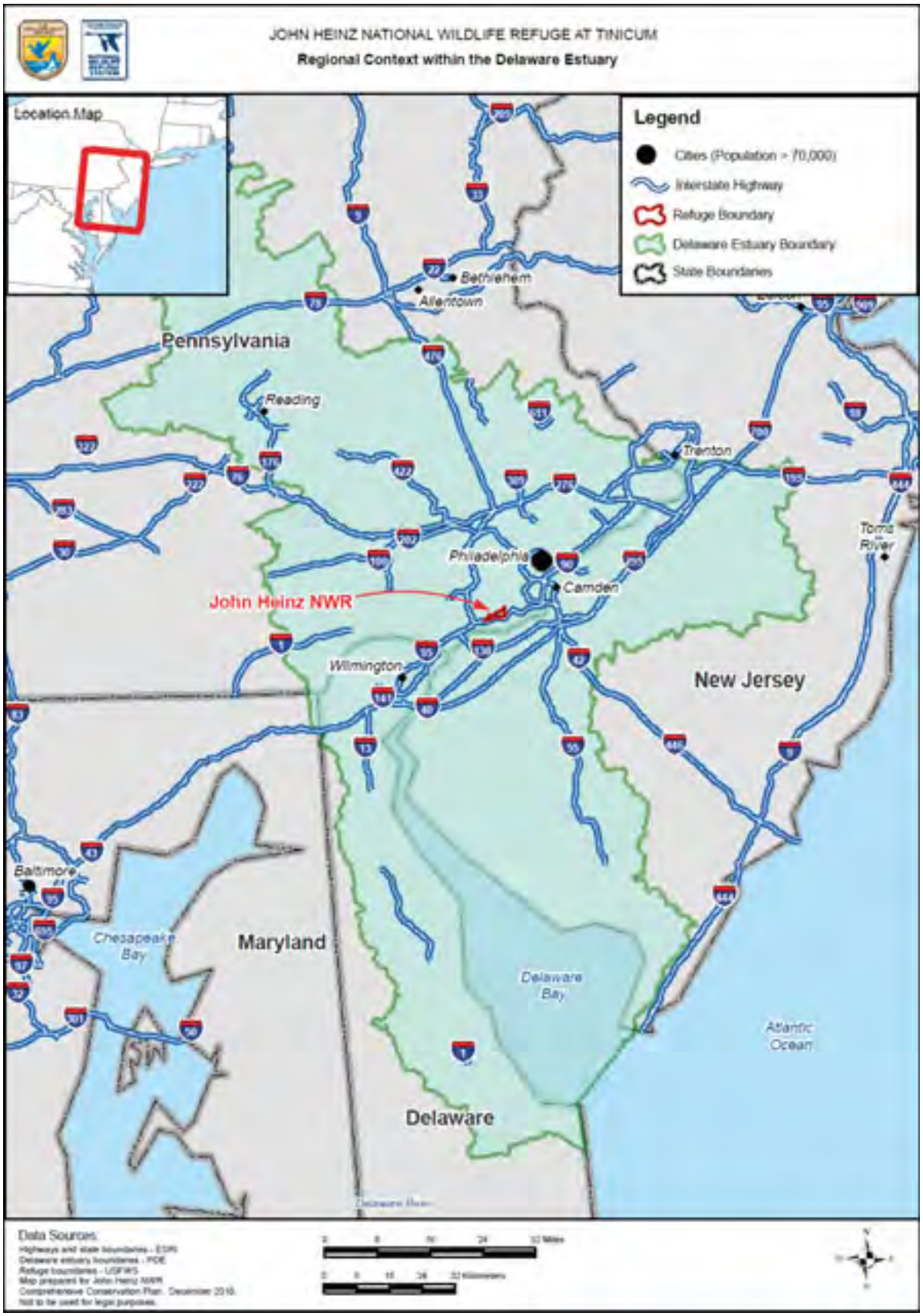
- stating clearly the desired future conditions for refuge habitat, wildlife, visitor services, staffing, and facilities;
- explaining concisely to state agencies, refuge neighbors, visitors, partners, and other stakeholders the reasons for management actions;
- ensuring that refuge management conforms to the policies and goals of the Refuge System and legal mandates;
- ensuring that present and future public uses are appropriate and compatible;
- providing long-term continuity and consistency in management direction; and,
- justifying budget requests for staffing, operating, and maintenance funds.

In addition to the needs for a CCP outlined by Service policies and mandates, John Heinz NWR has not completed a large-scale planning effort since development of its original master plan in 1980. The refuge, its use, and surrounding landscapes have changed significantly since then. Additional property has been acquired, biological management has shifted from a preservation-based approach to adaptive management focus, and improvements have been made to promote refuge visitation and recreational use. Conservation science has also improved over the past 30 years, including identification of priority species for conservation in light of population trends, available habitat, and landscape-level biological threats. All these changes since the refuge master plan are being considered in developing the CCP.

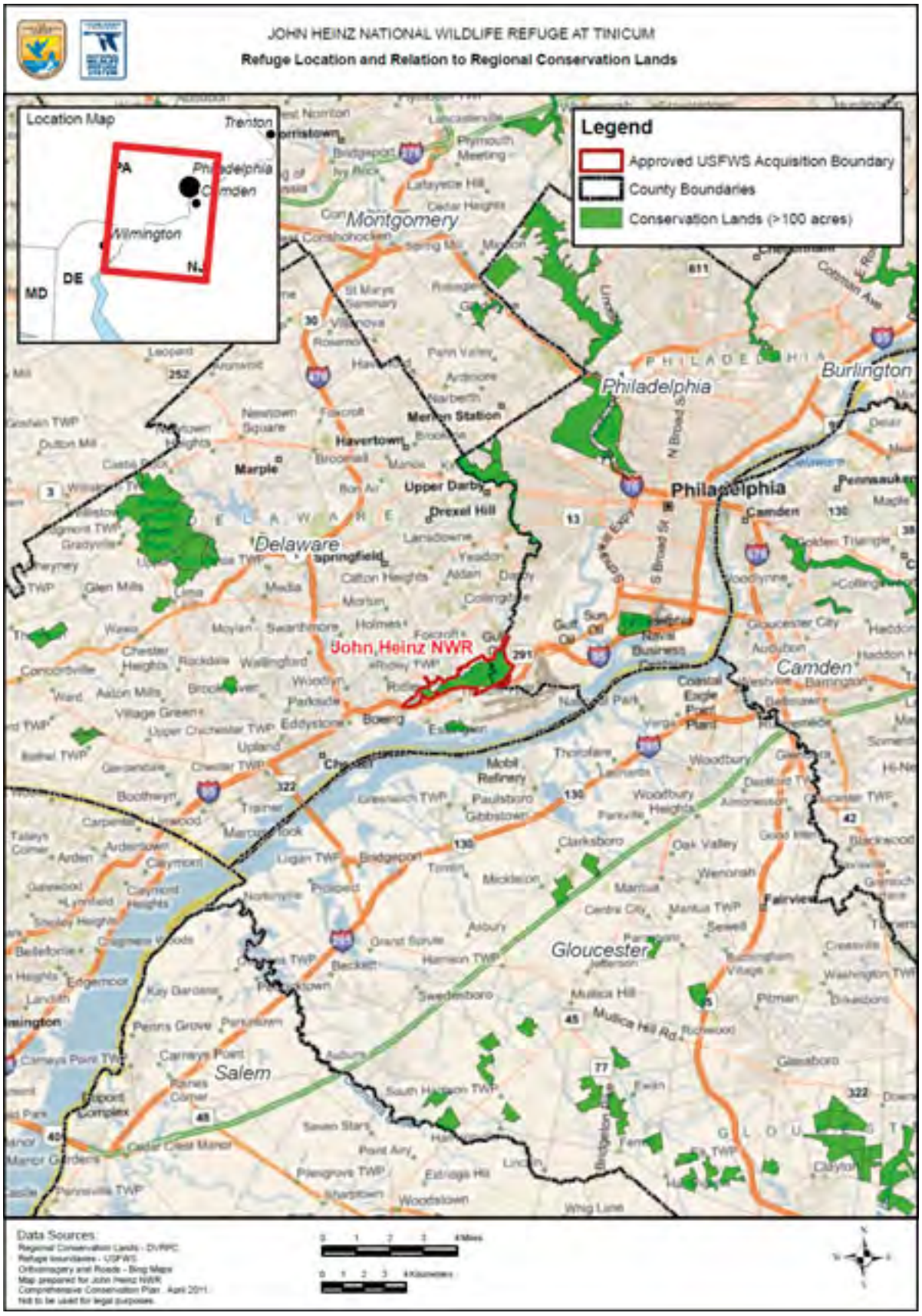
Project Area

The project location is John Heinz NWR, which is located in Philadelphia and Delaware Counties in the State of Pennsylvania. Darby Creek flows through the site shortly before its confluence with the Delaware River. The regional context of the project area is defined by the interactions of the surrounding Philadelphia metropolitan area, the Delaware Estuary, and the Darby Creek watershed (see maps 1.1 through 1.3). The refuge lies within the Atlantic Coastal Plain physiographic province. This area is located in the most southeastern part of the State, running approximately 40 miles in length and 4 miles in width. Local relief is very low in this section and elevations range from sea level to 200 feet above sea level (PADCNR 2010).

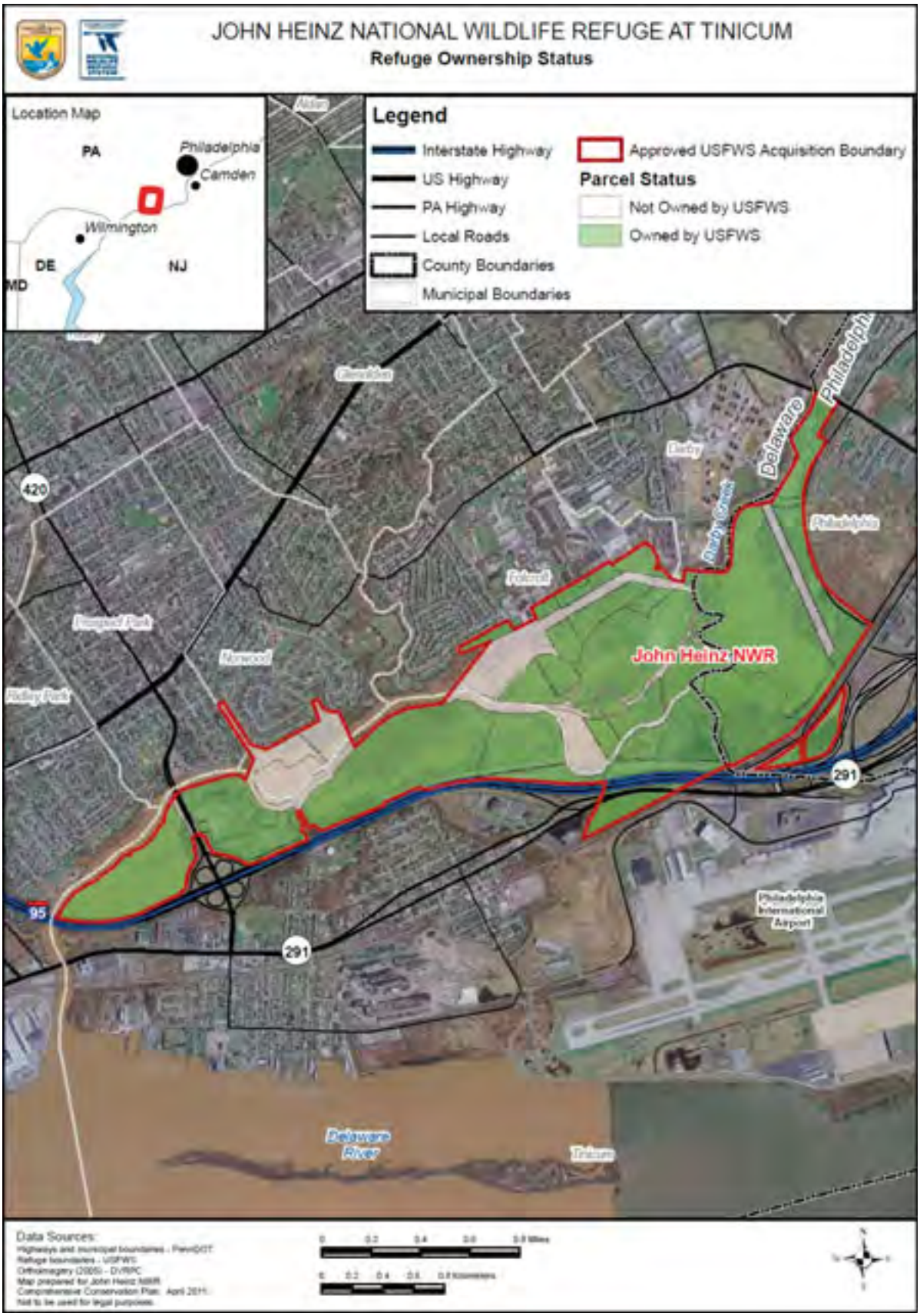
Map 1.1 John Heinz National Wildlife Refuge at Tinicum and Regional Context Within the Delaware Estuary



Map 1.2 John Heinz National Wildlife Refuge at Tinicum Location and Relation to Regional Conservation Lands



Map 1.3 John Heinz National Wildlife Refuge at Tinicum Ownership Status



1.3 Service and Refuge System: Policies and Mandates Guiding Planning

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

As part of the Department of the Interior, the Service administers the Refuge System. The Service mission is, "Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

Congress entrusts to the Service the conservation and protection of the following national natural resources:

- Migratory birds and fish
- Federally listed, endangered or threatened species
- Interjurisdictional fish
- Wetlands
- Certain marine mammals
- 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, and helps other countries develop conservation programs.

The Service Manual (USFWS 2010) contains the standing and continuing directives on implementing our authorities, responsibilities, and activities. The Service publishes special directives that affect the rights of citizens or the authorities of other agencies separately in the Code of Federal Regulations (CFR); the Service Manual does not duplicate them (see 50 CFR 1–99 at: *http://www.gpoaccess.gov/cfr/index.html;* accessed January 2012).

The National Wildlife Refuge System and its Mission and Policies

The Refuge System is the world's largest network of lands and waters set aside specifically for the conservation of wildlife and the protection of ecosystems. More than 550 national wildlife refuges encompass more than 150 million acres of lands and waters in all 50 States and several island territories. Each year, more than 40 million visitors hunt, fish, observe and photograph wildlife, or participate in environmental education and interpretation on refuges (Carver and Caudell 2007).

In 1997, President Clinton signed into law the National Wildlife Refuge System Improvement Act (Public Law 105-57; 111 Stat. 1253) amending the Refuge Administration Act (see Introduction of this chapter). The Refuge Improvement Act establishes the following unifying mission for the Refuge System:

"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" (Refuge Improvement Act; Public Law 105–57).

It also establishes a new process for determining compatibility of public uses on refuges, and requires the Service to prepare a CCP for each refuge. The Refuge Improvement Act states that the Refuge System must focus on wildlife conservation and that the mission of the Refuge System, coupled with the purpose(s) for which each refuge was established, will provide the principal management direction on that refuge.

The U.S. Refuge System Manual (Refuge Manual) contains policy governing the operation and management of the Refuge System that the Service Manual does not cover, including technical information on implementing refuge polices and guidelines on enforcing laws. The Service is in the process of updating and transferring the policies and guidance in the Refuge Manual into the Service Manual. While many of these policies are in the Service Manual, some have not been transferred yet and are still recorded in the Refuge Manual (USFWS 1989). The Refuge Manual is not available online, but can be viewed at refuge headquarters. Following are a few noteworthy policies instrumental in developing this draft CCP/EA.

Policy on the National Wildlife Refuge System Mission, Goals, and Purposes

This policy (601 FW 1) sets forth the Refuge System mission noted above, how it relates to the Service mission, and explains the relationship of the Refuge System mission and goals, and the purpose(s) of each unit in the Refuge System. In addition, it identifies the following Refuge System goals:

- Conserve a diversity of fish, wildlife, and plants.
- Develop and maintain a network of habitats.
- Conserve those ecosystems, plant communities, and wetlands that are unique within the United States.
- Provide and enhance opportunities to participate in compatible, wildlife-dependent recreation.
- Help to foster public understanding and appreciation of the diversity of fish, wildlife, and plants and their habitats.

This policy also establishes the following management priorities for the Refuge System:

- Conserve fish, wildlife, and plants and their habitats.
- Facilitate compatible wildlife-dependent recreational uses.
- Consider other appropriate and compatible uses.

Policy on Refuge System Planning

This policy (602 FW 1, 2, 3) establishes the requirements and guidance for Refuge System planning, including CCPs and step-down management plans. It states that the Service will manage all refuges in accordance with an approved CCP that, when implemented, will help

- achieve refuge purposes;
- fulfill the Refuge System mission;
- maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System;
- achieve the goals of the National Wilderness Preservation System (NWPS) and the National Wild and Scenic Rivers System (NWSRS); and,
- conform to other applicable laws, mandates, and policies.

This planning policy provides step-by-step directions and identifies the minimum requirements for developing all CCPs. Among them, the Service is to review any existing special designation areas such as wilderness and wild and scenic rivers, specifically address the potential for any new special designations, conduct a wilderness review, and incorporate a summary of that review into each CCP (602 FW 3). We include the wilderness review for John Heinz NWR as appendix G to this draft CCP/EA.

Policy on the Appropriateness of 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 visitors can enjoy its lands and waters. This 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:

(1) The use is a wildlife-dependent recreational use as identified in the Refuge Improvement Act.

(2) 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 Refuge Improvement Act became law.

(3) The use follows state regulations for the take of fish and wildlife.

(4) The use has been found to be appropriate after concluding a specified findings process using 10 criteria.

We include the findings of appropriateness for John Heinz NWR in appendix B to this draft CCP/EA.

Policy on Compatibility

This policy (603 FW 2) defines a compatible use as a use "that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." The compatibility policy complements the appropriateness policy. Once a refuge manager finds a use appropriate, they conduct a further evaluation through a compatibility determination assessment. We include the compatibility determinations completed for those public uses determined to be appropriate for John Heinz NWR as appendix B to this draft CCP/EA.

The policy provides guidelines for determining compatibility of uses and procedures for documentation and periodic review of existing uses. Highlights of this guidance follows:

- The Refuge Improvement Act and its regulations require an affirmative finding by the refuge manager on the compatibility of a public use before the Service allows it on a refuge.
- The refuge manager may authorize those priority uses on a refuge when they are compatible and consistent with public safety.
- There are six wildlife-dependent recreational uses that are to receive enhanced consideration on refuges: hunting, fishing, wildlife observation and photography, environmental education, and interpretation.

- When the refuge manager publishes a compatibility determination, it will stipulate the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses and 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 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.

Policy on Wildlife-dependent Public Uses

This policy (605 FW 1) presents specific guidance on implementing management of the priority public uses. This policy defines a quality, wildlife-dependent recreational program as a one that

(1) promotes safety of participants, other visitors, and facilities;

(2) promotes compliance with applicable laws and regulations and responsible behavior;

(3) minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan;

(4) minimizes or eliminates conflicts with other compatible, wildlife-dependent recreational uses;

(5) minimizes conflicts with neighboring landowners;

(6) promotes accessibility and availability to a broad spectrum of the American people;

(7) promotes resource stewardship and conservation;

(8) promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources;

(9) provides reliable and reasonable opportunities to experience wildlife;

(10) uses facilities that are accessible to people and blend into the natural setting; and

(11) uses visitor satisfaction to help to define and evaluate programs.

Policy on Maintaining Biological Integrity, Diversity, and Environmental Health

This policy (601 FW 3) provides guidance on maintaining and restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and restore lost or severely degraded components of the environment. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem.

Other Mandates

Although Service and Refuge System policy and the purpose(s) of each refuge provide the foundation for its management, other Federal laws, executive orders, treaties, interstate compacts, and regulations on conserving and protecting natural and cultural resources also affect how the Service manages refuges. The "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service" describes many of them at: *http://www.fws.gov/laws/Lawsdigest.html* (accessed January 2012).

Of particular note are the Federal laws that 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 the CCP for each refuge to identify its archaeological and cultural values. Following is a highlight of some cultural and historic resource protection laws which relate to the development of CCPs.

The Archaeological Resources Protection Act (ARPA) (16 U.S.C. 470aa–470ll; P.L. 96–95) approved October 31, 1979 (93 Stat. 721), largely supplanted the resource protection provisions of the Antiquities Act of 1906 for archaeological items. ARPA establishes detailed requirements for issuance of permits for any excavation 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 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 Archeological and Historic Preservation Act (AHPA) (16 U.S.C. 469–469c; P.L. 86–523,) approved June 27, 1960 (74 Stat. 220), as amended by P.L. 93–291, approved May 24, 1974 (88 Stat. 174), carries out the policy established by the Historic Sites, Buildings and Antiquities 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 (Historic Sites Act) (16 U.S.C. 461–462, 464–467; 49 Stat. 666) of August 21, 1935, as amended by P.L. 89–249, approved October 9, 1965 (79 Stat. 971), 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 them. Among other things, National Historic and Natural Landmarks are designated under the authority of this act.

The National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470–470b, 470c–470n), P.L. 89–665, approved October 15, 1966 (80 Stat. 915), and repeatedly amended, provides for the preservation of significant historical features (buildings, objects, and sites) through a grant-in-aid program to the states. It establishes a National Register of Historic Places 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 under P.L. 94–422, approved September 28,1976 (90 Stat. 1319). The act also 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 of Historic Places.

The Service also has a mandate to care for museum properties it owns in the public trust. 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 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 (P.L. 101-601) and Federal regulations governing Federal archaeological collections.

This program ensures that those collections will remain available to the public for learning and research.

Other Federal resource laws are also important to highlight as they are integral to developing a CCP. The Wilderness Act of 1964 (16 U.S.C. 1131–1136; P.L. 88–577) establishes the 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 to review every roadless area of 5,000 acres or more and every roadless island (regardless of size) within the Refuge System and National Park System (NPS) for inclusion in the NWPS. Service planning policy requires that the Service evaluate the potential for wilderness on refuge lands, as appropriate, during the CCP planning process. We include the wilderness review for John Heinz NWR as appendix G to the draft CCP/EA.

The Wild and Scenic Rivers Act of 1968 (P.L. 90-542; 16 U.S.C. 1271 *et seq.*), 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 requires that the Service evaluate the potential for wild and scenic rivers designation on refuge lands, as appropriate, during the CCP planning process. We include the wild and scenic rivers review for John Heinz NWR as appendix H to this draft CCP/EA.

1.4 Refuge Establishing Purposes

John Heinz NWR was established in 1972, under special legislation, for the following purpose:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Some additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).

- "Development, advancement, management, conservation, and protection of fish and wildlife resources...(16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956).

- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

1.5 Conservation Plans and Initiatives Guiding the Proposed Action

Important guidance for habitat management and visitor service management at John Heinz NWR has already been provided by a series of refuge-specific, State, regional, and national plans and their priorities.

Regional and National Plans and Initiatives

Refuge System Visioning: Fulfilling the Promise, Conserving the Future
The 1999 report, "Fulfilling the Promise, The National Wildlife Refuge System: Visions for Wildlife, Habitat, People and Leadership" (USFWS 1999), was the culmination of a year-long process by teams of Service employees to create a

Refuge System vision. This report was a result of the first-ever Refuge System Conference held in Keystone, Colorado, in October 1998. It was attended by every refuge manager in the country, other Service employees, and scores of conservation organizations. The report contains 42 recommendations organized under 3 vision statements relating to wildlife and habitat, people, and leadership. We have often looked to these recommendations while writing this draft CCP/EA. For example, the 1999 report recommends forging new alliances through citizen and community partnerships, and strengthening partnerships with the business community. One of the goals in our CCP is devoted to the development of community partnerships, while several of our strategies focus on forging new partnerships or strengthening existing ones.

The Refuge System's "Conserving the Future" conference was convened in July 2011 to renew and update the 1999 vision. It began with a draft vision document. Over the course of the conference, the Service collected both online and in-person feedback which was used to revise and finalize the draft vision. The Service finalized the "Conserving the Future" vision document in October 2011 (USFWS 2011). The document has 20 recommendations, including one focusing on urban refuges. Currently, implementation teams are developing strategies to help us accomplish the vision. We will incorporate implementation strategies for this recommendation and the others, as appropriate, in our step-down plans and refuge programs.

North Atlantic Landscape Conservation Cooperative Operations Plan (USFWS 2009a)
The Service is developing a coordinated network of landscape conservation cooperatives (LCCs) across the United States to address major environmental and human-related factors that limit fish and wildlife populations at the broadest of scales, including developing adaptation strategies in response to climate change. John Heinz NWR is located in the North Atlantic LCC, which is currently using the principles of strategic habitat conservation (SHC) to develop and communicate landscape-scale scientific information to shape conservation across the northeastern United States. The North Atlantic LCC's Operations Plan outlines the regional threats to conservation, priority species, and habitats, as well as active regional partnerships.

Mid-Atlantic Coast Bird Conservation Region Implementation Plan (USFWS 2008a)
The implementation plan for the Mid-Atlantic Coast Bird Conservation Region (BCR 30) combines regional plans, assessments, and research completed over the past two decades to develop continental-based bird conservation efforts. John Heinz NWR is located within the narrow portion of the Mid-Atlantic Coastal Plain in southeastern Pennsylvania. As such, this coastal zone is unique to the State of Pennsylvania and thus many of the priority species listed for BCR 30 are also species of concern listed within the Pennsylvania Wildlife Action Plan. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

A Natural Heritage Inventory of Philadelphia County, Pennsylvania (PNHP 2008)
The Philadelphia County Natural Heritage Inventory was compiled by the Pennsylvania Department of Conservation and Natural Resource's (PADCNR) Natural Heritage Program (PNHP) and the Western Pennsylvania Conservancy. It provides information on the general locations of rare, threatened, and endangered species and the highest quality natural areas in the county, and identifies areas in need of restoration. PNHP also provides State conservation rankings for each species of conservation concern in Pennsylvania. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

Pennsylvania Wildlife Action Plan (PGC and PFBC 2008)
The State Wildlife Action plan was completed in 2005 and updated in 2008 (Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC) 2008). While creating a strategic focus for State fish and wildlife management agencies, this plan attempts to provide a Statewide perspective on conservation by presenting geographic, species, and habitat priorities. Considering John Heinz NWR's protection of habitats unique to the State of Pennsylvania, species of conservation priority were considered in development of the refuge's resources of concern.

USFWS Migratory Bird Program Strategic Plan (USFWS 2004)
The Migratory Bird Program Strategic Plan provides direction for the Services' migratory bird management over the next decade (2004 to 2014). The plan contains a vision and recommendations for the Refuge System's place in bird conservation. It defines strategies for the Service, including the Refuge System, to actively support bird conservation through monitoring, conservation, consultation, and recreation. The refuge's draft Habitat Management Plan (HMP), to the extent practical, uses standard monitoring protocols, habitat assessment and management, and promotes nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

USFWS Birds of Conservation Concern (USFWS 2008b)
The USFWS Birds of Conservation Concern (BCC) report identifies the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent the Service's highest conservation priorities and draws attention to species in need of conservation action. The plan's geographic scope includes the United States, including the island territories in the Pacific Ocean and Caribbean. Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. Assessment scores are based on several factors, including population trends, threats, distribution, abundance, and area importance.

Wildlife Habitat in Pennsylvania, Past, Present, and Future (PADCNR 2001)
Today, the PADCNR ranks coastal plain habitats as "impaired." The coastal plain region of Pennsylvania includes some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNR report *Wildlife Habitat in Pennsylvania, Past, Present, and Future*, recommends that where possible, wetlands along the Delaware River should be restored. The plan recommends urban forest management to provide habitat for some tolerant forest wildlife. The reduction of runoff into streams and wetlands is also noted as a top priority, along with restoration of natural communities in undeveloped areas.

Bird Conservation Plan for the Mid-Atlantic Coastal Plain (Physiographic Area 44) (PIF 1999)
Partners in Flight (PIF) is a partnership of government agencies, private organizations, academic researchers, and private industry throughout North America focused on coordinating voluntary bird conservation efforts to benefit species at risk and their habitats. BCRs have been developed to guide management on a regional scale. Version 1.0 of the Mid-Atlantic Coastal Plain BCR Plan was completed in 1999. John Heinz NWR is located within this physiographic province and thus is considering the conservation priorities of this plan along with other conservation plans.

Delaware Estuary Comprehensive Conservation Management Plan (DEP 1996)
The Delaware Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development. To help address

these threats, the Delaware Estuary Program worked with many partners to develop the Comprehensive Conservation and Management Plan (CCMP) for the Delaware Estuary (DEP 1996). The CCMP is a comprehensive document describing the existing conditions of the Delaware Estuary and providing seven action plans (land management, water use management, habitat and living resources, toxics, education and involvement, and monitoring) and an implementation plan. While the Delaware Estuary Program has since merged with the Partnership for the Delaware Estuary, this reorganized entity is still active and is now responsible for addressing the various actions identified in the CCMP. We used this plan as a reference in developing habitat management and land protection planning objectives.

Refuge-specific Plans

We consulted a number of other refuge-specific plans in either their draft or final format to help guide decisionmaking. These plans will also be maintained and updated as necessary to maintain accordance with the recommendations of the CCP.

John Heinz National Wildlife Refuge at Tinicum Draft Habitat Management Plan (Appendix C)
The refuge's draft HMP (appendix C) proposes a long-term vision and specific guidance on managing the habitats for the indentified resources of concern at John Heinz NWR. The plan provides direction for the next 15 years. Subsequent reviews every 5 years and use of adaptive management will assess and modify management activities as research, monitoring, and priorities require. This plan will be finalized upon final approval of the CCP.

Draft White-tailed Deer Management Plan for John Heinz National Wildlife Refuge at Tinicum (D'Angelo 2011)
Refuge staff consulted with U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services to study the refuge's deer population and its impacts on refuge habitats, wildlife, and humans. The purpose of the deer management plan is to institute a biologically sound program to efficiently manage the deer population within a sustainable and healthy balance within the habitat and objectives of the refuge. This plan will be finalized upon final approval of the CCP.

Visitor Service Review (VanBeusichem et al. 2009)
A Service-based review team assessed the public use issues, opportunities, and facilities available at John Heinz NWR in preparation of the refuge's comprehensive conservation planning process and to develop recommendations to improve the quality of the refuge's visitor services program. The Visitor Services Review recommendations are used as a stepping-off point for visitor services planning. We used its recommendations to help develop goals, objectives, and strategies for refuge visitor services planning.

Restoration Management Plan for the Lower Darby Creek with Recommendations for the John Heinz National Wildlife Refuge at Tinicum (Salas et al. 2006)
This restoration management plan was developed in 2006 by Delaware Riverkeeper Network under a Delaware Estuary Grant awarded to the Friends of the Heinz Refuge and funded by the National Fish and Wildlife Foundation. The purpose of this plan was to initiate an ecological restoration approach to habitat management at the refuge. This plan identified historic disturbances to the site, the ecological communities existing at the refuge, and provided recommendations for the restoration of a more natural ecological composition, structure, and function to these communities. The extensive field and Geographic Information System (GIS) data, along with historic records and information compiled as part of this plan, were used heavily in the development of the Draft HMP.

Pennsylvania Important Bird Area #73: Phase I Conservation Plan (Cohen and Johnson 2004)
John Heinz NWR was designated as an Important Bird Area (IBA) by the National Audubon Society because of its critical location within the Atlantic Flyway and its complex of unique habitats. This plan identifies habitat-based site boundaries, describes the birds and wildlife habitat which occur on the site with special reference to the species for which the site was selected as an IBA, identifies conservation issues and threats to the site, and provides recommendations for conservation actions. Its conservation recommendations are being considered with those of other refuge and regional plans.

Step-down Plans

The Service Manual's refuge planning policy (602 FW 4) identifies more than 25 step-down management plans that may be completed for each refuge. Those plans provide the details necessary to "step-down" general goals and objectives to specific strategies and implementation schedules. Some require annual revisions, while others are revised every 5 to 10 years. Some require additional NEPA analysis, public involvement, and compatibility determinations before they can be implemented. The following is a list of step-down plans we anticipate needing for John Heinz NWR. Some of these plans are already completed, others have been released in draft form, and some have yet to be drafted.

- Annual Habitat Work Plan (most recently completed 2010, updated annually)
- Wildlife Disease Surveillance and Contingency Plan (completed 2006)
- Fire Management Plan (completed 2006, updated annually)
- Visitor Services Plan (currently in draft form, to be finalized in 2011)
- Law Enforcement Plan (currently in draft form, to be finalized in 2011)
- Hurricane Action Plan (completed 2010, updated annually)
- Energy Management Plan (completed 2003, updated annually)
- Safety Plan (completed 2010, updated annually)
- Fishing Plan (to be completed within 3 years of CCP approval)
- Deer Management Plan (currently in draft form, to be finalized within 1 year of CCP approval)

1.6 Refuge Vision

The planning team developed the following vision statement to provide a guiding philosophy and sense of purpose in the CCP.

John Heinz National Wildlife Refuge at Tinicum is a green respite nestled within the urban setting of the city of Philadelphia. Refuge lands are a thriving sanctuary teeming with a rich diversity of fish, wildlife, and plants native to the Delaware Estuary. Healthy and productive expanses of freshwater tidal marsh, open waters, mudflats, and forests support the hundreds of species that breed, rear their young, rest during migration, and call the refuge home year-round.

With partners' support, the refuge leads by example in the restoration and conservation of freshwater tidal marsh within the Delaware Estuary. Also, given its accessibility and visibility to over 35 million Americans living within a 2-hour drive, the refuge serves as a prominent ambassador of the National Wildlife Refuge System. Its high-quality programs promote natural and cultural resource

stewardship, demonstrate the conservation of urban wildlife habitat, encourage compatible outdoor public use, and serve as a living classroom to connect people with nature and local history. Those who visit John Heinz National Wildlife Refuge are inspired to take action to improve the quality of life for themselves and those around them.

1.7 Refuge Goals

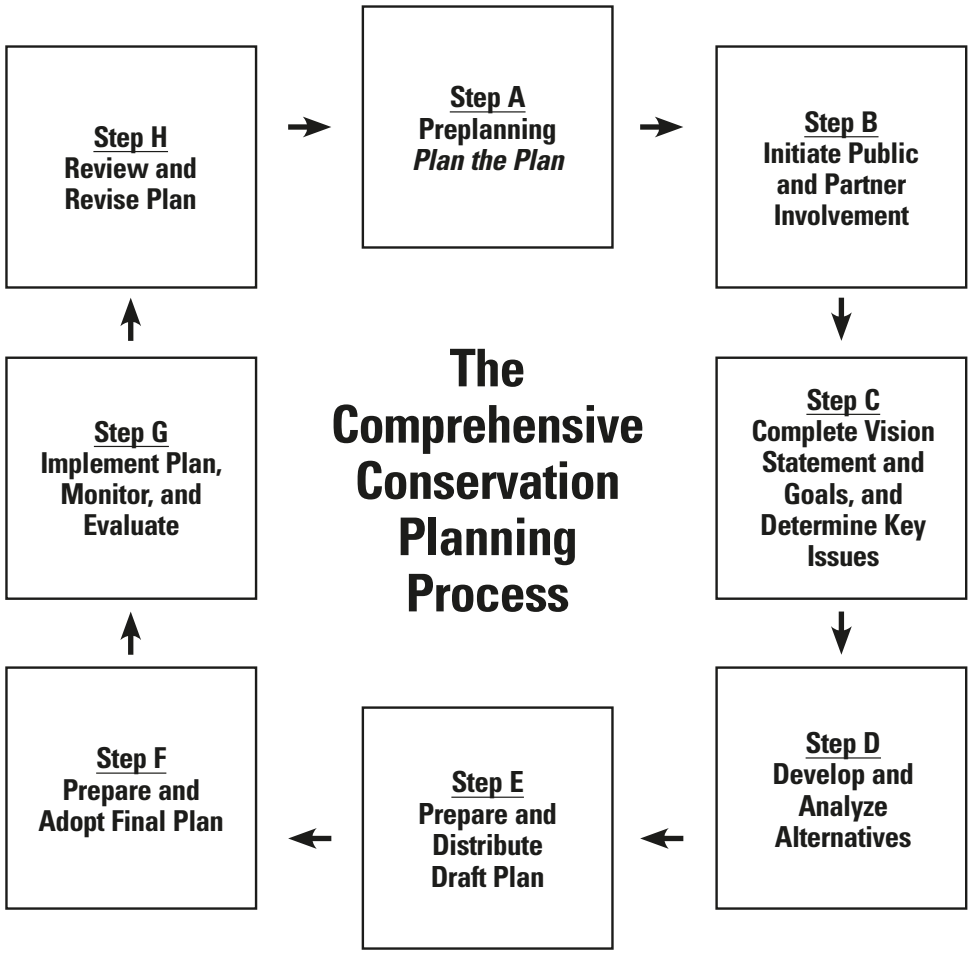
As we introduced earlier in this chapter, the planning team developed six goals (see section 1.2) after considering the vision statement, the purposes for establishing the refuge, the missions of the Service and the Refuge System, and the mandates, plans, and conservation initiatives noted above. These goals are intentionally broad, descriptive statements of purpose. They highlight elements that we will emphasize in its future management.

1.8 The Comprehensive Conservation Planning Process

Service policy (602 FW 3) establishes an eight-step planning process that also facilitates compliance with NEPA (see figure 1.1). The full text of the policy and a detailed description of the planning steps can be viewed at: *http://policy.fws.gov/602fw3.html* (accessed January 2012). The specific process implemented by John Heinz NWR's planning team in developing this draft CCP/EA is described below.

Since 1972, we have focused on conserving lands within the approved refuge boundary; facilitating wildlife-dependent public uses; managing habitat for several focal species, such as waterfowl and waterbirds; and establishing relationships with the community and our partners.

Figure 1.1. The Comprehensive Conservation Planning Process



Steps in the Planning Process

Step A: Initial Planning
We began formally developing a CCP on January 21, 2010, during a conference call between refuge staff, Regional Office staff, and planning contractors. One of the major outcomes of the meeting was a timetable for accomplishing the major steps in the planning process. Initially, we focused on collecting information on the refuge's natural and cultural resources and public use program. The CCP core team of refuge and Regional Office staff and a representative from PGC started meeting to discuss existing information, draft a vision statement, and prepare for the public scoping meeting and a technical meeting of State and Federal partners.

Step B: Public Scoping
The process seeking public involvement officially began in early April 2010, when the planning team distributed a newsletter to approximately 377 individuals, organizations, and agencies announcing the planning process and public scoping period. A press release announcing the public scoping meeting and requesting public input was distributed to major media outlets on April 22, 2010. Next, the Notice of Intent (NOI) to prepare a CCP was published in the *Federal Register* on Friday, May 7, 2010 (75 FR 25285).

Scoping activities in May 2010 included two public scoping meetings which were held at the visitor center on May 11, 2010. The meetings included a total of 24 attendees, including 17 attendees from the public and 7 members of refuge and planning staff. The meetings were held in an open house format with brief presentations on the refuge and CCP process status, followed by a question and answer session and informal discussion to identify issues and concerns. The planning team provided displays of the refuge context, habitat management units, visitor services and facilities, the past and planned marsh restoration projects, and handouts on the draft vision and goals.

The public scoping comment period ended on June 11, 2010. On June 21, 2010, the planning team discussed the major issues identified in the agency and public scoping meetings. A second newsletter was developed by the planning team to inform interested individuals, organizations, and agencies about the range of issues identified throughout the scoping process. The newsletter was sent to approximately 432 individuals, organizations, and agencies.

Steps C and D: Vision, Goals, and Alternatives Development
On February 19, 2010, invitations for the interagency scoping meeting were sent to 55 Federal and State contacts, elected officials, and 13 contacts from federally recognized Tribes associated with Pennsylvania, Delaware, and New Jersey. On March 29, 2010, the planning team met at the visitor center to finalize the draft vision and goals and coordinate agency scoping meeting logistics.

The agency scoping meeting was held on Wednesday, March 31, 2010, at the refuge's visitor center and included 26 attendees, including 13 contacts from partner agencies, 3 Service staff from Ecological Services, and 10 refuge and planning staff members. The meeting was held in a workshop-style format with brief presentations on the refuge and CCP process status; displays of the refuge context, habitat management units, visitor services, and facilities; and handouts on the draft vision and goals. We continued to consult with experts throughout 2010 and 2011, and to meet regularly as a core team, as we developed and refined our alternatives.

Step E: Draft CCP and NEPA Document
This draft CCP/EA represents planning step E to prepare a draft plan and NEPA document. We will publish a Notice of Availability in the *Federal Register*

announcing our release of this draft for a 30-day period of public review and comment. During the comment period, we will also hold one or more public meetings to obtain comments directly from individuals. We expect to receive comments by regular mail, e-mail, or at the public meeting. After the comment period ends, we will review and summarize all of the comments received, develop our responses, revise the CCP as warranted based on the comments, and publish the comments and our responses in an appendix to the final CCP.

Step F: Adopt Final Plan
Once we have prepared the final CCP, we will submit it to our Regional Director for approval. The Regional Director will determine whether it warrants a Finding of No Significant Impact (FONSI), and may find this document's analysis sufficient to simultaneously issue a decision adopting a CCP. If the Regional Director has concerns, we may be required to revise the EA or complete an environmental impact statement (EIS). We will announce the final decision by publishing a Notice of Availability in the *Federal Register*, where we will also notify people of the availability of the final CCP. That will complete planning step F to prepare and adopt a final plan.

Step G and H: Implement, Evaluate, and Revise the Plan
With the planning phase of the CCP process complete, "Step G: Implement Plan, Monitor and Evaluate" will begin. Periodic review of the CCP will be required to ensure that objectives are being met and management actions are being implemented. Ongoing monitoring and evaluation will be an important part of this process. Monitoring results or new information may indicate the need to change our strategies.

As part of "Step H: Review and Revise Plan," the Service will modify or revise the final CCP, as warranted, following the procedures in Service policies 602 FW 1, 3, and 4 and the NEPA requirements. Minor revisions that meet the criteria for categorical exclusions (550 FW 3.3C) will require only an environmental action memorandum. As the Refuge Improvement Act and Service policy stipulate, the Service will review and revise the CCP at least every 15 years.

Issues, Concerns, and Opportunities

The Service defines an issue as "any unsettled matter requiring a management decision" (USFWS 2010). 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; other Federal, state, local, and Tribal agencies; Congress; or our partners, neighbors, and user groups. One of the distinctions among the proposed management alternatives is how each addresses those issues.

From agency and public meetings and planning team discussions, we developed a list of issues, concerns, opportunities, and other items requiring a management decision. We placed them in two categories: key issues and issues outside the scope of this analysis and the EA.

Key issues—Key issues are those the Service has the jurisdiction and authority to resolve. The key issues, together with refuge goals, form the basis for developing and comparing the different management alternatives we analyze in chapter 3. The varying alternatives were generated by the wide-ranging opinions on how to address key issues and conform with the goals and objectives. We describe them in detail below.

Issues and concerns outside the scope of this analysis—These topics fall outside the jurisdiction and authority of the Service or were deemed impractical. We discuss them after "Key Issues" below, but this plan does not address them further.

The following summary provides a context for the issues that arose during the scoping process.

Key Issues
We derived the following key issues from public and partner meetings and planning team discussions. How they are addressed and how well they support refuge goals primarily distinguishes the three management alternatives in chapter 3.

Biological Management
For national wildlife refuges, the conservation of wildlife and habitats is the highest priority, and serves as the foundation for all that the Service does. Many refuges were established for a very specific purpose, such as protecting a particular species or habitat. John Heinz NWR has specific purposes mandating the preservation and restoration of Tinicum Marsh, as well as development of the refuge as an environmental education center.

Protection and restoration of coastal plain wetlands and their associated species on the refuge is an important issue addressed in this draft CCP/EA. The planning team received many opinions on specific actions or techniques to accomplish that endeavor. Some suggestions and actions fall outside Service jurisdiction. Some are best accomplished in partnership with other Federal or state agencies, or non-governmental organizations.

Specific questions asked regarding the topic of biological management, include:

(1) How will the refuge accommodate potential impacts of climate change on existing refuge habitats?

Climate change and its corresponding effects on sea level rise, species migrations, extreme shifts in temperature and precipitation, historic species range distributions, and invasive species introductions may pose dramatic threats and alterations to the habitats encompassed within the refuge and the world. The ability to adapt to or address these ever-changing concerns requires a comprehensive understanding of the refuge's landscape context, individual habitats, species utilization, and their resilience.

John Heinz NWR is located at or near sea level and is subject to tidal hydrology across much of its lands. We are evaluating potential changes caused by rising sea levels. We have analyzed the affect of sea level rise on refuge habitats through the use of a Sea Level Affecting Marshes Model (SLAMM) analysis originally completed in 2009, and recently refined in December 2010. We include the SLAMM analysis as appendix J to this draft CCP/EA. We also discuss the results of the analysis in chapter 2 and explain how the refuge will respond to its implications in chapter 3 under goal 1 for each alternative.

(2) How will the refuge work to improve its biological connectivity with other habitats throughout the region?

Fragmentation of both terrestrial and aquatic habitats can have adverse effects on many plant, fish, and wildlife species by reducing biodiversity, limiting genetic diversity, and increasing susceptibility to species invasion and other stressors.

The refuge is a biological oasis in an intensely urbanized landscape. As a result, except for a few rivers, streams, and riparian lands, few opportunities remain for improving biological connections to adjacent habitats. Most lands providing optimal connection to adjacent habitats are located outside refuge lands and require extensive landowner or partner coordination.

We envision working with a variety of partnerships with Federal, state, and non-governmental organizations to address biological connectivity to the refuge. We discuss how the refuge will respond to connectivity needs in chapter 3 under goals 1 and 2 for each alternative.

(3) How will the refuge continue to fulfill its original mandated purpose to protect Tinicum Marsh and conserve freshwater tidal marsh it encompasses?

Several questions and comments from state and Federal agencies focused on the refuge's protection of the original remnant of Tinicum Marsh, as well as expanding the freshwater tidal marsh through restoration of additional lands that were historically marsh.

Restoration of freshwater tidal marshes on other parts of the refuge through the removal of former fill material is a complex undertaking. Considerations of soil composition (including potential contaminants), surface elevations, hydrologic conditions, species establishment, and long-term maintenance are all necessary for successful restoration. Climate change impacts, such as sea level rise, increase the complexity for future tidal marsh restoration projects. These projects are also costly due to the equipment, duration, regulatory requirements, and complexities required in construction. Many areas of former tidal marsh have been altered and now encompass open water areas or forested habitats.

Identifying the ideal location and conditions for tidal marsh restoration, and evaluating their existing versus future potential in light of existing habitats and threats from climate change, will be necessary to ensure cost-effective and successful results. We discuss how the refuge will respond to concerns related to freshwater tidal marsh conservation and restoration needs in chapter 3 under goal 1 for each alternative.

(4) How will the refuge manage invasive, nonnative, and overabundant species?

Invasive plant species threaten refuge habitats by displacing native plant and animal species, degrading wetlands and other natural communities, and reducing natural diversity and wildlife habitat values.

Climate change may also result in a shift of species distributions or conditions across the region that may allow introduction of additional species in the future. Prioritization and management of invasive species should be put in context with other regional efforts to be most effective, but is compounded by limits on staff and resources available to implement treatments against invasive species.

Native species can also adversely affect natural biological diversity when they become overabundant. Numerous Federal and state agency partners noted the importance of managing and controlling both invasive, nonnative species and overabundant native species. Our response to these concerns is discussed in chapter 3 under goals 1 and 2 for each alternative.

(5) How will the refuge manage its 145-acre impoundment?

Impoundments are confined bodies of water. The refuge has one large impoundment with a water control structure (WCS) totaling approximately 145 acres and two small impoundments without water control structures totaling approximately 20 acres. Natural changes in water levels can occur from rainfall

and natural springs. Water levels in the impoundment with a water control structure can be altered by inserting or removing boards that either release water or allow tidal water to flow into the impoundment. Changes in water levels during specific times of the year provide habitat and food for an array of wildlife including shorebirds, wading birds, and waterfowl.

The 145-acre open water impoundment is the most accessible area for public observation of wildlife and a focal point for many refuge visitors. It provides a combination of habitats for migratory birds, and supplementary habitat for rare species of reptiles and amphibians. Water level management is difficult due to groundwater elevations, stormwater inputs, the staff resources required, and the capacity, design, and location of the control structures. Some recommendations have been made to restore part or all of the impoundment to freshwater tidal marsh as well as maintain it as open water, but with fluctuating (possibly tidal) hydrology. Our response to these concerns is discussed in chapter 3 under goals 1 and 2 for each alternative.

(6) How will the refuge address contaminants and other environmental hazards that may adversely affect wildlife and other resources on the refuge?

Polychlorinated biphenyls (PCB's), polycyclic aromatic hydrocarbons (PAH's), and other toxic hazards are known to occur within refuge lands and waters, posing a health risk to fish and wildlife species using the refuge. These compounds affect fish and wildlife by causing reproductive abnormalities, increasing embryonic mortality, increasing physical abnormalities, and decreasing immune system response.

The Lower Darby Creek Remedial Area is a designated Superfund site that consists of two closed landfills that pose these environmental health hazards to the refuge. The U.S. Environmental Protection Agency (USEPA), as a result of the Superfund designation, is leading the remediation efforts. One of these sites, Folcroft Landfill, is located on refuge property. This site is undergoing implementation of a long-term remediation strategy. Some concerns were voiced regarding the immediate and long-term effect of these compounds on fish and wildlife at the refuge. Our response to these concerns is discussed in chapter 3 under goals 1 and 2 for each alternative.

(7) What role will the refuge play in conservation throughout the Delaware Valley region?

The refuge, located within the city of Philadelphia and within an hour of four states (Pennsylvania, New Jersey, Delaware, and Maryland), has the potential to act as a regional portal for conservation. Its location and facilities can provide suitable accommodations for meetings, events, and other forums. Refuge staff has the potential to act as a clearinghouse of information related to issues facing the refuge and regional conservation community, such as tidal marsh restoration, deer management, public use effects and compatibility, and invasive species control. At the same time, the region is surrounded by many other organizations and agencies involved with fish and wildlife conservation. Defining our role in regional conservation is important to ensure the refuge protects those resources it can have the greatest impact on, minimizes duplication of efforts, and works with other organizations to achieve management goals. Several questions and comments were made asking us to consider various ways the refuge might embody a partnership or leadership role within regional conservation and associated issues. Our response to these concerns is discussed in chapter 3 under goals 1 through 5 for each of the alternatives.

Visitor Services
John Heinz NWR was created with the specific purpose of promoting environmental education, as well as wildlife observation. With limited land available to promote species and habitat conservation, providing appropriate and compatible public use is an important issue addressed within this draft CCP/EA. As with biological management, the issue of visitor services management encompasses a series of topics identified during the scoping process.

(1) How will the refuge continue to fulfill its original mandated purpose to create an environmental education center, and what types of programming and target audience will the refuge provide?

The refuge's location provides a great opportunity to introduce the public to the Service and Refuge System, and our role in conservation. With limited staff resources and several other environmental education providers within the region, identifying potential partnerships, the most receptive target audiences, and unique educational components is critical for providing the most effective environmental education opportunities at the refuge.

Several comments were received from agency staff and the public regarding environmental education at the refuge. Several commenters noted that the refuge needs to improve and focus educational programming to engage urban youth in and around the city of Philadelphia. Other recommendations included the need to improve and update refuge displays and expand offsite education, including new digital and interactive media technologies. Our response to these concerns is discussed in chapter 3 under goal 3 for each alternative.

(2) What will the refuge do to improve its environmental interpretation, wildlife-dependent recreation, and compatible public uses?

The refuge offers numerous opportunities for environmental interpretation by maintaining 10 miles of hiking trails, interpretive signs, displays, and kiosks, as well as sponsoring several public events focused on fish, wildlife, habitat, and their conservation. The majority of refuge visitors participate in self-guided interpretive or wildlife-oriented recreation, outside of planned programs and events.

Most refuge visitors access the refuge on foot for purposes of wildlife viewing, photography, fishing, environmental education programs, or exercise. Additional, but restricted, access is allowed for bicyclists and vehicles used by people with disabilities, where compatible with refuge management. Due to the location and surrounding urban context, there have been several requests to incorporate at least a portion of the refuge's trail system into local and regional bicycle trails. Recommendations have been made to improve access to the tidal marsh through new trails, viewing platforms, or shuttle buses as well as development of eco-tourism with nearby businesses. Determining what access is desired and compatible with the Refuge System mission, as well as feasible on the refuge, will be required to make the appropriate improvements to public accessibility.

We have also received requests to improve access and interpretive facilities at the refuge's west entrance near the SR420 entrance located in Delaware County (see map 1.3). With limited space and staff resources, identifying the most receptive target audiences and effective interpretive components are important for effectively accomplishing our goals for interpretation. Our response to these concerns and recommendations is discussed in chapter 3 under goals 4 and 5 for each of the alternatives.

(3) What will the refuge do to educate the public about local cultural resources on or around the refuge?

The refuge location and surrounding lands are significant not only from a natural resource standpoint, but also for cultural history. To date, the refuge has not incorporated many components of the regional cultural history into its education and interpretation. Opportunities to tie into the rich Philadelphia-area settlement history, Lenni-Lenape culture, as well as showcasing natural history topics, such as the changing history of conservation and attitudes towards wetlands, have been recommended for the refuge to consider incorporating into its public use programs. Historic and cultural programs can also attract a wider audience and can introduce new individuals to conservation and stewardship. Considering how, when, and what aspects of cultural history to incorporate into the refuge education and interpretation need to be defined in light of existing and proposed programs, their goals, and available resources. Our response to these concerns and recommendations is discussed in chapter 3 under goals 3 and 4 for each of the alternatives.

(4) How will the refuge utilize partnerships with area agencies, businesses, and organizations to benefit resource conservation and visitation?

Despite the focus of management on the refuge, there are many partners within the surrounding region that can complement or support refuge programs related to education, interpretation, biological management, and public use. The partnerships we develop can have lasting benefits to refuge resources and promoting the Refuge System mission. We continue to partner closely with the Friends of the Heinz Refuge to accomplish a variety of refuge goals related to biological management and environmental education and interpretation.

Several possibilities for partnerships and ways they may benefit the refuge were identified in comments from both agency partners and the public. Fostering transportation and tourism-based partnerships with Philadelphia International Airport, SEPTA, and the city of Philadelphia has potential to yield increases in visitors. The refuge was encouraged through public comment to cooperate and "cross-market" to audiences with other local and regional historic sites and conservation organizations to increase visitation. Participation and coordination with other local organizations and agencies can reduce duplicate efforts and enhance participation in events and programs. Identifying and developing partnerships throughout the region takes time and careful consideration to ensure results and compatibility with refuge goals and objectives. Our response to these concerns and recommendations is discussed in chapter 3 under goals 1 through 6 for each of the alternatives.

Issues and Concerns Outside the Scope of this Analysis

We derived the following concerns and issues from public and partner meetings and further team discussions. These topics listed below fall outside the jurisdiction and authority of the Service or were deemed impractical. As a result, they are not discussed further within this plan.

(1) How will the refuge address degraded water quality entering the refuge and its associated impacts on fish and wildlife?

The water quality at the refuge is determined by the combination of waters from Darby Creek, Cobbs Creek, and the Delaware River. Philadelphia Water Department and other local, regional, and State agencies have conducted a series of watershed assessments and water quality characterizations that have detailed the water quality impacts related to urbanization and other watershed impacts.

Other smaller streams (such as Muckinipattis and Hermesprota Creeks) directly connected to the refuge may also pose important considerations for water quality. Organic loading and pathogens are a growing water quality concern from State agencies in the Darby Creek watershed. Many water quality issues are watershed-scale concerns. The refuge, located at the base of the watershed, requires an understanding of these impacts and water rights and regulations to most effectively manage for environmental health.

Addressing the sources of degraded water quality requires a proactive, watershedwide, and multijurisdictional approach. We do not have the regulatory authority to adequately address the variety of nonpoint source pollution inputs that are impacting the refuge. We acknowledge that water quality plays an important role in the environmental health of the refuge. As a result, we will explore options for improving our monitoring of water quality as it relates to management on the refuge. As opportunities arise, we will support partner organizations to address water quality concerns that would directly benefit the refuge. These approaches are discussed in chapter 3 under goals 1 and 2 for each of the alternatives.

Chapter 2

Elizabeth Jackson/USFWS

Great egrets within the 145-acre impoundment at John Heinz NWR

Affected Environment

2.1 Introduction

This chapter describes the current and historic physical, biological, and socioeconomic landscape of John Heinz NWR. Included are descriptions of the physical landscape, the regional context and its history, and the refuge environment, including its history, current administration, programs, and specific refuge resources. Much of the information included herein was originally compiled in the Draft Habitat Management Plan (appendix B). Since then, several new studies and reports related to aspects of climate change, biological management, and socioeconomic demographics have been released. Those reports have been reviewed by the planning team and incorporated into the summary provided here.

2.2 The Physical Landscape

Watershed Context

John Heinz NWR is located within the Delaware River Basin, which encompasses 13,600 square miles and stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic Ocean. The Delaware River watershed includes portions of Delaware, Maryland, New York, New Jersey, and Pennsylvania (DRBC 2004).

Within the Delaware watershed, the pre-industrial landscape was predominantly woods and wetlands, with expanses of farmland and small areas of human settlement. Decades of development and harvesting resulted in filled wetlands and a decrease of forests (DRBC 2004).

The refuge is located near the confluence of Darby Creek and the Delaware River located on the southwest boundary of the city of Philadelphia. Most of the 77 square miles of the Darby Creek watershed lies within Delaware County with additional portions found within surrounding Chester, Delaware, Montgomery, and Philadelphia Counties. The watershed is very urbanized, encompassing all (or parts) of 31 municipalities, which are home to approximately 500,000 people, with an average density of nearly 10 persons per acre (DCVA 2005).

Geologic Development

John Heinz NWR is situated within Pennsylvania's southeastern most physiographic province, the Atlantic Coastal Plain (Low et al. 2010). This province extends from southern Delaware County up into Philadelphia County where it includes all of Philadelphia except the northwestern part. Outside of Pennsylvania, this province extends throughout areas along the Atlantic Ocean from Massachusetts to Florida, including all of southern New Jersey and most of Delaware.

This physiographic region is characteristically flat land with sandy soils. These soils are primarily composed of sand, silt, and gravel resulting from the weathering of very old Paleozoic and Precambrian metamorphic rocks. This rock, originally laid down as sediments 438 to 1,600 million years ago, was altered by heat and pressure to form various metamorphic rocks, which in turn weather relatively easily.

The refuge is influenced by the Delaware River and its soils are in a different group. Soils on the refuge are composed of sand and gravel laid down by periodic flooding over the last 1.6 million years with additional silt and clay deposits where finer material was able to settle. Alluvial sediments in areas along this reach of the Delaware River were deposited over the last 12,000 years (PNHP 2008). These finer alluvial sediments are those which naturally comprise much of the soils throughout the refuge. DCNR (2010) has highlighted Tinicum Marsh as an Outstanding Scenic Geological Feature worth noting within this physiographic province.

2.3 The Cultural Landscape Setting and Land Use History

Pre-European Habitat

The pre-settlement forest of southeastern Pennsylvania was a mixed-aged forest (Latham et al. 2005). In areas along the Delaware River, the coastal plain forest type covered a significant portion of the Philadelphia area. This community supported a suite of species common farther south. This community developed in this region because of the sandy soils combined with the warm coastal air blown up from Delaware Bay. This forest type was dominated by sweet-gum (*Liquidambar styraciflua*) and oaks (*Quercus spp.*) intermixed with species such as American beech (*Fagus grandifolia*). The understory would have also included broadleaved evergreen species such as American holly (*Ilex opaca*) (PNHP 2008).

Floodplain forests were also found along many river systems in this part of the State. These forests would have been regularly flooded, for various durations, on an annual basis. In the most frequently flooded areas, fast-growing species such as sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and American and slippery elm (*Ulmus americana and U. rubra,* respectively) would dominate. Associated species would include eastern cottonwood (*Populus deltoides*), common hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), green ash (*Fraxinus pennsylvanica*), and box-elder (*Acer negundo*) interspersed among them. Permanently wet or saturated areas, such as backwaters and isolated oxbows, would have supported swamp white oak (*Quercus bicolor*), pin oak (*Quercus palustris*), and red maple (*Acer rubrum*).

Grasslands and native meadows were likely to be found throughout the Philadelphia area prior to colonization. However, it is unlikely that these were self-maintaining systems. Meadows were often managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest partly in order to provide forage for game species such as grouse, turkey, deer, and elk (Latham et al. 2005).

PNHP estimates that Philadelphia County at one time contained 10 to 20 square miles (6,400to12, 800 acres) of freshwater tidal marsh (PNHP 2008). Historically, and as it is today, these wetlands provided an important breeding spot for many bird, mammal, fish, amphibian, reptile, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects over 1/3 square miles (282 acres) of the freshwater tidal marsh that remains in this part of the State (PNHP 2008).

Pre-European Settlement

Human occupation of the lower Delaware River drainage likely began as early as 16,000 years ago with the arrival of the ancestors of the Lenni–Lenape people, known to the English as the Delawares. This reach of the river was narrower and nontidalat that time, flowing through forested floodplain and freshwater marshes. Sea level rise had already been initiated by melting of the Wisconsin ice mass far to the north, and continued at a gradually slowing pace until about 5,000 years ago. By this time the local environment had stabilized as a tidal estuary with marshes comprising not only most of the current refuge land, but also a large part of the area now covered by Philadelphia International Airport.

As a result of the destruction caused by intensive historic period development, remarkably few archaeological sites dating from prior to European contact have been found in Philadelphia or its surrounding boroughs. The earliest recorded sites within the city date from approximately 5,000 years ago although, it is likely that earlier ones existed and some may still exist in small and scattered areas of undeveloped land.

Within the Tinicum Township, the landscape of the refuge consists entirely of tidal marsh overlaid by a system of dikes. Some of the dikes are wide enough to support trees and brush on their edges, but close examinations of early maps and photographs reveal no natural islands. The only refuge areas suitable for pre-Contact Native American occupation consist of two narrow strips of terrace on the north side of Darby Creek in Folcroft and a larger area within the Eastwick portion, containing the refuge headquarters and maintenance areas. These areas were farmland in the early 20th century but are now forested. These areas may retain some archaeological potential, though the immediate vicinity of the refuge headquarters consists of a deep and remarkably extensive modern fill.

European Settlement

Soon after European settlement in the mid-17th century farmers began to extensively dike and ditch tidal marsh to convert it to hayfields. Portions of the refuge dike system follow the trace of dikes dating from the mid-19th century, and likely considerably earlier. That earlier dike system was modified in the mid-20th century by installation of various water control structures, widening of virtually all dikes for construction of roads on top of them, construction of interior dikes at some locations, and erosion of considerable lengths that fell out of use. The ditch system, poorly represented on historic maps but visible in early 20th century photographs, has almost completely vanished due to modern erosion and siltation. There are no standing historic structures on the refuge. The only dwelling sites recorded are two farmsteads established in the 1870s or earlier, both of which were obliterated by bridge construction and widening of South 84th Street in the 1970s.

20th Century Influences

Events that destroyed or highly altered what are now refuge lands over the 20th century are well documented in Two Studies of Tinicum Marsh (McCormick et al. 1970). One of the first impacts of the 20th century was the construction of the Philadelphia and Chester Railway Company, a trolley service that provided direct transit between Chester and Philadelphia from 1901 to November 1946 (Schieck and Cox 1970). This former trolley bed runs parallel to the refuge's southern access road. While the trolley bed is not within the refuge boundary, its construction impacted current refuge lands with extensive cut and fill operations along its corridor. Aerial photos of the refuge area from 1928 document the presence of extensive marsh as well as several dike and road systems (figure 2.2). It continues to affect the hydrology and drainage in the area of the impoundment.

The 1930s saw numerous, and expensive, repairs and alterations by the U.S. Army Corps of Engineers (ACOE). The Federal Works Program Administration, Pennsylvania legislature, and Delaware County all appointed funds to repair the dikes along the southern edge of Darby Creek. In 1935, a proposal for mosquito control led ACOE to construct a series of ditches throughout Tinicum Marsh. Some of these artificial channels are still visible today in the northern half of the freshwater tidal marsh. From the 1930s until the 1950s, several areas within and around Tinicum Marsh were utilized by ACOE for landfills of dredged material (McCormick et al. 1970).

The early 1970s saw the construction of Interstate 95 (I-95) and an interchange system with State Road 420. These major projects resulted in the dredging and filling of many marsh areas around the refuge. Today, these areas remain as permanent open water features where dredging occurred and as either degraded floodplain forest or wetlands dominated by phragmites.

The Folcroft Landfill operated from the 1950s through the 1970s accepting municipal, demolition, and hospital waste. It was closed in 1973 as a result of permit violations and improper management. Closing activities included

regrading of the landfill, reducing steep slopes along with covering, and seeding the site (USEPA 2006).

Figure 2.1. Aerial photograph of John Heinz National Wildlife Refuge lands in 1928 (prior to refuge establishment). Note the presence of extensive marsh and wetlands surrounded by agriculture.

In 1980, Congress authorized the purchase of the Folcroft Landfill to increase the size of the refuge. At this time, a potentially responsible party (PRP) group is conducting a remedial investigation of the landfill pursuant to an administrative order on consent with the U.S. Environmental Protection Agency (USEPA) (USEPA 2006). Refuge staff is working with USEPA to facilitate the landfill cleanup efforts.

In 1991, through a bill sponsored by Congressman Curt Weldon, the Tinicum Wildlife Preserve officially became John Heinz National Wildlife Refuge at Tinicum in honor of the late Senator who was influential in the marsh's preservation.

In February 2000, a subsurface pipeline owned by Sun pipe Company and operated by Sunoco, Inc. ruptured, releasing 191,982 gallons of crude oil into the 145-acre impoundment in the refuge. At the time of the release, the impoundment contained a thick layer of ice that formed a natural barrier which prevented the oil from spreading throughout the impoundment. At its peak, the area affected by the oil spill encompassed approximately 1.6 acres. This included the oil slick floating under the ice and an area of shoreline adjacent to the slick containing emergent, scrub-shrub, and forested wetlands. Sunoco provided initial response personnel to secure the site and to begin the initial cleanup operation. More than 90 percent (173,799 gallons) of the spilled oil was recovered through the cleanup effort. In addition to the 1.6 acres directly impacted by oil contamination, another 1.25 acres were directly impacted by response vehicles and equipment.

Shortly after the oil leak was discovered and concurrent with the initial cleanup efforts, the Service, the PFBC, and the PADEP initiated a cooperative Natural Resource Damage Assessment (NRDA). Subsequently, the U.S. Environmental Protection Agency, Region III (USEPA) issued a Unilateral Administrative Order for the Abatement of Endangerment that required "restoring all areas, including soils and sediments, to the maximum extent possible, to their condition

before the discharge of oil." Sunoco and the participating agencies developed a restoration plan. Restoration efforts were completed and a final report was submitted to the USEPA on June 3, 2005 (Entrix, Inc. 2005).

Additional information on the history and cultural resources of the refuge and surrounding lands are identified in the Phase I Archaeological Survey Report developed for the Clearview Landfill, part of the Lower Darby Creek Area Site (Kim and Teamerson 2011). This report is available online at the EPA's Lower Darby Creek summary Web site.

Wildlife and Habitat Changes

Habitat loss and degradation is the single greatest cause of loss or decline of species across the globe (and in Pennsylvania), threatening over 80 percent of rare and endangered species (Wilcove et al. 1998). Invasive species that compete with or reduce populations of native species are the second greatest cause of declines (affecting over 50 percent of terrestrial species). In Pennsylvania, an estimated one-third of all plants are nonnative, and 11 percent of all fish are nonnative (Goodrich 2001).

Maps of the refuge area dating back to the late 1700s show an area largely comprised of wetlands—likely freshwater tidal marsh, as it was historically present along the Delaware River. Over the following two centuries, agriculture and urbanization slowly encroached on these wetland areas. John Heinz NWR today is largely an island of habitat within its urban surroundings. As a result, large predators and other species that would have once inhabited the area are now gone.

The Pennsylvania Department of Conservation and Natural Resources compiled an overall habitat quality rank by using estimates of habitat quality for streams, wetlands, forests, and grasslands index for each physiographic region throughout the State. This ranking highlights coastal plain habitats as the only "impaired" habitats within Pennsylvania and highlights the coastal plain region as being home to some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNR report *Wildlife Habitat in Pennsylvania, Past, Present, and Future*, recommends that where possible, wetlands along the Delaware should be restored. Urban forests could be focal points to provide habitat for some tolerant forest wildlife. Reduction of runoff into streams and wetlands should be top priority, along with restoration of natural communities in undeveloped areas (Goodrich 2001).

The Refuge, the Land, and the People

The cultural history of the region reflects changing societal values in the U.S. The Lenape and earlier indigenous people, along with European explorers and settlers valued the marshes and adjacent uplands for agriculture, fishing, and hunting along with its strategic location for trade and transportation. Undoubtedly, this area's ongoing relationship with different cultures and land ethics throughout the centuries has had many impacts on the refuge as it is known today.

As the Tinicum region developed, the perceived value of marshes diminished for the public, which resulted in the fill or dredging of many acres of wetlands. The history of the refuge over the past 50 years reflects a renewed and refined sense of ecological value in respect to habitat protection and conservation.

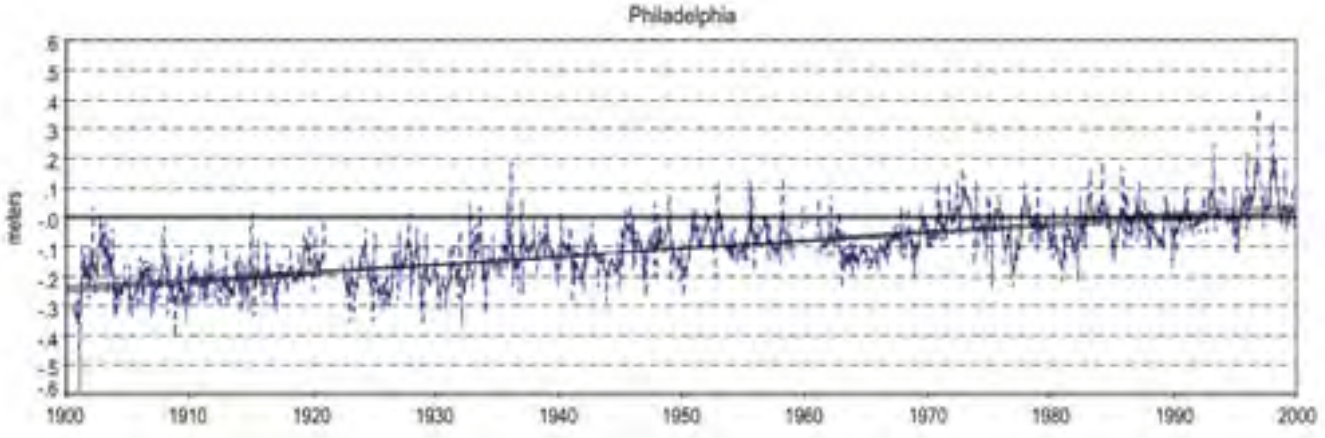
2.4 The Current Climate and Potential Effects of Climate Change

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. The average summer temperature is around 75° Fahrenheit (F), while the average winter temperature is 33°F. Average precipitation totals around 46 inches per year, with an average annual snowfall of around 30 inches (NRCC 2006). July tends to be the warmest and

wettest month with an average temperature around 85°F and average monthly rainfall around 4.38 inches. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events (NRCC 2006). In recent years, these large events have caused flooding in and around the refuge.

Like many areas throughout the world, the climate of southeastern Pennsylvania is changing. Over the past century mean annual temperature has risen 0.5°F (UCS 2008). Sea level, as measured by a tidal gauge at Philadelphia, has also risen nearly 1 foot over the past century as shown in figure 2.2 (NOAA/NOS 1999).

Figure 2.2. Monitored Sea Levels at Philadelphia, Pennsylvania (1900–2000). Note the nearly 1-foot rise in sea level over the past century (NOAA/NOS 1999).



Climate change and sea level rise projections for the region will potentially have major influences over the habitats of John Heinz NWR and their management over the coming decades. As with other areas throughout the world, the precise ecological impacts to John Heinz NWR from a changing climate are largely unknown at this time. Detailed monitoring of habitat conditions and species utilization will be necessary to identify potential shifts in species assemblages or distribution across the refuge and region. However, reports and guidance documents published in recent years provide projections and estimates upon which the refuge can begin to build an understanding of how these potential impacts may manifest themselves and impact the refuge.

According to a recent report released by the Union of Concerned Scientists, temperature projections for the coming decades (2010 to 2039) may make eastern Pennsylvania's climate more closely resemble that of Maryland or northern Virginia as we know it today (UCS 2008). Philadelphia and other large cities already experience extreme heat and air pollution events. The Intergovernmental Panel on Climate Change (IPCC) projects that urban areas throughout North America will experience more severe and longer heat waves and increased impacts from air pollution (UCS 2008; Philadelphia AMS 2008). In their *Summary Report for Policymakers*, the IPCC warns with "very high confidence" that these extreme temperature events may lead to increasing impacts on forests through disturbances from pests, diseases, and extended periods of high risks of fire. It is important to note that "very high confidence" is defined as a 9 in 10 likelihood of occurrence (IPCC 2007).

Recent estimates by the IPCC for global sea level rise could have serious implications for the freshwater tidal marsh within John Heinz NWR. Conservative estimates project a rise between 7 and 14 inches over the next century, while higher estimates range between 10 and 23 inches (UCS 2008). Najjar et al. (2000) estimate global sea level rise between 0.4 to 1.2 inches by 2030 and between 1.6 to 4.0 inches by 2095. Another recent estimate shows relative sea level rise (which accounts for mean sea level rise and land subsidence) may increase 2.6 to 5.6 feet by the end of the century (Kreeger et al. 2010).

Sea levels have fluctuated over many millennia. Tidal marshes (both salt and freshwater) typically respond to these fluctuations through two mechanisms: accretion of sediment across the marsh surface (i.e., a rising of the marsh surface elevation) or expansion into nearby (and topographically higher) riparian lands (i.e., conversion of surrounding lands) (Odum et al. 1984). Due to the unique landscape context of John Heinz NWR being situated within the Philadelphia metropolitan area, at the base of a highly urbanized watershed and at the confluence of Darby Creek with the Delaware River, the refuge's freshwater tidal marsh is particularly vulnerable to changing sea levels. Given this level of urbanization in the Darby Creek watershed, it is unclear which, if either, of these options may allow the necessary adjustment to rising sea levels.

In addition to the rise in water levels alone, the salt line of the Delaware River[1] has potential to shift upstream and into the zone encompassing the refuge. Currently, the refuge is less than 1 mile upstream from the salt line. The intrusion of salt water is problematic for freshwater tidal marshes and freshwater tidal swamps that cannot tolerate salinities greater than 0.5 milligrams per liter. Not only plants, but animal and microbial communities will be altered by salt intrusion (Weston et al. 2006, Craft et al. 2008). As plants with a low salt tolerance become stressed, less productive and die, marsh communities shift to salt-tolerant species.

A major shift in the salinity of waters within John Heinz NWR could lead to a major shift in plant communities and species within areas which are currently freshwater tidal marsh. Neither the effects of sea level rise on marsh elevations nor salinity levels are well understood within the Delaware Bay at this time, although preliminary analysis shows that the estuary has increased in salinity over time (Kreeger et al. 2010). Monitoring these influences over the coming years will be a major step in developing management options for the refuge into the future.

In an effort to address the potential effects of sea level rise on United States national wildlife refuges, the Service's Northeast Region contracted the application of the Sea Level Affecting Marshes Model (SLAMM) for most of its refuges with tidal waters. This analysis was initiated to inform the decisionmaking process as part of CCP development for each refuge along with other long-term management plans. Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the SLAMM 6.0. This model accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989; Warren Pinnacle 2011).

[1] This is the zone where low-salinity freshwaters from the Delaware River watershed combine with high-salinity waters from Delaware Bay (characterized as having a concentration of 250 milligrams per liter (mg/L) sodium chloride).

For John Heinz NWR's analysis, SLAMM 6.0 was run using scenario A1B from the Special Report on Emissions Scenarios (SRES)—mean and maximum estimates. The A1 scenario assumes that the future includes very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPPC 2007) suggests a likely range of 0.7 to 1.6 feet (0.21 to 0.48 meters) of sea level rise by 2090 to 2099 "excluding future rapid dynamical changes in ice flow." The A1B-mean scenario that was run as a part of the refuge-specific analysis falls near the middle of this estimated range, predicting 1.3 feet (0.40 meters) of global sea level rise by 2100. To allow for further analysis, SLAMM was also run assuming 3.3 feet (1 meter), 4.9 feet (1.5 meters), and 6.6 feet (2 meters) of global sea level rise by the year 2100.

According to the SLAMM analysis conducted, John Heinz NWR is predicted to experience significant effects of sea level rise. Undeveloped dry land, which makes up roughly one quarter of the refuge, is predicted to be lost at a rate between 24 percent and 54 percent (66 to 145 acres respectively) across the range of sea level rise scenarios. Tidal freshwater marsh, which makes up roughly one third of the refuge, is predicted by to be lost at a rate of 9 percent to 84 percent (approximately 14 to 352 acres respectively) once scenarios exceed 1.3 feet (0.39 meters) of global sea level rise (Warren Pinnacle Consulting 2010). According to these results, the refuge will begin to see the most drastic effects of sea level rise once it exceeds 2.3 feet (0.69 meters). These levels of sea level rise would result in major shifts in the habitat types and species composition across the refuge (table 2.1). Appendix J provides more information on the SLAMM analysis and the predicted impacts of sea level rise on John Heinz NWR.

Another concern related to sea level rise is increasing salinity. Increasing sea levels will result in larger tidal volumes that carry more salt water higher up into the estuary. Sea level rise could increase the tidal range in the Delaware system (Walters 1992). Tidal range changes would also likely increase the salinity range over the tidal cycle (Kreeger et al. 2010). A preliminary analysis, completed by Dr. Najjar of Pennsylvania State University, reviewed existing salinity measurements dating back to 1927 to document trends in salinity within the Delaware Estuary. His results suggest that salinity is increasing at a rate greater than can be explained by streamflow and models of the response of salinity to sea level. This phenomenon could be a result of other forces in the estuary, such as successive channel deepening events that occurred during the period of analysis, which could have also contributed to salinity intrusion due to larger tidal volumes and bathymetric changes (Kreeger 2010). Due to such complexities in determining salinity migration at the upper end of the estuary, modeling of potential changes in salinity resulting from sea level rise could not be completed at the time of this writing.

Again, the IPCC warns with "high confidence" (or an 8 in 10 chance) that, "the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers…" (IPCC 2007). Heavy rain and snow events are anticipated for many

parts of North America. For John Heinz NWR, being at the base of the Darby Creek watershed which is already highly urbanized and experiencing frequent flooding, this prediction would likely lead to more frequent flood events over the coming decades.

Table 2.1. Predicted Net Loss of Habitat Types at John Heinz NWR Using a Simulated Scenario of a 2.3 feet of Sea Level Rise through 2100.

	Predicted Acreage by Habitat Type				
Habitat Type	**Initial**	**2025**	**2050**	**2075**	**2100**
Tidal Fresh Marsh	419.7	406.7	401.2	395.7	381.2
Undeveloped Dry Land	268.0	217.5	209.8	200.4	176.2
Inland Open Water	184.6	164.5	164.6	164.4	163.9
Riverine Tidal	145.0	68.9	67.6	60.7	59.6
Inland Fresh Marsh	66.5	62.5	62.5	62.3	47.3
Tidal Swamp	61.6	58.7	58.0	56.6	54.8
Developed Dry Land	41.6	36.3	35.4	34.2	32.6
Inland Shore	7.8	6.7	5.5	4.2	3.2
Estuarine Open Water	0.0	97.6	104.9	123.3	140.2
Tidal Flat	0.0	0.0	28.6	23.9	20.1
Regularly Flooded Marsh	0.0	55.2	25.9	33.5	38.1
Transitional Salt Marsh	0.0	18.1	22.2	26.0	60.0
Irregularly Flooded Marsh	0.0	1.9	8.6	9.6	17.7
Total Acreage (including water)	**1194.7**	**1194.7**	**1194.7**	**1194.7**	**1194.7**

Over the last century the annual average temperature in Pennsylvania increased by over 0.5°F (UCS 2008; NOAA 2008). This warming has resulted in many climate-related changes such as more frequent days with temperatures above 90°F, a longer growing season, increased heavy precipitation events, less winter precipitation in the form of snow and more as rain, and rising sea surface temperatures and sea level (Hayhoe et al. 2007).

Being located in a physiographic region (the piedmont and coastal plain) where the ranges of many species overlap between northern and southern regions, the area's plant, fish, and animal populations are diverse. These shifts in temperature and precipitation will likely impact the plant and animal populations adapted to the historic climate of the Mid-Atlantic. As summers are projected to become warmer across the Northeast, many plant species are likely to shift ranges northward (Iverson et al. 2008).

As outlined in earlier chapters, the refuge has acted as an ecological oasis within the highly urbanized lands surrounding Philadelphia. It has provided refuge for many species using its habitats for migratory stopovers, nesting, spawning, and feeding. Unfortunately, the isolation of the refuge from other natural areas will limit the ability of refuge habitats to respond to the predicted impacts of climate change. For example, marsh habitat will be unable to shift inland because of the urban development surrounding the refuge.

2.5 Air Quality

The Philadelphia Department of Public Health, Air Management Services (AMS), the local air pollution control agency for the city of Philadelphia, is responsible for the prevention, abatement, and control of air pollution and air pollution nuisances, achieving and maintaining Federal National Ambient Air Quality Standards (NAAQS) in Philadelphia, and protecting the health and quality of life of the Philadelphia community from the adverse effects of air contaminants and noise (Philadelphia AMS 2010).

Philadelphia and its surrounding communities face many of the same air pollution challenges as other urban areas, mainly as emissions from vehicles and industries. The city of Philadelphia maintains a network of ten air monitoring sites located throughout the city. Many of the monitoring sites measure in "real time" the criteria principal pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM10 and PM2.5), and lead (Pb). Five of the sites also measure toxics, such as 1, 3-butadiene, benzene and carbon tetrachloride.

Areas of Pennsylvania where air pollution levels consistently stay below these standards are designated "attainment." Areas where air pollution levels persistently exceed these standards are designated "nonattainment" (PADEP 2011). According to the Pennsylvania DEP Bureau of Air Quality, Delaware and Philadelphia Counties are rated as moderate for attainment of the 1997 8-hour ozone standard of 0.08 ppm. These counties are also rated as "nonattainment" for standards related to particulate matter. Philadelphia County is also considered "nonattainment" for carbon monoxide standards (PADEP 2011).

Based on a preview of the results to State and local air agencies, air toxins in Philadelphia that show an excess lifetime cancer risk of greater than one in a million are: formaldehyde, benzene (including benzene from gasoline), acetaldehyde, 1,3-butadiene, carbon tetrachloride, naphthalene, chromium compounds, arsenic compounds (inorganic including arsine), PAHs and polyoxymethylene (POM), tetrachloroethylene (perchloroethylene), and ethylene oxide.

In Philadelphia, motor vehicles account for up to 60 percent of the total air pollution, according to the EPA (Clean Air Council 2011). According to the Delaware Valley Regional Planning Commission (DVRPC), I-95 immediately adjacent to and south of the refuge carries approximately 80,000 vehicles per day through Delaware County and South Philadelphia, and reaches a peak of 150,000 vehicles per day through Center City Philadelphia (DVRPC 2009). Bartram Avenue adjacent to the eastern refuge boundary carries about 20,000 vehicles per day (DVRPC 2005).

The Philadelphia AMS maintains the area Air Quality Index (AQI). The AQI is based on the five criteria air pollutants: ground level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Each pollutant is scored using formulas developed by the EPA. Based on the AQI, the number of days with good air quality in Philadelphia steadily increased from 1990 until 1999 and then decreased until 2002 before again increasing and subsequently leveling

off around 2005. In the same timeframe, the number of days with moderate air quality increased and leveled off (Philadelphia AMS 2010). Over the period from 1990 through 1998, the annual number of days with unhealthy air quality dramatically decreased and has remained about the same, roughly 23 days per year for each year since 2008 (Philadelphia AMS 2010). According to Philadelphia AMS, these improvements can be attributed mainly to emission reductions from gasoline markets, including vapor recovery at retail gasoline stations, and companies shutting down pollution producing processes (Philadelphia AMS 2010).

2.6 Soils

The Soil Survey of Philadelphia County shows the lands of John Heinz NWR being comprised of marsh soils and urban land (i.e., organic and mixed fill) (NRCS 2009). As discussed in previous sections, the natural soil composition of most, if not all, of the refuge lands consisted of silty alluvial soils deposited over the last 12,000 years. However, significant soil disturbances that occurred during the 20th century altered the soil structure (and consequently the hydrology) of many areas in and around the refuge. Thus, most upland areas within the refuge are comprised of organic fill material. Despite this significant impact, many of the riparian forest communities that naturally occur within this region (coastal plain and floodplain forests) seemed to have established in many of these areas.

2.7 Hydrology and Water Quality

Hydrology and Geomorphology

John Heinz NWR is located at or slightly above sea level. Consequently, Darby Creek and the freshwater tidal marsh within the refuge experience a daily tidal fluctuation of around 6 feet. Darby Creek flows through the refuge just upstream from its confluence with the Delaware River. Collectively, the Darby Creek and Cobbs Creek (a major tributary of Darby Creek) watersheds drain approximately 74.1square miles by the time they reach the refuge (USGS 2009).

As part of the Delaware Riverkeeper Network plan completed in 2005, baseline geomorphic stream data was collected and analyzed for trends in erosion and sinuosity from historic (1965 to 1990) and more recent (2000) aerial photographs along with topographic and other maps displaying the refuge area dating between 1757 and 2004. Darby Creek throughout much of the refuge is characterized by a braided stream channel with variable sinuosity. This channel type is common in coastal tidal streams near river deltas and tends be a relatively stable channel. However, major changes to the stream or watershed such as loss of vegetation, channel alterations, and urbanization, can affect stream morphology and cause the stream channel to adjust significantly (e.g., cause erosion and deposition) (Salas et al. 2006).

The basic geomorphic assessment of Darby Creek and other tributaries within the refuge generally reflect this inherent stability and response to major impacts. The majority of streams within the refuge have remained relatively stable over the past 40 years and longer. Analysis of historic aerial photographs and other maps show Hermesprota and Little Thoroughfare Creeks and portions of Darby Creek appearing relatively unchanged. However, major changes have been noted on Bow Creek and on other portions of Darby Creek.

Bow Creek, which historically connected Darby Creek and the Delaware River across what is now Philadelphia International Airport, is today completely isolated from Darby Creek. Darby Creek itself has displayed several signs of adjustment, most notably during the 1980s. Analysis of aerial photos from 1980 and 1990 show that the multi-channeled Darby's main channel cut through the center of Tinicum Marsh, shortening its total length by nearly half (from 8,400 linear feet to 4,800 linear feet). It is unclear what influenced this dramatic shift or whether the blockage of Bow Creek may have influenced this alteration of

Darby Creek. The channel has remained relatively unchanged since this last adjustment period.

Many of the areas in and around the refuge were historically freshwater tidal marsh. As discussed previously, loss and alteration of wetlands dates back centuries, as early as the first Dutch settlements of the 1640s, when many marsh areas around the Tinicum region were diked for agriculture. More recent losses of tidal marsh occurred between the 1950s and early 1970s, when several areas of the refuge were filled or dredged. These large-scale disturbances, altered hydrology, invasive species introductions, and high levels of deer browse continually impact many of the natural communities within the refuge. As observed as part of Delaware Riverkeeper Network's field surveys conducted in 2005, these areas are typically dominated by near monocultures of nonnative invasive species, contain fill and debris, unnatural amounts of open water habitat, and lack proper ecosystem structure (Salas et al. 2006).

The refuge also contains a 145-acre open water impoundment. The impoundment as we know it today was likely constructed sometime during the 1940s or 1950s. Historically, the impoundment was managed as open water with periodic tidal fluctuation. Two water control structures are still in place along portions of the impoundment dike. However, these structures became unusable as Darby Creek's channel pattern shifted further away from the dike in these locations during the early 1980s. This caused the structures to become silted in. Today, the refuge maintains one active water control structure in the northwest corner of the impoundment.

Water Quality

The refuge is located within highly urbanized and industrial surroundings, making it vulnerable to many factors that could negatively affect ecosystem and wildlife health. Point source and nonpoint source pollution within the Darby Creek watershed and Delaware Estuary affects water quality and available food chain support for ecosystems providing habitat at the refuge.

Water quality in the refuge is the result of the inputs to three major waterways: Darby Creek, Cobbs Creeks (a major tributary to the Darby) and the Delaware River. The contribution from each of these sources varies depending upon hydrologic, climatologic and anthropogenic conditions. Thus, the water quality found in the refuge is highly variable and complex. The status of water quality and aquatic life is determined by various chemical, physical and biological parameters. For management purposes, the tidal portions of Delaware River tributaries are considered to be part of the river. Twice each day, river water enters the Darby Creek system during high tide. In addition, various fish species freely move between Darby Creek and the Delaware River. Because of these factors, the tidal portion of Darby Creek is considered part of the Delaware River Basin Commission's Interstate Pollution Control Zone 4 (DRBC 2004). A zone-by-zone assessment of the attainment of designated water quality uses by the DRBC indicated that Zone 4 attained its recreational designated uses, but not its aquatic life uses (DRBC 2004).

Data for Darby and Cobbs Creeks have been collected by the Pennsylvania Department of Environmental Protection (PADEP), the U.S. Geological Survey (USGS), the Philadelphia Water Department (PWD), Darby Creek Valley Association (DCVA), the Academy of Natural Sciences (ANS), and others. Long-term monitoring of the tidal Delaware River occurs through the Delaware River Basin Commission (DRBC) with the Delaware Department of Natural Resources and Environmental Conservation (DNREC) conducting the sampling via contract from DRBC. The refuge is fortunate that a number of reports have been produced that describe the status of the Darby Creek watershed based on

recent data: the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 EPA Facility Report (NOAA 2000), and the Darby-Cobbs Characterization Report (PWD 2002).

During the early 20th century, the Delaware River in the vicinity of Philadelphia and Camden was the most polluted stretch of river in the U.S., if not the world (Albert 1988). In September 1946, no dissolved oxygen was found in this reach of the river; a "dead zone" that extended for more than 20 miles. In the intervening years, a massive effort was made to clean up the Delaware Estuary. By the mid-1980s, major reductions in nutrient pollution resulted in needed water quality improvements. The reach where Darby Creek enters the Delaware has shown substantial improvement in this regard.

Fish data collected in recent years indicate that Darby Creek's species diversity has increased over previous levels, including some pollution intolerant species. Environmental health metric scores based on fish populations suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor" (PWD 2002). Cobbs Creek fish metrics indicate only "fair" or "poor" environmental health scores (PWD 2002).

Environmental Contaminants

Environmental contaminants have an impact on wildlife present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site. The Lower Darby Creek Area includes four other sites within a 2 mile stretch along Darby Creek (NOAA 2000). Of the five sites, only Folcroft Landfill is located on the refuge. Coordination with the EPA regarding contaminant remediation is ongoing. EPA currently maintains authority over the remediation of the site. The Service currently owns this property and will ultimately take on management of it once the legal cases are settled and site closure is completed.

Over the years, aquatic life uses, as determined by PADEP and the Pennsylvania Fish and Boat Commission were not attained because of widespread fish advisories in the river and various tidal tributaries, not including Darby Creek. These advisories are the result of contaminants found in fish, including polychlorinated biphenyls (PCBs).

In 2003, staff from the Service's Chesapeake Bay Ecological Services Field Office, assisted by the Pennsylvania Ecological Services Office, collected 31 brown bullheads (*Ameiurus nebulosus*) as part of a study on the effects of polycyclic aromatic hydrocarbons (PAHs) in urbanized watersheds. The main objective was to determine the prevalence of liver and skin tumors, lesions that precede tumor development, and barbel abnormalities. Their findings reported a 26 percent prevalence of liver tumors and a six percent prevalence of skin tumors in brown bullheads (less than 260 mm in length) from Lower Darby Creek. Liver tumor prevalence is indicative of a contaminated habitat. Levels of liver tumors found were more than five times the Baumann (2002) criteria for distinguishing highly contaminated Areas of Concern from less contaminated Areas of Recovery (Pinkney et al. 2004).

A large crude oil spill in 2000 located on the refuge impacted the reproduction of resident turtle populations. Research was conducted to determine the effect of crude oil exposure on female snapping turtle and painted turtle fertility, reproductive output, and development of offspring. There was no significant difference in egg fertility between female snapping turtles exposed to oil or control turtles. However, female snapping turtles had significantly lower fertility of eggs in 2002 compared to 2000. There was no difference in reproductive output between exposure groups or years for snapping turtles or painted turtles. Most

snapping turtle embryos died early in development, and there were significantly more early deaths for oil exposed snapping turtles than controls. Control painted turtles not only had a higher incidence of abnormality than control snapping turtles, but malformations were more severe in the former than the latter. Oil exposure exacerbated developmental problems in snapping turtles, causing increased incidence and severity of deformity in embryos.

The study noted that both species exhibit high rates of embryonic and adult deformity and that although the refuge offers many advantages to the resident turtle populations, background pollution places a developmental burden on the life history of turtles that was exacerbated by exposure to crude oil. Despite the deformities documented in both oilexposed and control turtles, exposure to crude oil did not appear to have significantly affected the fertility or relative clutch size of snapping turtles or painted turtles (Bell 2005).

2.8 Noise and Soundscapes

John Heinz NWR is northwest of the Philadelphia International Airport (PHL) and is separated from the airport by I-95, a Southeastern Philadelphia Transportation Authority (SEPTA) rail line, and Bartram Avenue. The refuge is not aligned with any existing runway and is not on the direct approach or departure track for any of the existing runways. The noise analysis completed for a runway expansion project environmental impact statement (EIS) demonstrated that the refuge experiences noise levels between 45 and 60 decibels (dB) based on the Day-Night Average Sound Level (DNL) recorded near the refuge. A noise monitoring site on Lindberg Boulevard south of the refuge showed an average DNL of 50 dB. This is calculated to increase to 55.4 dB in 2007 and 56.5 dB in 2015 with the runway expansion project (PHL 2005).

These noise levels are considered compatible with the outdoor recreational use of the refuge in accordance with Federal Aviation Regulations Part 150 criteria for compatible land use (PHL 2005). However, we and other conservation partners are concerned about the ongoing impact of noise on wildlife present on the refuge. Noise generated from I-95 and Philadelphia International Airport, may adversely affect foraging of some species dependent on echolocation, including songbirds, bats, and frogs (Cohen and Johnson 2004, Siemers and Schaub 2010).

Noise impacts on wildlife are variable depending on the intensity and duration of the noise, as well as the auditory range of the animal itself. A study of wintering bald eagles found that human activities such as boating and fishing disturb eagles (especially adults). Normally occurring sounds were not particularly disturbing, although acute noise (such as gunshots) elicited escape behavior (Stalmaster and Newman 1978). Another study of bald eagles found human pedestrian activity was more disturbing than overflights by aircraft (Grubb and King 1991). At a study (Burger and Gochfeld 1998) conducted on a national wildlife refuge in Florida, researchers found that waterbirds such as the sora rail, glossy ibis, little blue heron and Louisiana heron were disturbed by the presence of visitors and that loudness was as significant of a disturbance as the number of people in this effect.

Highway noise has varied impacts, depending on species, tolerance to disturbance, and species preference. A study of impact of highways measured forest breeding birds in transects extending 1,200 feet (400 meters) from the edge of I-95 in Maine and found that four species were less abundant near the road while another six became more abundant near the roadway (Ferris 1979). Species that became less abundant near the road include the bay-breasted warbler, blue jay, Blackburnian warblers, and winter wrens. The six species that became more abundant near the road included the chestnut sided warbler, white-throated sparrow, wood thrush, common yellowthroat, robin, and Tennessee warbler.

Noise impacts can influence amphibians as well. The vocalizations of closely related anuran species, or even local populations of those with disjunctive

distributions, are known to differ in frequencies, harmonics, duration and rate of repetition of individual calls, as well as trill or pulsation rates (Bogert 1960). Decibels (dB) are routinely used as a measure of sound intensity. Griffin and Hopkins (1974) measured sound levels of bullfrog (*Rana catesbieana*) choruses and noted that the sound of calls travels unpredictably across a site depending on landscape and other ambient sounds. To be effective, the sound serving as the stimulus (i.e. frog calls) probably must be within relatively narrow limits of variation to be identified by that individual species (Bogert 1960). As documented in these studies, some amphibian calls occur within a narrow frequency bandwidth. In relation to the refuge, calls at these lower decibel ranges may easily be overpowered by ambient noise, depending on the location within the refuge, based on the existing average DNL of 50 dB measured near Lindberg Boulevard. As such, noise associated with I-95 and the airport likely prevents effective communication by impeding these calls because the dB levels overlap with the dB levels of the amphibian calls.

Road noise has been documented to adversely impact amphibians. For instance, when exposed to motorcycle sounds up to 95 dB, estivating spadefoot toads (Scaphiopus couchi) responded by emerging from their burrows (Brattstrom and Bondello 1983). Emerging prematurely may cause stress on the toads because estivation has exacerbated dehydration and depleted energy reserves. While this species is not located on the refuge, the research implications provide concern for the less-researched amphibian species found on the refuge. If intense sounds, such as low-altitude aircraft, cause the toads in the refuge to emerge at a time when food and water are not available, chances are likely they will not survive, let alone be able to reproduce.

Even though the refuge is an undeveloped area within a highly urbanized landscape, some elements of the natural landscape are maintained. Emerging science on natural soundscapes shows the importance of recognizing and documenting local, natural soundscapes. These soundscapes are considered to be an essential part of a landscape, its representative and "vocal" wildlife, and one's personal experience in the wild, whether in a park, wilderness, refuge, or similar form of natural landscape. As with other regions in North America, natural soundscapes have suffered greatly, mostly within the last 20 years. There are two main contributors to these changes: habitat destruction and an increase in human noise due to aircraft and land-based machinery, the impact of which is observed miles from the source (Krause 1999). There is no specific information on the soundscape of John Heinz NWR but there are clearly the sounds and noises of an urbanized landscape, in addition to the natural sounds normally associated with refuges. Traffic, airplanes, heavy equipment operation, industrial and commercial operations, and building and road construction all contribute to community noise and disturbance in varying degrees. These disturbances can be a feature of a degraded environment, and impacts due to human-induced noise need to be mitigated wherever possible.

2.9 Socioeconomic Landscape

Socioeconomic Setting of the Philadelphia Area and Refuge Surroundings

The refuge is located in southeastern Pennsylvania within Delaware and Philadelphia counties. Between 2000 and 2010, the population of Delaware County increased 1.5 percent and the population of Philadelphia County increased 0.6 percent (U.S. Census Bureau 2011). This is compared to a 3.4 percent increase across the State of Pennsylvania and 9.7 percent for the country as a whole (U.S. Census Bureau 2011). In 2009, the median household income in Delaware County was $61,848 and for Philadelphia County was $36,959, compared to $49,501 for the State and $50,221 for the United States overall. Between 2005 and 2009, unemployment was estimated at 3.7 percent in Delaware County, 12.1 percent in Philadelphia County, and 6.8 percent for the State of Pennsylvania (U.S. Census Bureau 2011).

According to the Delaware Valley Regional Planning Commission, 6 percent of the region's population is 5 years old or younger; 22 percent is between 5 and 19 years; 59 percent is between 20 and 64 years; and 13 percent is considered elderly, age 65 and older. One of the greatest challenges facing the region in coming years will be the continued aging of the population, particularly in the suburbs, as nearly nine percent of the population is between the ages of 55 and 64 years (considered "near elderly"). In particular, many of the neighborhoods immediately adjacent to the refuge are estimated to have over 15 percent of their residents 65 years or older (DVRPC 2009).

The surrounding landscape is demographically diverse. The percentage of the non-white and/or Hispanic population in surrounding neighborhoods ranges from less than 8 to over 30 percent. The average household income ranges from $27,000 to 51,800 in surrounding portions of Philadelphia County and $27,000 to 63,300 in neighboring portions of Delaware County. Single parents with children under 17 years of age comprise over ten percent of households in most surrounding neighborhoods. From a transportation perspective, some neighboring communities in Philadelphia County have up to 47 percent of carless households—relying solely on public transportation or other means of transportation. While in surrounding Delaware County, carless households range from 8 to 30 percent (DVRPC 2009).

Population trends forecasted for Philadelphia over the period between 2000 and 2020 anticipate a slight loss in overall population. The surrounding population will continue to have a large percent of elderly residents, with some areas forecasted to have over 15 percent of its population be 65 years or older (DVRPC 2009). Minority populations in the region will continue to increase. Philadelphia is a "majority-minority" city, with 61 percent of its population being of minority race and/or Hispanic as of 2006. The percentage of minorities increased in every county in the region between 2000 and 2006, with 2006 percentages in the region's suburban counties ranging from 36 percent in Camden County to 11 percent in Bucks County. Much of this growth in the minority population is attributable to growth in the numbers of Asians and Hispanics (DVRPC 2009).

Refuge Contribution to the Local Economy

The economic contribution of the refuge was evaluated as part of a nationwide survey and analysis conducted in 2006. In that year, the refuge recorded 106,491 visits. Ninety-eight percent of visits were for non-consumptive purposes such as hiking, wildlife observation, and photography. The majority of the visits (approximately 72 percent) were by nearby residents.

Total visitor expenditures related to recreation on the refuge estimated a total of about $1.1 million in FY 2006. Non-residents spent 67 percent of all visitor expenditures (about $719,500). Based on the analysis conducted by the evaluation final demand associated with refuge visitor recreational spending totaled $1.7 million. This represents the total dollars generated to the local economy as the result of refuge visits. This demand resulted in 14 jobs, which generated $536,300 in income and $241,400 in tax revenue. Non-resident visitors generated $1.1 million in economic stimulus to the local economy (Carver and Caudell 2007).

In context, the 36 million visitors to the Greater Philadelphia area spent $5 billion in 2009 (Tourism Economics 2009). Tourism is a significant part of the economy in the region and 83,664 jobs were sustained by visitors in 2009 with a total income of $2.6 billion (GPTMC 2010). The Greater Philadelphia Tourism Marketing Corporation estimates that tourism generated $1.2 billion in taxes in 2009 and that 5 percent of all jobs in the region are sustained by tourism.

2.10 Refuge Administration

Staffing

John Heinz NWR is managed by staff dedicated specifically to the refuge and its programs. This refuge currently has ten permanent staff: a refuge manager, deputy refuge manager, refuge wildlife biologist, a supervisory park ranger, one park ranger/law enforcement officer, a park ranger (vistor services), two outdoor recreation planners, facilities manager, and a maintenance worker. Seasonal staff positions, including a temporary biological technician, currently vary between one and five each year.

Budget

Operational funding includes salaries, supplies, utilities, fuel, and all other operational activities (wildlife and habitat surveys and management) that are not funded by special projects. Base maintenance funds, used to repair vehicles, equipment, and facilities, generally have been stable over the past 5 years. The replacement of vehicles, larger pieces of equipment (e.g., tractor, backhoe), or larger facilities (buildings) are funded as projects.

Our annual funding fluctuates according to the number and size of special projects funded that year (e.g., vehicle or equipment replacement, visitor service enhancements, and facility improvements). In 2010, the refuge operated on a budget of approximately $1.2 million. This level of funding is relatively consistent with prior years: $1.1 million in 2008, $1.3 million in 2009.

Acquisition

Map 1.3 depicts the refuge ownership boundary as of December 30, 2010. Table 2.2 below summarizes the land acquisition history of the refuge by year. The refuge currently owns 993 acres within its 1,200 acre approved acquisition boundary. There are eight existing right-of-way easements for pipeline, utility, and transportation infrastructure located within lands owned in fee by the refuge.

Table 2.2. Land Acquisition History of John Heinz National Wildlife Refuge at Tinicum.

Acquisition Date	Funding Source	Acres
1910	MBCF, NONE	167.59
1973	NONE	145.33
1978	LWCF, NONE	147.56
1979	LWCF, NONE	139.93
1980	LWCF, NONE	318.76
1986	OTHER	0.00
1995	NONE	18.30
1996	LWCF	55.70
	Total Acreage =	**993.2**

LWCF—Land and Water Conservation Fund.—funding sources include revenues from the sale of surplus Federal real property, motorboat fuel taxes, fees for recreation on Federal lands, and receipts from mineral leases on the outer continental shelf.

MBCF—Migratory Bird Conservation Fund.—the funding source is receipts from the sale of Federal Migratory Bird Hunting and Conservation Stamps.

Distributing Refuge Revenue Sharing Payments

Since 1935, the Service has made refuge revenue sharing payments to local municipalities containing lands under its administration. The actual amount of the payments is determined by formulas specified in the Revenue Sharing Act (16 U.S.C. 715s) and annual funding appropriated by Congress. The formulas used to determine payments to local municipalities are based on the number of acres in each municipality and the appraised value of refuge lands in their jurisdiction. Currently for John Heinz NWR, we make revenue sharing payments to Delaware County, the townships of Darby, Folcroft, and Tinicum, the Interboro School District, and the city of Philadelphia. Between fiscal years 2005 and 2009, combined payments to all municipalities have averaged about $38,000 per year.

2.11 Refuge Natural Resources

John Heinz NWR is located within the city of Philadelphia and neighboring Tinicum Township in Philadelphia and Delaware Counties, about one-half mile north of Philadelphia International Airport (map 2.1). The freshwater tidal marsh at the refuge now comprises approximately 80 percent of the State's coastal wetland (Cohen 2004; PNHP 2008). The refuge represents an important migratory stopover along the Atlantic Flyway that provides a mix of freshwater habitats. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen 2004).

The refuge contains a variety of ecosystems unique within Pennsylvania and the Philadelphia metropolitan area including tidal and nontidal freshwater marsh, freshwater tidal creek, open impoundment waters, coastal plain and riparian forests, and early successional grasslands. Many of the refuge's ecosystems have been degraded, damaged, or (in some cases) destroyed as a result of the numerous anthropogenic impacts. However, many of these impacted ecosystems have the potential to be restored or enhanced through various management efforts. Some areas, including portions of the tidal marsh, contain healthy and intact ecological communities. Because of the refuge's location within the coastal plain (a small and unique physiographic region within Pennsylvania), many of its ecosystems contain unique plant communities or species of conservation concern.

Regional Conservation Context

Being situated within a highly urbanized landscape, the refuge is geographically isolated from many other conservation lands in the region (see map 1.2). The largest (over 1,000 acres) and closest natural areas near the refuge consist of freshwater tidal marsh located across the Delaware River in New Jersey (less than 5 miles away), as well as the forested habitats of Fairmount Park, Ridley Creek State Park, and Valley Forge National Historic Park (all within 25 miles of the refuge).

As a result, the refuge has limited biological connectivity to adjacent conservation lands. Aside from a single 100-acre parcel of forested land abutting the eastern refuge boundary, there is little other terrestrial habitat available directly outside of the refuge boundary. Aquatic resources remain connected between the tidal Darby Creek and the Delaware River. Nontidal portions of Darby Creek do contain several low-head dams impeding upstream movement of fish and limiting available spawning habitat.

The refuge is the only Federal conservation land located in Delaware and Philadelphia Counties. The nearest national wildlife refuge, Supawna Meadows NWR, is located approximately an hour's drive south of the refuge near Salem, New Jersey. The recently authorized Cherry Valley NWR will be located approximately a 1 to 2 hour's drive north the refuge.

2.12 Refuge Biological Resources

Natural Community Types

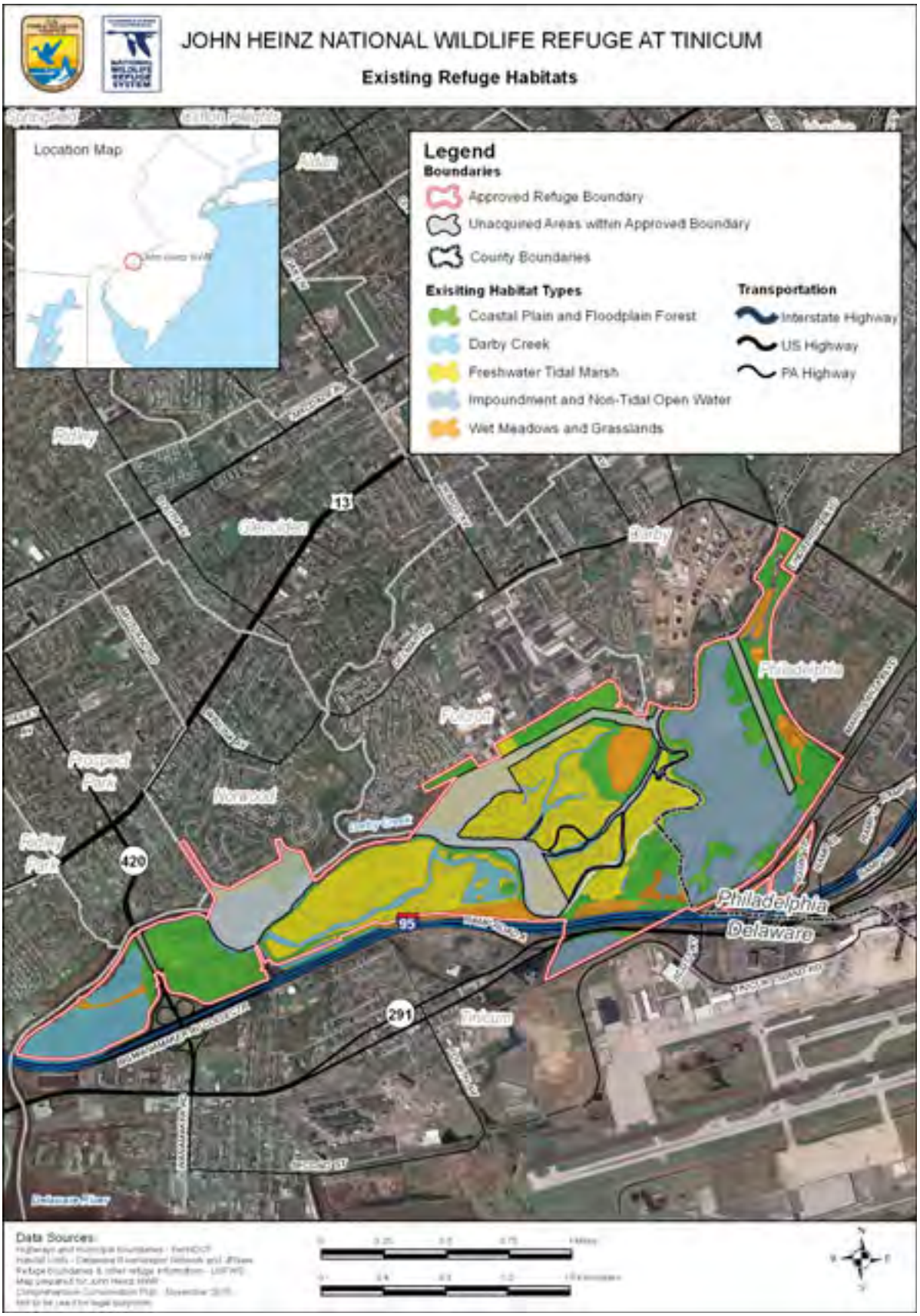
Refuge lands include a variety of ecosystems including open water, forests, grasslands, and tidal and nontidal wetlands. Many of the ecosystems (and the habitats they support) have been degraded, damaged, or destroyed as a result of the numerous impacts previously cited. Despite these alterations, many of these impacted ecosystems have the potential to be restored through various management actions and specific projects. Other areas, including portions of the freshwater tidal marsh, contain healthy and intact plant communities. Some ecosystems support plant communities or species of concern.

The Refuge System has adopted the National Vegetation Classification System (NVCS) developed by the Nature Conservancy and the Natural Heritage Network as a standard for classifying plant communities. The classification contains hierarchical levels of community specificity. The broader habitat categories that are comprised of these communities are displayed on map 2.1. The location and extent of the individual plant communities are displayed on map 2.2.

Bill Thompson

Bald eagle

Map 2.1. Habitats of John Heinz National Wildlife Refuge at Tinicum



Map 2.2. Plant Communities of John Heinz National Wildlife Refuge at Tinicum

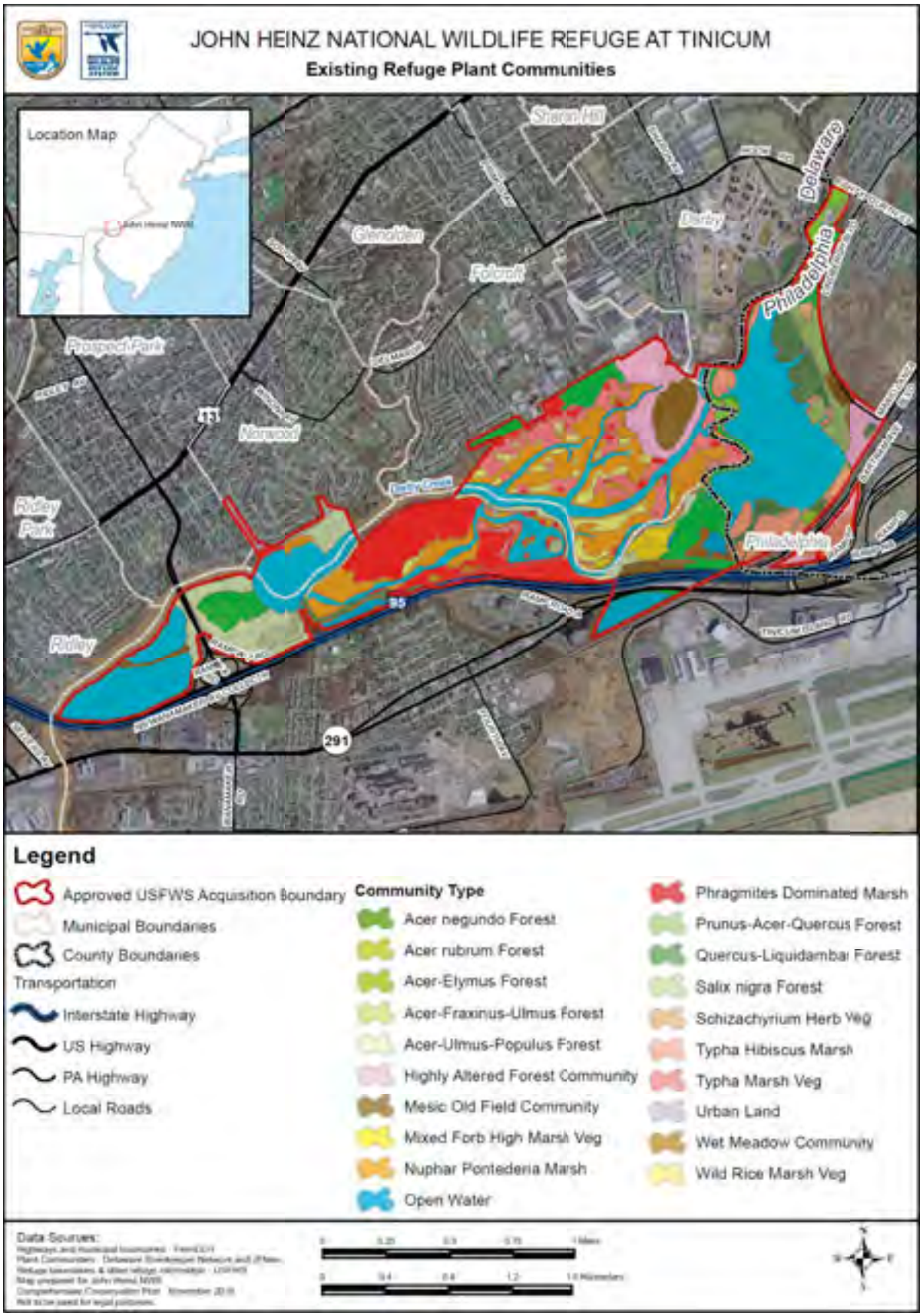


Table 2.3 lists the NVCS Associations found within the various broad scale habitats of the refuge. Where possible, the conservation status rankings have been indicated as referenced by NatureServe Explorer and the Pennsylvania Natural Heritage Program. Conservation status rankings indicate how imperiled a species or community is on either a global, national, or state level. "S" identifies state rankings, where "G" designates global rankings. A scale of 1 through 5 is applied to denote the conservation significance of a particular habitat on each scale. A 1 identifies the habitat as "critically imperiled," a 3 indicates the habitat as "vulnerable," while a rank of 5 notes an occurrence as "secure."

Table 2.3. Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found within John Heinz National Wildlife Refuge at Tinicum.

Broad Habitat Types	Natural Community Types	Conservation Ranking (Global; State) (NatureServe; PNHP)
Freshwater Tidal Marsh	Atlantic Coast Wild Rice Tidal Marsh	G4; S1
	Freshwater Intertidal Mudflat	G3/G4; S1
	Freshwater Tidal Mixed Forbs High Marsh	GNR; S1
	Spadderdock Tidal Marsh	GNR; SNR
	Arrowhead – Pickerelweed Tidal Herbaceous Vegetation	G3/G4; S1
	Phragmites Dominated Marsh	GNR; SNR
	Cattail – Bulrush Eastern Herbaceous Vegetation	G5; SNR
Freshwater Nontidal Wetlands	Phragmites Dominated Marsh	GNR; SNR
	Narrow-leaved Cattail – Swamp Rose Mallow Herbaceous Vegetation	GNR; SNR
Open Water	Freshwater Intertidal Mudflat	G3; S1
Coastal Plain Forest	Pin oak – Swamp White Oak – Sweetgum Mixed Hardwood Forest	G3; S2
Floodplain Forest	Boxelder Forest	GNR; SNR
	Red Maple Forest	GNR; SNR
	Silver Maple - Boxelder / Virginia Wild Rye Forest	G4; SNR
	Maple (Red, Silver) – Ash – American Elm Forest	G4; S1
	Silver Maple – American Elm – (Cottonwood) Forest	G4; S3
	Black Willow Temporarily Flooded Shrubland	GNR; SNR
	Black Cherry – Red Maple – Serviceberry – Oak Forest Alliance	GNR; SNR

Freshwater Tidal Wetlands

Freshwater tidal wetlands comprise approximately one-third of the refuge. Protection of this habitat is one of the primary purposes outlined in the refuge's mandated purposes. The marsh contains some ecological communities considered State critically imperiled (S1) and globally rare (G3) and occurrences of State/federally rare, threatened, and endangered plant and animal species

(NatureServe 2005; PNHP 2008). These wetlands are subject to a range of tidal fluctuation on a daily basis of approximately 6 feet between mean high tide and mean low tide. Vegetation is diverse, with species and plant communities directly influenced by the relative elevation of mean high tide.

Most freshwater tidal marsh is dominated by pickerelweed, arrowhead, spadderdock, or wild rice. However, PADCNR notes that portions of this marsh support several State rare species such as waterhemp ragweed (*Amaranthus cannabinus)*, field dodder (*Cuscuta pentagona)*, Walter's barnyard-grass (*Echinochloa walteri)*, an un-named eupatorium (*Eupatorium rotundifolium*), forked rush (*Juncus dichotomus)*, and shrubby camphor-weed (*Pluchea odorata)* (VanDervort-Sneed personal communication 2010).

Coastal Plain and Floodplain Forests
Coastal plain and floodplain forests are the habitat type that is considered to be the late-successional forest community typical of the Pennsylvania Coastal Plain region. Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Atlantic Coastal Plain in Pennsylvania was historically found only in a 1 to 5 mile-wide strip along the lower 50 miles of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008).

Coastal plain forests are noted as a rare habitat type within Pennsylvania (PNHP 2008). These forests are dominated by a canopy mix of oak and sweetgum. Under reference conditions, oaks should typically comprise at least 25 percent of the dominance in a stand. Other typical canopy associates may dominate, including sweetgum, blackgum, and swamp white oak. Other wetland hardwood species can occur, including silver maple, river birch, and northern red oak. Native shrub and vine species are variable and may include dogwoods, spicebush, Virginia creeper, and elderberry (NatureServe 2005; Westervelt 2006).

Intactness of this forest type varies between stands; however, most are impacted by excessive deer browse and invasive species colonization. Garlic mustard, Japanese honeysuckle, and Japanese stiltgrass dominate much of the groundlayer while vines such as Oriental bittersweet are also frequent. Mile-a-minute vine is widespread in many canopy gaps and appears to be preventing canopy tree regeneration. Additional invasive species found within the canopy include Norway maple and tree-of-heaven. A portion of the floodplain forest located in the southeastern portion of the refuge is dominated by a hybridized, nonnative gray poplar (*Populus x canescens or alba*) (Salas et al. 2006), see "Highly Altered Habitats" later in this section for additional information.

Darby Creek
The tidal portion of Darby Creek and its side channels flows through the refuge and tidal marsh. Since this represents an aquatic habitat, the ranking system used for the terrestrial habitats does not apply. Despite a lack of ranking, Darby Creek is known to support a diversity of estuarine fish species described in more detail in the next section.

The geomorphology, water quality, and influences of Darby Creek are discussed in more detail in section 2.6 above.

Impoundment and Nontidal Open Waters
The refuge contains several small open water features and a managed impoundment (table 2.4).

Eastern box turtle

USFWS

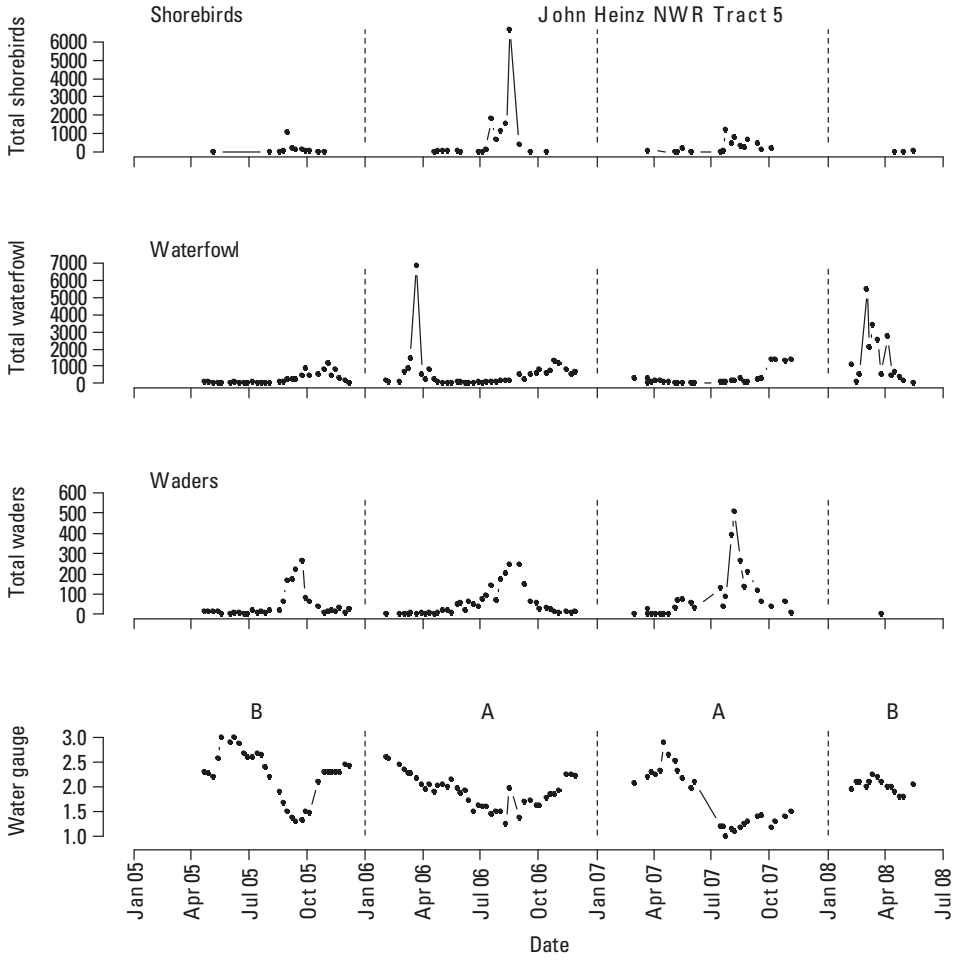
Table 2.4. Summary of Existing Open Water Features at John Heinz National Wildlife Refuge at Tinicum.

Name	Size (Acres)	Features
145-acre Impoundment	145	Managed impoundment for open water and mudflat.
Impoundment Fringe	34.1	Open water and marsh areas surrounding Impoundment.
Frog Pond	<0.5	Shallow water area near visitor center.
Hoys Pond	5	Deep water pond near I-95.
16-acre Pond	16	Open water bounded by Bartram Ave and I-95.

The 145-acre impoundment and nearby nontidal open water habitats of the refuge provide stopover habitat for a variety of waterbirds, waterfowl, and shorebirds. Over the past several years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008; Phillips personal communication 2008). This recent management was completed in conjunction with 23 other refuges across the Service's Regions 3 and 5 as part of a 3-year management experiment. Management prescriptions for the timing of water manipulation in impoundments involved drawdowns to coincide with either spring or fall shorebird migration. The effects of this timing on waterbird communities, invertebrate communities, and vegetation communities, throughout the annual wetland cycle, were monitored. In addition to evaluating the effects of traditional habitat management practices on attaining objectives for a suite of trust species, this study provides monitoring protocols, databases, and analytical methods that can be used by the refuges after the study ends for adaptive management of their impoundments (Lyons et al. 2005).

The recently completed impoundment study included timed drawdowns. These timed drawdowns focused on providing the optimal habitat available within the impoundment for various bird groups during their peak migration stopovers in both spring and fall (figure 2.3).

Figure 2.3. Shorebird, Waterfowl, and Wader Abundance (adjusted for partial observability) and Water Gauge Levels within the 145-acre impoundment at John Heinz National Wildlife Refuge (from Green et al. 2008).



The two treatments noted were an early season drawdown timed to coincide with spring shorebird migration (Treatment A), and a late season drawdown coinciding with summer/fall shorebird migration (Treatment B). Timing of each treatment (as displayed above) includes 2005, Treatment B; 2006–2007, Treatment A; 2008, Treatment B. Dashed vertical lines indicate the beginning of a year.

It appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008; Phillips personal communication 2008). Based on the draft results of this study, variations in mean water levels and vegetation composition provide the most benefits for migrating groups are presented in table 2.5.

Table 2.5. Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement Within the Impoundment (based on results of the R3/5 Impoundment Study).

Bird Groups	Water Depth (inches)	Vegetation Composition and Areal Coverage	Time of Year
Shorebirds	0.0 to 6.0	Mudflats containing less than 10 percent vegetative cover.	Spring: May Fall: Mid-August to September
Waterfowl	6.0 to 24.0	<10 percent cover of shallow marsh and emergent aquatic species (including *Carex, Polygonum,* and *Peltandra)*	Spring: Late March Fall: Late October
Wading Birds	6.0 to 12.0	Open water containing less than 10 percent vegetative cover.	Spring: Late March Fall: Late August

Portions of the impoundment also contain numerous nesting boxes. These boxes (primarily for swallow, but also for wood ducks) have been installed and maintained by a combination of refuge staff and volunteers. These boxes were initially installed to provide opportunities for wildlife observation and interpretation, including how visitors can benefit wildlife in their own backyard.

The impoundment and open waters also provide support for reptile and landbird breeding habitat. Bald eagles have nested successfully in forested areas adjacent to the impoundment. The impoundment area also provides secondary habitat for the State-listed coastal plain leopard frog and breeding, feeding, and hibernation habitat for the State-listed red-bellied turtle (Stolz personal communication 2005). Management considerations must be made to sustain the use by and protection of these non-bird focal species as well.

There are several impediments to effectively managing the 145-acre impoundment. The mean bed surface of the impoundment is approximately 1 foot below that of the mean low flow elevation of Darby Creek. Additionally, the impoundment receives uncontrolled stormwater from neighboring lands in which is a source of pollution and added water volume during rain events. Increasingly, the impoundment also becomes flooded out during high flow events resulting from more frequent and extreme precipitation. These excessive water levels have breached or caused substantial damage to the dike and access road system around the impoundment on at least four occasions over the past 10 years (Stolz personal communication 2010).

Another issue with impoundment management is ongoing maintenance of the dike and access road along the north and western edge of the impoundment. Burrowing mammals may potentially excavate small holes and tunnels into the sides of dike roads. These burrows can lead to dike weakening and collapse over time if unaddressed. To minimize or repair the damage from burrowing mammals, the refuge occasionally adds stone rip rap or fill to portions of dikes washed out by high water. To date, burrowing has not resulted in any major dike failures, however refuge staff continue to evaluate the potential for this management concern.

The remaining 56 acres of nontidal open waters owned by the refuge include a series of deeper ponds near or adjacent to I-95. Hoy's Pond is a 5 acre pond with maximum depths between 6 and 10 feet. The water is relatively clear with large mats of duckweed (*Lemna* spp.) covering much of the water surface around the edge of the pond. Hoy's Pond is a popular fishing site, where anglers pursue largemouth bass (*Micropertus salmoides*) and sunfish (*Lepomis* spp.) species. In

the past, refuge staff has added discarded Christmas trees to the pond to serve as cover for fish species.

Another open water habitat area is known as 16-acre pond. It is located along Route 291 and Bartram Avenue. It is shallow with depths generally less than 3 or 4 feet with some spadderdock coverage. This pond receives stormwater inputs from surrounding industrial and commercial lands. Its location between several roads and highways with heavy traffic makes it not only biologically isolated, but also difficult to access for management. As a result of the low habitat values observed and isolation from other nearby waters (Sweka and Mohler 2010), we do not actively manage the 16-acre pond. The water of 16-acre pond is highly eutrophic (Sweka and Mohler 2010). This pond contains a mix of common, pollution-tolerant, warm-water fish species such as bluegill.

Grasslands and Wet Meadows

Grasslands and native meadows likely covered a substantial proportion of the Philadelphia area prior to European colonization. It is unlikely that these were self-sustaining ecosystems in this area. There is extensive evidence that meadows were managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest and provide foraging areas for game species such as grouse, turkey, deer, and elk (Latham et al. 2005). These systems supported plant species that are generally common to the extensive grasslands found in Midwestern States despite their diminutive size. As availability of grassland habitats has decreased, these species have experienced population declines and are now considered among the most threatened species within the Mid-Atlantic region (PIF 1999). Several remnant native meadows exist within Philadelphia with active restoration plans. Active management of these areas typically includes the removal of nonnative invasive species, replanting of lost native species, and control of woody species (PNHP 2008).

Prior to the past few decades, John Heinz NWR had a substantially greater amount of grasslands than today (McCormick et al. 1970, McMenamin personal communication 2008). Currently, many of these historic grasslands are covered by coastal plain or floodplain forest community types. The Restoration Management Plan for Lower Darby Creek compared habitat coverage between those documented in the Two Studies of Tinicum Marsh (McCormick et al. 1970) and those identified as part of field inventories conducted in 2005 (Salas et al. 2006). Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and "old field" vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type. Additionally, historic aerial photographs reviewed as part of that plan documented a greater extent of grasslands east of the existing impoundment (Salas et al. 2006). Due to this relatively isolated and small (less than 100 acres) component of grassland, it is unlikely that the refuge ever had significant regional populations of priority grassland birds.

Several meadow and grassland communities at the refuge provide stopover habitat for neo-tropical migrant birds, raptors, amphibians, reptiles, and mammal species. These grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the coastal plain leopard frog. The coastal plain leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within the refuge's wet meadow grasslands (Phillips and McMenamin personal communication 2008).

Most of the grasslands existing on the refuge today are the result of managed utility right-of-ways that intersect portions of the refuge. Utility corridors transporting oil, gas, potable water, wastewater, and electricity all pass through the refuge. Due to the disturbed nature of these communities, none contain the

species composition to make them identifiable with known grassland associations by the NVCS.

Highly Altered Habitats

In addition to the naturally occurring communities located within the refuge, there are several highly altered communities present. Highly altered forests of John Heinz NWR consist of existing forested habitats that have either not been completely inventoried to understand and delineate their NVCS community types due to access restrictions or contain substantial variation from natural forest communities typical of the refuge and surrounding region. Despite their alteration, these habitats can still provide significant ecological value and quality habitat. The 145-acre impoundment already discussed provides significant value to migratory and overwintering waterfowl and shorebirds. Additionally, altered grasslands, forests, and wetlands provide diversity of habitat types and a unique set of ecological services that benefit both wildlife and visitors to the refuge.

Federally Listed Species

The refuge does not support any known federally listed threatened or endangered species. The refuge does provide potential foraging and nursery habitat for the federally listed, endangered shortnose sturgeon (*Acipenser brevirostrum*). This species is known to occur in the nearby Delaware River. However, this species has not been identified within Darby Creek or on the refuge to date.

State-listed Species

The refuge does support a number of State-listed threatened or endangered plants and animals. State endangered birds such as the American bittern, least bittern, black crowned night heron, king rail, great egret, yellow-crowned night heron, and sedge wren all forage and/or breed on the refuge. The same is true for State threatened species such as the bald eagle. The State endangered coastal plain leopard frog is known to breed in shallow wetlands found within refuge forests and grasslands. The State threatened reptile, the red-bellied turtle, is also known to breed on the refuge as well.

Rare Plant Species and Exemplary Natural Communities

John Heinz NWR protects the last significant remnant of freshwater tidal marsh within the State of Pennsylvania. Several of the natural communities within the freshwater tidal marsh are ranked as S1—critically imperiled within the State (typically 5 or fewer occurrences or very few remaining individuals or acres), or S3—vulnerable in the State either because they are rare and uncommon, or found only in a restricted range, or because of other factors making them vulnerable to extirpation (typically 21 to 100 occurrences). The forested habitats of the refuge also contain communities of significant conservation status. Several coastal plain and floodplain forest communities identified on the refuge are ranked as S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable).

Wildlife

John Heinz NWR was established in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. The diverse habitats support a variety of resident and migratory wildlife including 300 species of birds recorded since 1950, as well as many mammals, fish, amphibians, reptiles, insects, and plants. Refer to appendix A for the refuge's comprehensive list of species of conservation concern.

Birds

The refuge is a complex of critical habitats for birds in the highly urbanized landscape of greater Philadelphia. It has been designated as an Important Bird Area by the National Audubon Society. While most of the 300 plus avian species identified at the refuge utilize it as a migratory stopover, more than 80 species have been recorded nesting on the refuge over the years. Several species are also State-listed threatened or endangered species or species of State or national management concern.

The periodic drawing down of the impoundment and the presence of tidal mud flats provide some of the best stopover habitat for migrating shorebirds in Pennsylvania (Cohen and Johnson 2004). In addition, many waterfowl, wading birds, waterbirds, and landbirds utilize the impoundment. The area serves as a wintering ground for over 20 species of waterfowl with 1,100 to 1,400 individuals observed per day between September and March (Green et al. 2008).

State endangered species such as the least bittern (*Ixobrychus exilis*) are known to breed at the refuge. Other Pennsylvania endangered species that have been observed at the site during migration, but are considered occasional or rare in abundance, include: yellow-crowned night-heron (*Nyctanassa violacea*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), king rail (*Rallus elegans*), short-eared owl (*Asio flammeus*) and loggerhead shrike (*Lanius ludovicianus*). The king rail historically nested at the site (prior to 2000). The piping plover (*Charadrius melodus*) listed as extirpated in Pennsylvania, is an occasional "accidental" occurrence during migration.

Bald eagles (*Haliaeetus leucocephalus*), a former federally listed endangered species that has recovered and been delisted, have historically utilized the refuge for hunting and roosting. The first known bald eagle nest on the refuge was built in 2009 with the first two refuge eaglets successfully hatched in 2010. The pair returned to breed on the refuge in 2011.

The peregrine falcon (*Falco peregrinus*), another former federally listed, endangered species that has recovered and become federally delisted, is often observed from the refuge during its migration. A number of active peregrine nests now occur in the Philadelphia area with these birds also potentially increasing their use of refuge habitats (Cohen and Johnson 2004).

The State–listed, threatened species, upland sandpiper (*Bartramia longicauda*) and yellow-bellied flycatcher (*Empidonax flaviventris*), have been observed at the site, but are considered rare or occasional in abundance, observed primarily during the migratory season. Osprey (*Pandion haliaetus*) is present during migration and is frequently observed throughout summer. Two osprey platforms have been added to the refuge in hopes to lure in nesting birds. State species of special concern that use the refuge are the black-crowned night-heron (*Nycticorax nycticorax*) and northern harrier (*Circus cyaneus*). The black-crowned night-heron nested (52 nests reported) at the site prior to 1996 but are now considered transient. Northern harrier is observed less frequently at the site since grassland buffer habitat has disappeared due to habitat successional changes and development. The green-winged teal (*Anas crecca*) and marsh wren (*Cistothorus palustris*) are State rare species that nest at the refuge. The pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), wilson's snipe (*Gallinago delicata*), swainson's thrush (*Catharus ustulatus*), prothonotary warbler (*Protonotaria citrea*) and summer tanager (*Piranga rubra*) are other State candidate-rare species that have been observed at the refuge as well (Cohen and Johnson 2004).

The refuge also provides habitat for occasional visits from species outside of their standard range. Recently in July 2011, the refuge confirmed its first occurrence of an immature white ibis (*Eudocimus albus*) foraging on the refuge. White ibis has been reported as a rare visitor to Pennsylvania (Audubon 1843), and New Jersey (Turnbull 1869) since the nineteenth century. The last sighting of this species occurred during the summer of 1980 (Miller 1982c, 1988, Paxton et al. 1981).

Mammals

John Heinz NWR is 1 of 44 Important Mammal Areas designated by the Pennsylvania Wildlife Federation. The designation was awarded noting the

refuge as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat (*Oryzomys palustris*) in the State.

While no formal inventories have been conducted to date, numerous mammals are known to inhabit the refuge. Two nonnative species present include the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*). The gray squirrel (*Sciurus carolinensis*) is a common species found throughout upland habitats of the refuge, where it plays an important role in seed dispersal. Other common open space species supported by the refuge include the northern short-tailed shrew (*Blarina brevicauda*); the meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*) and several other rodent species, as well as raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), eastern cottontail rabbit (*Sylvilagus floridanus*) (PNHP 2008). Woodchuck (*Marmota monax*) and red fox (*Vulpes vulpes*) have been observed damaging the impoundment levee system as they attempt to burrow dens into dikes (Stolz personal communication 2008). Feral domestic house cats pose a serious invasive mammalian predatory threat to all small native wildlife (birds, mammals, reptiles and amphibians) and need to be removed from the refuge when found.

Muskrat (*Ondatra zibethica*), long-tailed weasel (*Mustela frenata*), and least shrew (*Cryptotis parva*) are fairly common. Recent records also indicate beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) occur occasionally on the refuge. It is also likely that the refuge sees occasional use by coyote, which have been documented on adjacent property at Philadelphia International Airport (Stolz personal communication 2008). Bats are frequently observed on the refuge during warmer seasons and a formal species diversity and population survey would provide valuable information on recent declines of these important creatures due to white nose syndrome and habitat disturbances.

White-tailed deer (*Odocoileus virginianus*) are another mammal supported by the refuge. Refuge staff has conducted on-the-ground deer population surveys for several years. These surveys have been conducted by counting deer driven systematically from various portions of the refuge. Several different types of surveys were conducted in development of the refuge's deer management plan (D'Angelo 2011). Between 2001 and 2010, deer density estimates ranged from 57 to 163 deer per square mile based upon standardized deer drives conducted by refuge staff and volunteers. While standardized, this type of survey does have the potential to double-count individuals. Between 2008 and 2011, the refuge also conducted forward looking infared (FLiR) surveys, which reduce the likelihood of double-counting. According to these surveys, deer densities were between 57 and 83 deer per square mile.

Density levels at which a deer population is considered "ecologically sustainable" varies depending on the habitat involved and the variables studied. A separate deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994). Additional research has shown a population density not exceeding 20 deer per square mile is optimal for forest regeneration (Rooney 2001).

As noted, refuge staff estimates that the current deer population utilizing the refuge far exceeds this density. It is reasonable to assume, therefore, that these adverse effects on vegetation are present. Some of these effects were noted in vegetative surveys previously conducted on the refuge (Salas et al. 2006). More current surveys (D'Angelo 2011) also document these impacts. Oak and maple saplings were present within fenced deer exclosures, while similar vegetation outside of the exclosures was browsed to the ground. D'Angelo also noted that invasive plants, which are often consumed to a lesser extent by deer, have become dominate vegetation types on many portions of the refuge. While such impacts

affect current forest understory and wildlife dependent on this vegetation, the long term implications are that the refuge's native forested areas could lose the ability to replace themselves through time (D' Angelo 2011).

The Service and the U.S. Department of Agriculture Division of Wildlife Services have drafted a deer management plan. Once finalized, this plan will provide detailed guidance on management of the resident deer population based on observable impacts to (and recovery of) the refuge's habitats, not on a particular density target (D'Angelo personal communication 2009).

Reptiles and Amphibians
While no formal inventories have been conducted, there are eight turtle, three snake, and eight frog and toad species known to inhabit the refuge. Common frog and toad species such as bull frog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), pickerel frog (*Rana palustris*), spring peeper (*Pseudacris crucifer*), American toad (*Bufo americanus*), and Fowler's toad (*Bufo woodhousei fowleri*) have all been heard calling during their respective breeding seasons. The State-endangered species, coastal plain leopard frog (*Rana sphenocephala aka utricularia*), is known to inhabit and breed at the refuge in shallow open water and isolated vernal pools.

The northern water snake (*Nerodia sipedon sipedon*), eastern garter snake (*Thamnophis sirtalis sirtalis*), and northern brown snake (*Storeria dekayi dekayi*) are all found at the refuge. These common species are generally associated with forested habitats and/or nearby open water.

Numerous turtles are known to use the open water habitats of the impoundment, freshwater tidal marsh, and Darby Creek. Species common to these habitats at the refuge include common musk turtle (*Sternothaerus odoratus*), eastern box turtle (*Terrapene c. carolina*), painted turtle (*Chrysemys picta x marginata*), common map turtle (*Graptemys geographica*), eastern spiny softshell turtle (*Apalone spinifera*) and the nonnative, invasive red-eared slider (*Trachemys scripta elegans*) (USFWS 2009b). The refuge also supports several rare species of turtle such as the formerly State endangered (now considered potentially extirpated in PA) eastern mud turtle (*Kinosternon subrubrum*), the northern diamond-backed terrapin (*Malaclemys terrapin*), and a significant population of the State-threatened red-bellied turtle (*Pseudemys rubriventris*). These rare species are more commonly associated with the freshwater tidal marsh and open waters of Darby Creek. However, some of these have been known to move to and from the 145-acre impoundment as well.

Historically, the refuge and surrounding lands supported additional species of reptiles. The wood turtle (*Clemmys insculpta*) has been identified on lands adjacent to the refuge (Sunoco tank farms). Although considered extirpated in Pennsylvania, a road kill gravid female Eastern Mud Turtle was documented in nearby Bucks County in 2008. State surveys for the species were then conducted by East Stroudsburg State University including the refuge, and two small populations of eastern mud turtles were found in nearby Bucks County with continued hopes that they may still or in the future be rediscovered on the refuge (Stolz, personal communication 2010).

A number of other reptile and amphibian species native to southeast Pennsylvania could potentially be discovered on the refuge where suitable habitat occurs within their native ranges. Such species include black rat snake, black racer, eastern ribbon snake, eastern Milk snake, five-lined skink, eastern fence swift, gray tree frog, eastern chorus frog, red-backed salamander, long-tailed salamander, dusky salamander, red salamander and spotted salamander. Numerous nocturnal anuran vocalization surveys have been conducted as well as turtle mark-recapture studies with Drexel University and University of Philadelphia. At this time, a herpetological survey that includes terrestrial habitat and breeding areas

to establish baseline data is necessary for long-term management of the refuge's reptile and amphibian fauna. Dr. Jim Spotila of Drexel University has indicated turtle nest predation on the refuge may be as high as 98 percent (most likely from raccoon, red fox, skunk and opossum) (Stolz personal communication 2009).

Fish

The refuge provides not only important terrestrial habitat, but aquatic habitat as well. Freshwater tidal marshes, like Tinicum Marsh, are used by many aquatic species for spawning, year-round food and shelter, and as a nursery and rearing habitat (Mitch and Gosselink 1993). Freshwater tidal marshes are also a mixing zone for various groups of fish typically associated with certain habitats. Freshwater species, such as sunfish (*Lepomis spp.*) and catfish (*Ictalurus spp.*), estuarine species including killifishes (*Fundulus diaphanus*) and mummichogs (*Fundulus heteroclitus*), anadromous species including shad (*Dorosoma spp.*) and herrings (*Alosa spp.*), and the catadromous American eel (*Anguilla rostrata*) can all be found within Tinicum Marsh. A list of fish species observed on the refuge and in adjacent similar marsh areas around the Philadelphia International Airport can be found in table 2.6 (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010; Stolz personal communication 2011).

Darby Creek and the open water areas of the freshwater tidal marsh may also provide suitable habitat for the Federal and State-endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrhynchus*) (PNHP 2008; PGC & PFBC 2008). While this species has not been confirmed within the refuge itself, it is known to occur in the nearby Delaware River, thus making protection of suitable habitat within the refuge a priority.

In June 2011, refuge staff confirmed the first record of a bowfin (*Amia calva*), a Pennsylvania candidate rare species, within the refuge boundaries. The individual fish was caught during a refuge interpretive fishing event and released back into waters located on the refuge. Another sighting of this species also occurred adjacent to the refuge in 2010 near the Ridley Park Marina along Darby Creek (Stolz personal communication 2011).

Table 2.6. Fish Species and Use of Lower Darby Creek and Freshwater Tidal Marsh Habitats (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010; Stolz personal communication 2011)

Species		Habitat Use			
Scientific Name	Common Name	Spawning Area	Nursery Grounds	Shelter	Adult Forage
Freshwater Species					
Ameirus catus	White catfish	~	~	~	~
Ameirus nebulosus	Brown bullhead	~	~	~	~
Amia calva	Bowfin	~	~	~	~
Catostomus commersoni	White sucker	~	~		~
Cyprinus carpio	Common carp	~	~		~
Etheostoma olmstedi	Tessellated darter	~	~	~	~
Gambusia holbrooki	Eastern mosquitofish	~	~	~	~
Hybognathus regius	Eastern silvery minnow	~	~	~	~
Ictalurus punctatus	Channel catfish	~	~	~	~

Species		Habitat Use			
Scientific Name	**Common Name**	**Spawning Area**	**Nursery Grounds**	**Shelter**	**Adult Forage**
Lepomis cyanellus	Green sunfish	~	~		~
Lepomis gibbosus	Pumpkinseed	~	~		~
Lepomis macrochirus	Bluegill	~	~		~
Micropterus salmoides	Largemouth bass	~	~		~
Notemigonus crysoleucas	Golden shiner	~	~	~	~
Notropis hudsonius	Spottail shiner	~	~	~	~
Perca flavescens	Yellow perch	~	~		~
Pimephales notatus	Bluntnose minnow	~	~		~
Poxomis nigromaculatus	Black crappie	~	~		~
Umbra pygmaea	Eastern mudminnow	~	~	~	~
Estuarine-Marine Species					
Brevoortia tyrannus	Atlantic menhaden				~
Fundulus diaphanus	Banded killifish	~	~	~	~
Fundulus heteroclitus	Mummichog	~	~	~	~
Leiostomus xanthurus	Spot	~	~		~
Menedia beryllina	Inland silversides	~	~	~	~
Micropogonias undulatus	Atlantic croaker	~	~		
Trinectes maculatus	Hogchocker		~	~	~
Anadramous Species					
Alosa aestivalis	Blueback herring	~	~	~	
Alosa mediocris	Hickory shad	~	~	~	
Alosa pseudoherangus	Alewife	~	~	~	
Dorosoma cepedianum	Gizzard shad	~	~		~
Morone saxatilis	Striped bass		~		~
Morone americana	White perch	~	~		~
Mugil cephalus	Striped mullet		~		
Catadromous Species					
Anguilla rostrata	American eel		~	~	~

Invertebrates

While no invertebrate inventories have been conducted to date within the refuge or along Darby Creek, recent findings along the nearby Delaware River indicate that invertebrate conservation may be an added focus along Darby Creek. A series of mussel beds was identified in the stretch of river connected to the confluence with Darby Creek. Seven mussel species were identified within the Delaware River, including two species which were thought to be extinct in Pennsylvania and New Jersey: the alewife floater (*Anodonta implicate*), and the tidewater mucket (*Leptodea ochracea*). Other species included two species

considered critically imperiled: the pond mussel (*Ligumia nasuta*), and yellow lampmussel (*Lampsilis cariosa*), two species considered vulnerable: the creeper (*Strophitus undulates*) and the eastern floater (*Pyganodon cataracta*) and one common species: the eastern elliptio (*Elliptio complana*).

In addition to mussels, the refuge lacks inventories of invertebrate insect species. Benthic macroinvertebrate sampling has been conducted upstream of the refuge in conjunction with water quality monitoring and characterization. No species of conservation concern were identified in those surveys. No terrestrial invertebrate inventories have been conducted on refuge to date.

Nonnative, Invasive Plants

Federal management of nonnative, invasive plant species is guided by the planning efforts outlined in Executive Order 13112 signed into law on February 3, 1999. This Executive Order requires that a Council of Departments dealing with invasive species be created and develop a National Invasive Species Management Plan every 2 years. The first such plan was released in January 2001, providing the basis for Federal management of invasive species. The Executive Order defines an invasive species as a species that is a) nonnative to the ecosystem under consideration and b) whose introduction causes (or is likely to cause) economic or environmental harm, or harm to human health.

The planning and inventory work completed as part of the Restoration Management Plan for the Lower Darby Creek in 2005 identified invasive plant species as one of the top impacts to refuge plant communities and a management priority for the coming years. The inventory identified nonnative invasive species present throughout John Heinz NWR and ranked their management priority based on a) the extent to which the species is established on the refuge, b) the potential ecological impact of the species on refuge plant communities, and c) the degree of management difficulty involved in controlling the species. The results of this inventory and prioritization are included in table 2.7 (Salas et al. 2006). Management prescriptions for identified invasive species are included in the Draft HMP included in appendix B.

Table 2.7. Invasive Species Identified at John Heinz National Wildlife Refuge at Tinicum and Their Associated Management Ranking.

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Japanese knotweed *Polyganum cuspidatum*	1	●	○	●	High Prevent New Introductions and Eradicate Localized Occurrences
Porcelainberry *Ampelopsis brevipedunculata*	2	◉	○	◉	
Multiflora rose *Rosa multiflora*	3	◉	○	◉	
Reed canarygrass *Phalaris arundinacea*	4	◉	○	◉	
European privet *Ligustrum arvense*	5	○	○	○	
Common Reed *Phragmites australis*	6	●	◉	●	
Purple Loosestrife *Lythrum salicaria*	7	●	◉	●	

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Mile-a-minute *Polyganum perfoliatum*	8	●	◉	○	Medium Eradicate Localized Occurrences and Reduce Size of Existing Populations
Japanese honeysuckle *Lonicera japonica*	9	●	◉	●	
Norway maple *Acer platanoides*	10	◉	◉	●	
Oriental bittersweet *Celastrus orbiculatus*	11	◉	◉	◉	
Tree-of-heaven *Ailanthus altissema*	12	◉	◉	◉	
Japanese hops *Humulus japonica*	13	◉	◉	◉	
Bush honeysuckle *Lonicera maackii*	14	◉	◉	◉	Low Focus Primarily on Areas of Conservation Significance
Japanese stiltgrass *Microstegium vimeneum*	15	●	●	◉	
Garlic mustard *Alliaria petiolata*	16	●	●	●	

● = High ◉ = Medium ○ = Low

2.13 Special Use Permits, Including Research

Special use permits are issued to individuals, organizations, and agencies that request the use of refuge facilities or resources beyond what is available to the public. To ensure that wildlife disturbance is minimized, special conditions and restrictions are analyzed individually for each request.

Currently, the refuge maintains several special use permits for various ongoing research utilizing the refuge:

- USDA-APHIS is currently permitted to continue the ongoing research related to deer abundance and effects on refuge vegetation and habitats. This research will continue to inform refuge staff of the level of deer controls necessary to restore biological integrity and diversity to the refuge.

- The Academy of Natural Sciences and the Partnership for the Delaware Estuary are establishing long-term data collection sites to monitor sea level rise over the coming decades through the use of surface elevation tables. Surface elevation tables (SETs) and rod-SETs (rSETs) measure changes in marsh elevation at the millimeter scale, on an annual, and in some cases, seasonal basis. This level of precision is required to track very slow accretion or subsidence rates over time. SETs and rSETs can be used to determine a marsh's change in elevation due to a response to climate stressors such as sea level rise and/or non-climate stressors including management activities like burning and invasive species control.

- Philadelphia Zoo has conducted annual and ongoing amphibian vocalization surveys throughout the spring breeding season. This research provides the refuge with species inventory and habitat use information for frog species across the refuge.

Ongoing Research and Monitoring Projects

Impoundment Management Study
In 2005 to 2007, John Heinz NWR participated in the Service Region 3 and Region 5 Impoundment Management Study. The goal of this study was to determine the effects of timed water level management related to use by waterfowl, shorebirds, and wading birds. This study found that waterfowl were observed throughout the year, while shorebirds and waders were observed primarily between April and October. Shorebird frequencies peaked around the spring and fall migration periods, and wader frequencies peaked in mid-summer. Shorebird species composition was dominated by peeps (semipalmated sandpiper, unidentified peep, least sandpiper) in both the spring (approximately 80 percent of all shorebirds observed) and fall (approximately 90 percent). Waterfowl species most abundant during the spring migration period were ducks. Four species (northern shoveler, green-winged teal, mallard, northern pintail) accounted for more than 70 percent of the waterfowl during that period. Species composition was similar during the fall, with mallards and gadwall accounting for 47 percent of the waterfowl seen. Canada geese became the second-most abundant species during this same period. Great egrets and great blue herons dominated the waders observed during the breeding season (Green et al. 2008).

White-tailed Deer Monitoring and Management
In 2008, the Service contracted with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, and Wildlife Services to assist in studying the impacts of the deer population on plant communities within the refuge. Based on their analysis, they reported that the white-tailed deer population at John Heinz NWR was believed to surpass the carrying capacity of available habitat, causing severe ecological damage that negatively affected all other native species of plants and animals (D'Angelo 2011). See previous discussion under Mammals in Section 2.11 Refuge Biological Resources.

2.14 Refuge Visitor Services Program

The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its wildlife-first mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. John Heinz NWR currently provides opportunities for the public to participate in five of the six priority uses.

Environmental education, interpretation, wildlife observation, photography, and fishing are all provided via access throughout the refuge's extensive trail network. Kiosks and signs provide interpretive materials for trail users. The visitor center is an impressive facility, free to the public, Americans with Disabilities Act (ADA) compliant, and accessible by public and private transportation. The facility is visited by many schools and conservation organizations for classroom use and meeting space. The building is also an important example of sustainable design and environmentally friendly construction.

With over 10 miles of trails, the refuge provides many areas for visitors to explore. Most refuge visitors are families, wildlife observers, and neighborhood residents interested in viewing nature and wildlife. Well over 90 percent of the estimated 135,000 visitors take part in some sort of wildlife-dependent recreation activity, be it wildlife observation, photography, or fishing (table 2.8). Many visitors post images of refuge wildlife on the internet via photo-sharing sites. Fishing within Darby Creek draws regular visitation from surrounding communities throughout the summer months. While fishing is supported on the refuge, we encourage participants to practice catch and release due to the presence of contaminants within Darby Creek.

Table 2.8. Number of Refuge Participants by Activity (2009)*

Activity	Number of Refuge Visitors
Wildlife Observation	133,000
Nature Photography	6,000
Freshwater Recreational Fishing	4,950
Environmental Education Programs Onsite	8,400
Environmental Education Programs Offsite	1,200
Interpretative Programs Onsite	13,300
Interpretative Programs Offsite	4,800

**Numbers outlined here are not additive. Refuge visitors may have participated in more than one activity during a visit. Numbers provided here are representative of the primary activity of a particular visit.*

Annual refuge visitation is estimated through multipliers of the number of visitors by activity, from visitor contacts at refuge headquarters, road-traffic counts, program attendance, and observations by our refuge staff and volunteers. According to numbers reported by refuge staff, approximately 133,000 visits were made to the refuge in 2009. Out of this total, over 13,300 people visited the visitor center that same year. A summary of participants in refuge programs is provided below:

Being located in a large urban center allows the refuge to host a variety of visitors including school groups, homeschoolers, youth groups, family groups, anglers, birders, paddlers, bicyclists, refuge neighbors, surrounding community members, tourists (primary local, but regional, national and international visitor numbers are growing), as well as businesses.

The main goals of the visitor services program are to work with partners to promote the benefits of wildlife and habitat conservation and management; to foster an awareness and appreciation for the refuge and its role along the Atlantic flyway and within the Refuge System; and to provide quality wildlife dependent recreational experiences to visitors. Through these goals, refuge staff seek to develop a sense of environmental stewardship and conservation ethics in visitors.

The visitor services staff, and refuge staff overall, are passionate about and dedicated to, natural resources and their roles at the refuge; the entire staff is involved in the visitor services program. Since the refuge has been established, in part, to offer environmental education and wildlife-dependent recreation, refuge staff is not only in the business of habitat restoration and conservation, but also in "customer service" on behalf of the Service itself. For many residents of Philadelphia, the staff of John Heinz NWR may be their one and only interaction with the Service. Refuge staff is very active in outreach and partnership development. The refuge staff is dedicated to reaching out to new audiences, while maintaining the value of the refuge to its core audience.

Because environmental education is one of the establishing purposes of the refuge, much of the visitor services program focuses on environmental education programs. Currently, about 9,400 students a year participate in environmental education opportunities led by their teachers or by refuge staff and volunteers. Of that, 8,200 participate in onsite programs while another 1,200 participate in

offsite programs. Education activities currently offered by refuge staff focus primarily on assisting teachers in developing environmental lesson plans for both onsite and offsite learning, sponsoring various onsite environmental workshops, and conducting onsite field trips for school groups.

Staff offer teacher trainings in delivering some of the widely-used conservation education programs such as Project WET, WILD, and Learning Tree workshops. About 200 teachers a year participate in these programs. Typical audiences for existing education activities consist of School District of Philadelphia elementary classes, summer camps, and some interest from local college programs for architecture, wildlife, and environmental studies. The refuge receives a number of education visits through field trips. These are generally guided by the teacher and/or chaperones that accompany the group. See appendix I (USGS Phase 1 Environmental Education Needs Assessment) for additional information on the refuge's current environmental education program.

The refuge recently completed an environmental education needs assessment as part of the CCP process to identify opportunities for future refuge educational programming and reduce potential for overlap with similar programs across the refuge. This effort is being conducted in two phases: Phase 1 Summary of Current Environmental Education Program is included as appendix H. Phase 2 has recently been completed. Recommendations from Phase 2 will be incorporated into future visitor services planning.

The refuge is not open to hunting because of potential conflicts with local refuge regulations and safety and staffing availability concerns. Pennsylvania Game Commission (PGC) regulations only allow hunting within Philadelphia County through the use of archery or crossbows. While the refuge does not currently allow hunting, it does support hunting activities through sponsoring hunter education courses, managing the Pennsylvania Chapter of the Federal Junior Duck Stamp Program, and making informational materials available.

For additional details on the refuge's current visitor service program, please see chapter 3, section 3.4, Current Management.

2.15 Archeological and Historical Resources

The portion of the refuge within Tinicum Township now consists entirely of tidal marsh or artificial landforms, including the refuge dike system. Examination of historic maps as well as a sequence of aerial photographs beginning in the 1920s reveals that has been the situation for at least the last150 years, probably far longer. However, two areas of terrace on the north side of Darby Creek in Folcroft and a considerably larger area within Eastwick appear to consist of natural upland having potential to contain intact pre-Contact Native American archaeological sites. Historic period archaeological sites could also exist in those three areas, though examination of historic maps and aerial photographs indicate that after the 17th century those areas were more likely used as pasture associated with farmsteads built closer to the historic road system.

Map evidence indicates that some refuge dikes follow the alignment of dikes constructed prior to the mid-19th century, some perhaps even originating in the 17th or 18th century. However, virtually all of the surviving dike system was modified in the mid-20th century by installation of water control structures, addition of interior dikes in some areas, and widening of most dikes to support a modern maintenance road system atop them. Erosion associated with relatively recent storm events has also obliterated considerable portions of the historic period system. Although the appearance of refuge dikes now differs substantially from that of the historic period, it seems probable that in at least some places the timber cribbing of early dikes may remain intact beneath wider modern cross-sections. Therefore, archaeological monitoring may be advisable if any future dike repairs will extend beneath the fabric of 20th century modifications.

Chapter 3

LaVonda Walton/USFWS

Judges review entries at the 2011 Federal Junior Duck Stamp Contest held at the refuge

Alternatives Considered, Including the Service-preferred Alternative

3.1 Introduction

This chapter describes our process for formulating alternatives, the actions that are common to all of the alternatives, the actions or alternatives we considered (but did not fully develop), and the three alternatives we analyzed in detail. At the end of this chapter, table 3.2 compares how each of the alternatives addresses key issues, supports major programs, and achieves refuge goals.

3.2 Formulating Alternatives

3.2.1 Relating Goals, Objectives, and Strategies

The refuge goals developed are intentionally broad, descriptive statements of the desired future condition of refuge resources. Goals articulate the principal elements of the refuge purposes and our vision statement, and provide a foundation for developing specific management objectives and strategies. All of the alternatives analyzed address the same goals.

The objectives are essentially incremental steps toward achieving a goal; they further define management targets in measurable terms. Typically, they vary among the alternatives, and provide the basis for determining strategies that are more detailed, monitoring refuge accomplishments, and evaluating our successes. "Writing Refuge Management Goals and Objectives: A Handbook" (USFWS 2004a) recommends writing "SMART" objectives that possess 5 characteristics: (1) specific; (2) measurable; (3) achievable; (4) results-oriented and (5) time-fixed. A rationale accompanies each objective to explain its context and importance. The objectives outlined in the alternative selected for the final CCP will guide the future development of refuge step-down plans, which we describe later in this chapter.

Strategies are the specific or combined actions, tools, or techniques we may use to achieve the objectives. The list of strategies in each objective represents the potential suite of actions we may implement. We will evaluate most of them further as to how, when, and where we should implement them when we write our refuge step-down plans. We will measure our successes by how well our strategies achieve our objectives and goals.

3.2.2 Developing Alternatives, Including the "No Action" Alternative

Over the course of several months, the core planning team and refuge staff held meetings and conference calls to identify a wide range of possible management objectives and strategies that could achieve our goals. After these were initially developed, we began the process of designing detailed management alternatives. Each management alternative is intended as an alignment of complementary objectives and strategies designed to meet refuge purposes, vision, and goals, and the Refuge System mission and goals, while responding to the issues and opportunities that arose during the planning process.

We grouped objectives that seemed to fit together in what we loosely term "alternative themes." For example, we considered such themes as "enhanced biological and visitor services management" and "management with an emphasis on the regional role of the refuge." After forming objectives into three management alternatives, we further evaluated how the objectives would interact and how well they would fulfill the refuge purposes

In this chapter, we fully analyze three alternatives that characterize different ways of managing the refuge over the next 15 years. As required by NEPA, we believe they represent a reasonable range of alternatives for achieving the refuge purpose, vision, and goals, and addressing the issues described in chapter 1. Unless otherwise noted, refuge staff would implement all actions.

Alternative A addresses the NEPA requirement of a "No Action" alternative, which we define as continuing current management. It describes our existing management priorities and activities, and serves as a baseline for comparing and contrasting alternatives B and C. To better understand the scope and context embodied within the various alternatives, please see chapter 2, "Description of the Affected Environment," for detailed descriptions of current refuge resources and programs.

Many of the objectives in alternative A do not strictly follow the guidance in the Service goals and objectives handbook, because we are describing current management decisions and activities that we established prior to that guidance. Our descriptions of those activities devolve from a variety of formal and informal management decisions and planning documents. Thus, the objectives in alternative A are fewer and more subjective than are those in alternatives B or C.

Alternative B, the Service-preferred alternative, combines the actions we believe would achieve most effectively the refuge purposes, vision, goals, and respond to public issues. It emphasizes the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern in the Delaware Estuary and southeastern Pennsylvania. In particular, we emphasize habitat restoration for globally rare plant communities and habitat types and related priority species of conservation concern. In addition, this alternative would enhance our present visitor services programs in a manner that addresses the legislatively determined purposes of John Heinz NWR as well as national and regional Service policies and mandates.

Alternative C proposes a philosophy of cautious pursuit of restoration and conservation measures in light of the unknown implications of climate change within the life of the plan (15 years) and restoration of early successional upland habitats currently underrepresented on and around the refuge, but of importance to some of the focal species of concern identified by Service staff in development of the Draft Habitat Management Plan (appendix C). Alternative C also emphasizes the role of the refuge as a leader and technical resource in regional conservation and environmental education efforts.

3.3 Actions Common to All of the Alternatives

All of the alternatives share some common actions. Some are required by law or policy, or represent actions that have undergone previous NEPA analysis, public review, agency review, and approval. Others may be administrative actions that do not require public review, but that we want to highlight in this public document.

All of the following actions are current practices or policies that would continue under all alternatives:

- Using an adaptive management approach, where appropriate
- Continuing land protection by purchasing fee title and conservation easements from willing sellers, and accepting donations, within the current, approved acquisition boundary
- Controlling invasive species
- Monitoring and abatement of diseases affecting wildlife and forest health
- Controlling pest plants and animals

- Facilitating or conducting biological research and investigations
- Completing existing onsite projects managed by outside programs, such as restoring 55 acres of freshwater tidal marsh and site remediation of Folcroft Landfill
- Developing a comprehensive GIS database for the refuge and the surrounding landscape to better inform and facilitate on-the-ground management
- Completing findings of appropriate use and compatibility determinations
- Providing refuge staffing and administration

3.3.1 Adaptive Management

All of the alternatives will employ an adaptive management approach for improving resource management by learning from management outcomes. To provide guidance on policy and procedures for implementing adaptive management in departmental agencies, an intradepartmental working group developed a technical guidebook to assist managers and practitioners (Williams et al. 2009). It defines adaptive management, the conditions under which we should consider using it, the process for implementing it in a structured framework, and evaluating its effectiveness (Williams et al. 2009). In the guidebook adaptive management is defined as:

> *"…a decision process that promotes flexible decisionmaking that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.*

At the refuge level, monitoring key resources and management actions and outcomes will be important to implementing an adaptive management process. Our freshwater tidal marsh restoration and management, invasive species, and impoundment management activities are examples of refuge programs or activities where an adaptive management approach may be implemented. The refuge manager will be responsible for changing management actions and strategies if they do not produce the desired conditions. Significant changes from what we present in our final CCP may warrant additional NEPA analysis and public comment. Minor changes will not, but we will document them in our project evaluation or annual reports. Implementing an adaptive management approach supports all six goals of the refuge.

3.3.2 Protecting Land

The Service is authorized to protect 1,200 acres within its existing, approved refuge boundary. Currently, the Service has acquired 993 acres in fee title. We will continue to work with willing sellers and in partnership with other agencies and organizations to protect the remaining 207 acres within the refuge's authorized acquisition boundary.

It is impossible to predict the size, type, and location of future acquisitions that may come under our management within the next 15 years. Although the refuge seeks to acquire suitable and available habitat within its approved refuge boundary, concerted efforts to purchase those lands is not a primary focus of refuge management since the refuge already owns the majority of lands within its approved boundary. Instead, we will focus on creating partnerships with adjacent and nearby land owners in support of broader conservation issues that affect the refuge (e.g., habitat fragmentation).

The permanent protection of land is the keystone of wildlife and habitat conservation. Land protected by the Refuge System will be available forever to

support fish, wildlife, and plants. We can restore, enhance, or maintain the land we own interest in to provide optimal conditions for Federal trust resources, such as threatened or endangered species and those species whose populations are in decline.

3.3.3 Managing Invasive and Pest Species

Invasive Species

The establishment and spread of invasive species, particularly invasive plants, is a significant problem that reaches across all habitat types. For the purposes of this discussion, we use the definition of invasive species contained in the Service Manual (620 FW 1.4E): "Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm, or harm to human health. Alien species, or non-indigenous species, are species that are not native to a particular ecosystem. We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere."

The unchecked spread of invasive plants threatens the biological diversity, integrity and environmental health of all refuge habitats. In many cases, they have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. Over the past several decades, government agencies, conservation organizations, and the public have become more acutely aware of the negative effects of invasive species. Many plans, strategies, and initiatives target the more effective management of invasive species (e.g., USFWS 2004b, National Wildlife Refuge Association 2002). The Refuge System biological discussion database and relevant workshops continually provide new information and updates on recent advances in control techniques. Sources of funding are also available, both in the Service budget and through competitive grants, to conduct inventory and control programs.

Sixteen known invasive plant species targeted for invasive species management on the refuge are outlined in Section 2.8 Refuge Biological Resources of Chapter 2 "Affected Environment." Refuge staff currently focuses control on the following invasive plants, listed in alphabetical order by common name: bush honeysuckle, Canada thistle, phragmites, garlic mustard, Japanese hops, Japanese honeysuckle, Japanese knotweed, Japanese stiltgrass, mile-a-minute weed, multiflora rose, Norway maple, Oriental bittersweet, porcelainberry, purple loosestrife, and tree-of-heaven. Other invasive species have been identified, but have not been a focus of existing control efforts due to a combination of limited resources and the species' limited likelihood of additional expansion on the refuge. Those species include European privet, princess tree, buckthorn, and reed canary grass. We also monitor refuge and adjacent lands and waters for the presence of invasive animal species, such as mute swans, feral cats, carp, red-eared slider, rusty crayfish, Asian stinkbugs, and snakehead, and are prepared to respond quickly to control them if discovered.

Of particular note, the emerald ash borer (EAB) is an invasive insect that has spread throughout portions of the northcentral and eastern U.S., including Pennsylvania. EAB was first identified in western Pennsylvania in 2007. A separate population was identified in central Maryland in 2003. EAB larvae feed on the tissues under the bark of ash trees, causing the death of branches and entire trees (PADCNR 2010). Since many of the floodplain forest communities of the refuge contain green ash as a dominant species, the location and expansion of EAB populations is another special concern.

Guidance on managing invasive species on refuges appears in the Service Manual (620 FW 1.7G). The following actions, define our general strategies on the refuge:

(1) Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and to prevent new and expanded infestations of invasive species.

(2) Conduct refuge habitat management to prevent, control, or eradicate invasive species using techniques described through an integrated pest management plan, or other similar management plan, the plans comprehensively evaluate all potential integrated management options, including def ning threshold/risk levels that will initiate the implementation of proposed management actions.

(3) Evaluate native habitat management activities with respect to their potential to accidentally introduce or increase the spread of invasive species and modify our habitat management operations to prevent increasing invasive species populations.

(4) Refuge integrated pest management (IPM) planning addresses the abilities and limitations of potential techniques including chemical, biological, mechanical, and cultural techniques. See additional discussion on IPM (section 3.3.3 below).

(5) Manage invasive species on refuges under the guidance of the National Strategy for Invasive Species Management (USFWS 2004) and within the context of applicable policy.

The following actions define our specific strategies for the refuge:

(1) Continue the treatment of the most problematic species ranked in management priority based on (a) the extent to which the species is established on the refuge, (b) the potential ecological impact of the species on refuge plant communities, and (c) the degree of management diff culty involved in controlling the species.

(2) Maintain early detection and rapid-response readiness regarding new invasions.

(3) Maintain accessibility to affected areas for control and monitoring.

(4) Continue to promote research into the biological control alternatives.

(5) Continue and increase efforts to involve the community in promoting awareness of invasive species issues, and seek assistance for control programs on and off the refuge.

Pest Species

At times, native plants and animals interfere with management objectives when they become overabundant. The Refuge Manual (7 RM 14.4A) defines a pest as "Any terrestrial or aquatic plant or animal which interferes, or threatens to interfere, at an unacceptable level, with the attainment of refuge objectives or which poses a threat to human health." That definition could include the invasive species defined above, but in this section, we describe some situations involving native species and under what conditions we will initiate control.

We use the following general strategies in pest management:

(1) Determine the need for site-specif c control based on the potential to affect our management objectives for a given area. We will employ an adaptive management strategy and we expect lethal control or removal of individual animals to be the exception rather than the rule. To establish general thresholds for lethal control is diff cult. So we will determine our solution on a case-by-case basis. For example, in some years, spadderdock (also known as yellow pond lily) has expanded within the 145-acre impoundment to create a single-species population that vegetates managed mudf at habitat and outcompetes other native vegetation targeted for migratory bird management such as native, annual vegetation such as smartweeds, sedges, and rushes. As a result, we annually monitor establishment and expansion of spadderdock populations within the impoundment and adjust water level management to limit spadderdock expansion or selectively apply herbicides to favor establishment of desired annual native vegetation.

(2) Employ integrated pest management techniques, when a species is having a signif cant impact on an area resulting in major habitat replacement and loss of valuable canopy trees (such as oaks) or desired native vegetation (such as sedges, rushes, and smartweeds).

(3) Monitor results to ensure that pests do not exceed acceptable levels.

Integrated Pest Management (IPM)
In accordance with 517 DM 1 and 7 RM 14, an integrated pest management (IPM) approach will continue to be used, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on the refuge. IPM involves using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target organisms and the refuge environment. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. Furthermore, pesticides would be used primarily to supplement, rather than as a substitute for, practical and effective control measures of other types. If a pesticide is used on the refuge, the most specific (selective) chemical available for the target species would be used unless considerations of persistence or other environmental or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage would be further restricted because only pesticides registered with the EPA in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and as provided in regulations, orders, or permits issued by the EPA may be applied on lands and waters under refuge jurisdiction.

Environmental harm by pest species is defined as a biologically substantial decrease in environmental quality as indicated by one or more of a variety of potential factors including declines of native species' populations or communities, degraded habitat quality or long-term habitat loss, or altered ecological processes. We define environmental harm as resulting in direct effects of pests on native species including preying and feeding on them; causing or spreading diseases; preventing other native species from reproducing or killing their young; out-competing other native species for food, nutrients, light, nest sites or other vital resources; or hybridizing with them so frequently that within a few generations, few if any truly native individuals remain. In contrast, environmental harm can be the result of an indirect effect of pest species. For example, decreased waterfowl use may result from invasive plant infestations reducing the availability or abundance of native wetland plants that provide forage during the winter.

We will refine our control program to address the most critical problems first. We may adjust our priorities to reflect regional Service priorities, the availability of new information, or a new priority resource.

3.3.4 Monitoring and Abating Wildlife and Plant Diseases

The Service has not yet published its manual chapter on Disease Prevention and Control. In the meantime, we derive guidance on this topic from the Refuge Manual and specific directives from the Director of the Fish and Wildlife Service or the Secretary of the Interior. The Refuge Manual (7 RM 17.3) lists three objectives for the prevention and control of disease:

(1) Manage wildlife populations and habitats to minimize the likelihood of the contraction and contagion of disease.

(2) Provide for the early detection and identif cation of disease mortality when it occurs.

(3) Minimize the losses of wildlife from outbreaks of disease.

The Service published those objectives in 1982. Since then, in addition to diseases that cause serious mortality among wildlife, diseases transmitted through wildlife to humans have received more attention. One example is Lyme disease. In 2002, the Service published a Service Manual chapter (242 FW 5) on Lyme disease prevention to inform employees, volunteers, and national service workers about this disease, its prevention, and treatment. In addition to Lyme disease, several other wildlife and plant diseases are particularly concerning at John Heinz NWR:

These are the general strategies for preventing or controlling disease:

(1) Continue to conduct disease surveillance in conjunction with other f eldwork.

(2) Cooperate with State agencies, particularly the Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission, and Pennsylvania Natural Heritage Program, in conducting surveillance, providing access for sampling, and following protocols in the event of an outbreak.

(3) Monitor forests and other habitats for indicators of the increased occurrence of pests or disease. For example, note changes in f owering or fruiting phenology, physical damage, decay, weakening, sudden death (particularly of canopy and source trees of major host species), and changes in wildlife use of habitats, such as the absence of breeding birds that used to appear regularly.

(4) Follow the protocols in national, State, and refuge disease prevention and control plans.

Avian Influenza and Avian Botulism

Avian influenza is another serious wildlife disease that has received considerable attention worldwide. Of particular concern is the highly pathogenic Eurasian form (H5N1). In 2006, all refuges were instructed to prepare an Avian Influenza Surveillance and Contingency Plan. The John Heinz National Wildlife Refuge Avian Influenza Surveillance and Disease Contingency Plan was approved in April 2007 and discusses methods for dealing with this disease (USFWS 2007).

Avian botulism is caused when birds ingest a toxin produced by the bacteria, *Clostridium botulinum*. This bacteria is common in soils, but does not produce the toxin unless warm temperatures combine with a protein source and anaerobic (no oxygen) conditions (USGS 2011). Occasionally, large numbers of fish can

die off during drawdowns of the impoundment. This can result in conditions conducive to production of the Avian botulism toxin. Refuge staff monitor the impoundment during drawdowns to determine whether or not conditions for Avian botulism are present. If these conditions are present, refuge staff may need to open the water control structure to allow additional water into the impoundment to prevent an outbreak of this disease in the refuge's waterfowl and waterbirds.

Chronic Wasting Disease
Chronic Wasting Disease (CWD) is a fatal disease that attacks the brain and spinal cord of deer and elk. While the exact cause is unknown, it is believed to be caused by a prion, an altered protein that causes other normal proteins to change and cause sponge-like holes in the brain. CWD was first identified in the 1960s in a Colorado research facility. Since that time, it has been found in numerous states including the nearby States of New York and West Virginia. CWD has not been found in white-tailed deer in Pennsylvania. Prion diseases like CWD do not move easily between species. There is no scientific evidence that CWD has been transmitted to animals other than deer, elk, and moose. The Chronic Wasting Disease Surveillance and Contingency Plan for John Heinz National Wildlife Refuge was approved in October 2007 (USFWS 2007c) and discusses early detection and response to any potential CWD occurrence at the refuge.

Epizootic Hemorrhagic Disease
Epizootic Hemorrhagic Disease (EHD) is a virus and the most common infectious disease of white-tailed deer in the eastern U.S. It is not transferable to humans and only rarely does it cause illness in other animals. EHD is spread from animal to animal by biting midges that live in or near water and wet, muddy areas. These midges transmit the virus as they feed. Outbreaks among white-tailed deer have occurred in Pennsylvania in 1996 (unconfirmed), 2002, and in 2007. Due to the midge being the main mode of transmission, control is very difficult and typically ineffective. More frequent exposure to the virus allows deer to develop immunity, allowing it to recover. EHD outbreaks in southern states, which occur more frequently than in more northern states, typically have lower mortality rates than what is seen when the disease comes to Pennsylvania (PGC 2011). However, the New Jersey Department of Environmental Protection Division of Fish and Wildlife's Office of Fish and Wildlife Health and Forensics, reported a documented outbreak of Type 2 EHD in Salem County (approximately 20 miles from the refuge) in the fall of 2010. This outbreak of Type 2 EHD in New Jersey raises concern that this strain may persist and reoccur annually as it does in the southern U.S (NJDEP 2010).

Oak Diseases
Diseases can affect forest health as well. Diseases that affect oaks are a special concern because of the importance of the coastal plain forest community which is dominated in part by pin oaks. More than 80 documented insects and diseases affect oak trees in the United States. Their impacts range from minor defoliation to rapid mortality. In some years, pests cause the loss of a major portion of the acorn crop, impeding oak regeneration. A few pests have altered or may alter eastern U.S. oak forests on a broad scale. For example, humans' inadvertently transporting masses of eggs have aided the spread of the gypsy moth, an introduced defoliator, in the last few decades.

3.3.5 Biological and Ecological Research and Investigations

The Refuge Manual and the Service Manual both contain guidance on conducting and facilitating biological and ecological research and investigations on refuges. In 1982, the Service published three objectives in the Refuge Manual for supporting research on units of the Refuge System (4 RM 6.2):

(1) Promote new information and improve the basis for, and quality of, refuge and other Service management decisions.

(2) Expand the body of scientif c knowledge about f sh and wildlife, their habitats, the use of these resources, appropriate resource management, and the environment in general.

(3) Provide the opportunity for students and others to learn the principles of f eld research.

In 2006, the Service Manual provided supplemental guidance on the appropriateness of research on refuges: "We actively encourage cooperative natural and cultural research activities that address our management needs. We also encourage research related to the management of priority general public uses. Such research activities are generally appropriate. However, we must review all research activities to decide if they are appropriate or not as defined in section 1.11. Research that directly benefits refuge management has priority over other research." (603 FW 1.10D (4))

All research conducted on the refuge must be consistent with an approved finding of appropriateness and compatibility determination for research. If a research project does not fall within the scope of a current Finding of Appropriateness (FOA) and Compatibility Determination (CD), we would need to complete a project-specific FOA and CD before issuing a special use permit. Research projects may also contribute to a specific need identified by the refuge or the Service. As we note in chapter 2, we have allowed many research projects that meet these criteria. We expect additional opportunities to arise under any of the alternatives we propose in this draft CCP. A special use permit will be issued for all research projects we allow. In addition, we will employ the following general strategies:

(1) Seek qualif ed researchers and funding to help answer refuge-specif c management questions.

(2) Participate in appropriate multi-refuge studies conducted in partnership with the United States Geological Survey (USGS).

(3) Facilitate appropriate and compatible research by providing compatible access and utilization of the refuge as a location for ongoing research.

3.3.6 Completing Existing Projects Outside the Scope of the CCP Process

Several projects in progress on the refuge are being managed by programs outside of the refuge either due to funding sources or jurisdiction. Although these projects are occurring on the refuge, NEPA compliance for these projects is being addressed outside this CCP because they are being planned and analyzed by other Service programs or other Federal agencies. Because projects are progressing outside the framework of this CCP, any decisions about when and how they will proceed will be the same under all alternatives.

The Service's Chesapeake Bay Ecological Services (ES) office in Annapolis, Maryland, is spearheading efforts to restore 55 acres of freshwater tidal marsh that is currently a phragmites-dominated wetland. Funding for this project's design and construction has been secured and is provided through the Natural Resource Damage Assessment (NRDA) settlement on behalf of the 2006 Athos oil spill on the nearby Delaware River. Currently, the Chesapeake Bay ES office is planning the project and will comply with NEPA as needed. This project will be the largest freshwater tidal marsh restoration project on the refuge once completed.

Remediation of the Folcroft Landfill is another large-scale effort that will likely continue for years before completion. The EPA is leading the multi-agency effort to complete the characterization and remediation of the Folcroft Landfill. At the time of this writing, the EPA finalized a legal agreement with a group of potentially responsible parties (PRPs) requiring them to perform the Remedial Investigation and Feasibility Study (RI/FS). The Service owns the Folcroft Landfill as part of the refuge. Field investigations on the site started at the end of November 2006 and continued until summer of 2007. During this time groundwater wells were installed and sampled and soil samples were collected. This environmental data will be included in the RI/FS for the Folcroft Landfill which is currently underway. The RI for the Folcroft Landfill was recently submitted to the EPA and is currently being reviewed. Once remediation is complete, the Service will manage these lands according to an approved plan. At that time, we would determine which public uses would be allowed.

3.3.7 Protecting Cultural Resources

As a Federal land management agency, we are responsible for locating and protecting all historic resources, specifically archeological sites and historic structures eligible for listing or listed on the National Register of Historic Places. That applies not only to refuge land, but also to land affected by refuge activities, and includes any museum properties. We are not aware of any documented archaeological resources on the refuge at this time.

Modifications to refuge structures dating over 50 years in age, construction of new refuge facilities, and habitat modifications requiring earthmoving are all subject to review under Sec. 106 of the National Historic Preservation Act. That review process requires consultation with the Pennsylvania Historical and Museum Commission and federally recognized Tribes, as well as any other interested parties that may be identified during the process. The potential for intact pre-Contact or historic period resources that could be affected by a refuge undertaking varies according to the characteristics of natural landforms, extent of modern disturbance, and nature of the undertaking itself.

Under all the alternatives, we will evaluate the potential for our management activities to impact archeological and historical resources as required, and will consult with the Service's regional archaeologists, Pennsylvania Historical and Museum Commission, and appropriate federally recognized Tribes to ensure compliance with Section 106 of the National Historic Preservation Act and any other applicable laws and regulations, regardless of the alternative implemented. That compliance may require any or all of the following: a State Historic Preservation Records survey, literature survey, or field survey.

3.3.8 Wildlife-dependent Recreational Program

The Refuge Improvement Act designated six priority public uses on National Wildlife Refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Per the General Guidelines for Wildlife-dependent Recreation (Fish and Wildlife Service Manual 605 FW 1), we will continue to use the following criteria for a quality wildlife-dependent recreation program in developing refuge programs. According to Service policy, quality wildlife-dependent recreation

(1) promotes safety of participants, other visitors, and facilities;

(2) promotes compliance with applicable laws and regulations and responsible behavior;

(3) minimizes or eliminates conf ict with f sh and wildlife population or habitat goals or objectives in an approved plan;

(4) minimizes or eliminates conf icts with other compatible wildlife-dependent recreation;

(5) minimizes conf icts with neighboring landowners;

(6) promotes accessibility and availability to a broad spectrum of the American people;

(7) promotes resource stewardship and conservation;

(8) promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources;

(9) provides reliable/reasonable opportunities to experience wildlife;

(10) uses facilities that are accessible to people and blend into the natural setting; and,

(11) uses visitor satisfaction to help to def ne and evaluate programs.

While no formal survey has been conducted, observations by refuge staff indicate that most visitors to the refuge engage in some form of wildlife-dependent recreation. Wildlife observation and onsite environmental interpretation are the two most common activities (see chapter 2, section 2.13). The refuge offers opportunities for five of the six designated priority uses. The refuge does not allow hunting because of public safety concerns and compliance with local regulations. Despite the exclusion of hunting from the refuge, we still support hunting as an activity through sponsoring related activities such as hunter-education and archery programs.

In recent years, the Service has recognized the importance of connecting children with nature. Scholars and health care professionals are suggesting a link between a loss of connection with the natural world and many physical and mental problems in our nation's youth (Louv 2005). We will continue to promote the concept of connecting children with nature in all of our compatible recreational programming. Our partners, Friends of the Heinz Refuge (FOHR), and other volunteers will continue to help us expand these priority public use programs.

3.3.9 Appropriateness and Compatibility Determinations

Chapter 1 describes the requirements for determinations of appropriateness and compatibility. Appendix B includes appropriateness and compatibility determinations consistent with implementing alternative B, the Service-preferred alternative. All existing findings of appropriateness and compatibility determinations will be updated for the alternative selected under the final CCP. These activities would be evaluated based on whether or not they contribute to meeting or facilitating refuge purposes, goals, and objectives. As noted above, hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when compatible, are the priority wildlife-dependent uses of the Refuge System. According to Service Manual 605 FW 1, these uses should receive preferential consideration in refuge planning and management before the refuge manager analyzes other public uses for appropriateness and compatibility.

3.3.10 Activities Not Allowed

The refuge location within the city of Philadelphia and neighboring communities of Delaware County makes it accessible to a variety of visitors. We have received requests for non-priority, non-wildlife-dependent activities that are typically not allowed on refuges. In appendix B, we formally propose that the following are

not appropriate on refuge lands: off-trail wildlife observation, bicycling off of designated areas, cycling events (such as tours and races), camping, commercial fishing, trapping, dog training and field trials, refuge entry after dark, pets off-leash, jogging offroad, picnicking, and swimming and sunbathing. Appendix B documents the refuge manager's justification for why they are deemed not appropriate or not compatible. Other ownerships nearby or elsewhere sufficiently provide most of those activities, so the lack of refuge access does not eliminate opportunities for those activities within the Philadelphia metropolitan area. According to Service policy, (603 FW 1), if the refuge manager determines a use is not appropriate, it can be denied without determining its compatibility.

3.3.11 Activities Allowed

Some activities are already approved through an existing finding of appropriateness and a compatibility determination (CD). These include research, wildlife observation, photography, environmental education and interpretation, recreational fishing, and bicycling for the purposes of accessing wildlife-dependent recreation opportunities (limited to existing access roads). We are in the process of updating these CDs, which are included in appendix B for public review and comment. Appendix B details our proposals for all of those activities.

3.3.12 Refuge Staffing and Administration

Our proposals in this document do not constitute a commitment for staffing increases, or funding for operations, maintenance, or future land acquisition. Congress determines our annual budgets, which our Washington Headquarters and regional offices distribute to the field stations. Chapter 2 presents our levels of staffing and operating and maintenance funds for the refuge over the last 5 years.

Permanent Staffing and Operational Budgets
In all the alternatives, our objective is to sustain levels of annual funding and staffing that allow us to achieve refuge purposes, as interpreted by the goals, objectives, and strategies that we will establish in the final CCP. We achieved many of our most highly visible projects since refuge establishment through special project funds that typically have a 1- to 2-year duration. Although those funds are very important, their flexibility is limited, because we cannot use them for any other priority project that may arise. As previously mentioned, funding for land acquisition derives primarily from two sources: the Land and Water Conservation Fund, and the Migratory Bird Conservation Fund. We generally direct the funds from those sources at specific acquisitions.

In all the alternatives, we would seek to fill any currently approved but vacant positions, which we believe are necessary to accomplish our highest priority projects. Alternatives B and C also propose additional staff to support expanded biological and visitor services programs. We identify our recommended priority order for new staffing in the Refuge Operating Needs (RONS) tables in appendix D. The alternatives also seek an increase in our maintenance staff, because they provide invaluable support to all program areas. Appendix C identifies current and proposed staffing levels.

Facilities Construction and Maintenance
Congress passed legislation establishing the refuge in 1972, but construction of the visitor center did not begin until 2000. Since its completion in 2001, no other major building construction has occurred on the refuge. The refuge did install a paved, 0.6-mile, handicapped accessible trail loop near the visitor center and main parking lot in the summer of 2009. In 2011, the refuge completed installation of an outdoor pavilion. The outdoor pavilion was developed to better accommodate large school and community groups. While the visitor center provides large meeting space and smaller classroom facilities, the outdoor pavilion allows these

groups to more effectively utilize their limited time on the trail and spend more time outside, experiencing the refuge.

Under all proposed alternatives, we will continue to make incremental progress in upgrading appropriate facilities to ADA standards. We will also continue to improve access and refuge visibility in the community for visitors. We have identified the need for additional directional signs both on and offsite. We will work with the Pennsylvania Department of Transportation (PENNDOT), Southeastern Pennsylvania Transportation Authority (SEPTA), and the city of Philadelphia to improve directional signs offsite.

Improved signage will help raise the visibility of the refuge and the Service in the region. As observed by refuge staff, and verified by numerous web postings and blogs, the refuge remains unknown to many people living near the refuge. We must also take care to upgrade and maintain all facilities to Service standards to keep them safe, fully accessible, functional, and attractive.

Distributing Refuge Revenue Sharing Payments
As discussed in chapter 2, we pay local municipalities in Philadelphia and Delaware Counties annual refuge revenue sharing payments based on the number of acres in each municipality and the appraised value of refuge lands in their jurisdiction. All of the alternatives would continue these payments in accordance with the Revenue Sharing Act, commensurate with changes in the appraised market value of refuge lands, or new appropriation levels dictated by Congress.

Refuge Operating Hours
All of the alternatives will open the refuge for public use from official sunrise to sunset, 7 days a week, to ensure visitor safety and protect refuge resources. However, the refuge manager does have the authority to issue a special use permit to allow others access outside those periods. For example, we may permit access for research personnel or wildlife control specialists at different times, or organized groups to conduct nocturnal activities, such as wildlife observation, and educational and interpretive programs.

3.3.13 Conducting a Wilderness Review

The 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 the Service owns in fee simple. Our inventory of this refuge determined that no areas meet the eligibility criteria for a wilderness study area (WSA) as defined by the Wilderness Act. Therefore, we did not analyze further the refuge's suitability for wilderness designation. See appendix E for the results of the wilderness inventory. The refuge will undergo another wilderness review in 15 years as part of the next comprehensive conservation planning process.

3.3.14 Conducting a Wild and Scenic Rivers Review

Service planning policy also requires that we conduct a wild and scenic rivers review during the CCP process. We inventoried the segment of the Darby Creek that flows through the refuge, and determined that it does not meet the criteria for wild and scenic river eligibility (see appendix F). As such, we are not pursuing further study to determine suitability, nor recommending this segment of the river be designated as wild and scenic at this time. Should another State or Federal agency, or a non-governmental partner, initiate a study, we would participate in that effort.

3.3.15 Completing Refuge Step-down Plans

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. The existing step-down plans in place on the refuge are summarized previously in Section 1.5, "Conservation Plans and Initiatives Guiding the Proposed Action," of chapter 1.

Under all alternatives, we will revise and finalize the HMP in conjunction with the final CCP. The annual habitat work plan (AHWP), an inventory and monitoring plan (IMP), an integrated pest management Plan (IPM), and the Visitor Services Plan (VSP) are also identified as high priority step-down plans to complete, regardless of the alternative selected for implementation. We describe them in more detail below. To keep them relevant, we will modify and update them as we obtain new information. The completion of these plans supports all refuge goals.

The alternatives schedule the completion of the following step-down management plans:

- Draft HMP will be finalized during the CCP process (see discussion below)
- Environmental Education Plan, drafted in 2010, will be finalized following CCP approval
- Law Enforcement Plan, drafted in 2010, will be finalized following CCP approval
- AHWP, annually after CCP approval (see discussion below)
- IMP, annually after CCP approval (see discussion below)
- Visitor Services Plan (VSP), drafted in 2010, will be finalized following CCP approval
- Facilities and Sign Plan, within 3 years of CCP approval
- Integrated Pest Management Plan (IPM), within 3 years of CCP approval
- Fishing Management Plan, within 3 years of CCP approval

Habitat Management Plan
A HMP for the refuge is the requisite first step toward achieving the objectives of goals 1 and 2, regardless of the alternative selected for implementation. For example, the HMP will incorporate the selected alternative's habitat objectives developed herein, and will identify "what, which, how, and when" actions and strategies would be implemented over the 15-year period to achieve those objectives. Specifically, the HMP will define management areas and treatment units, identify the 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 strategies in each objective identify how we intend to manage habitats on the refuge. We based both the draft CCP/EA and draft HMP on current resource information, published research, and our own field experiences. We will update our methods, timing, and techniques as new, credible information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major changes in vegetation at least every 5 years. As appropriate, we will incorporate the actions common to all alternatives into the HMP.

Annual Habitat Work Plan and Inventory and Monitoring Plan
The AHWP and IMP for the refuge are also priorities for completion upon CCP approval. Regardless of the alternative chosen, those plans also are vital for implementing habitat management actions and measuring our success in meeting

the objectives. Each year, we will generate from the HMP and AHWP that will outline specific management activities for that year. The IMP will outline the methodology to assess whether our original assumptions and proposed management actions support our habitat and species objectives. We will prioritize our inventory and monitoring needs in the IMP. 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.

Integrated Pest Management Plan
The refuge's IPM plan will be completed within 3 years of CCP approval. The IPM supplements both the CCP and HMP with documentation on how to manage invasive or pest species. Along with a more detailed discussion of IPM techniques, the IPM plan describes the selective use of pesticides for pest management on the refuge, where necessary. Throughout the life of the CCP or HMP, most proposed pesticide uses on the refuge would be evaluated for potential effects to refuge biological resources and environmental quality. These potential effects would be documented in "Chemical Profiles" in the forthcoming IPM document. Pesticide uses with appropriate and practical best management practices (BMPs) for habitat management as well as cropland and facilities maintenance would be approved for use on the refuge where there likely would be only minor, temporary, and localized effects to species and environmental quality based upon non-exceedance of threshold values in chemical profiles. However, pesticides may be used on a refuge where substantial effects to species and the environment are possible (exceed threshold values) in order to protect human health and safety (e.g., mosquito-borne disease). Pesticide Use Proposals are submitted annually for each herbicide to acquire approval prior to management applications.

3.3.16 Additional NEPA Analysis

For all major Federal actions, NEPA requires the site-specific analysis and disclosure of their impacts, either in an environmental assessment (EA) or in an environmental impact statement (EIS). NEPA categorically excludes other, routine activities from that requirement (see chapter 4, section 4.1.3 for some examples).

Most of the major actions proposed in the three alternatives and fully analyzed in this draft CCP/EA are described in enough detail to comply with NEPA, and would not require additional environmental analysis. Although this list is not all-inclusive, the following projects fall into that category:

- The HMP, including its specified restoration projects and habitat management programs
- The draft white-tailed deer management plan
- Constructing a boardwalk into Tinicum Marsh
- Controlling invasive plants
- Changing our priority public use programs, with the exception of new hunting and fishing proposals if applicable

The current fire management plan has already undergone the NEPA analysis process. Those environmental documents can be requested from refuge headquarters.

3.4 Alternative A: Current Management (No Action)

In addition to the actions common to all, this alternative describes our current refuge programs on the 993 acres (currently owned in full fee title) for habitat management, fish and wildlife inventories and monitoring, administrative infrastructure and staffing, and visitor services. Although we intend this alternative to describe a "snapshot in time" of current management actions, we are including activities we have put in motion but are not in their final, desired state.

3.4.1 Land Protection

As we describe under the heading "Protecting Land" under "Common to All" above, we would continue to work with willing sellers and in partnership with other agencies and organizations to acquire the remaining 207 acres within the refuge's approved acquisition boundary.

3.4.2 Habitat Management

Our present habitat management program uses the strategy of adaptive management. This chapter presents the existing refuge habitat types in table 3.3 and across the refuge in map 3.1.

Under current management, we would continue to intensively manage refuge fee lands utilizing a combination of mowing, herbicide application, and other strategies to manage the 993 acres of freshwater tidal marsh, nontidal wetlands, coastal plain and floodplain forests, grasslands, and open waters owned by the Service. We would work with the Service's Chesapeake Bay ES office to complete the 55-acre tidal marsh restoration project, but would otherwise maintain the existing 285 acres of freshwater tidal marsh currently owned. We would continue to manage the existing 34 acres of coastal plain forest and 252 acres of floodplain forest communities to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog. No deer management efforts would be implemented, but we would continue to monitor the impacts of the deer herd on habitat structure and biodiversity. The refuge would continue to maintain the existing 72 acres of meadows and grasslands through a combination of mowing and targeted herbicide application. The refuge would continue to maintain the 200 acres of impoundments and 132 acres of Darby Creek within the refuge boundaries to provide habitat for a variety of aquatic resources.

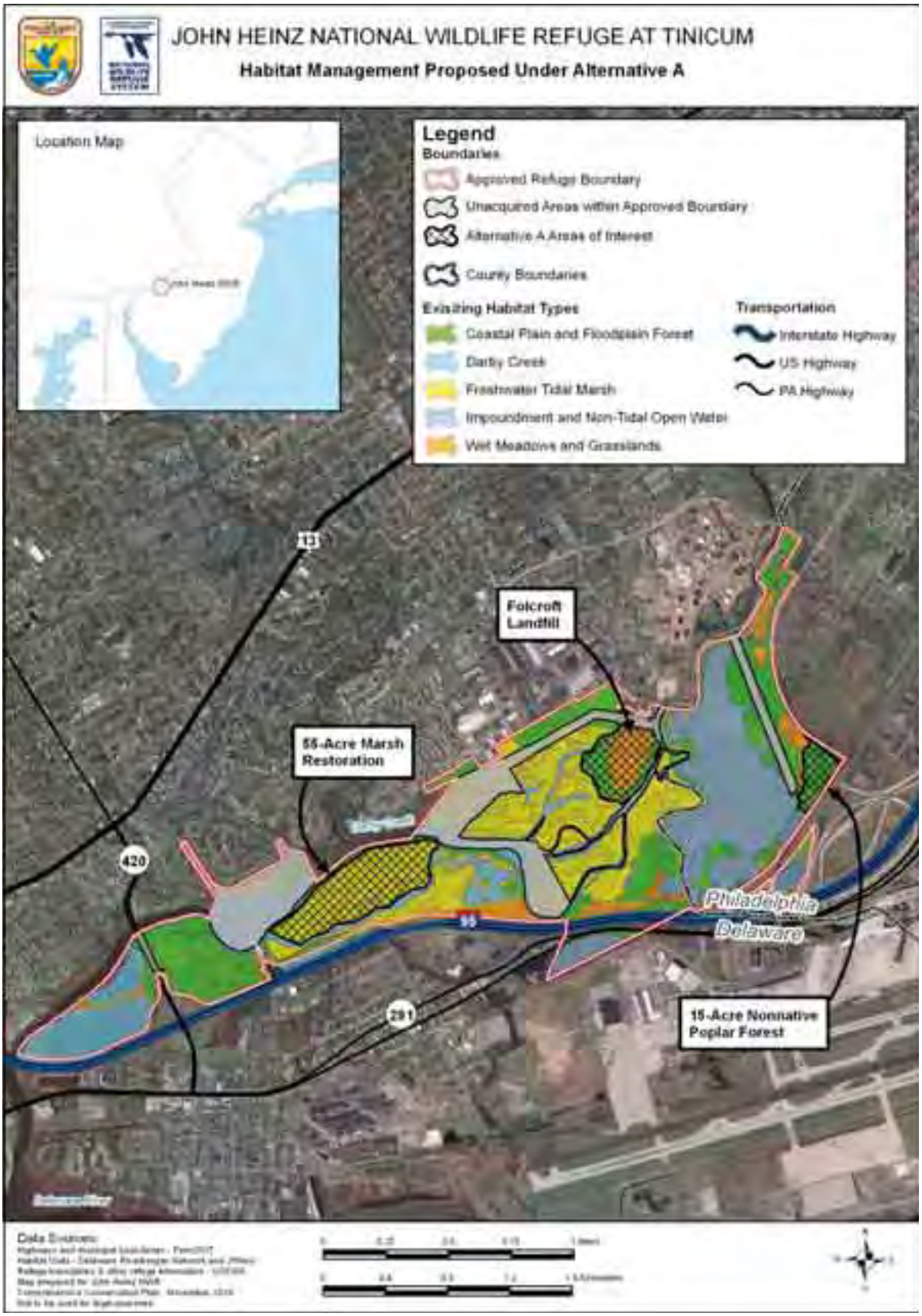
3.4.3 Inventories and Monitoring

Under current management, we are conducting baseline surveys and monitoring the results of selected management actions. In recent years, we have conducted breeding bird surveys, spring frog and toad call counts, marsh bird surveys, migratory and wintering waterfowl surveys, fish species diversity inventory, habitat monitoring, and initial surveys related to freshwater tidal marsh geomorphology and adaptation to climate change. We would continue that level of monitoring and inventory, modifying existing protocols, adding new ones, and dropping old ones as necessary to gain information to inform adaptive management decisions. As with all of our activities, the degree to which we can conduct monitoring and inventories depends on the availability of resources, including refuge funding and staff, and the contributions of partners and volunteers.

3.4.4 Visitor Services

The types of visitor service programs we provide would continue under the current management alternative. No major additions or changes in facilities would occur, except for ongoing upgrades to meet ADA-accessibility requirements and completion of an outdoor pavilion for environmental education. Each year, we host a series of environmental education programs throughout the school year. We also organize and provide at least 11 interpretive and outreach programs (five off the refuge and six on the refuge). Wildlife observation, walking/hiking, and participating in education and interpretive programs are the most popular public uses on the refuge. Hunting is, and would continue to

Map 3.1. Existing Habitats Comprising John Heinz National Wildlife Refuge at Tinicum Under Alternative A.



be, prohibited on the refuge, due to safety concerns and compliance with local regulations. We predict a slight increase in visitor numbers per year on the refuge, consistent with our observations of regional recreational trends.

Our current environmental education staff would continue to implement existing programs as resources and audience interest allows. Staff would continue to provide online curriculum and resources while pursuing ongoing alignment of programs with Pennsylvania academic standards and student standardized test requirements for all environmental education programs. Annually, the refuge would maintain partnerships with area schools that result in refuge visitation and student/educator engagement in environmental education programs. Volunteers and teachers would continue to directly lead educational programs on the refuge.

The refuge's interpretation efforts would continue to focus on maintaining existing access points and infrastructure, including trails, parking, and interpretive exhibits, kiosks, printed materials, the refuge Web site, and signage. Existing visitor services infrastructure and opportunities are presented in map 3.2. We would continue to host environmental art displays at the visitor center and complete the redevelopment of the existing example backyard habitat and installation of the webcam at the bald eagle's nest.

Based on refuge visitation estimates for 2001 through 2009, total visitation is increasing by approximately 3,000 visits per year. Using this figure, total refuge visitation is expected to increase to approximately 179,000 after 15 years.

3.4.5 Refuge Administration

In this alternative, refuge staffing would remain at ten positions for the refuge: all of which would be stationed on the refuge except the current contaminants zone biologist position shared with (and stationed out of) Great Swamp NWR. Staff is located on the refuge within two separate facilities: law enforcement is located within an office and garage combination unit, while biological, visitor services, and administrative staff are located within the headquarters office at the visitor center. All staff share biological and visitor services responsibilities for the entire refuge.

The headquarters office would remain at the visitor center, and we would upgrade these facilities as necessary for safety, ADA accessibility, and utility over time as funding permits. We would maintain our present visitor service facilities as funds and staffing permit, but would construct no new ones, with the exception of an outdoor pavilion already in progress.

In the discussion that follows, we describe in detail the goals, objectives, and strategies that we would implement under alternative A.

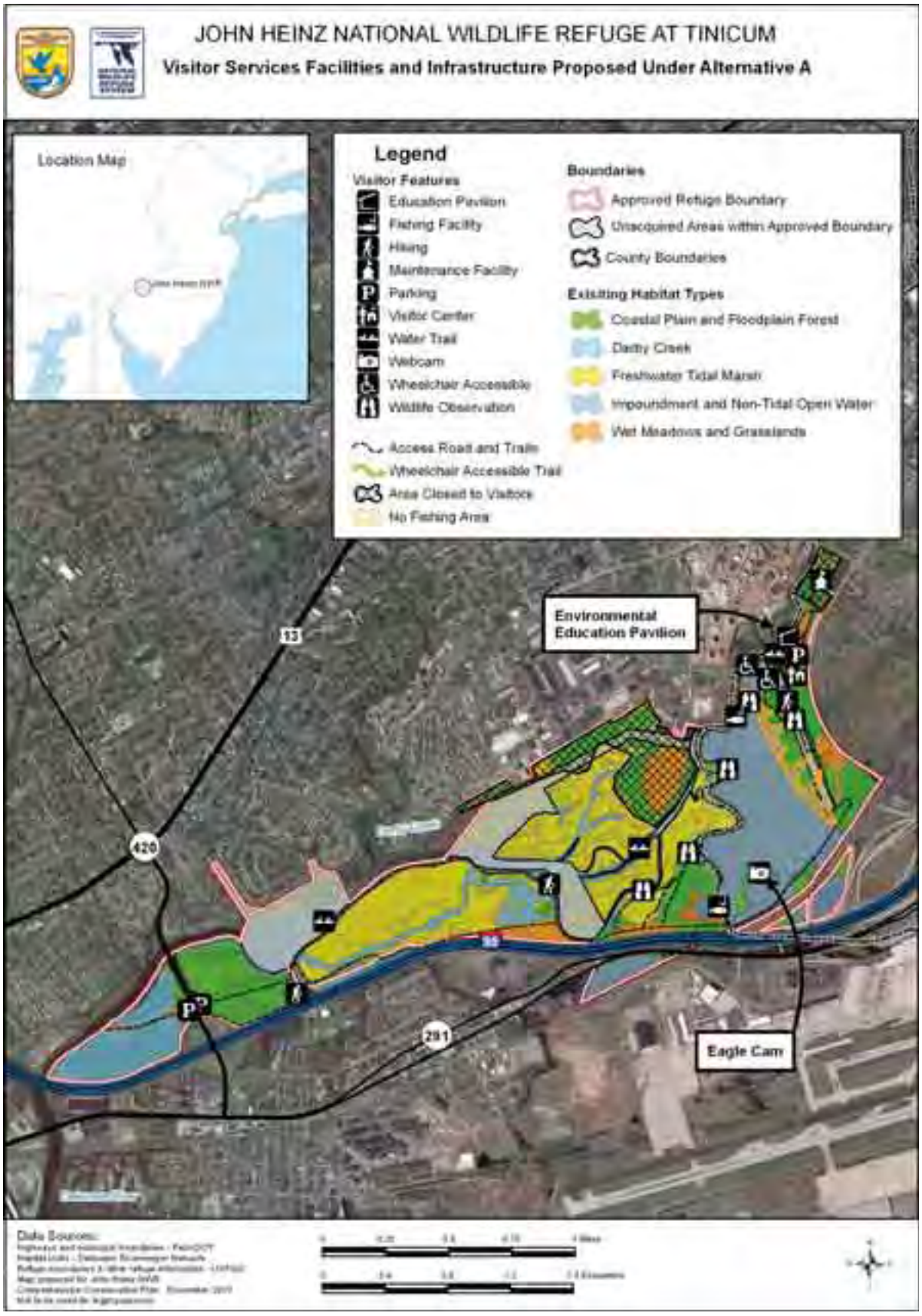
3.4.6 Goals, Objectives, and Strategies Under Alternative A

GOAL 1. **Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania coastal plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.**

Strategies that apply to all objectives under this goal include:

- Recruit, hire, and train interns, volunteers, and students to assist with aspects of biological management including invasive species control and biological monitoring.
- Support Friends of Heinz Refuge to assist with aspects of biological management such as invasive species control.

Map 3.2. Existing Visitor Services Facilities and Infrastructure at John Heinz National Wildlife Refuge at Tinicum Under Alternative A.



- Continue to develop memorandums of understanding (MOUs) or memorandums of agreement (MOAs) for in-holdings to allow for habitat management and law enforcement, where important for maintaining refuge resources and public safety.

Objective 1.1 Freshwater Tidal Marsh

Over the next 15 years, continue to manage the existing 282 acres of freshwater tidal marsh to maintain a diverse assemblage of plant communities and breeding and migratory habitat suitable for waterbirds identified as species of conservation concern. Restore an additional 55 acres of freshwater tidal marsh that would be designed and managed to be dominated by native marsh vegetation including, but not limited to, wild rice *(Zizia aquatica)*, spadderdock *(Nuphar lutea)*, pickerelweed *(Pontederia cordata)*, and tick-seed sunflower *(Bidens* spp.). Restored marshes would re-establish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Rationale

Approximately 5 percent of the original acreage of freshwater tidal marsh remains within the Delaware Estuary, amounting to 28,921 acres (11,709 hectares) based on the latest available 1980s data from the National Wetland Inventory. Nevertheless, the Delaware Estuary still supports more of this marsh type than any other estuary in the nation (Kreeger et al. 2010). The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained 6,400 to 12,800 acres (10 to 20 square miles) of freshwater tidal marsh (PNHP 2008). Historically, these wetlands provided an important breeding spot for many bird, mammal, fish, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the largest remnant of freshwater tidal marsh, roughly 285 acres (one third square mile) that remains in this part of the State (PNHP 2008). Freshwater tidal marshes are some of the most biologically productive ecosystems in the world: containing high plant diversity and supporting more bird use than any other wetland type (Mitsch and Gosselink 1993). Coastal marshes (including freshwater tidal marshes) are among the highest priority habitats within BCR 30 due to impacts from surrounding land use, rates of loss, or lack of information on present spatial distribution (USFWS 2008a).

Although this remnant area of freshwater tidal marsh has been severely degraded over the years, it still supports a variety of species unique to the surrounding landscape and region. Nine of the 22 priority species of conservation concern identified in the refuge's draft Habitat Management Plan are primarily associated with this habitat type. At least another 8 of these 22 species also use the marsh habitat. Vegetation structure, microhabitat conditions (elevations relative to mean high tide, presence of small channels across the marsh plain, occasional shrubs or small trees), and landscape context (surrounding land use, size, and contiguousness) are more critical habitat components for species of concern, rather than specific plant species. However, the presence of high marsh, that is, portions of marsh that are at the upper extent of the high tide fluctuation and subject to shorter durations of inundation tend to support a greater variety of plant species and suitable nesting sites for species such as American bittern, least bittern, king rail, and marsh rice rat.

About 60 acres of the refuge's tidal marsh are currently dominated by phragmites. Many of these populations are smaller than 0.5 acres. Marsh vegetation and elevation surveys completed in 2005 documented the correlation

between marsh plain elevations and species composition (Salas et al. 2006). Phragmites was found to generally inhabit the same zone as the highly diverse areas of high marsh which provide the most suitable nesting habitats for waterbirds (Weller 1961, Palmer 1962, Meanley 1969, Kushlan 1973, Harrison 1978, Aniskowicz 1981). As such, controlling and reducing the coverage of phragmites across the freshwater tidal marsh would provide improved breeding site opportunities.

Several State-listed endangered or threatened waterbird species use wetlands across the refuge including American bittern, great egret, king rail, and least bittern. These species primarily use a combination of the freshwater tidal marsh habitat and nearby open waters such as Darby Creek and the impoundment. The freshwater tidal marsh provides breeding habitat for all of these State-listed species, while the open waters provide foraging habitat.

Planned restoration for a 55-acre area dominated by phragmites would restore tidal hydrology across a marsh surface. The restoration is intended to not only restore a native freshwater tidal marsh plant community, but also expand available aquatic habitat. Strategy 3 of the National Fish Habitat Action Plan (NFHAP 2006) (Reconnecting fragmented river systems and spawning and nursery habitats) would be addressed in development of this project. Planned marsh design would incorporate surface channels similar to those present under reference conditions in other portions of the marsh.

Recent reports projecting the potential effects of climate change, have underscored the high importance of monitoring freshwater tidal and other coastal marshes for their long-term conservation (USFWS 2008, Kreeger et al. 2010). Due to the unique landscape context of John Heinz NWR being situated within the Philadelphia metropolitan area, at the base of a highly urbanized watershed and at the confluence of Darby Creek with the Delaware River, as well as being less than 1 mile upstream from the river's salt line, the refuge's freshwater tidal marsh is particularly vulnerable to changing sea levels. Alteration in the balance of marsh elevations, sediment accretion rates, sea levels, and salinity can have major impacts on the existing marsh area. At this time, it is unclear to what extent sea level will rise and how it might affect the refuge (UCS 2008). Due to this uncertainty, the refuge needs to create a marsh monitoring program to document and evaluate local trends in sedimentation rates, vegetative cover and species composition, as well as changes in percent of marsh surface as open water at low tide. During the summer of 2010, scientists from the Academy of Natural Sciences and the Partnership for the Delaware Estuary have initiated research related to sea level rise, marsh accretion rates, and the nitrogen removal capacity of the freshwater tidal marsh within the refuge. Continuing to support this needed research would help develop baseline data necessary for tracking the long-term trends in the hydrogeomorphology and vegetation composition of the marsh.

Strategies
Continue to:

- Provide technical support to restoration efforts upon request and to targeted projects, such as the following:
  - Tinicum Township/Long Hook Creek wildlife and riparian corridor restoration
  - Philadelphia International Airport marsh mitigation/restoration

- Use existing biological datasets to guide species and habitat management restoration.

- Continue annual aerial spray treatments to control 10 to 15 acres of phragmites-dominated wetlands.

- Participate in Spill Prevention, Control, and Countermeasure Plans or other environmental emergency action plans as related to protection of Darby Creek, open water and tidal wetlands on refuge lands.

Within 5 years:
- Work with the Service's Chesapeake Bay ES office to complete the restoration of a 55-acre wetland area dominated by phragmites to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species such as pickerelweed, spadderdock, and wild rice. Restored marshes would contain a network of channels across the marsh surface that resemble the pattern, dimension, and profile of channels within reference marsh areas in order to provide foraging and nursery habitat for fish.

Monitoring Elements
Continue to:
- Support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh by the Academy of Natural Sciences.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, maintain the existing 34 acres of coastal plain forest and 252 acres of floodplain forest communities to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog.

Rationale
Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Atlantic coastal plain in Pennsylvania was historically found only in a 1 to 5 mile-wide strip along the lower 50 miles of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008). Focal species of concern identified for this habitat within the draft Habitat Management Plan (appendix C) include northern oriole, prothonotary warbler, wood thrush, and worm-eating warbler. Other associated species such as the Swainson's warbler, cerulean warbler, Kentucky warbler, Acadian flycatcher, and yellow-throated vireo, are all primarily associated with forested wetlands and have high concern scores within the mid-Atlantic Coastal Plain (PIF 1999).

The prothonotary warbler and other landbirds utilize mature deciduous floodplain, riverine, and swamp forests primarily for migratory stopover and foraging habitat at the refuge (DeGraaf et al. 1980, Christman 1984). Although this species will utilize the drier portion of the forested wetland gradient, flooded habitats have been shown elsewhere to be preferred and of higher quality (Petit and Petit 1996). Prothonotary warblers are secondary cavity nesters and a good indicator species for permanently flooded forested wetlands. Prothonotary warblers are widespread throughout the extensive swamps and riverine forested wetlands within the Mid-Atlantic region (PIF 1999). However, these habitats are largely unrepresented in this portion of Pennsylvania and along the Delaware River. Regional conservation plans developed by Partners in Flight (PIF 1999) and the Atlantic Coast Joint Venture (ACJV) (USFWS 2008) both emphasize the

Wood Thrush

Bill Thompson

need for inventory and monitoring of nesting sites for forested wetland nesting species such as prothonotary warbler, wood thrush, and worm-eating warbler.

The coastal plain forest also supports the single nest location for bald eagles on the refuge. The refuge is identified on a list of bald eagle watching sites in Pennsylvania and the successful breeding pair has drawn wide media attention to the refuge. Given that the breeding territory size of eagles ranges between 1,700 and 5,300 acres (Gerrard et al. 1992, Anthony et al. 1993), we do not anticipate any additional nesting pairs of eagles to be found on the refuge. However, the existing coastal plain and floodplain forest continue to provide a visual and acoustic buffer for the successful breeding pair currently on site.

Species associated primarily with other habitats for foraging also utilize forested areas for nest sites. For example, bald eagles (primarily associated with the impoundment and Darby Creek habitat) require forested areas for nesting sites. The short-eared owl (associated primarily with freshwater tidal marsh) is also known to nest in portions of the coastal and floodplain forests of John Heinz NWR.

Most invasive plants reduce the availability and quality of native habitats, and these can have major impacts on priority bird species (USFWS 2008). The Restoration Management Plan for Lower Darby Creek documented extensive invasive species populations within the coastal plain and floodplain forest ecosystems (Salas et al. 2006). Multiflora rose, garlic mustard, Japanese honeysuckle, Japanese stiltgrass, and mile-a-minute vine are the most common invasive plant species found throughout forested habitats (Salas et al. 2006). An abundance of invasive species can result in reduced biodiversity and poor habitat quality. Invasive herbaceous and vine species can dominate the forest understory and prevent or inhibit tree and shrub regeneration. Many floodplain forest restoration projects in and around the Delaware Valley have not been successful at restoring this habitat type due to competition by nonnative, invasive species (PNHP 2008). Oriental bittersweet, Japanese hops, Japanese knotweed, Chinese wisteria, and bush honeysuckle are also major invasive species in this habitat at John Heinz NWR. In a few cases, some native birds of concern, including northern saw whet owls, have benefited from the cover provided by entanglements of invasive vines including Oriental bittersweet and Japanese honeysuckle.

A portion of the floodplain forest located in the southeastern portion of the refuge is dominated by a hybridized, nonnative gray poplar (*Populus x canescens or alba*). This 15-acre area also contains other nonnative species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine. Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Surrounding forests are dominated by native coastal plain and floodplain forest species such as pin oak, wild black cherry, sweetgum, and green ash; however, these species have historically been unable to compete with the nonnative and fast growing poplar species.

One of the most critical habitat components within forested ecosystems is a well-developed forest structure including canopy trees, sub-canopy trees, understory shrubs, and a diverse ground cover. These structural components provide numerous feeding opportunities as well as protective cover to escape predation. Much of this natural structure has been severely altered within John Heinz NWR as a result of excessive deer browse as documented in the Restoration Management Plan for Lower Darby Creek (Salas et al. 2006) and more recently in the draft Deer Management Plan (D'Angelo 2011). The impacts of deer on forest ecosystems and their habitat components has been well documented, including their status, trend, and impact within Pennsylvania (Latham et al. 2005). Long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded areas would not be feasible with continued impacts of an unsustainable deer population.

Reduction of plant species diversity and richness is a commonly noted effect of deer overpopulation. On long affected sites, the establishment and dominance of browse resilient species often is the result. Consequently, deer browse can have a measured effect on the balance between native and introduced species. Studies have repeatedly shown that deer avoid nonnative species such as garlic mustard, Eurasian honeysuckle, Japanese barberry, and tree-of-heaven if other sources of food are available (Latham et al. 2005). Deer abundance also alters ecosystem structure by reducing densities of understory trees and eliminating shrubs. Research in central Pennsylvania indicated that the occurrence of canopy gaps increased by 41 percent on lands where deer control efforts were prohibited as compared to State lands where control efforts were undertaken (Pederson and Wallis 2004).

The adverse effects of excessive deer browse are not limited to plant species. It can also alter ecosystems to the extent that they become unfavorable habitats for other wildlife. Gray squirrel, white-footed mouse, and some amphibian species have been shown to decline in areas highly browsed by deer (Elliot 1978, Nixon and Hanson 1987). Subsequently, predators of these species, i.e., owls, hawks and other carnivores, decline (Flowerdew and Elwood 2001). At a site in Virginia, a reduction in forest plant species densities also leads to increased nest predation and lower bird abundance (Leimgruber et al. 1994). These results were reinforced by a study of songbird and deer population relationships in British Columbia that found a 93 percent decrease in bird species dependent on understory vegetation (Allombert et al. 2005).

In addition to impacts of overabundant deer on refuge wildlife, high deer populations may also increase the prevalence of the Lyme disease bearing deer tick. This concern is discussed in more detail in the section on wildlife diseases included in chapter 2. Potential effects of deer management and relation to Lyme disease are also discussed in chapter 4.

Refuge biologists have been conducting deer population inventories for more than 10 years. These surveys involve counting deer that are driven systematically

from various portions of the refuge. The results of refuge surveys have consistently recorded population numbers in the range of 60 deer per square mile. Forward Looking Infrared (FLiR) counts completed by USDA Division of Wildlife Services generally confirmed similar population densities on the refuge in 2009. By comparison, a deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994).

In partnership with the USDA Division of Wildlife Services, refuge biologists are currently finalizing the Deer Management Plan. This plan would inventory and evaluate the level of deer browse pressure on the refuge habitats and develop population management recommendations based on measurable results from browse surveys and vegetation transects. This plan guides deer management based on actual impacts to refuge habitats, rather than attempting to achieve an arbitrary density estimates (i.e., deer per square mile or set number of individuals; D'Angelo 2011).

As part of the Deer Management Plan, fenced vegetation plots that exclude white-tailed deer are being incorporated into long-term monitoring. These plots would be used to gauge the potential for natural forest regeneration when browsing by deer is suppressed. Fenced plots would be paired with nearby unfenced plots.

Strategies
Continue to:

- Reforest naturally occurring canopy gaps within the 15-acre stand of nonnative poplar with native tree species.
- Install occasional tree plantings to close canopy gaps and supplement poor regeneration due to deer browse pressure. Protect saplings with individual deer exclosures to minimize browse and decrease associated tree mortality.
- Finalize the Deer Management Plan drafted by USDA Division of Wildlife Services. No deer management control actions would be implemented.
- Restrict public access to eagle nesting areas during the breeding season and limit public access to areas of the refuge used by other rare species during their breeding seasons as needed.

Monitoring Elements
Continue to:

- Complete deer browse impact monitoring using established USDA Division of Wildlife Services protocols including the review of deer population densities, deer habitat characterization, tree regeneration analysis, and relative effects on human populations.
- Conduct annual population monitoring (flushing surveys) to evaluate deer population trends on the refuge. Utilize FLiR counts completed in January 2009 and 2010 to evaluate population levels and trends of flushing surveys.

Objective 1.3 Darby Creek

Over the next 15 years, manage refuge inputs to Darby Creek to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous and catadromous fish populations and other Federal trust resources, including American eel, striped bass, blueback herring, hickory shad, and alewife.

Rationale
Tidal portions of Darby Creek, in combination with freshwater tidal marsh, provide a unique and productive habitat for many fish species. Some estuarine species, such as killifishes and mummichogs (*Fundulus spp.*) complete their entire life cycle in estuarine portions of rivers, creek, and tidal marshes. Anadromous fish, such as the blueback herring and alewife, use tidal streams and rivers like Darby Creek and its side channels as nursery habitat for juveniles (Odum et al. 1984). American eel, the only catadromous fish species in Atlantic Coast estuaries, spends most of its adult life in freshwater and are common in tidal creeks, rivers, and marsh channels (Lippson et al. 1979). Thus, improving water quality and restoring suitable channel morphology where possible is critical to maintaining healthy biological integrity, diversity, and environmental health (BIDEH) parameters that support fish species.

The NFHAP outlines several management strategies that can help guide aquatic habitat management on the refuge, as well as connecting habitats both up and downstream (NFHAP 2006). Restoration efforts by local and regional organizations within the Darby Creek watershed support components of Strategy 2 of the NFHAP (Restoring natural flow and habitat variability to streams and rivers). Dam removal and other fish barrier removal efforts along Darby Creek support Strategy 3 (Reconnecting fragmented river systems and spawning and nursery habitats). While these efforts are mainly located beyond the boundaries of John Heinz NWR, Strategy 3 can be supported at the refuge by freshwater tidal marsh restoration efforts that incorporate the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species.

Several other waterfowl and wetland birds that are not State-listed, but identified as regional conservation priorities are also found on the refuge. Waterfowl like the American black duck, lesser scaup, and northern pintail as well as shorebirds like black-bellied plover, greater yellowlegs, and semipalmated sandpiper utilize open water habitats primarily along Darby Creek and the impoundment for migratory stopovers. These species are all noted as high management priorities in plans such as Mid-Atlantic Coast Bird Conservation Region Plan (USFWS 2008a), the Service's Birds of Conservation Concern list (USFWS 2008b), and Pennsylvania's Wildlife Action Plan (PGC 2005).

As previously described in detail in chapter 2, section 2.6, water quality within the refuge is a highly variable and complex phenomenon. Due to the complexity and regional scale of these water quality impacts, there is little that can be done to alleviate these concerns through management on the refuge. However, John Heinz NWR can play an active role in coordination and technical assistance toward efforts that result in improved water quality on and off the refuge. The geographic location of the refuge at the base of the Darby Creek watershed and near the Delaware River, make it an ideal location for environmental education and interpretation of watershed-based impacts to the refuge, fish, and wildlife.

Much of the management related to Darby Creek at the refuge level relates to prevention, response, and monitoring. Given the potential for hazardous spills from neighboring roads, tank farms, industrial sites, and communities, refuge staff annually reviews and updates the refuge's spill response and coordination plans.

Strategies
Continue to:
- Maintain existing partnerships to assess and manage for water quality improvements impacting the refuge.

- Coordinate with EPA and other stakeholders to close Folcroft and Clearview landfills and minimize environmental health impacts related to contaminants associated with these sites.

- Annually, review and refresh staff in spill response protocols and emergency protection measures.

- Assist Chesapeake Bay ES office in coordinating and providing technical assistance to fish passage, stream, and riparian restoration projects within the Darby Creek watershed that have potential to increase available habitat for species utilizing the refuge or improvements to water quality.

Monitoring Elements
Continue to:
- Support volunteer-based water quality monitoring along Darby Creek on the refuge as resources allow.

- Support of occasional and ongoing research to evaluate fish tissue surveys, contaminant level accumulation, and other environmental impacts of environmental hazards.

- Complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring.

GOAL 2. **Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.**

Objective 2.1
145-Acre Impoundment and Nontidal Open Waters

Manage the existing 145-acre impoundment and 55 acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control. To the extent practicable, these measures would include the following:

(1) Annually support migratory shorebirds by maintaining a mix of shallow water (less than 6 inches water depth), mudf at with sparse vegetation (less than 10 percent cover), and mudf ats with no vegetation, at times of peak migration (spring: May, and fall: mid-August through September).

(2) Annually support migratory waterfowl by maintaining a mix of shallow (6 to 24 inches water depth) f ooded vegetation (sedges, smartweeds, and pickerelweed) at times of peak migration (spring: late March, and fall: late October).

(3) Annually support migratory wading birds by maintaining a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

(4) Sustain State-threatened red-bellied turtle by protecting hibernation, foraging, basking, and nesting habitat.

Rationale
As discussed in chapter 2, section 2.12 under *Impoundment and Nontidal Open Waters*, over the past several years the Service has participated in an impoundment study, managing the water levels within the impoundment to

benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008; Phillips personal communication 2008). It appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008; Phillips personal communication 2008). Draft results indicate that this management should be continued.

Management of the impoundment requires an adaptive approach to reduce, control, or eliminate undesirable plant species such as the invasive, nonnative purple loosestrife and the aggressive, native spadderdock, while at the same time promoting the germination of seed producing vegetation such as smartweeds and providing mudflats for benthic invertebrates. In some years, it is anticipated that the annual water level management objectives would likely require some variation from the timing most adaptable for migratory birds. To maintain extensive mudflats, annual vegetation, and shallow pools, the impoundment may occasionally require extensive inundation to prevent long-term establishment of perennial invasive species, such as purple loosestrife.

Extended inundation periods should be employed when the presence of invasive species becomes larger than feasible for control through herbicide applications. The threshold for this type of management action would be when the impoundment begins to support approximately 10 acres (7 percent) coverage of a nearly monotypic population of invasive nonnative or aggressive native species.

When timed well, this intensive form of water level management can produce beneficial habitat for a wide range of migratory and resident species of birds, reptiles, and amphibians. Unfortunately, as discussed in chapter 2, water level management of the 145-acre impoundment is currently difficult.

Strategies

Continue to:

- Control invasive species impacting the impoundment and nearby open water habitats as feasible. Purple loosestrife (*Lythrum salicaria*) and phragmites when they spread over 5 percent (7 acres) of areal coverage across the impoundment. The aggressive native species—spadderdock (*Nuphar lutea*) when it spreads across greater than 10 percent (14 acres) of areal coverage. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible.

- Attempt management of impoundment water levels as conditions allow maximizing benefits to migrating shorebirds, waterfowl, waterbirds, and wading birds during each group's peak migration periods. Adjust drawdown timing and duration to control nonnative, invasive species when herbicide applications become a less effective option against larger populations.

- Maintain existing dike system to prevent and minimize structural damage sustained to access roads and dikes by flood events and muskrat nesting burrows.

- Close the water control structure into the impoundment during forecasted storm events to minimize stormwater runoff and pollution inputs.

- Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.

- Maintain existing wood duck and swallow nesting boxes primarily through volunteer assistance.

Monitoring Elements
Continue to:
- Support annual volunteer frog monitoring.
- Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year.
- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment during spring and fall migrations. Use data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.
- Conduct migratory bird surveys for landbirds, waterbirds, and waterfowl.
- Complete fisheries inventory of Hoy's Pond and the 16-acre pond on refuge lands.

Objective 2.2 Grasslands and Wet Meadows

Annually, maintain up to 72 acres of grasslands to create a mix of wet meadow, grassland, and forest opening habitats to sustain stopover foraging and cover for migratory landbirds where patch size and species diversity and structure yield stopover habitat benefits for migratory landbirds, as well as breeding habitat for resident amphibians (coastal plain leopard frog) where possible.

Rationale
Grasslands were uncommon in the Northeast prior to European settlement, and grassland birds are of moderate concern in the region (USFWS 2008a). Fewer grasslands are available to birds throughout the Mid-Atlantic region as agricultural lands have been lost to commercial and residential development as well as natural succession. Today, grassland dependent birds within the Mid-Atlantic region depend upon agricultural landscapes and other artificial habitats to maintain populations. Military installations, airports, golf courses, parks, recreational fields and other artificial and maintained grasslands also provide some modified types of this habitat today.

Until the past few decades, the upland habitats of John Heinz NWR were comprised of a substantially greater amount of grasslands than today (McCormick et al. 1970, McMenamin personal communication 2008). The Restoration Management Plan for Lower Darby Creek compared habitat coverage between those documented in the Two Studies of Tinicum Marsh (McCormick et al. 1970) and those identified as part of field inventories conducted in 2005 (Salas et al. 2006). Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and "old field" vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type. Additionally, historic aerial photographs reviewed as part of that plan documented a greater extent of grasslands east of the existing impoundment (Salas et al. 2006). Due to this relatively isolated and small (less than 100 acres) component of grassland, it is unlikely that the refuge ever had (or would be able to) contribute significantly to regional populations of priority grassland birds.

Today, many of these historic grasslands are covered by coastal plain or floodplain forest community types. Coastal plain and floodplain forests are the habitat type that is considered to be the late-successional forest community typical of the Pennsylvania Coastal Plain region. As a result of the urbanization of the Philadelphia area, few examples of this habitat are available in Pennsylvania, causing the State to list some of the associated community types as S3, or State-rare.

While the grasslands of John Heinz NWR are generally too small to support nesting of priority grassland species within the region, some grassland areas can provide suitable migratory stopover and foraging habitat for migratory birds. Additionally, these grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the coastal plain leopard frog. The coastal plain leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within the refuge's wet meadow grasslands (Phillips and McMenamin personal communication 2008).

Most of the grasslands existing on the refuge today are the result of managed utility right-of-ways that intersect portions of the refuge. Utility corridors transporting oil, gas, potable water, wastewater, and electricity all pass through the refuge. Utility companies are required to maintain these areas free of trees and shrubs in order to prevent damage by root growth or wind thrown trees. Maintaining these areas without tree or shrub growth also aids utility maintenance and emergency response by facilitating efficient access to the corridor when needed. As a result, the refuge (and those entities that manage the existing right-of-ways) would continue to maintain these portions of grassland for the foreseeable future.

Strategies
Continue to:

- Annually mow to maintain the existing 72 acres of wet meadow, grassland, and forest opening habitats for wildlife, environmental education, and interpretive purposes.
- Control invasive species impacting wet meadow and grassland habitats through a combination of herbicide application, hand pulling, and mowing.
- Maintain vernal pool and wet meadows for amphibian breeding and grassland bird stopover habitat.
- Promote warm-season grass establishment in areas previously dominated by cool-season grasses.

Monitoring Elements
Annually conduct frog call surveys of known vernal pools to monitor species and their use of areas for breeding sites. Utilize data to document sensitive breeding areas and long-term effectiveness of management activities in order to adjust management protocols as necessary.

GOAL 3.

Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.

Objective 3.1 Environmental Education

Annually, continue to provide approximately 30 environmental education programs and other resources for about 9,600 participants, that describe the habitats, wildlife, environment, and cultural resources of the refuge, describe the purpose of the refuge, and meet Pennsylvania educational standards and curriculum requirements to school groups and teachers as staff resources and audience interest allows.

Rationale
As discussed in chapters 1 and 2, environmental education is one of the original establishing purposes of John Heinz NWR. In its establishing legislation, the refuge was directed to develop "…a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972). The Refuge Improvement Act also identifies environmental education as a priority public use on refuges.

The Service policy on Priority Wildlife-dependent Recreation (605 FW 6) defines environmental education as activities that use a planned process to build knowledge, skills, and abilities in students and others, about wildlife-related environmental topics. Environmental education teaches students the history and importance of conservation and ecological principles, and scientific knowledge of our Nation's natural resources. In doing so, we can help develop a citizen base that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively toward the conservation of our Nation's environmental resources.

John Heinz NWR is particularly well-positioned to reach a large audience due to its location within the Philadelphia metropolitan area. The School District of Philadelphia alone manages over 280 schools and is the 8th largest school district in the United States. Over 160,000 students are enrolled in Philadelphia public schools (School District of Philadelphia 2010). Philadelphia is also one of the largest college towns in the U.S., with over 120,000 students enrolled among the 80 colleges, universities, trade, and specialty schools in the area.

As with many other states in the country, Pennsylvania has incorporated environmental education into required State curricula through the Pennsylvania Department of Education Academic Standards for Environment and Ecology. These standards describe what students should know and be able to do in the following areas: ecology, watersheds and wetlands, natural resources, agriculture and society, humans and the environment, integrated pest management, threatened, endangered, and extinct species, environmental laws and regulations, renewable and nonrenewable resources, and environmental health. John Heinz NWR, the Refuge System, and the Service can help teachers and schools meet these educational standards while raising the awareness of area students about the role of the refuge, the Refuge System, and the Service in protecting species and habitats. Students would also understand the benefits of these conservation efforts for species and society and the importance and value of the history and cultural resources on the refuge. Refuge environmental education programming should continue to incorporate science and chemistry curricula.

To encourage visitors to better understand the natural history of the area and related cultural resources, the refuge engages students in understanding cultural resources and conservation history as an introduction to environmental education lessons. No cultural or archaeological areas of significance are believed to remain on the refuge itself.

As discussed in chapter 2 section 2.14, about 9,400 students a year participate in environmental education opportunities led by their teachers or by refuge staff and volunteers. Education activities currently offered by refuge staff focus primarily on assisting teachers in developing environmental lesson plans for both onsite and offsite learning, sponsoring various onsite environmental workshops, and conducting onsite field trips for school groups. About 200 teachers a year participate in these programs. Typical audiences for existing education activities consist of School District of Philadelphia elementary classes, summer camps,

and some interest from local college programs for architecture, wildlife, and environmental studies. Also, see appendix I (USGS Phase 1 Environmental Education Needs Assessment) for additional information on the refuge's current environmental education program.

Strategies
Continue to:

- Pursue ongoing alignment of educational programs with Pennsylvania academic standards and student standardized test requirements.
- Annually, maintain at least three partnerships with area schools that result in refuge visitation and student and educator engagement in environmental education programs.
- Pursue alternative funding or grant programs for supporting transportation to facilitate field trips with interested schools.
- Utilize staff and volunteers to directly lead approximately 30 environmental education programs per year to reach about 8,200 students onsite and 1,200 students offsite.
- Provide online curriculum and other resources (e.g., loan boxes, field trip equipment) via the refuge Web site and links from partnering organizations.
- Maintain existing local natural history exhibits as part of visitor center displays.
- Maintain the existing natural history educational resource program including Web-based lesson plans, loan boxes, and equipment.

Monitoring Elements
Annually complete an evaluation summary of environmental education opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, schools, teachers, and students engaged).

GOAL 4.

Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.

Objective 4.1 Environmental Interpretation

Annually, provide an array of on and offsite environmental interpretation opportunities for up to 22,500 visitors, students, and area residents that emphasize the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary and maintain the infrastructure and facilities necessary to provide a quality interpretive experience.

Rationale
The Refuge Improvement Act identifies environmental interpretation as one of the six priority public uses. Environmental interpretation includes activities, talks, publications, events, programs, audio-visual media, signs, and exhibits that convey key messages about natural and cultural resources to visitors, but that do not address a specific educational curriculum requirement. It provides opportunities for visitors to make their own connections to nature and wildlife, which invites participation in resource stewardship and helps refuge visitors understand their relationships to, and impacts on, those resources.

With over 35 million people within a 2-hour drive, the refuge lies within one of the most densely populated areas of the nation. Being located in such a high density, urban area with many recreational options, the refuge can easily be overlooked. Life-long residents located near the refuge report never having known about the refuge prior to their first visit.

In 2009, about 13,300 people participated in onsite interpretive programs at the refuge, which includes programs led by refuge staff, volunteers, and other partners. Another 4,800 participated in offsite refuge interpretive programs, including Web based programs. Because of the refuge's location and ongoing environmental interpretation programs, we anticipate increased participation in environmental interpretation over the 15-year life of the plan. While we are not sure what the increase would be under alternative A, based on data from 2001 through 2009 we anticipate an increase of 34 percent over the next 15 years, or approximately 17,700 onsite participants. We do not intend to increase our offsite environmental interpretation efforts, so predict this number would remain at about 4,800 offsite participants annually.

The refuge interpretive programming includes a variety of experiences that appeal to varying audiences, visitor interests, and learning styles. In addition to passive interpretation, the refuge offers several interpretive events annually such as the Cradle of Birding Festival, National Refuge Week events, and Pennsylvania's division of the Federal Duck Stamp competition. Refuge staff and volunteers also participate in a variety of interpretive programs with partnering organizations such as scout troops, the YMCA, and the Audubon Society.

In early spring of 2010, the refuge was home to its first-ever recorded pair of bald eagle chicks. This successful breeding of bald eagles at this highly urban refuge provides a unique opportunity for interpreting the importance of conservation. The hatching of these chicks was nationally recognized online, on television, and in newspapers including the Philadelphia Inquirer, the Washington Post, and the Kansas City Star. To expand the interpretive opportunities associated with the eagles, the refuge is currently implementing plans to install a webcam near the nest site to allow the public to view the eagles up close and without disturbance via the internet.

Strategies
Continue to:

- Maintain existing publications, access points and infrastructure, including trails, parking, and interpretive exhibits, kiosks, printed materials, and signage.
- Host environmental art displays at the visitor center as opportunities arise.
- Maintain ongoing updates to the refuge Web site.
- Annually, host at least 100 volunteer-led nature walks and programs, for example regular bird and plant walks.
- Provide programs and camps designed specifically for families and youth including: Through the Lens, MicroLife, Wildlife Photography Summer Camp, and a Birding and Fishing Summer Camp.
- Annually, host at least six conservation-oriented or wildlife-dependent interpretive events.
- Annually, conduct at least five offsite environmental interpretation programs.

- Work with partners and volunteers to develop and present onsite and offsite programs for non-school audiences, such as families, libraries, festivals, and scout groups that support the mission and goals of the Service.
- Complete the redevelopment of the existing example backyard habitat.
- Complete installation of the webcam at the eagle's nest.
- Promote and participate in Service initiatives such as the National Junior Duck Stamp Program.

Monitoring Elements
Annually complete an evaluation summary of environmental interpretation opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

GOAL 5. **Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.**

Objective 5.1 Wildlife-dependent Recreation

Annually, provide visitors with wildlife-dependent recreation opportunities including fishing, wildlife observation, and nature photography and maintain the infrastructure and facilities necessary to provide a quality interpretive experience.

Rationale
As discussed in chapter 2 section 2.14, John Heinz NWR offers shaded trails, vistas of the impoundment and tidal marsh, as well as fishing and other activities allowing people to take a break from the busy urban setting in which they work and live (VanBeusichem et al. 2009). Wildlife-dependent recreation is one of the largest draws for visitation at the refuge.

Fishing is a large draw for anglers and families who visit the refuge. Panfish, largemouth bass, and striped bass are species commonly fished for on the refuge. The refuge sponsors an annual Fishing Derby, in addition to Family Fishing Days, both well-attended programs. Also available to visitors, free of charge, is the Rod Loaner program. Sponsored by Pennsylvania Fish and Boat Commission, this program allows visitors to borrow some of the basic equipment needed to fish the waters around the refuge during their visit. All of these opportunities allow for public interaction with refuge staff and volunteers while participating in a priority public use. USA Today Travel highlights the refuge as a primary fishing destination for children near Philadelphia (Russell 2010). Yahoo's Associated Content Web site also highlights the refuge as the "best fishing spot in Philadelphia" (Bove 2010).

The refuge also offers several opportunities for wildlife observation and photography. These opportunities consist of both self-guided and staff and volunteer guided programs. Resources that promote self-guided wildlife observation and photography include equipment loans, photography blinds, and boardwalks and other structures outfitted with telescopes. Staff and volunteers guide regular bird and plant walks, sponsor a photography contest and traveling photo exhibit, and provide a series of programs and camps designed specifically for families and youth. These programs and camps include Through the Lens, MicroLife, a Wildlife Photography Summer Camp, and a Birding and Fishing Summer Camp (VanBeusichem et al. 2009).

The annual return and successful breeding of bald eagles on the refuge have generated renewed interest in the refuge and its residents. To expand upon

this interest, the refuge is continuing to support its Friends group with the installation of a webcam that would afford web browsers the opportunity to observe the refuge wildlife at their convenience. The installation of this webcam also creates new opportunities for education and interpretation with area schools and other environmental education programs.

Strategies
Continue to:

- Provide visitors with the opportunity to engage in wildlife-dependent recreation opportunities throughout the year by
  - maintaining fishing piers and other bank access points along Darby Creek, including an ADA-compliant fishing pier;
  - maintaining equipment loans (e.g., binoculars), photography blinds, viewing telescopes, hiking trails, water trails, and viewing platforms for wildlife observation and photography; and
  - providing brochures and other literature to support fishing and wildlife observation and photography on the refuge.
- Support hunting programs by facilitating Pennsylvania Game Commission hunter education classes as well as distributing Pennsylvania Game Commission hunting publications.
- Complete installation and networking of a Webcam viewing the bald eagle nest.
- Promote self-guided wildlife observation and photography by maintaining and providing equipment loans, photography blinds, boardwalks, and other structures outfitted with viewing telescopes.
- Have staff and volunteers guide programs including
  - regular bird and plant walks;
  - sponsoring a photography contest and traveling photo exhibit; and
  - providing programs and camps designed specifically for families and youth, such as "Through the Lens," Wildlife Photography Summer Camp, and Birding and Fishing Summer Camp.

Monitoring Elements
Annually complete an evaluation summary of wildlife-dependent recreation opportunities provided (number of opportunities, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

GOAL 6. **Communicate and collaborate with local communities, Federal and state agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.**

Objective 6.1 Role of Refuge in Regional Conservation

Continue collaboration with a variety of partners to increase community understanding and appreciation of the refuge's regional significance to natural resource conservation, its contribution to the Refuge System, and to garner additional support for refuge programs.

Rationale
The Philadelphia metropolitan area and the three states bordering the majority of the Delaware Estuary (Delaware, New Jersey, and Pennsylvania) contain numerous state and Federal agencies, dozens of nongovernmental conservation organizations, and hundreds of municipalities and environmentally concerned citizens. With this diversity of interested parties and stakeholders, the refuge plays a unique role in regional conservation efforts. Our central location in Philadelphia provides a facility for housing conservation workshops and meetings that bring together partners from around the region. The refuge is also the only Federal property within an hour drive of Philadelphia whose primary mission is wildlife conservation and management.

The Friends of the Heinz Refuge (FOHR, Friends) provides a great deal of support to the refuge in terms of volunteer assistance in carrying out all aspects of our mission. Their members participate and guide interpretive and educational programs, invasive species control workdays, monitoring efforts, and cleanup projects. Moving forward, we would continue to partner with FOHR and work together to accomplish our mission and management goals, while providing opportunities for volunteer participation.

The refuge's proximity to the city of Philadelphia, along with its central location within the Delaware Estuary and close proximity to I-95 and other transportation routes (bus and rail), allows potential visitors multiple options for commuting to the refuge. The visitor center provides an easily accessible facility making it an ideal location for meetings, workshops, and events. The refuge sponsors a number of these meetings throughout the year.

Additionally, the refuge has a unique partnership with Philadelphia International Airport. The refuge has provided opportunities for previous wetland mitigation projects on the refuge. Both the airport and the refuge have also found common ground in their desire to preserve open space around the refuge and airport. The airport desires such lands for a visual and acoustic buffer, while some properties could also provide additional habitat buffers for refuge lands where applicable.

Strategies
Continue to:
- Collaborate with a diversity of partners (academic institutions, state and Federal agencies, transportation partners, municipalities, non-governmental organizations, private landowners, and businesses) on regional habitat issues and instilling the values of habitat conservation and environmental stewardship.

- Work with Philadelphia International Airport to conduct wetland mitigation, restoration, and land acquisition both on and off the refuge.

- Provide a facility for regional, conservation-related meetings, workshops, and activities, upon request.

Monitoring Elements
- Complete annual evaluations and summaries of partnership efforts and roles that the refuge has played in regional conservation through those partners/events.

- Provide opportunities for monitoring and research partnerships with universities and other academic institutions around the Philadelphia metropolitan area.

Objective 6.2
Outreach and Partnerships

Continue community outreach by conducting or sponsoring at least three outreach programs or events each year, maintaining partnerships with at least ten organizations, and providing regular updates on refuge programming and events through local media outlets, thereby increasing community understanding and appreciation of the refuge's significance to natural resource conservation, its contribution to the Refuge System, and garner additional support for refuge programs.

Rationale
According to the Pennsylvania State Outdoor Recreation Plan (PADCNR 2009), many park users have a difficult time distinguishing the difference in land ownership, management focus, and mission between parks (municipal, state, national, and private) and national wildlife refuges. For John Heinz NWR, it is critical to communicate the refuge's role in wildlife conservation and habitat protection. We utilize a variety of local media outlets to convey this message and generate interest and visitation, including internet, radio, newsprint, and television media. Maintaining connections with these media outlets allows us to connect with diverse audiences that otherwise may not be reached.

The refuge strives to generate partnerships with a broad array of local, regional, state, and national partners to achieve its conservation mission and mandated purpose. We accomplish this through a variety of events, sponsorships, and workshops provided by or with partner organizations. The work of the refuge's Friends organization—the Friends of the Heinz Refuge—is critical to this goal. The Friends provide support to refuge staff by staffing the visitor center gift shop, organizing and participating in volunteer-led programs, and assisting in community outreach.

Strategies
Continue to:

- Maintain partnerships with at least ten organizations, agencies, and individuals in relation to the diverse habitats, programs, and goals encompassed by refuge management. Examples include:
  - 50 inner city volunteers through SCA
  - 600 volunteers from Big Brother/Big Sister
  - Nature Champions partnership
- Maintain close partnership with Friends of the Heinz Refuge to support the refuge mission and management activities.
- Maintain weekly updates to refuge information station 1670 AM.
- Develop close partnerships with local print and broadcast media to reach diverse audiences through multiple channels.
- Conduct or sponsor at least three outreach programs or events each year and provide regular updates on refuge programming and events through local media outlets.

Monitoring Elements
Complete annual evaluations and summaries of partnership and outreach efforts and resulting benefits to refuge (increased visitation, awareness, or understanding).

3.5 Alternative B: Increased Restoration and Increased Focus on Urban Youth (Service-preferred Alternative)

Alternative B represents an extension and progression of refuge programs. Under alternative B, we would expand our freshwater tidal marsh restoration efforts, implement additional forest habitat restoration and management efforts, and increase the efficiency and effectiveness of our grassland management. Programs provided by our visitor services program would be expanded and target the Service's regional priorities for engaging the public. We would expand administrative facilities to accommodate additional staff needed to implement these additional activities and to collocate refuge law enforcement with the other programs in an effort to improve cross-program coordination.

3.5.1 Land Protection

As we describe under the heading "Protecting Land" under "Common to All" above, we would continue to work with willing sellers and in partnership with other agencies and organizations to acquire the remaining 207 acres within the refuge's approved acquisition boundary.

3.5.2 Habitat Management

Under alternative B, habitat management would expand freshwater tidal marsh restoration within the refuge. Since protecting and preserving Tinicum Marsh is one of the refuge's establishing purposes, and it supports the greatest number and diversity of species of conservation concern, we would increase management resources for controlling or eliminating invasive species, restoring freshwater tidal marsh, and monitoring and adapting to climate change.

Forest habitat restoration would be expanded under this alternative as well. This alternative includes the restoration of a 15-acre forest stand currently dominated by a nonnative gray poplar to a mix of native coastal plain tree species. This alternative would also initiate a deer management program. Controlling the size of the resident deer herd would improve natural regeneration of native species and enhance habitat for other wildlife such as birds, amphibians, reptiles, and small mammals.

Habitat management on the refuge would expand utilization of partnerships to enhance biological programs. In doing so, our staff can leverage the resources and expertise of our various partnerships to accomplish the goals and objectives we have set forth.

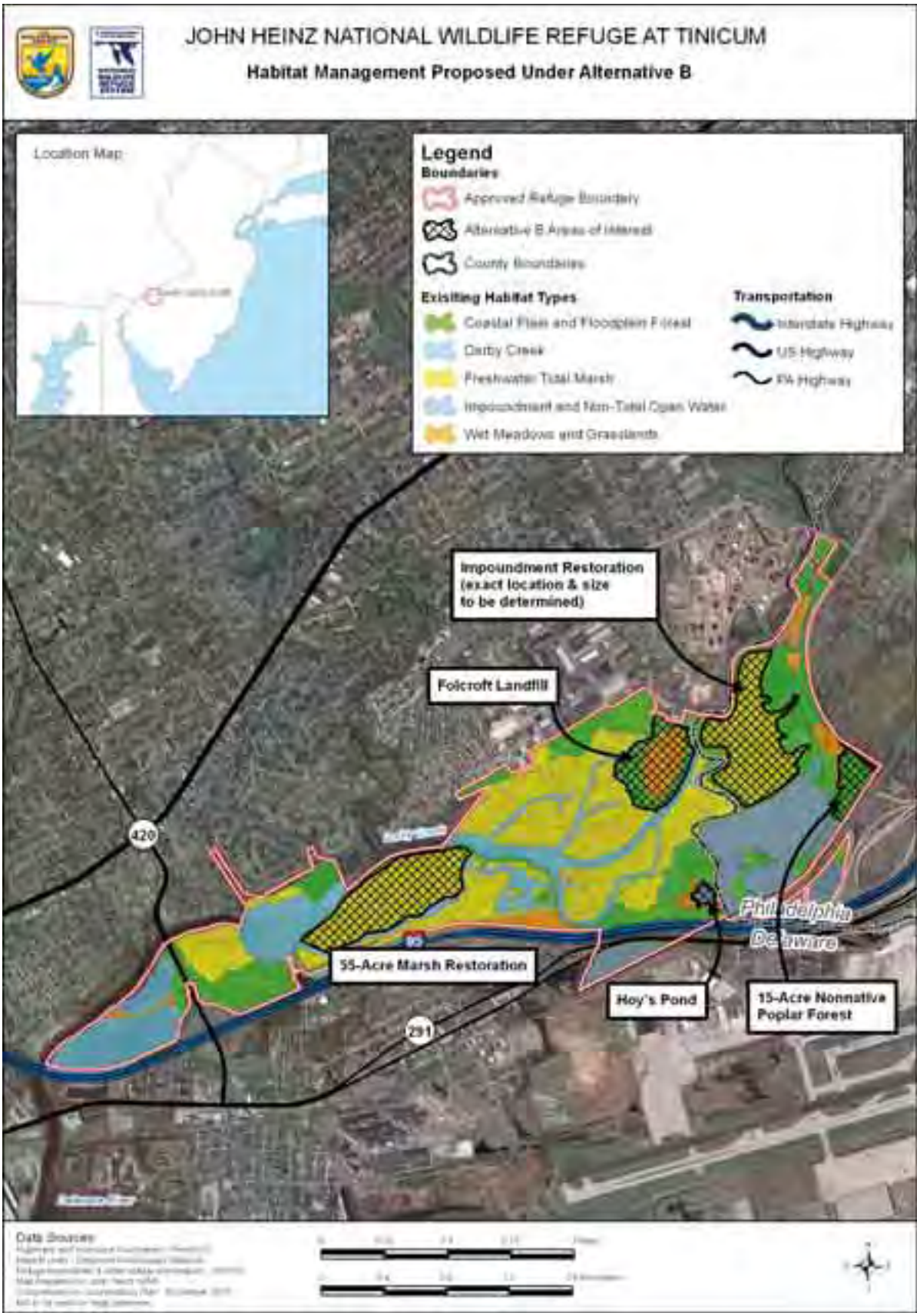
Habitat types and management proposed under alternative B are displayed on map 3.3.

3.5.3 Inventory and Monitoring

As with alternative A, we would continue existing monitoring and inventory efforts as long as they continue to provide useful information that would inform us about the effectiveness of habitat management, habitat adaptation to climate change, and we have the necessary resources to accomplish them. We would target any alterations or additions to these ongoing surveys toward helping us understand better the implications of our management actions and ways to improve our efficiency and effectiveness. We would also continue to seek ways to reduce our management costs for establishing and maintaining monitoring protocols.

We would expand our inventory and monitoring under alternative B to inform our understanding of how sea level rise may impact our long-term habitat management. Long-term monitoring stations dedicated to measuring parameters related to marsh response to sea level rise would be monitored throughout the life of this CCP. We would also expand biological inventories and monitoring projects to improve our knowledge and understanding of species that utilize the refuge.

Map 3.3. Proposed Habitats Comprising John Heinz National Wildlife Refuge at Tinicum Under Alternative B.



3.5.4 Visitor Services

Under alternative B, we would expand existing opportunities for five of the six priority public uses, with an emphasis on expanding our environmental education program. Map 3.4 presents the current and proposed public use facilities under alternative B. We would use the results of the Environmental Education Stakeholder Needs Assessment Phase II (Wells and White 2011) to help refuge staff develop a series of environmental education programs that are unique to education centers around the Philadelphia metropolitan area.

Environmental interpretation would also be updated and improved under alternative B. Refuge interpretive infrastructure such as signs, kiosks, and displays would be improved and updated, and additional kiosks would be added. We would also provide more interpretive options readily accessible to urban youth and more technologically savvy visitors such as podcasts, virtual tours, and interactive programs available via the refuge Web site, cell phone, or podcast-based self-guided tour options. We would also provide more programs and materials in different languages and for disabled visitors.

Because of our efforts to expand programs and facilities under this alternative, we expect total refuge visitation to increase the most under alternative B. We estimate total refuge visitation to reach approximately 196,300 visits over the life of the plan. Most of this increase is expected in onsite environmental education, interpretation, and wildlife observation.

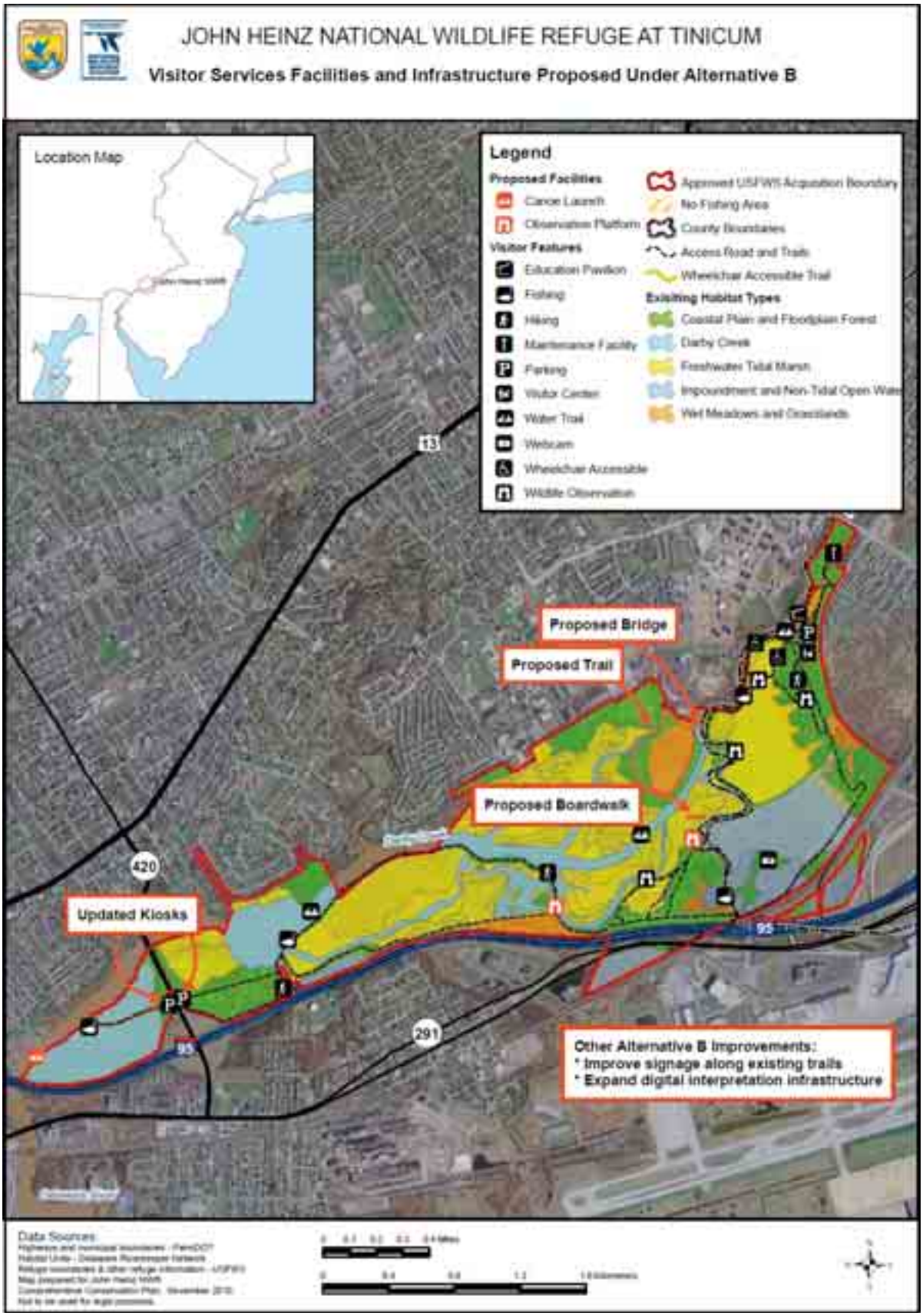
In expanding opportunities for compatible wildlife-dependent recreation, we hope to contribute to communities and businesses around the refuge, both in terms of health and well-being, and economically. We would join other agencies and organizations to promote connecting children with nature. A growing body of research suggests that a lack of direct involvement with the outside world may be contributing to a variety of social issues affecting children today (Louv 2005). By offering places and programs where children and their parents can observe wildlife in natural settings, and participate in other wildlife-dependent recreation such as photography and fishing, we would contribute to the growing national initiative to reconnect children with nature.

3.5.5 Refuge Administration

Under this alternative, we would expand refuge staff to support expanded habitat management efforts and increases in the visitor services program. We propose to add up to five positions: a regional visitor services coordinator (stationed at the refuge), a park ranger/volunteer coordinator, a biological technician, a maintenance worker, and an administrative assistant (see proposed staff chart in appendix D). We would base any increases in staffing on available sources of funding, and would make personnel decisions based on regional and refuge priorities.

We propose expanding administrative facilities to accommodate the additional staff and collocate refuge law enforcement with the other refuge programs (see appendix K for conceptual design plan). Under current management, maintenance and law enforcement are housed in a separate building located approximately a 0.25 miles from the visitor center and refuge's administrative offices. Expanding existing offices to collocate all staff would allow the refuge to achieve the regional priority of housing all refuge programs under the same roof to improve cross-program coordination. As with alternative A, all other facilities would be maintained and upgraded to meet safety and accessibility requirements over the 15-year life of the plan.

Map 3.4. Proposed Visitor Services Infrastructure and Facilities at John Heinz National Wildlife Refuge at Tinicum Under Alternative B.



3.5.6 Goals, Objectives, and Strategies Under Alternative B

GOAL 1.

Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.

Strategies that apply to all objectives under this goal include:
In addition to strategies in alternative A:

- Work with PENNDOT and Philadelphia International Airport to evaluate the extent of effects on the refuge of traffic and airport noise on birds, amphibians, and other wildlife in order to determine if a sound barrier is needed and if so, the most effective size, type, and location of sound barriers around the refuge.

- Within 7 years of plan approval, coordinate with partnering agencies and NGO's to conduct plant and animal species inventories and monitoring to obtain updated information on refuge populations, their distribution, and indicators of habitat use.

Objective 1.1 Freshwater Tidal Marsh

Over the next 15 years, protect the existing 282 acres of freshwater tidal marsh within the refuge, improve 55 acres of this exiting habitat, and acquire and restore up to 70 additional acres as opportunities arise. Restore up to 103 acres to freshwater tidal marsh throughout the refuge. Restored and improved marsh would be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spadderdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and tick-seed sunflower (*Bidens* spp.). Restored marshes would re-establish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Rationale
The conservation significance of freshwater tidal marsh has been previously described under Objective 1.1 in alternative A. Protecting and preserving Tinicum Marsh is one of the originally mandated purposes of John Heinz NWR. Given these factors, we consider restoration and conservation of freshwater tidal marsh to be the highest priority for habitat management. While we considered habitat restoration to be of primary importance, the refuge's proximity to Philadelphia International Airport may be of concern. Collisions between wildlife and aircraft are considered rare, but can be catastrophic (USDA 2010). It is important for us to work with airport management to address any potential negative effects of refuge habitat restoration on airport operations.

The uncertainties of climate change impacts could have a major impact on the size and type of wetlands that comprise Tinicum Marsh in the future. Most notably, sea level rise and a corresponding increase in salinity levels can result in a variety of alterations in Tinicum Marsh as we know it. SLAMM (Sea Level Affecting Marshes Model) modeling completed for the wetlands within John Heinz NWR indicates that up to 92 percent of the refuge's tidal marsh may be converted to shallow open water habitat over the next 100 years, depending on the extent of sea level rise. Recent literature (Chen et al. 2006, Monaghan et al. 2006) indicates that the global rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations (Clough et al. 2010).

The Restoration Management Plan for Lower Darby Creek identifies areas of historic tidal marsh that have been severely altered along with the approximate date of impact (Salas et al. 2006). Some of these areas are suitable locations for restoration of tidal marsh habitat. Refuge staff has recently restored approximately 10 acres of tidal marsh that was previously dominated by phragmites. Under alternative B, we would pursue additional restoration of freshwater tidal marsh with the understanding that (a) restoration of existing degraded systems to freshwater tidal marsh would provide greater conservation benefit for an unspecified duration, (b) to the extent possible, restoration efforts must incorporate some resiliency to accommodate potential effects of climate change (e.g., sea level rise), and (c) that, with sufficient monitoring and evaluation, we would be able to apply adaptive management to marsh areas in light of actual changes in sea level rise and salinity.

As a result, setting up long-term monitoring stations within the refuge would be critical to the ongoing protection of Tinicum Marsh. As previously described under objective 1.1 in alternative A, we are working with the Academy of Natural Sciences and the Partnership for the Delaware Estuary to monitor parameters related to sea level rise, marsh accretion rates, and the nitrogen removal capacity of the freshwater tidal marsh within the refuge. These researchers are establishing SETs at various locations on the refuge.

SETs measure changes in marsh elevation at the millimeter scale, on an annual, and in some cases, seasonal basis. This level of precision is required to track very slow accretion or subsidence rates over time. Installation of marker horizons at SETs helps to differentiate if subsidence or accretion is most impacting marsh elevation changes. Establishment of high-quality, permanent elevation benchmarks, at or near SETs, as mentioned above, allows tracking marsh elevation changes relative to a common vertical datum or mean sea level. SETs can be used to determine a marsh's change in elevation due to response to climate stressors such as sea level rise and non-climate stressors including management activities like prescribed burning and invasive species control.

These SETs would be incorporated into the Service's region-wide effort to monitor changes to surface elevations on refuges across the northeastern Atlantic coast. Working with all Service programs, states, and other partners we can make meaningful contributions to address tidal marsh stressors and increase marsh health and resilience. This comprehensive approach is our best opportunity to preserve existing tidal marsh habitat and to understand (and address where needed) the rate of change as sea level rises.

Strategies
In addition to strategies in alternative A:

- Work with Philadelphia International Airport management to conduct an assessment of wildlife hazards prior to implementing wetland restoration projects on the refuge. The assessment would evaluate potential impacts of restoration projects on airport operations and ways to mitigate any potential negative effects on the airport.

- Pursue funding for additional marsh restoration projects and complete marsh restoration as funding allows.

- Control nonnative, invasive species focused primarily on phragmites and purple loosestrife through a combination of aerial herbicide application, and spot treatments throughout the growing season when populations exceed greater than 5 percent (10 acres) areal coverage across the existing 282 acres of freshwater tidal marsh.

Within 5 years of plan approval:

- Develop an assessment and prioritization list of potential freshwater tidal marsh wetland restoration projects on the refuge in accordance with the refuge's Habitat Management Plan and the Restoration Management Plan for the Lower Darby Creek.

- Identify and implement where feasible adaptive management strategies appropriately to minimize potential impacts of a changing climate.

- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.

Within 10 years of plan approval:

- Work with partners, including Tinicum Township, to complete a study evaluating the environmental effects of restoring some (about half) of the 145-acre impoundment to freshwater tidal marsh.

- If we determine restoration is desirable, complete a restoration plan detailing the optimal size, location, and components for restoration of part of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management and habitat enhancement of the remaining impoundment area. The impoundment restoration plan should address effects of potential changes in flood elevations on the impoundment's existing (or new) dikes, water control structure(s), and other structures on or near the refuge and determine if these structures need to be modified or removed.

Within 15 years of plan approval:

- If we choose to develop a restoration plan, work to obtain funding for restoration of the 145-acre impoundment. Implement restoration plan if funding is obtained.

- Implement the restoration of a 27-acre wetland area dominated by degraded floodplain forest.

Monitoring Elements

In addition to strategies outlined in alternative A:

Within 5 years of plan approval:

- Monitor and adapt marsh restoration projects to address effects of climate change to the extent practical.

- Partner with local universities and regional researchers to define a baseline monitoring plan that continues monitoring of variables related to climate change impacts within the existing marsh. Utilize partners to evaluate monitoring data to verify accuracy of previous and current model results.

Within 10 years of plan approval:

- Begin to evaluate the feasibility of expanding the refuge's acquisition boundary to address rising sea level caused by climate change because much of what is currently within the refuge boundaries could be under water in the next 50 to 100 years.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire, restore, and manage up to 313 acres of forested communities (52 acres of coastal plain forest and 261 acres of floodplain forest) to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by maintaining

a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005.

Rationale
The conservation significance of coastal plain and floodplain forests has been described previously under objective 1.2 in alternative A. These forest communities provide diverse habitat required for a variety of landbirds, reptiles, amphibians, and small mammals. Providing a mixed age stand including natural tree regeneration, primary and secondary canopy, as well as a shrub and herbaceous understory, would help maximize the biological potential available on the refuge for these species that stopover during migration or breed within this habitat type.

Under alternative B, we would implement recommendations within the Deer Management Plan, once finalized, to reduce the deer herd over the course of several years to a level that would allow adequate regeneration of native plants and benefit the habitat and other wildlife on the refuge. We would use wildlife control specialists to control the deer population. Other land managers throughout the Philadelphia area have used similar specialists to successfully reduce and manage deer populations, most notably, the Fairmount Park Commission.

We would also begin large scale restoration of the 15-acre forest area currently dominated by the nonnative gray poplar. We would clear canopy trees, control re-sprout saplings, and plant an assemblage of canopy species typical of other coastal plain forests found on the refuge, such as pin oak and sweetgum. As noted in alternative A, coastal plain forests are a State and globally rare community type that provides valuable habitat components for species of conservation concern. The long-term success of this habitat and corresponding intensity of management is directly related to the size and impacts of resident deer populations.

As stated under alternative A, objective 2.2, grasslands existing on the refuge are too small to provide breeding habitat for grassland species of regional conservation concern. By allowing these areas to transition to coastal plain and floodplain forest, these areas would be contiguous with surrounding rare forests of similar type, thereby maintaining connectivity. Forested habitats also require less maintenance than early successional habitats (like grassland and shrubland) once restored. We do not anticipate a mature forest development over the life of this CCP (15 years). Instead, we aim at creating an early successional forest habitat in transition to eventually becoming a mature coastal plain forest.

Strategies
In addition to strategies outlined in alternative A:

Within 5 years of plan approval:
- Reduce and then maintain resident deer populations through the use of wildlife control specialists, based on recommendations of the finalized deer management plan, to reduce deer population densities, improve the available deer habitat, improve tree regeneration, and reduce potential conflicts with human populations (e.g., risk of deer/vehicle collisions). Monitor regeneration for density, plant richness, and diversity within established monitoring plots.

- Adapt long-term management plan for forest habitats to create mixed-age stands of hardwood species identified as primary components of coastal plain and floodplain target communities.

Within 10 years of plan approval:

- Initiate phased restoration of 15 acres of nonnative, poplar-dominated forest to establish a successional trajectory towards coastal plain and/or floodplain forest communities containing biological diversity and integrity similar to other forest habitats existing on the refuge.

- Restore at least 7.7 acres of existing cool-season grass meadows to at least 50 percent cover by early successional coastal plain forest species near the 10-acre marsh restoration site and an additional 0.6 acres within the grasslands restored as part of the oil spill wetland mitigation site.

Monitoring Elements

- Continue to monitor deer browse impacts using APHIS protocols to help adaptively manage deer population control efforts.

Objective 1.3 Darby Creek

Over the next 15 years, manage on-refuge inputs to Darby Creek to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous (e.g., herring, alewife) and catadromous (e.g., American eel) fish populations and other Federal trust species

Rationale

As noted, under alternative A, objective 1.3, Darby Creek provides habitat that supports a diverse assemblage of fish species on the refuge.

Given the relative stability of the channel itself, and available habitat provided by adjacent marsh channels, overhanging vegetation, and large woody structure, the largest management concerns are related to the water quality and environmental health of waters entering the refuge. Under alternative B, we would continue to support the variety of ongoing efforts to monitor basic water quality parameters within Darby Creek.

We would continue to implement best management practices, such as adhering to instructional labels when applying herbicides, to protect against potential contamination of the tidal rivers and other open tidal waters that could be impacted by refuge management activities.

We would also install water quality monitoring equipment along Darby Creek within the refuge. To date, it has been difficult to adequately gather and analyze the variety of data sets collected by agencies and volunteer-based monitoring groups. Improved and automated collection of long-term data would inform our refuge biologist on changes in long-term trends, timing (and potential affects) of acute changes in water quality, and long-term trends in salinity.

Strategies

In addition to strategies outlined in alternative A:

- Where feasible, install stormwater management systems, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands.

Monitoring Elements

In addition to strategies outlined in alternative A:

Within 5 years of plan approval:

- Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring of salinity, dissolved oxygen, pH, temperature, flow rate, and other parameters.

GOAL 2. **Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.**

Objective 2.1 145-Acre Impoundment and Nontidal Open Waters

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 67-acre impoundment and 57 acres of nontidal open water (ponds) to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods, while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures would include:

(1) Annually support migratory shorebirds by maintaining a mix of shallow water (less than6 inches water depth), mudf at with sparse vegetation less than10 percent cover), and mudf ats with no vegetation, at times of peak migration (spring: May, and fall: mid-August to September).

(2) Annually support migratory waterfowl by maintaining a mix of shallow (6 to 24 inches water depth) f ooded vegetation (*Carex, Polygonum, Peltandra*) at times of peak migration (spring: late March, and fall: late October).

(3) Annually support migratory wading birds by maintaining a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

(4) Sustain State-threatened red-bellied turtle by protecting hibernation, foraging, basking, and nesting habitat.

Rationale

The impoundment is, and continues to be, the focal point of the refuge for many visitors and wildlife. As noted, under alternative A, objective 2.1, the 145-acre impoundment, when we are able to manage as intended, provides habitat for numerous migratory landbirds, shorebirds, shallow wading waterbirds, and waterfowl.

However, as noted in alternative A, there are numerous challenges to adequately manage the impoundment to the specific water levels required for optimal use by various bird groups during their migration. For these reasons, under this alternative, we would restore about half of the 145-acre impoundment to freshwater tidal marsh in an effort to reduce overall impoundment management and maintenance, restore additional acres of a priority habitat type, and provide improved access to this habitat for educational and interpretive purposes. Given the complexities of marsh restoration and impoundment management, the size, type, location, and cost of such restoration is unknown at this time.

Biologists have questioned how much impact the water level management has on *actual* bird population versus *perceived* populations. While the 3-year impoundment study did indicate an increase in bird populations within the impoundment during migration, there were no corresponding control surveys conducted within the adjacent freshwater tidal marsh (Phillips personal communication 2010). The increase in use observed may actually be the result

of birds favoring the impoundment over use of the freshwater tidal marsh during the drawdowns, which would cause a corresponding decrease within the freshwater tidal marsh. In addition, some areas of the impoundment are important habitat for other species of conservation concern, for example the State-listed red-bellied turtle. Therefore, we would complete a survey and analysis of both habitats to better inform the extent and location of marsh restoration within the impoundment.

As under alternative A, the other open water areas (the 5-acre Hoys Pond and the 16-acre pond) would not be managed. These areas consist of several isolated water bodies located near I-95. Due to the shallow open water habitat, lack of species of conservation concern, and biological isolation (each pond is surrounded by heavily traveled secondary roads); we would not invest resources into long-term management of these areas. We would complete a series of inventories and evaluations related to priority species, such as the red-bellied turtle, to better inform long-term management of these areas.

Strategies
The same as strategies outlined in alternative A except:

Within 5 years of plan approval:
- Begin to phase out existing wood duck and swallow nesting boxes. Maintain a minimum number of boxes in a few locations as determined by the refuge manager for interpretive purposes.

- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.

- Evaluate sources and locations of stormwater drainage discharging onto refuge lands and develop improvement measures such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.

Within 15 years of plan approval:
- If we decide to pursue restoration of some of the impoundment, work with partners to complete and implement a restoration plan detailing the optimal size, location, and components for restoration of part (about half) of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management and habitat enhancement of the remaining impoundment area (see strategies under objective 1.1 for additional details).

Monitoring Elements
In addition to strategies outlined in alternative A:

- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment. Use data to determine the effectiveness of water level management activities and adjust management protocols as necessary.

Within 5 years of plan approval:
- Conduct baseline red-bellied turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites. Where feasible, complete inventories in partnership with local universities and state agencies.

- Explore opportunities for reducing turtle nest predation through predator trapping, predator relocating, or other measures.

- Explore coordination with Pennsylvania Fish and Boat Commission for potential red-eared slider removal.

Objective 2.2 Grasslands and Early Successional Habitats

Manage up to 64 acres of grasslands and wet meadows to create a mix of native grasses and flowering plants, including early successional shrubs and trees, to sustain stopover foraging and cover for migratory landbirds. Specifically,

- Annually, manage habitat around Frog Pond and Hoy's Pond fringe as wet meadow containing less than 15 percent areal coverage of tree and shrub species, no more than 5 percent bare ground, and at least 90 percent of the total areal cover is comprised of native species.

- Within 10 years of plan approval, restore biological diversity to the existing 7 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of seven species of native grasses, and seven species of native flowering plants.

Rationale

As noted, under alternative A, objective 2.2, the wet meadows and grasslands of the refuge provide foraging and stopover habitat for migratory landbirds, as well as breeding habitat for the coastal plain leopard frog.

Grasslands also require a great amount of maintenance to control invasive species and reduce woody species establishment. While there is some variation in area sensitivity among grassland-dependent birds (Ribic et al. 2010), they generally need areas greater than 25 acres for nesting, with many preferring or requiring patches greater than 75 acres (Mitchell et al. 2000, Morgan and Burger 2008).

We must maintain some of the refuge's grasslands to protect existing pipelines that would be damaged by tree or shrub roots if the area was allowed to succeed to forest. Likewise, the Folcroft Landfill area would need to remain in early successional habitat, probably grasslands, to ensure that deep-rooted trees do not compromise the integrity of the site remediation resulting in the release of contaminants. These areas also benefit from being maintained as grassland to provide access for maintenance and emergency response. Under alternative B, areas where we have identified the least habitat benefit due to a combination of maintenance needs, patch size, and current species composition would be allowed to succeed to shrub or forest. We want to maintain and enhance the remaining grasslands to provide habitat diversity, breeding habitat for coastal plain leopard frog, and for environmental interpretation purposes.

As described under alternative B, objective 1.2, we would allow two main areas of grassland to transition to shrub or forest: the first is 7.7 acres along the southern edge of the refuge, along I-95 near Hoy's Pond, and the second, an additional 0.6 acres of warm-season grasslands located at the location of the 2000 oil spill mitigation site on the eastern border of the impoundment. Under this alternative, we would cease regular mowing and promote the conversion of these to early successional forest and scrub-shrub habitat. This change in management would reduce resources needed for management and also create an additional habitat type to support landbirds such as prothonotary warblers and short-eared owls. In addition, we would work with utilities to discuss the feasibility of converting additional grasslands along the utility right of ways to scrub-shrub habitat. Providing additional benefits to the landbirds mentioned above and further reducing resources needed for management.

The remaining 64 acres of grassland found within the refuge would be enhanced under this alternative though a combination of invasive species control and supplemental planting or seeding. Grasslands near the refuge entrance and

along right-of-ways are comprised largely of cool-season grasses such as Kentucky bluegrass, fescue, orchard grass, and brome grass. An endophyte (*Neotyphodium coenophialum*) present in the cold-season grass tall fescue (*Lolium arundinaceum*) has been shown to have detrimental effects on herbivorous species and associated ecosystems (see summary in Rudgers and Clay 2007). Under this alternative, where possible, we would undertake efforts to enhance species diversity and conversion to grasslands dominated by warm-season grasses to enhance the habitat value for landbirds of conservation concern and benefit herbivorous animals such as voles and rabbits. Some areas may not be appropriate for warm-season grass enhancements due to jurisdiction or where warm-season grasses may interfere with long-term management and protection, such as Folcroft Landfill.

Strategies
In addition to strategies outlined in alternative A:

Within 5 years of plan approval:
- Cease annual mowing of 8.3 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat type.

- Begin supplemental plantings within the grasslands surrounding the visitor center to enhance species diversity so that 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.

- Where feasible, install stormwater best management practices, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands.

- Discuss feasibility of converting portions of utility right of ways to additional shrub-scrub habitat in light of access, maintenance requirements, and compromising infrastructure (i.e. pipelines).

Within 15 years of plan approval:
- Complete habitat management, compatible use, and public use planning for the Folcroft Landfill site within 2 years of site remediation and release.

Monitoring Elements
- Same as strategy outlined in alternative A.

GOAL 3. **Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.**

Discussion
As described in alternative A, objective 3.1 and elsewhere in this document, environmental education is one of the establishing purposes of John Heinz NWR. The study of the environment and ecology allows students to actively participate in solving real issues that affect them, their homes, their schools, and their communities. This provides a tremendous opportunity for mutually beneficial relationships between the refuge and Pennsylvania schools. Opportunities to support State educational standards are not limited to the study of the environment and ecology. In addition to the items outlined under "Actions Common to All Alternatives" and those under alternative A, this management alternative expands education programs at the refuge to incorporate subjects

such as writing, math, art and history into all lesson plans. Providing refuge programming with connections to a variety of school subjects is an opportunity not only to educate, but to also inspire stewardship and connect many young people with nature who traditionally may have limited access to or experience with refuges and nature.

As discussed in chapter 1, section 1.5, the Service recently developed a new vision for the Refuge System. The vision, which provides guidance for the entire Refuge System over the next 10 to 15 years, was released in October 2011 (online at: *http://americaswildlife.org/vision/*). As part of its recommendations, the vision outlines an urban refuge initiative that highlights the importance and role of urban refuges in connecting with diverse audiences and a more urban population. With its natural resources, visitor facilities, and proximity to the Philadelphia metropolitan area, John Heinz NWR is well situated to help fulfill the goals for urban refuges in the Refuge System vision. It offers teachers, urban students, and other environmental education partners an opportunity to study habitat management and restoration, effects of climate change, and five different habitats including Pennsylvania's largest tidal marsh in a natural setting.

Under this alternative we expect to increase our onsite and offsite student visits from 9,400 to up to 24,000 visits, as well as maintaining our teacher training programs. To accommodate this increase, we would hire additional refuge staff and would recruit and train additional volunteers. To ensure high quality delivery of the new refuge programs, we would create a docent training program, in which volunteers are trained and evaluated with baseline competency guidelines for knowledge, skills, and abilities (Examples include Philadelphia Zoo Docent Training Program and National Park Service), to provide unified and consistent programming as well as rewarded for their service and dedication.

There are several environmental education centers located within an hour's drive of the refuge, including the Cobbs Creek Community Environmental Education Center, Schuylkill Center for Environmental Education, Overbrook Environmental Education Center, Tyler Arboretum, and Riverbend Environmental Education Center. Our intent is to provide a site-specific education experience that focuses on the natural resources found at John Heinz NWR. To help us ensure that we are addressing target audiences and meeting the needs of environmental education participants, we initiated a study with USGS to both capture the refuge's current program (Phase I, see appendix I) and the needs of current and potential participants in the refuge's environmental education program (Phase II). The Environmental Education Stakeholder Needs Assessment Phase II report (Wells and White 2011) identifies some of the existing programs around the area, reviews demographics and potential audiences, summarizes where opportunities are available, and makes some suggestions to guide future planning. Under this alternative, we would use these results to guide our future environmental education program planning, including developing new environmental education programming and completing the environmental education component of the refuge's visitor services plan.

Every national wildlife refuge is required to complete a visitor services step-down plan which will help focus visitor services efforts. Visitor services plans encompass all aspects of visitor services on the refuge, including a section on environmental education. Under this alternative, the visitor services plan would identify, define, and prioritize audiences. It would also identify themed messages and topics that would apply to all environmental education and interpretation programming. Given the importance of environmental education to the refuge, and the refuge's critical role in connecting young people with nature and representing the Refuge System and the Service in an urban environment, developing and implementing a visitor services plan is particularly important at John Heinz NWR. For this reason, John Heinz NWR staff would begin writing the refuge's visitor services plan as soon as possible.

Strategies that apply to all objectives under this goal include:

- Within 2 years of CCP approval, complete the refuge's visitor services plan. This plan would: 1) specify themed messages and topics tied to refuge-specific resource conservation issues, the Refuge System mission and new vision, and the Service mission and goals, 2) be consistent among the different visitor services programs (i.e., environmental education and interpretation), and 3) identify, define, and prioritize audiences.

- Use the visitor services plan and the results of the Environmental Education Stakeholder Needs Assessment Phase II Report (Wells and White 2011) to guide the refuge's environmental education program focusing on urban schools (grades K-12), including creating a series of lesson plans that explore the resources of the refuge that are unique to the refuge, and consistent with themed messages and topics, Expand the refuge's capacity to deliver quality environmental education programming by recruiting additional volunteers and establishing a docent training and reward program for volunteers.

- Pursue ongoing alignment of the refuge's environmental educational program with Pennsylvania State academic standards and if applicable, certifications for curricula and teacher trainings.

- If resources allow, hire two additional outreach and environmental education and interpretation staff (one would be stationed at John Heinz NWR but shared with other refuges in the Northeast Region) to help expand the environmental education program and meet the projected increase in visitation. We would also hire an additional maintenance worker to help maintain visitor facilities to support programs if resources allow (see appendix D for proposed staffing chart).

- Pursue alternative funding or grant programs for supporting transportation to and from the refuge for interested and qualifying schools and groups based on the results of the Environmental Education Stakeholder Needs Assessment and actions outlined within the visitor services plan.

- Update and incorporate all appropriate media (brochures, website, social media, displays, etc.) to accurately communicate the environmental education components available to the public.

Monitoring elements:

- Determine which schools or school districts would be defined as urban and non-urban. Monitor and record visitation by urban and non-urban schools to determine if we are reaching our target audience.

- Annually complete an evaluation summary of environmental education opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, schools, teachers, and students engaged).

- Work with teachers, school administrators, and other environmental education partners to monitor and assess the efficacy of new environmental education curricula and materials. Modify the curricula as needed to ensure content is meeting identified priorities [i.e., curricula are 1) consistent with themed messages and topics identified in the visitor services plan (once developed), 2) relevant to urban youth, 3) staff and volunteer led, hands-on, place-based (i.e., unique to the refuge), and 4) aligned to applicable education standards.]

- Work with environmental education partners to monitor efficacy of established environmental education programs every 1 to 3 years. Monitoring efforts may include surveys developed and conducted by partners, peer observation and review, self-evaluations, verbal discussions with participants (teachers and students), record number of repeat visits (within and among years) and new participants.

Objective 3.1 Providing Environmental Education Focusing on Youth in Urban Schools

Over the 15 year life of the plan, provide a quality environmental education program at John Heinz NWR with specific themes and learning objectives. The environmental education program would

(1) focus on urban schools (grades K-12);

(2) provide a variety of programming that is site specif c and relevant to the target audiences;

(3) meet State education standards when applicable;

(4) be based on refuge management and conservation programs;

(5) support the missions of the Service and Refuge System;

(6) increase student visits from urban schools to approximately 16,000 per year;

(7) focus on providing staff-led and volunteer-led programming;

(8) develop long-term relationships with students and at least three schools and respective school districts; and

(9) provide stewardship opportunities.

Rationale (In Addition to Discussion)
John Heinz NWR is one of four refuges within the Northeast Region (of 73 refuge units) that is located within 45 miles of a major metropolitan area[1]. Given its location partially within the city of Philadelphia, the refuge has the opportunity to form long-term relationships with local urban schools containing a population of students and teachers who traditionally may have had limited access to and experience with nature.

When asked, refuges identify transportation costs, transportation (i.e., bus) schedules, and school proximity to the refuge as three of the largest barriers to their ability to work with populations from urban environments (USFWS Northeast Region unpublished data). For John Heinz NWR, these barriers are significantly reduced as there are more than 300 urban public schools that serve over 146,000 students (grades K-12) within the Philadelphia school district alone (Philadelphia School District 2011). Friends of Heinz Refuge also offers grants to schools to pay for bussing. Given the important opportunity that John Heinz NWR has for working with students from urban settings, the refuge would focus limited staff and volunteer time towards working directly with students from urban schools (grades K-12) through both on and offsite programming. The intention is to maintain and expand the current program and also to formulate long-term relationships with school districts that involve: 1) incorporation of refuge curricula into school curricula; 2) school participation in the program over many years, and 3) refuge staff working with students multiple times in a year.

[1] The U.S. Census Bureau def nes a major metropolitan area as containing a population of one million or more people.

Repeated visits help students gain confidence with nature, foster a connection between students and the refuge, and increase the chances that students would feel a sense of stewardship towards the environment.

Since every school has different needs, refuge staff and volunteers would work with schools to design programming that meets Pennsylvania State standards of learning, covers a range of media (e.g. outdoor investigations, service projects, discovery hunts, etc.), and is relevant to the audience. One way we may be relevant to our audiences would be to connect with the lives of students, working to identify ways they can make a difference in solving problems and high priority issues within the local community. We would focus on environmental education programming at the refuge but would use offsite programs to develop long-term relationships with urban schools. In addition, this programming would be designed in accordance with the visitor services plan with well defined themes and topics, and with an evaluation system in place. All programming would complement the missions of the Service and Refuge System, and speak to refuge management strategies.

Strategies
In addition to the strategies presented above under strategies that apply to all objectives:

Within 7 years of CCP approval:

- Maintain relationships and programming with area schools that currently visit the refuge for environmental education.

- Offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education programs so interested teachers are provided an opportunity to lead their own classes on the refuge.

- Work with local teachers, school administrators, and other environmental education partners to develop lesson plans that would enhance environmental education curricula that are 1) consistent with themed messages and topics identified in the visitor services plan (once developed), 2) targeted towards urban schools and relevant to urban youth, 3) led by refuge staff or trained volunteers and hands-on, place-based (i.e., unique to the refuge), and 4) aligned to applicable education standards.

- Review and evaluate existing components (e.g., Habitats of the Refuge, Birds of a Feather, Peoples Interaction with the Environment, teacher education courses, Microlife) of the environmental education program to determine if they meet the specific criteria identified under this objective and are effective. Modify, add, or eliminate components as needed.

- Identify local urban schools and school districts that meet our definition of targeted audiences and create a prioritized list of at least 15 of these schools.

- Use our relationship with the Interboro School District as a model to help develop long-term relationships with at least three additional local urban school systems from our prioritized list. A long-term relationship could include formal adoption of refuge programs into the school districts' curricula, repeated visits of refuge staff to the school, and repeated visits of students to the refuge both within the academic year and in subsequent years.

- Expand use of alternative funding or grant programs for transportation to and from the refuge for schools based on the results of the Environmental Education Stakeholder Needs Assessment Phase II Report and actions outlined within the visitor services plan.

- Have refuge staff or trained volunteers lead 200 student-focused programs per year both on and offsite, totaling about 12,000 student visits per year.

Within 15 years of CCP approval:

- Continue to develop and expand course curricula in cooperation with local teachers, school administrators, and other environmental education partners.
- Expand long-term relationships with local schools to at least three more urban schools.
- Have staff and trained volunteers lead 275 student-focused programs per year both on and offsite, totaling about 16,000 student visits per year.

Monitoring Elements

- Work with teachers, school administrators, and other environmental education partners to annually monitor efficacy of established environmental education programs targeting urban youth. Monitoring efforts may include surveys developed and conducted by partners, peer observation and review, self-evaluations, verbal discussions with participants (teachers and students), record number of repeat visits (within and among years) and new participants.
- After new programs have been in place for 5 years, assess feasibility of developing an official Service survey to evaluate effectiveness of programs.

Objective 3.2 Environmental Education for Other Youth Audiences

Over the 15 year life of the plan, provide a quality environmental education program at John Heinz NWR with specific themes and learning objectives. The environmental education program would

- include programs for other youth audiences, for example home schooled students, 4H. YMCA, SeaGrant, Boy Scouts, Girl Scouts, college students, and other nonprofit youth organizations;
- increase student participation in refuge programs by these groups to 8,000 student visits per year;
- focus on providing teacher education;
- provide a variety of programming that is site specific and relevant to the audiences;
- meet State education standards;
- be based on refuge management and conservation programs;
- support the missions of the Service and Refuge System; and
- provide stewardship opportunities.

Rationale (in addition to the Discussion)

While our focus is on youth in urban schools, we recognize the importance and value of providing environmental education opportunities to all interested partners. Refuge neighbors and partners are crucial to helping the refuge and the Service meet conservation goals. We would like to support these groups in their environmental education efforts. Participants under this objective would include a variety of groups such as: students that are from outside of the local urban area, non-traditional K-12 students (e.g., home schooled students), participants in non-formal education programs (e.g., Boy Scouts, Girl Scouts), college-level students, and education providers for these groups. Because refuge

resources are limited and much of the staff and volunteer time would be focused on priority urban youth audiences, environmental education programming for other youth audiences would focus on more teacher-led programs with less direct involvement from staff and trained volunteers. Ultimately, our goal would be for most educators of these audiences to independently lead refuge programming or their own program (provided it incorporates appropriate refuge themes as identified in the visitor services plan and refuge-specific content) with minimal input from staff. When staff time and other resources allow, refuge staff and volunteers would work directly with these audiences.

To support teachers' environmental education efforts within their classrooms, the refuge would expand on available teaching materials and loan boxes offered to schools. School budgets are often restricted and materials that teachers can borrow which teach about local environmental concerns and about the refuge make it easier for teachers to implement environmental education into their curricula. Curricula developed to reach priority urban youth would also be made available for these other youth audiences.

Strategies
In addition to the strategies presented above under strategies that apply to all objectives, we would continue to:

- Provide educational activities, curriculum, and other appropriate resources on the refuge Web site.

- Continue to offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education programs so that education providers can lead programs on the refuge.

Within 7 years of plan approval:
- Work with teachers, university professors, academic administrators, and other environmental education partners to expand the teachers workshops to include additional programming based on the results of the Environmental Education Stakeholder Needs Assessment and actions outlined within the visitor services plan (e.g., additional college-level programs).

- Evaluate and modify or expand, if appropriate, loan boxes and teaching equipment and supplies.

- Review and evaluate existing components (e.g., teach the teacher workshops, Microlife) of the environmental education program to determine if they meet the specific criteria identified under this objective and in the visitor services plan and are effective. Modify or eliminate components as needed.

Within 15 years of CCP approval:
- Develop a set of days dedicated to programming for scouts and other youth groups.

- Formalize partnerships with youth organizations such as Big Brother Big Sister Program, 4H, YMCA, SeaGrant, Boy Scouts, Girl Scouts, college students, and other nonprofit youth organizations.

Monitoring Elements
Same as monitoring elements under strategies that apply to all objectives under this goal.

GOAL 4. **Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.**

Objective 4.1 Environmental Interpretation

Over the life of the plan, expand on and offsite environmental interpretation opportunities through updating refuge infrastructure and developing electronic media for up to 35,600 visitors, students, and area residents that emphasize the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary and enhance the infrastructure and facilities necessary to provide a quality interpretive experience.

Rationale

Under alternative B, we would build upon our existing programs (alternative A) to make upgrades in interpretive infrastructure necessary to improve accessibility and utilize newer technologies to convey our interpretive goals. Providing an array of options for engaging visitors in interpretive programs and events is critical to increasing refuge visitation and expanding participation in resource stewardship and protection. It also achieves a national Service priority which is connecting children with nature.

We would expand upon our existing mix of guided interpretive tools, Service-sponsored events (such as the Cradle of Birding Festival and National Wildlife Refuge Week), and partner-sponsored events to increase annual participation from its current level (13,300 participants in 2009) up to 26,000 participants within 15 years of plan approval. We hope to improve the amount of off-season visitation (November through early March) to the refuge by providing programs and events that target young families and would encourage connecting youth with nature. By inviting visitation through off-season interpretive events, we can showcase the seasonal variation of the refuge and encourage repeated visitation throughout the year.

We hope to increase the amount of offsite participation in environmental interpretation to about 9,600 participants. New Web-based programs combined with additional partnerships would help us reach these additional goals.

Improving the quality self-guided services, signs, and facilities would also enable us to reach a larger audience, be more readily available, and allow visitors to use them at their own pace, while still initiating discussion and providing answers to questions.

Improving interpretation of Tinicum Marsh is another focus of alternative B. By constructing additional infrastructure in the form of boardwalks, bridges, and observation areas, we can improve access and visibility of the marsh areas existing and proposed for restoration under this alternative. When coupled with the addition of digital technology, such as a cellular phone tour or podcast, we would open a broad array of new interpretive options for visitors.

Strategies

In addition to strategies outlined under alternative A:

Within 2 years of plan approval:

- Identify key user groups utilizing the refuge and compile a targeted list of associated organizations, businesses, and affiliations potentially interested in learning more about the refuge through interpretive events and programs.

- Improve directional trail, regulatory, and interpretive signage, including development of a formalized entrance along SR 420 and improve directional signage to the refuge.

- Develop new day camp programs and expand the number of day camps offered to at least 12 per year.

Within 5 years of plan approval:

- Complete the refuge's visitor services plan, including an environmental interpretation component. This would specify themed messages that would be consistent among the different programs and would prioritize audiences. Themes would describe refuge management and its relationship to habitats and wildlife and would include larger-scale concepts such as climate change and green building.

- Develop events and programs tailored to targeted audiences incorporating themes from the visitor services plan. Host these events between November and May to encourage use in these slower months.

- Re-orient existing displays and expand exhibits in a way that promotes exploration and longer viewing time by visitors.

- Develop at least two interpretive materials (e.g., bilingual signs and brochures) in other languages (e.g., Spanish) to help increase our effectiveness at reaching out to non-English speaking audiences.

- Develop at least three interpretive materials and programs specifically designed for people with disabilities including activities such as guided bird song tours of the refuge, signs and brochures in braille.

- Update all refuge displays, kiosks, signage, and trail system to support a more digital interpretive infrastructure applicable to urban youth and technology-ready visitors. Possibilities include the following:

  - Providing at least three tools available via the web such as podcasts, virtual tours, interactive programs,

  - Developing a cellular phone-based interactive trail,

  - Updating refuge-orientation DVD

  - Creating an interactive flyover exhibit to explore the habitats of the refuge

- Pursue additional alternative funding or grant programs for supporting transportation to and from the refuge for interested and qualifying groups based on actions outlined within the visitor services plan.

Within 10 years of plan approval:

- Work with the EPA to develop an interpretive plan for the Folcroft Landfill including public use features such as an interpretive trail system, observation tower, and pedestrian bridge to develop access to upon site release.

- Create more interactive exhibits suitable for younger visitors (2 to 8 years old).

- Develop easily updated displays related to the various habitats found across the refuge.

- Improve access to and interpretation of Tinicum Marsh utilizing methods that provide access while minimizing visitor impacts to the marsh and wildlife, utilizing its habitat through new interpretive infrastructural measures such as boardwalks, wildlife viewing blinds, and bridges.

- Develop a series of programs and travelling exhibits on specific topics targeted to particular groups and events. Work with group leaders to develop environmental education programs that are hands-on, place-based, and aligned with applicable education standards/requirements.

Monitoring Elements
- Annually complete an evaluation summary of environmental interpretation opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

GOAL 5. **Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.**

Objective 5.1 Wildlife-dependent Recreation

Annually, provide visitors with wildlife-dependent recreation opportunities including fishing, wildlife observation, and nature photography, and maintain the infrastructure and facilities necessary to provide a quality experience.

Rationale
As noted in objective 5.1 under alternative A, the refuge provides recreation opportunities unique to the Philadelphia area through its management for habitat protection and wildlife diversity. All refuges are encouraged to provide wildlife-dependent recreation opportunities under the Refuge Improvement Act. This type of recreation is intended to encourage connection with nature and foster wildlife conservation and environmental stewardship. With over 120,000 visitors annually participating in some form of wildlife-dependent activity, wildlife-dependent recreation is by far the largest reason for visitation to the refuge. By improving signs to direct visitors, promoting compatible recreational use, and expanding recreational infrastructure, we would encourage wildlife-dependent recreational use and seek participation by up to 170,000 visitors annually.

According to surveys conducted as part of the Pennsylvania State Comprehensive Outdoor Recreation Plan (PA SCORP), most recreationists do not distinguish the differences in management directives between local, county, state, and Federal lands and agencies (Graefe et al. 2009). For many visitors the refuge is considered another city park. Trail users at John Heinz NWR participate in activities typically not allowed on other wildlife refuges: dog walking, bicycling, and running. In recent years, we have received requests for increases in recreational use not considered to be wildlife-dependent including, but not limited to, geocaching and bike trail development. We are re-evaluating compatible recreational uses as part of this comprehensive conservation planning process (see appendix B).

Under this alternative, we would begin improvements in wildlife-dependent recreation by ensuring enforcement of inappropriate or non-compatible uses. We would upgrade and expand the onsite directional signs to better guide users, pedestrian traffic, and parking for cars and bicycles. In particular, we would work with the Pennsylvania Department of Transportation to develop self-serve contact stations at the trailheads located along State Highway 420. A contact station along this eastern entrance has been requested by Delaware County staff and neighboring residents for several years. The refuge receives numerous

visitors throughout the year from this entrance point. A contact station would welcome visitors and encourage interpretive uses at this location.

The majority of visitors at the refuge are interested in wildlife observation and experiencing nature. As we pursue an increase in visitation over the next 15 years, we hope to develop additional infrastructure in order to expand opportunities for traditional wildlife observation, water-based wildlife observation and recreation, and trail access, primarily around Tinicum Marsh. Construction of additional observation platforms or blinds would be focused on improving observation of wildlife within Tinicum Marsh, improved trails and additional boardwalks would increase access to those observation areas. Access to Tinicum Marsh via waterways and water trails would be improved under this alternative as well. We would expand access to Darby Creek and Tinicum Marsh by improving and adding canoe launches as well as exploring partnerships with neighboring marinas or boat launches to promote the refuge.

Strategies
In addition to strategies outlined under alternative A:

Within 2 years of plan approval:
- Improve wildlife-viewing and photography by expanding enforcement of non-compatible trail uses.
- Explore opportunities to connect to regional bicycle trails and greenways to encourage non-motorized visits to the refuge.

Within 5 years of plan approval:
- Improve signs to direct pedestrian bicycle traffic and hiking accessibility as well as parking.
- Construct a self-serve contact station at State Road 420.

Within 15 years of plan approval:
- Construct a boardwalk into Tinicum Marsh to provide opportunities for visitor to observe wildlife and for us to better interpret the marsh.
- Based on the visitor service plan, construct additional fishing access points, bird and photography blinds, and non-motorized water recreation enhancements (i.e. canoe launches).
- Partner with neighboring marinas and boat launches to institute organized boat tours of Tinicum Marsh, upon request.

Monitoring Elements
- Annually complete an evaluation summary of wildlife-dependent recreation opportunities provided (number of opportunities, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

Objective 5.2 Evaluate Possibility of Providing Deer Hunting Opportunities

In partnership with PGC, evaluate the possibility of providing a quality deer hunt program by opening portions of refuge lands to public deer hunting.

Rationale
PGC is interested in expanding hunting opportunities in Pennsylvania. In particular, there is interest in the refuge providing opportunities for a limited youth or handicap-accessible hunt, consistent with State and local regulations.

At present, we have not developed a hunt program proposal to the extent that we could conduct a NEPA analysis and involve the public. Instead, within 10 years of CCP approval, we would initiate preliminary public scoping and detailed discussions with PGC about the possibility of opening the refuge to a limited deer hunt program. If there is public and PGC interest in pursuing a deer hunt program, we would identify and analyze a detailed proposal and involve the public before making a decision. Because the refuge provides important resting and foraging habitat for migrating birds as well as other species of conservation concern, there is limited marsh habitat available in the State, and because the available marsh habitat on the refuge is limited, we are not considering opening the refuge to migratory waterfowl hunting.

Hunting, if approved, would provide a priority public use in an area where public hunting opportunities have largely been eliminated by development. John Heinz NWR is in a unique position to offer limited deer hunting in an urban environment and there are potential benefits to refuge habitats associated with controlling the resident deer population. The Refuge Improvement Act specifically identifies hunting as a priority, wildlife-dependent recreational activity on refuges, and as such we are required to give it enhanced consideration on refuges. Our particular interest in evaluating a hunt program at this refuge stems from its urban location, limited upland areas, concentrated public use, potential concerns over public safety, and potential conflicts with one of the refuge's establishing purposes (i.e., providing opportunities for environmental education) and other priority public uses.

Strategies
Within 10 years of CCP implementation:

- Initiate preliminary public scoping and detailed conversations with PGC to see if a detailed analysis of a deer hunt program is warranted.

- If warranted, partner with PGC to evaluate in detail a proposal to provide opportunities for deer hunting on the refuge that are consistent with State and local regulations and laws. Other alternatives, including no action (i.e., no hunting) would be considered in this evaluation, and there would be additional opportunities for public involvement before a final decision would be made.

GOAL 6. **Communicate and collaborate with local communities, Federal and state agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.**

Objective 6.1 Role of Refuge in Regional Conservation

Within 15 years of CCP approval, establish the refuge as a regional center for hosting and sponsoring conservation-related events to facilitate collaboration with a variety of partners and increase community understanding and appreciation of the refuge's regional significance to natural resource conservation, its contribution to the Refuge System, and to garner additional support for refuge programs.

Rationale
The refuge and visitor center currently provide a meeting place for conservation-related groups, meetings, and workshops. Under alternative B, we would encourage the refuge's regional role in conservation as a center for meetings, workshops, and seminars. By housing these events, we introduce visitors to the refuge, foster regional efforts in habitat protection and environmental conservation, and introduce new audiences to the National Wildlife Refuge System.

In addition to providing facilities for conservation-related meetings by agencies and organizations from around the region, we would work to expand the refuge and Service's role in regional conservation by hosting and/or leading technical workshops and meetings or by providing project tours, technical workshops, or public presentations. These efforts are focused on making us more visible to our partners and interested audiences around the region. By increasing our visibility in the conservation community of greater Philadelphia, we help promote the Service, National Wildlife Refuge System, and garner additional support for refuge programs.

Strategies
In addition to strategies mentioned under alternative A:

Within 5 years of plan approval:
- Develop an interpretive exhibit outlining the refuge and the Refuge System's role and purpose in relation to other natural areas within the Delaware Estuary and the Landscape Conservation Cooperative.

- Annually host and lead at least two national or regional workshops related to climate change, biological management and monitoring, environmental education, or other topics supporting the refuge goals.

Within 15 years of plan approval:
- Work with academic institutions to encourage climate change research that would inform refuge management and would support regional and global initiatives on the effects of climate change.

- Study adjacent and nearby areas, including potential expansions to the refuge's acquisition boundary to determine ways the refuge can adapt to climate change.

- Explore opportunities to assess and evaluate ecosystem services provided by the refuge habitats through collaboration with universities and agencies.

- Establish and promote the refuge's role as a regional center for conservation, freshwater tidal marsh management, and fish and wildlife protection by providing project tours, technical workshops, or public presentations.

Monitoring Elements
- Annually complete an evaluation summary of partnership efforts and roles that the refuge has played in regional conservation through those partners/events.

Objective 6.2 Outreach and Partnerships

Throughout the life of the CCP, work with partners throughout the Philadelphia metropolitan area to increase community understanding and appreciation of the refuge's significance to natural resource conservation, its contribution to the Refuge System, and to garner additional support for refuge programs by increasing refuge visitation and participation in refuge programs.

Rationale
The vision for John Heinz NWR embodied in this comprehensive conservation plan cannot be fulfilled without the continued and diverse benefits the refuge receives from its partnering organizations, businesses, and agencies. The range of partnerships and outreach activities we currently participate in is detailed under alternative A, objective 6.2.

Under alternative B, we would continue these outreach avenues while pursuing increased partnership with area non-profit organizations, local tourist attractions, transportation agencies, and travel businesses. The refuge is located within a half-mile of the Philadelphia International Airport. With 18 hotels within a 4-mile radius of the refuge and airport, there is a large population of traveling public that is within close proximity to the refuge for an extended period of time. This presents an opportunity for the refuge to partner with area hotels and the Philadelphia Airport to highlight the refuge as a local point of interest.

In doing so, we would increase the refuge's visibility and generate increased interest by coupling with other local travel destinations such as Bartram's Gardens and Fort Mifflin. We anticipate that partnering with these and other local attractions can position the refuge and its neighbors as a local day-trip destination.

Strategies
In addition to strategies outlined in alternative A:

Within 2 years of plan approval:
- Pursue a specialized partnership with Fort Mifflin and Bartram's Gardens to co-schedule and promote events and programs.

Within 5 years of plan approval:
- Implement at least 3 examples of cross-referencing and publishing of workshops and events with partnering organizations.
- Work with at least three hotels around the airport to install a display advertising the refuge as a visitor destination to promote visitation.
- Provide refuge brochures to an additional 10 area hotels to promote refuge visitation.
- Work with PENNDOT, SEPTA, and Philadelphia International Airport to provide displays, brochures and information identifying the refuge as a visitor destination.
- Expand media outreach into online social networking and modern technology communications.

Within 10 years of plan approval:
- Work with PENNDOT, SEPTA, and Philadelphia International Airport to improve the visibility of and transportation connections to the refuge.

Monitoring Elements
- Annually complete an evaluation summary of partnership and outreach efforts and resulting benefits to the refuge (increased visitation, awareness, or understanding).

3.6 Alternative C: Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research

Alternative C is similar to alternative B in its approach to refuge administration and facilities. It differs substantially, however, from alternatives A and B in its habitat management approach as well as areas of emphasis for education and interpretive programs.

3.6.1 Land Protection

As we describe under the heading "Protecting Land" under "Common to All" above, we would continue to work with willing sellers and in partnership with other agencies and organizations to acquire the remaining 207 acres within the refuge's approved acquisition boundary.

3.6.2 Habitat Management

Under alternative C, habitat management would focus on restoring degraded forests and specific grassland areas to a scrub-shrub habitat type. Shrub-dominated habitats are not found anywhere on the refuge currently and it would support a variety of species of conservation concern. Similar to alternative B, we would also focus a large degree of habitat management resources towards invasive species management, freshwater tidal marsh restoration, and monitoring for climate change adaptation.

Tidal marsh restoration in alternative C would be delayed to allow for additional data collection and sea level rise analysis prior to initiation of future marsh restoration efforts. Forest management would continue invasive species control and monitoring the impacts of high deer populations. However, alternative C would convert a 15-acre stand dominated by a nonnative gray poplar to a scrub-shrub dominated habitat. This alternative would also initiate a deer management control program. Proposed changes in habitat management under alternative C are displayed in map 3.5.

3.6.3 Inventory and Monitoring

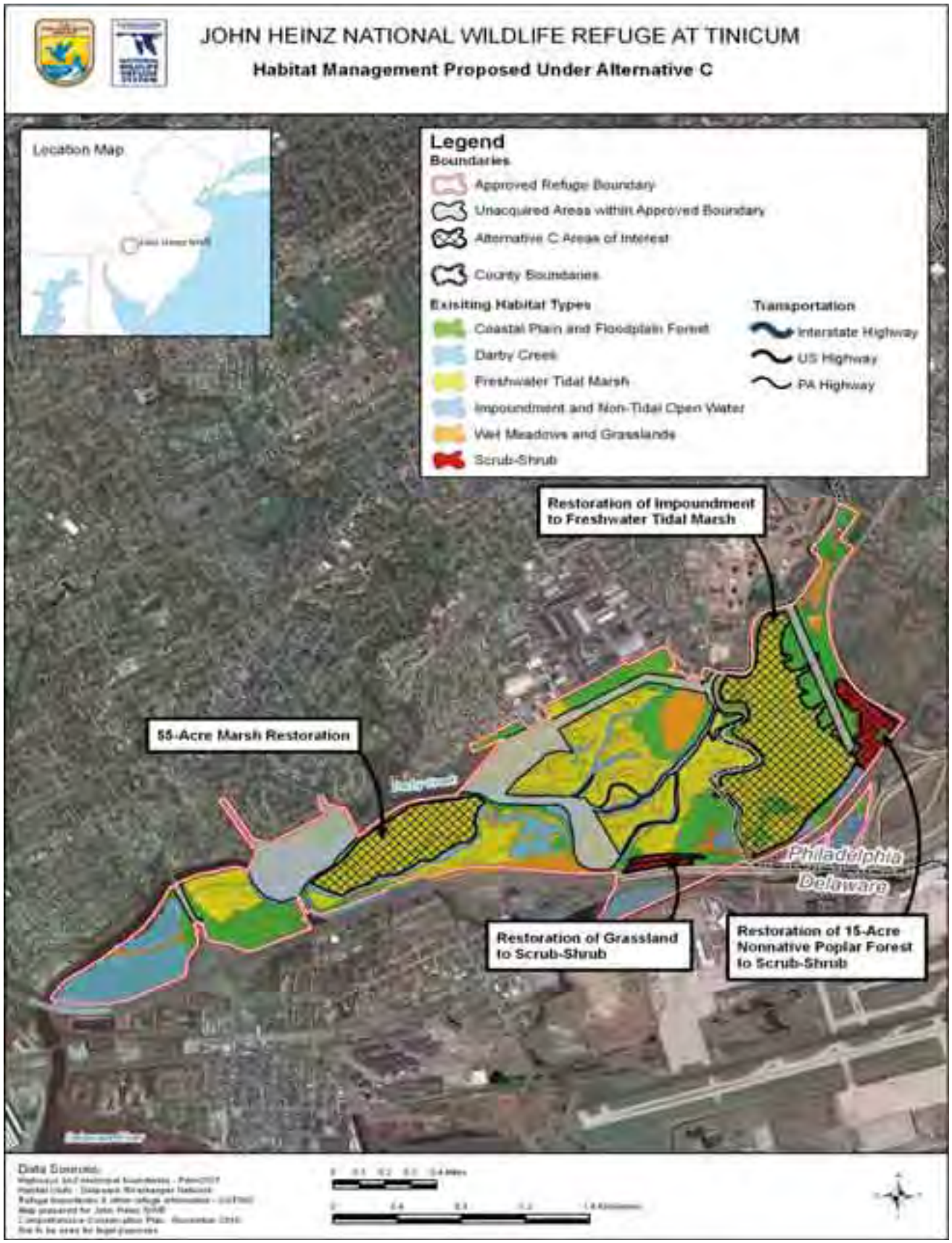
Similar to alternative B, we would continue existing monitoring and inventory efforts as long as they continue to provide useful information that would inform us about the effectiveness of habitat management, habitat adaptation to climate change, and we have the necessary resources to accomplish them. We would target any alterations or additions to these ongoing surveys toward helping us understand better the implications of our management actions and ways to improve our efficiency and effectiveness. We would also continue to seek ways to reduce our management costs for establishing and maintaining monitoring protocols.

3.6.4 Visitor Services

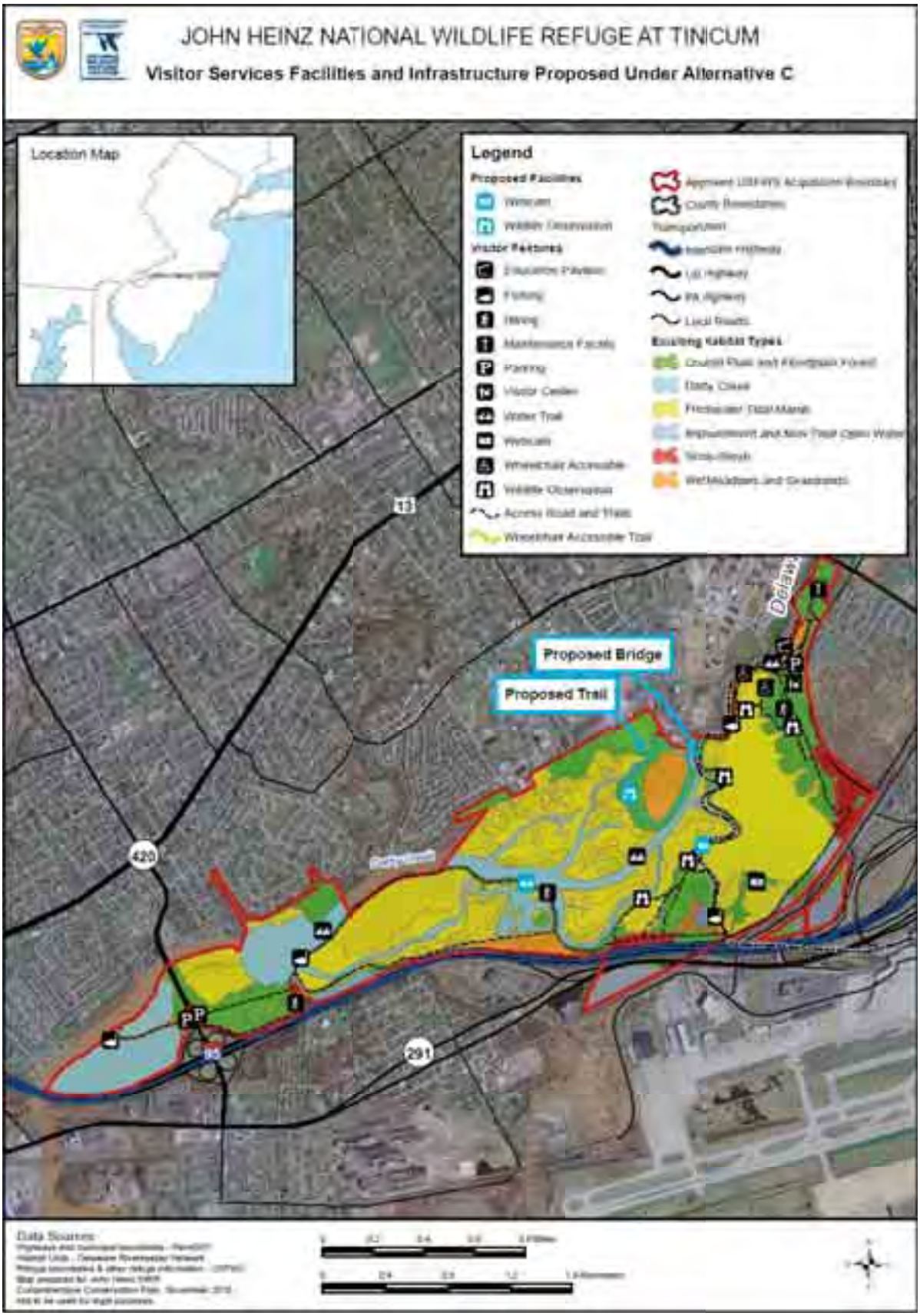
Under alternative C, we would expand existing opportunities for all six priority public uses at John Heinz NWR. Map 3.6 presents the current and proposed public use opportunities under alternative C.

Similar to alternative B, we would use the results of the Environmental Education Stakeholder Needs Assessment (Wells and White 2011) to complete the visitor services plan and develop environmental education programs. However, under alternative C, environmental educational programming would focus on providing high school, college, and post-graduate level environmental education focused on encouraging and training the next generation of conservation professionals and environmentally concerned citizens.

Map 3.5. Proposed Habitats Comprising John Heinz National Wildlife Refuge at Tinicum Under Alternative C.



Map 3.6. Proposed Visitor Services Infrastructure and Facilities at John Heinz National Wildlife Refuge at Tinicum Under Alternative C.



Environmental interpretation infrastructure would also be expanded under alternative C. Infrastructure components such as trails, boardwalks, viewing platforms, and a shuttle service are considered as more intensive alternatives for encouraging and directing interpretation as compared to alternative B.

We expect total onsite visitation to be intermediate between alternatives A and B, at about 183,000 visits per year. Because of the expansion in programs (i.e., hunting and expanded environmental education) and infrastructure, we expect visitation to be a bit higher compared to alternative A. Because the hunt program would need to be limited, and under alternative C we would not place as much effort into expanding onsite environmental education and interpretation as we would under alternative B, total visitation is expected to be slightly lower than estimated under alternative B.

3.6.5 Refuge Administration

Similar to alternative B, we would add five positions under alternative C. These positions are the same as those proposed under alternative B with one exception. Because we would not pursue as much active management and restoration throughout the life of the plan and would increase our reliance on partners to conduct research and monitoring on the refuge, we propose another Park Ranger position to assist with visitor services instead of the biological technician (see appendix D).

Under alternative C, the refuge would upgrade and expand its existing visitor center to allow co-location of most refuge programs. Maintenance staff would continue to have offices within the existing garage facility. The facility proposed under this alternative would also allow for expansion of interpretive displays. All other facilities would be maintained and upgraded to meet safety and accessibility requirements over the 15-year life of the plan.

In the section that follows, we describe in detail the goals, objectives, and strategies we would implement under alternative C.

3.6.6 Goals, Objectives, and Strategies Under Alternative C

GOAL 1. **Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the Refuge and sustain native plants and wildlife, including species of conservation concern.**

Strategies that apply to all objectives under this goal include:
In addition to strategies in alternative A:

- Explore construction of a sound barrier along I-95 to reduce sound impacts on birds, amphibians, and other wildlife.

Objective 1.1 Freshwater Tidal Marsh

Over the next 15 years, maintain and improve the existing 282 acres of freshwater tidal marsh by reducing the amount of area dominated by phragmites from 24 acres (12 percent) to less than 10 acres (5 percent), and reestablish greater than 80 percent coverage of native marsh plant species in areas of phragmites reduction. Monitor for effects of climate change prior to developing restoration plans for up to 263 acres of freshwater tidal marsh, including the 145-acre impoundment area. Restored marsh areas would be dominated by native marsh vegetation, and would contain less than 5 percent areal coverage of invasive plant species.

Rationale
Alternative C is similar to previous alternatives in that we would continue to protect the existing Tinicum Marsh and pursue restoration of additional tidal

marsh acreage. The difference in alternative C, versus alternative B, is the timing and extent of that additional restoration. This alternative recognizes that climate change projections (and specifically sea level rise predictions) are still in a state of fluctuation as models and their considerations become more and more complex, as noted in the rationale discussion of alternative A, objective 1.1. Because of this uncertainty, freshwater tidal marsh management under this alternative is largely focused on establishing, collecting, and monitoring long-term data trends within Tinicum Marsh in order to improve our projections and evaluation of potential sea level rise prior to implementing marsh restoration projects.

Ultimately, under this alternative, we intend to restore the 145-acre impoundment to freshwater tidal marsh. Since the protection of Tinicum Marsh is one of the highest management priorities put forth by the original legislated purposes, we are considering the full restoration of this area. Historic maps indicate the existing impoundment was once covered by wetlands, presumably freshwater tidal marsh, as recent as the early 20th century. While the impoundment does provide important habitat benefits when managed effectively, that type of management is challenging and is likely to become more difficult with projected changes in climate. Additionally, many of the same species of conservation concern that use the impoundment benefit from freshwater tidal marsh habitat. In light of the uncertainty of sea level rise projections and our general evaluation and monitoring approach under alternative C, restoration of the 145-acre impoundment would not occur until sometime near the end of this CCP lifespan (15 years), or perhaps longer if uncertainty still exists. This restoration would be designed and implemented based on updated sea level rise information and monitoring on the refuge. Any plan to restore the impoundment will require additional NEPA analysis and public involvement.

Strategies
In addition to strategies outlined in alternative A, objective 1.1 we would:

- Control nonnative, invasive species focused primarily on phragmites through a combination of aerial herbicide application, and spot treatments throughout the growing season when populations exceed greater than 5 percent (10 acres) areal coverage across the existing 282 acres of freshwater tidal marsh.

Within 2 years of plan approval:
- Develop an assessment and prioritization list of potential freshwater tidal marsh wetland restoration projects on the refuge in accordance with the refuge's Habitat Management Plan and the Restoration Management Plan for the Lower Darby Creek.

- Initiate partnerships with regional agencies and non-governmental organizations within the Landscape Conservation Cooperative to support stream, wetland, and riparian restoration and fish barrier removal projects directly connected to refuge habitats and within Darby Creek watershed.

- Support restoration of a large patchwork of habitats not directly connected to the refuge, but within the Landscape Conservation Cooperative for migratory birds and other species in order to enhance migratory stopover habitat as opportunities arise.

Within 5 years of plan approval:
- Focus climate change management on making the refuge a regional focal point for research and information related to climate change impacts such as sea level rise, species migrations, and other landscape-scale impacts.

- Utilize regional-scale habitat models to evaluate changes in habitat or species distributions based on changes in climatic conditions. Observe changes in species or habitats and verify model results.

Within 15 years of plan approval:

- Reevaluate tidal marsh management and proposed restoration projects based on climate change data collection at the refuge and improved regional analysis of climate change trends.

- Conduct a wildlife hazard assessment prior to implementation of wetland restoration projects to evaluate the potential impacts on wildlife of concern to Philadelphia International Airport.

- After conducting monitoring of the 145-acre impoundment, develop and implement a detailed plan to restore the impoundment to freshwater tidal marsh, consistent with the results of the monitoring.

Monitoring Elements

Continue to:

- Support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh by Academy of Natural Sciences.

- Participate in Spill Prevention, Control, and Countermeasure Plans or other environmental emergency action plans as related to protection of Darby Creek, open water and tidal wetlands on refuge lands.

Within 5 years of plan approval:

- Monitor and adapt marsh restoration projects to climate change impacts to the extent practical.

Within 15 years of plan approval:

- Evaluate effects and climate trends over the course of the plan and determine thresholds for particular adaptive actions based on updated projections.

- Use climate change monitoring data and regional models and analyses of climate change trends to develop restoration plans for restoring 145-acre impoundment to tidal marsh and for other tidal marsh areas.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, manage and maintain up to 287 acres of coastal plain and floodplain forests to increase native herbaceous and shrub species diversity and richness. This includes converting 15 acres of existing forest dominated by nonnative poplar to an early successional scrub-shrub habitat. The net changes of these alterations and additions would result in approximately 1 acre of additional forest habitats compared to alternative A.

The 287 acres of coastal plain and floodplain forest communities would be managed to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by maintaining a canopy dominated by native trees, increasing native understory shrub/sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, nonnative, invasive species as compared to levels inventoried in 2005.

Rationale

Forest management under alternative C is focused primarily on implementation of a deer management program in order to reduce the high population densities noted in the discussion of alternative A, objective 1.2. Here, the deer management controls implemented would be initiated through a limited hunting program (e.g., a youth or handicapped-accessible hunt) with wildlife control specialists being utilized as supplemental controls as needed to effectively reduce deer population densities. Implementation of a controlled hunt would make one of the priority public uses available in this urban area. However, the hunt program would be limited to ensure public safety, and minimize conflicts with other priority public uses. Also, any controlled hunt on the refuge would be consistent with State and

local regulations and laws. As outlined in chapter 4, section 4.1.3, "Management Actions Not Analyzed in Detail," we would need to conduct additional NEPA" analysis and public involvement after we have evaluated and developed a more detailed plan. We would also need to complete additional Service documentation including a compatibility determination for the hunt program.

Under this alternative, we would restore the 15-acre stand of nonnative gray poplar to a scrub-shrub dominated habitat type. Scrub-shrub or early successional habitat is currently not available within the refuge. By converting the nonnative and invasive dominated canopy to a native shrub-dominated community, we would enhance stopover and potential breeding sites for migratory songbirds and allow for improved long-term control of invasive species through periodic (once every 3 to 5 years) brush cutting and clearing of this area.

Due to the focus on deer management implementation and forest to scrub-shrub conversion, invasive species control efforts would be reduced to focus primarily on the prevention of new introductions and incorporation of biological controls for long-term management. By implementing these other management actions, we hope to increase the re-establishment of native species which would provide competition to increase the effectiveness of our long-term invasive species control strategies.

Strategies
In addition to strategies identified under alternative A:

Within 2 years of plan approval:
- Focus control of nonnative, invasive species on preventing new invasions. Conduct regular species surveys and regional distribution research.

Within 10 years of plan approval:
- Implement a limited deer hunting program, consistent with State and local regulations and laws (e.g., youth hunt, handicapped-accessible archery hunt), with supplemental use of wildlife control specialists as necessary to reduce and then maintain populations as recommended in the USDA-APHIS Deer Management Plan and document the effects of deer population control efforts on forest regeneration and plant species richness and diversity within established monitoring plots.

- Identify low quality areas of floodplain forest and implement conversion to coastal plain forests through selective cutting and re-planting in order to improve wildlife foraging and nesting habitat and restoration of priority plant communities (i.e., State or globally rare).

- Explore use of refuge as a test site for new USDA biological controls related to invasive plant species.

Monitoring Elements
In addition to strategies outlined under alternative A:

- Within 2 years of CCP approval, develop a comprehensive Early Detection Rapid Response Plan to survey and detect newly established invasive species and immediately address control or eradication of newly detected populations.

- Within 2 years of deer management initiation, document effects on vegetation species richness and diversity within established monitoring plots.

Objective 1.3 Darby Creek

Over the next 15 years, increase the refuge's involvement with regional partners to identify and reduce water quality impacts, reduce contaminants, and provide spawning, nursery, foraging, and cover habitat for Federal trust fish and wildlife species, including American eel, striped bass, blueback herring, and alewife.

Rationale
This alternative is similar to alternative B, objective 1.3, but with an increased focus on participation in local and regional efforts to monitor and improve water quality along Darby Creek, tributaries draining directly to the refuge, and adjacent creeks and rivers that are biologically connected to the refuge. Whereas alternative B focuses primarily on onsite opportunities for water quality monitoring and improvement projects, under this alternative we would work more closely with partners on a regional or watershed-scale to improve water quality.

Monitoring of the three tributaries draining into Tinicum Marsh (Hermesprota Creek, Muckinipattis Creek, and Stony Run) would be initiated by the refuge in order to improve our understanding of how these tributaries affect onsite water quality. These three tributaries to Darby Creek are generally not monitored due to their location in the watershed (near the mouth of Darby Creek within the tidal zone). As such, we do not have a full understanding of how they contribute to the environmental health of the refuge or watershed.

Strategies
In addition to strategies outlined in alternative A:

Within 5 years of plan approval:
- Play an active role in local, State, and Federal partnerships and initiatives in order to improve water quality and reduce contaminants within the Darby Creek watershed, and consequently, the refuge.

Monitoring Elements
In addition to strategies outlined in alternative A:

Within 2 years of plan approval:
- Organize a regional network of monitors to evaluate water quality along waterways directly draining to the refuge (Darby Creek, Hermesprota Creek, and Muckinipattis Creek) as well as additional creeks within the vicinity of the refuge such as Crum Creek, Raccoon Creek, and Stony Creek.

Within 5 years of plan approval:
- Install a network of water quality monitoring equipment on the refuge along Darby Creek to implement long-term and continuous monitoring of salinity, DO, pH, temperature, flow rate, and other parameters.

GOAL 2. **Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.**

Objective 2.1 145-Acre Impoundment and Nontidal Open Waters

Within 15 years of plan approval, develop a plan to restore all of the 145-acre impoundment to freshwater tidal marsh. Over the course of the plan, maintain 35 acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

Rationale
As noted under objective 1.1, the impoundment management under alternative C is focused on the eventual restoration of the entire 145-acre impoundment to freshwater tidal marsh. In the meantime, we would continue to attempt water control management in a way that improves available habitat for migratory birds throughout the spring and fall migrations. Effective water level management in the 145-acre impoundment is difficult due to shallow groundwater and more regular flooding of the impoundment. The projected trends in sea level

rise will likely make these challenging conditions more pronounced in the coming decades.

We understand that the impoundment is often the focal point of many visitors' experience of the refuge due to its proximity to the refuge entrance and visitor center. However, this area was historically wetland—presumably freshwater tidal marsh—as indicated by several historic maps of the site and its surroundings. Because the conversion of this prominent landscape feature on the refuge would be a complex and costly undertaking, complicated by projected effects of climate change, we envision a large component of the next 15 years being devoted to the feasibility, evaluation, design, and preparation required for such a large-scale and high-visibility restoration. In the end, restoration of this area would improve our protection of Tinicum Marsh and our interpretation of its unique resources, and would hopefully serve as an example of how to incorporate climate change data into habitat restoration planning and implementation.

The Service's policy on managing for biological integrity, diversity, and environmental health encourages the restoration of habitats based on known historic conditions and composition where practical. Restoration of the 145-acre impoundment would address this management directive by restoring the historic condition (pre-1930s) of this area as freshwater tidal marsh.

As discussed in alternative A, the other nontidal open waters located on the refuge are of minimal habitat value for aquatic species. Under this alternative, we would undertake a series of habitat enhancement projects (such as revegetation or addition of artificial cover structures) in order to improve conditions for fish and other aquatic species. These efforts could provide benefits to both wildlife-dependent recreation as well as minor improvements for species such as the red-bellied turtle.

Strategies
Until the 145-acre impoundment is restored to tidal marsh:

- Control nonnative, invasive species affecting the impoundment and nearby open water habitats when they spread over 5 percent (3.5 acres) of areal coverage across the impoundment. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible and cost-effective.

- Control the aggressive native species, spadderdock (*Nuphar lutea*), when it spreads across greater than 10 percent (7.25 acres) of areal coverage. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible and cost-effective.

- Attempt management of impoundment water levels as conditions allow maximizing benefits to migrating shorebirds, waterfowl, waterbirds, and wading birds during each group's peak migration periods.

- Maintain existing dike system in order to prevent and minimize structural damage to the dike and access road sustained by flood events and muskrat nesting burrows.

- Close the water control structure into the impoundment during forecasted storm events to minimize stormwater runoff and pollution inputs.

- Work with Tinicum Township to address flood control concerns associated with removal of the impoundment.

- Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.

Within 2 years of plan approval:
- Begin to phase out existing wood duck and swallow nesting boxes. Maintain a minimum number of boxes in a few locations for interpretive purposes, as determined by the refuge manager.

Within 5 years of plan approval:
- Initiate the feasibility, data collection, design, and regulatory discussions for restoration of the 145-acre impoundment to freshwater tidal marsh restoration.

Within 10 years of plan approval:
- Improve habitat availability within Hoys Pond and the 16-acre pond for fish, reptiles, amphibians, and small mammals through completion of various habitat enhancement projects.

Within 15 years of plan approval:
- Complete restoration plan and begin restoration of the 145-acre impoundment to freshwater tidal marsh.

Monitoring Elements
Continue to:
- Complete current fisheries inventory of Hoys Pond and the 16-acre pond on refuge lands.

- Support annual volunteer frog monitoring.

- Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year to maintain water quality for biological productivity until restoration to tidal marsh.

- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment. Utilize data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.

- Conduct migratory bird surveys for landbirds, waterbirds, and waterfowl during spring and fall migration.

Within 5 years of plan approval:
- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits of open water, managed mudflat, and tidal marsh habitats.

- Evaluate water quality inputs from neighboring stormwater drainage discharging onto refuge lands and initiate development of improvement measures, such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.

- With partners, conduct baseline red-bellied turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites.

Objective 2.2 Grasslands and Wet Meadows

Over the life of the plan, convert up to 14 acres of existing grasslands to scrub-shrub habitat and manage the remaining 57 acres to create a mix of native grasses, forbs with no greater than 5 percent bare ground, and so that nonnative, invasive species comprise less than 10 percent of the total areal cover.

Rationale
In contrast to alternatives A and B, grassland management under this alternative is focused on supplemental conversion of selected areas to a scrub-shrub dominated habitat type. When coupled with the scrub-shrub conversions proposed under the forest management objective within this alternative, we would have established a considerable amount of conversion acreage that would provide a new habitat type not currently available on the refuge.

Areas selected for conversion were based on evaluation of species composition, patch size, ownership, and presence of utilities or infrastructure. Many of the existing grasslands within the refuge are within utility right-of-way corridors (some of which are not owned by the Service) that limit the potential options for habitat management. An existing 7.7 acre cool-season grass meadow located near the recent 2009 marsh restoration site (located southwest of the existing wildlife observation blind overlooking Tinicum Marsh) is one such area targeted for conversion due to its low existing species diversity and proximity to I-95. Another area highlighted for conversion is up to 6 acres of the meadow known as Frog Pond—located along the eastern boundary of the refuge. Much of this area is surrounded by coastal plain or floodplain forest and/or dominated by cool-season grasses and invasive species such as phragmites.

Existing grassland areas would continue to be enhanced through nonnative, invasive species control and supplemental seeding/planting as necessary to achieve our biological goals. Some grassland is currently dominated by cool-season grasses such as orchardgrass and fescue species. These species tend to promote habitat for small mammals, but provide little structure for ground-nesting birds, migratory landbirds, or amphibians. In addition, as discussed in objective 2.2 under alternative B, tall fescue often hosts an endophyte that can have detrimental effects on small mammals or other herbivorous species. Where possible, the refuge would continue its efforts to restore warm-season grasses and native flowering species to these areas.

Some areas of Folcroft Landfill may be converted to scrub-shrub as well. However, final determination of what areas (if any) are suitable would be determined once the site is remediated and released.

Strategies
Continue to:
- Annually mow to maintain 57 acres of grassland habitats.

- Control nonnative, invasive species affecting wet meadow and grassland habitats, (e.g. Japanese honeysuckle, purple loosestrife, mile-a-minute vine, and multiflora rose) through a combination of herbicide application, hand pulling, and mowing.

- Promote warm-season grass establishment in areas previously dominated by cool-season grasses.

Within 5 years of plan approval:
- Remove all 15 acres of the nonnative poplar stand and manage a shrub-scrub early successional habitat to promote habitat diversification for migratory landbirds.

- Cease annual mowing of 9 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat type.

- Install supplemental plantings using volunteers within the grasslands surrounding the visitor center to enhance species diversity with no greater than 5 percent bare ground, and so that nonnative, invasive species comprise less than 10 percent of the total areal cover.

Within 10 years of plan approval:

- Initiate conversion of up to 14 acres of grassland habitats (7.7 acres of existing cool-season grass meadows near the 10-acre marsh restoration site, an additional 6 acres either near Frog Pond or on Folcroft Landfill, and 0.6 acres near the oil spill mitigation site) to allow succession into shrub-scrub habitat. Continue to maintain shrub-scrub habitat as a new, long-term management routine.

Monitoring Elements

- Annually conduct frog call surveys of known vernal pools to monitor species and their use of areas for breeding sites. Utilize data to document sensitive breeding areas and long-term effectiveness of management activities in order to adjust management protocols as necessary.

GOAL 3.

Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.

Objective 3.1 Environmental Education

Over the 15 year life of the plan, provide an environmental education program with specific themes and learning objectives for up to 11,000 students onsite annually. The program would focus on higher-level conservation education, with lessons and resources that describe the habitats, wildlife, environment, and cultural resources of the refuge, describe the purpose of the refuge, and meet Pennsylvania educational standards and curriculum requirements for students and teachers

Rationale

Environmental education is one of the original establishing purposes of John Heinz NWR as highlighted in alternative A, objective 3.1. Compared to alternative A, alternative C would expand the existing suite of programs we provide to elementary, middle, and high school students from across southeastern Pennsylvania.

As discussed under alternative B, objective 3.1, to help us ensure that we are addressing target audiences and meeting the needs of environmental education participants, we initiated a study with USGS to both capture the refuge's current program (Phase I, see appendix I) and the needs of current and potential participants in the refuge's environmental education program (Phase II; Wells and White 2011). Similar to alternative B, under this alternative, we would use these results to guide our future environmental education program planning, including developing new environmental education programming and completing the environmental education component of the refuge's visitor services plan. However, in contrast to alternative B, this alternative would emphasize providing environmental education to college-aged and conservation professional development. We envision the courses and the professional training model embodied by institutions such as the Pennsylvania Institute for Conservation Education or the Humboldt Institute. Since neither of the education centers are located near the refuge, we do not anticipate that programming provided under the refuge's programs would compete with the services provided by these institutions. We would work with other conservation educators throughout the region to ensure that programming provided at the refuge does not compete with other opportunities existing throughout the region, but that would complement other programs.

Under alternative C, we would also build upon our existing programs (alternative A) to incorporate a greater emphasis on cultural resources of the Tinicum and Philadelphia area as it relates to the habitats and their conservation. We

would use the recent cultural history of the 19th and 20th centuries to highlight the changing perception of wetlands, utilization for resources, and resource conservation. With its long history of dike construction, ditching, dredging, filling, transportation building (rail, road, and air travel), to the preservation by local citizens, the refuge has a history of culturally driven land changes worth sharing through educational programming.

Strategies
In addition to strategies identified under alternative A:

Within 5 years of plan approval:
- Continue to provide environmental education programming to at least 150 elementary, middle, and high school classes.
- Work with partners and use results of Environmental Education Stakeholder Needs Assessment Phase II to incorporate results into visitor services planning.
- Explore the creation of a field school for higher conservation education similar to the programs offered at the Pennsylvania Institute for Conservation Education or the Humboldt Institute.
- Pursue formal adoption of refuge programs as part of curriculum by at least three schools, including one college or community college.
- Define education standards applicable to MicroLife program and pursue certification of credits for K-12 schools.
- Expand educational programs related to the history of wetland conservation and the environmental movement's role in resource protection, highlighting the citizen-led preservation of Tinicum Marsh.
- Expand web-based information, exhibits, and programs related to land protection efforts surrounding Tinicum Marsh by providing at least three new web-based educational tools.

Within 10 years of plan approval:
- Explore potential for shuttle, tram, boat, or bus tour programs to improve access to and education about Tinicum Marsh.

Monitoring Elements
- Annually complete an evaluation summary of environmental education opportunities provided (e.g., number of programs, events, and outreach efforts) and their utilization (e.g., number of visits, schools, teachers, and students engaged).

GOAL 4. **Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.**

Objective 4.1 Environmental Interpretation

Over the life of the plan, expand environmental interpretation infrastructure to accommodate up to 22,500 onsite participants. Expand web-based opportunities for visitors, students, and area residents. New and expanded interpretation program and facilities would emphasize the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary.

Rationale
The importance of environmental interpretation has been outlined in objective 4.1 within alternatives A and B previously. Under this alternative, we would continue to provide the interpretive opportunities and programming currently available. In contrast to alternative B, this alternative focuses on maintaining existing interpretive programming while expanding infrastructure to aid in both onsite and web-based interpretation. Under this alternative, we expect a similar increase in active, onsite participation

Onsite improvements would include remodeling of the visitor center to expand interpretive exhibits. Updated and expanded interpretive facilities would improve displays as well as improve accessibility needed when accommodating the additional visitation expected over the next 15 years.

Incorporating web-based exhibits and tools is also important to our interpretive program. We would install a series of webcams at various points of interest such as the bald eagle nest, Tinicum Marsh, Darby Creek, and the visitor center in order to create opportunities for offsite interpretive interest and promote visitation.

Strategies
In addition to strategies identified under alternative A:

Within 2 years of plan approval:
- Begin to phase out existing wood duck and swallow nesting boxes. Maintain a minimum number of boxes in a few locations as determined by the refuge manager for interpretive purposes.

Within 5 years of plan approval:
Install additional webcams at points of interest such as Tinicum Marsh, the visitor center, and Darby Creek.

- Develop at least two interpretive materials (e.g., bilingual signs and brochures) in other languages (e.g., Spanish) to help increase our effectiveness in reaching out to non-English speaking audiences.

Within 10 years of plan approval:
- Work with the EPA to develop an interpretive plan for the Folcroft Landfill including public use features such as an interpretive trail system, observation tower, and pedestrian bridge to develop access upon site release.

- Develop at least three interpretive materials and programs specifically designed for people with disabilities, including activities such as guided bird song tours of the refuge and signs and brochures in braille.

- Remodel the visitor center to allow expansion of interpretive exhibits.

Monitoring Elements
Complete a yearly evaluation summary of environmental interpretation opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

GOAL 5. **Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.**

Objective 5.1 Wildlife-dependent Recreation

Over the next 15 years, improve accessibility for priority public uses, provide an array of wildlife-dependent recreation opportunities to visitors, and expand infrastructure and facilities necessary to provide a quality interpretive experience.

Rationale
As previously noted in alternatives A and B, wildlife-dependent recreation accounts for the largest number of visitation to the refuge. As with alternative B, we would expand our existing network of recreation opportunities throughout the refuge. However, the specific mechanisms by which we provide those new and expanded opportunities varies considerably.

This alternative would pursue other methods of introducing visitors to Tinicum Marsh. Much of the marsh and adjacent trails are over 2 miles from the visitor center, making them inaccessible for many visitors due to time availability or ability. We would pursue alternative transportation via a bus, shuttle, or tram to transport visitors to the trail network found within the central portions of the refuge. This service would allow reliable transportation to and from these central portions of the refuge and the visitor center.

As with alternative B, we also would improve access via water trails to Tinicum Marsh. However, unlike alternative B, here we propose offering an opportunity for a commercial partnership to develop and operate guided boat tours to improve access to Darby Creek and Tinicum Marsh. The benefits of this would reduce the need for Service staff operation and maintenance as well as limit the amount of additional infrastructure proposed under alternative B.

Strategies
In addition to strategies identified under alternative A:

Within 10 years of plan approval:
- Establish a series of alternative means for which visitors can better access wildlife-dependent recreation opportunities in or around Tinicum Marsh. Potential options to explore include the following:
  - Create a transportation shuttle, tram, or bus to transport visitors from the visitor center to Tinicum Marsh.
  - Consider commercial partnership to develop small non-motorized boat access to Tinicum Marsh and water trails.
- Explore the feasibility of constructing a pedestrian bridge or other means of safe pedestrian crossing over State Highway 420.
- Initiate a youth or handicapped accessible archery hunting program in conjunction with deer management control efforts.
- Develop a canoe/kayak launch site on refuge to facilitate wildlife observation and photography

Monitoring Elements
Annually complete a yearly evaluation summary of wildlife-dependent recreation opportunities provided (number of opportunities, events, outreach efforts provided) and their utilization (number of visits, type of activity, and participants engaged).

Objective 5.2 Implement a Deer Hunt Program

Within 10 years, evaluate and implement a quality deer hunt program in partnership with the Pennsylvania Game Commission.

Rationale
As discussed under alternative B, objective 5.2, PGC is interested in expanding hunting opportunities in Pennsylvania. In particular, there is interest in the

refuge providing opportunities for a limited youth hunt or hunt for people with disabilities, consistent with State and local regulations. Under this alternative, we would develop and implement a limited deer hunt to provide this priority public use on the refuge and to help control the refuge's deer population. Because the refuge provides important resting and foraging habitat for migrating birds as well as other species of conservation concern, there is limited marsh habitat available in the State, and because the available marsh habitat on the refuge is limited, we are not considering opening the refuge to migratory waterfowl hunting.

As discussed under alternative B, objective 6.3, hunting would provide a priority public use in an area where public hunting opportunities have largely been eliminated by development. John Heinz NWR is in a unique position to offer limited deer hunting in an urban environment and there are potential benefits to refuge habitats associated with controlling the resident deer population. The Refuge Improvement Act specifically identifies hunting as a priority, wildlife-dependent recreational activity on refuges, and as such we are required to give it enhanced consideration on the refuges.

Strategies
Within 10 years of CCP implementation:
- Partner with PGC to develop a limited deer hunt program on the refuge consistent with State and local regulations and laws. This process would include additional NEPA compliance and environmental documentation. Other alternatives, including no action (i.e., no hunting) would be considered in this evaluation, and there would be additional opportunities for public involvement before a final decision would be made.

GOAL 6. **Communicate and collaborate with local communities, Federal and state agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.**

Objective 6.1 Role of Refuge in Regional Conservation

Within 15 years of CCP approval, establish the refuge as a regional coordination center for climate change research, as well as coastal plain habitat conservation and management, and tidal marsh restoration through collaboration with a variety of partners. Through this, we would foster appreciation of the refuge's regional significance to natural resource conservation, its contribution to the Refuge System, and garner additional support for refuge programs.

Rationale
The refuge plays an important role in regional conservation by providing a facility to house meetings, workshops, and seminars related to conservation and environmental protection. Alternative C embodies an approach that promotes the Service and National Wildlife Refuge System as an important regional contributor to conservation. We would utilize the location of the refuge and expertise of the refuge and other Service program staff to develop regional workshops, offer seminars and presentations, and sponsor technical forums. These events would be targeted for the regional conservation community using the refuge as a central location for facilitation and networking.

Additionally, the refuge has a unique partnership with Philadelphia International Airport. The refuge has provided opportunities for previous wetland mitigation projects on the refuge. Both the airport and the refuge have also found common ground in their desire to preserve open space around the refuge and airport. The airport desires such lands for a visual and acoustic buffer, while some properties could also provide additional habitat buffers for refuge lands where applicable.

Strategies
In addition to strategies identified under alternative A:

Within 15 years of plan approval:
- Establish facilities and programs to promote the refuge (and its staff) as a regional focal point for climate change research, coastal plain habitat conservation and management, and tidal marsh restoration through participation in regional workshops, offering seminars and presentations, and sponsoring technical forums.

- Work with Philadelphia International Airport to conduct wetland mitigation, restoration, and land acquisition both on and off the refuge.

- Use relationships developed through the refuge's new field school for higher conservation education to encourage research and promote the refuge's role as a regional focal point for studying the effects of climate change.

- Work with academic institutions to encourage climate change research that would inform refuge management, and would support regional and global initiatives on the effects of climate change.

- Study adjacent and nearby areas, including potential expansions to the refuge's acquisition boundary to determine ways the refuge can adapt to climate change.

Monitoring Elements
- Complete a yearly evaluation summary of partnership efforts and roles that the refuge has played in climate change research, coastal plain habitat conservation and management, and tidal marsh restoration.

Objective 6.2 Outreach and Partnerships

Within 15 years of CCP approval, increase community outreach by conducting or sponsoring at least three outreach programs or events each year, and provide regular updates on refuge programming and outreach to surrounding businesses and communities to increase refuge visitation.

Rationale
Partnerships under alternative C would mirror much of what is currently underway within alternative A. Where this alternative differs is that much of the partnership involvement would be directed towards working closely with the Friends of the Heinz Refuge to assist in outreach and partnership development. By working with the Friends organization, we can expand the level of outreach we pursue by working with area residents and businesses to garner support and interest in the refuge.

Related to this strategy, we would develop a series of standalone displays for area hotels and businesses. These displays would encourage visitation, inform interested individuals about the refuge, and provide directions to and from the refuge. We would work closely with the Friends, Philadelphia International Airport, and surrounding businesses to sponsor such displays.

Strategies
In addition to strategies identified under alternative A:

Within 5 years of plan approval:
- Work with the Friends group to expand their pursuit of local partnerships to increase public interest and visitation to the refuge.

- Develop a stand-alone photo display for local hotels and the Philadelphia Airport that can be updated annually or seasonally.

Monitoring Elements

- Complete a yearly evaluation summary of partnership and outreach efforts and resulting benefits to the refuge (increased visitation, awareness, or understanding).

Within 10 years of plan approval:

- Establish at least one partnership with local universities to implement public use surveys and complete user analysis.

3.7 Comparison of Alternatives

The following tables display the comparison of alternatives A through C as discussed throughout this chapter. Table 3.1 illustrates the difference in acreage and habitat types between alternatives. Table 3.2 is a comparison of strategies discussed throughout the chapter between alternatives A through C.

Table 3.1. Summary of Habitat Acreage by Alternative

Acreages By Alternatives			
Habitat	**Alternative A (acres currently owned and managed)**	**Alternative B Preferred Alternative (total acres within acquisition boundary)**	**Alternative C (total acres within acquisition boundary)**
Coastal Plains and Floodplain Forest	286.2	313.5	287.1
Floodplain Forest	*236.9*	*261.2*	*243.9*
Coastal Plain Forest	*34.2*	*52.3*	*43.2*
Nonnative Gray Poplar Forest	*15.0*	*0.0*	*0.0*
Darby Creek	132.4	204.2	204.2
Freshwater Tidal Marsh	282	454.8	544.8
Native species Freshwater Tidal Marsh	*221.6*	*426.6*	*522.1*
Phragmites-dominated Tidal Marsh	*60*	*22.7*	*22.7*
Impoundment and Nontidal Open Water	200.6	123.1	35.4
145-Acre Impoundment	*144.2*	*72.1**	*0.0*
Ponds and Other Nontidal Open Water	*56.4*	*56.4*	*35.4*
Wet Meadows and Grasslands	71.6	63.9	57.2
Scrub-Shrub	0.0	0.0	30.9
Developed Land	21.2	34.2	34.2
Sum**	**993.6**	**1193.7**	**1193.7**

**Actual acreage would vary depending on final outcome of restoration feasibility study and design.*

***Summary acreages included are based on GIS data used for planning purposes. The refuge is authorized to acquire up to 1,200 acres based on approvals outlined in Public Law 92-326. June 30, 1972.*

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
Refuge Staffing and Administration		
Maintain existing ten positions and types of staff resources. See existing organization chart in appendix D.	Increase staff by up to five positions to achieve levels outlined by the national staffing model, including: 1. Biological Technician (GS-5/7) 2. Administrative Assistant (GS-5/7) 3. Shared Zone Outreach Coordinator (Visitor Services) (GS-11) 4. Maintenance Worker (GS-5/6/7) 5. Park Ranger – Volunteer Coordinator/ Education Specialist (GS-5/7/9)	Increase staff by up to five positions to achieve levels outlined by the national staffing model, including: 1. Administrative Assistant (GS-5/7) 2. Shared Zone Outreach Coordinator (Visitor Services) (GS-11) 3. Maintenance Worker (GS-5/6/7) 4. Park Ranger – Volunteer Coordinator/Education Specialist (GS-5/7/9) 5. Park Ranger – Environmental Education (GS-5/7/9)
Refuge Buildings and Facilities		
Maintain existing facilities and complete planned improvements and upgrade appropriate facilities to ADA standards. Complete construction of outdoor pavilion.	*In addition to alternative A:* Expand existing facilities to accommodate additional staff and collocate all refuge programs within the same facility.	*In addition to alternative A:* Remodel existing facilities to provide co-location of most refuge programs (except maintenance) and expansion of environmental education and interpretation facilities.
Strategies that Apply to All Objectives under Goals 1 and 2		
Recruit, hire and train, interns, volunteers, and students under the student assistance programs to assist with aspects of biological management such as invasive species control and biological monitoring. Support Friends of Heinz NWR to assist with biological management such as invasive species control. Continue to develop MOU's or MOA's on in-holdings to allow for habitat management and law enforcement where important for maintaining refuge resources and public safety.	*In addition to alternative A:* Work with PENNDOT and Philadelphia International Airport to evaluate effects of traffic and airport noise on refuge wildlife to determine if a sound barrier is warranted. If warranted, explore determine location(s), design(s), types(s) of appropriate barriers. Within 7 years of plan approval, coordinate with partners to conduct plant and animal species inventories and monitoring to update information on refuge populations.	*In addition to alternative A:* Explore construction of a sound barrier along I-95 to reduce sound impacts on birds, amphibians, and other wildlife.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 1. COASTAL PLAIN ECOLOGICAL COMMUNITIES Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern**.**		
Responds to Issues: Biological connectivity, potential climate change impacts, invasive species, deer management, tidal marsh restoration, water quality, and environmental hazards		
Objective 1.1 Freshwater Tidal Marsh		
Continue to protect and manage existing 282 acres of marsh. Improve 55 acres of this existing freshwater tidal marsh.	Over the next 15 years, protect the existing 282 acres of freshwater tidal marsh within the refuge, improve 55 acres of this exiting habitat, and acquire and restore up to 70 additional acres as opportunities arise. Restore up to 103 acres to freshwater tidal marsh throughout the refuge.	Protect and manage existing 282 acres of tidal marsh and improve 55 acres of this exiting habitat. Monitor for effects of climate change before restoring approximately 263 additional acres of tidal marsh.
Provide technical support to regional corridors and restoration efforts upon request and to targeted projects, such as: 1. Tinicum Township/Long Hook Creek Connection/Restoration 2. Philadelphia International Airport	*In addition to strategies outlined in alternative A:* Work with Philadelphia International Airport management to conduct an assessment of wildlife hazards prior to implementing wetland restoration projects on the refuge.	*Same as alternative A, plus:* Work with Philadelphia International Airport management to conduct an assessment of wildlife hazards prior to implementing wetland restoration projects. Support restoration of a large patchwork of habitats not directly connected to the refuge, but within the Landscape Conservation Cooperative for migratory birds and other species Initiate partnerships with regional agencies and organizations within the LCC to implement stream, wetland, and riparian restoration and fish barrier removal projects directly connected to refuge habitats and within Darby Creek watershed. Support restoration of large patchwork habitats not directly connected to the refuge, but within the LCC for migratory birds and other species in order to enhance migratory stopover habitat.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 1. COASTAL PLAIN ECOLOGICAL COMMUNITIES (cont.) Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.		
Responds to Issues: Biological connectivity, potential climate change impacts, invasive species, deer management, tidal marsh restoration, water quality, and environmental hazards (cont.)		
Objective 1.1 Freshwater Tidal Marsh (cont.)		
Use existing biological datasets to guide species and habitat management restoration. Participate in environmental emergency action plans (e.g., Spill Prevention and Control Plans) as appropriate to protect Darby Creek, open water, and tidal marsh wetlands on refuge lands.	*In addition to alternative A:* Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.	*In addition to alternative A:* Focus climate change management on making the refuge a regional focal point for research and information related to climate change impacts such as sea level rise, species migrations, and other landscape-scale impacts. Utilize regional-scale habitat models to evaluate changes in habitat or species distributions based on changes in climatic conditions. Observe changes in species or habitats and verify model results.
Continue to support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh.	*In addition to alternative A:* *Within 5 years:* Monitor and adapt marsh restoration projects to address effects of climate change to the extent practical. Identify and implement where feasible adaptive management strategies to minimize potential impacts of a changing climate. Partner with local universities and regional researchers to define a baseline monitoring plan that continues monitoring for climate change impacts within the existing marsh. *Within 10 years:* Begin to evaluate the feasibility of expanding the refuge's acquisition boundary to address rising sea level caused by climate change.	*In addition to alternative A:* Re-evaluate tidal marsh management and proposed restoration projects based on climate change data collection at the refuge and improved regional analysis of climate change trends. Monitor and adapt marsh restoration projects to climate change impacts to the extent practical. Use climate change monitoring data and regional models and analyses of climate change trends to develop restoration plans for restoring 145-acre impoundment to tidal marsh and for other tidal marsh areas.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 1. COASTAL PLAIN ECOLOGICAL COMMUNITIES (cont.) Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern**.**		
Responds to Issues: Biological connectivity, potential climate change impacts, invasive species, deer management, tidal marsh restoration, water quality, and environmental hazards (cont.)		
Objective 1.1 Freshwater Tidal Marsh (cont.)		
Complete restoration of funded 55-acre restoration site in cooperation with Chesapeake Bay ES office and other partners. Continue annual aerial spray treatments to control 10 to 15 acres of phragmites-dominated tidal marsh.	*The same as alternative A, plus:* Pursue funding for additional marsh restoration projects and complete marsh restoration as funding allows. Control nonnative, invasive species when populations exceed greater than 5 percent areal coverage across freshwater tidal marsh. *Within 5 years:* Develop a prioritized list of potential habitat restoration projects on the refuge. *Within 10 years* Work with partners to complete a study evaluating the environmental effects of restoring about half of the 145-acre impoundment to freshwater tidal marsh. If we determine restoration is desirable, complete a restoration plan detailing the optimal size, location, and components for restoration of part of the 145-acre impoundment to freshwater tidal marsh. *Within 15 years:* Begin restoration of a 27-acre wetland area dominated by degraded floodplain forest. If we choose to pursue restoration, work to obtain funding for restoration plan developed for the 145-acre impoundment. Implement restoration plan if funding is obtained.	*The same as alternative A, plus:* Develop an assessment and prioritization list of potential freshwater tidal marsh wetland restoration projects on the refuge. Control nonnative, invasive species when populations exceed greater than 5 percent areal coverage across the existing 282 acres of freshwater tidal marsh.
Objective 1.2 Coastal Plain and Floodplain Forests		
Maintain the existing 34 acres of coastal plain forest and 252 acres of floodplain forest communities to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog.	Acquire, restore, and manage up to 313 acres of forested communities (52 acres of coastal plain forest and 261 acres of floodplain forest) to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog	Manage and maintain up to 287 acres of coastal plain and floodplain forests to increase native herbaceous and shrub species diversity and richness to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 1. COASTAL PLAIN ECOLOGICAL COMMUNITIES (cont.) Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.		
Responds to Issues: Biological connectivity, potential climate change impacts, invasive species, deer management, tidal marsh restoration, water quality, and environmental hazards (cont.)		
Objective 1.2 Coastal Plain and Floodplain Forests (cont.)		
Install occasional tree plantings to close canopy gaps and supplement poor regeneration due to deer browse pressure. Reforest naturally occurring canopy gaps within the 15-acre stand of nonnative poplar with native tree species as opportunities arise.	Adapt a long-term management plan for forest habitats to create mixed-age stands of hardwood species identified for coastal plain and floodplain target communities. Initiate phased restoration of 15 acres of nonnative poplar-dominated forest to establish a successional trajectory towards coastal plain and/or floodplain forest communities. Restore 8.3 acres of existing grasslands to at least 50 percent cover by early successional coastal plain forest species.	Identify low quality areas of floodplain forest and implement conversion to coastal plain forests to improve wildlife foraging and nesting habitat and restoration of priority plant communities Remove all 15 acres of nonnative poplar from the refuge and manage a shrub-scrub or other early successional habitat to promote habitat diversity.
Invasive species control same as common to all.	*In addition to common to all:* Incorporate biological control methods for invasive species where available and feasible (e.g., mile-a-minute weed, purple loosestrife).	*Same as alternative B, plus:* Develop a comprehensive Early Detection Rapid Response Plan to survey and detect newly established invasive species and immediately addresses those populations through the appropriate control measure. Refer to appendix B of the HMP for more detailed information. Prioritize control efforts primarily on preventing new invasions. Conduct regular species surveys and regional distribution research. Explore use of refuge as a test site for new USDA biological controls related to invasive plant species.
Finalize the Deer Management Plan. Continue annual population monitoring to evaluate deer population trends on the refuge. Complete deer browse impact monitoring using established deer exclosures and USDA-APHIS protocols.	*In addition to alternative A:* Continue ongoing deer browse impact monitoring utilizing established deer exclosures and USDA-APHIS protocols. Reduce and then maintain resident deer populations through the use of wildlife control specialists. Document extent of regeneration in flora richness and diversity within established monitoring plots.	*In addition to alternative A:* Implement a limited hunting program (e.g., youth hunt) with supplemental use of wildlife control specialists as necessary to control the deer population. Within 2 years of deer management initiation, document effects on vegetation, species richness, and diversity within established monitoring plots.
Continue to restrict public access to eagle nesting areas during the breeding season. Limit public access to areas utilized by other rare species during their breeding seasons.	*Same as alternative A.*	*Same as alternative A.*

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 1. COASTAL PLAIN ECOLOGICAL COMMUNITIES (cont.) Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania Coastal Plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.		
Responds to Issues: Biological connectivity, potential climate change impacts, invasive species, deer management, tidal marsh restoration, water quality, and environmental hazards (cont.)		
Objective 1.3 Darby Creek		
Manage refuge inputs to Darby Creek to protect water quality and provide habitat for Federal trust resources, particularly aquatic species.	*Same as alternative A*	Over the next 15 years, increase the refuge's involvement with regional partners to identify and reduce water quality impacts, reduce contaminants, and provide spawning, nursery, foraging, and cover habitat for Federal trust fish and wildlife species.
Support volunteer-based water quality monitoring along Darby Creek, completed as resources allow. Maintain existing partnerships to assess and manage for water quality improvements impacting the refuge. Complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring. Annually, review and refresh staff in contaminant spill response calls and emergency protection measures. Continue coordination with EPA and other stakeholders to close hazardous sites and minimize environmental health impacts. Continue support of occasional and ongoing research to evaluate fish tissue surveys, contaminant level accumulation, and other environmental impacts of environmental hazards.	*Same as alternative A, plus:* Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring of salinity, DO, pH, temperature, flow rate, and other parameters. Where feasible, install stormwater management systems, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands.	*Same as alternative B, plus:* Organize a regional network of monitors to evaluate water quality along waterways directly draining to the refuge as well as additional creeks within the vicinity of the refuge. Play an active role in local, state, and Federal partnerships and initiatives in order to improve water quality and reduce contaminants within the Darby Creek watershed, and consequently, the refuge. Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring.
Goal 2. Open Waters and Grassland Habitats Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.		
Responds to Issues: Invasive species, tidal marsh restoration, water quality, environmental hazards, and grassland management		
Objective 2.1 145-Acre Impoundment and Other Open Waters		
Manage existing 145-acre impoundment and 55 acres of nontidal, open water to provide habitat for shorebirds, waterfowl, and wading birds while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles.	Manage about 67 acres of impoundment and 57 acres of nontidal open water (ponds) to enhance habitat available for shorebirds, waterfowl, and wading birds during migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles.	Within 15 years of plan approval, develop a plan to restore all of the 145-acre impoundment to freshwater tidal marsh. Maintain 35 acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 2. OPEN WATERS AND GRASSLAND HABITATS (cont.) Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.		
Responds to Issues: Invasive species, tidal marsh restoration, water quality, environmental hazards, and grassland management (cont.)		
Objective 2.1 145-Acre Impoundment and Other Open Waters (cont.)		
Control nonnative, invasive species affecting the impoundment and nearby open water habitats when they spread over 5 percent of areal coverage across the impoundment. Control the aggressive native species spadderdock when it spreads across greater than 10 percent of areal coverage. Continue annual frog monitoring.	*Same as alternative A.*	*Same as alternative A.*
Continue to attempt seasonal drawdowns to create freshwater mudflats and stimulate annual moist-soil vegetation to benefit migrating birds. Maintain existing dike system and water control structure.	*Within 5 years:* Inventory species and habitat use of the current 145-acre impoundment and freshwater tidal marsh to evaluate benefits of open water, managed mudflat, and tidal marsh habitats. *Within 15 years:* If we determine restoration is desirable, work with partners to complete and implement a restoration plan to restore part of the 145-acre impoundment to freshwater tidal marsh as described under objective 1.1.	Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits of open water, managed mudflat, and tidal marsh habitats. After 10 years, evaluate most current sea level rise trends and explore feasibility of the restoration of the 145-acre impoundment to freshwater tidal marsh restoration. Restore all of the 145-acre impoundment to freshwater tidal marsh. Until restoration occurs, continue to maintain impoundment as in alternative A.
Continue closures of water control structure into the impoundment during forecasted storm events to minimize stormwater discharge and pollution inputs into the impoundment. Continue partnership with Tinicum Township to manage stormwater inputs and open waters along Long Hook Creek.	*In addition to alternative A:* Evaluate sources and locations of stormwater drainage discharging onto refuge lands and develop improvement measures such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.	*In addition to alternative A:* Work with Tinicum Township to address flood control concerns associated with removal of the impoundment. Evaluate water quality inputs from neighboring stormwater drainage discharging onto refuge lands and initiate development of improvement measures, such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek. Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.
Maintain existing wood duck and swallow nesting boxes.	*Within 5 years:* Begin to phase out existing wood duck and swallow nesting boxes. Maintain a minimum number of boxes for interpretive purposes.	*Same as alternative B.*

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 2. OPEN WATERS AND GRASSLAND HABITATS (cont.) Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge's managed open waters and grasslands.		
Responds to Issues: Invasive species, tidal marsh restoration, water quality, environmental hazards, and grassland management (cont.)		
Objective 2.1 145-Acre Impoundment and Other Open Waters (cont.)		
Monitor water quality parameters (e.g., temperature, pH) and water level fluctuations in impoundment. Continue migratory bird surveys for landbirds, waterbirds, and waterfowl. Complete fisheries inventory of isolated ponds on refuge lands.	*In addition to alternative A:* Conduct weekly monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment. Use data to determine the effectiveness of water level management activities and adjust management protocols as necessary. With partners, conduct baseline red-bellied turtle inventory surveys within 5 years. Create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites. *Within 5 years:* Explore opportunities for reducing turtle nest predation through predator trapping, predator relocating, or other measures. Explore coordination with Pennsylvania Fish and Boat Commission to remove red-eared sliders.	*Same as alternative B, plus:* Improve habitat availability within isolated pond for fish, reptiles, amphibians, and small mammals through completion of various habitat enhancement projects. Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year to maintain water quality for biological productivity until restoration to tidal marsh. With partners, conduct baseline red-bellied turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites.
Objective 2.2 Grasslands and Early Successional Habitats		
Annually, manage 72 acres of grassland habitats to sustain stopover foraging and cover for migratory landbirds. Continue to maintain vernal pool and wet meadow habitat for amphibian breeding and grassland bird stopover habitat. Continue to promote warm-season grass establishment in areas previously dominated by cool-season grasses. Annually, conduct frog call surveys with volunteers to document breeding areas and adjust management as needed.	Annually, manage 64 acres of grassland and wet meadows to create stopover foraging and cover habitat for migratory landbirds. *Same as alternative A, except:* *Within 5 years:* Cease annual mowing of 8.3 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat. Begin supplemental plantings within the grasslands surrounding the visitor center to enhance species diversity. Install stormwater management systems, such as vegetated swales or rain gardens to minimize stormwater runoff from the refuge and surrounding lands. Work with utilities to discuss feasibility of converting portions of utility right of ways to additional shrub-scrub habitat. *Within 15 years:* Complete habitat management planning on Folcroft Landfill within 2 years of site remediation and release.	Over the life of the plan, convert up to 14 acres of existing grasslands to shrub-scrub habitat and manage the remaining 57 acres to create a mix of native grasses Allow 14 acres of grassland habitats to succeed to shrub-scrub habitat. Maintain as scrub-shrub habitat. Restore up to 15 acres of forested areas currently dominated by nonnative poplar to shrub-scrub habitats. Maintain 57 acres of existing grassland habitat. Install supplemental plantings in grasslands around visitor center to enhance diversity.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 3. ENVIRONMENTAL EDUCATION Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.		
Responds to Issues: Environmental, conservation-related history, and cultural resource education		
	Management actions that apply to all objectives under alternative B, goal 3: Within 2 years of CCP approval, complete the refuge's visitor services plan. Use the visitor services plan and the results of the Environmental Education Stakeholder Needs Assessment Phase II Report to guide the refuge's environmental education program focusing on urban schools (grades K-12). If resources allow, hire two additional outreach and environmental education and interpretation staff to help expand the environmental education program and meet the projected increase in visitation. Pursue alternative funding or grant programs for supporting transportation to and from the refuge for interested and qualifying schools and groups. Update and incorporate all appropriate media (brochures, website, social media, displays, etc.) to accurately communicate the environmental education components available to the public. Determine which schools or school districts would be defined as urban and non-urban. Monitor and record visitation by urban and non-urban schools to determine if we are reaching our target audience. Annually complete an evaluation summary of environmental education opportunities provided (number of programs, events, outreach efforts provided) and their utilization (number of visits, schools, teachers, and students engaged). Work with environmental education partners to monitor and assess the efficacy of new environmental education curricula and materials. Modify the curricula as needed to ensure content is meeting identified priorities.	

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 3. ENVIRONMENTAL EDUCATION (cont.) Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.		
Responds to Issues: Environmental, conservation-related history, and cultural resource education (cont.)		
Objective 3.1 Environmental Education		
Staff and volunteers continue to directly lead about 30 educational programs for the refuge, reaching about 8,200 students onsite and 1,200 students offsite. Continue ongoing alignment of programs with PA academic standards (student standardized test requirements). Annually, maintain at least three partnerships with area schools that result in refuge visitation and student/educator engagement in environmental education programs. Continue to pursue alternative funding or grant programs for supporting transportation to/from the refuge from schools. Continue to provide online curriculum, loan boxes, and other resources. Annually complete an evaluation summary of environmental education opportunities provided.	Over the 15 year life of the plan, provide a quality environmental education program focusing on urban youth, reaching about 16,000 students onsite, and 2,400 students offsite per year. *Within 7 years:* Maintain relationships and programming with area schools that currently visit the refuge for environmental education. Offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education programs. Work with local teachers, school administrators, and other environmental education partners to develop lesson plans that would enhance environmental education curricula. Review and evaluate existing components (e.g., loan boxes, teacher education courses, Microlife) of the environmental education program to determine if they meet the specific criteria identified under this objective and are effective. Modify, add, or eliminate components as needed. Identify local urban schools and school districts and create a prioritized list of at least 15 of these schools. Use our relationship with the Interboro School District as a model to help develop long-term relationships with at least three additional local urban school systems from our prioritized list. Expand use of alternative funding or grant programs for transportation to and from the refuge for schools. Have refuge staff or trained volunteers lead 200 student-focused programs per year both on and offsite, totaling about 12,000 student visits per year.	Provide an environmental education program with specific themes and learning objectives for up to 11,000 students annually. The program would focus on higher-level conservation education, with lessons and resources that describe the habitats, wildlife, environment, and cultural resources of the refuge, describe the purpose of the refuge, and meet Pennsylvania educational standards *Same as alternative A, plus:* Continue to provide environmental education programming to at least 150 elementary, middle, and high school classes. Use results of Environmental Education Stakeholder Needs Assessment Phase II to incorporate results into visitor services planning. Explore creation of a field school for higher conservation education similar to the programs offered at the Pennsylvania Institute for Conservation Education or the Humboldt Institute. Pursue formal adoption of refuge programs as part of curriculum by at least three schools, including one college or community college. Expand educational programs related to the history of wetland conservation and the environmental movement's role in resource protection, highlighting the citizen-led preservation of Tinicum Marsh. Expand web-based information, exhibits, and programs related to land protection efforts surrounding Tinicum Marsh by providing at least three new web-based educational tools. Explore potential for shuttle, tram, boat, or bus tour programs to improve access to and education about Tinicum Marsh.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 3. ENVIRONMENTAL EDUCATION (cont.) Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.		
Responds to Issues: Environmental, conservation-related history, and cultural resource education (cont.)		
Objective 3.1 Environmental Education (cont.)		
	Within 15 years: Continue to develop and expand course curricula in cooperation with local teachers, school administrators, and other environmental education partners. Expand long-term relationships with local schools to at least three more urban schools. Have staff and trained volunteers lead 275 student-focused programs per year both on and offsite, totaling about 16,000 student visits per year. After new programs have been in place for 5 years, assess feasibility of developing an official Service survey to evaluate effectiveness of programs.	
Objective 3.2 Environmental Education for Other Use Audiences		
All included under objective 3.1	Over the 15 year life of the plan, provide a quality environmental education program that would include programs for other youth audiences, increase student participation in refuge programs by these groups to 8,000 student visits per year.	All included under objective 3.1

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 3. ENVIRONMENTAL EDUCATION (cont.) Provide a wide range of environmental educational opportunities, focusing on urban youth, which raise awareness and understanding of the Service and the National Wildlife Refuge System, inspire appreciation and stewardship of our natural and cultural resources, and expand understanding of Tinicum Marsh as a unique component of the Delaware Estuary and the local community.		
Responds to Issues: Environmental, conservation-related history, and cultural resource education (cont.)		
Objective 3.2 Environmental Education for Other Use Audiences (cont.)		
	We would continue to: Provide educational activities, curriculum, and other resources on the refuge Web site. Continue to offer at least 12 workshops annually that focus on teaching teachers how to implement refuge environmental education. *Within 7 years:* Work with environmental education partners to expand the teachers' workshops to include additional programming based on the results of the Environmental Education Stakeholder Needs Assessment Phase II report and actions outlined within the visitor services plan. Evaluate and modify or expand, if appropriate, loan boxes and teaching equipment and supplies. Review and evaluate existing components of the environmental education program to determine if they meet the specific criteria identified under this objective and in the visitor services plan and are effective. Modify or eliminate components as needed. *Within 15 years:* Develop a set of days dedicated to programming for scouts and other youth groups. Formalize partnerships with youth organizations such as Big Brother Big Sister Program, 4H, YMCA.	

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 4. INTERPRETATION Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.		
Responds to Issues: Existing exhibits and interpretive facilities; diversity of user groups; refuge accessibility		
Objective 4.1 Environmental Interpretation		
Annually, provide onsite and offsite environmental interpretation opportunities for up to 22,500 visitors, students, and area residents. Continue to maintain existing access points and infrastructure, including trails, parking, and interpretive exhibits, kiosks, printed materials, and signage. Maintain ongoing updates to the refuge Web site. Annually, host 100 volunteer-led guided nature walks and programs. Annually, host at least six conservation-oriented and/or wildlife-dependent interpretive events. Annually, conduct at least five offsite environmental interpretation programs. Continue to host environmental art displays at the visitor center as opportunities arise. Work with partners and volunteers to develop and present programs for non-school audiences such as for families, libraries, festivals, and scout groups that support the mission and goals of the Service. Complete the redevelopment of the existing example backyard habitat. Complete installation of the webcam at the eagle's nest. Promote and participate in Service initiatives such as the National Junior Duck Stamp Program.	Over the life of the plan, expand on and offsite environmental interpretation opportunities through updating refuge infrastructure and developing electronic media for up to 35,600 visitors, students, and area residents. *Same as alternative A, plus:* Identify key user groups utilizing the refuge and compile a list of associated organizations, businesses, and affiliations potentially interested in learning more about the refuge through interpretive events and programs. Improve directional trail, regulatory, and interpretive signage. Create more interactive exhibits suitable to younger visitors (2 to 8 year olds). Develop new camp programs and expand number of camps offered to at least 12 per year. Complete the refuge's visitor services plan, including an environmental interpretation component. Develop events and programs tailored to targeted audiences incorporating themes from the visitor service plan. Host these events between November and May to encourage use during these slower months. Develop at least two interpretive materials in other languages (e.g., Spanish) to help increase our effectiveness at reaching out to non-English speaking audiences. Develop at least three interpretive materials and programs specifically designed for people with disabilities (e.g., guided bird song tours of the refuge, signs and brochures in braille).	Over the life of the plan, expand environmental interpretation infrastructure to accommodate up to 22,500 onsite participants. Expand web-based opportunities for visitors, students, and area residents. *Same as alternative A, plus:* Begin to phase out existing wood duck and swallow nesting boxes. Maintain a minimum number of boxes for interpretive purposes. Remodel the visitor center to allow expansion of interpretive exhibits. Develop interpretive trail system, observation tower, and pedestrian bridge to improve access to Folcroft Landfill upon site release. Install additional webcams at points of interest such as Darby Creek and Tinicum Marsh, or visitor center. Develop at least two interpretive materials in other languages (e.g., Spanish) to help increase our effectiveness at reaching out to non-English speaking audiences. Develop at least three interpretive materials and programs specifically designed for people with disabilities including activities such as guided bird song tours of the refuge. *Within 10 years:* Work with the EPA to develop an interpretive plan for the Folcroft Landfill including public use features such as interpretive trail system, observation tower, and pedestrian bridge to develop access to upon site release.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 4. INTERPRETATION (cont.) Visitors, students, and local residents of all ages and abilities enjoy their refuge experience, understand and appreciate the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary, and are inspired to become better stewards in their everyday lives.		
Responds to Issues: Existing exhibits and interpretive facilities; diversity of user groups; refuge accessibility (cont.)		
Objective 4.1 Environmental Interpretation (cont.)		
	Re-orient the existing displays and expand exhibits in a way that promotes exploration of exhibits and longer viewing time by visitors. Update all refuge displays, kiosks, signage, and trail system to support a more digital interpretive infrastructure applicable to urban youth and technology-ready visitors. Improve access to and interpretation of Tinicum Marsh. Develop a series of programs and travelling exhibits on specific topics targeted to particular groups and events.	
GOAL 5. WILDLIFE-DEPENDENT RECREATION *Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.*		
Responds to Issues: Desire for recreational access improvements; compatible use		
Objective 5.1 Wildlife Dependent Recreation		
Continue to provide visitors with the opportunity to engage in wildlife-dependent recreation opportunities such as fishing, wildlife observation, and photography. Maintain existing fishing piers (including ADA compliant fishing pier) and bank access for fishing. Maintain existing equipment loans (e.g., binoculars), photography blinds, viewing telescopes, hiking trails, water trails, and viewing platforms. Provide brochures and other literature to support fishing and wildlife observation and photography on the refuge. Support hunting programs by facilitating Pennsylvania Game Commission hunter education classes and distributing State hunting publications. Complete installation of bald eagle nest webcam. Have staff and volunteers guide programs including bird and plant walks, photography events, and providing programs and camps designed specifically for families and youth including.	Annually, provide visitors with wildlife-dependent recreation opportunities including fishing, wildlife observation, and nature photography and maintain the infrastructure and facilities necessary to provide a quality experience. *In addition to alternative A:* Improve wildlife-viewing and photography by expanding enforcement of non-compatible trail uses. Improve signage to direct pedestrian bicycle traffic and parking as well as hiking accessibility. Construct a self-serve contact station at State Road 420. Construct fishing access points, boardwalks, and additional bird and photography blinds. Explore opportunities to connect to regional bicycle trails and greenways to encourage non-motorized visits to refuge. Construct a boardwalk into Tinicum Marsh. Based on the visitor service plan, construct additional fishing access points bird and photography blinds, and canoe/kayak boat launch. Partner with neighboring marinas and boat launches to institute organized boat tours of Tinicum Marsh, upon request.	Over the next 15 years, improve accessibility for priority public uses and provide an array of wildlife-dependent recreation opportunities to visitors and expand infrastructure and facilities necessary to provide a quality interpretive experience. *In addition to alternative A:* Establish a series of alternative means for which visitors can better access wildlife-dependent recreation opportunities in or around Tinicum Marsh. Potential options to explore include: 1. Create a transportation shuttle, tram, or bus to transport visitors from the visitor center to Tinicum Marsh. 2. Consider commercial partnership to develop paddling access to Tinicum Marsh and water trails. 3. Explore bridge or other options for safe pedestrian crossing of SR 420. 4. Develop a canoe/kayak launch site on refuge to facilitate wildlife observation and photography.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 5. WILDLIFE-DEPENDENT RECREATION (cont.) *Provide quality, wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors.*		
Responds to Issues: Desire for recreational access improvements; compatible use		
Objective 5.2 Potential Deer Hunt Program		
None	Evaluate opportunities for providing a quality deer hunt program in partnership with Pennsylvania Game Commission. Initiate preliminary public scoping and detailed conversations with PGC to see if a detailed analysis of a deer hunt program is warranted. If warranted, partner with PGC to evaluate in detail a proposal to provide opportunities for deer hunting on the refuge consistent with State and local regulations and laws.	*Within 10 years:* Evaluate and implement a quality deer hunt program in partnership with Pennsylvania Game Commission.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 6. OUTREACH AND PARTNERSHIPS Communicate and collaborate with local communities, Federal and state agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.		
Responds to Issues: Need to protect refuge resources through collaborative actions; Need to promote refuge education and interpretive programs.		
Objective 6.1 Role of Refuge in Regional Conservation		
Continue collaboration with a diversity of partners on regional habitat issues and instill values of habitat conservation and environmental stewardship. Work with Philadelphia International Airport to conduct wetland mitigation, restoration, and land acquisition both on and off the refuge. Provide a facility for regional conservation-related meetings, workshops, and activities, upon request. Provide opportunities for monitoring and research partnerships with academic institutions in the area.	*In addition to alternative A:* Develop an interpretive exhibit outlining the refuge and the Refuge System's role and purpose in relation to other natural areas within the Delaware Estuary and the Landscape Conservation Cooperative. Annually host and lead at least two national or regional workshops related to climate change and other topics supporting the refuge goals. Work with academic institutions to encourage climate change research that would inform refuge management, and would support regional and global initiatives. Study adjacent and nearby areas, including potential expansions to the refuge's acquisition boundary to determine ways the refuge can adapt to climate change. Explore opportunities to assess and evaluate ecosystem services provided by the refuge habitats through collaboration. Establish and promote the refuge's role as a regional center for conservation, freshwater tidal marsh management, and fish and wildlife protection by providing project tours, technical workshops, or public presentations.	Within 15 years of CCP approval, establish the refuge as a regional coordination center for climate change research, as well as coastal plain habitat conservation and management, and tidal marsh restoration through collaboration with a variety of partners. *In addition to alternative A:* Establish facilities and programs to promote the refuge (and its staff) as a regional expert related to climate change research, as well as coastal plain habitat conservation and management, and tidal marsh restoration. Work with Philadelphia International Airport to conduct wetland mitigation, restoration, and land acquisition both on and off the refuge. Use relationships developed through the refuge's new field school for higher conservation education to encourage research and promote the refuge's role as a regional focal point for studying effects of climate change. Work with academic institutions to encourage climate change research that would inform refuge management, and would support regional and global initiatives. Study adjacent and nearby areas, including potential expansions to the refuge's acquisition boundary to determine ways the refuge can adapt to climate change.

Alternative A Current Management	Alternative B Service-preferred Alternative	Alternative C
GOAL 6. OUTREACH AND PARTNERSHIPS (cont.) Communicate and collaborate with local communities, Federal and state agencies, Tribal governments, academic institutions, and conservation organizations throughout the Delaware Estuary to promote natural and cultural resource conservation and the mission of the National Wildlife Refuge System.		
Responds to Issues: Need to protect refuge resources through collaborative actions; Need to promote refuge education and interpretive programs. (cont.)		
Objective 6.2 Outreach and Partnerships		
Continue community outreach by conducting or sponsoring at least three outreach programs or events each year and providing updates on refuge programs and events through local media outlets. Continue to maintain partnerships with at least ten organizations, agencies, and individuals in relation to the diverse habitats, programs, and goals encompassed by refuge management. Continue close partnership with Friends of the Heinz Refuge to support the refuge mission and management activities. Maintain weekly updates to the refuge information station 1670 AM. Continue close partnership with local print and broadcast media to reach diverse audience through multiple channels.	*In addition to alternative A:* Develop a specialized partnership with Fort Mifflin and Bartram's Gardens to co-schedule and promote events and programs. Implement at least three examples of cross-referencing and publishing of workshops and events with partnering organizations. Work with at least three hotels around the airport to install a display advertising the refuge as a visitor destination to promote visitation. Work with PENNDOT, SEPTA, and Philadelphia International Airport to provide displays, brochures and information identifying the refuge as a visitor destination. Develop partnerships with PENNDOT, SEPTA, and Philadelphia International Airport to improve the visibility and transportation connections to the refuge. Expand media outreach into online social networking and modern technology communications.	*In addition to alternative A:* Within 15 years of CCP approval, increase community outreach by conducting or sponsoring at least three outreach programs or events each year, and provide regular updates on refuge programming and outreach to surrounding businesses and communities. Work with the Friends group to expand their pursuit of local partnerships to improve interest and visitor access. Develop a standalone photo display for local hotels that can be updated annually or seasonally. Establish at least one partnership with local universities to implement public use surveys and complete user analysis.

Chapter 4

LaVonda Walton/USFWS

Children watching birds during a refuge interpretive program

Environmental Consequences

4.1 Introduction

This chapter describes the environmental consequences we predict from implementing the refuge management alternatives presented in chapter 3. Where detailed information is available, we present a scientific and analytic comparison between alternatives and their anticipated consequences, which we describe as "impacts" or "effects." In the absence of detailed information, we make comparisons based on our professional judgment and experience.

We focus our discussion on the impacts associated with the goals and key issues identified in chapter 1, "Purpose and Need for Action". Direct, indirect, short-term, beneficial and adverse effects likely to occur over the 15-year life span of the plan are discussed. Beyond the 15-year planning horizon, we give a more speculative description of the direct, indirect, and cumulative effects. The chapter identifies cumulative impacts, any irreversible and irretrievable commitment of resources and the relationship between short-term uses of the environment and its long-term productivity. At the end of this chapter, table 4.3 summarizes the effects predicted for each alternative and allows for a side-by-side comparison.

4.1.1 Regional, Historical, and Watershed Context

As required by the Council on Environmental Quality (CEQ) and U.S. Fish and Wildlife Service (Service) regulations implementing the National Environmental Policy Act (NEPA), we assessed the importance of the effects of the alternatives presented in the draft EA based on their context and intensity. The context of the impacts ranges from site-specific to broader regional and ecoregional scales (table 4.1). Although refuge lands comprise a small percentage of these larger regional area contexts, all alternatives were developed to contribute towards conservation goals in these larger contexts.

John Heinz NWR is located within the Delaware River Basin, which encompasses 13,600 square miles and stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic Ocean. The Delaware River watershed includes portions of Delaware, Maryland, New York, New Jersey, and Pennsylvania (DRBC 2008). Our project area (the refuge) is situated near the confluence of Darby Creek and the Delaware River and has a tidal range of about six feet.

Table 4.1. Regional Context for Impacts Analyses at John Heinz National Wildlife Refuge at Tinicum

John Heinz NWR	Entire refuge is 993 acres to up to 1,200 acres within the acquisition boundary
Delaware and Philadelphia Counties, PA	209,152 acres (326.8 miles^2)
Delaware River Basin	8,704,00 acres (13,600miles^2)
Partners In Flight Landbird Conservation Area Physiographic Region 44 (Mid Atlantic)	13, 891,658 acres (21,700 miles^2)
Bird Conservation Region 30	24,428,000 acres (38,170 miles^2)

Across a more localized regional landscape scale, John Heinz NWR protects a variety of unique resources and also provides a unique opportunity for the education and outreach near the urban center of the City of Philadelphia, the nation's fifth largest metropolitan area (map 2.1) (US Census Bureau 2011). Connecting children and families with nature is a high priority national program of the Service. The urban interface of John Heinz NWR provides excellent opportunities for such environmental education and conservation outreach. The

ecosystems within John Heinz NWR, especially freshwater tidal marsh, support some of our nation's most biologically diverse assemblages of fish, wildlife, and plant species.

More than 133,000 visitors from around the Delaware Valley and beyond visit the refuge each year. John Heinz NWR is in a position where it can foster greater community understanding of natural systems, species of conservation concern, the value of the refuge system, and the Service's mission in conserving and protecting those resources. Each of the management alternatives is consistent with State, regional, ecosystem, and watershed conservation plans identified in chapter 1. At varying levels, each of the alternatives would make positive contributions to these larger landscape-scale conservation endeavors.

John Heinz NWR's location near the confluence of Darby Creek and the Delaware River also plays a significant role in the habitats and species utilizing the refuge. As one of only a few large freshwater marsh expanses along the Delaware River, the refuge provides an important stopover for many species during migration up the Delaware River flyway. The expanse of freshwater tidal marsh also provides important spawning and nursery habitat for many riverine fish species. The refuge connects with regional wildlife corridors such as the Schuylkill and Delaware Rivers, and the developing local greenways along Darby and Cobbs Creeks.

Much of the land surrounding the refuge is, and has been, urbanized for nearly 200 years. Major land use changes over the 20th century however brought major impacts to the refuge site and surrounding landscape like never seen before. Interstate highway, international airport, and expanded residential and industrial construction made John Heinz NWR a biological island contrasted amongst a highly urbanized landscape.

The urban environment and high levels of historical disturbance of mainly upland portions of the refuge also present many challenges ranging from minimizing visitor impacts to minimizing or mitigating wildlife impacts due to degraded regional water and air quality, noise levels, and other conditions associated with urban environments. Environmental contaminants may have a major impact on the health and fitness of wildlife present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, and the Clearview Landfill are part of the Lower Darby Creek Area Superfund Site. The aquatic environments of Tinicum Marsh and Darby Creek are also part of the Superfund Site. In all alternatives, the refuge would continue to provide technical support and continue to coordinate with the EPA regarding studies, monitoring, and contaminant remediation that is ongoing, and final closure design and implementation.

The refuge's ability to directly and beneficially impact the regional environment is limited because of its size, but the refuge participates to the degree possible in regional efforts for land conservation, protection of wildlife corridors, air and water quality improvements, and early detection and management of regional invasive species. Given this urban context, the analysis of impacts mainly focuses on how the Service's actions at the refuge might affect the physical and biological environment, socioeconomic, historical, and cultural resources, as well as wildlife-dependent public uses. Where possible and information is available, we also provide discussions of how management actions would impact regional resources.

4.1.2 Evaluation of Environmental Impacts and Time Frames

Per Council of Environmental Quality (CEQ) and Service regulations on implementing the National Environmental Policy Act (NEPA), we assess the importance of the effects of the alternatives based on their context and intensity. The scale of their context ranges from site-specific to local, landscape, or

regional. Although the area of the refuge is only a small percent of the context in its ecosystem or region, we developed all of our management alternatives to contribute to the many conservation goals in those larger contexts. For each alternative, we based our evaluation of the intensity of the effects on the following factors:

- The expected degree or percent of change in the resource from current conditions
- The frequency and duration of the effect during the 15-year planning horizon
- The sensitivity of the resource to such an effect or its natural resiliency to recover from such an effect
- The potential for implementing effective preventive or mitigating measures to lessen the effect

4.1.3 Management Actions Not Analyzed in Detail

The impacts of the management activities on the following list are not analyzed in detail in this document because they are both trivial in effect and common to all alternatives. The following would qualify for categorical exclusion under applicable regulations if independently proposed:

(1) Operations and maintenance of existing infrastructure and facilities (unless major renovation is involved)

(2) Issuance of new or revised management plans when only minor changes are planned

(3) Law enforcement activities

(4) Environmental education and interpretative programs (unless major construction is involved, or a significant increase in visitation is expected)

(5) Research, resource inventories, and other resource information collection activities

(6) Routine, recurring management activities and improvements, including managing invasive species

(7) Small construction projects (for example, fences, berms, small stream and wetland restoration projects, trail maintenance, interpretative kiosks, and development of access for routine management purposes)

(8) Minor vegetation plantings

(9) Reintroducing native plants and animals

(10) Minor changes in amounts or types of public use

"Extraordinary circumstances" in 43 CFR 46.215 are exceptions to our categorical exclusions. If any of these exceptions apply, we will conduct further NEPA analysis of the proposed action. Where possible and information is available, we provide discussions of how the below management actions could beneficially or adversely impact refuge resources. Actions that are not categorically excluded and that may require additional NEPA analysis beyond this draft CCP and EA are the following:

(1) The restoration of 55-acre phragmites-dominated wetland to a healthier freshwater tidal wetland under all alternatives

(2) Restoration and closure of Folcroft Landfill under all alternatives

(3) Restoring some or all of the impoundment to freshwater tidal wetlands under alternatives B and C, respectively

(4) Restoring formerly dredged open water to freshwater tidal marsh under alternative B

(5) Opening the refuge to a controlled hunt

(6) Construction of a noise barrier along interstate Route I-95 or other major sound mitigation measures determined in alternative C

(7) Constructing a pedestrian bridge or other access to provide safe crossing of Route 420 under alternative C

(8) Improving visitor access to freshwater tidal wetlands by supporting or providing non-motorized boat tours and/or use of multi-passenger vehicles for a wider diversity of refuge visitors under alternative C

We did not fully analyze these actions in this CCP for several reasons. The first two actions listed, the restoration of the 55-acre wetland and Folcroft Landfill, are outside the scope of this CCP and are being conducted by other Service offices or agencies. The Service's Chesapeake Bay ES Office is planning the wetland restoration and will conduct the NEPA analysis for the project. Similarly, the EPA is planning and conducting the NEPA analysis for the Folcroft Landfill closure and restoration.

For the remaining six actions, the refuge will conduct further NEPA analysis at a future time, if needed. Currently, we do not have enough specific and detailed information to adequately analyze potential impacts and comply with NEPA.

4.1.4 Adaptive Management Actions Common to All Resources

Adaptive management strategies are proposed for all management actions to mitigate uncertainties in information which the proposed activities are based on. We propose continued and expanded monitoring, surveying, and inventorying of resources to ensure that we have sufficient scientific data, or have consulted with sufficient subject matter experts, to support our proposed activities affecting refuge resources. Where baseline data is lacking, we have proposed additional inventories. We propose continuing ongoing research and monitoring such as deer population and impact studies that would help inform proposed management actions. We propose strengthening and expanding partnerships with agencies, universities, and other designated parties to help conduct these activities to address uncertainties and improve management practices (see chapter 3).

All of the alternatives include a renewed focus on gathering baseline information on refuge resources and monitoring resources to evaluate the potential impacts of climate change. The potential impacts of specific monitoring, surveying, and inventorying resources to physical and biological environments are controlled and mitigated by special uses permits that specify the research activities, locations, frequency of activities and limitations, such as seasonal or tidal timing restrictions to mitigate potential impacts. Generally, these activities are considered to have short-term and localized adverse impacts to physical biological resources. However, the amount and variety of these activities could have potential adverse cumulative impacts as discussed in section 4.19.

4.1.5 Organization of Chapter 4

We have organized this chapter by major resource heading so that each section describes the impacts of all management activities proposed under each of the three alternatives that would likely have an effect on a given resource, such as an impact on air quality or on waterfowl. We begin with the physical environmental (air, water, soils, etc.), then the biological resources (habitats and wildlife), and finally the socioeconomic, cultural, and historic environment. Under each heading, we discuss the resource context and the types of benefits and adverse impacts of management actions that we evaluated. We then discuss the benefits and adverse effects that would occur regardless of which alternative is selected and the benefits and adverse effects of each of the CCP alternatives.

Physical Environment

4.2 Impacts on Air Quality

Chapter 2, "Affected Environment," discusses the status of air quality around the refuge. Given the urban context of the refuge, the analysis of air quality impacts considered only how the Service's actions at the refuge might affect air pollutants, visibility, and climate change to a minimal degree, focusing on the potential for localized air quality impacts or improvement.

We evaluated the potential benefits of our actions that would protect or improve air quality by

- conserving and protecting refuge lands to limit the growth of development, thereby limiting sources of emissions and reducing loss of forest vegetation;
- managing and restoring forests and wetlands to enhance carbon sequestration and reduce greenhouse gases;
- controlling invasive species;
- continuing and expanding energy efficiency practices to reduce the refuge contribution to emissions;
- supporting regional trails and public transit to improve and encourage pedestrian and bicycle access to the refuge, and reduce total vehicle emissions; and
- increasing public awareness through environmental interpretation and education.

We evaluated the potential for the proposed actions to cause increased emissions and adverse effects on air quality by

- using staff vehicles and equipment for regular management activities;
- expanding or remodeling administrative and visitor facilities;
- constructing additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds;
- invasive species control, including aerial spraying of invasive species;
- managing and restoring forests and wetlands to enhance carbon sequestration and reduce greenhouse gases;

emissions from increases in visitors from vehicles and facilities and trespassing by offroad vehicles; and

maintaining the existing impoundment and potential impacts from emissions of methane from the impounded area.

4.2.1 Impacts on Air Quality That Would Not Vary by Alternative

Due to the highly urban context of the refuge, we believe that the impacts of refuge management on regional air quality would be negligible and would not vary significantly under any of the alternatives. We predict that refuge land management, regardless of alternative, would be expected to have a net positive effect on air quality.

Benefits

Our management activities should not adversely affect regional air quality. None of the alternatives would violate Federal Environmental Protection Agency (EPA) standards and all would comply with the Clean Air Act. There would be no major stationary or mobile sources of air pollutants at the refuge created under any of the refuge management alternatives. On the contrary, the Service limits public uses of the refuge to compatible wildlife-oriented activities, and land ownership and protection curtails human sources of emissions from vehicles and infrastructure by preventing development and consequent impacts to air quality.

Maintaining natural vegetation on over 97 percent of the refuge would continue to provide benefits to air quality with respect to the six air pollutants for which 1990 National Ambient Air Quality Standards (40 CFR part 50) have been established by the EPA. Trees have been shown to reduce the concentration of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter (PM) less than 10 and 2.5 microns in diameter (PM10 and PM2.5), primarily through direct uptake and adhesion to stems and leaves (Escobedo et al. 2007). With respect to greenhouse gases, plants absorb carbon dioxide (CO_2) and as a result, vegetated areas can act as an important carbon sink (Heath and Smith 2004). This "carbon sequestration" is essentially the process by which plants take up carbon dioxide through photosynthesis, after which it is stored in plant biomass (wood) and in the soil. Grasslands can function as carbon sinks if plant biomass is converted to soil (Buyanovsky and Wagner 1998).

Generally, succession to forest stores the most carbon, and the rate of sequestration declines as trees mature (Heath and Smith 2004).

Managing and restoring forests and wetlands would minimally benefit air quality in a number of ways. Long-term benefits of restoration are healthier native plant communities that would perform more ecological services, support a greater number and diversity of wildlife year round, and sustain or improve carbon sequestration capacity. Wetlands and forests both act as carbon sinks by incorporating decaying vegetation into sediment and trees, respectively. Wetlands can also produce methane, a greenhouse gas, but we believe there is a net long-term benefit to air quality. Management activities in these habitats such as removing invasive trees, controlling invasive plants that suppress regeneration, and planting and protecting trees from deer browse all contribute to improvements in habitat quality and carbon sequestration capacity. These activities would occur no matter which alternative is selected, but the degree to which we practice them would vary, and thus would their impacts. Because of the urbanized nature of the region and the close proximity to heavily travelled roadways and the Philadelphia International airport, we do not expect our management actions to result in measurably improved regional air quality, but they would contribute marginally to improving local air quality.

The refuge does not practice prescribed burns due to the urban surroundings and the area of the refuge has no history of catastrophic wildfire. Humans cause most of the small fires in the area. Nevertheless, we would seek to minimize the possibility of serious fires and their associated health and safety concerns. We would assess the hazards associated with the wildland-urban interface along the refuge boundaries with privately owned land to ensure that our management practices are not creating excessive fuel loading that would lead to severe fires.

The visitor center was designed as a "green building" with energy efficient lighting, heat, and cooling. It uses recycled materials; reducing water use by recycling waste water for toilets, and uses native landscaping and rainwater harvesting. In compliance with Federal mandates, these and other energy efficient practices to reduce air emissions would be continued and expanded under all alternatives

Under all alternatives, we would continue to support the refuge's connection to public transit and regional trail systems that decrease air emissions from vehicles and encourages non-motorized access to the refuge. Increasing public awareness of air quality issues would continue to be part of environmental education programs and the ways the public can improve air quality would continue to be communicated and demonstrated by displays, signs, and literature available in the visitor center.

Adverse Impacts
Maintenance of access roads, trails, and buildings and other facilities would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. The regular management actions that may affect air quality the most are emissions from staff vehicles and equipment, particularly routine law enforcement and maintenance vehicles. Periodic use of large gasoline pumps during flooding events to control water levels in the impoundment and Long Hook Creek and equipment emissions for repair of dikes and access roads after flooding events are more intensive, but less frequent management activities. These activities would likely occur to some degree no matter which alternative is selected, and specific management actions such as consolidating staff facilities and improving water control infrastructure are proposed in alternatives B and C to help mitigate these impacts.

Managing and restoring coastal plain communities and freshwater tidal wetlands are consistent with the refuge goals and are common to all of the alternatives in different degrees. Of these two activities, restoring plain communities and freshwater tidal wetlands would affect air quality the most. All of the alternatives include restoring tidal marsh on the 55-acre restoration site. Air quality impacts resulting from the release of carbon monoxide and particulate emissions would occur at the site during the restoration project, but are generally not considered far-reaching. Air quality impacts during construction include the release of carbon monoxide and particulate emissions. Exhaust from construction vehicles and particulates from disturbed soils during construction and prior to the establishment of cover vegetation would have a short-term effect on the immediate air quality around the construction operation, but should not significantly impact areas outside of the refuge. These effects are short-term, and would subside upon completion of construction activities. Once re-growth is initiated, the resulting plant community would continue to sequester carbon and uptake other pollutants. Long-term benefits of restoration would include healthier native plant communities that would perform more ecological services and support a greater number and of wildlife diversity year round, and in particular would provide additional healthy foraging and resting for migrant birds.

Under each alternative, the refuge would continue to use Service-approved chemicals to control invasive plants and for other management purposes (i.e., to create openings in emergent marshes to benefit a variety of waterbirds). Generally, the refuge only sprays chemicals on the Field Station Approval List, as other pesticides require either Regional or Service Headquarters approval. We must request approval, through a Pesticide Use Proposal, for all uses of chemicals on the refuge. The refuge manager, regional pest management coordinator, and national pest management coordinator have the authority to approve chemicals and their application procedures. Aerial spraying is used to control 10 to 15 acres of phragmites-dominated wetlands each year. Access to and treatment of these areas would not be possible by other means and any potential risk would be mitigated through proper application procedures, including established best management practices.

Refuge visitation is likely to rise, regardless of alternative, with an associated increase in the number of vehicles on the refuge. Most visitors to the refuge are local residents (about 72 percent), about 8,200 students typically arrive by van or bus annually, and a number of visitors arrive by foot or bicycle from surrounding neighborhoods. These factors reduce the overall emissions per visitor. Posted speed limits on the refuge are 15 mph or slower. Required lower speeds help ensure visitor safety and minimize disturbance to wildlife, but also minimize negative effects on air quality by minimizing vehicle emissions. In addition, the number of vehicles on the refuge at any given time is not expected to be sufficiently large to create a significant impact to air quality. By comparison, there are approximately 100,000 vehicles per day that travel on interstate highway I-95 and main roadways immediately adjacent to the refuge (DVRPC 2009). Given the urban area surrounding the refuge, visitor impacts on refuge and regional air quality are negligible.

We would continue to restrict use of motorized vehicles on trails for wildlife observation and other compatible recreation. We do not intend to provide access for motor boats, and currently provide access only for non-motorized boats such as canoes or kayaks, which have no impact on air quality. Darby Creek itself is considered a navigable waterway; therefore, it is under the jurisdiction of the U.S. Army Corps of Engineers and the State of Pennsylvania. As such, the refuge cannot prevent access by motorized boats traveling to the refuge from adjacent lands.

Trespassing by off-road vehicles (ORV), such as ATVs, impacts air quality locally at the Folcroft Landfill. In all alternatives, we would continue to prohibit and enforce regulations to prevent and reduce these activities. These impacts could be potentially eliminated as part of the restoration and closure of the Folcroft Landfill by installation of physical barriers or off-road vehicle access limitations. Increasing posted regulatory signs and improving access for law enforcement as part of the closure could also reduce the frequency of these illegal activities and wildfires. Remediation of Folcroft Landfill is under EPA's jurisdiction. We would continue to work with the EPA to minimize potential adverse effects to air quality.

Under all alternatives, we would continue to operate existing refuge facilities and vehicles. While emissions from heating and cooling refuge facilities and employee travel would contribute to air pollution, those emissions can be reduced through use of energy efficient systems and vehicles. With our current facilities and vehicles, we have implemented actions such as installing energy efficient windows, energy efficient lighting, heating, and cooling; using recycled materials; reducing water use by recycling waste water for toilets; and native landscaping and rainwater harvesting.

4.2.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to air quality are the same as those discussed in section 4.2.1, *Impacts on Air Quality That Would Not Vary by Alternative.*

Adverse Impacts
In addition to the impacts discussed in section 4.2.1, *Impacts on Air Quality That Would Not Vary by Alternative*, we would continue to maintain 72 acres of grassland and wet meadow, primarily through mowing. Mowing can lead to a temporary and localized suspension of particulate matter. However, the limited mowing occurring under current refuge management is of negligible impact on local air quality.

Operation of the refuge buildings would continue to contribute negligibly to local stationary source emissions. We would continue to house maintenance and law enforcement programs in a separate facility 0.25 miles from the refuge administrative offices. The separation of these program facilities results in minimal vehicle travel by refuge staff and emissions from vehicle exhaust. Vehicles and equipment used by staff would contribute a negligible amount to local mobile source air emissions and particulates.

In 2009, we estimated 133,000 visits to the refuge and we expect a 5 percent average increase per year over the life of the plan. Given the urban area surrounding the refuge, this increase in visitation is expected to have negligible impacts on air quality.

4.2.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Benefits to air quality under alternative B are similar to those described previously in section 4.2.1, *Impacts on Air Quality That Would Not Vary by Alternative*. There would be continuing benefits to air quality from maintaining the natural vegetation on up to 314 acres of coastal plains and floodplain forests acres, 454 acres of refuge tidal marsh, and up to 64 acres of other habitats (based on total acreage within acquisition boundary). Natural vegetation serves to filter air pollutants, and maintaining the refuge lands precludes development and the introduction of attendant sources of pollutant emissions on the land.

Alternative B would provide some long-term benefits to the air quality as a result of the restoration of additional coastal plain and floodplain forests. This alternative also includes emphasis on improving riparian forests and coastal plain forests. Management activities in these habitats such as removing invasive trees, controlling invasive plants that suppress regeneration, and planting and protecting trees from deer browse all contribute to improvements in habitat quality and carbon sequestration capacity. Minor beneficial impacts in alternative B would be added from succession of 7 acres of grassland to forested uplands. One management action under alternative B critical to the success of the above activities is decreasing the deer population to numbers compatible with forest regeneration and carrying capacity. This would result in improved forest regeneration and some additional benefits to air quality.

This alternative would result in a decrease in approximately 77 acres of open water habitat associated with the conversion of approximately half of the 145-acre impoundment to freshwater tidal marsh. The currently recorded dissolved oxygen levels in the impoundment create an anoxic (very low or no oxygen) environment that supports bacteria that produce methane during the decomposition of organic material (EPA 2010). Current information regarding carbon storage and methane production potential of wetlands is highly uncertain and varies based on wetland location and type (Bridgham et al. 2007). We are uncertain if the refuge impoundments act as a net source or sink for greenhouse

gasses in the atmosphere. If these impoundments do act as a source, restoration of tidal flow would improve dissolved oxygen levels and could reduce emissions of methane, a powerful greenhouse gas. Regardless, given the relatively small size of the impoundment regionally and globally, it is not expected to be a significant source of methane.

Adverse Impacts
The adverse impacts of alternative B are similar to alternative A; however,under alternative B, there would be more short-term impacts to air quality from equipment exhaust and particulates from soil disturbance and construction associated with the additional habitat restoration efforts. The phased conversion of the 15-acre nonnative poplar stand to a mixed hardwood species would result in short-term, localized impacts from vehicle and equipment emissions and a short-term loss of carbon sequestration; however in comparison to alternative C, the phased approach would reduce the intensity of impacts by spreading the impacts out over time.

Construction activities associated with expanding administrative facilities under alternative B would cause short-term, localized increases in emissions from construction vehicles and equipment exhausts. However, these localized increases would be temporary and of negligible levels as compared to emissions from nearby roads and interstates. Operations of the expanded facility would result in slight increases in emissions from its heating and cooling systems. These would be partially offset by co-locating the law enforcement and maintenance programs in the same building that could result in a reduction of staff travel between facilities and the reduction in emissions from vehicle exhaust, as well as a reduction in heating and cooling system needs. As with the current facilities, we would employ "green" building practices to minimize energy consumption and associated emissions and effects on air quality.

Alternative B also anticipates an increase in refuge visits, from the 133,000 estimated in 2009 to around 196,300 over the next 15 years. Much of this increase is expected in the form of school groups or wildlife-dependent recreational uses. Under alternative B, increases in vehicle emissions from visitor vehicles is partially mitigated by increasing partnership efforts to connect the refuge with public transit and regional trail systems that decrease air emissions from vehicles and encourages non-motorized access to the refuge. This level of visitation is still minimal when compared to the overall local population and associated emissions as described in section 4.2.1, *Impacts on Air Quality That Would Not Vary by Alternative.*

Added public use associated with additional infrastructure including a recently completed outdoor pavilion, observation decks, and Route 420 contact station proposed under alternative B would cause negligible impacts to air quality from short-term, localized increases in emissions from vehicles and equipment.

4.2.4 Impacts of Alternative C

Benefits
The benefits of alternative C are similar to alternative B, except:

Remodeling the visitor center would result in fewer long-term benefits in comparison to alternative B. Conversion of the entire 145-acre impoundment to a freshwater tidal wetland would potentially provide more air quality benefits than alternative B in terms of increased carbon sequestration and decreased methane emissions. A one-time, clearcut removal of the 15-acre stand of nonnative poplar would result in the short-term loss of mature trees and more carbon sequestering capacity than the phased removal approach proposed in alternative B.

Adverse Impacts
The adverse impacts of alternative C are similar to alternative B, except:

Remodeling the visitor center to collocate only the law enforcement program would have less short-term adverse effects on air quality since this would be a smaller-scale project, This alternative would result in more freshwater tidal wetland restoration, including restoration of the entire 145-acre impoundment. In comparison to alterative B, this would result in more short-term impacts to air quality from equipment exhaust and particulates from soil disturbance and construction.

In contrast to alternative B, alternative C would clear the entire 15-acre nonnative poplar stand in one season, concentrating vehicle and equipment emissions over a shorter time frame, increasing local air quality impacts during that time. Similar to alternative B, conversion to a shrub-scrub habitat type would not significantly reduce the amount of forested habitat and carbon sequestration capacity.

Alternative C anticipates an increase in refuge participation and visitation although not to the extent expected under alternative B. Alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B. As noted in the discussion of *Impacts of Alternative B*, no significant adverse impacts on air quality are anticipated with this increase in visitation.

4.3 Impacts on Geology and Visual Resources

Chapter 2, "Affected Environment," discusses the status of geologic history of the Coastal Plain and the geology of the refuge. Tinicum Marsh is designated as a registered National Natural Landmark (NNL) and an outstanding scenic geological feature in Pennsylvania as a representative example of a coastal plain marsh.

None of the alternatives presented would adversely impact the underlying geology or detract from the scenic quality of this landform. Construction of facilities (for example, expanded administrative offices, observation areas, and trails), habitat restoration efforts, and impoundment maintenance and improvement projects would impact the upper layers of fill or previously disturbed soils, but not impact the underlying geology. Freshwater tidal wetland restoration activities under all alternatives would remove or reduce the visibility of artificial structures (such as dikes) on the coastal plain landscape and could be designed to more closely duplicate coastal plain landforms. Potential impacts to soils are described below.

Visual resources (aesthetics) would not differ among the alternatives, and impacts are expected to be minimal. The extension of administrative offices proposed in alternative B would be the same height and exterior design as the current headquarters building. Where possible, a consistent design for public use infrastructure would be implemented in alternatives B and C.

4.4 Impacts on Soils

Chapter 2, "Affected Environment," discusses the geologic history of the coastal plain and the soils of the refuge. Soils are the structural matrix and nutrient source for plant productivity and must be protected to sustain the variety of upland and wetland habitats that would meet refuge habitat and species management goals. Overall, the upland soils of the refuge are a mixed organic fill material from past dredging projects and the marsh soils are organic muck underlain by alluvial sediments.

Outside of the Folcroft Landfill area, there is some degree of soil contamination, but it is believed to be present below State and Federal levels for human contact and inhalation. Compaction is a localized problem in high traffic areas around the visitor center and some trails, but much of the heavy site use is confined to paved areas, gravel access roads, boardwalks, and observation areas. However, certain areas, particularly the dikes and access roads are experiencing ongoing erosion and are susceptible to damage during flooding events. We would continue to manage these areas to minimize human disturbance and to mitigate for natural processes that result in loss of valuable habitats, particularly at kingfisher and heron nesting sites.

We evaluated the potential benefits of our proposed actions that would conserve, restore, and improve soils, including the following:

- Limiting sources of sediment by maintaining forest and other vegetation cover and preventing erosion
- The potential of refuge habitat management and restoration projects to re-use excavated soils and improve soils in upland areas
- The potential invasive plant management to improve soils
- Potential of expanding public use facilities and signage to minimize soil loss and compaction

We evaluated the potential for the actions proposed to cause adverse effects on soils, including the following:

- Disturbing soils during non-regular refuge maintenance activities
- Improving riparian and coastal plain forests
- Disturbing soils during tidal marsh restoration projects
- Impacting soils by herbicide application and invasive plant management
- Disturbing soils during office and other major public use infrastructure construction projects

4.4.1 Impacts on Soils That Would Not Vary by Alternative

Due to the highly disturbed soils in the refuge, we believe that the impacts of refuge management on soil structure and productivity would be negligible and would not vary significantly under any of the alternatives. We predict that refuge land management, regardless of which alternative, would be expected to have a net positive effect on soil quality. The following management actions would benefit or impact soils under all alternatives dependent on the scale, frequency, and duration of these activities, and the sensitivity of the soils to erosion and compaction.

Benefits
Under all alternatives, we would continue to pursue land protection as described in the refuge's establishing documents. This would result in the permanent protection of approximately 1,200 acres and the attendant protection of soils from potential development or degradation. Conservation and protection of natural vegetation and soils on approximately 286 acres of floodplain and coastal plain forests, 282 acres of freshwater tidal marsh, 201 acres of open water habitat, and 72 acres of wet meadows and grasslands minimizes soil losses through erosion.

Managing and restoring forests and wetlands would benefit soil quality and help restore soil structure and improve the biological productivity of soil. By restoring the natural vegetation and hydrology, we encourage the natural physical, chemical, biological weathering and other soil-formation processes. Overall, the protection, maintenance, and restoration of habitats on the refuge are expected to benefit soils. Restoration projects would consider natural landform and transitional zones with project designs in order to replicate transitional soil characteristics, soil stability, and hydrology. The refuge would consider beneficial uses of any extra soils excavated onsite such as construction of a noise barrier and restoration of tidal wetlands in open waters.

Increasing public awareness of soil erosion and the ways people can reduce soil erosion would continue to be part of environmental education and interpretation programs.

Adverse Impacts
Significant excavation and grading of soils common to wetland habitat restoration or hydrology restoration projects would occur no matter which alternative is selected, but the degree to which we practice them would vary, and thus would their impacts. In general, no soil from offsite would be brought onto the refuge unless bringing in clean soil is determined to be less disturbing to refuge resources than using onsite soils.

Public use impacts to soil have not been observed on the refuge. We regularly monitor trails and roads and have not observed any major impact areas resulting from wildlife observation, photography, environmental education, or interpretive uses. Public use trails, wildlife observation areas, parking areas, and other high use areas are designed and maintained to minimize impacts on soils. We note and correct any erosion problems during routine refuge monitoring and maintenance. We monitor parking and other concentration areas and have not observed excessive soil impacts. Maintenance of access roads, trails, and other facilities could cause negligible short-term, localized soil compaction and erosion. These activities would occur to some degree no matter which alternative is selected. We would continue to use best management practices to minimize any potential adverse impacts.

Unauthorized public use activities have the potential to impact soils through trampling and trespassing. Off-road vehicles such as ATVs can indirectly affect soils by loosening surface layers and compressing underlying layers. Coupled with a loss of plant cover, the result can be increased soil erosion (Hammitt 1998). Trampling also decreases the abundance and diversity of soil organisms such as microbes, earthworms, arthropods, snails, and slugs, which often play a major role in nutrient cycling (Liddle 1997). Under all alternatives, we would continue to enforce regulations prohibiting off-trail use and non-authorized use of motorized vehicles (e.g., ATVs) to prevent soil erosion and compaction. This issue is mostly a concern at Folcroft Landfill.

Managing and restoring coastal plain communities and freshwater tidal wetlands are consistent with the refuge goals and are common to all of the alternatives in different degrees. Of these two activities, restoring plain communities and freshwater tidal wetlands would affect soil quality the most. Soil disturbance during construction activities and prior to the establishment of cover vegetation could increase soil erosion. However, we would follow established best management practices to avoid and minimize sedimentation impacts to the extent practicable.

Under all alternatives, we would continue to use Service-approved herbicides and pesticides to

- treat and control aquatic and terrestrial invasive plants to improve refuge habitats and restore native plant communities;
- control mosquitoes to protect public and wildlife health; and
- for other management purposes, such as to create openings in emergent marshes to benefit a variety of waterbirds.

Prior to using any herbicide or pesticide on the refuge, we must request approval, through a Pesticide Use Proposal. The refuge manager, regional pest management coordinator, and national pest management coordinator have the authority to approve chemicals and their application procedures. Currently, the refuge has approved Pesticide Use Proposals for five herbicides to treat aquatic and terrestrial invasive plant species and two pesticides to control mosquitoes. The approved herbicides are triclopyr, glyphosate, imazapic, imazamox, and aminopyralid. The pesticides are *Bacillus thuringiensis israelensis* and *Bacillus sphaericus.*

There is some minimal risk that herbicides and pesticides used for invasive plant and mosquito control could impact refuge soils by affecting soil microorganisms, persisting in the soils, and adsorbtion. The herbicides currently used on the refuge degrade in soils through microbial action, light, or both, with approximate half-lives ranging between 46 and 106 days (USDOE 2000a, USDOE 2000b, USDOE 2006a, USDOE 2006b). Both *Bacillus* species are naturally occurring soil bacteria and are not expected to have any adverse effects on soils (USEPA 1998, USEPA 1999). All herbicides and pesticides used on the refuge have been deemed safe for use on the refuge, when applied according to label instructions. We would mitigate any potential risk by using only herbicides and pesticides on the Field Station Approval list (as other pesticides require either Regional or Service Headquarter approval) and following proper application procedures. For more specific information on pesticides used on the refuge, contact the refuge manager.

Refuge visitation is likely to rise, regardless of alternative, with an associated increase in the utilization of trails and potential for increased soil erosion and compaction.

4.4.2 Impacts of Alternative A (Current Management)

Benefits
Benefits from refuge management are the same as those described under impacts that would not vary by alternative. Other potential beneficial impacts of alternative A, are described below:

Occasional dewatering of the 145-acre impoundment to support migratory birds or assist in disease prevention efforts exposes much of the impoundment soils to air which oxidizes some of the thick organic layer and indirectly improves soil quality and productivity. The current condition and arrangement of the existing water control structures limit the impoundment water levels thatrefuge staff can control; therefore, we cannot drain the entire impoundment and expose all of the soils to air.

Adverse Impacts
Currently, the refuge has about 1 mile of crushed gravel access roads to facilitate refuge management activities and recreational access for visitors (by foot, by bicycle, or special access for visitors with disabilities). Although these roads are pervious to precipitation, they do cause the compaction of soils and the loss of vegetation. These access roads are used only by refuge staff vehicles or by special

access permit. Gravel access roads are generally located in areas previously disturbed by the former access for filling wetlands with dredge material in the 1950s. Maintenance of access roads, grading to minimize storm water erosion, and repairing soil erosion is done on an as needed basis, and regular maintenance does not typically exceed one acre per year. No new roads are proposed under any alternative.

We also maintain approximately 2 miles of foot paths and trails consisting of mowed paths across fields, or paths cut through the woods. Soil compaction occurs on those trails as well, although not to the same extent as on gravel access roads. These trails are designated for pedestrian use; however, refuge staff has observed unauthorized activities occurring on these trails such as bicycling. These unauthorized activities can increase soil compaction and erosion. Refuge staff minimizes these effects by posting appropriate signs and distributing literature, and refuge law enforcement staff continues to enforce refuge rules and regulations. We would continue to prohibit certain recreational activities, such as ATV's or mountain biking on these trails that would damage soils on the refuge.

Alternative A includes completing construction of an outdoor environmental education pavilion. This pavilion is located near the existing visitor center on lands that have already been disturbed. We are following best management practices to minimize potential for soil erosion during construction. Hiking trails, wildlife observation areas, parking areas, and other high-use areas would continue to be well maintained to keep soil effects to a minimum. Any erosion problems would be noted during routine refuge monitoring and corrected as soon as feasible.

4.4.3 Impacts on Soils Under Alternative B (Service-preferred Alternative)

Benefits
Benefits to soil would be similar to those that are common to all alternatives. The added restoration emphasis under alternative B would potentially improve soils by improving biological function (as a result of restoring vegetation and hydrology and other components of ecosystem structure). Restoration of additional tidal marsh, and the associated removal of fill material would potentially restore historic soil profiles where previously buried, or remove or contain contaminated sediments.

Adverse Impacts
The adverse impacts of alternative B are similar to alternative A, except:

The refuge is proposing to expand the current refuge headquarters by adding on an office wing to collocate the law enforcement and maintenance programs with the other refuge programs and accommodate additional staff. Although the exact footprint of the proposed facilities has not been determined, we believe the addition would look similar to the conceptual design presented in appendix K. The expansion is expected to be about 1,800 square feet. Some ground disturbance is expected in the already disturbed area where the expansion would be located, as the area would need to be excavated. The expansion may also require a relatively small (probably less than half an acre) section of the grassy area adjacent to the current building to be removed to build the foundation of the expansion. These soils have already been disturbed and overall impacts to soils are expected to be minimal.

Phased removal of the 15-acre stand of nonnative poplar would result in the minor soil compaction and short-term loss of vegetative cover that could potentially increase soil erosion. By using a phased approach, the refuge minimizes soil impacts to the area at any one time and we would apply best management practices to reduce soil erosion and plant grasses to establish vegetative cover where needed.

Alternative B proposes construction of additional facilities including: a boardwalk, observation decks, kiosks, fishing access, and other small improvements. During the construction of these structures some upper layers of soils would be disturbed and compacted. By providing a path for users to cross over the wetlands and not through them, long-term effects to unsuitable and highly compactable soils would be avoided. One of the observation decks would re-use, if practical, existing concrete pilings to support the observation deck to minimize the impacts to soils; however, where needed new pilings would have to be driven into the soil.

The construction activity with the most potential disturbance to soils, particularly marsh soils, would be the construction of boardwalk that would extend out into the tidal marsh. The anticipated size of the boardwalk would be 200 to 300 feet long by 6 feet wide. Soil disturbance would be limited to the placing of pilings in the marsh area and the associated upland construction staging area. However, long-term soil disturbance is not expected, and the impact of these projects would be minimal. No construction other than placement of boardwalk pilings would be done in wetlands, resulting in short-term localized effects to wetland soils during construction and potential for long-term impacts on wetland plants from the shading effect produced by the boardwalk itself. As with other activities on the refuge that have the potential to disturb soils, the refuge would implement best management practices, including soil erosion plans as necessary, to minimize any negative effects on soils including erosion and compaction.

4.4.4 Impacts of Alternative C

Benefits
The benefits of alternative C are similar to alternative B.

Adverse Impacts
The adverse impacts of alternative C are similar to alternative B, except:

This alternative would result in more freshwater tidal wetland restoration, including restoration of the entire 145-acre impoundment. In comparison to alterative B, this would result in more short-term impacts to soil.

In contrast to alternative B, alternative C would cut and restore the entire 15-acre nonnative poplar stand at once. This would concentrate vehicle and equipment disturbance over a shorter time frame, potentially increasing local soil impacts.

As in alternative B, alternative C also anticipates an increase in refuge participation and visitation, as noted in the discussion of *Soil Impacts That Would Not Vary by Alternative and Impacts of Alternative A*. Although alternative C would also result slightly lower numbers of public use visitation when compared to alternative B. Added infrastructure under alternative C would primarily be focused around the Folcroft Landfill. These impacts would only occur once the site is remediated and released. The final site design would determine the location, size, and extent of infrastructure allowed in this location, and impacts would be addressed through a separate NEPA process. No significant increase in soil impacts is anticipated with this increase in visitation.

4.5 Impacts on Hydrology and Water Quality

As discussed in chapter 2, the hydrology on much of the refuge has been altered and water quality of the Darby Creek is generally poor and highly variable. The water quality at the refuge is variable and affected by point and non-point sources and related upstream impacts.

We evaluated the effects on hydrology and water quantity as a result of these management actions under each of the alternatives, including the following:

- Conserving and protecting refuge lands to limit the growth of development, thereby limiting sources of pollution and reducing losses of forest vegetation
- Protecting, conserving, and monitoring vernal pools that are important habitat for amphibians of special concern
- Improving water quality by managing and restoring freshwater tidal marsh and improving riparian forests and coastal plain forests, creating and maintaining buffers between habitats and high use areas, and restoring hydrologic function to these habitat
- Maintaining wildlife habitat and supporting wildlife in the impoundment by actively controlling water levels, and restoration of all or a portion of the impoundment to freshwater tidal marsh
- Controlling invasive species
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation
- Implementing measures to control erosion and prevent spills or other pollutants during construction of public and administrative facilities, particularly large scale (over 20 acres) restoration projects
- Supporting regional restoration and riparian buffer projects, increasing visitor and public awareness through environmental interpretation and education and continuing existing partnerships to benefit water quality and hydrology

We evaluated the potential for the proposed actions to cause adverse effects on hydrology and water quality, including the following:

- Impacts to water quality from public use
- Impacts on water quality from the construction and management of facilities, including public use and expanding administrative offices.
- Impacts to water quality from managing and restoring freshwater tidal marsh and improving riparian forests and coastal plain forests, and restoring hydrologic function to these habitats
- Invasive plant control, including aerial spraying and controlling invasive species including the use of herbicides, on water quality
- Larger scale routine management activities such as mowing fields and maintaining or controlling water levels in the impoundment, and less regular activities such as repairing flood damage
- Updating, expanding, and managing public use facilities and administrative offices
- Constructing, expanding, and managing additional public use facilities
- Increasing visitation and expanding the six priority public uses
- Planning for larger-scale public access projects such as construction of a pedestrian access at Route 420, construction of noise barrier(s), and consideration of more intensive public access such as guided tours in the marsh

4.5.1 Impacts on Water Quality and Hydrology That Would Not Vary by Alternative

Water quality in the refuge is a highly variable and complex phenomenon resulting from inputs of

three major waterways: Darby Creek, Cobbs Creeks (a major tributary to Darby Creek) and the Delaware River. The contribution from each of these sources at any given time varies depending upon tidal, hydrological, climatological, and anthropogenic conditions.

Benefits
Conservation and protection, of natural vegetation and soils on approximately 286 acres of floodplain and coastal plain forests, 282 acres of freshwater tidal marsh, 201 acres of open water habitat, and 72 acres of wet meadows and grasslands would continue to benefit water quality in the Delaware River watershed by limiting development in that part of the watershed and acting as a buffer against non-point-source pollution in the surrounding landscape. The benefits of wetlands to water quality are well established, and include trapping, recycling, and exporting sediments, nutrients, organic materials, and contaminants (Carter 1996). The existing and restored wetlands would filter water moving into the river and help improve water quality.

All of the alternatives propose restoring 55 acres of phragmites-dominated wetland to freshwater tidal marsh and closure and restoration of Folcroft Landfill. Both projects would improve water quality. Closure and restoration of Folcroft Landfill would permanently cap the landfill and would reduce contamination of Darby Creek and Tinicum Marsh. Restoring 55 acres of phragmites–dominated wetland to freshwater tidal marsh would greatly benefit water quality of Tinicum Marsh by improving biological exchange, regular tidal flushing, improving filtering and uptake of pollutants and suspended solids, and increasing dissolved oxygen concentrations.

Restoration of tidal marsh in this location may have a small, but positive impact on Tinicum Township by helping to reduce flooding. By removing historic fill material and restoring tidal hydrology, we also increase the floodway capacity along this section of Darby Creek. While we do not anticipate this single action would reduce frequency of flooding, the restoration of historic hydrologic regimes and flood capacity in this location adds to the cumulative effects of other flood management efforts.

Adverse Impacts
The hydrology and land surface across much of the refuge has been altered. Drainage is impeded and some areas of the coastal plain and floodplain forests on the refuge are occasionally flooded (such as forests adjacent to dikes). These areas are topographically low features, which cause them to hold storm water and remain inundated for extended periods. Since these areas rely on surface water runoff or overbank flooding of Darby Creek, they can also be dry during extended period of drought. We would closely monitor and mitigate all of our routine activities that have some potential to result in chemical contamination of water directly through leakage or spills or indirectly through soil runoff. These include control of weeds and insects around structures, use of chemicals for de-icing walkways, and use of soaps and detergents for cleaning vehicles and equipment. Personnel would continue to take the following precautions to minimize the potential for the chemicals and petroleum products becoming a water quality problem:

- Pour or mix chemicals or petroleum products no closer than 100 feet from surface water and over a non-porous surface material.

- Train all staff in spill prevention and spill response.
- Clean all vehicle and equipment at the existing maintenance facility to minimize runoff.
- Ensure all pesticide applicators are State certified.
- Apply all pesticides according to Service policies. In particular, we would ensure application according to label instructions.

As discussed in section 4.4.1, the herbicides selected for refuge management are reviewed by the Regional Contaminants Specialist who is responsible for upholding Federal standards for water quality and soil protection. Only those chemicals approved by the Service will be used. It is also acknowledged that reducing our dependency on chemical pesticides would help protect refuge resources.

There is some minimal risk that herbicides and pesticides used for invasive plant and mosquito control could impact water quality on the refuge. Triclopyr (BEE) has a low potential to leach into ground water and a moderate potential for surface water runoff (USDOE 2000a). Glyphosate has a low leaching potential because it adsorbs rapidly and tightly to soil (SERA 2011). It degrades in water with an estimated half-life of 35 to 70 days, depending on the soil type (USFS 1997). Imazapic degrades in water with an estimated half-life of 1 to 2 days. The potential of imazapic to leach into surface water and groundwater is highly dependent on the soil type present where it is applied (USDOE 2006a). Imazamox is very rapidly degraded by light in water, with an estimated half-life of 7 hours (USEPA 1997). It has a very limited potential to leach into groundwater and surface waters (USEPA 1997). Aminopyralid is relatively immobile and non-persistent in soils and, therefore, has little potential to leach into surface and groundwater (USDOE 2006b). *Bacillus thruingiensis israelensis* and *Bacillus sphaericus* are not aquatic bacteria and are not expected to have any adverse impacts on water quality or hydrology (USEPA 1998).

Some potential exists for the concentration of herbicides to build up over time in river sediments, lakes, ponds, and wetland habitats. The potential depends on the balance of pesticide input and removal from the lake or pond system. Herbicide inputs may occur either through direct application, water inflow, or through re-suspension and diffusion from the sediment layer. Herbicide removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al. 2001). The rate of herbicide degradation is an important consideration for assessing the effects of any herbicide on aquatic systems. By only using herbicides and pesticides approved for aquatic use in or near water, and employing the other best management practices described above, we anticipate little to no adverse impacts on water quality.

All of the alternatives include closure and restoration of Folcroft Landfill, which became part of the refuge in 1980. This landfill is part of the Lower Darby Creek Area Superfund Site, which also includes the Clearview Landfill, located just upstream of the refuge, and four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). These sites would continue to impact water quality until cleanup and closure. Coordination with the EPA regarding contaminant remediation is ongoing.

The upstream impacts to water quality and risks of hazardous spills from neighboring roads, tank farms, industrial sites, and communities would continue

no matter which alternative would be selected. The refuge would continue to annually update management plans such as the Spill Prevention and Response Plan and would continue to monitor water quality. Stringent precautions in conducting refuge management activities would prevent chemical contamination of water directly through leaks or spills or indirectly through soil runoff.

Regardless of alternative, there would continue to be negligible impacts to refuge water quality from the use of vehicles and equipment by refuge staff in surveillance, monitoring, and routine facility maintenance activities on the refuge property. Trace amounts of petroleum products from vehicles and equipment may be carried into refuge water in rainfall runoff; minimal soil disturbance might also lead to negligible amounts of turbidity in runoff waters. Maintenance of access roads, ongoing trail, and other maintenance activities would cause negligible short-term, localized soil erosion. These activities could occur to some degree no matter which alternative is selected. We would minimize these impacts by using best management practices.

Refuge visitation is likely to rise, regardless of alternative, with an associated increase in the utilization of facilities and trails and the potential for increased soil erosion, trash and debris, and pollutants from vehicles such as grease and detergents. Vegetated buffers and swales and infiltration trenches would continue to capture and filter contaminants from the parking lots and heavy use areas. A significant amount of trash and debris from upstream areas would continue to be deposited in the refuge, especially when Darby Creek floods. The refuge would continue to support Darby Creek cleanup events; however these events, while good for public awareness, likely make little difference in the amount of trash and debris present in the system. We would continue the existing partnerships with the Darby Creek Valley Association, the Delaware Estuary Program, and continue to support ongoing research to better understand and improve the water quality of Darby Creek, Cobbs Creek, and the Delaware Estuary. The impacts of refuge management to water quality are negligible in relation to the cumulative watershed-scale influences impacting the refuge.

4.5.2 Impacts of Alternative A (Current Management)

Benefits
Benefits of refuge management on water quality and hydrology are similar to benefits that would not vary by alternative plus:

Hydrology and water quality would benefit by protecting refuge habitats from development. Refuge lands are surrounded by high density urban residential and industrial development. By maintaining and protecting the natural buffers and wetlands along Darby Creek, refuge lands help protect neighboring communities from additional impacts from flooding and stormwater pollutants. Vegetation helps filter pollutants, stabilize soils and prevent erosion and associated sedimentation in creeks. Riparian vegetation helps shade waterways, decreasing water temperatures and increasing the water's capacity to retain dissolved oxygen. The refuge would continue to manage potential impacts of refuge activities on inputs to Darby Creek in order to reduce contaminants and stormwater impacts from the refuge. Habitat management actions such as invasive plant control would continue although it would be less extensive and would have fewer benefits in comparison to alternatives B and C. By maintaining current levels of invasive species control, we would continue to have minimal impacts on water quality as the result of habitat management.

The 145-acre impoundment would continue to be managed to provide a variety of habitats suitable for feeding, nesting, brood rearing, and resting habitats for migratory birds and resident wildlife to the degree possible, using the existing infrastructure and supplemental pumping (see vegetation and wildlife for

specific impacts on these resources). Water levels would continue to be adjusted seasonally to mimic natural hydroperiods associated with unaltered riverine wetlands to provide the best possible habitat for priority migratory birds and wildlife species. The impoundment would continue to be managed to mimic historic hydrology; however, the ability to effectively manipulate impoundment hydrology would continue to be impeded due to the inadequate capacity of the existing water control infrastructure. The refuge would continue to use the remaining and functioning water control structure in the northeast corner of the impoundment.

Adverse Impacts
Potential adverse impacts to water quality are the same as *Adverse Impacts That Would Not Vary By Alternative* plus the potential adverse impacts of alternative A described below:

Other restoration and management activities on the refuge would be limited thus minimizing short-term impacts to hydrology and water quality. The hydrology and water quality would continue to be locally impacted by dikes and other drainage features which are not planned for restoration under current management of the refuge. Dikes block tidal flow and surface drainage, which helps build soils and encourages the establishment of phragmites and reduces the number and effectiveness of small tidal channels. Dikes can also restrict the flow of water off the land, causing extended periods of inundation which can result in the loss of plant species that require periods of drying. In the case of impoundment management, it can negatively impact the effectiveness of water level management for migratory bird stopover habitat.

Under this alternative, we would continue to monitor the deer population and impacts on the refuge. We would continue to prohibit hunting and would not implement any management efforts to control the deer population. This would likely allow the deer population to increase. Deer would continue to have minimal negative effects on water quality by reducing vegetative cover and disturbing soils on trails which could cause erosion and sedimentation, and would suppress forest regeneration that could benefit water quality.

Under alternative A, the risk of herbicide contamination, used in invasive plant control, to open water and wetland habitats would be minimal. Currently glyphosate-based herbicides are the primary chemicals used for refuge management operations. Glyphosate also quickly adsorbs to suspended soil particles in water, rapidly making it biologically unavailable. As discussed under section 5.2.1, we would minimize potential adverse effects to aquatic organisms by applying all herbicides according to label instructions and only using herbicides approved for aquatic use in and around waters and wetlands.

There would be little change to public and administrative facilities that would affect water quality. The area around the impoundment would continue to be one of the most heavily used areas of the refuge. It would continue to have the highest concentration of wildlife observation facilities, and would be frequently used for interpretative and educational programs.

In alternative A, we estimate that wildlife-dependent recreation would increase by about 15 percent, over the 15-year life of the plan. That presents an increased potential for adverse effects on refuge water quality through littering, soil sedimentation from fishing, hiking, biking, canoeing, and kayaking, and runoff of petroleum products from parking lots. The refuge would continue to minimize adverse impacts to water resources from visitors by routinely monitoring roads and trails for damage and by remediating problem areas. An increase in

recreational boating activities might lead to river and stream contamination. Public outreach would increase awareness of issues such as littering, invasive aquatic plants, introduction of nonnative fish, and lead contamination. Thus, outreach would help to mitigate risks associated with visitor use of waterways on the refuge. Adverse impacts to hydrology and water quality are expected to be less compared to alternatives B and C, because the increase in visits and overall visitor use is expected to be about half of the increase projected under the other alternatives.

4.5.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Benefits to water quality are the same as benefits of proposed actions in alternative A plus:

Conversion of a portion of the 145-acre impoundment to a freshwater tidal wetland would have the similar benefits as other wetland restoration projects described in alternative A. These actions would restore tidal hydrology historically present in these areas. By doing so, the refuge would restore some of the natural floodway capacity historically present along this portion of Darby Creek. While we do not anticipate this single action would reduce frequency of flooding, the restoration of historic hydrologic regimes and flood capacity in this location adds to the cumulative effects of other flood management efforts.

Improving impoundment water level control infrastructure and adaptive management of water levels would improve the ability to manipulate impoundment water levels to improve dissolved oxygen (DO) levels in the impoundment.

More intensive management of coastal plain and freshwater tidal marsh habitats would increase the benefits in comparison to alternative A. The combination of establishing a deer management program, along with invasive species control efforts, would help to restore native plant communities that are indigenous to the coastal plain.

Under this alternative, we would complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring. This data would be used to inform refuge staff of localized water quality concerns and their influences on our habitat management and public uses.

Adverse Impacts
Adverse impacts to water quality are the same as adverse impacts of proposed actions in alternative A plus:

Additional restoration activities under alternative B would have minor, short-term impacts on localized hydrology. Poplars are known to have high evapotranspiration rates as compared to other hardwood trees. Clearing of the 15-acres of nonnative poplar forests would likely reduce the amount of evapotranspiration over the first several years while coastal plain and floodplain forest vegetation is restored to the area. Due to the relatively small scale of vegetative removal, we do not anticipate this change to significantly change local groundwater hydrology.

Conversion of a portion of the 145-acre impoundment to a freshwater tidal wetland would have short-term impacts on water quality including potential erosion of disturbed soils and potential spills and leaks from equipment associated with the restoration process. These impacts would be minimized by using best management practices implemented to minimize soil loss, erosion, and

reduce potential impact of equipment spills or leaks. Disturbance to vegetation and soils during construction would potentially cause short-term erosion and sedimentation to nearby water ways. Construction also increases the risk of hazardous material spills from equipment while present on site.

An increase in public use could cause increases in negative impacts on water quality. By increasing onsite refuge visitation by about 47 percent (about 63,300 visits) over the life of the CCP, we increase the likelihood of increased runoff from refuge parking lots and roads and increased sedimentation in refuge waterways from soil erosion associated with increased foot traffic. These impacts would be localized to refuge entrance points and trails. We would monitor these areas for potential impacts and would modify use or close areas as needed to protect resources.

Under alternative B, the refuge would construct public use infrastructure to support the expected increase in visitors for wildlife-oriented recreation and other refuge programs. The small construction projects include additional observation platforms, blinds, kiosks, and an unstaffed visitor contact station along Route 420. The public infrastructure project with the most potential adverse impacts under alternative B is a boardwalk into the marsh. The boardwalk would be approximately 1,600 to 2,400 square feet. This project would mainly create short-term localized water quality impacts during construction access to the boardwalk and disturbing wetlands during placement of boardwalk pilings. The disturbed soils and suspended sediment would be managed using construction best management practices. After construction, the long-term effects to hydrology and water quality would be minimal and use of these facilities for interpretive and environmental programs would raise appreciation and awareness of the refuge's resources including hydrology and water quality issues.

4.5.3 Impacts on Hydrology and Water Quality (Alternative C)

Benefits
Benefits to water quality are the same as benefits of proposed actions in alternative B, plus the potential beneficial impacts of alternative C described below:

The complete conversion of the 145-acre impoundment would also increase water quality benefits in comparison to alternative B, in terms of increased filtering and uptake of pollutants by vegetation and restoring the natural tidal hydrology. Restoration of the impoundment to tidal marsh would restore tidal hydrology historically present in this area. By doing so, the refuge would restore the natural floodway capacity historically present along this portion of Darby Creek. While we do not anticipate this single action would reduce frequency of flooding, the restoration of historic hydrologic regimes and flood capacity in this location adds to the cumulative effects of other flood management efforts.

Adding a controlled youth hunt in addition to wildlife specialists would assist in maintaining deer populations and would have the same water quality benefits as alternative B. As in alternative B, the combination of reducing the refuge deer population, along with invasive species control efforts, would help to restore native plant communities that are indigenous to the coastal plain.

Adverse Impacts
The adverse impacts of alternative C are similar to alternative B, except:

This alternative includes restoration of the entire 145-acre impoundment. In comparison to alterative B, this would result in more potential short-term impacts on water quality and hydrology. The area of soil disturbance would

increase, increasing the potential for erosion and sedimentation. It is unclear at this time if Tinicum Township would experience increased risks of flooding if the impoundment is restored. Increased flooding in the area would increase contamination, adversely affecting water quality. We would work with the township, qualified engineers, and hydrologists as needed to ensure proper design of the impoundment restoration to minimize potential risks of flooding.

In contrast to alternative B, alternative C would clear the 15-acre nonnative poplar stand and result in more disturbances of vegetation and soils, increasing the potential for erosion and sedimentation. Conversion of the 15-acre nonnative poplar stand to a shrub-scrub habitat type would likely result in little change in local hydrology. The initial, one-time clearing of 15-acres would likely have a short-term, negligible effect on groundwater and evapotranspiration in this location.

As in alternative B, alternative C also anticipates a similar increase in refuge participation and visitation, as noted in the discussion of *Impacts of Alternative B*, and no significant adverse impacts on water quality are anticipated with this increase in visitation. There is some additional, although minimal, potential adverse effects associated with opening a youth deer hunt since this usually involves off-trail access. These would be somewhat similar to those from the wildlife management specialists utilized under alternative B, but there would fewer individuals—and thus fewer impacts.

Remodeling the visitor center to collocate only the law enforcement program would result in a slightly less water quality impact in comparison to alternative B, due to the reduced need for equipment and associated construction impacts.

4.6 Impacts on Noise

The refuge conducts its management in a noise-filled, urban environment. Traffic, airplanes, heavy equipment operation, industrial and commercial operations, building and road construction, all contribute to local noise and disturbance in varying degrees. Noise impacts are expected to be similar under each alternative. Source of noise would include traffic, the Philadelphia International Airport, mechanized equipment (mowing, brush-hogging, chainsaws, etc), firearms from the nearby Delaware County Training Facility, and construction projects. Noise from traffic would be minimal from refuge drives, due to low speeds and limited use.

Noise from human activities can have different impacts to wildlife depending upon the auditory communication system of the species and the intensity, duration, and timing of the noise. Research (Knight 1984) shows that human activities such as boating and fishing could disturb wintering bald eagles (especially adults). Boat noise disrupted feeding activity which reduced the eagles' energy intake. Avoidance flights simultaneously increased the energy expended by the eagles, which in turn magnifies their energy deficit. The same study found that some migrant birds are disturbed by the presence of visitors and that loudness was as significant of a disturbance as the number of people in this effect (Burger and Gochfeld 1998). As indicated by these examples and elsewhere, the effects of noise on particular species is dependent on the species' or individual's tolerance to noise.

A study on the impact of highways measured forest breeding birds in transects extending 1,200 feet (400 meters) from the edge of I-95 in Maine and found that four species were less abundant near the road while another six became more abundant near the roadway (Ferris 1979). Species that became less abundant near the road include the bay-breasted warbler, blue jay, Blackburnian warblers, and winter wrens. The six species that became more abundant near the road

included the chestnut sided warbler, white-throated sparrow, wood thrush, common yellowthroat, robin, and Tennessee warbler.

Noise can affect amphibians as well. In relation to the refuge, calls at these lower decibel ranges may easily be overpowered by ambient noise, depending on the location within the refuge, based on the existing average Day-Night Average Sound Level of 50 dB measured near Lindberg Boulevard. This is calculated to increase to 55.4 dB in 2007 and 56.5 dB in 2015 with the runway expansion project (FAA 2005).

Aircraft noise can have negative impacts on terrestrial and aquatic species. The severity of these impacts depends on the frequency of flights, the altitude the craft is flying at, the type of aircraft (i.e., fixed-wing versus helicopter), and the wildlife species (Gladwin et al. 1988). Wildlife responses to aircraft noise can vary greatly, from apparent habituation in many species (USDA 2010), slight reactions, such as calling or becoming more alert in white-tailed deer and turkey, flushing of waterfowl and small birds, and startle and jumping actions in fish (Manci et al. 1988, Gladwin et al. 1987). Generally, lower altitude flights and helicopters appear to be more likely to negatively impact species than higher altitude and fixed-wing aircrafts (Gladwin et al. 1987). In a survey of Service staff (Gladwin et al. 1987), waterfowl species were the most frequently reported animal group disturbed by aircraft. In this survey, national fish hatchery staff also reported fish deaths due to intense sonic booms that caused fish to jump out of their tanks or have seizures. A report on wildlife hazards at Philadelphia International Airport found a variety of wildlife species, using the airport property, for example waterfowl, migratory landbirds, and mammals (USDA 2010). This same study reported large numbers of animals feeding, resting, and nesting on the airport, indicating at least some level of habituation to noise and other associated disturbance from airport operations.

In light of this ambient noise in the refuge landscape, we considered how refuge management actions might add to the soundscape. We evaluated the effects of noise as a result of potential management actions under each of the alternatives.

4.6.1 Noise Impacts That Would Not Vary by Alternative

Benefits

There is no specific information on the soundscape of John Heinz NWR but there are clearly the sounds and noises of an urbanized landscape. Traffic, airplanes, heavy equipment operation, industrial and commercial operations, and building and road construction all contribute to community noise and disturbance in varying degrees.

By comparison, the refuge benefits the local soundscape by providing aspects of natural soundscapes uncommon in urban areas. The sounds of frogs calling, birds singing, fish jumping, and wind through the leaves provide benefits for both wildlife (in terms of breeding and territorial vocalizations) and visitors (in terms of wildlife-dependent recreation).

Adverse Impacts

John Heinz National Wildlife Refuge at Tinicum is northwest of the Philadelphia International Airport and is separated from the airport by I-95, a Southeastern Philadelphia Transportation Authority (SEPTA) rail line, and Bartram Avenue. The refuge is not aligned with any existing runway and is not on the direct approach or departure track for any of the existing runways.

The noise analysis completed for the airport's runway expansion environmental impact statement demonstrated that the refuge experiences noise levels between 45 and 60 decibels (dB) based on the Day-Night Average Sound Level

(DNL) recorded near the refuge. As documented by these measurements, the refuge is located in an area containing high levels of ambient noise as a result of surrounding commercial, industrial, and transportation activities. Ongoing maintenance activities, habitat restoration projects, and visitation would contribute negligible amounts of noise to existing background levels. Screamer-shells fired by refuge staff to flush birds for monitoring purposes may be used infrequently during day time hours. No activity identified under any alternative is expected to have a major or long-term impact on noise on the refuge or to adjacent lands.

4.6.2. Impacts of Alternative A (Current Management)

Benefits
Noise benefits would continue as described in *Noise Impacts That Would Not Vary by Alternative*.

In addition, we are planting trees along nonforested portions of the refuge that parallel I-95 in an attempt to reduce traffic sounds using a natural, long-term sound barrier. This barrier may improve audibility of nature sounds including frog calls and bird songs. This would improve the soundscape on the refuge by decreasing disturbance to visitors and wildlife associated with anthropogenic sounds.

Adverse Impacts
Noise impacts would continue as described in *Noise Impacts That Would Not Vary by Alternative*.

4.6.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Noise benefits would continue as described under alternative A. Noise benefits under this alternative may be slightly greater than alternative A since increased restoration efforts would likely increase habitat quality and result in associated increases in wildlife. This would improve the soundscape on the refuge by increasing the numbers and types of natural sounds on the refuge.

Adverse Impacts
Impacts of noise are expected to be slightly increased compared to alternative A.

Adverse impacts associated with refuge visitation would likely be slightly greater because of the increase in visitation compared to alternative A, but are expected to be negligible compared to the current soundscape.

Under alternative B, there would be noise from firearms used by wildlife management specialists, but only during daylight hours and very infrequently. As in alternative A, screamer-shells fired by refuge staff to flush birds for monitoring purposes may be used infrequently during day time hours. Construction of additional facilities and equipment-related noise associated with routine maintenance and operations would have short-term adverse effects. In general, noise generated by any of these sources could potentially have minimal, but temporary, effects on nearby wildlife and people in the form of encouraging flight response or avoidance of surrounding habitat. None of these activities are expected to have long-term adverse effects on the area's soundscape.

4.6.4 Impacts of Alternative C

Benefits
Noise benefits would continue as described in *Noise Impacts That Would Not Vary by Alternative*.

Unlike alternatives A and B, this alternative would explore construction of a more extensive sound barrier along I-95 to reduce sound impacts on birds, amphibians, and other wildlife.

Adverse Impacts
Under alternative C there would be noise from firearms used by hunters and wildlife management specialists, but only during daylight hours and very infrequently. Screamer-shells fired by refuge staff to flush birds for monitoring purposes may be used infrequently during day time hours. As described under alternative B, construction of additional facilities and equipment-related noise associated with routine maintenance and operations would have short-term adverse effects. In general, noise generated by any of these sources could potentially have minimal, but temporary effects on nearby wildlife and people. None of these activities are expected to have long-term adverse effects on the area's soundscape.

4.7 Impacts on Vegetation

As discussed in chapter 2, refuge lands include a variety of ecosystems including open water, forests, grasslands, and tidal and nontidal wetlands (see map 2.1). Many of the ecosystems (and the habitats they support) have been degraded, damaged, or destroyed as a result of the numerous impacts previously discussed. Despite these alterations, many of these impacted ecosystems have the potential to be restored through various management actions and specific projects. Other areas, including portions of the freshwater tidal marsh, contain healthy and intact plant communities. Some ecosystems support plant communities or species of concern.

We evaluated the following benefits to vegetation as a result of potential management actions under each of the alternatives:

- Conserving and protecting refuge lands to limit the growth of development, thereby limiting impacts on vegetation and losses of ecosystem integrity
- Protecting, conserving, and monitoring habitats that contain rare or endangered plants, unique habitats and habitats which are important habitat for species of special concern
- Conversion or restoration of certain areas of the refuge to more productive or unique wetlands and coastal plain shrub-scrub habitat
- Maintaining wildlife habitat and supporting wildlife in the impoundment by actively controlling water levels, and restoring a portion of the impoundment or the entire impoundment to freshwater tidal marsh
- Controlling invasive species and pests that impact vegetation on the refuge, and monitoring for these pests, particularly pests known to be present in the region
- Supporting regional restoration projects and biological and scientific studies which improve habitat management, knowledge of species of concern, or provide learning opportunities for students.
- Increasing public awareness of the importance of vegetation to habitat quality through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on vegetation and losses of ecosystem integrity, including the following:

- Direct or indirect actions causing soil, hydrology, and water quality impacts that could adversely impact vegetation, and habitat productivity and integrity.

- Managing and restoring tidal marsh and improving riparian forests and coastal plain forests
- Invasive plant control
- Larger scale routine management activities such as mowing fields and maintaining or controlling water levels in the impoundment, and less regular activities such as repairing flood damage
- Constructing, updating, expanding, and managing public use facilities and administrative offices
- Increasing visitation and expanding the six priority uses
- Planning for larger-scale public access projects such as construction of a pedestrian access at Route 420, construction of noise barrier(s), and consideration of more intensive public access such as guided tours in the marsh

4.7.1 Impacts on Vegetation That Would Not Vary by Alternative

We predict that refuge land management, regardless of which alternative is selected, would be expected to have a net positive effect on vegetation abundance and quality.

Benefits
Under all of these alternatives, we would continue to pursue land protection as described in the refuge's establishing documents, which would benefit all habitat types on the refuge. As discussed previously, we would also continue restoration of 55 acres of phragmites dominated tidal marsh and would continue to support the remediation and restoration of the Folcroft Landfill.[1] By restoring the natural vegetation and hydrology, we encourage the natural physical, chemical, biological weathering, and other ecological processes that support the establishment and persistence of native vegetation. Overall, the protection, maintenance, and restoration of habitats are expected to benefit vegetation.

Protecting and Managing Habitats
Under all alternatives, the refuge would continue to protect existing wetlands. Restoration of freshwater tidal marsh proposed under all alternatives would generally result in improved biodiversity and habitat for rare plant species know to occur at the refuge. Restoration projects involving earthmoving and grading would consider climate change, natural landform, and transitional zones with project designs in order to replicate transitional vegetation and plant communities.

Under all alternatives we would continue to employ our Early Detection and Rapid Response monitoring in conjunction with other conservation partners, to prevent establishment of any known invasive aquatic plants.

Our invasive species control efforts would continue under all alternatives. These efforts are expected to result in a net benefit to native vegetation across the freshwater tidal marsh. These efforts include annual aerial herbicide application on 10 to 15 acres of phragmites within the existing freshwater tidal marsh.

[1] We will complete compliance with the National Environmental Policy Act for these projects separately.

Invasive species control of nontidal wetlands, including areas of wet meadows, would continue to focus on phragmites, as well as purple loosestrife. These treatments typically utilize spot foliar treatment of individual plants and populations to minimize unintended damage to nearby native vegetation.

Under all alternatives, the refuge would continue to protect areas of coastal plain and floodplain forests. Management efforts across all alternatives would include invasive species controls expected to result in a net benefit to native vegetation across all forested habitats. These efforts include annual foliar herbicide application on garlic mustard and other targeted invasive plant species. These treatments help control existing populations by minimizing the spread and reproduction of these species throughout the refuge.

Grassland habitats would benefit by continuing a transition from cool season to warm season grasses through regular herbicide applications and supplemental planting and seeding. This transition results in improved species diversity and habitat structure beneficial to wildlife.

Under all alternatives, the refuge would continue to protect areas of open water habitats and associated vegetation. No major management is proposed for Darby Creek itself. While Darby Creek is outside the jurisdiction of the Service, the refuge would continue to protect existing lands adjacent to the creek that influence aquatic vegetation in and along Darby Creek.

Offering Public Use
Public use can benefit vegetation through our education and interpretive actions proposed under all alternatives. By educating visitors on the importance and identification of vegetation, we help individuals to recognize the prevalence of invasive species and the benefits of native species. Under all alternatives, we would continue to encourage volunteer-based efforts to help control invasive species and restore native plant communities.

Adverse Impacts
As first discussed in section 4.4.1 *Impacts on Soils That Would Not Vary by Alternative,* we would continue to use Service-approved herbicides and pesticides to treat and control invasive plants and mosquitoes. By only applying approved herbicides and pesticides, using proper application procedures, and following best management practices, we anticipate only negligible adverse impacts to native vegetation on the refuge.

Protecting and Managing Habitats
Aerial spraying would continue to be used to control 10 to 15 acres of phragmites-dominated wetlands annually. There is minimal risk that the herbicides used could adversely impact nontarget, native plant species. Although some of the herbicides used on the refuge are highly selective, some could also affect nontarget plant species. We make every effort to minimize off-target application of herbicides and have successfully completed annual applications in previous years with minimal impacts to nontarget species and areas. We would continue to use proper application techniques and rates to minimize the potential to damage nontarget plant species.

Managing and restoring of forest communities are consistent with the refuge goals and are common to all of the alternatives in different degrees. Of these two activities, restoring forest communities and freshwater tidal wetlands would affect vegetation the most. Vegetation clearing or removal during construction activities (and prior to the establishment of cover vegetation) would result in a temporary loss of vegetative cover. However, we would promote re-vegetation

of restored areas with native species typical of the target plant communities identified for each project.

Grassland habitats would benefit by continuing a transition from cool season to warm season grasses through regular herbicide applications and supplemental planting and seeding. This transition results in improved species diversity and habitat structure beneficial to wildlife.

Bacillus thruingiensis israelensis and *sphaericus* are not expected to have any adverse impacts to plants, including terrestrial, semi-aquatic, or aquatic species (USEPA 1998, USEPA 1999).

Offering Public Use
Public use can affect vegetation in a variety of ways including directly by trampling and indirectly through soil compaction which can affect root systems. We regularly monitor trails and roads and have not observed any major impact areas resulting from wildlife observation, photography, environmental education, or interpretive uses. Public use trails, wildlife observation areas, parking areas, and other high use areas are designed and maintained to minimize impacts on vegetation. The most intense concentration of public uses by maintenance of access roads, ongoing trail, and other maintenance activities would cause negligible short-term, localized disturbance (e.g., mowing, herbicide application) to vegetation. These activities would occur to some degree no matter which alternative is selected and the impacts would be minimized by best management practices.

Unauthorized public use activities have the potential to impact vegetation by trampling. This loss of plant cover can result in increased soil erosion (Hammitt 1998). Under all alternatives, we would continue to enforce regulations prohibiting non-authorized use of vehicles (e.g., bicycles or ATVs) to prevent damage to vegetation.

4.7.2 Impacts of Alternative A (Current Management)

Benefits
Benefits from refuge management are similar to those described under *Impacts on Vegetation That Would Not Vary by Alternative*. Other potential benefits of alternative A include:

Protecting and Managing Habitats
Seasonal dewatering of the 145-acre impoundment to support migratory birds or assist in disease prevention efforts exposes much of the impoundment soils to air. This encourages establishment of native annual vegetation on exposed mudflats across the impoundment. The current condition and arrangement of the existing water control structures limits the amount refuge staff can control impoundment water levels.

Adverse Impacts
Protecting and Managing Habitats
The refuge forests would continue to be negatively affected by deer browse, which severely limits the development of quality forest structure including canopy trees, sub-canopy trees, understory shrubs, and a diverse ground cover. Excessive deer browse also greatly reduces the overall diversity of plant species across all habitats. Vegetation surveys conducted in preparation of the deer management plan (D'Angelo 2011) noted prominent browse lines were evident in all forested areas of the refuge. Successful regeneration of tree seedlings was not observed. As an example of this, during the early growing season forest regeneration surveys, only two tree seedlings were recorded. By the late growing season surveys, no tree seedlings were recorded. The two seedlings recorded

during the early growing season had apparently succumbed to browsing by deer and were not found. This indicates that the long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded forested areas would not be feasible with continued impacts of an over-abundant deer population. The refuge ecosystems would continue to be altered to the extent that they become less favorable habitats for other wildlife.

Offering Public Use
We would continue to maintain approximately 2 miles of foot paths and trails consisting of mowed paths across fields, or paths cut through the woods. Occasional mowing or clearing would occur along these trails as part of ongoing trail maintenance.

Alternative A includes completing construction of an outdoor environmental education pavilion. Use and maintenance of existing trails, wildlife observation areas, parking areas, and other visitor facilities would continue to be maintained to keep effects on vegetation to a minimum. Any introductions of new invasive species or disturbance to existing vegetation would be noted during routine refuge monitoring and corrected as soon as feasible.

4.7.2 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Protecting and Managing Habitats
In addition to the benefits to vegetation described under *Impacts on Vegetation That Would Not Vary by Alternative,* alternative B would create a renewed focus on restoring and expanding freshwater tidal marsh within the refuge. Since protecting and preserving Tinicum Marsh is one of the refuge's original mandated purposes, and it supports the greatest number and diversity of species of conservation concern, we are seeking to focus a large degree of habitat management resources towards invasive species management, freshwater tidal marsh restoration, and monitoring for climate change adaptation. Restoration of additional freshwater tidal marsh would improve and expand the overall acreage of high-quality wetland habitat and the plant communities that comprise them. Marsh habitats also support many of the rare plant species known to occur on the refuge. We anticipate that, over time, restoration of tidal marsh would benefit and support the expansion of rare vegetation at this site.

Conversion of the 15-acre nonnative poplar stand to coastal plain and floodplain forest communities would restore native vegetation and structure to this portion of the refuge's forested habitats. Over the long term, this would help make the coastal plain and floodplain forest complex less fragmented on the refuge. This alternative would also initiate a deer management control program to reduce the size of the resident deer herd to promote natural regeneration of native species and enhance plant diversity and abundance.

Over the next 15 years, we would acquire or restore an additional 18 acres of coastal plain and floodplain forest, and manage the existing 34 acres of coastal plain forest and 261 acres of floodplain forest communities to provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by maintaining a canopy dominated by native trees, increasing native understory shrub/sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005. Controlling the deer population would benefit refuge habitats, particularly forested areas.

Under alternative B, we would develop a long-term management plan for forest habitats to create mixed-age stands of hardwood species identified as primary components of coastal plain and floodplain target communities.

Alternative B would also begin converting some grassland habitat into forested habitat over the life of the plan. This would shift the plant community structure and species composition over this time. However, as outlined in chapter 2 and the refuge's draft Habitat Management Plan (appendix C), forested habitats tend to provide greater benefits to a wide array of conservation priority species. Under this alternative, we would convert 8 acres of cool-season grass meadow located on the southern edge of the refuge near I-95 to coastal plain forest. We would also allow an additional 6 acres of grassland located along the eastern boundary of the refuge to succeed to forest. Much of this area is surrounded by coastal plain or floodplain forest, and this area is dominated by cool-season grasses and invasive species such as phragmites.

Remaining grasslands would be enhanced to improve vegetative structure and species composition in order to more closely resemble the small grassland patches historically present in the Philadelphia area. Other grasslands within the refuge are within utility right-of-way corridors (some of which are not owned by the Service) that limit the potential options for habitat management.

Offering Public Use
In addition to the benefits to vegetation described under *Impacts on Vegetation That Would Not Vary by Alternative,* we would also utilize partnerships with local universities and regional researchers to define a baseline monitoring plan that continues monitoring of variables related to climate change impacts within the existing marsh, including vegetation trends. We would use this data to inform and improve long-term habitat management within the marsh.

Adverse Impacts
The adverse impacts of alternative B are similar to alternative A, except:

Protecting and Managing Habitats
Up to approximately 73 acres of open water habitat would be lost when restoration of the impoundment is completed. There would be negative effects on vegetation associated with construction staging areas, construction of the new dike, and tidal marsh restoration area. These effects are expected to be temporary and the restoration plan would include strategies for minimizing negative effects (e.g. damage to soils and vegetation) and revegetating disturbed areas.

Phased removal of the 15-acre stand of nonnative poplar would result in the short-term loss of vegetative cover that could potentially increase establishment of nonnative invasive species. By using a phased approach, the refuge seeks to minimize these impacts and would apply best management practices to reduce potential for invasive species introductions and reestablish native vegetative cover where needed.

The refuge is proposing to expand the current refuge headquarters by adding on an office wing to collocate the law enforcement and maintenance programs with the other refuge programs. Although the exact footprint of the proposed facilities has not been finalized, the construction of any of the designs would have similar impacts on vegetation. Some ground disturbance is expected, as limited areas that are currently developed would be excavated. The expansion would also require a relatively small (probably less than half an acre) section of vegetated area adjacent to the current building to be removed to build the foundation of the expansion. This vegetation is already disturbed and overall impacts to vegetation are expected to be minimal.

Offering Public Use
Alternative B proposes construction of additional facilities including: a boardwalk, observation decks, kiosks, fishing access, and other small improvements. During the construction of these structures some areas of vegetation would be disturbed. Most, if not all, small project construction would be located where vegetation is already degraded, so a minor permanent loss of vegetated cover would result in a negligible impact. One of the observation decks would re-use, if practical, existing concrete pilings to support the observation deck to minimize the impacts to vegetation. However, where needed, new pilings would have to be driven into the soil and disturb vegetation. The construction activity with the most potential disturbance to vegetation, particularly marsh vegetation, would be the construction of boardwalk that would extend 200 to 300 feet into the tidal marsh. Vegetation loss and disturbance would be limited to the placing of pilings in the marsh area and the associated shading of the boardwalk itself. However, the long-term impact of these projects would be minimal less than 0.01 percent of the refuge's current tidal marsh being affected. As with other activities that have the potential to disturb vegetation, the refuge will implement best management practices, including revegetation plans as necessary, to minimize any temporary negative effects on vegetation.

4.7.3 Impacts of Alternative C

Benefits
The benefits of alternative C are similar to alternative B.

Protecting and Managing Habitats
This alternative would result in more acres of freshwater tidal wetland restoration if fully implemented. The majority of this would come from restoring the entire 145-acre impoundment to tidal marsh. In contrast to alternative B, we would delay this restoration until we had at least 10 years of data on effects of climate change, primarily sea level rise, on the refuge and could compare this to updated regional climate change trends. This information would need to be incorporated into a feasibility study and proposed project designs.

Alternative C would convert a 15-acre forested stand dominated by a nonnative poplar to an early successional, shrub-scrub dominated habitat. This would reduce the dominance of the nonnative poplar species that (combined with excessive deer browse) continue to exclude native species regeneration. Over the long term this would establish and maintain a native shrub-dominated vegetative cover. This early successional habitat type is currently not found in high densities at the refuge.

Offering Public Use
Added infrastructure under alternative C would primarily be focused around the Folcroft Landfill. These impacts would only occur once the site is remediated and released. The final site design would likely have some impact on the location, size, and extent of vegetation allowed at the site.

Adverse Impacts
The adverse impacts of alternative C are similar to alternative B, except:

Protecting and Managing Habitats
Forest management would continue invasive species control and monitoring the impacts of high deer populations. A deer control program would be initiated, including a controlled hunt program and wildlife control specialists, to reduce the deer herd.

Conversion of a 15-acre forested stand dominated by a nonnative poplar to an early successional, shrub-scrub, dominated habitat would result in a temporary

loss of vegetation across this area, as well as a permanent loss of forest vegetation. However, this loss is relatively small when compared to the remaining forest acreage maintained by the refuge.

Offering Public Use
Compared to alternatives A and B, there would be potential for more people walking off-trail on the refuge increasing, risks of trampling vegetation. Since the refuge would initiate a controlled hunt program, refuge staff would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on vegetation.

As in alternative B, alternative C also anticipates an increase in refuge participation and visitation. However, alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B. Effects of increased visitation under alternative C are expected to be similar to those described under alternative B.

4.8 Federally Listed and Recently Delisted Species

There are no known federally listed species on the refuge at this time. However, the recently delisted bald eagle occurs on the refuge and there is potential habitat on and adjacent to the refuge for the federally endangered shortnose sturgeon. As part of the National Wildlife Refuge System, one of our highest priorities is the conservation and management of federally listed or recently delisted species. State-endangered species (including amphibians, reptiles, birds, and plants) also occur on the refuge, and are addressed under their individual taxonomic sections.

Bald eagle
Although we removed the bald eagle from the Federal list of Endangered and Threatened Species on August 12, 2007, it is still a federally protected species under the Bald and Golden Eagle Protection Act and the State continues to list it as a threatened species. The refuge is identified on a list of bald eagle watching sites in Pennsylvania and the successful breeding pair has drawn wide media attention to the refuge. Bald eagles remain a priority for conservation on the refuge. We would continue to adhere to the management guidelines for bald eagles in Pennsylvania. We evaluated each of the alternatives for its potential to beneficially or adversely affect the habitats where breeding, wintering, and foraging bald eagles concentrate.

Shortnose sturgeon
As mentioned above, there is potential habitat on and adjacent to the refuge for the federally listed, endangered shortnose sturgeon. While this species is not known yet to occur on the refuge, management activities could have minor effects on water quality in the Delaware River where this species is known to occur.

As part of our effects analysis, we evaluated the potential negative and positive effects on both the bald eagle and the shortnose sturgeon. Our actions that would conserve, restore, improve, or increase habitats for these species include the following:

- Improving water quality
- Improving riparian forests and coastal plain forests
- Managing and restoring freshwater tidal marsh
- Controlling invasive species

- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We also evaluated the potential for the proposed actions to cause adverse effects on habitats of federally listed and recently delisted species including the following:

- Disturbance to listed species from public use
- Impacts on habitat quality from the construction of facilities and other management actions (e.g., habitat restoration and maintenance)
- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration

4.8.1 Impacts on Endangered and Threatened Species That Would Not Vary by Alternative

Benefits

One known breeding pair of eagles occurs on the refuge. This species is not only a species of priority conservation concern, but its presence on the refuge affords valuable opportunities for environmental education and interpretation. Eagles nest in the coastal plain forest and floodplain forest habitats adjacent to open waters. Given that the breeding territory size of eagles ranges between 1,700 to 5,300 acres (Gerrard et al. 1992, Anthony et al. 1993), we do not anticipate any additional nesting pairs of eagles to be found on the refuge.

Under all alternatives, the refuge would continue to restrict access and management activities when and where appropriate near eagle nesting sites and continue monitoring the breeding success of known pairs. Long-term benefits to eagles are anticipated through the ongoing management of coastal plain and floodplain forests and open waters around the refuge. Associated benefits such as increasing native plant diversity, managing for mixed aged stands, promoting water quality, and improving habitat would also benefit nesting, foraging, and resting habitat for this species. Ongoing management activities, such as invasive species management and inventory and monitoring programs, would continue to be completed in a manner that would prevent potential impacts to bald eagles.

The refuge would continue to coordinate with the Pennsylvania Game Commission and Department of Conservation and Natural Resources, along with our conservation partners, to ensure that we utilize the best available science in our management decisions.

Remediation of Folcroft Landfill, restoration of refuge habitats, continued land acquisition and protection of vegetation and water resources, all benefit water quality on the refuge and to a minimal extent off-refuge. Improved water quality provides minimal benefits to shortnose sturgeon in the Delaware River.

Adverse Impacts

Refuge management actions, public use, and construction projects could have adverse effects on bald eagles using the refuge. We would carefully plan all refuge management actions in or nearby nesting habitat to ensure that we do not inadvertently alter potential nesting site characteristics. While foot traffic from visitors is not likely to impact eagles utilizing the existing nest location, we would continue to employ outreach efforts to trail users to avoid any potential noise disturbance created from trail use.

Construction of new interpretive infrastructure, such as the webcam viewing the existing eagle nest, will follow protocols outlined in the National Bald Eagle

Management Guidelines and Pennsylvania Bald Eagle Management Plan to ensure minimal negative impacts.

Under all three alternatives, public use, refuge management actions, and construction projects could have short-term, localized adverse effects on water quality. As stated previously, we would follow best management practices to minimize potential adverse effects associated with these activities, including best management practices for soil erosion and for preventing spills. Given that the eagle nest is located in a portion of the refuge inaccessible to the public, and without major facilities, we expect the likelihood of impacts to be minimal regardless. Although there may be short-term negative impacts to bald eagle foraging areas, these impacts would be very localized. Because bald eagles tend to have large ranges and are highly mobile foragers (Elliott et al. 2006), we expect these impacts to be minimal. These activities are not expected to have noticeable effects on water quality within the Delaware River; therefore, no adverse effects are expected on shortnose sturgeon.

4.8.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to shortnose sturgeon are the same as those discussed in *Impacts That Would Not Vary by Alternative*.

In addition to the benefits described under *Impacts That Would Not Vary by Alternative*, bald eagles may also be affected by drawdown of the refuge impoundment. Depending on the timing, the drawdown of the impoundment reduces the overall acreage of available open water habitat for eagle foraging. Based on observations (Stolz and Phillips personal communication 2011), this may actually concentrate the fish present in the impoundment and improve foraging efficiency. As a result, the drawdowns are thought to have a net-neutral or slightly beneficial effect.

Adverse Impacts
Adverse impacts to bald eagle populations are similar to those discussed in *Impacts That Would Not Vary by Alternative,* plus the following.

In addition to activities common to all alternatives, alternative A continues the current management practice of manipulating water levels within the 145-acre impoundment in order to provide seasonal migration stopover habitat for various bird groups such as waterfowl, wading waterbirds, and shorebirds. As discussed above, the drawdown of the impoundment may reduce the overall acreage of available open water habitat for eagle foraging. This temporary alteration of habitat is unlikely to result in any major loss of habitat for known eagle populations because areas of freshwater tidal marsh, along with open waters of Darby Creek and the Delaware River, continue to provide suitable amounts of available habitat.

Potential adverse impacts on shortnose sturgeon are described under *Impacts That Would Not Vary by Alternative.*

4.8.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Alternative B would provide long-term benefits to the bald eagle as a result of the restoration of additional coastal plain and floodplain forests. The conversion of the 15-acre nonnative poplar stand to a mix of hardwood species would provide improved rest, roosting, and nesting habitat. The restoration of additional freshwater tidal marsh would also provide additional forage habitat for eagles as well (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990).

The additional nursery habitat for fish species could also benefit shortnose sturgeon populations by contributing to their prey base. This contribution is expected to be negligible.

Adverse Impacts
This alternative would result in a decrease in up to 73 acres in open water habitat associated with the conversion of up to half of the 145-acre impoundment to freshwater tidal marsh. This conversion of habitat types would reduce the available open water acreage near the known nesting site. However, the planned habitat type, freshwater tidal marsh, is another favorable foraging habitat for eagles (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990); as a result, no substantial adverse impacts from restoring portions of the impoundment are expected on this species.

The restoration of the 15-acre nonnative poplar stand to native forest could result in a localized, short-term loss of habitat for bald eagles. We would follow the recommendations in the National Bald Eagle Management Guidelines and the Pennsylvania Bald Eagle Management Plan to ensure minimal negative impacts. We would also complete the restoration in several phases, so that at any one time fewer than 10 acres would be impacted.

Alternative B also anticipates an increase onsite visitation to the refuge from the 133,000 estimated in 2009, to around 196,300 over the next 15 years. Much of this increase is expected in the form of school groups or wildlife-dependent recreational visitors. Eagles typically avoid nest sites with nearby human activity (boat traffic, pedestrians) and buildings or development (Buehler et al. 1991). The current nesting site is over 400 feet from the nearest trail and is inaccessible to visitors, and no new trails would be constructed near the known nesting areas. An increase in general trail use is unlikely to create noise impacts or disturbances of note, especially in relation to the ambient noise and disturbance already present from regional rail line and Bartram Avenue traffic located roughly 700 feet from the nesting site.

Noise from construction activities could potentially carry to eagles and be a disturbance; however, most infrastructure improvements identified under this alternative are located well beyond the landscape buffer distance requirements highlighted in the National Bald Eagle Management Guidelines. We would follow the Service's guidelines to ensure there are no adverse effects to eagles on the refuge including observing season restrictions and landscape buffer zones.

Potential adverse impacts on shortnose sturgeon are described under *Impacts That Would Not Vary by Alternative.*

4.8.4 Impacts of Alternative C

Benefits
Similar to alternative B, alternative C would maintain and restore most habitats utilized by bald eagles on the refuge. The restoration of additional freshwater tidal marsh would provide additional forage habitat for eagles as well (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990).

The additional nursery habitat for fish species could also benefit shortnose sturgeon populations by contributing to their prey base. This contribution is expected to be negligible.

Adverse Impacts
Compared to alternatives A and B, this alternative would result in the most decrease in open water habitat with the restoration of the entire 145-acre impoundment to freshwater tidal marsh. This conversion of habitat types would

reduce the available open water acreage near the known nesting site. However, eagles are known to nest up to 1 mile (1.6 kilometers) from open water (Anthony and Isaacs 1989). Areas of freshwater tidal marsh, along with open waters of Darby Creek and the Delaware River continue to provide suitable amounts of available habitat so any potential adverse impacts are expected to be minimal.

In contrast to alternative B, alternative C would convert the 15-acre nonnative poplar stand to a shrub-scrub habitat type. Shrub-scrub is not a habitat type that provides significant resting, breeding, or foraging habitat for bald eagles. Conversion to a shrub-scrub habitat type would not significantly reduce the amount of forested habitat, but it would reduce the overall acreage of forested habitats near open water or tidal marsh habitat.

Compared to alternatives A and B, there would be more people walking off-trail on the refuge if opened to hunting. Since the hunt would be controlled, refuge staff would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on these species.

As in alternative B, alternative C anticipates an increase in refuge participation and visitation. However, alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B. As noted in the discussion of *Impacts of Alternative B*, minimal adverse impacts on eagle nesting sites are anticipated with this increase in visitation. We would continue to monitor the eagles present on the refuge and make changes in management or access as needed to continue our protection of this species.

As with alternative B, construction activities could have adverse effects on bald eagles. We would continue to adhere to Service guidelines as described under alternative B to ensure there are no adverse effects to bald eagles on the refuge, including observing landscape buffer zones and seasonal restrictions.

4.9 Impacts on Landbirds

The conservation and management of forested and grassland habitats are a priority of the refuge and consistent with its establishment purposes, as well as one of our CCP goals. We evaluated each of the alternatives for its potential to benefit or adversely affect early successional and forested habitats and associated landbirds.

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of landbirds and identified focal species (e.g., osprey, peregrine falcon, sedge wren, and the short-eared owl), including the following:

- Improving riparian forests and coastal plain forests
- Managing and restoring freshwater tidal marsh
- Controlling invasive species
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of landbird focal species, including the following:

- The disturbance of listed species from public use
- The impacts on habitat quality from the construction of facilities

- The potential impacts from the aerial spraying of invasive species, forest Improvements, impoundment water level manipulation, or marsh restoration.
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds.

4.9.1 Impacts on Landbirds That Would Not Vary by Alternative

Benefits

Besides the bald eagle, several other State-listed endangered or threatened landbirds use the refuge including osprey, peregrine falcon, sedge wren, and the short-eared owl. These species primarily use coastal plain and floodplain forests for breeding, foraging, and resting habitats. Habitat use does extend into other habitat types, for example Osprey hunt in open water and riverine habitats. Sedge wrens nest and forage primarily in freshwater tidal marsh and nontidal wetlands. Peregrine falcons also hunt in grassland and wetland habitats.

Several other landbirds that are not State-listed, but identified as regional conservation priorities, are included in this group as well. Species such as American woodcock, marsh wren, prothonotary warbler, wood thrush, and worm-eating warbler are all noted as high management priorities in plans such as BCR 30, the Service's Birds of Conservation Concern list, and Pennsylvania's Wildlife Action Plan.

Under all alternatives, the refuge would continue to restrict access and management activities when and where appropriate near known nesting sites and continue breeding success monitoring as described in chapter 3. Long term benefits to landbirds are anticipated through the ongoing management of coastal plain and floodplain forests and other terrestrial habitats around the refuge. Invasive species management and supplemental plantings help enhance and restore the habitats landbirds use for nesting, foraging, and migratory stopover. Ongoing management activities, such as invasive species management and inventory and monitoring programs would continue to be completed in a manner that would prevent potential impacts to individual species.

The refuge would continue to coordinate with Pennsylvania Game Commission and Department of Conservation and Natural Resources, along with our conservation partners, to ensure that we use the best available science in our management decisions related to State-listed species.

Adverse Impacts

Regardless of the alternative, we would continue to employ a range of management tools to achieve our objectives in managing for the improved health and integrity of landbird habitats. We would use these tools only when and where appropriate, and only with the proper training and focused application to avoid adverse impacts. For example, invasive species control can be detrimental to landbirds if proper timing and application are not considered. Short-eared owls have been known to nest on the refuge under colonies of mile-a-minute vines within the 15-acre nonnative poplar stand. As a result, our invasive species control efforts for both the nonnative poplar and mile-a-minute are completed outside of the nesting season, generally from mid-March to mid-September in the Northeast (Holt and Melvin 1986; Tate and Melvin 1987, 1988; Combs and Melvin 1989).

We do not expect negative impacts to land birds associated with herbicide or pesticides used on the refuge. All of the herbicides used on the refuge are practically non-toxic to birds (USDOE 2000a, USDOE 2000b, USDOE 2006a,

USDOE 2006b, USEPA 1997). Triclopyr, glyphosate, and imazapic also have no to low potential to bioaccumulate in bird tissues (USDOE 2000a, USDOE 2000b, USDOE 2006a). According to the USEPA (1998), no studies have found *Bacillus thruingiensis israelensis* to be toxic to birds. *Bacillus sphaericus* is not expected to have any adverse impacts to any nontarget species (USEPA 1999).

In general, the presence of humans disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Disturbance varies by wildlife species involved and the type, level, frequency, duration and the time of year activities occur. Disturbance can cause shifts in habitat use, abandonment of habitat, and increased energy demands on affected wildlife (Knight and Cole 1991). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. In this study, common species (e.g., American robins) were found near trails and rare species (e.g., Blackburnian warblers) were found farther from trails. In some cases there is a clear link between the extent of disturbance and either the survival or reproductive success of individuals (Schulz and Stock 1993), but in many cases disturbance acts in a more subtle way by reducing access to resources such as food supplies or nesting sites (Gill et al. 1996). Bird flight in response to disturbance can lower reproductive success by exposing individuals and nests to predators. For recreation activities that occur simultaneously (hiking, biking, and horseback riding) there would likely be compounding negative impacts to wildlife (Knight and Cole 1991).

Wildlife disturbance may be compounded by seasonal needs. For example, some species, like warblers, could be negatively affected by disturbance associated with bird watching particularly during the breeding season. When visitors approach nests too closely, they often cause the adult bird to flush, exposing the eggs to weather conditions or predators (Banks and Bryant 2007, Miller et al. 2001). The extent of that disturbance along the trail also depends on visibility and the density of vegetation. For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Disturbance may also affect the reproductive fitness of males by hampering territory defense, mate selection, and other reproductive functions of vocalizations (Arrese 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents, which are time- and energy-consuming in defending territories (Ewald and Carpenter 1978).

As discussed throughout this document, the refuge is located in a highly urban environment, with substantial baseline disturbance associated with the international airport, I-95, several State routes, and numerous houses, businesses, community buildings, and associated human activity. By limiting the presence of humans to refuge trails and infrastructure, refuge visitors are not expected to add significantly to existing disturbance levels. Overall, the direct disturbance from public use is expected to have minimal or no adverse effects on landbirds.

Domestic or house cats, both free ranging domestic and feral, also have negative effects on wildlife. Cats prey on wildlife, compete with native wildlife, and can transmit diseases to wildlife, pets, and people. Cat predation is an added stress to wildlife populations already struggling to survive habitat loss, pollution, pesticides, and other human impacts (ABC 2009). The cumulative negative effects of cats on wildlife are impossible to quantify; however, the growing body of literature strongly indicates that domestic cats are a significant factor in the mortality of native small mammals, birds, reptiles, and amphibians (CDFG 2009). At this time, we do not manage feral cat populations on the refuge. We would

continue to monitor the impacts of feral cats on landbirds and make changes in management or access as needed to continue our protection of these species.

4.9.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to landbirds are the same as those discussed in *Impacts on Landbirds That Would Not Vary by Alternative*, in addition to the following.

The prothonotary warbler and other landbirds utilize mature deciduous floodplain, riverine, and swamp forests primarily for migratory stopover and foraging habitat at the refuge (DeGraaf et al. 1980, Christman 1984). Under alternative A, we would continue to provide flooded habitats in the floodplain forests, but would not attempt to restore them to higher quality for the prothonotary warblers (Petit and Petit 1996).

As described under section 4.8.3, depending on the timing, the drawdown of the impoundment reduces the overall acreage of available open water habitat for osprey foraging but may actually concentrate the fish present in the impoundment and improve foraging efficiency. For this reason, the drawdowns are thought to have a net-neutral or slightly beneficial effect.

Adverse Impacts
Adverse impacts to landbirds are the same as those discussed in *Impacts on Landbirds That Would Not Vary by Alternative*, in addition to the following.

In addition to activities common to all alternatives, alternative A continues the current management practice of manipulating water levels within the 145-acre impoundment primarily to provide seasonal migration stopover habitat for various bird groups such as waterfowl, wading waterbirds, and shorebirds. While the drawdown of the impoundment may reduce the overall acreage of available open water habitat for osprey foraging, this temporary alteration of habitat does not result in any major loss of habitat for osprey. Area of freshwater tidal marsh, along with open waters of Darby Creek and the Delaware River continue to provide suitable amounts of open water habitat.

4.9.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Compared to alternative A, alternative B would provide additional long-term benefits to landbirds through the protection and restoration of additional coastal plain and floodplain forests, freshwater tidal marsh, and grassland enhancements. The conversion of the 15-acre nonnative poplar stand to a mix of hardwood species would provide improved habitat structure and species composition needed for various warblers and other forest birds like the short-eared owl, peregrine falcon, and wood thrush. Phased removal and reforestation of this area would help minimize short-term impacts or habitat loss. The restoration of additional freshwater tidal marsh would improve nesting habitat for landbirds such as the sedge wren or marsh wren, while also improving forage habitat for short-eared owls and peregrine falcons (AOU 1983).

We would also maintain and improve the larger patches of grassland to provide the most benefit to species that use this habitat. By expanding warm-season grass coverage in conjunction with seed-producing native flowering species, we would improve habitat quality for bird species that use these areas for foraging and potentially nesting.

Controlling the deer population under alternative B would improve plant regeneration in forested and grasslands areas of the refuge. An increased diversity and abundance of vegetation across these habitats would help improve nesting site availability and success.

Adverse Impacts
Restoration of freshwater tidal marsh, forests, and grasslands under alternative B would likely result in short-term and infrequent disturbances to landbirds during the construction and maintenance of these areas. We would continue to monitor known nest locations and adjust our management to minimize impacts on landbirds.

Restoration of the 15-acre nonnative poplar forest would result in the short-term loss of nesting habitat for the short-eared owl. This species currently nests under canopy cover created by the nonnative, invasive mile-a-minute vine found throughout this portion of the refuge. Phased clearing of the 15-acre area would reduce the impact on long-term disturbance to nesting sites. The short-eared owl builds temporary nest sites and tends to be a habitat generalist in terms of selecting nest locations. As a result, we anticipate that the conversion to coastal plain or floodplain forest in this area would result in a net-neutral benefit for the short-eared owl.

Alternative B anticipates an increase in refuge participation and visitation, from the 133,000 estimated in 2009, to around 196,300 over the next 15 years. Much of this increase is expected in the form of school groups or recreational uses. As noted in the *Impacts on Landbirds That Would Not Vary by Alternative* discussion, use of existing trails poses minimal potential impact to nesting landbirds. Most current visitation occurs on the trails surrounding the impoundment and forests located east of the impoundment (Stolz personal communication 2010). This overall trend in where visitation occurs is likely to remain the same, although there is potential that additional visitation could be made available at the Folcroft Landfill site upon its closure and release. The potential for public access in light of site remediation and long-term maintenance has yet to be determined at the time of this writing. Opportunities for additional access would need to be evaluated in the future.

We would take all necessary measures to mitigate those potential adverse effects, particularly where group educational activities are involved. We would minimize potential adverse effects by spreading visitation out over time and, if possible and beneficial, space. Under this alternative we would pursue additional school groups to visit the refuge during slower seasons (i.e., fall and winter). We would also pursue opening additional trails and visitor facilities, such as overlooks, on the Folcroft Landfill site after site remediation is completed and the area has been cleared for public use. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

Added public use infrastructure proposed under alternative B, such as boardwalks and kiosks, would not be constructed near known nesting areas. Construction timing would also be considered where necessary to avoid potential disturbance to nesting species, as well as to minimize impacts on foraging and resting habitat during important seasonal periods such as nesting or migration. As a result minimal adverse impacts are anticipated from proposed construction projects. Construction of some of these infrastructure improvements would result in a minor loss of grasslands. However, effects on grassland dependent species are expected to be minimal since habitat patches are generally small (less than 10 acres) and no nesting is known to occur in these areas.

Expansion of office facilities proposed under alternative B would have a minimal short-term adverse impact on landbirds utilizing the floodplain forests or

grasslands around the visitor center. The majority of the building expansion footprint would be contained within an area already covered by asphalt pavement. A small portion of edge woodland (less than 0.1 acres) along the refuge border near Lindbergh Boulevard would likely be lost as a result of construction. No State-listed species or species of conservation concern are known to nest within, or adjacent to, the proposed construction footprint. As a result, no significant, long-term impacts are expected as a result of the office facility construction.

4.9.4 Impacts of Alternative C

Benefits
Alternative C differs slightly from alternative B in benefits to landbirds. This alternative would restore the 15-acre nonnative poplar stand to a shrub-scrub community. This habitat type is currently under-represented across the refuge and region. Its conversion on the refuge would benefit various warbler species and other songbirds that benefit from dense shrub cover. Restoration of the entire 145-acre impoundment to freshwater tidal marsh would provide increased benefits (compared to alternative B) by providing additional nesting habitat for landbirds such as the sedge wren or marsh wren, while also increasing foraging habitat for many land bird species including short-eared owls and peregrine falcons (AOU 1983).

Similar to alternative B, providing additional opportunities for environmental education and interpretation would raise public awareness and support for wildlife protection and habitat conservation.

Adverse Impacts
Adverse impacts to landbirds are similar to those discussed in alternative B. In contrast to alternative B, alternative C would result in less acreage of forested habitat (26 fewer acres) and grasslands (6 fewer acres). The acres lost from these habitats would coincide with an equal increase in shrub-scrub habitat.

This conversion of habitat types would provide habitat for some landbirds, but not specifically for those identified as State-listed species or focal species of conservation concern such as prothonotary warbler, short-eared owl, or osprey (Holt and Melvin 1986, Stasz 1996, AOU 1983). Despite this, the acreage targeted for conversion is relatively small (approximately 8 percent) in total land cover in comparison to other upland forest and grassland habitats.

Short-eared owls nesting in the nonnative poplar forest (as described under alternative B) would experience greater displacement in nesting opportunities under alternative C due to the single large-scale clearing of the entire 15-acre area. We would time the restoration to avoid the nesting season for this species. In addition, as described under alternative B, this species is a nesting generalist and is likely to find suitable nesting habitat elsewhere throughout the refuge. As a result, we anticipate a minimal negative impact on this species over the short term until individuals identify new nesting sites.

As in alternative B, alternative C also anticipates a similar increase in refuge participation and visitation, although alternative C would also result slightly lower numbers of public use visitation when compared to alternative B. Potential adverse impacts under this alternative would be intermediate between alternatives A and B. Compared to alternatives A and B, there would be more people walking off-trail on the refuge if opened to hunting, increasing potential for disturbance. Since the hunt would be controlled, refuge staff would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on these species.

4.10 Impacts on Open Water and Wetland Bird Species

The conservation and management of open water and wetland habitats are a priority of the refuge. Their management is consistent with the refuge's purposes and our CCP goals. We evaluated the management actions each of the alternatives proposes for their potential to benefit or adversely affect open waters and wetland habitats and their associated focal species.

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of waterbird focal species (e.g., American bittern, great egret, king rail, and least bittern), including the following:

- Managing and restoring freshwater tidal marsh
- Controlling invasive species
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of waterbird focal species, including the following:

- The disturbance of species from public use
- The impacts on habitat quality from the construction of facilities
- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds

4.10.1 Impacts on Open Water and Wetland Birds That Would Not Vary by Alternative

Benefits
Under all alternatives, the refuge would continue to restrict access and management activities when and where appropriate near known nesting sites and continue breeding success monitoring. Long term benefits to waterbirds are anticipated through the ongoing management of existing freshwater tidal marsh and the impoundment, primarily in the control and reduction of purple loosestrife and phragmites. Management efforts to control purple loosestrife and phragmites can provide long-term habitat benefits to some wetland bird species (Gibbs and Melvin 1992, Hammerson and Mehlman 1995).

The refuge would continue to coordinate with Pennsylvania Game Commission and Department of Conservation and Natural Resources, along with our conservation partners, to ensure that we utilize the best available science in our management decisions related to State-listed species.

Waterfowl and shorebirds that are not State-listed, but still of regional conservation priority, would continue to utilize freshwater tidal marsh, open waters and associated mudflats along Darby Creek. Restoration of the 55-acre phragmites-dominated wetland to freshwater tidal marsh would add beneficial habitat for many open water and wetland bird species.

Adverse Impacts
Some wetland birds may be present during aerial applications of herbicides for phragmites control and may experience direct contact with herbicides if they do not flush ahead of the helicopter flyover, or if spray misses the targeted

application patch. We do not expect this as a frequent occurrence, as those species (such as American bittern) show no strong affiliation with dense stands of phragmites (Gibbs and Melvin 1992, Hammerson and Mehlman 1995). If waterbirds do come in direct contact with herbicides, as mentioned in section 4.9.1, all of the herbicides used on the refuge are practically non-toxic to birds (USDOE 2000a, USDOE 2000b, USDOE 2006a, USDOE 2006b, USEPA 1997). Also as mentioned above, neither of the pesticides used on the refuge are expected to adversely impact birds (USEPA 1998, USEPA 1999).

Bennett and Zuelke (1999) summarize several studies indicating that recreation activities would have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). As discussed under the section on landbirds above, we would take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

Public users of the areas along Darby Creek, the 145-acre impoundment, and tidal marsh could damage marsh grasses or disturb nesting or foraging marsh birds or otherwise degrade these areas. This can occur through the deposit of used fishing line, tackle, or other trash or by disturbance to bank areas and creation of turbidity. Refuge signage, flyers, and other public information materials would continue to be used to ensure that the public is aware of these issues and does not engage in harmful activities.

Boaters that access the refuge from Darby Creek could disturb species using these habitats. The refuge does not own or control access for most of Darby Creek. We do post speed limits for motorized boats within refuge waters to minimize disturbance to wildlife and habitats. Erosion problems caused by power boats are addressed by the creation of no wake zones and State boating regulations.

It is important to note that the refuge exists within a highly altered area with substantial baseline levels of disturbance associated with interstate traffic, airport activities, adjacent neighborhoods and roads. Overall, the effects from public use are expected to have minimal adverse effects on birds utilizing open water and wetland habitats. There are few visitor facilities (e.g., trails) in these habitats due to the presence of open water and saturated soils; therefore, they are relatively inaccessible to the public. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species like American bittern against human disturbance (Gibbs and Melvin 1992). Boaters that access the refuge from Darby Creek could disturb species using these habitats. The refuge does not own or control access for most of Darby Creek. We do post speed limits for motorized boats within refuge waters to minimize disturbance to wildlife and habitats.

4.10.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to open water and wetland birds are the same as those discussed in *Impacts That Would Not Vary by Alternative.*

In addition to activities common to all alternatives, alternative A continues the current management practice of manipulating water levels within the 145-acre impoundment in order to provide seasonal migration stopover habitat for

various bird groups such as waterfowl, wading waterbirds, and shorebirds. As discussed in chapter 3, alternative A, and documented by a regional study of refuge impoundment management (Green et al. 2008) the proper management of impoundment water levels creates beneficial stopover habitat for waterfowl, wading waterbirds, and shorebirds. Areas of freshwater tidal marsh, along with open waters of Darby Creek and the Delaware River would also continue to provide available nesting, foraging, and stopover habitat for water birds.

Adverse Impacts
Impacts to open water and wetland birds are the same as those discussed in *Impacts That Would Not Vary by Alternative.*

4.10.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Alternative B would provide long-term expansion of open water and wetland habitats through the restoration of additional freshwater tidal marsh. The restoration of large freshwater tidal marsh areas would increase nesting, foraging, and migratory stopover habitat for waterfowl, shorebirds, and wetland wading birds (AOU 1983, Brown and Dinsmore 1986, Frazer et al. 1990, Gibbs and Melvin 1990).

Restoration of up to half of the impoundment would add to the benefits provided by freshwater tidal marsh. More detailed comparison of use of freshwater tidal marsh and the 145-acre impoundment by birds on the refuge would be evaluated further under this alternative to ensure that the most beneficial array of marsh and open water habitat is provided. Constructing a new dike and reconfiguring the impoundment would include installing a new water control structure. This would benefit associated waterbirds by improving our ability to control water levels within the impoundment to better address needs of migrating birds.

Expanded restoration of freshwater tidal marsh, including portions of the 145-acre impoundment, would allow us to improve our education and interpretation about the importance of tidal marsh habitat, habitat restoration, and wildlife conservation. The added level of environmental education and environmental interpretation outlined in alternative B would increase awareness about the importance of open water and freshwater tidal marsh habitat for waterbirds. Understanding the value of its conservation would potentially create long-term benefits for these species and their habitats.

Adverse Impacts
The conversion of up to half of the 145-acre impoundment would result in a loss of nontidal open water habitat from the refuge. However, the adverse effects on wildlife as a result of this would likely be negligible, since most waterfowl, wetland wading birds, and shorebirds readily utilize freshwater tidal marsh and open waters and mudflats which are available elsewhere on the refuge (AOU 1983, Brown and Dinsmore 1986, Frazer et al. 1990, Gibbs and Melvin 1990). Under this alternative, we would retain some of the open water impoundment habitat, limiting potential adverse effects associated with this project.

Construction of this, and other restoration projects proposed under alternative B, would result in short-term disturbances to soils, vegetation, hydrology, and soundscapes of localized portions of habitat used by open water and wetland birds. We would undertake considerations during our construction and its timing to minimize these impacts. We anticipate the long-term benefit of this habitat to exceed any minor, short-term impact on these species' habitat.

Alternative B anticipates an increase in refuge participation and visitation, from the 143,200 estimated in 2010, to around 196,300 over the next 15 years. Much

of this increase is expected in the form of school groups or recreational uses. As noted in the "adverse impacts common to all alternatives" discussion, use of existing trails poses minimal potential impact to birds nesting in open water or wetland habitats. Most current visitation occurs on the trails surrounding the impoundment and forests located east of the impoundment (Stolz personal communication 2010). This overall trend is where visitation occurs and is likely to remain the same.

Added public use infrastructure proposed under alternative B such as boardwalks and kiosks would not be constructed near known nesting areas. Public viewing areas with regular use near rookeries have documented no impact on species such as egrets (DeMauro 1993). Construction timing would also be considered where necessary to avoid potential disturbance to sensitive species. As a result, only minimal, short-term impacts are anticipated from proposed construction projects.

4.10.4 Impacts of Alternative C

Benefits

Compared to alternative B, alternative C varies slightly in its benefits to open water and wetland birds. The restoration of the entire 145-acre impoundment to freshwater tidal marsh would improve foraging and nesting habitat for State-listed wetland wading birds such as the American bittern, least bittern, and king rail (AOU 1983, Brown and Dinsmore 1986, Gibbs and Melvin 1990) as well as waterfowl like the American black duck, lesser scaup, and northern pintail (AOU 1983, AOU 1998, Frazer et al. 1990). Marsh and adjacent intertidal mudflats along Darby Creek and marsh channels would also continue to provide foraging and stopover habitat for migratory shorebirds such as black-bellied plover, greater yellowlegs, and lesser yellowlegs (AOU 1983, Stiles and Skutch 1989).

Similar to alternative B, a more detailed comparison of use of freshwater tidal marsh and the 145-acre impoundment by birds on the refuge would be evaluated further under this alternative to ensure that the most beneficial array of marsh habitat is provided.

Adverse Impacts

Similar to alternative B, alternative C anticipates an increase in refuge visitation. As noted in the discussion of *Impacts of Alternative B*, precautionary measures already in place on the refuge would result in infrequent, localized impacts on open water or wetland birds with the anticipated increase in visitation. We would continue to monitor refuge visitation and potential impacts on open water and wetland birds and adjust our management to continue our protection of these species as needed.

Compared to alternatives A and B, there would be more people walking off-trail on the refuge if opened to hunting, increasing the potential for disturbance. Since the hunt would be controlled, refuge staff would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on these species.

Alternative C also would develop a secondary method of transportation that would allow visitors to gain access to portions of the freshwater tidal marsh either via a tram, shuttle bus, or boat tour. Detailed plans for this component are not in development at this time. A full evaluation of impacts would be required prior to developing this activity. Depending on the frequency, duration, and method of transportation, providing any of these options could pose disturbance to populations of open water or wetland birds on the refuge. We would continue to only pursue a transportation option that minimizes the impact on wildlife and the habitats they utilize.

4.11 Impacts on Fisheries

The nearby Delaware River holds a unique distinction as being one of North America's few great rivers without a dam on the main channel, allowing for the continued passage of fish and a biologically connected river ecosystem. In past years, however, the fisheries in and around Philadelphia have been degraded by human influences. Channelization and damming of headwater streams, modification to the original river channels through dredging, deepening, and filling, increased sediment loads, alteration to flow rates and patterns, and the removal of tidal marsh habitat have combined to put the future of this resource in jeopardy. Contaminants from adjacent landfills have also been documented as negatively impacting the health of some fish on the refuge (Pinkney et al. 2004). One of the largest remaining migrations of anadromous fish along the east coast of the United States passes almost unnoticed along the shoreline of Philadelphia every year. Every spring, generally from April to June, tens of thousands of shad, herring, and alewife migrate from the Atlantic Ocean up the Delaware River to spawning grounds in the vast network of headwater tributaries (PNHP 2008). The Delaware River is also home to the federally listed, endangered shortnose sturgeon. Individuals from the Delaware River population spawn in the freshwater section of the Delaware River from mid-winter to early spring and spend the summer near the mouth of Delaware Bay (Hastings and O'Herron 1987 et al., NMFS 1998). Because this species prefers larger rivers (Dadswell et al. 1984) sturgeon are not expected to occur in waters passing through the refuge.

The refuge supports a relatively diverse fish community with at least 28 documented species. Water quality is generally within the tolerable range for most species along Darby Creek. Estimates of species richness suggest the total number of species in refuge waters may be as high as 36 species. The refuge also serves as habitat for some species that are of Federal or State conservation concern, which is notable in such an urban environment (Sweka and Mohler 2010).

The refuge supports several Federal trust fish species, such as blueback herring, hickory shad (also considered State-endangered), alewife, American eel, and striped bass. These species are considered species of conservation and management concern by the Region 5 Fisheries program (Sweka and Mohler 2010).

Fishing is a regular public use across the refuge. The largemouth bass and sunfish populations in refuge waters appear to supply quality recreational angling opportunities as does Hoy's Pond. Some fish are nearly 16 inches (400 mm) in total length (Sweka and Mohler 2010).

Wetland management to protect the river's fisheries and nurseries for native anadromous and catadromous fish is a priority at the refuge, one that is consistent with its original establishing purposes, and our CCP goals. We evaluated the management actions and public uses each of the alternatives proposes for its potential to benefit or adversely affect wetlands and riparian habitats used by fish.

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of fish species likely to utilize refuge habitats, including the following:

- Managing and restoring coastal plain and floodplain forests, the 145-acre impoundment, grasslands, open waters, and freshwater tidal marsh
- Controlling invasive species

- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of fish, including the following:

- The disturbance of species from public use
- The impacts on habitat quality from the construction of facilities
- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds

4.11.1 Impacts on Fisheries That Would Not Vary by Alternative

Benefits

Many of the same management actions for protecting wetlands and other species, such as controlling nonnative invasive plants and providing or improving vegetated buffers around wetland-upland interfaces and riparian edges, are actions that would take place regardless of which alternative we select, and would not only benefit wetlands but the fish species that depend on good water quality and a well-functioning wetland ecosystem. Controlling phragmites throughout freshwater tidal marsh habitats has an indirect benefit for fish. The build-up of leaf litter from phragmites raises marsh elevations, which in turn affects the hydrologic regime that creates the little shaded rivulets and pools that fish need for nurseries and foraging. Over time, these nursery areas would likely disappear without phragmites control.

Where floodplain forests are found adjacent to open water, the debris from trees and other vegetation falling into the water provides cover and food, as well as helping to lower water temperatures. Many related benefits of floodplain forests are also described under the section on hydrology and water quality. Components regarding open water and wetlands relate to fisheries as well.

Protection and conservation of tidal portions of Darby Creek, in combination with freshwater tidal marsh, provides a unique and productive habitat for many fish species. Some estuarine species, such as killifishes and mummichogs (*Fundulus spp.*), complete their entire life cycle in estuarine portions of rivers, creeks, and tidal marshes. Anadromous fish, such as the blueback herring and alewife, use tidal streams and rivers like Darby Creek and its side channels as nursery habitat for juveniles (Odum et. al. 1984). American eel, the only catadromous fish species in Atlantic Coast estuaries, spends most of its adult life in freshwater estuaries and are common in tidal creeks, rivers, and marsh channels (Lippson et al. 1979). Thus, improving water quality and restoring suitable channel morphology where possible is critical to maintaining healthy biological integrity, diversity, and environmental health (BIDEH) parameters that support these and other fish species.

The restoration of the 55-acre freshwater tidal marsh project would likely include the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species. This would increase and improve foraging and nursery habitat for fish species using the refuge's waters.

We would continue to work with EPA to complete the eventual remediation and closure of Folcroft Landfill. This effort is expected to reduce long-term contaminant levels within Darby Creek, and at least marginally in the Delaware River, and as a result would increase the health of aquatic resources utilizing the refuge.

We would also continue to work with neighboring entities (such as Philadelphia International Airport and Tinicum Township) to complete conservation-related projects that would restore biological connections and suitable habitat for fish species of Federal, State, or regional conservation priority.

Several dam removal and other fish barrier removal efforts along Darby Creek have been implemented in the past few years supporting the National Fish Habitat Action Plan (NFHAP 2008) Strategy 3. While these efforts are mainly located beyond the boundaries of John Heinz NWR, Strategy 3 can be supported at the refuge by freshwater tidal marsh restoration efforts that incorporate the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species.

The refuge would also continue to coordinate with Pennsylvania Fish and Boat Commission, along with our conservation partners, to ensure that we utilize the best available science in our management decisions related to State-listed species.

Adverse Impacts
The restoration of the 55-acre freshwater tidal marsh project could cause localized temporary impacts to fishery resources due to soil disturbance and sedimentation. We would take precautions necessary to minimize the impacts associated with a large-scale wetland restoration. Detailed information on how this would be addressed would be developed during the restoration plan development.

Overall, the effects from public use (both current and anticipated) are not likely to have an impact on fisheries utilizing open water and wetland habitats along Darby Creek and other areas of the refuge. By providing fishing opportunities, we do pose impacts to individual fish. However, anglers on the refuge are required to comply with State fishing regulations which are intended to protect fish populations. While we encourage catch and release because of the potential contaminants present in game fish, this also helps maintain local fish populations. We feel that the long-term protection benefits gained by connecting people to nature through this public use outweigh the adverse impacts on individual fish. Regardless of the alternative, we would continue to employ a range of management tools to achieve our objectives in managing for the improved health and integrity of open water and wetland habitats.

Environmental contaminants have a major impact on the health and fitness of fish present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site. The Lower Darby Creek Area includes four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Of the five sites, only Folcroft Landfill is located on the refuge. In all alternatives, the refuge would continue to provide technical support and continue to coordinate with the EPA regarding studies, monitoring, and contaminant remediation that is ongoing, and final closure design and implementation.

Other sources of environmental contamination can be created by stormwater runoff from surrounding lands and the watershed. Our use of herbicides

in invasive species control could also potentially cause small localized and temporary contamination in the event of an unintentional spill or misapplication. Triclopyr is highly toxic to freshwater fish, but has little potential to bioaccumulate (USDOE 2000a). Since we use triclopyr to treat upland invasive species on the refuge and it has a low potential to leach into groundwater and a moderate potential for surface water runoff (USDOE 2000a), we do not anticipate any adverse impacts to refuge fish. Imazapic is slightly toxic to freshwater fish, but has a low potential to bioaccumulate in fish tissue (USDOE 2006a). Since we use impazapic to treat upland invasive species on the refuge, we do not anticipate any adverse impacts to refuge fish. Glyphosate formulations labeled for terrestrial uses are moderately toxic to freshwater fish and have little to no potential to bioaccumulate (USDOE 2000b). Formulations labeled for aquatic and terrestrial uses are practically non-toxic to freshwater fish, and also have little to no potential to bioaccumulate (USDOE 2000b). Both imazamox and animopyralid are practically non-toxic to fish and aminopyralid is not expected to bioaccumulate in fish tissue (USEPA 1997, USDOE 2006b). *Bacillus thruingiensis israelensis* and *Bacillus sphaericus* are also not expected to have any adverse impacts to fish species (USEPA 1998, USEPA 1999). By continuing to only apply approved herbicides and pesticides, use proper application procedures, and follow best management practices, we anticipate little to no adverse impacts to fish on the refuge.

4.11.2 Impacts of Alternative A (Current Management)

Benefits

Benefits to fisheries are the same as those discussed in *Impacts That Would Not Vary by Alternative*.

Adverse Impacts

Impacts to fisheries are the same as those discussed in *Impacts That Would Not Vary by Alternative*.

4.11.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits

In addition to benefits discussed in *Impacts That Would Not Vary by Alternative*, alternative B would provide long-term expansion of wetland habitats through the restoration of additional freshwater tidal marsh. The restoration of large freshwater tidal marsh areas would expand and improve nursery, cover, and forage habitat for fish species of conservation concern (PNHP 2008).

This alternative would also include several stormwater improvement projects (such as vegetated swales and rain gardens) with the intention of reducing the impact of stormwater runoff generated by the refuge. While this would be a negligible improvement to stormwater inputs into Darby Creek, it would reduce the refuge's specific inputs and provide a demonstration for our neighboring partners and municipalities to utilize and replicate elsewhere throughout the watershed.

Expanded infrastructure under alternative B would allow visitors improved fishing opportunities as well as access to view Darby Creek. As discussed under *Impacts That Would Not Vary by Alternative*, this would create isolated negative impacts for some individual fish and would increase potential for adverse impacts associated with increased public use (e.g., littering); however, we feel that connecting people to nature through this activity would help encourage habitat conservation over time.

Adverse Impacts
Impacts to fisheries are similar to those discussed in *Impacts That Would Not Vary by Alternative*.

Alternative B also anticipates an increase in refuge visitation, from the 133,000 estimated in 2009, to around 196,300 over the next 15 years. Much of this increase is expected in the form of school groups or recreational uses such as wildlife observation and photography. Recreational fishing is likely to increase along with this trend. In 2009, the refuge estimated roughly 4,950 angler visits to the refuge. A corresponding increase in angling along with general visitation would result in an increase of up to around 6,600 angling visits per year over the life of the CCP. At this time, we do not anticipate impacts on local fish populations as a result of this increase. As noted, this would create isolated negative impacts for some individual fish; however, we believe adhering to State fishing regulations protects fish populations and that connecting people to nature through this activity would help encourage habitat conservation over time.

The expansion of office facilities proposed under alternative B would not impact any open waters. The majority of the building expansion footprint would be contained within an area already covered by asphalt pavement or a small portion of edge woodland (less than 0.1 acres) along the refuge border near Lindbergh Boulevard. Stormwater runoff generated from this construction would be relatively small and likely discharged to a combination of rain barrels and the stormwater treatment wetland already in place near the visitor center.

Added public use infrastructure proposed under alternative B such as boardwalks and kiosks would result in a negligible decrease in the amount of available open water, mostly associated with the placement of pilings to support the board walk. These facilities are not expected to generate any significant additions to stormwater discharge and therefore be of minimal impact to fisheries.

Construction of visitor services facilities and habitat restoration projects could result in short-term, localized soil disturbance, which has potential to increase sedimentation to Darby Creek and other waters on the refuge. The refuge would continue to utilize best management practices, including soil erosion and sedimentation controls, as part of all construction projects to minimize the impacts to fisheries.

4.11.4 Impacts of Alternative C

Benefits
Benefits to fisheries are similar to those discussed in *Impacts of Alternative B*. Restoration of the entire impoundment would provide additional nursery, cover, and forage habitat for fish species of conservation concern (PNHP 2008).

Adverse Impacts
Adverse impacts to fisheries are similar to those discussed in *Impacts of Alternative B*.

One difference when compared to alternative B is that the refuge would hold off on future tidal marsh restoration, which would delay short-term negative effects associated with restoration efforts but would also delay benefits to fish species utilizing this habitat type for nursery areas or cover.

Similar to alternative B, alternative C anticipates an increase in refuge participation and visitation, although alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B. As discussed under *Impacts That Would Not Vary by Alternative*, this would

create isolated negative impacts for some individual fish, however, we feel that connecting people to nature through this activity would help encourage habitat conservation over time. Development of a transportation system is not likely to cause any major impacts to fisheries populations. However, a boat tour route would need to consider impacts related to access and travel along Darby Creek or its side channels to avoid disturbance. Because hunters and wildlife control specialists would not hunt in open waters, there would be no adverse effects on fish species.

Effects of construction and restoration projects would be similar to those described under alternative B.

4.12 Impacts on Mammals

Mammals in southeast Pennsylvania occupy a diverse array of habitat types, food webs, and play an important role in the ecosystems within the refuge boundary. As a taxonomic group, mammals would benefit from the refuge land protection and management of coastal plain and floodplain forests, grasslands, shrub-scrub, open waters, and wetlands. Likewise, refuge habitats would benefit from careful attention to the impacts on mammals resulting from any of its activities.

Mammals on the refuge consist largely of relatively common species found across the northeast. Most of these species are able to utilize a variety of wetland or terrestrial woodland habitats, and their populations on the refuge would not be expected to change under each alternative.

There are no State-listed mammals known to exist on the refuge. No bat species of conservation concern are known to utilize the refuge. The marsh rice rat, considered to be extirpated from Pennsylvania, utilizes freshwater tidal marshes similar to those found on the refuge (PNHP 2008, Kruchek 2004). To date, no inventories have been conducted to assess potential presence or absence of this species on the refuge. River otters have been found in the rivers adjacent to the refuge (PNHP 2008). The open waters of Darby Creek throughout the refuge provide suitable habitat for otter. The refuge is listed as an area important to the conservation and protection of Pennsylvania's mammal populations under the Important Mammal Area (IMA) program, developed by the Pennsylvania Biological Survey. The area is noted as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat in the Commonwealth (PNHP 2008).

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of mammal species likely to utilize refuge habitats:

- Managing and restoring freshwater tidal marsh
- Controlling invasive species
- Establishing a white-tailed deer control program
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of mammals:

- The disturbance of species from public use
- The impacts on habitat quality from the construction of facilities

- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds

4.12.1 Impacts on Mammals That Would Not Vary by Alternative

Benefits

The programs that hold potential for impacts on mammals, and that would continue regardless of the alternative we select, are our strategies for habitat improvement measures and controlling invasive or nuisance species. Each of those indirectly benefits mammals over the long term by ensuring the continuation of quality natural habitats on the refuge. Ongoing management activities, such as invasive species management and inventory and monitoring programs would continue to be completed in a manner that would minimize potential impacts to individual species.

The refuge would continue to coordinate with Pennsylvania Game Commission and Department of Conservation and Natural Resources, along with our conservation partners, to ensure that we utilize the best available science in our management decisions related to State-listed species.

Adverse Impacts

Regardless of the alternative, we would continue to employ a range of management tools to achieve our objectives in managing for the improved health and integrity of terrestrial and wetland habitats. We would use these tools only when and where appropriate, and only with the proper training and focused application to avoid adverse impacts.

One such example is the control of invasive species. While there are no anticipated adverse impacts associated with the herbicides and pesticides themselves (USDOE 2000a, USDOE 2000b, USDOE 2006a, USDOE 2006b, USEPA 1997, USEPA 1998, USEPA 1999), the temporary loss of habitat on a very small scale may occur where invasive species control or diversity objectives warrant clearing an entire monoculture stand of a given species. The timing of herbicide applications to be most effective varies depending on the target species and treatment method. Occasionally, eliminating an entire field of a single nonnative species is necessary, but in most cases, the treatments are spot-specific. The treated sites soon re-grow, and mammals still have margins of habitat or other areas nearby for alternate use. Therefore, this activity is expected to have minimal negative impacts on some individuals that are localized and short-term.

Overall, the effects from public use are not likely to have an impact on mammals. Limiting visitors to existing trails prevents unintended disturbance to terrestrial mammals. Rare mammals potentially present such as the marsh rice rat and the river otter, are adequately buffered from human disturbance by the waters of Darby Creek and expanses of freshwater tidal marsh. An expected increase in visitation may create isolated negative impacts for some individual mammals; however, we feel that connecting people to nature through appropriate wildlife-dependent recreation, such as wildlife observation and photography would help encourage habitat conservation over time at a cost of only negligible impact to refuge resources.

4.12.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to mammals are the same as those discussed in *Impacts That Would Not Vary by Alternative*.

Adverse Impacts
In addition to the impacts to mammals discussed in *Impacts That Would Not Vary by Alternative*, failing to control the deer population would have negative impacts on mammal habitats and potentially mammal populations on the refuge. Habitats for wildlife have diminished considerably over the past few decades as urban and suburban development has expanded throughout southeast Pennsylvania. As a result, the remaining protected lands must support a wide variety of wildlife in a limited area. Competition among wildlife species for space and foraging habitat is intensified. At the refuge, the damage caused by deer to forest regeneration is documented by monitoring plots established by USDA-APHIS (D'Angelo 2011). Monitoring results record the presence of oak and maple saplings within fenced deer exclosures, while similar vegetation outside of the exclosures is continually browsed to the ground. Nonnative, invasive plants, which are often considered less palatable by deer, have become the dominant vegetation types in many areas. These impacts currently affect forest understory and the invertebrates, amphibians, reptiles, birds, and mammals dependent on this vegetation zone. The long-term implications of this indicate that these forested habitats could lose the ability to replace themselves over time if the deer population on the refuge is not controlled.

4.12.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Alternative B would provide long-term expansion of wetland habitats through the restoration of additional freshwater tidal marsh. The restoration of large freshwater tidal marsh areas would improve available habitats to support potentially rare mammals such as the marsh rice rat and river otter (PNHP 2008, Dubec et al. 1990, Kruchek 2004).

Restoration of coastal plain or floodplain forest to the 15-acre area currently dominated by nonnative poplar would improve available native species cover and forage for mammals. Clearing nonnative poplar in phases, such as clearings up to 5 acres in size, over several years would reduce potential impacts to mammals. As discussed in *Impacts That Would Not Vary by Alternative*, management actions may temporarily displace individual species, but no long-term impacts are expected as a result of the forest conversion.

White-tailed deer have become a major source of damage to forest and herbaceous vegetation on the refuge (D'Angelo 2011). The draft deer management plan (D'Angelo 2011) developed for the refuge by USDA-APHIS as well as the extensive report Managing White-tailed Deer in Forest Habitat from an Ecosystem Perspective: Pennsylvania Case Study (Latham et al. 2005), detail the ecological impacts of overabundant deer populations on plant biodiversity and other wildlife.

This alternative would initiate a deer management program for the refuge. As we attempt to strengthen the biodiversity and integrity of the forests and wetlands on the refuge, controlling the white-tailed deer population is imperative. Under this alternative, the refuge would utilize wildlife control specialists to effectively reduce the deer population to targeted levels that would allow herbaceous plant and tree regeneration. For urban habitats such as the refuge, deer densities less than 10 deer per square mile are recommended (D'Angelo 2011). Once the desired herd target is achieved, the deer population would be maintained through persistent annual harvest (D'Angelo 2011). This level of reduction would benefit refuge forest and wetland habitats by restoring natural regeneration of

vegetation, reducing the potential spread of Lyme disease, improving the health of remaining resident deer, and enhancing the habitat conditions available for other wildlife.

Adverse Impacts
Impacts to mammals are similar to those discussed in *Impacts That Would Not Vary by Alternative*.

Compared to alternative A, there would be increased off-trail disturbance associated with wildlife control specialists. Refuge staff would establish set times and seasons and would monitor locations and numbers of wildlife control specialists to ensure there are no long-term effects on mammals.

The expansion of office facilities proposed under alternative B would have no adverse impact on mammals utilizing the floodplain forests or grasslands around the visitor center. The majority of the building expansion footprint would be contained within an area already covered by asphalt pavement. A small portion of edge woodland (less than 0.1 acres) along the refuge border near Lindbergh Boulevard would likely be lost as a result of construction. Added public use infrastructure proposed under alternative B such as boardwalks and kiosks would not impact known mammal dens or burrows, and footprints of these structures would be small, with minimal impacts on their habitats. Most kiosks would be located in areas already disturbed (e.g., existing parking areas and along existing trails). Any potential impact anticipated from proposed construction projects would be minimal and unlikely in occurrence.

4.12.4 Impacts of Alternative C

Benefits
Benefits to mammals are similar to those discussed in *Impacts of Alternative B*.

One difference when compared to alternative B is that the refuge would hold off on future tidal marsh restoration, which would delay benefits to rare mammals potentially present, such as the marsh rice rat or the river otter. Also, the conversion of nonnative poplar forests to a shrub-scrub dominated habitat would not have any major shift in mammal populations, but individual species may be displaced over the short term.

Deer management would also be initiated under alternative C, but in contrast to alternative B, the primary method of control would be utilization of a specialized archery hunt program. Controlling the deer population would improve refuge habitats for wildlife including mammals, although we anticipate the benefits under alternative C would occur over a longer time period.

Adverse Impacts
Adverse impacts to mammals are similar to those discussed in *Impacts of Alternative B*.

As in alternative B, alternative C anticipates an increase in refuge visitation, although alternative C would also result slightly lower numbers of public use visitation when compared to alternative B. As noted in the discussion of *Impacts That Would Not Vary by Alternative*, negligible adverse impacts on mammals are anticipated with the expected increase in visitation or development of a transportation system.

Allowing a specialized hunt under alternative C may require a longer time to effectively reduce the deer population to a level consistent with recommendations within the deer management plan. The refuge would employ wildlife control specialists after the managed hunt to control the deer population under this

alternative. Delays in controlling the deer population would result in delays in recruitment of native plants and subsequent improvement in the quality of refuge habitats. This would mean delayed benefits to mammals using the refuges habitats. Compared to alternatives A and B, there would be increased off-trail disturbance associated with the deer hunters and wildlife control specialists. Since the hunt and use of wildlife control specialists would be controlled, refuge staff would establish set times and seasons and would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on mammals.

4.13 Impacts on Amphibians and Reptiles

Amphibians in southeast Pennsylvania occupy a wide range of habitat types. As one of the oldest metropolitan centers in the United States, the Philadelphia area has experienced substantial habitat degradation, destruction, and fragmentation due to the conversion of land to agriculture and then urban and suburban development. Extensive marshes were drained and filled, destroying much of the habitat for a number of species that thrived in the coastal plain, including reptiles and amphibians (PNHP 2008).

As a group, amphibians and reptiles would benefit from the refuge land protection and management of coastal plain and floodplain forests, grasslands, shrub-scrub, open waters, and wetlands. Amphibians and reptiles on the refuge consist largely of relatively common species found across the northeast. Occasionally, the refuge has found southern species utilizing its habitats, species of conservation concern like the diamondback terrapin. The status of some amphibians, such as salamanders, on the refuge is unknown. No individual salamanders have been observed to date, although no formal inventories have been conducted (Stolz and Phillips personal communication 2010).

The refuge does support at least one State-endangered amphibian: the coastal plain leopard frog. The refuge provides important habitat for this species that are identified as a priority for conservation in Philadelphia County (PNHP 2008). The coastal plain leopard frog breeds in still, shallow, permanent or temporary waters. Egg masses may be attached to vegetation or float free in shallow water (Ryan and Winne 2001), and this species is known to breed on the refuge.

The refuge also supports a State-threatened reptile: the red-bellied turtle. These turtles occupy large deep aquatic habitats such as ponds, rivers, and creeks but are known to inhabit terrestrial habitats as well. They prefer soft bottom and abundant aquatic vegetation. Eggs are laid in nests dug in soft soil in open areas usually within 100 yards of water (USFWS 1981). Like the leopard frog, the refuge provides important habitat for this species also identified as a priority for conservation in Philadelphia County (PNHP 2008).

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of amphibians and reptiles likely to utilize refuge habitats, including the following:

- Managing and restoring coastal plain and floodplain forests, the 145-acre impoundment, grasslands, open waters, and freshwater tidal marsh
- Controlling invasive species
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of amphibians and reptiles, including the following:

- The disturbance of listed species from public use
- The impacts on habitat quality from the construction of facilities
- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds

4.13.1 Impacts on Amphibians and Reptiles That Would Not Vary by Alternative

Benefits
Under all alternatives, the refuge would continue to restrict access and management activities when and where appropriate near known breeding sites and would continue limited population monitoring for frogs. The refuge would continue to protect and maintain breeding areas known to support both the coastal plain leopard frog and red-bellied turtle. Under all alternatives, the refuge would continue to maintain vernal pool habitat and create new vernal pools where appropriate.

Long-term improvements in water quality, especially related to the reduction of contaminants through the closure and remediation of Folcroft Landfill, would create benefits to environmental health and populations of amphibians and reptiles. Amphibians and reptiles would likely continue to be impacted by environmental contaminants that are not related to refuge activities but are known to occur in waters around the refuge. A study conducted on the refuge between 2000 and 2002 documented that background pollution places a developmental burden on the life history of turtles on the refuge (specifically painted and snapping turtles) and that these effects can be exacerbated by exposure to additional hazards, such as crude oil (Bell 2005). Under all alternatives, we would continue to work together with our environmental partners to remediate and rehabilitate the known Superfund sites within the EPA's Lower Darby Creek Area in order to reduce the effects of contaminants on amphibians and reptiles.

We anticipate long-term benefits to amphibians and reptiles through the ongoing management of existing freshwater tidal marsh and the impoundment, primarily the control and reduction of nonnative species, such as purple loosestrife and phragmites. The abundance of nonnative plant species is often an indicator of decreased environmental health (Maerz et al. 2009) and can negatively impact native reptiles and amphibians by altering the structure and other characteristics (e.g., moisture levels and mircoclimates) of habitat (Watling et al. 2011). Management efforts to control purple loosestrife and phragmites can provide long-term habitat benefits by reducing dense vegetation cover, allowing native plant species to re-vegetate the area, and restoring native habitat characteristics. The refuge would continue to coordinate with Pennsylvania Fish and Boat Commission and our conservation partners to ensure that we utilize the best available science in our management decisions related to State-listed species.

In addition, restoration of the 55-acre freshwater tidal marsh project would provide expanded habitat for the red-bellied turtle and reduce the extent of aerial herbicide applications as native vegetation becomes reestablished.

We would also continue to work with neighboring entities (such as Philadelphia International Airport and Tinicum Township) to complete conservation-related

projects that would restore habitats suitable for amphibian and reptile species of State or regional conservation priority.

Adverse Impacts
Regardless of the alternative, we would continue to employ a range of management tools to achieve our objectives in managing for the improved health and integrity of open water and wetland habitats. We would use these tools only when and where appropriate, and only with the proper training and focused application to minimize or avoid adverse impacts. We would continue to avoid mowing in early successional habitats and wet grasslands when amphibians or reptiles may be breeding or seasonally moving through transitional zones. Some amphibians and reptiles may be present during applications of herbicides and may experience direct contact with herbicides if they are present during applications, or if spray misses the targeted application patch. There is limited information on the impacts to amphibians and reptiles from the herbicides and pesticides used on the refuge. By only applying approved herbicides and pesticides, using proper application procedures, and following best management practices, we anticipate only negligible adverse impacts to amphibians and reptiles. Other management activities, such as inventory and monitoring programs, would continue to be completed in a manner that would minimize potential impacts.

The restoration the 55-acre freshwater tidal marsh project could result in localized temporary impacts due to soil disturbance and sedimentation to surrounding waters. To the extent practicable, we would avoid construction during reptile and amphibian breeding periods and take efforts to exclude species from the work area during construction. We would take precautions necessary to minimize the impacts associated with a large-scale wetland restoration. Detailed information on how this would be addressed would be developed during the restoration plan development.

Overall, the effects from public use are likely to minimally impact amphibians and reptiles utilizing forested, grassland, open water, and wetland habitats on the refuge. The refuge restricts trail access to known breeding areas during the breeding seasons. Added infrastructure related to environmental education and interpretation could potentially cause additional disturbance or lead to short-term, isolated stormwater runoff or sedimentation during construction. However, these disturbances, if present, would be infrequent and of negligible impact.

4.13.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to amphibians and reptiles are the same as those discussed in *Impacts on Amphibians and Reptiles That Would Not Vary by Alternative*.

Adverse Impacts
Impacts to amphibians and reptiles are the same as those discussed in *Impacts on Amphibians and Reptiles That Would Not Vary by Alternative*.

Water level management within the 145-acre impoundment would continue to take foraging and overwintering habitat for the red-bellied turtle into account when timing drawdowns.

Similar to the adverse impacts for alternative A discussed for mammals above, overbrowsing of deer would continue to have negative effects on amphibian and reptile habitats, and potentially their populations on the refuge. The greatest impacts appear to be in forested habitats and the species that depend on them.

4.13.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Alternative B would provide additional benefits compared to alternative A through long-term expansion of wetland habitats and the restoration of additional freshwater tidal marsh. The restoration of large freshwater tidal marsh areas, including up to half of the 145-acre impoundment, would improve available habitats to support red-bellied turtles and other amphibians or reptiles of conservation concern (PNHP 2008). Retaining approximately half of the impoundment would protect known basking, foraging, and nesting locations for this species as well.

Restoration of the 15-acre area currently dominated by nonnative poplar to coastal plain or floodplain forest would improve available native species cover for species such as the coastal plain leopard frog. Clearing nonnative poplar in phases, such as clearings up to 5 acres in size, over several years would reduce potential impacts to individuals. Management actions may temporarily displace individuals of these species, but no long-term impacts are expected as a result of the forest restoration.

This alternative would also initiate a deer management program across the refuge. Improving natural regeneration of ground cover and shrub vegetation, through reduction of the deer population, would improve available cover and non-breeding habitat for the coastal plain leopard frog and other reptiles and amphibians.

Adverse Impacts
Impacts to amphibians and reptiles are similar to those discussed in *Impacts on Amphibians and Reptiles That Would Not Vary by Alternative*.

The restoration of additional freshwater tidal marsh would potentially result in short-term, localized temporary impacts due to soil disturbance and sedimentation. To the extent practicable, we would avoid construction during reptile and amphibian breeding periods and take efforts to exclude species from the work area during construction. We would take precautions necessary to minimize the impacts associated with a large-scale wetland restoration during the restoration plan development.

In addition, the expansion of office facilities proposed under alternative B is not expected to have any long-term adverse impact on amphibians and reptiles utilizing the floodplain forests or grasslands around the visitor center. The majority of the building expansion footprint would be contained within an area already covered by asphalt pavement. A small portion of edge woodland (less than 0.1 acres) along the refuge border near Lindbergh Boulevard would likely be lost as a result of construction. No known or potential breeding habitat is found within the proposed footprint.

Added public use infrastructure proposed under alternative B, such as boardwalks and kiosks, are not expected to have long-term negative effects on known amphibian and reptile breeding sites as these would be avoided. Added infrastructure could cause additional disturbance or lead to isolated stormwater runoff or sedimentation during construction. However, we feel that these disturbances, if present, would be infrequent and of negligible impact.

Compared to alternative A, there would be minor increases in off-trail disturbance from wildlife control specialists used to control the deer population. Since the use of wildlife control specialists would be controlled through a special use permit, refuge staff would establish set times, seasons, and locations and

would monitor this program to ensure there are no long-term effects on these species or their habitats.

4.13.4 Impacts of Alternative C

Benefits
Benefits to amphibians and reptiles are similar to those discussed in *Impacts of Alternative B*.

One difference when compared to alternative B is that the refuge would hold off on future tidal marsh restoration, which would delay benefits to rare amphibians and reptiles that utilize this habitat type. Also, the conversion of nonnative poplar forests to a shrub-scrub dominated habitat would not have any major impacts on amphibian and reptile populations, but individual species may be displaced over the short term.

Water level management within the 145-acre impoundment would continue to take foraging and overwintering habitat for the red-bellied turtle into account when timing drawdowns.

Deer management would also be initiated under alternative C, but in contrast to alternative B, we would implement a managed hunt as well as using wildlife control specialists. The long-term benefits to vegetation as it relates to amphibian and reptile populations would still be achieved, but likely over a slightly longer timeframe.

Adverse Impacts
Adverse impacts to amphibians and reptiles are similar to those discussed in *Impacts of Alternative B*.

As in alternative B, alternative C anticipates an increase in refuge participation and visitation, although alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B. As noted in the discussion of *Impacts on Amphibians and Reptiles That Would Not Vary by Alternative*, we anticipate minimal long-term adverse impacts on amphibians and reptiles with an increase in visitation. Development of a transportation system could pose an increased risk of mortality related to increased motorized traffic along refuge access roads. However, we would undertake precautions to minimize potential impacts related to a shuttle bus or tram route to minimize disturbance or individual turtle mortality. This would need to be analyzed further before implementation.

Compared to alternatives A and B, there would be increased off-trail disturbance associated with the deer hunters and wildlife control specialists. Since the hunt and use of wildlife control specialists would be controlled, refuge staff would establish set times and seasons and would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on mammals.

4.14 Impacts on Invertebrates

This broad group is the least understood within the ecosystems around the refuge. Yet, they are likely the most important contributor and modifier in the functioning of those ecosystems and related food webs. Invertebrates play key roles in those ecosystems as

- detritivores, returning nutrients and basic elements back to the soil and the system;
- pollinators, without which many sexually reproducing plants would not be able to propagate;

- prey for other species in the food web, such as the millions of mosquitoes upon which fish, frogs, birds and bats feed;
- predators, such as spiders, that help keep rapidly producing insects in check; and
- filters of sediment, nutrients, and other contaminants, making conditions better for fish and aquatic life (e.g., mussels).

Judging from the diverse bird community during breeding season, particularly foliage gleaners, forest litter gleaners, and woodpeckers, and by the seed and nut production of the trees, apparently there are enough pollinator and prey base resources to sustain forest life, at least for the forest species now present. Therefore, we must operate on the assumptions that our management would affect invertebrates the least if we conduct it during the dormant season (overwintering pupae and larvae excepted) and that a diversity of plant life begets a healthy diversity of insect life, and vice versa.

No mussel surveys have been conducted on Darby Creek to date. However, recent findings along the nearby Delaware River indicate that invertebrate conservation may be an added focus along Darby Creek. A series of mussel beds was identified in the stretch of river connected to the confluence with Darby Creek. Seven mussel species were identified within the Delaware River, including two species that were thought to be extinct in Pennsylvania and New Jersey: the alewife floater and the tidewater mucket. Other species included two species considered critically imperiled, two species considered vulnerable, and one common species (see chapter 2 for details).

We evaluated the benefits of our actions that would conserve, restore, improve, or increase habitats of invertebrates likely to utilize refuge habitats, including the following:

- Managing and restoring coastal plain and floodplain forests, the 145-acre impoundment, grasslands, open waters, and freshwater tidal marsh
- Controlling invasive species
- Increasing public awareness through environmental interpretation and wildlife-dependent recreation

We evaluated the potential for the proposed actions to cause adverse effects on habitats of invertebrates, including the following:

- The disturbance from public use
- The impacts on habitat quality from the construction of facilities
- The potential impacts from the aerial spraying of invasive species, forest improvements, impoundment water level manipulation, or marsh restoration
- Expanding office facilities
- Construction of additional wildlife observation infrastructure such as boardwalks, observation decks, and viewing blinds

4.14.1 Impacts on Invertebrates That Would Not Vary by Alternative

Benefits
Our land protection and management provides a wide array of general habitat types and microhabitats that serve as foraging, breeding, and overwintering habitat for many groups of invertebrates.

Removing invasive species permits native plants to reestablish and expand. That especially benefits the insects that coevolved with the native plants, particularly those that are host-specific, such as the monarch butterfly which mostly uses milkweed as the host plant for their eggs. Many species of invasive, nonnative plants are not optimal hosts for native insects, and do not contribute to the health or diversity of the pollinator community. Therefore, we presume that removing these nonnative plants and planting or allowing native species to regenerate would be beneficial to native invertebrates. Any dependence on those plants is minimal and, therefore, removing them would not result in unacceptable losses in the insect populations.

The restoration of the 55-acre freshwater tidal marsh project would provide expanded vegetation diversity and available invertebrate habitat as native vegetation becomes reestablished. Planting native trees, shrubs, and herbaceous species is another strategy that, over time, would benefit invertebrates by providing a diversity of food sources for which host-specific insects have evolved, as is the case for numerous species of moths and butterflies, and for more generalist species such as native bees.

Adverse Impacts
Maintaining refuge grounds currently involves mowing of roadsides, parking areas, walking paths, and small lawn areas, and spraying glyphosate-based herbicide on the parking lots, trails, around buildings, walkways, signs, and kiosks. Generally, regularly mowed areas are kept short in vegetation height (less than 6 inches). Thus, they provide very limited sources of nectar, usually clovers. Where grasses and forbs have grown tall, such as along seldom-used roads or paths where they begin to flower and set seed, pollinators and herbivorous insects would be found. Mowing in the warm months, when insects are breeding, may destroy the eggs or pupae attached to leaves, consume adults, remove food sources, or unfavorably alter microhabitat. However, the area we maintain is a very small fraction of the amount of land serving as habitat.

Although the Service approves the herbicides we use in controlling invasive species because of their neutrality on animal life, invertebrates that come into direct contact with an herbicide or its surfactant may experience mortality, reduced fitness, or abnormal development. Triclopyr (BEE) is moderately to highly toxic to aquatic and estuarine invertebrates (USDOE 2000a). It is practically non-toxic to honeybees (USDOE 2000a). Since we use triclopyr to treat upland invasive species on the refuge and it has a low potential to leach into groundwater and a moderate potential for surface water runoff (USDOE 2000a), we anticipate little to no adverse impacts to aquatic invertebrates. Glyphosate and imazapic are both practically non-toxic to honeybees and slightly toxic to freshwater invertebrates (USDOE 2000b, USDOE 2006a). Aminopyralid is practically non-toxic to aquatic invertebrates, while imazamox is practically non-toxic to both aquatic invertebrates and honeybees (USDOE 2006b, USEPA 1997). *Bacillus thruingiensis israelensis* has little to no toxicity in many terrestrial invertebrates. However, it is moderately toxic to some freshwater invertebrates and minimally toxic to honey bees. *Bacillus sphaericus* is not expected to have any adverse impacts to any nontarget species (USEPA 1999). Since we treat limited portions of the refuge each year, overall negative effects on invertebrate populations are expected to be minimal.

It is also possible that some native invertebrates may use nonnative plants for feeding, breeding, or pupating. We presume that any dependence on those plants is incidental and, therefore, removing them would not result in unacceptable losses in the insect populations.

The restoration the 55-acre freshwater tidal marsh would result in localized impacts to aquatic invertebrates and terrestrial invertebrates in staging areas due to soil disturbance and sedimentation. Without a more detailed restoration plan, it is not possible to fully analyze the impacts of the restoration on invertebrates at this time. We will analyze these impacts in a separate, subsequent NEPA process once we have developed the detailed restoration plan. We will also include precautions and mitigation strategies in the restoration plan to help minimize the impacts associated with a large-scale wetland restoration.

Artificial lighting for the security of existing facilities and administrative buildings, such as the visitor center and maintenance building, is a potential source of adverse impact on invertebrates, particularly nocturnal moths. Decreases in populations of moths have been attributed to artificial lighting. However, extinctions due exclusively to lighting have not been recorded, and some species of moths thrive in well-lit communities or cities. When compounded with other disturbances, such has habitat fragmentation, unnatural lighting may weaken or eliminate local populations (Frank 2002).

A century ago, collectors used to find hundreds of species in large quantities attracted to the early electric lights in big cities. Today, lamps in big cities such as Washington, D.C., Philadelphia, and Boston rank among the worst places to collect moths and reductions have been noted in other locations. Several explanations have been posited: declines in moth populations, dilution of moths among thousands of city light sources, and diffuse background light suppressing flight to light behavior, even genetic shifts in behavior. The direct impacts of lighting on moths and other arthropods are increased rates of predation, entrapment, desiccation and burning of moths and other insects that fly into lamp housings, disruption in migration, and interference with mating, vision, dispersal, migration, feeding, depositing eggs, and possibly circadian rhythm. An indirect impact may result in densely illuminated urban environments where the lighting may have favored species that either fly during the day, do not fly to lamps, or do not fly at all (Frank 1988).

To the extent practical, given needs for facility security, maintenance, and access, the refuge has minimized its use of artificial lighting. No new projects proposed under any alternative would pose a substantial increase in artificial lighting.

4.14.2 Impacts of Alternative A (Current Management)

Benefits
Benefits to invertebrates are the same as those discussed in *Impacts on Invertebrates That Would Not Vary by Alternative.*

Adverse Impacts
Impacts to invertebrates are the same as those discussed in *Impacts on Invertebrates That Would Not Vary by Alternative.*

4.14.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Alternative B would provide long-term expansion of wetland habitats through the restoration of additional freshwater tidal marsh. The restoration of large freshwater tidal marsh areas would improve available habitats for invertebrates of conservation concern, specifically for dragonflies and damselflies (PNHP 2008). Increased knowledge and understanding of invertebrate populations

resulting from U.S. Forest Service inventory would help us better quantify the effects on invertebrate species on the refuge.

Conservation of forested habitats is another recommendation for invertebrate conservation in Philadelphia (PNHP 2008). Restoration of coastal plain or floodplain forest to the 15-acre area currently dominated by nonnative poplar would improve vegetation diversity in this portion of the refuge. We would also be converting some small grasslands to forest habitats under this alternative. As a result, we expect this to provide beneficial habitat for invertebrates utilizing forest vegetation. To this extent, the initiation of a deer control management program across the refuge would also improve available beneficial habitat for invertebrates.

The populations of Lyme disease-bearing ticks, *Ixodes scapularis* (the blacklegged or "deer" tick), are believed to be related to increased densities of the white-tailed deer population and changing habitats on a landscape scale (Stafford 2007). That leads to increased chances of contact with humans. At least from a human disease perspective, reducing an overabundance of deer would likely help suppress the tick population, which would benefit the human population, although not the ticks. To what extent Lyme disease affects other mammals is unknown. The ticks are known to parasitize other reptile, amphibian, and bird species.

Adverse Impacts
Impacts to invertebrates are similar to those discussed in *Impacts That Would Not Vary by Alternative*.

Similar to the adverse impacts from the 55-acre marsh restoration discussed above in *Impacts That Would Not Vary by Alternative*, the restoration of additional freshwater tidal marsh areas and the conversion of a portion of the impoundment would potentially result in localized temporary impacts to soil disturbance, vegetation, and sedimentation. Without a more detailed restoration plan, it is not possible to fully analyze the impacts of the restoration on invertebrates at this time. We would more fully analyze these impacts in a separate, subsequent NEPA process once we have developed a detailed restoration plan. We will also include precautions and mitigation strategies in the restoration plan to help minimize the impacts associated with a large-scale wetland restoration. Overall, we feel that the short-term impacts on habitat disturbance during construction would be negligible by comparison to the long-term benefits created by restoration of the diverse plant communities associated with freshwater tidal marsh.

Although we have yet to conduct a formal forest health inspection for diseases and pests, observations by staff while conducting bird or other surveys have not yet suggested an infestation to the level that would warrant intervention. However, we foresee that we may need to control for forest pests, such as the gypsy moth, in the future. We would consult with forestry experts and the Service authority on pesticide use for recommendations on the least harmful products and methods of averting impacts on non-target species.

In addition, the expansion of office facilities proposed under alternative B would have no long-term adverse impacts on invertebrates utilizing the floodplain forests or grasslands around the visitor center. The majority of the building expansion footprint would be contained within an area already covered by asphalt pavement. A small portion of edge woodland (less than 0.1 acres) along the refuge border near Lindbergh Boulevard would likely be lost as a result of construction.

Added public use infrastructure proposed under alternative B such as boardwalks and kiosks may have short-term, localized impacts to individuals but likely would not impact a large enough area to cause any adverse effects on local invertebrate populations.

4.14.4 Impacts of Alternative C

Benefits
Benefits to invertebrates are similar to those discussed in *Impacts of Alternative B*.

In addition, under this alternative the 15-acre nonnative poplar forest would be converted to scrub-shrub habitat. Over time, the establishment of native shrubs would provide additional habitat and a unique vegetation type for the refuge. Additional research would be needed to determine the net impact of this shift in habitat type over time on invertebrates.

Adverse Impacts
Adverse impacts to invertebrates are similar to those discussed in *Impacts of Alternative B*.

By comparison, one difference in alternative C would be the conversion of the 15-acre nonnative poplar forest that would be targeted to develop into a shrub-scrub early successional habitat. This would be accomplished through a one-time clearing of the entire 15-acre area, which would result in a short-term loss of invertebrate habitat in this area. As discussed under *Impacts of Alternative C, Benefits* above, over time the establishment of native shrubs would provide additional habitat and a unique vegetation type for the refuge. Additional research would be needed to determine the net impact of this shift in habitat type on invertebrates.

Similar to the adverse impacts described in *Impacts on Invertebrates That Would Not Vary by Alternative* and *Impacts of Alternative B*, alternative C would result in localized, temporary impacts to aquatic invertebrates, as well as terrestrial invertebrates in staging areas, due to soil disturbance and sedimentation during the restoration of additional freshwater tidal marsh areas and the conversion of the entire 145-acre impoundment. Without a more detailed restoration plan, it is not possible to fully analyze the impacts of the restoration on invertebrates at this time. We would more fully analyze these impacts in a separate, subsequent NEPA process once we have developed a detailed restoration plan. We would also include precautions and mitigation strategies in the restoration plan to help minimize the impacts associated with a large-scale wetland restoration.

4.15 Impacts on Public Use and Access

Annual refuge visitation is estimated to be 133,000 visits to the refuge in 2009. While no formal survey has been conducted, observations by refuge staff indicate that most visitors to the refuge engage in some form of wildlife-dependent recreation. Environmental interpretation programs and environmental education programs are thought to be the two activities with the most participants (see table 2.4). Over 13,300 people visited the visitor center in 2009. A summary of participants in refuge programs is provided on table 2.4. Being located in a large urban center allows the refuge to host a variety of visitors that include: school groups, homeschoolers, youth groups, family groups, anglers, birders, paddlers, bicyclists, refuge neighbors, surrounding community members, tourists (primary local, but regional, national and international visitor numbers are growing), as well as corporations and businesses.

4.15.2 Impacts on Public Use and Access That Would Not Vary by Alternative

Benefits

The main goals of the visitor services program would continue to be to work with partners to promote the benefits of wildlife and habitat conservation and management; to foster an awareness and appreciation for the refuge and its role along the Atlantic Flyway and within the Refuge System; and to provide quality wildlife dependent recreational experiences to visitors. We would continue to evaluate environmental education programs already available across the region to identify potential needs in the environmental education community. For many residents of Philadelphia, the staff of John Heinz NWR may be their one and only interaction with the Service. Under all alternatives, refuge staff would continue to be active in outreach and partnership development.

Under all alternatives, the refuge would continue to allow at least five of the six designated priority public uses. While hunting itself is not supported under all alternatives, we would continue to support hunting as an activity by sponsoring related activities such as hunter-education and archery programs and the Pennsylvania chapter of the Federal Junior Duck Stamp "Conservation through the Arts" program. We would continue to promote the concept of connecting children with nature in all of our compatible public use programming. Our partners, Friends, and other volunteers would continue to help us expand those and other priority public use programs. Leashed dogs would continue to be permitted on designated trails which may encourage public use of the refuge for users beyond anglers, birdwatchers, etc, and may lead to more people (including young families and seniors with pets) gaining an appreciation for the refuge's resources.

The visitor center would continue to be free to the public and accessible by public and private transportation. The facility would continue to be an important example of sustainable design and construction, and we would continue to use it as an interpretive tool for the benefits of sustainable building and relate this to effects on climate change.

Adverse Impacts

We would continue to limit access to ecologically sensitive areas such as nesting sites during breeding seasons and high quality wetlands. While these would result in short-term restrictions on public access and use, we would minimize these restrictions to the extent possible while ensuring proper protection of wildlife and their habitats. We do not anticipate any long-term negative impacts on public use and access.

Dogs frequently accompany recreationists to the refuge. Their presence can lead to short-term and long-term adverse impacts to wildlife populations. Some wildlife species are particularly sensitive to the presence of dogs and their response to disturbance is amplified above and beyond disturbance effects from recreationists traveling without dogs. Declines in bird diversity and abundance on trails where leashed dogs were permitted were in excess of declines observed from human disturbance alone (Banks and Bryant 2007). Lenth and Knight (2006) found, in areas that prohibited dogs, mule deer were less active up to 160 feet from recreational trails. In areas that allowed dogs, mule deer showed reduced activity within at least 320 feet of trails. The same study found similar adverse effects for small mammals including squirrels, rabbits, chipmunks, and mice. This means that there is a certain area around recreational trails that becomes unsuitable habitat for certain wildlife species, even though the habitat would otherwise be suitable (Lenth and Knight 2006). In addition, native carnivores, bobcats and coyotes, also appear to shift their periods and areas of activity to avoid peak times of recreational use (George and Crooks 2006). In all

alternatives, the refuge permits dogs on leash as long as the activity is restricted to designated access road corridors.

4.15.3 Impacts of Alternative A (Current Management)

Impacts on public use and access would be the same as *Impacts on Public Use and Access That Would Not Vary by Alternative*, in addition to the following.

Benefits
Under alternative A, we would continue to allow currently approved public uses on refuge lands. These are noted in chapter 3, alternative A. Appendix B documents the refuge manager's justification for why they are deemed appropriate. Other ownerships nearby or elsewhere sufficiently provide opportunities for other activities not determined to be compatible with the purposes of refuge management, so the lack of refuge access does not eliminate opportunities for those activities within the Philadelphia metropolitan area.

No major additions or changes in facilities would occur, except for ongoing upgrades to meet ADA-accessibility requirements, installation of a webcam at the bald eagle nest, and completion of an outdoor pavilion for environmental education. The refuge would continue to allow already approved public uses. These include plant and wildlife research, wildlife observation and photography, environmental education and interpretation, and recreational fishing.

Adverse Impacts
Hunting is, and would continue to be, prohibited on the refuge due to safety concerns and compliance with local regulations. We predict a slight increase in visitor numbers per year on the refuge, and would expect a commensurate increase in demand for refuge programs. However, under alternative A, we would continue to provide the same level of programming as we currently do. This would result in less programming in comparison to that provided under alternatives B and C, and we would likely not meet the increased demand for refuge programs.

Our current environmental education staff would continue to implement existing programs. Volunteers and teachers would continue to directly lead most of the educational programs on refuge. As a result, refuge staff would have less direct interaction with and influence on the education and interpretive content shared by outside volunteers and teachers.

4.15.4 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Under alternative B, we would expand facilities and programs for five of the six priority public uses. We would build upon our existing programs (alternative A) to make upgrades in interpretive infrastructure necessary to improve accessibility and utilize newer technologies to convey our interpretive goals. We would complete our visitor services step-down plan. This would provide details on focused themes and messages for education and interpretation programs, identify and prioritize target audiences, and provide strategies on how to reach out to specific audiences (e.g., bilingual programs and materials, specific events or materials for people with special needs). We would expand upon our existing mix of guided interpretive tools, Service-sponsored events (such as the Cradle of Birding Festival and National Wildlife Refuge Week), and partner-sponsored events to increase annual participation from its current level (13,300 participants in 2009) to up to 26,000 participants within 15 years of plan approval.

Over the life of the plan, we would continue to expand onsite and offsite environmental interpretation opportunities to visitors, students, and area residents. These opportunities would the refuge's natural and cultural resources and its contribution to conserving those resources in the Delaware Estuary

and enhance the infrastructure and facilities necessary to provide a quality interpretive experience.

Under alternative B, we would expand the existing suite of programs we provide to elementary, middle, and high school students from across southeastern Pennsylvania. Added staff and expanded programming would result in more direct contact between Service staff and children, as well as other visitors. Added staff and expanded programming would also improve the overall quality of visitor experience. By expanding partnerships and developing a team of trained volunteers to interact with visitors, we would connect with more visitors and communicate the refuge and Service mission better. Under alternative B, we would use the results of our Stakeholder Needs Assessment to ensure refuge programs are integrated with both environmental education users (e.g., schools) and other area environmental education providers.

Adverse Impacts
Adverse impacts on public use and access would be the same as *Impacts on Public Use and Access That Would Not Vary by Alternative.*

4.15.5 Benefits and Impacts on Public Use and Access of Alternative C

Benefits
Environmental education is one of the original mandated purposes of John Heinz NWR as highlighted in alternative A, objective 3.1. Under alternative C, education would focus on high school, college, and early professional age students. Focusing on older students could potentially result in more on-the-ground research, inventory, and monitoring that could inform long-term refuge management. This focus could improve our refuge-specific knowledge of refuge resources, which would inform future management and decisionmaking.

Under alternative C, we would expand existing opportunities for all six priority public uses at John Heinz NWR, with an emphasis on expanding infrastructure to improve wildlife observation opportunities. Under this alternative, we would offer a controlled hunting program as part of our deer herd reduction efforts. This alternative, when compared to others, offers the only opportunity for public hunting on the refuge.

Environmental interpretation infrastructure would also be expanded under alternative C. Infrastructure components such as trails, boardwalks, viewing platforms, and a shuttle service are considered as more intensive alternatives for encouraging and directing interpretation as compared to alternative B.

Adverse Impacts
In contrast to alternative B, this alternative would focus on providing higher-level education to college-aged and conservation professional development. While this would help train a new group of interested individuals participating directly in the conservation workforce, we would not likely be able to direct as much staff resources into education and interpretation for younger visitors. As such, this alternative would not fulfill the Service's policy on connecting children with nature as well as in alternative B. Alternative C would also result in slightly lower numbers of public use visitation when compared to alternative B.

While we would create a controlled hunting program under alternative C, initiation of this program would likely result in the temporary, short-term closure of portions of the refuge to other uses to ensure public safety. However, we do not anticipate any large-scale or long-term impacts on public access or use as part of alternative C.

4.16 Impacts on Cultural and Historic Resources

4.16.1 Impacts on Cultural and Historic Resources That Would Not Vary by Alternative

Benefits
As summarized in chapter 2, our coordination with the Pennsylvania Historical and Museum Commission's Bureau for Historic Preservation and the Service's regional cultural and historic resource liaison identified no known cultural or historic resources within the refuge boundaries. Much of the refuge contains disturbed lands or fill material that was introduced to the site since the 1950s. As a result, no cultural and historic resources have been identified or appear likely on refuge lands and no impacts to these resources are anticipated.

Under all alternatives, the refuge would expand its interpretation of cultural and historic resources related to the refuge and conservation. The extent and emphasis of cultural and historic resource interpretation varies between alternatives. Under alternative B we would increase efforts to include information about cultural and historic resources compared to alternatives A and C. However, under all scenarios the refuge communicates the importance of understanding and appreciating the area's rich cultural history and how it relates to our natural history. In doing so, we would potentially provide long-term benefits to regional cultural and historic resources.

Adverse Impacts
While no adverse impacts to cultural or historic resources are anticipated, we will send this draft CCP/EA to the SHPO for review in compliance with section 106 of the NHPA. In all of the alternatives, we will consult with our regional archeologist and the SHPO as needed to ensure compliance with NHPA and other applicable laws and regulations.

4.17 Impacts to the Socioeconomic Environment

Chapter 2, "Affected Environment," discusses the socioeconomic environment of the refuge and its context within the greater Philadelphia area. The refuge management activities of economic concern in the analysis are the following:

- Purchasing of goods and services within the local community for refuge operations
- Spending of salaries by refuge personnel
- Spending in the local area by refuge visitors
- Purchasing additional refuge land and resulting changes in local tax revenues
- Effects of refuge management on local townships

As discussed in chapter 2, the economic contribution of the refuge in terms of visitor spending, salaries of refuge personnel, and tax revenues is minor compared to the Philadelphia region as a whole. The total refuge visitor expenditures were estimated at $1.1 million in FY 2006, while visitors to the greater Philadelphia area generated over $5.5 billion during the same time period. In 2009, the refuge received over 133,000 visitors and the greater Philadelphia area over 36 million visitors. The salaries of refuge staff generate less than $800,000 of income and tax revenue, which constitutes less than 0.1 percent of the $2.6 billion of employment income and $1.2 billion in taxes generated by tourism in the Greater Philadelphia area in 2009 (Carver and Caudell 2007).

Although the refuge economic contribution is relatively minor, tourism and recreation contribute significantly to the local economy. The majority of the visits (approximately 72 percent) to the refuge were by nearby residents, although non-residents make the greatest economic contribution to the economy. This economic environment increases the potential of the refuge to increase visitation through management actions such as increased coordination with local cultural attractions and transportation hubs, and support of regional trail connections with the refuge.

Another important aspect of the socioeconomic setting is the number of educational institutions and environmental education centers in the Philadelphia area. With over 200,000 grade school students in the area and 80 degree-granting institutions, the refuge is uniquely situated to provide environmental education and interpretation at the grade school level to a wide audience and encourage research oriented activities at the refuge through partnership with colleges and universities. The Philadelphia area has a long history of conservation and there are several nonprofit organizations that provide environmental education to students and the public in Philadelphia, Delaware, Chester and Montgomery Counties.

4.17.1 Impacts on Socioeconomic Environment That Would Not Vary by Alternative

Of the management activities that would not vary by alternative, the following would benefit or adversely affect the socioeconomic environment of the refuge: protecting land, maintaining facilities, implementing the 55-acre restoration project, supporting research and Friends of Heinz Refuge group activities at the refuge, and implementing existing priority public use opportunities. We discuss the general impacts below and the details of the impacts specific to each alternative in the next section.

Benefits
Implementation of the 55-acre restoration project is common to all alternatives and this may provide a short-term contribution to the local economy in terms of contractor income, expenditures, and purchase of goods and services for restoration activities. It is impossible to predict the impacts to the local economy until the work is awarded.

Ongoing public uses related to wildlife-dependent recreation, environmental education, and interpretation would continue to have a small but positive effect on the local economies surrounding the refuge. Refuge visitors, researchers, and volunteers would continue to utilize businesses around the refuge for food, fuel, and lodging. We would continue to provide environmental education and interpretation programming free-of-charge to local schools in order to allow all students access to quality environmental educational programming. We would also continue to provide monetary assistance to help pay for busing students to and from the refuge for field trips.

We would continue to provide meeting space to conservation organizations and agencies upon request in order to facilitate decisionmaking and coordination related to regional conservation and environmental protection.

Adverse Impacts
The impact of protecting land is considered negligible on the economy of the region. Although some loss of tax revenue and commercial income results from protecting lands, most of the refuge is marsh and wetlands and is not suitable for development. The Service is currently authorized to protect 1,200 acres in fee title within its existing, approved refuge boundary. By October 2010, the refuge acquired 993 acres in fee title and concerted efforts to acquire additional land within the refuge boundary are not a primary focus of refuge management. Instead the Service would engage in conversations related to donation or purchase of suitable habitat as the opportunities arise.

4.17.2 Impacts on Socioeconomic Environment in Alternative A

Benefits
In summary, implementing alternative A would continue to provide socioeconomic benefits to the community. The refuge helps to maintain the quality of life not only for local residents, but also for all refuge visitors. Alternative A would continue to provide opportunities for public use, and current refuge regulations would remain in effect (see chapters 2 and 3).

The refuge provides economic benefits mainly through spending in the local area by refuge visitors and refuge staff income and taxes. It also provides benefits from public use, as in the increasingly important ecotourism industry. The economic contribution of the refuge was evaluated as part of a nationwide survey and analysis conducted in 2006 (Carver and Caudell 2007). In that year, the refuge recorded 106,491 visits. Ninety-eight percent of visits were for non-consumptive purposes such as hiking, wildlife observation, and photography. The majority of the visits (approximately 72 percent) were by nearby residents.

Total visitor expenditures related to recreation on the refuge was estimated at about $1.1 million in FY 2006 (Carver and Caudell 2007). Non-residents spent most of the money generated from refuge visits (67 percent), a total of $719,500. Based on the analysis conducted by the evaluation, the analyzed demand associated with refuge visitor recreational spending totaled $1.7 million. This amount represents the total dollars generated to the local economy as the result of refuge visits. This demand resulted in an estimated 14 non-Service jobs, which generated $536,300 in income and $241,400 in tax revenue. Non-resident visitors generated $1.1 million in economic stimulus to the local economy (Carver and Caudell 2007).

Adverse Impacts
Adverse impacts under this alternative are the same as those discussed under *Impacts on Socioeconomic Environment That Would Not Vary by Alternative.*

4.17.3 Impacts of Alternative B (Service-preferred Alternative)

Benefits
Over the 15-year life of the plan, alternative B is expected to benefit the local economy by increasing visitation by 47 percent or an estimated 63,300 additional annual visits resulting in an increase in total visitor expenditures within the 15-year time frame of this CCP. A visit is defined as an individual, uninterrupted visit to the refuge for any length of time in a day. One person may make multiple visits to the refuge in one day if they leave and return. Several of the management actions in alternative B are specifically designed to take advantage of the regional tourism and include the following:

- Developing a specialized partnership with local historical sites (Fort Mifflin and Bartram's Gardens) to co-schedule and promote events
- Creating specialized materials for use at local hotels to advertize the refuge as a visitor destination and appeal to overnight visitors
- Developing partnership with PENNDOT, SEPTA, and Philadelphia Airport to improve the visibility and transportation connections to the refuge

At this time, it is unclear how restoration of part of the 145-acre impoundment would affect flooding in Darby Creek. Breaching of dikes along Darby Creek and restoring part of the impoundment would improve floodway access along the creek, thereby reducing the overall impact of flood waters in the area and pressure for flood control in areas adjacent to the refuge. However, this benefit would be negligible on its own and needs to be considered in light of broader floodway management across the area. This would also reduce the capacity of the impoundment, which could have adverse effects on flood control (see below).

Based on the nationwide survey and analysis conducted in 2006 the non-resident visitors (28 percent) contributed $719,500 or $19.60 per visitor to the local economy and residents contributed $380,500 or $4.96 per resident visitor. Using the 2006 dollar figures, alternative B would result in a projected additional 55,000 non-resident visitors contributing an additional $1,078,000 to the local economy, and an additional 141,300 resident visitors contributing $700,848 to the local economy.

Adding five refuge staff would result in a negligible increase in benefits to the local economy in jobs, income, and expenditures. Expansion of refuge administrative facilities, creation of interactive exhibits, construction of boardwalks, and work to upgrade kiosks, a contact station, and signs would provide minor contributions to the local economy through expenditures for labor, materials, and services.

Under this alternative, the refuge would improve programs for under-represented audiences including providing interpretive materials in other languages, providing programs and materials designed to meet the needs of people with special needs, as well as continuing to reach out to urban youth. The refuge also tends to draw students from nearby schools that might not otherwise be exposed to environmental education programs. Under alternative B, we would create more opportunities for blind and bilingual visitors to appreciate wildlife-dependent recreation and the refuge's role in conservation. In doing so, we would reach out to new audiences to experience the refuge first-hand, and ultimately foster environmental stewardship and support for conservation in their own lives.

In our visitor services step-down plan, we would identify themed messages that support refuge purposes, the Refuge System mission, and the Service mission and that address specific issues and challenges facing wildlife, people, and habitats on the refuge, region, and world.

Adverse Impacts
There are several environmental education centers in the region that offer fee-based programs, while there are no fees for refuge educational programs. The content of the refuge programs are designed to meet Pennsylvania education standards and therefore could be similar to and compete with programs at other environmental education centers in the area. The refuge recently completed Phase II of the Environmental Education Stakeholder Needs Assessment and would use the results to develop programs that address specific environmental education needs, are unique to the refuge, and that would not duplicate or be in competition with other environmental education centers. In our opinion, the refuge does not compete or detract from other environmental education programs in the area and the freshwater tidal marsh offers a unique experience to students and teachers alike.

Breaching of up to half of the impoundment for tidal marsh restoration purposes would reduce the water capacity of the impoundment, and may affect our ability to buffer local areas from potential flood events. This could have an adverse effect on neighboring properties that view the 145-acre impoundment as a floodwater storage area. The actual influence of the impoundment area on the Darby Creek floodway, as well as its restoration to freshwater tidal marsh, will be analyzed in more detail during the feasibility studies completed prior to restoration design. While we do not maintain or restore habitats for flood control purposes, we would work with neighboring municipalities when planning the impoundment restoration to avoid or minimize to the maximum extent practicable potential adverse effects.

4.17.4 Impacts of Alternative C

Benefits
Alternative C proposes different management actions designed to increase visitation discussed in alternative B and staffing levels. However, the benefits of increased visitation and visitor expenditures would resemble those in alternative B. The alternatives differ in that alternative C proposes a transportation shuttle and a commercial partnership with paddling access to the marsh, however it is expected that these actions would provide a minimal economic benefit. It is not possible to estimate the potential economic impact of proposed shuttle service or commercial paddling as these plans are not developed.

Similar to the discussion under alternative B, we don't know what the effects of restoring the impoundment to tidal marsh would be. Breaching of dikes along Darby Creek and restoring all of the impoundment would improve floodway access along the creek, potentially reducing the overall impact of flood waters in the area and pressure for flood control in areas adjacent to the refuge. However, this benefit would be negligible on its own and needs to be considered in light of broader floodway management across the area. This would also eliminate the water capacity of the impoundment, which could have adverse effects on flood control (see below).

Adverse Impacts
Adverse effects would be the same as discussed under alternative B except that breaching of the entire impoundment for tidal marsh restoration purposes would eliminate the refuge's ability to manipulate water levels in the impoundment in response to anticipated or experienced flood events. Compared to alternative B, this could have a larger adverse effect on neighboring properties that view the 145-acre impoundment as a floodwater storage area. The actual influence of the impoundment area on the Darby Creek floodway, as well as its restoration to freshwater tidal marsh, will be analyzed in more detail during the feasibility studies completed prior to restoration design. While we do not maintain or restore habitats for flood control purposes, we would work with neighboring municipalities when planning the impoundment restoration to avoid or minimize the maximum extent practicable potential adverse effects.

4.18 Cumulative Impacts

According to the CEQ regulations on implementing NEPA (40 CFR 1508.7), a cumulative impact is the impact on the environment that 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 other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

This cumulative impacts assessment includes the actions of other agencies or organizations, if they are interrelated 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.

4.18.1 Cumulative Impacts on the Physical Environment

Air Quality
We predict no cumulative impacts on Class I airsheds. With our partners, we would continue to contribute to improving air quality through management of native upland and wetland vegetation, which ensures that those areas would continue to filter out many air pollutants harmful to humans and the environment. We also strive to reduce energy consumption with "green" infrastructure and products.

Water Quality
Due to the extent and complexity of pollution and environmental contaminant sources within the Darby Creek watershed, we do not anticipate that any of the alternatives would produce significant adverse cumulative impacts on water quality. We would continue to use best management practices and measures to

control erosion and sediments in all ground-disturbing operations to ensure their impacts are minimal.

Alternatives B and C and, to a lesser extent, alternative A, call for increased attention to habitat restoration or enhancement projects, floodplain and adjacent land acquisition, and improvements in water quality in terms of both chemistry and reduced sediment. Collectively, and over time, those actions would improve the ability of the wetland system to process nutrients and store carbon and, along with other basin-wide regulations and initiatives, contribute to improvements in hypoxia in the Delaware Estuary and overall climate change. Restoring and managing riparian habitat would help restore tributaries and improve water quality, resulting in a more diverse and dynamic system.

Although the rates and amounts of sediment leaving the refuge and eventually reaching Darby Creek and the Delaware River may reduce over time, none of the alternatives would adequately address sedimentation problems in the Darby Creek. Thus, the actions in the alternatives are not expected to cumulatively improve the continued deficit in the water quality of the river or bay. Actions taken to ensure the long-term health of forest habitat and acquire and manage a variety of habitats, would result in improved water quality

Soils
Due to the highly disturbed soils in the refuge, we believe that adverse impacts of refuge management on soil structure and productivity would be negligible and would not vary significantly under any of the alternatives. We predict that refuge land management, regardless of which alternative, would be expected to have a net positive effect on soils. The following management actions would benefit or impact soils under all alternatives dependent on the scale, frequency, and duration of these activities, and the sensitivity of the soils to erosion and compaction.

The greatest past and present adverse impacts on refuge soils occurred from agriculture and development. Under all of the alternatives, we expect to restore native plant communities on lands that otherwise would be threatened by conversion or, in some cases dominated by invasive species. Overall, the upland soils of the refuge are a mixed organic fill material from past dredging projects and the marsh soils are organic muck underlain by alluvial sediments.

Soil disturbance would be greatest during restoration of freshwater tidal marsh areas, the greatest extent of which would likely occur under alternative B, and to a lesser extent under alternative C. Even though alternative C results in a higher acreage of freshwater tidal marsh, nearly all of that acreage is expected as a result of restoration of the impoundment to tidal marsh. Restoration of the 145-acre impoundment would likely not require as extensive soil excavation or grading as in other areas proposed for restoration. We do not anticipate any cumulative impacts to soils on the refuge, as soil erosion and sedimentation controls would be implemented as appropriate on all proposed construction projects.

There is some degree of soil contamination, but it is believed to be present below State and Federal levels for human contact and inhalation. Compaction is a localized problem in high traffic areas around the visitor center and some trails, but much of the heavy site use is or would be confined to paved areas, gravel access roads, boardwalks, and observation areas. However, certain areas, particularly the dikes and access roads, experience ongoing erosion and are susceptible to damage during flooding events. We would continue to manage refuge dikes and Folcroft Landfill to minimize human disturbance and to mitigate for natural processes that result in loss of valuable habitats, particularly at bald eagle and heron nesting.

4.18.2 Cumulative Impacts on the Biological Environment

All of the alternatives would maintain or improve native biological resources on the refuge, in the Delaware Estuary, and in the Mid-Atlantic region ecosystem. The combination of our management actions with those of other conservation organizations and landowners could result in beneficial cumulative effects by

- increasing the protection and management of Federal trust species, State-listed threatened or endangered species, and other native species;
- protecting or improving upland and wetland habitats that are regionally declining or affected by development; and
- controlling invasive plants and nuisance animals.

The biological resources that we would manage to control, prevent, or eliminate, such as invasive plants, are not natural components of those areas; we would not consider the loss of those biotic components an adverse effect.

Habitat improvements under the alternatives should benefit rare or declining species and marginally benefit species federally listed as threatened or endangered. Appendix A lists species of conservation concern in the area that would benefit from management. In particular, we target State-listed bird, amphibian, reptile, and Federal trust species. For some species, such as bald eagles, the refuge may provide a source for populations expanding onto adjacent lands or, conversely, may provide habitat for expanding populations searching for new habitats to utilize.

Although all of the alternatives either maintain or increase monitoring and controlling invasive plants and animals, we expect infestations to continue to increase and expand to new areas. All alternatives have a strong biological monitoring component, with increases in surveying the species and habitats under alternatives B and C, and research and coordination with others. That additional information not only would aid decisionmaking that benefits fish and wildlife on the refuge, but also would add to the body of knowledge collected by other agencies, which can affect resource decisionmaking over a broader landscape.

Alternatives B and C outline proposed actions to initiate control efforts on the overabundant deer populations existing on the refuge. Alternative B would utilize wildlife control specialists, while alternative C would utilize a combination of a controlled hunt program (to also foster additional wildlife-dependent recreation) along with use of wildlife control specialists. Under either alternative, control efforts would likely result in benefits to the many other biological resources that utilize the refuge by aiding in restoration of native plant communities and forest structure.

Each alternative anticipates an increase in refuge visitation. Alternative A would continue current management and make no additions or improvements to account for added visitation. Alternative B would result in the greatest amount of added infrastructure, but also provide the most opportunity for public uses and added access for the increased visitation expected. Alternative C would focus most public use improvements on Folcroft Landfill once it is released by the EPA and opened for public access by the Service. Alternative C would have similar levels of visitation, but visitors would largely utilize existing infrastructure for much of the next 15 years.

The refuge does allow fishing according to State regulations. Fishing results in the direct loss of individual fish. We describe the site-specific impacts of

our fishing program earlier in this chapter and in appendix B, "Compatibility Determinations." As described in those sections, we do not believe current or planned levels of fishing would have any cumulative adverse effects on fish populations.

4.18.3 Cumulative Impacts on the Socioeconomic Environment

We expect none of the three proposed alternatives to have significant adverse cumulative impacts on the economy of the towns or counties in which refuge lies. We would expect none of the alternatives to alter the demographic or economic characteristics of the local community. The actions we propose would neither disproportionately affect any communities nor damage or undermine any businesses or community organizations. All of the alternatives would maintain the existing landscape. Consequently, no adverse impacts would be expected, including changes in the community character or demographic composition.

Implementing any of the alternatives would likely result in several minor beneficial impacts on the social communities near the refuge and in the region as a whole. We expect public use of the refuge to increase, thereby increasing the number of days visitors spend in the area and, correspondingly, the level of visitor spending in the local community. Fully funding the additional staffing in alternatives B and C would also make a small, incremental contribution to the employment, income, and spending in the local community.

Various objectives in alternatives B and C would have varying degrees of impact on the recreational use of the refuge. Earlier sections detailed specific impacts on individual uses, such as hunting, fishing, and observing or photographing wildlife. Cumulatively, each alternative has a different economic impact since it affects the level of public use. The table at the end of this chapter summarizes the cumulative impact by alternative. Each alternative takes a different approach to managing the variety of recreational uses on the refuge, ranging from current management (alternative A) to an integrated approach (alternatives B and C) that seeks to conserve wildlife and habitat while providing additional diverse wildlife-oriented recreational opportunities for visitors.

These varying alternatives would have some cumulative impacts, because we expect the demand for nearly all recreation to grow while the amount of refuge space and natural resources stays relatively constant. In alternative A, current uses would continue without much change. Alternatives B and C attempt to strike a reasonable balance to ensure that the refuge remains a destination of choice for both wildlife and people. If successful, that integrated approach may have positive, long-term impacts on natural resources on the refuge, and social and economic impacts on the communities beyond through improving fish and wildlife habitat and raising awareness and stewardship of the environment.

Our working relationships with the State of Pennsylvania, area colleges and universities, private landowners and others should improve in terms of the responsiveness to inquiries and speed of joint projects under alternatives B and C. That improvement mainly would result from the increased staffing in key areas such as biology, public use, and maintenance.

More emphasis on environmental education and interpretation in alternatives B and C should foster more understanding and appreciation of resource issues and needs, and could lead to increased political support and funding, which could positively affect fish and wildlife resources in the refuge and the Delaware Estuary. The increased outreach of these alternatives could also positively affect land use decisions outside the refuge by local governments and private landowners, and thus lead to increased fish and wildlife populations over a broader area.

4.18.4 Cumulative Impacts on the Cultural and Historical Environment

As noted, no known cultural or historic resources have been identified on the refuge. Regardless, the refuge staff would, during the early planning of actions, continue to work with our regional archaeologists and consult with the State Historic Preservation Officer and other parties as appropriate to ensure compliance with NHPA and other applicable laws and regulations.

We expect none of the alternatives to have significant adverse cumulative impacts on cultural resources on the refuge. Depending on the alternative, beneficial effects would vary, because of the changes proposed in habitat management and increasing environmental education and interpretation programs. Alternatives B and C would both increase the amount of cultural and historic resource interpretation integrated into environmental education and interpretation. As a result, we would expect a small beneficial increase in awareness and appreciation of these resources.

4.18.5 Cumulative Impacts Related to Climate Change

The 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 decisionmaking." This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decisionmaking. Additionally, it calls for the incorporation of climate change considerations into long-term planning documents, such as a CCP.

The Wildlife Society (TWS) 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 such publications as the Intergovernmental Panel on Climate Change (IPCC) 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 hugely complex because not only is it important to predict changing precipitation and temperature patterns, but more importantly their rate of change, as well as 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, nonnative 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 TWS 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 TWS 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, 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 some effects considered negative and others considered positive. Generally, the prediction in North America is that the ranges of habitats and wildlife would generally move upwards in elevation and northward as temperature rises. Species with small or isolated populations and low genetic variability would 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 would 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 and to ecosystem changes, their interactions with other species, and the impacts from other stressors in the environment. In other words, only generalizations can be made about the implications of our refuge management on regional climate change.

Our evaluation of the proposed actions concludes that only one area of activities may contribute negligibly, but incrementally, to stressors regionally affecting climate change: our use of vehicles and equipment to administer the refuge. We discuss the direct and indirect impacts of those activities elsewhere in chapter 4. We also discuss measures to minimize the impacts of both. With regards 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 (as exemplified by the green construction incorporated in our visitor center), along with reduced travel, more energy efficient vehicles, and other conservation measures.

In our professional judgment, most of the management actions we propose would not exacerbate climate change in the region or project area, and in fact some might incrementally prevent or slow down local impacts. We discuss our actions relative to the 18 recommendations the TWS report gives to assist land and resource managers in meeting the challenges of climate change when working to conserve wildlife resources (Inkley et al. 2004).

- ***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.

Throughout our alternatives we've highlighted the need to address climate change, specifically in regards to sea level rise and new species introductions on the refuge. We have proposed a series of strategies involving monitoring, accounting for sea level rise during restoration planning, and other potential impacts of climate change as it relates to the long-term protection and management of habitats in light of our defined refuge purposes and proposed goals outlined in this draft CCP/EA.

The Service is taking a major role among Federal agencies in distributing and interpreting information on climate change. There is a dedicated webpage to this issue at *http://www.fws.gov/home/climatechange/*. The Service's Northeast Region also co-hosted a workshop in June 2008 titled "Climate Change in the Northeast: Preparing for the Future." All of the Northeast Region Refuge Supervisors and planners attended, as did over 20 refuge field staff.

- ***Recommendation #2:*** Manage for diverse conditions: 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 native marshes, forests, open waters, and grasslands. Protecting the integrity of wetlands and managing for fully functioning riparian forests and biological corridors areas is also a priority for refuge management, which has been identified as a priority area of focus for conservation (Seavy et al. 2009). We have identified monitoring elements, which will be fully developed in the IMP 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: This recommendation relates to the point that historical climate, habitat and wildlife conditions are less reliable predictors as 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.

We are aware of these implications and plan to build these considerations into our IMP so that we can make adjustments accordingly. The Service is working to establish long-term monitoring protocols and sites to document future trends in sea level rise in the Northeast Region. At John Heinz NWR, we have authorized the Partnership for the Delaware Estuary and the Academy of Natural Sciences to establish long-term monitoring sites across Tinicum Marsh, in conjunction with similar monitoring stations they are placing throughout the Delaware Estuary. When completed, we would ensure that researchers monitoring effects of sea level rise on the refuge do so in a manner compatible with Service monitoring protocols to allow for regional comparisons. Our results and reports, and those of other researchers on the refuge, would be shared within the conservation community.

- ***Recommendation #4:*** Expect surprises, including extreme events: 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. As outlined in chapter 2, the refuge has already experienced a series of large flood events over the past 10 years. Due to the frequency experienced, these types of events are being considered as a "new normal" when planning annual needs. Other Regional operations funds would also be re-directed as needed to deal with an emergency.

- ***Recommendation #5:*** Reduce non-climate stressors on the ecosystem: This recommendation relates to reducing human factors that adversely affect resiliency of habitats and species.

Similar to our response to #2 above, the objectives of our habitat management program are to protect the biological integrity, diversity and environmental health of refuge lands. Objectives to enhance riparian habitat for watershed protection, and establish healthy, diverse native forests would help offset the local impacts of climate change.

- ***Recommendation #6:*** Maintain healthy, connected, genetically diverse populations: 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 species populations and can offer better habitat quality in core areas.

As noted in chapter 2, the refuge is in many ways a biological island surrounded by dense urbanization. Where we can restore or preserve connections, we pursue these opportunities. We would also continue to work with our many conservation partners at the State and regional level to support and complement restoration and protection efforts.

- ***Recommendation #7:*** Translocate individuals: This recommendation suggests that it may sometimes be necessary to physically move wildlife from one area to another to maintain species viability. However, it is cautioned that this tool has potential consequences and should only be used in severely limited circumstances as a conservation strategy.

We have no plans to translocate plants or animals within the 15 year time frame of this CCP.

- ***Recommendation #8:*** Protect coastal wetlands and accommodate sea level rise: 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 responses to recommendations #2, #3, and #6 above identifies our objectives to establish fully functioning riparian areas, protect wetlands, and maintain healthy native habitat. Our initiation of long-term monitoring would help us to identify adaptive courses of action as the need arises. For example, this information can help inform future restoration projects to ensure restored tidal marshes and wetlands function at current and projected sea levels. Unfortunately, the limited footprint of the refuge and lack of nearby undeveloped uplands limits opportunities for expanding buffer areas and purchasing additional easements and properties.

- ***Recommendation #9:*** Reduce the risk of catastrophic fire: This recommendation acknowledges that fire can be a natural part of the ecosystem, but that climate change could lead to more frequent fires and/or a greater likelihood of a catastrophic fire.

Our plans to maintain forests and grasslands, control invasive plants, in combination with the naturally wet conditions found across the refuge would reduce the overall risk of a catastrophic fire.

- ***Recommendation #10:*** Reduce likelihood of catastrophic events affecting populations: This recommendation states that increased intensity of severe weather can put wildlife at risk. While the severe weather cannot be controlled, it may be possible to minimize the effects by supporting multiple, widely spaced populations to offset losses.

Our response to recommendations #2, #3, and #6 above describes the actions we are taking to minimize this risk. Unfortunately, the limited footprint of the refuge and lack of nearby undeveloped lands limits opportunities for the refuge itself to support multiple, widely spaced populations. We work with other regional conservation land managers to support this effort.

- ***Recommendation #11:*** Prevent and control invasive species: 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 and on the refuge. The Northeast Region, in particular, has taken a very active stand. In chapter 3, we provide detailed 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: This recommendation suggests that managers may have to adapt yield and harvest regulations in response to climate variability and change to reduce the impact on species and habitats.

We do not have plans for any significant harvest activities. Our monitoring program would include detecting population trends in focal species to alert us to any significant changes.

Regarding animal harvest through proposed fishing and hunting programs, the refuge does not set harvest regulations. In terms of deer hunting, annual monitoring and harvest goals would be determined for deer control purposes. Opening the refuge to a deer hunt would require a separate EA and subsequent compatibility determination in order to address effects of hunting including cumulative impacts.

- ***Recommendation #13:*** Account for known climatic conditions: This recommendation states we should monitor key resources through predictable short-term periodic weather phenomenon, such as El Nino, to aid us in future management efforts.

We plan to develop a monitoring program that would help us evaluate our assumptions and success in achieving objectives, as well as help us make future management decisions. Any restoration activities or management actions would be carefully planned and their effectiveness monitored and documented so we can use this information in future management decisions.

- ***Recommendation #14:*** Conduct medium- and long-range planning: 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 15-year CCP addresses climate change with its emphasis on restoring and maintaining healthy, contiguous, native habitat areas, reducing human stressors on refuge lands, working with private landowners to improve the health and integrity of their lands, and pursuing larger conservation connections and corridors with partners to enhance protected core areas. Our monitoring program and adaptive management strategies would also facilitate our ability to respond to climate change.

- ***Recommendation #15:*** Select and manage conservation areas appropriately: This recommendation states that establishing refuges, parks and reserves is used as a conservation strategy to try 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. For example, it is suggested that decisions on new acquisition consider the anticipated northward migrations of many species, or the northern portion of species ranges. Managers of existing conservation lands should consider climate change in future planning.

The Service as a whole is working with partners on making decisions on where and how to provide conservation areas in light of climate change. In particular, the Service is developing Landscape Conservation Cooperatives throughout the country. The refuge would continue to support these nationwide as well as more local efforts.

- ***Recommendation #16:*** Ensure ecosystem processes: This recommendation suggests that managers may need to enhance or replace diminished or lost ecosystem processes. Manually dispersing seed, reintroducing pollinators, treating invasive plants and pests, are examples used.

While we plan to take an aggressive approach to treating invasive plants, we also are planning actions to enhance or replace ecosystem processes. Freshwater tidal marsh restoration, reduction of deer populations, and restoration of forest habitats all involve actions that address ecosystem functions. Further, none of our proposed management actions would diminish natural ecosystems processes underway. Should our monitoring results reveal that we should take a more active role in enhancing or replacing those processes, we will reevaluate and/or refine our management objectives and strategies.

- ***Recommendation #17:*** Look for new opportunities: This recommendation states that managers must be continually alert to anticipate and take advantage of new opportunities that arise. Creating wildlife conservation areas out of abandoned or unusable agricultural land, and taking advantage of industry interest in investing in carbon sequestration or restoration programs, are two examples cited.

Refuge staff has maintained many conservation partners in the area which, in turn, are networked throughout the larger region. We hear about many opportunities for land protection or habitat restoration through that broad-based network. Our Northeast Region has field offices and a regional office that integrates the other Service program areas, including those that work with private entities. 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: 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 alternatives B and C of our draft CCP/EA and in the draft HMP. We will develop a detailed step-down IMP designed to test our assumptions and management effectiveness in light of ongoing changes. With that information in hand, we would either adapt our management techniques, or reevaluate or refine our objectives as needed.

4.18.6 Unavoidable Adverse Effects

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and that cannot be avoided, even with mitigation measures. All of the alternatives would result in some minor, localized, unavoidable adverse effects. For example, marsh restoration projects would produce minor, short-term, localized, adverse effects. Increased visitation could have minor unavoidable effects. However, we do not believe that any of these effects would rise to a significant level.

Many of the habitat management and facility construction projects in the alternatives have a certain level of unavoidable adverse effects, especially during the actual construction. Those effects are mitigated to some degree by the use of practices and precautions that safeguard water quality, avoid sensitive habitats, or time the actions (or include safeguards) to avoid or minimize impacts on fish and wildlife. The adverse effects generally are short-term and more than offset by the long-term gains in habitat quality and fish, wildlife, and plant productivity.

Some habitat types on the refuge would be adversely affected. In alternatives B and C, for example, we proposed restoration of a portion or all of the 145-acre impoundment. However, historically this area was tidal marsh.

Forest habitat is also likely to undergo changes in species composition and structure as we create a more natural forest composition resembling native coastal plain or floodplain forests. In areas where we are converting nonnative poplar forest to native species, we would consider habitat requirements and timing restrictions in order to protect State-listed species such as the short-eared owl. These owls, unlike other owl species, are ground nesting. Suitable habitat for nesting is found elsewhere on the refuge so we do not expect significant adverse consequences. Under alternative B, these short-term adverse impacts are further minimized by completing restoration work using a phased approach. Restoration would be spread out over approximately 5 years.

Some aspects of wildlife-dependent recreation, such as hunting or fishing, would result in the unavoidable adverse impacts on individual fish and wildlife as a result of providing that activity. However, we would protect populations from adverse effects by requiring all participants follow applicable State and refuge regulations. In addition, we anticipate long-term benefits to species and habitats from connecting people with nature through these activities. Fishing, under all alternatives, would continue in designated areas on the refuge. This activity results in the unavoidable adverse loss of individuals. However, this activity constitutes a relatively minor impact on fisheries populations. In addition, alternatives B and C propose management actions that would result in improved and increased habitat for fisheries. The deer management programs proposed under alternatives B and C would also result in the unavoidable adverse loss of individuals. However, the overall health of the refuge's deer population would likely improve by reducing competition for limited resources. There would be long-term benefits to refuge habitats, particularly upland habitats, and the other species that depend on them.

All of these unavoidable adverse effects on the physical and biological environment would be relatively local and more than offset by the long-term benefits for the diversity and ecological health of the broader landscape.

Some impacts on certain individuals or refuge neighbors may be unavoidable, but our responsibility is to provide equal opportunities to the American public, not a select few. We believe we have sought a fair balance in minimizing and mitigating adverse impacts while providing quality recreational opportunities to the public. All of what we propose in the arena of public use results from public involvement and input during the planning process.

4.18.7 Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be undone, except perhaps in the extreme long term. One example is an action that contributes to a species' extinction. Once extinct, it can never be replaced and is an irreversible loss. By comparison, irretrievable commitments of resources are those that are lost for an extended period of time, but could be undone given sufficient time and resources, although there may be a loss in productivity or use for a time. An example of an irretrievable commitment is converting what was once a mature

forest and actively managing and maintaining it in an early successional forest habitat condition. If, for some reason, that early successional habitat was no longer an objective, those acres could progress gradually to mature forest again over a period of 70 or more years, or we could determine it best to expedite that reversion by planting shrubs and trees and controlling invasive plants.

Expansion of the visitor center and some expanded infrastructure would be considered to be irretrievable commitments. However, we believe these improvements to be necessary to improve the effectiveness of refuge management and public uses. As a result, the commitment of resources required for them are relatively small by comparison to the benefits gained through efficient staff resource management and improved visitor services.

4.18.8 Environmental Justice

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 with access to public information and participation in matters relating to human health or the environment.

We expect none of the three proposed alternatives to have significant adverse cumulative impacts on the economy of the towns or counties in which the refuge lies. We would expect none of the alternatives to alter the demographic or economic characteristics of the local community. The actions we propose would neither disproportionately affect any communities nor damage or undermine any businesses or community organizations. All of the alternatives would maintain the existing landscape. Consequently, no adverse impacts would be expected including changes in the community character or demographic composition.

Overall, we expect that none of the alternatives would place disproportionately high, adverse environmental, economic, social, or health effects on minority or low-income persons. Our programs and facilities are open to all who are willing to adhere to the established refuge rules and regulations, we acquire land only from willing sellers, and we do not discriminate in our responses for technical assistance in managing private lands. In addition, proposed refuge construction projects under alternatives B and C would occur within the refuge boundary and are not expected to have disproportionate adverse effects on any group or area.

4.19 Summary of Environmental Consequences by Alternative

Table 4.2. A Summary of the Foreseeable Consequences of each Alternative.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Air Quality	Refuge land management would help reduce any future direct and cumulative impacts by maintaining natural vegetative cover on up to 993 acres, requiring that all upgrades to existing facilities, or all new facilities, be energy efficient, and by allowing limited public uses to those that are appropriate, compatible, and wildlife-oriented activities. Collectively, these management actions would help reduce the potential for additional synthetic sources of emissions in the surrounding landscape. Alternative A would include fewer ground-disturbing and construction activities that would introduce additional short-term emission sources than alternatives B and C. We would continue to house maintenance and law enforcement programs in a separate facility ¼ mile from the refuge administrative offices. The travel on access roads and maintenance of access roads, dikes, or other facilities would cause short-term, localized effects from the exhausts of vehicles or other equipment and suspended particles from gravel surfaces and disturbed soils. The regional vehicle emissions resulting from 133,000 visitors to the refuge would continue to be negligible in comparison to ambient air quality and emission from an urbanized area.	Long-term benefits for air filtering and carbon sequestration from land protection would be similar to those in alternative A, except added forest habitat restoration and management would result in a small amount of additional air filtering and carbon sequestration. Construction activities involved in land management and expanding administrative facilities to collocate staff in one facility would cause short-term, localized effects from construction vehicles and equipment exhausts would occur. Expanding refuge programs, outreach efforts and improving facilities and exhibits is expected to increase visitation over the 15-year period of the plan. An increase in local vehicle emissions would result from the increase in visitation, but it would be negligible in comparison to ambient air quality and emissions from a variety of industrial and urban land uses surrounding the refuge. These impacts are not expected to exceed Federal Clean Air Act air quality standards. No Class I air quality areas are affected.	Air quality impacts would be similar to those described under alternative B, except for restoring the entire 145-acre impoundment to freshwater tidal marsh which would have more short-term impact due to construction activities. Long-term benefits for air filtering and carbon sequestration from land protection and deer management would be similar to those in alternative B. Short-term impacts due to construction emissions would be similar to alternative B, however the duration and timing of those impacts would vary by comparison. Impacts due to the increase in visitation would be similar to alternative B.
	Under all of the alternatives, synthetic sources of emissions from refuge activities and visitor vehicles are negligible compared to emissions associated with the industrial and urban land uses of the Philadelphia area, adjacent highways and rail line and the nearby Philadelphia International Airport. We would continue to support the connection to regional trail systems that encourage non-motorized access to the refuge and non-motorized use of trails for wildlife observation and other compatible recreation. There are no major stationary or mobile sources of air pollution present on the refuge nor would any be created under any of the alternatives. All of the alternatives include restoring tidal marsh on the 55-acre restoration site. Air quality impacts resulting from the release of carbon monoxide and particulate emissions would occur at the site during the restoration project, but are generally not considered far-reaching. Exhaust from construction vehicles and particulates from disturbed soils during construction and prior to the establishment of cover vegetation would have an effect on the immediate air quality around the construction operation, but should not significantly impact areas outside of the refuge. These emissions would subside upon completion of construction activities.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Hydrology and Water Quality	Long-term benefits for hydrology and water quality would result from protecting up to 993 acres within the approved refuge boundary. In addition, significant management emphasis on maintaining riparian buffers, treating invasive plants, especially Phragmites, and restoring disturbed refuge uplands would increase benefits for water quality and hydrology. Some risks to water quality from herbicide use exist in conjunction with invasive plant management. Such impacts are minimized by using only approved herbicides, having a spill plan, and using the herbicide as instructed by the manufacturer and refuge policy. We would continue to monitor impoundment water quality parameters and support volunteer based monitoring of Darby Creek to better inform management actions. Additional visitation to the refuge poses a minimal risk to water quality and hydrology through runoff and pollutants from vehicles.	Overall impacts would be the similar to alternative A. Improving impoundment water level control infrastructure and adaptive management of water levels would improve the ability to manipulate impoundment water levels to improve dissolved oxygen (DO) levels in the impoundment. Installing a network of water quality monitoring equipment along Darby Creek within the refuge and implementing long-term and continuous monitoring would provide additional information to guide management actions in regards to water quality and adaptation to climate change. Restoration of a portion of the 145-acre impoundment to a freshwater tidal wetland would restore the historic hydrologic regime to portions of this area and create a significant improvement in local DO levels and biological exchange with the Tinicum Marsh. Construction may result in localized sedimentation that will be minimized through use of appropriate BMPs. Potential for impacts associated with land management, forest conversion, and increased visitation will be monitored to minimize impacts of refuge hydrology and water quality.	Overall impacts would be the same as those for alternatives A and B, except restoration of the entire impoundment would expand short-term adverse impacts and long-term benefits described in alternative B. As with alternative B, potential for impacts associated with land management, forest conversion, and increased visitation will be monitored to minimize impacts of refuge hydrology and water quality. The duration and timing of some land management activities would vary as compared to alternative B.
	Under all of the alternatives, we would continue to support existing partnerships for volunteer monitoring of Darby Creek and to assess and manage for water quality improvements impacting the refuge as time and resources allow. We would annually review and refresh staff in spill response protocols and emergency protection measures. We would also continue to coordinate with EPA and other stakeholders to remediate Folcroft and Clearview Landfills and minimize water quality and environmental health impacts related to contaminants associated with these sites. None of our proposed refuge management activities should adversely affect local or regional hydrology and water quality. None would violate Federal or State standards for contributing pollutants to water sources; all three would comply with the Clean Water Act. Continue to partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek in an effort to minimize flooding in the Township. Construction activities at the 55-acre restoration site would have a short-term impact on water quality, although all necessary soil erosion and sediment controls would be used to minimize this impact. In addition, the contractor would be required to complete a plan that describes measures to prevent hazardous materials (e.g. fuel and oils) from impacting water quality.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Soils	Long-term benefits for soils from protecting up to 993 acres within the approved refuge boundary. Increased visitation could potentially result in localized soil compaction or erosion. Refuge staff will monitor trails to evaluate ongoing impacts and needs to minimize impacts. Minor soil displacement and loss would result from maintenance activities, installation of interpretative infrastructure, and construction of outdoor pavilions.	Long-term benefits for soils from land protection would be similar to alternative A. Short-term soil compaction and erosion from trail maintenance crews and refuge visitors, but impact area limited to existing trails. Restoration of a portion of the 145-acre impoundment to freshwater tidal marsh would impact soils along construction and access roads, although soil erosion and sediment controls would minimize this impact. Minor soil displacement of already disturbed soils would result from proposed 1,800 square-foot expansion of headquarters/visitor contact facility. Construction of up to 300 feet of boardwalk within the freshwater tidal marsh would result in temporary disturbance and minor wetland fill associated with the footings used to support the boardwalk structure. Increased visitation under alternative B could result in increased potential for soil compaction and erosion along trails and other access areas. Refuge staff would monitor trails and access areas to evaluate any impacts as a result of increased use.	Long-term benefits for soils from land protection would be similar to alternative B. Overall impacts would be the same as for alternatives A and B, except restoration of the entire impoundment would result in increased short-term adverse impacts and long-term benefits described in alternative B. Removal and conversion of a 15-acre stand of nonnative gray poplar to a shrub-scrub dominated habitat would potentially result in soil compaction and erosion, although any necessary soil erosion and sediment controls would be used to minimize this impact. Increased visitation under alternative C could result in increased potential for soil compaction and erosion along trails and other access areas. Refuge staff would monitor trails and access areas to evaluate any impacts as a result of increased use.
	Under all alternatives, the refuge would expand its ownership of lands within the approved acquisition boundary, which would provide long-term protection of soils. The refuge would continue to experience localized impacts due to public use, vehicular traffic, and occasional construction disturbance.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Noise	Establishment of tree plantings along I-95 would result in a slight reduction of noise impacts on localized portions of the refuge.	Soundscapes and noise impacts would be similar to alternative A, except: Short-term negative impacts on natural soundscape would increase as compared to alternative A as a result of increased visitation and construction activities. Periodic, short-term noise impacts would be generated from firing of non-lethal screamer shells for monitoring purposes as well as firearms related to deer management activities. No long-term effects on the natural soundscape of the refuge.	Soundscapes and noise impacts would be similar to alternative B, except: Under alternative C, the refuge would explore construction of a physical sound barrier along I-95.
	The soundscape of John Heinz NWR clearly contains the sounds and noises of an urbanized landscape. Traffic, airplanes, heavy equipment operation, industrial and commercial operations, and building and road constructionall contribute to community noise and disturbance in varying degrees. The noise analysis completed for the PHL runway expansion environmental impact statement demonstrated that the refuge experiences noise levels between 45 and 60 decibels (dB) based on the Day-Night Average Sound Level (DNL) recorded near the refuge. A noise monitoring site on Lindberg Boulevard south of the refuge showed an average DNL of 50 dB. This is calculated to increase to 55.4 dB in 2007 and 56.5 dB in 2015 with the runway expansion project (FAA 2005).		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Vegetation	We would continue forest management focused primarily on invasive species control and monitoring the impacts of high deer populations. Long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded forested areas would not be feasible with continued impacts of an over-abundant deer population. Construction of an environmental education pavilion would result in the permanent loss of mostly cool season, old field vegetation. Seasonal water level management in the 145-acre impoundment would be used to promote growth of annual vegetation and mudflats.	This alternative would emphasize restoration of freshwater tidal marsh that would result in expanded freshwater tidal marsh vegetation. Implementing a deer management control plan would reduce the deer herd and promote natural regeneration of native species, and provide added competition in control of invasive species. Invasive plant control in marsh, forest, and grassland habitat would result in short-term losses of available vegetative cover. This impact would be offset by long-term benefits of increasing native plant species diversity and richness. Conversion of 15 acres of nonnative poplar forest to coastal plain or floodplain forest would result in short-term impacts due to removal of vegetation and loss of cover. In the long term this area will reestablish native vegetation. Conversion of 14-acres of grassland to coastal plain or floodplain forest will result in expanded acreage of forest habitats, along with a corresponding loss of grassland habitat. Infrastructure construction projects, such as boardwalks and facility expansions, will result in small scale and localized loss of grassland or marsh vegetation. Restoration construction projects will result in a short-term, localized, and temporary loss of vegetation during completion of work. Long-term benefits will be created to vegetation as a result of restoration projects. Increased visitation could potentially result in added off-trail usage and impacts as a result of soil compaction and trampling of vegetation. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use.	This alternative would potentially undertake restoration of the entire 145-acre impoundment to freshwater tidal marsh. If pursued, this restoration would be delayed at least 10 years to evaluate future sea level rise trends. Delay of this work would postpone the benefits of added marsh vegetation. Invasive plant control in marsh, forest, and grassland habitat would result in short-term losses of available vegetative cover, but long-term benefits of increasing native plant species diversity and richness. Long-term benefits from conversion of a 15-acre stand of nonnative gray poplar to a shrub-scrub dominated habitat which is not found on the refuge and that would provide habitat for a variety of species of concern. Restoration construction projects will result in a short-term, localized, and temporary loss of vegetation during completion of work. Long-term benefits will be created to vegetation as a result of restoration projects. Increased visitation could potentially result in added off-trail usage and impacts as a result of soil compaction and trampling of vegetation. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Vegetation (cont.)	Under all alternatives we would continue to monitor and manage invasive species that cause environmental harm, such as the decline of native species and disruption of environmental processes. We would continue to employ IPM approach and adaptive management to control invasive plant species. We would also continue to promote visitor and public awareness of invasive plant species issues which could result in increased management of invasive plant species in the region. Completion of the 55-acre marsh restoration will result in a short-term, localized, and temporary loss of vegetation during completion of work. Long-term benefits will be created to vegetation as a result. Continue to conduct annual aerial herbicide application on 10 to15 acres of phragmites within the existing freshwater tidal marsh to reduce invasive species populations. This may result in potential for minimal off-target damage to native vegetation. Continue education and interpretation of native and invasive vegetation to encourage volunteer based control of invasive species. Public use can affect vegetation in a variety of ways including directly by trampling and indirectly through soil compaction which can affect root systems. We regularly monitor trails and roads and have not observed any major impact areas resulting from wildlife observation, photography, environmental education, or interpretive uses. Grassland habitats would benefit by continuing a transition from cool season to warm season grasses through regular herbicide applications and supplemental planting and seeding. This transition results in improved species diversity and habitat structure beneficial to wildlife. Occasional mowing or clearing would occur along trails as part of ongoing trail maintenance under all alternatives, resulting in the promotion of disturbance tolerant species along mowed areas.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Federal Endangered and Threatened Species	Depending on the timing, the drawdown of the impoundment reduces the overall acreage of available open water habitat for eagle foraging, but may potentially increase foraging efficiency. Continue to maintain nesting and foraging habitat for bald eagles and potential foraging habitat for shortnose sturgeon.	Restoration of additional forest habitat under this alternative will result in added roost habitat and buffer for bald eagles. Emphasis on restoration of tidal marsh will provide additional potential for forage and nursery habitat for shortnose sturgeon. Increased visitation could potentially result in added off-trail usage impacts and disturbance as a result of use. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use or added disturbance that might influence nesting.	Conversion of grasslands and 15 acres of nonnative poplar forest to shrub-scrub habitat would result in a minor loss of potential roost habitat as compared to alternative B. Delayed restoration of any tidal marsh would postpone any net benefits to the shortnose sturgeon that may utilize the refuge. Increased visitation could potentially result in added off-trail usage impacts and disturbance as a result of use. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use or added disturbance that might influence nesting.
	We would continue to implement public access restrictions to protect the nesting American bald eagles through closure of the nesting sites and would offset the inconvenience to some visitors by completing installation of a webcam at the nesting site. Remediation of Folcroft Landfill, restoration of refuge habitats, continued land acquisition and protection and associated protection of vegetation and water resources all benefit water quality on refuge and to a minimal extent off refuge. Improved water quality provides minimal benefits to shortnose sturgeon in the Delaware River. We will continue to coordinate with PGC and PADCNR on information sharing and decisionmaking recommendations to maintain partnerships in protection of endangered species.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Landbirds	Continue forest management with an existing focus on control of invasive species already established in forested habitats. Seasonal drawdowns of water levels within the 145-acre impoundment may affect osprey and eagle foraging. The concentration of fish as a result of drawdowns may have a net neutral or positive effect.	Minimal habitat manipulation of forest habitat would maintain distribution and quality for forest dwelling birds. Short-term, temporary impacts result from human presence on trails, research, and the presence of dogs; however, the requirement to stay on trails and on leash would minimize the extent and duration of impacts. Increased knowledge and understanding of bird populations resulting from various surveys and inventories would help us better quantify effects on birds on the refuge. Initiation of deer management efforts through the use of wildlife control specialists would result in improvements in forest structure and vegetation diversity, which would improve the available cover and forage for landbirds over time. Conversion of the 15 acres of nonnative poplar forest to coastal plain or floodplain forest will result in short-term losses of forest bird habitat, although forest composition and structure will be improved as a result of long-term restoration. Conversion of 14 acres of grasslands to coastal plain or floodplain forest will result in expanded acreage of forest habitats and species, along with a corresponding loss of grassland habitat and suitable stopover habitat for associated species. Increased visitation could potentially result in added off-trail usage impacts and disturbance as a result of use. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use or added disturbance that might influence nesting. Added public use infrastructure proposed under alternative B such as boardwalks and kiosks would not be constructed near known nesting areas.	Similar to alternative B, except: Considering installation of sound barriers next to interstate I-95 could lead to noise abatement measures that would improve breeding and rearing success. Initiation of deer management efforts would result in improvements in forest structure and vegetation diversity, which would improve the available cover and forage for landbirds over time. Under this alternative, we would anticipate those benefits taking longer to develop as a result of the combination of specialized hunts and wildlife control specialists. Conversion of the 15 acres of nonnative poplar forest to shrub-scrub habitat will result in losses of forest bird habitat, although development of early successional habitat would create a habitat type currently unavailable on the refuge. In particular, short-eared owls nesting in the nonnative poplar forest would experience greater displacement in nesting opportunities under alternative C due to the single large-scale clearing of the entire 15-acre area. Conversion of 14 acres of grasslands to shrub-scrub habitat will result in reductions of forest habitats and species, along with a corresponding increase in early successional habitat and suitable stopover habitat for associated species. Increased visitation could potentially result in added off-trail usage impacts and disturbance as a result of use. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use or added disturbance that might influence nesting.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Landbirds (cont.)	Continue to maintain breeding, foraging, and stopover habitat for State-listed and regional priority landbird species as part of refuge wetland, grassland, and forest management. Continue to restrict access and management activities when and where appropriate near known nesting sites and continue breeding success monitoring. We will continue to coordinate with PGC and PADCNR on information sharing and decisionmaking recommendations to maintain partnerships in protection of endangered species. Landbirds will continue to be impacted by disturbance as a result of the presence of humans in portions of the habitats present at the refuge. We will continue to not manage feral cat populations on the refuge. We would continue to monitor the impacts of feral cats on landbirds and make changes in management or access as needed to continue our protection of landbird species.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Open Water and Wetland Bird Species	Continue manipulating water levels within the 145-acre impoundment in order to provide seasonal migration stopover habitat for various bird groups such as waterfowl, wading waterbirds, and shorebirds. Areas of freshwater tidal marsh, along with open waters of Darby Creek and the Delaware River would also continue to provide available nesting, foraging, and stopover habitat for water birds.	Alternative B would provide long-term expansion of open water and wetland habitats through the restoration of additional freshwater tidal marsh, which would increase nesting, foraging, and migratory stopover habitat for waterfowl, shorebirds, and wetland wading birds. Restoration of up to half of the impoundment would add to the benefits provided by freshwater tidal marsh. More detailed comparison of use of freshwater tidal marsh and the 145-acre impoundment by birds on the refuge would be evaluated further under this alternative to ensure that the most beneficial array of marsh and open water habitat is provided. Expanded restoration of freshwater tidal marsh, including portions of the 145-acre impoundment, would allow us to improve our education and interpretation about the importance of tidal marsh habitat, habitat restoration, and wildlife conservation. The conversion of up to half of the 145-acre impoundment would result in a loss of nontidal open water habitat from the refuge. However, the adverse effects on wildlife as a result of this would likely be negligible, since most waterfowl, wetland wading birds, and shorebirds readily utilize freshwater tidal marsh and open waters and mudflats which are available elsewhere on the refuge. Construction of restoration projects proposed would result in short-term disturbances to soils, vegetation, hydrology, and soundscapes of localized portions of habitat used by open water and wetland birds. We would undertake considerations during our construction and its timing to minimize these impacts. We anticipate the long-term benefit of this habitat to exceed any minor short-term impact on these species' habitat.	The restoration of the entire 145-acre impoundment to freshwater tidal marsh would improve foraging and nesting habitat for State-listed wetland wading birds such as the American bittern, least bittern, and king rail as well as waterfowl like the American black duck, lesser scaup, and northern pintail. Similar to alternative B, a more detailed comparison of use of freshwater tidal marsh and the 145-acre impoundment by birds on the refuge would be evaluated further under this alternative to ensure that the most beneficial array of marsh habitat is provided. Alternative B anticipates an increase in refuge participation and visitation. Much of this increase is expected in the form of school groups or recreational uses. Use of existing trails poses minimal potential impact to birds nesting in open water or wetland habitats. Compared to alternatives A and B, there would be more people walking off-trail on the refuge if opened to hunting, increasing potential for disturbance. Since the hunt would be controlled, refuge staff would monitor locations and numbers of hunters and wildlife control specialists to ensure there are no long-term effects on these species.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Open Water and Wetland Bird Species (cont.)		Alternative B anticipates an increase in refuge participation and visitation. Much of this increase is expected in the form of school groups or recreational uses. Use of existing trails poses minimal potential impact to birds nesting in open water or wetland habitats. Added public use infrastructure proposed under alternative B such as boardwalks and kiosks would not be constructed near known nesting areas. Construction timing would also be considered where necessary to avoid potential disturbance to sensitive species.	Alternative C also would develop a secondary method of transportation that would allow visitors to gain access to portions of the freshwater tidal marsh either via a tram, shuttle bus, or boat tour. Depending on the frequency, duration, and method of transportation, providing any of these options could pose disturbance to populations of open water or wetland birds on the refuge. We would continue to only pursue a transportation option that minimizes the impact on wildlife and the habitats they utilize.
	Under all alternatives, the refuge would continue to restrict access and management activities when and where appropriate near known nesting sites and continue breeding success monitoring. Long term benefits to waterbirds are anticipated through the ongoing management of existing freshwater tidal marsh and the impoundment, primarily in the control and reduction of purple loosestrife and phragmites. The refuge would continue to coordinate with Pennsylvania Game Commission and Department of Conservation and Natural Resources, along with our conservation partners, to ensure that we utilize the best available science in our management decisions related to State-listed species. Waterfowl and shorebirds that are not State-listed, but still of regional conservation priority, would continue to utilize freshwater tidal marsh, open waters and associated mudflats along Darby Creek. Restoration of the 55-acre phragmites-dominated wetland to freshwater tidal marsh, proposed under all alternatives, would add beneficial habitat for many open water and wetland bird species. Some wetland birds may be present during aerial applications of herbicides for phragmites control and may experience direct contact with herbicides if they do not flush ahead of the helicopter flyover, or if spray misses the targeted application patch. The herbicides and surfactants approved for use in marshes are not toxic to birds, and would wet them only temporarily, if at all. We do not expect this as a frequent occurrence, as many marsh birds are not likely to inhabit phragmites stands. Bennett and Zuelke (1999) summarize several studies indicating recreation activities would have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges. We will take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them. Public users of the areas along Darby Creek, the 145-acre impoundment, and tidal marsh could damage marsh grasses or disturb nesting or foraging marsh birds or otherwise degrade these areas, for example through deposit of used fishing line, tackle, or other trash or by disturbance to bank areas and creation of turbidity. Refuge signage, flyers, and other public information materials would continue to be used to ensure that the public is aware of these issues and does not engage in harmful activities.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Fisheries	Same as *Impacts on Fisheries That Would Not Vary by Alternative.*	Same impacts as alternative A; plus: Restoring and expanding freshwater tidal marsh within the refuge would increase the available habitat for spawning, year-round food and shelter, and nursery and rearing habitat. Potential impacts from recreational users would also slightly increase over alternative A with expanded fishing opportunities. Increased risk from shoreline erosion or debris and other waste could affect water quality. However, we plan to monitor those sites closely and address any elevated concerns. Installing a network of water quality monitoring equipment along Darby Creek within the refuge and implementing long-term and continuous monitoring would provide additional information to guide management actions in regards to fisheries. Restoration of a portion of the 145 acre impoundment to a freshwater tidal wetland would have a short-term impact on fishing resources. Since finfish are mobile most impacts would be avoided; however some impacts to eggs and larvae may occur. Providing additional fishing access points and expanding fishing programs would provide additional opportunities for fishing. Designated fishing access points would concentrate use and disturbance. Marsh restoration construction projects will result in a short-term, localized, and temporary disturbance during completion of work. Long-term benefits to available habitat will be created as a result of restoration projects.	Fishing impacts are similar to those described under alternative B, except for the restoration of the entire 145-acre impoundment to freshwater tidal marsh. However, the delay of the marsh restoration would postpone potential benefits in creating spawning, nursery, and foraging opportunities for fish. Marsh restoration construction projects will result in a short-term, localized, and temporary disturbance during completion of work. Long-term benefits to available habitat will be created as a result of restoration projects.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Fisheries (cont.)	Protection of the existing freshwater tidal marsh, impoundment, and other open water areas at the refuge protects and supports a number of aquatic species (see Table 2-2), and may also provide habitat for species of conservation concern, such as the federally and State-listed endangered shortnose sturgeon. Completion of the 55-acre marsh restoration will result in short-term, localized, and temporary impacts during completion of work. Long-term benefits will be created to fish spawning, nursery, and forage habitat as a result. Continue enforcement against deliberate introductions of nonnative fish, and outreach and education to explain the impacts of those introductions as well as the accidental introductions of invasive plants, pathogens, and exotic, invasive invertebrates. State regulations would be adhered to, which establish species and harvest limits to ensure no cumulative impact on any fish populations. Support ongoing research and studies for monitoring impacts to fisheries due to contaminants and/or climate change. We would continue to work with the PFBC on outreach, education and law enforcement related to fisheries found at the refuge. We would also continue to coordinate with EPA and other stakeholders to close Folcroft and Clearview Landfill and minimize water quality and fishery impacts related to contaminants associated with these sites.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Mammals	Lack of deer management would continue to impact other mammal species as a result of the ongoing degradation of habitats including loss of vegetative cover and species diversity.	Implementing a deer management control plan through the use of wildlife control specialists would reduce the deer herd, resulting in the loss of individual deer, while improving the health of remaining individuals. Deer management would also promote natural regeneration of native species, creating added cover and forage for other small mammals. Conversion of 15 acres of nonnative poplar forest to coastal plain or floodplain forest would result in short-term impacts due to removal of vegetation and loss of cover. In the long term this area will reestablish native vegetation and mammal habitat across this site. Infrastructure construction projects, such as boardwalks and facility expansions, will result in minimal and localized disturbance to potential mammal foraging and nesting habitat. Restoration construction projects will result in a short-term, localized, and temporary loss of habitat during completion of work. Long-term benefits will be created to mammal habitat as a result of restoration projects. Increased visitation could potentially result in added off-trail usage and disturbance to individual mammals. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use.	Same as alternative B, except: The delay of the marsh restoration would postpone potential benefits in creating habitat opportunities for small mammals. Initiation of deer management efforts would result in improvements in forest structure and vegetation diversity, which would improve the available cover and forage for mammals over time. Under this alternative, we would anticipate those benefits taking longer to develop as a result of the combination of specialized hunts and wildlife control specialists.
	We will continue to coordinate with PGC and PADCNR on information sharing and decisionmaking recommendations to maintain partnerships in protection of mammals utilizing the refuge. Overall, the effects from public use are not likely to have an impact on mammals. Limiting visitors to existing trails prevents unintended disturbance to terrestrial mammals. Rare mammals potentially present such as the marsh rice rat and the river otter, are adequately buffered from human disturbance by the waters of Darby Creek and expanses of freshwater tidal marsh.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Amphibians and Reptiles	Lack of deer management would continue to impact other amphibian and reptile species as a result of the ongoing degradation of habitats including loss of vegetative cover and species diversity.	Implementing a deer management control plan through the use of wildlife control specialists would reduce the deer herd, which would promote natural regeneration of native species, creating added cover and forage habitat for amphibians and reptiles. Conversion of 15 acres of nonnative poplar forest to coastal plain or floodplain forest would result in short-term impacts due to removal of vegetation and loss of cover. Long-term this area will reestablish native vegetation and cover and forage habitat across this site. Added emphasis on marsh restoration projects will result in a short-term, localized, and temporary loss of habitat during completion of work. Long-term benefits will be created to nesting and foraging habitat for both amphibians and reptiles as a result of restoration projects. Increased visitation could potentially result in added off-trail usage and disturbance. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use. Increased knowledge and understanding of amphibian and reptile populations resulting from various surveys and inventories would help us better quantify our effects on amphibian and reptile species on the refuge.	Initiation of deer management efforts would result in improvements in forest structure and vegetation diversity, which would improve the available cover and forage for mammals over time. Under this alternative, we would anticipate those benefits taking longer to develop as a result of the combination of specialized hunts and wildlife control specialists. Conversion of 15 acres of nonnative poplar forest to shrub-scrub would result in short-term impacts due to removal of vegetation and loss of cover. Long-term this area will reestablish native vegetation providing cover and forage habitat. The delay of the marsh restoration would postpone potential benefits in creating habitat opportunities for amphibians and reptiles. Increased visitation could potentially result in added off-trail usage and disturbance. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use. Considering installation of sound barriers next to interstate I-95 could lead to noise abatement measures that would improve breeding and rearing success.
	We will continue to coordinate with EPA and other stakeholders to close Folcroft and Clearview Landfill and minimize water quality and amphibian and reptile impacts related to contaminants associated with these sites. We will continue to employ a range of management tools to achieve our objectives in managing for the improved health and integrity of open water and wetland habitats. We would use these tools only when and where appropriate, and only with the proper training and focused application to minimize or avoid adverse impacts. Completion of the 55-acre marsh restoration will result in short-term, localized, and temporary impacts during completion of work. Long-term benefits will be created for reptile and amphibian habitat as a result. We will continue to sustain the State-threatened red-bellied turtle through protection of hibernation, foraging, basking, and nesting habitat.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Invertebrates	Same as impacts identified under effects common to all alternatives below.	Increased knowledge and understanding of invertebrate populations resulting from U.S. Forest Service inventory would help us better quantify the effects on invertebrate species on the refuge. Conversion of 15 acres of nonnative poplar forest to coastal plain or floodplain forest would result in short-term impacts due to removal of vegetation and loss of cover. In the long term this area will reestablish native vegetation and invertebrate habitat across this site. Conversion of 14 acres of grassland to coastal plain or floodplain forest will result in expanded acreage of forest habitats, along with a corresponding loss of grassland habitat. Added emphasis on marsh restoration projects will result in a short-term, localized, and temporary loss of invertebrate habitat during completion of work. Long-term benefits will be created for invertebrates as a result of restoration projects. Implementing a deer management control plan through the use of wildlife control specialists would reduce the deer herd, which would promote natural regeneration of native species, creating an added diversity of species and habitats for invertebrates.	Same as alternative B, except: The conversion of 15 acres of nonnative poplar forest to shrub-scrub, as well as the conversion of 14 acres of grassland to shrub-scrub will result in a change of vegetation cover type. The resulting impact on invertebrates, and whether it would be a net positive or negative impact, is unclear at this time.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Invertebrates (cont.)	Completion of the 55-acre marsh restoration will result in short-term, localized, and temporary impacts during completion of work. Long-term benefits will be created for invertebrate habitat as a result. Under all alternatives we would continue to monitor and manage invasive species that cause environmental harm such as the decline of native species and disruption of environmental processes. The use of herbicides to complete aspects of invasive species management can cause negative impacts to some invertebrates. However, our attempts to minimize use and application of IPM techniques should minimize any impact on invertebrate populations. The restoration of native plants as a result of invasive species control and other land management would improve vegetation diversity, which in turn would likely improve available habitat for invertebrates. Outdoor lighting at the refuge can create impacts to certain species in the butterflies and moths family. We have minimized the use of outdoor lighting at the refuge and thereby maintain a negligible effect on invertebrates.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Public Use and Access	We would maintain the existing five priority public uses (excluding hunting). Hunting would continue to be prohibited on the refuge in compliance with local regulations. Complete ongoing upgrades to meet ADA-accessibility requirements, installation of a webcam at the bald eagle nest, and completion of an outdoor pavilion for environmental education. We predict a slight increase in visitor numbers per year on the refuge, and would expect a commensurate increase in demand for refuge programs.	In the short term, access limitations at restoration sites during or after construction would inconvenient some visitors. In the long term, increased emphasis on restoration would provide additional habitat for wildlife and therefore increased opportunities for compatible, wildlife-dependent recreation. Implementing this alternative would expand existing opportunities for five of the six priority public uses with a focus on offering places, programs, and exhibits that appeal to children and families and that help reconnect them with nature. Providing additional fishing access points, boardwalks, bird and photography blinds would increase opportunities for wildlife observation. Regularly updating and improving interpretation infrastructure such as signage, kiosks, and displays would improve the quality of visitor experiences. Providing more interpretive options such as virtual tours, podcasts, and interactive programs via the refuge Web site or cellphone would engage urban youth and technologically savvy visitors. Increased visitation could potentially result in added off-trail usage and disturbance. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use. Partnering with neighboring marinas and boat launches to institute organized boat tours of Tinicum Marsh would increase wildlife viewing opportunities, particularly for the elderly and families and would attract new visitors.	This alternative would also initiate a deer management control program utilizing a controlled youth hunt in order to assist in reducing the size of the resident deer herd. This would promote natural regeneration of native species and enhance habitat for other wildlife such as birds, amphibians, reptiles, and small mammals. Installation of additional webcams at the refuge would allow refuge visitors to observe wildlife via the internet and virtually explore portions of the refuge they may not normally observe. Under this alternative, the refuge anticipates increased visitation, although slightly less in numbers as compared to alternative B. This increase could potentially result in added off-trail usage and disturbance. Refuge staff will monitor usage to prevent or correct any unauthorized off-trail use.

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Public Use and Access (cont.)	Under all alternatives, we would continue to provide quality, compatible wildlife-dependent recreation that allows a diversity of visitors to connect with nature in the outdoors. We would maintain our infrastructure to support those activities, upgrade appropriate facilities to ADA standards, and provide safe access. We would continue to permit dog walking as long as dogs are kept on leash and the activity is restricted to designated access road corridors. We would continue to limit access to ecologically sensitive areas such as nesting sites during breeding seasons and high quality wetlands. We would make efforts to minimize the impact on public use and access to those locations and timeframes necessary for adequate species protection. We would continue to seek qualified researchers and funding to answer refuge specific questions, participate in multi-refuge studies in partnership with USGS, and facilitate appropriate and compatible research.		
Effects on Cultural and Historic Resources	Under all alternatives, we would maintain the existing local natural history exhibits as part of the visitor center displays and maintain the existing natural history educational resource program including web-based lesson plans, loan boxes, and equipment. No archaeological or historic sites or structures are known to exist on the refuge. Given the extent of tidal marsh and the past level of land fill and disturbance in upland areas, it is unlikely that archeological resources would be identified at the refuge in the future. The refuge owns no museum property. While no adverse impacts to cultural or historic resources are anticipated, we will send this draft CCP/EA to the RHPO for review in compliance with section 106 of the NHPA. In all of the alternatives, we will consult with our regional archeologist and the RHPO as needed to ensure compliance with NHPA and other applicable laws and regulations.		

Refuge Resource or Program	Alternative A Current Management	Alternative B Increased Restoration and Improved Visitor Services	Alternative C Delayed Restoration with Increased Focus on Regional Role in Higher Education in Conservation and Research
Effects on Socioeconomic Environment	Continue to contribute minimally to the local and much larger Philadelphia area economy, in terms of refuge staff jobs, income, refuge and visitor expenditures, and the purchase of goods and services for refuge activities. Estimate of total annual refuge visitation of 133,000 contributes up to $1.5 million to the State or local economy.	Increasing visitation by 54 percent over the next 15 years could contribute annually up to approximately $2.3 million to the State or local economy. Expanding opportunities for five of six priority public uses. Adding five refuge staff would minimally increase benefits for the local economy in jobs, income, expenditures, and purchases of goods and services for refuge activities. Implementing management actions such as partnership with local cultural attractions, developing marketing materials for hotels, and partnership with regional transportation are specifically designed to take advantage of the regional tourism and increase visitors and their contribution to the local economy. Special construction projects would also contribute to the local economy for labor, materials, and services.	Alternative C proposes similar management actions designed to increase visitation discussed in alternative B and staffing levels. The benefits of increased visitation and visitor expenditures would resemble those in alternative B. Restoration of the entire 145-acre impoundment to freshwater tidal marsh could limit the refuge's ability to manipulate water levels in order to assist neighboring Tinicum Township with flood control.
	Of the management activities that would not vary by alternative, the following would benefit or adversely affect the socioeconomic environment of the refuge: protecting land, maintaining facilities, implementing the 55-acre restoration project, supporting research and Friends of Heinz NWR group activities at the refuge, and implementing existing priority public use opportunities.		

Chapter 5

Frank Miles/USFWS

Great blue heron feeding on common carp at the refuge

Consultation and Coordination

5.1 Introduction

This chapter describes how we engaged others in developing this draft CCP/EA. In chronological order, it details our efforts to encourage the involvement of the public and conservation partners: other Federal and State agencies, Tribes, county officials, civic groups, nongovernmental conservation and education organizations, and user groups. It also identifies who contributed in writing the plan or significantly contributed to its contents.

It does not detail the dozens of informal discussions the refuge manager and his staff have had over the last two years where the CCP was a topic of conversation. Those involved a wide range of audiences, including local community leaders and other residents, refuge neighbors, refuge visitors, and other interested individuals. During those discussions, the refuge manager and his staff often would provide an update on our progress and encourage comments and other participation.

A 30-day period for public review follows our release of this draft CCP/EA. We encourage you to respond with your ideas about the plan. During that period, we will host open-house public meetings at locations near the refuge to gather opinions and answer questions about our proposals. We will weigh public responses carefully before we finalize the CCP.

According to Service policy, we must review and update our final CCP at least once every 15 years. We may update the plan sooner, if we determine that we need to markedly change management direction or our Director or Regional Director deem it necessary. If so, we will once again announce our revised planning and encourage your participation.

5.2 Planning to Protect Land and Resources

January 2010

Our refuge planning began formally on January 21, 2010 during a conference call between refuge staff, regional office staff, and contractors. One of the major outcomes of the meeting was a timetable for accomplishing the major steps in the planning process and determining when and how we should involve others.

February 2010

Our pre-planning activities in February included development of a draft communications plan and finalizing the contact database for notification of the CCP and invitation to the agency scoping meeting. Invitations to the scoping meeting were sent to 55 Federal and State contacts, elected officials, and 13 federally recognized Tribes associated with Pennsylvania, Delaware, and New Jersey.

On February 3, 2010 refuge staff met with the contractor to identify data needs, obtain input on the contact database and review the CCP process.

On February 18, 2010 refuge staff, regional staff, and the contractor reviewed the agency scoping meeting agenda, meeting logistics, and determined the display maps and presentation materials needed for the meeting. We also discussed finalization of maps to show refuge boundaries, in-holdings, and utility right-of-ways.

On February 20, 2010 the refuge manager sent invitations to the agency scoping meeting with attachments that included: the meeting time and location, agenda, guidance on the refuge establishment authority, and the Service mission and Service policy that guides the CCP planning process.

March 2010

Our pre-planning and scoping activities in March included coordination with the Delaware Nation on participation in the CCP process; holding the agency scoping meeting on March 31, 2010; and preparing for and setting the date for the public scoping meeting for May 11, 2010.

On March 23, 2010 refuge staff, regional staff, and the contractor reviewed and commented on the agency scoping meeting presentation, meeting logistics, and display maps and handouts to be provided at the meeting.

On March 29, 2010 refuge staff, regional staff, and the contractor met at the visitor center to finalize the draft vision and goals, finalize meeting power point presentations, and set the date of May 11, 2010 for public scoping meetings during the afternoon and evening.

The agency scoping meeting was held on Wednesday, March 31, 2010 from 9:00 AM to 2:00 PM at the visitor center and included a total of 26 attendees including the refuge staff and the core planning team. The list of attendees is attached and a summary of comments from the Federal agencies Representative is provided below. The meeting was an open house format with brief presentations on the CCP process and refuge status, and displays of the refuge context, habitat management units, visitor services and facilities, and handouts on the draft vision and goals.

April 2010

On April 20, 2010 refuge staff, regional staff, and the contractor reviewed and commented on the agency scoping meeting presentation, meeting logistics, and display maps and handouts to be provided at the public scoping meeting.

The press release announcing the scoping meeting and requesting public input was distributed to major media outlets on April 22, 2010.

A newsletter announcing the Service's intent to prepare a CCP and EA was prepared and distributed to 380 people on the contacts list. 280 of those contacts received the newsletter via email, while an additional 100 were mailed paper copies since no email address was available for those contacts. In addition, the refuge made an additional 200 copies available to the public in its visitor center.

May 2010

The Notice of Intent (NOI) to prepare a CCP and EA for John Heinz NWR was published on May 7, 2010 (75 FR 25285), officially opening the public scoping period for comments through June 11, 2010.

We held two public scoping meetings which were at the refuge's visitor center on May 11, 2010 from 2:00 to 4:00 p.m. and from 6:30 to 8:30 p.m.

The meetings included a total of 18 attendees, including refuge staff and the core planning team. The list of attendees is attached and a summary of comments from the attendees and those providing comments by June 11, 2010 is provided below. The meeting was an open house format with brief presentations on the CCP process and refuge status, and displays of the refuge context, habitat management units, visitor services and facilities, the past and planned marsh restoration projects, and handouts on the draft vision and goals.

June 2010

Our scoping activities in June included summarizing comments from the public scoping meeting and other written comments submitted before the official comment period ended on June 11, 2010.

On June 21, refuge staff, regional staff, and the contractor discussed the major issues identified in the public scoping meeting, decided on a format for summarizing the scoping comments, followed up with the education community, and discussed the content and deadlines for the newsletter. The core planning team also determined that the main objectives of meeting with the Service hydrologist would be to assist in evaluating hydrology issues, such as control of water in the impoundment, stormwater flowing onto the property from offsite sources, and monitoring needs for climate change and water management.

On June 29th the refuge staff, contractor, and Tinicum Township Engineer, Mr. Herb McCombie, met with the Service hydrologist from the Pennsylvania Ecological Service's Office, Dr. Larry Brannaka. They reviewed hydrology issues at the refuge, natural and man-made drainage south of the refuge that connects with or influences stormwater flowing onto the property, and flooding, tidal, and drainage issues in Tinicum Township. On June 30th the refuge staff, contractor, and Dr. Brannaka discussed the hydrology data needs for evaluating impoundment management options and monitoring needs for climate change and water management.

July 2010 through June 2011

The core team prepared a newsletter that informed interested parties of the summary of scoping activities and comments received during the public comment period. This newsletter was distributed on August 9, 2010 to approximately 294 contacts via email, plus an additional 88 paper copies were mailed to those contacts for which email addresses were unavailable.

From July through December 2010, the core team worked together to analyze comments and evaluate alternative management options that would help achieve the refuge's purposes and draft goals. Over the course of three

workshop-style meetings, the core team developed the basic framework for what is proposed within this draft CCP/EA.

From December 2010 through June 2011, the planning team has been developing alternatives, completing appendices, and writing and editing the various chapters.

July 2011 through March 2012

We completed "Step E: Prepare Draft Plan and NEPA document," by publishing our Notice of Availability (NOA) in the *Federal Register* announcing the release of this draft CCP/EA and by distributing this document for public review. During the 30-day period of public review, we will hold one or more public meetings to obtain comments. We also expect to receive comments by regular mail and electronic mail. After the comment period ends, we will review and summarize all of the comments we have received and develop our responses. We will present them in an appendix to the final CCP.

Once we have prepared the final CCP, we will submit it to our Regional Director for review and approval. He will determine whether a Finding of No Significant Impact (FONSI) is appropriate, and certify whether the final CCP meets agency compliance requirements, achieves refuge purposes, and helps fulfill the mission of the Refuge System. With an affirmative FONSI and other positive findings, the Regional Director can approve the final CCP. If that happens, we will publish another *Federal Register* NOA to announce the availability of the final plan. That will complete "Step F: Prepare and Adopt a Final Plan." We can then begin "Step G: Implement Plan, Monitor and Evaluate."

Congressional Meetings

May 21, 2009

Met with Congressional Staff Eriade Hunter (Congressman Robert Brady, PA-1), Kasey Gillette (Senator Robert Casey, Jr.), and Alex Halper (Senator Arlen Specter) with Sue McMahon from FWS-Region 5.

December 8, 2010

Met with Congressional Staff-Maureen O'Dea (Senator Robert Casey, Jr.) and Ashley Shillingsburg (Congressman Robert Brady, PA-1) with Joseph McCauley from FWS-Region 5.

5.3 Partners Involved in Refuge Planning

Refuge programs enjoy a great deal of support from outside the Service in many areas, including: conducting biological surveys, enhancing public use and refuge programs, restoring habitat, and protecting land. Our partnerships will continue to expand under the increasing interest in conserving refuge resources. Since January 2010, we have contacted the following partners to apprise them of the planning process and encourage their involvement.

- Academy of Natural Sciences
- American Birding Association
- American Fisheries Society
- American Sportsfishing Association
- AmeriCorps Vista
- Army Corp of Engineers, Regulatory Branch
- Assateague Coastal Trust

- Audubon Society, Valley Forge Chapter
- Audubon, Mill Grove
- Bartram's Garden
- Borough of Folcroft
- Borough of Norwood
- Borough of Prospect Park
- Boy Scouts of America, Cradle of Freedom Council
- Brandywine Conservancy, Inc.
- Brandywine Environmental Education Center
- Brandywine Valley Association, Inc.
- Brandywine Visitor Bureau
- Brandywine Zoo
- Brandywine CVB
- Cabrini College
- Camden Academy
- Cayuga Nation
- Chester Valley Sportsmen Association
- Chester-Ridley-Crum Watershed Association
- Chestnut Hill Local
- Clean Air Council
- Clean Water Action
- Congressional Sportsmen's Foundation
- Congressman Joe Sestak
- Congressman Robert Brady
- Cooperative Alliance for Refuge Enhancement
- Council on Environmental Quality
- Daily Pennsylvanian
- Darby Borough
- Darby Creek Valley Association
- Darby Township
- Darby-Cobbs Watershed Partnership
- Pennsylvania Department of Conservation and Natural Resources
- Defenders of Wildlife
- Delaware Coastal Management Program
- Delaware County Conservation District
- Delaware County Cooperative Extension of Penn State
- Delaware County Field and Stream Association
- Delaware County Institute of Science
- Delaware County Orienteering Association
- Delaware County Parks and Recreation Board
- Delaware County Planning Department
- Delaware County Solid Waste Authority
- Delaware Estuary Program
- Delaware Museum of Natural History
- Delaware Nation of Oklahoma
- Delaware Nature Society
- Delaware Planning Department
- Delaware River and Bay Authority
- Delaware River Basin Commission
- Delaware Riverkeeper Network

- Delaware Tribe
- Delaware Valley Regional Planning Commission
- Drexel University
- Ducks Unlimited, Inc.
- EarthForce
- Eastern Lenape Nation of Pennsylvania
- EHY Associates
- Energy Coordinating Agency of Pennsylvania
- Environmental Defense Fund
- Federal Aviation Administration
- Fairmount Park Commission
- French Creek State Park
- Friends of Heinz Wildlife Refuge
- Forest Partners International
- Fort Mifflin
- Franklin Institute
- Girl Scouts of Eastern Pennsylvania
- GreenSpace Alliance
- Haverford College
- Hawk Mountain Sanctuary
- International Association of Fish and Wildlife Agencies
- Keystone Trails Association
- Longwood Gardens
- Mid-Atlantic Council of Watershed Associations
- Morris Arboretum
- Nanticoke Indian Association, Inc.
- Nanticoke Lenni-Lenape
- National Audubon Society
- National Fish and Wildlife Foundation
- National Oceanic and Atmospheric Association
- National Rifle Association of America
- National Trappers Association, Inc.
- National Wildlife Federation
- National Wildlife Refuge Association
- Natural Lands Trust, Inc.
- Natural Resources and Conservation Service
- New Jersey Adventure Aquarium
- New Jersey Department of Environmental Protection
- National Oceanic and Atmospheric Administration
- North American Butterfly Association
- National Water Resources Association
- Oneida Indian Nation
- Onondaga Nation
- Pennsylvania Association of Conservation Districts
- Pennsylvania Bureau of Forestry–William Penn District
- Pennsylvania Citizens Advisory Council
- Pennsylvania Department of Environmental Protection
- Pennsylvania Fish and Boat Commission
- Pennsylvania Forestry Association
- Pennsylvania Game Commission

- Pennsylvania Senate and House of Representatives
- Pennsylvania State Museum
- Partnership for the Delaware Estuary
- Patrick Center for Environmental Research
- Pennsylvania Department of Transportation
- Pennsylvania Environmental Council
- Pennsylvania Federation of Sportsmen Clubs
- Pennsylvania Recreation and Park Society, Inc.
- Pennsylvania Resource Council
- Pennsylvania Sea Grant
- Pennsylvania State Preservation, Historical Museum Commission
- Philadelphia Recreation Department
- Philadelphia Herpetological Society
- Philadelphia University – School of Science and Health
- Philadelphia Water Department
- Philadelphia Zoo
- Rails to Trails
- REED
- Ridley Creek State Park
- Ridley Township
- Ridley Township Business Association
- Rutgers Cooperative Extension of Camden County
- Rutgers University, Haskin Shellfish Research Laboratory
- Safari Club International
- Student Conservation Association
- Schuylkill Center for Environmental Education
- Senator Arlen Specter
- Senator Robert P. Casey, Jr.
- Seneca Nation Tribal Historic Preservation
- Senior Environmental Corp
- Southeastern Pennsylvania Transportation Authority
- Sierra Club – Eastern Pennsylvania Group
- Stroud Water Resources Center
- Swarthmore College
- Temple University
- The Academy of Natural Sciences
- The Conservation Fund
- The Corps Network
- The Humane Society of the United States
- The Izaak Walton League of America, Inc.
- The Nature Conservancy
- The Wilderness Society
- The Wildlife Legislative Fund of America
- The Wildlife Society
- Tinicum Township
- Tri-State Bird Rescue & Research
- Trout Unlimited
- Trust for Public Land

- Tyler Arboretum
- US Department of Transportation
- US Environmental Protection Agency
- Union of Concerned Scientists
- United American Indians of Delaware Valley, Inc.
- University of Delaware
- University of Sciences, Philadelphia
- Ursinus College
- US Geological Survey
- US Department of Agriculture
- Villanova University
- Wagner Free Institute of Science
- Webbed Foot Wildlife Rehab
- Western Pennsylvania Conservancy–Natural Heritage Division
- Widener University
- Wildlife Forever
- Wildlife Management Institute
- Wildlife Rehabilitation Clinic
- William Rush Memorial Bird Carvers Association

5.4 Contact Information

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Chapter 6

Ron Holmes/USFWS

Osprey soaring over waters at the refuge

List of Preparers

6.1 Members of the Core Planning Team

Service Personnel	**Gary Stolz**	*Refuge Manager,* John Heinz National Wildlife Refuge at Tinicum
	Larry Woodward	*(former) Deputy Refuge Manager,* John Heinz National Wildlife Refuge at Tinicum
	Brendalee Phillips	*Refuge Biologist,* John Heinz National Wildlife Refuge at Tinicum
	Lia McLaughlin	*Natural Resource Planner,* Northeast Region, Region 5 Regional Office
State Agency Personnel	**Eric Miller**	*Chief,* Public Lands Habitat Section–Bureau of Wildlife Habitat Management, Pennsylvania Game Commission
Contractor Personnel	**Dan Salas**	*Ecologist,* ESA Certified, Cardno JFNew
	Dave Williams	*Project Manager,* Land & Stream Improvements LLC

6.2 Assistance from Other Service Personnel

Mariana Bergerson	*Park Ranger,* John Heinz National Wildlife Refuge at Tinicum
Dr. Larry Brannaka	*Hydrologist,* Pennsylvania Ecological Services Office
William Buchanan	*Outdoor Recreation Planner,* John Heinz National Wildlife Refuge at Tinicum
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Green frog

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Greg Thompson/USFWS

White-tailed deer yearling

Glossary and Acronyms

Glossary

accessibility — the state or quality of being easily approached or entered, particularly as it relates to complying with the Americans With Disabilities Act.

accessible facilities — structures accessible for most people with disabilities without assistance; facilities that meet UFAS standards; ADA-accessible [e.g., parking lots, trails, pathways, ramps, picnic and camping areas, restrooms, boating facilities (docks, piers, gangways), fishing facilities, playgrounds, amphitheaters, exhibits, audiovisual programs, and wayside sites].

aggregate — many parts considered together as a whole.

agricultural land — non-forested land (now or recently orchards, pastures, or crops).

alternative — a reasonable way to fix an identified problem or satisfy a stated need [40 CFR 1500.2] (see "management alternative").

anthropogenic — caused or produced by humans.

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 the policy.

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 which 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 Refuge System until the Service buys them or they are placed under an agreement that provides for their management as part of the Refuge System.

aquatic — growing in, living in, or dependent upon water.

area of biological significance — see "special focus area."

best management practices — land management practices that produce desired results.

[N.b. Usually describing forestry or agricultural practices effective in reducing non point source pollution, like reseeding skidder trails or not storing manure in a flood plain. In their broader sense, practices that benefit target species.]

biological diversity or biodiversity — the variety of life and its processes and includes 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 the natural biological processes that shape genomes, organisms and communities.

breeding habitat — habitat used by migratory birds or other animals during the breeding season.

categorical exclusion (CE, CX, CATEX, CATX) — pursuant to the National Environmental Policy Act (NEPA), a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment [40 CFR 1508.4].

CFR — the Code of Federal Regulations.

community — an assemblage of plants occurring together at any point in time.

community type — a particular assemblage of plants and animals, named for its dominant characteristic.

compatible use — "The term 'compatible use' means a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge."—National Wildlife Refuge System Improvement Act of 1997 [Public Law 105-57; 111 Stat. 1253].

compatibility determination — a required determination for wildlife-dependent recreational uses or any other public uses of a refuge.

comprehensive conservation plan (CCP) — mandated by the Refuge Improvement Act, a document that provides a description of the desired future conditions and long-range guidance for the project leader to accomplish purposes of the refuge system and the refuge. CCPs establish management direction to achieve refuge purposes [P.L. 105-57; USFWS Manual 602 FW 1.4].

concern — see "issue."

conservation — managing natural resources to prevent loss or waste.

[N.b. Management actions may include preservation, restoration, and enhancement.]

conservation easement — a legal agreement between a landowner and a land trust (e.g., a private, nonprofit conservation organization) or government agency that permanently limits the uses of a property to protect its conservation values.

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 not necessarily become part of the National Wildlife Refuge System.

critical habitat — according to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.

cultural resources — archaeological sites, historic structures, and historic landscapes.

cultural resource overview — a comprehensive document prepared for a field office that discusses, among other things, project prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement of how program objectives should be met and conflicts resolved. [An overview should reference or incorporate information from a field office's background or literature search described in section VIII of the Cultural Resource Management Handbook (cf. USFWS Manual 614 FW 1.7).]

database — a collection of data arranged for ease and speed of analysis and retrieval, usually computerized.

degradation — the loss of native species and processes due to human activities such that only certain components of the original biodiversity persist, often including significantly altered natural communities.

designated wilderness area — an area designated by Congress as part of the National Wilderness Preservation System [USFWS Manual 610 FW 1.5 9 draft)].

digitizing — the process of converting maps into geographically referenced electronic files for a geographic information system (GIS).

disturbance — any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

donation — a citizen or group may wish to give land or interests in land to the Service for the benefit of wildlife. Aside from the cost factor, these acquisitions are no different than any other means of land acquisition. Gifts and donations have the same planning requirements as purchases.

easement — an agreement by which landowners give up or sell one of the rights on their property (e.g., landowners may donate rights-of-way across their properties to allow community members access to a river). See "conservation easement."

ecological processes — a complex mix of interactions among animals, plants, and their environment that ensures maintenance of an ecosystem's full range of biodiversity. Examples include population and predator-prey dynamics, pollination and seed dispersal, nutrient cycling, migration, and dispersal.

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 natural community of organisms interacting with its physical environment, regarded as a unit.

ecotourism visits to an area that maintains and preserves natural resources as a basis for promoting its economic growth and development.

emergent wetland wetlands dominated by erect, rooted, herbaceous plants.

endangered species a federally or state-listed protected species in danger of extinction throughout all or a significant portion of its range.

endophyte a bacterium or fungus that lives within a plant for at least part of its life without causing apparent disease.

environmental education curriculum-based education aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward solving them.

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.

Environmental Assessment (EA) a public document that discusses the purpose and need for an action, its alternatives, and provides sufficient evidence and analysis of its impacts to determine whether to prepare an environmental impact statement or a finding of no significant impact (q.v.) [cf. 40 CFR 1508.9].

exemplary community type an outstanding example of a particular community type.

extirpated status of a species or population that has completely vanished from a given area but that continues to exist in some other location.

exotic species a species that is not native to an area and has been introduced intentionally or unintentionally by humans; not all exotics become successfully established.

Federal land public land owned by the Federal Government, including national forests, national parks, and national wildlife refuges.

federally listed species a species listed either as endangered or threatened 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. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (e.g., the ability to continue using the land for a specified time period, such as the remainder of the owner's life).

Finding of No Significant Impact (FONSI) supported by an environmental assessment, a document that briefly presents why a Federal action will have no significant effect on the human environment, and for which an environmental impact statement, therefore, will not be prepared [40 CFR 1508.13].

fire regime the characteristic frequency, intensity, and spatial distribution of natural fires within a given ecoregion or habitat.

floodplain flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the process of being built up by stream deposition.

focus areas see "special focus areas" .

forested land land dominated by trees. For impacts analysis in CCP's, we assume all forested land has the potential for occasional harvesting; we assume forested land owned by timber companies is harvested on a more intensive, regular schedule.

forested wetlands wetlands dominated by trees.

fragmentation the disruption of extensive habitats into isolated and small patches. Fragmentation has two negative components for biota: the loss of total habitat area and the creation of smaller, more isolated patches of habitat remaining.

geographic information system (GIS) a computerized system to compile, store, analyze, and display geographically referenced information (e.g., GIS can overlay multiple sets of information on the distribution of a variety of biological and physical features).

grassland a habitat type with landscapes dominated by grasses and with biodiversity characterized by species with wide distributions, communities being relatively resilient to short-term disturbances but not too prolonged, and intensive burning or grazing. In such systems, larger vertebrates, birds, and invertebrates display extensive movement to track seasonal or patchy resources.

groundwater water in the ground that is in the zone of saturation, from which wells and springs and groundwater runoff are supplied.

habitat fragmentation the breaking up of a specific habitat into isolated and small patches.

[N.b. A habitat area that is too small may not provide enough space to maintain a breeding population of the species in question.]

habitat conservation protecting an animal or plant habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced.

habitat the place where a particular type of plant or animal lives.

[N.b. An organism's habitat must provide all of the basic requirements for life, and should be free of harmful contaminants.]

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.

hydrologic or flow regime characteristic fluctuations in river flows.

hydrology the science of waters of the earth: their occurrences, distributions, and circulations; their physical and chemical properties; and their reactions with the environment, including living beings.

impoundment a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use.

indigenous native to an area.

interpretive facilities structures that provide information about an event, place, or thing by a variety of means, including printed, audiovisual, or multimedia materials (e.g., kiosks that offer printed materials and audiovisuals, signs, and trail heads).

interpretive materials any tool used to provide or clarify information, explain events or things, or increase awareness and understanding of the events or things (e.g., printed materials like brochures, maps or curriculum materials; audio/visual materials like video and audio tapes, films, or slides; and, interactive multimedia materials, CD ROM or other computer technology).

invasive species a non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

invertebrate any animal lacking a backbone or bony segment that encloses the central nerve cord.

issue any unsettled matter that requires a management decision (e.g., a Service initiative, an opportunity, a management problem, a threat to the resources of the unit, a conflict in uses, a public concern, or the presence of an undesirable resource condition).

[N.b. A CCP should document, describe, and analyze issues even if they cannot be resolved during the planning process (FWS Manual 602 FW 1.4).]

Land Protection Plan (LPP) a document that identifies and prioritizes lands for potential Service acquisition from a willing seller, and describes other methods of providing protection. Landowners within project boundaries will find this document, which is released with environmental assessments, most useful.

land trusts organizations dedicated to conserving land by purchase, donation, or conservation easement from landowners.

landscape an aggregate of landforms, together with its biological communities.

management alternative a set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4.].

management concern see “issue” and “migratory nongame birds of management concern.”

management opportunity see “issue.”

management plan a plan that guides future land management practices on a tract.

[N.b. In the context of an environmental impact statement, management plans may be designed to produce additional wildlife habitat along with primary products like timber or agricultural crops (see “cooperative agreement”).]

management strategy a general approach to meeting unit objectives.

[N.b. A strategy may be broad, or it may be detailed enough to guide implementation through specific actions, tasks, and projects (FWS Manual 602 FW 1.4).]

mesic soil — sandy-to-clay loams containing moisture-retentive organic matter, well-drained (no standing water).

mission statement — a succinct statement of the purpose for which the unit was established; its reason for being.

mitigation — actions to compensate for the negative effects of a particular project (e.g., wetland mitigation usually restores or enhances a previously damaged wetland or creates a new wetland).

National Environmental Policy Act of 1969 (NEPA) — 42 U.S.C. 4321 et seq. requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in planning and implementing environmental actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decisionmaking (cf. 40 CFR 1500).

National Wildlife Refuge System (Refuge System) — all lands and waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction.

native — a species that, other than as a result of an introduction, historically occurred or currently occurs in a particular ecosystem.

native plant — a plant that has grown in the region since the last glaciation, and occurred before European settlement.

natural disturbance event — any natural event that significantly alters the structure, composition, or dynamics of a natural community (e.g., floods, fires, and storms).

non-consumptive, wildlife-oriented recreation — wildlife observation and photography and environmental education and interpretation (see "wildlife-dependent recreation").

nonnative species — see "exotic species."

nonpoint source pollution — a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from diffuse sources or a number of points that are spread out and difficult to identify and control.

non-forested wetlands — wetlands dominated by shrubs or emergent vegetation.

Notice of Intent (NOI) — an announcement we publish in the *Federal Register* that we will prepare and review an environmental impact statement or an environmental assessment [40 CFR 1508.22].

Notice of Availability (NOA) — an announcement we publish in the *Federal Register* that we have prepared an environmental impact statement or an environmental assessment and that it is available for public review and comment.

objective — see "unit objective."

old fields areas formerly cultivated or grazed, where woody vegetation has begun to invade.

[N.b. If left undisturbed, old fields will eventually succeed into forest. Many occur at sites marginally suitable for crops or pasture. They vary markedly in the Northeast, depending on soil and land use and management history.]

outdoor education educational activities that take place in an outdoor setting.

partnership a contract or agreement among two or more individuals, groups of individuals, organizations, or agencies, in which each agrees to furnish a part of the capital or some service in kind (e.g., labor) for a mutually beneficial enterprise.

payment in lieu of taxes cf. Revenue Sharing Act of 1935, Chapter One, Legal Context.

point source a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant outfall pipe.

population monitoring assessing the characteristics of populations to ascertain their status and establish trends on their abundance, condition, distribution, or other characteristics.

prescribed fire the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives [FWS Manual 621 FW 1.7].

priority public use a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation.

private land land owned by a private individual or group or nongovernmental organization.

private landowner see "private land."

private organization any nongovernmental organization.

protection mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations at a site.

public individuals, organizations, and nongovernment groups; officials of Federal, state, and local government agencies; Native American Tribes, and foreign nations includes anyone outside the core planning team, those who may or may not have indicated an interest in the issues, and those who do or do not realize that our decisions may affect them.

public involvement offering an opportunity to interested individuals and organizations whom our actions or policies may affect to become informed; soliciting their individual opinions. We thoroughly study public input, and give it thoughtful consideration in shaping decisions about managing refuges.

public land land owned by the local, state, or Federal Government.

rare species species identified for special management emphasis because of their uncommon occurrence within a watershed.

rare community types	plant community types classified as rare by any state program; includes exemplary community types.
refuge goals	According to "Writing Refuge Management Goals and Objectives: A Handbook," refuge goals are "…descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units."
refuge purposes	According to the National Wildlife Refuge System Improvement Act of 1997, "The terms 'purposes of the refuge' and 'purposes of each refuge' mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit."
refuge lands	lands in which the Service holds full interest in fee title or partial interest like an easement.
restoration	management of a disturbed or degraded habitat that results in the recovery of its original state (e.g., restoration may involve planting native grasses and forbs, removing shrubs, prescribed burning, or reestablishing habitat for native plants and animals on degraded grassland).
riparian	referring to the interface between freshwater habitats and the terrestrial landscape.
riparian habitat	habitat along the banks of a stream or river (see note above).
riverine	within the active channel of a river or stream.
riverine wetlands	generally, all the wetlands and deepwater habitats occurring within a freshwater river channel not dominated by trees, shrubs, or persistent emergents.
runoff	water from rain, melted snow, or agricultural or landscape irrigation that flows over a land surface into a water body (see "urban runoff").
Service presence	Service programs and facilities that it directs or shares with other organizations; public awareness of the Service as a sole or cooperative provider of programs and facilities
shrublands	habitats dominated by various species of shrubs, often with many grasses and forbs.
species of concern or species of conservation concern	species not federally listed as threatened or endangered, but about which we or our partners are concerned.
species diversity	usually synonymous with "species richness," but may also include the proportional distribution of species.
species richness	a simple measure of species diversity calculated as the total number of species in a habitat or community.
state agencies	natural resource agencies of state governments.
state land	state-owned public land.

state-listed species see "federally listed species."

step-down management plan a plan for dealing with specific refuge management subjects, strategies, and schedules, e.g., cropland, wilderness, and fire [FWS Manual 602 FW 1.4.].

strategy a specific action, tool, technique, or combination of actions, tools, and techniques for meeting unit objectives.

succession the natural, sequential change of species composition of a community in a given area.

surface water all waters whose surface is naturally exposed to the atmosphere, or wells or other collectors directly influenced by surface water.

sustainable development the attempts to meet economic objectives in ways that do not degrade the underlying environmental support system. Note that there is considerable debate over the meaning of this term; we define it as "human activities conducted in a manner that respects the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature's capital rather than the capital itself."

terrestrial living on land.

threatened species a federally listed, protected species that is likely to become an endangered species in the foreseeable future over all or a significant portion of its range.

tributary a stream or river that flows into a larger stream, river, or lake, feeding it water.

trust resource a resource that the Government holds in trust for the people through law or administrative act.

[N.b. A Federal trust resource is one for which responsibility is given wholly or in part to the Federal Government by law or administrative act. Generally, Federal trust resources are nationally or internationally important no matter where they occur, like endangered species or migratory birds and fish that regularly move across state lines. They also include cultural resources protected by Federal historic preservation laws, and nationally important or threatened habitats, notably wetlands, navigable waters, and public lands like s national wildlife refuges.]

unfragmented habitat large, unbroken blocks of a particular type of habitat.

upland dry ground (i.e., other than wetlands).

upland meadow or pasture upland pastures are areas maintained in grass for livestock grazing; upland meadows are hay production areas.

[N.b. Meadows may occur naturally in tidal marshes and inland flooded river valleys or, more frequently, at upland sites where vegetation has been cleared and grasses planted. Eventually, meadows will revert to old fields and forest if they are not mowed, grazed, or burned. Grasses in both managed meadows and pastures usually are similar, but pasture herbs often differ because of selective grazing.]

urban runoff water from rain, melted snow, or landscape irrigation flowing from city streets and domestic or commercial properties that may carry pollutants into a sewer system or water body.

vernal pool — depressions holding water for a temporary period in the spring, and in which various amphibians lay eggs.

vision statement — a concise statement of what the refuge could achieve in the next 10 to 15 years.

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.

wetlands — lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. These areas are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted to life in saturated soil conditions.

wilderness study areas — lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation that they be included in the designated wilderness area.

wilderness — see "designated wilderness area."

wildfire — a free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands [FWS Manual 621 FW 1.7].

wildlife-dependent recreation — recreational activities in which wildlife is the focus of the experience. According to the National Wildlife Refuge Improvement Act of 1997, "The terms 'wildlife-dependent recreation' and 'wildlife-dependent recreational use' mean a use of a refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation."

wildlife-dependent recreational use — a use of a national wildlife refuge involving hunting, fishing, wildlife observation or photography, or environmental education or interpretation (National Wildlife Refuge System Administration Act of 1966).

wildlife management — manipulating wildlife populations, either directly by regulating the numbers, ages, and sex ratios harvested, or indirectly by providing favorable habitat conditions and alleviating limiting factors.

Acronyms

Acronym	Full Name
ACJV	Atlantic Coast Joint Venture
ADA	American Disabilities Act
AHMP	Annual Habitat Management Plan
ARPA	Archaeological Resource Protection Act
ATV	All-terrain Vehicle
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BMP	Best Management Practice
CAP	Contaminants Assessment Protocol
CCP	Comprehensive Conservation Plan
CD	Compatibility Determination
CFR	Code of Federal Regulations
CWD	Chronic Wasting Disease
DEP	Department of Environmental Protection
EA	Environmental Assessment
EHD	Epizootic Hemorrhagic Disease
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FHWAR	Fishing, Hunting, and Wildlife Associated Recreation
FONSI	Finding of No Significant Impact
FOHR	Friends of the Heinz Refuge
FTE	Full-time Employee
FY	Fiscal Year
GIS	Geographic Information System
HMP	Habitat Management Plan
IPCC	Intergovernmental Panel on Climate Change

Acronym	Full Name
LWCF	Land and Water Conservation Fund
MBCF	Migratory Bird Conservation Fund
MOU	Memorandum of Understand
NABCI	North American Bird Conservation Initiative
NAWCA	North American Wetlands Conservation Act
NAWMP	North American Waterfowl Management Plan
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NHPA	National Historic Preservation Act
NNL	National Natural Landmark
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRI	Nationwide Rivers Inventory
NWPS	National Wilderness Preservation System
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NWSR	National Wild and Scenic River
NWSRS	National Wild and Scenic River System
OMB	Office of Management and Budget
ORV	Off-road Vehicle
OSHA	Occupational Safety and Health Administration
PA	Pennsylvania
PADCNR	Pennsylvania Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission
PIF	Partners in Flight

Acronym	Full Name
PNHP	Pennsylvania Natural Heritage Program
REAP	Rehabilitation Environmental Action Plan
Refuge Improvement Act	National Wildlife Refuge System Improvement Act of 1997
Refuge System	National Wildlife Refuge System
RHPO	Regional Historic Preservation Officer
RNA	Research Natural Area
RONS	Refuge Operating Needs System
ROW	Right-of-way
SAMMS	Service Asset Maintenance Management System
SETs	surface elevation tables
SHC	Strategic Habitat Conservation
SHPO	State Historic Preservation Office
SLAMM	Sea Level Affecting Marshes Model
STEP	Student Temporary Employment Program
SUP	Special Use Permit
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USDOI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	U.S. Geological Survey
VS	Visitor Services
WAP	Wildlife Action Plan
WCU	Wildlife Control Unit
WIA	Wilderness Inventory Area
WSA	Wilderness Study Area
YCC	Youth Conservation Corps

Appendix A

Frank Miles/USFWS

A pine warbler in the refuge's coastal plain forest habitat

Known Species of Conservation Concern

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
WATERBIRDS																
American Bittern	c	r	o	r	Y		PE	M	2		X		HC			
American Coot	c	o	c	o	Y								MC			
Black Tern	o	r	o				PE								M	
Black-crowned Night Heron	a	a	a	o	Y		PE	M					V		M	
Bonaparte's Gull	o	r	o	r											M	
Caspian Tern	o	r	o						5						L	
Cattle Egret	o	o	r												NR	
Common Moorhen	u	u	u	r	Y				5				MC			
Common Tern	r	r	r				PE	M					V		L	
Double-crested Cormorant	c	r	c	r											NR	
Forster's Tern	r	o	c						5						M	
Glaucous Gull	r		r	r											NR	
Glossy Ibis	o	o	o					H	5						L	
Great Blue Heron	a	c	a	c					5				MC		NR	
Great Egret	a	a	a	r	Y		PE		5				V		NR	
Gull-billed Tern			r					HH	2	X	X				H	
Herring Gull	c	o	c	c											L	
Horned Grebe	r		r	r				H			X					
Iceland Gull	r		r	r											L	
King Rail	o	o	o	r	Y		PE	M	1B				V			
Laughing Gull	o	o	c	r											NR	
Least Bittern	o	c	o		Y		PE		2		X		V			
Least Tern	r	r	r					H	2		X				H	
Little Blue Heron	o	c	c					M	5						H	
Northern Gannet			r	r				H							NR	

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
WATERBIRDS (cont.)																
Pied-billed Grebe	c	r	c	o	Y				5		X		MC			
Red-throated Loon			r	r				HH			X					
Ring-billed Gull	c	o	c	c											NR	
Royal Tern			r					M	5						M	
Snowy Egret	a	a	a		Y			M			X				H	
Sora	o	o	o	r	Y			M					MC			
Tricolored Heron	o	o	o					M	5						H	
Virginia Rail	o	o	o	r	Y								HC			
White Ibis	r		r												M	
Yellow-crowned Night Heron	r	r	r				PE	M	5				V		M	
WATERFOWL																
American Black Duck	a	c	a	c	Y			HH	1B	X			MC			D
American Wigeon	o		o	o				M								I
Blue-winged Teal	c	c	c	r	Y											I
Brant	r		r	r						X						
Bufflehead	o		o	r				H								I
Canada Goose	a	a	a	c	Y					X						
Canvasback	o		o	r				H								I
Common Goldeneye	r	r	r	r				M								
Common Merganser	o		o	o												I
Gadwall	o	r	o	o				M								I
Greater Scaup	c	r	o	o				H								I
Green-winged Teal	c	o	a	c	Y			M					V			I
Hooded Merganser	o	r	o	r	Y			M								I
Lesser Scaup	o		o	o				H								D
Mallard	a	a	a	c	Y			H								NT

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
WATERFOWL (cont.)																
Northern Pintail	c	o	c	c	Y			M								D
Northern Shoveler	c	r	c	o	Y											I
Red-breasted Merganser	o		r	r				M								I
Redhead	r	r	r	r												NT
Ring-necked Duck	o	r	o	o												I
Ruddy Duck	c	o	c	c				M					MC			I
Tundra Swan	r		r	r				H					R			
Wood Duck	a	c	a	o	Y			M								I
LANDBIRDS																
Acadian Flycatcher	r	r	u						1B				MC			
Alder Flycatcher	o	o	u		Y								MC			
American Kestrel	c	c	c	c	Y				2							
Bald Eagle	u	r	u	u			PT	M	5		X		HC			
Bank Swallow	c	o	c						5				MC			
Barn Owl	c	c	c	c	Y		CR		2				MC			
Barred Owl	r	r	r	r					5							
Bay-breasted Warbler	c	r	c					H		X	X					
Black-and-white Warbler	c	r	c	r				H								
Black-billed Cuckoo	o	o	o		Y								MC			
Blackburnian Warbler	c	r	c					M					MC			
Blackpoll Warbler	c	r	c				PE						V			
Black-throated Blue Warbler	c	r	c										MC			
Black-throated Green Warbler	c	r	c										MC			
Blue-winged Warbler	o	o	o					HH	1B	X	X		R			
Bobolink	o	r	c						5							
Brewer's Blackbird			r	r												

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 4[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Broad-winged Hawk	o	o	c	r				H					MC			
Brown Creeper	c		c	c												
Brown Thrasher	c	c	c	o	Y			H	2				MC			
Canada Warbler	c	r	c					M		X	X		MC			
Cerulean Warbler	r	r	r					M	1B		X		HC			
Chimney Swift	c	c	c					H	2				MC			
Cliff Swallow	o	r	o						5							
Common Nighthawk	c	o	c										MC			
Cooper's Hawk	o	r	o	o					5							
Dickcissel	r	r	r	r					3				HC			
Eastern Kingbird	c	c	c		Y			H								
Eastern Meadowlark	o	r	o	r									MC			
Eastern Wood Pewee	o	r	o						1B							
Field Sparrow	c	o	c	c	Y			H	2							
Golden Eagle	r		r	r									V			
Golden-winged Warbler	r	r	r					M			X		HC			
Grasshopper Sparrow	r		r					M					MC			
Gray Catbird	c	c	c	o	Y			M	2							
Great Crested Flycatcher	o	r	o		Y			H								
Henslow's Sparrow	r		r						1B		X		HC			
Kentucky Warbler	r	r	u					H	1B		X		MC			
Loggerhead Shrike	r	r	r	r			PE		5		X		IC			
Long-eared Owl	r		r	r									HC			
Louisiana Waterthrush	r	r	u					H	1B				R			
Marsh Wren	c	c	c	r	Y		CR	H					HC			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Northern Bobwhite	r	r	r	r				H	2				IC			
Northern Flicker	c	c	c	o	Y			H								
Northern Goshawk	r		r	r									V			
Northern Harrier	c	o	c	c	Y		CA		5				HC			
Northern Oriole	c	o	c	r	Y			H								
Olive-sided Flycatcher	r		u								X		IC			
Osprey	o	o	o				PT		5				V			
Peregrine Falcon	r	r	r	r			PE		5		X		HC			
Pine Siskin	r	r	o	o									V			
Prairie Warbler	c	r	c					HH	1B	X	X		MC			
Prothonotary Warbler	r	r	u					H	1B				HC			
Red Crossbill				r									V			
Red-headed Woodpecker	r	r	r					M	2		X					
Red-shouldered Hawk	o	r	o	o					5				MC			
Rusty Blackbird	c	r	c	o				H			X					
Savannah Sparrow	c	r	c	r	Y				5							
Scarlet Tanager	c	r	c					H	2				R			
Sedge Wren	r	r	r		Y		PE	M	1B		X		IC			
Sharp-shinned Hawk	o	r	o	r									MC			
Short-eared Owl	o		o	o			PE	M	5		X		IC			
Summer Tanager	r	r	r										HC			
Swainson's Thrush	c	o	c								X		V			
Vesper Sparrow	c	o	o	o					5							
Whip-poor-will	r	r	r					H			X		MC			
White-eyed Vireo	c	c	c		Y				1B							

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
LANDBIRDS (cont)																
Willow Flycatcher	c	c	u		Y								MC			
Winter Wren	o		c	r									MC			
Wood Thrush	c	c	c	r	Y			HH	1B	X	X		R			
Worm-eating Warbler	r	r	u					H	1B		X		R			
Yellow-bellied Flycatcher	r	r	u				PE						V			
Yellow-breasted Chat	c	c	c	r	Y				2				MC			
Yellow-throated Vireo	o	r	o					H	1B				MC			
SHOREBIRDS																
American Woodcock	c	c	c	r	Y			HH		X			MC	X		
Black-bellied Plover	o	r	c	r				H								
Buff-breasted Sandpiper			r					H			X					
Common Snipe	c	r	c	o				M								
Dunlin	o		o	r				H								
Greater Yellowlegs	c	o	c	r				H								
Hudsonian Godwit			o					H			X					
Killdeer	a	a	a	o	Y			M								
Least Sandpiper	o	o	o	r				M								
Lesser Yellowlegs	o	o	0	r				M			X					
Marbled Godwit			r					H			X					
Piping Plover	r		r			E		HH	1A	X				X		
Red Knot	r		r					HH		X	X			X		
Red-necked Phalorope	r		r							X						
Ruddy Turnstone	r	r	r					HH								
Sanderling	r		r					HH		X						
Semipalmated Plover	c	r	c					M								

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
SHOREBIRDS (cont.)																
Semipalmated Sandpiper	c	o	c	r				H		X	X					
Short-billed Dowitcher	o	r	o	r				H			X					
Solitary Sandpiper	c	o	c								X		MC			
Spotted Sandpiper	c	c	c		Y			M								
Upland Sandpiper	r	r	r				PT	M	1B		X		IC			
Western Sandpiper		r	o	r				M								
Whimbrel	r		r					HH		X	X			X		
White-rumped Sandpiper	o	o	o					H								
Willet	r		r					H	3							
Wilson's Phalarope	r	r	r					H								
MAMMALS																
Marsh rice rat	nc	nc	nc	nc			SX									
Northern river otter	nc	nc	nc	nc			CA						MC			
AMPHIBIANS																
Coastal plain leopard frog	c	c	c	c	Y		PE						V			
REPTILES																
Eastern mud turtle	nc	nc	nc	nc	Y		PX									
Red-bellied turtle	u	u	u	u	Y		PT						HC			
FISH																
American eel	p	p	p	p								X	MC			
Alewife	p	p	p	p						X		X				
Blueback Herring	p	p	p	p								X				
Eastern mudminnow	p	p	p	p			CR									
Hickory shad	p	p	p	p			PE					X				
Striped Bass	p	p	p	p						X		X				
Shortnose sturgeon	nc	nc	nc	nc		E	PE			X		X	IC			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
PLANTS																
Waterhemp Ragweed	p	p	p	p			PR					X	MC			
Field Dodder	p	p	p	p			PT									
Walter's Barnyard-grass	p	p	p	p			PE									
A Eupatorium	p	p	p	p												
Forked Rush	p	p	p	p			PT									
Shrubby Camphor-weed	p	p	p	p						X		X				

Sources

[1] U.S. Fish and Wildlife Service. John Heinz NWR at Tinicum website. Available online at *http://www.fws.gov/heinz/index.html;* accessed January 2012.

a–abundant; c- common; u–uncommon; o–occasional; r–rare;
nc–not confirmed on refuge, but potential habitat;
p–present (from surveys) but seasonal abundance unknown

[2] U.S. Fish and Wildlife Service. Endangered Species Program website. Available online at *http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp;* accessed January 2012.

E–Endangered; T–Threatened; R–Rare

[3] Pennsylvania Natural Heritage Program. Pennsylvania Natural Heritage Program website. Available online at http://www.naturalheritage.state.pa.us/; accessed January 2012.

PE–Endangered; PT–Threatened; PR–Rare; PX/SX–Extirpated; CA–Candidate at Risk; CR–Candidate Rare

[4] U.S Fish and Wildlife Service. 2008. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. Atlantic Coast Joint Venture, Hadley, MA: Regoin 5, Fish and Wildlife Service, U.S. Department of the Interior. http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf; accessed January 2012.

HH–Highest Priority; H–High Priority; M–Moderate Priority

[5] Partners in Flight. April 1999. Partners in Flight: Mid-Atlantic Coastal Plain Bird Conservation Plan (Physiographic Area #44) Version 1.0. Williamsburg, VA. Prioritization Rankings = 1 (Highest)–5 (Lowest)

[6] U.S. Fish and Wildlife Service. December 2009. North Atlantic Landscape Conservation Cooperative Development and Operations Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.

[7] U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. Division of Migratory Bird Management, Arlington, Virginia. 93 pp. Online version available at *http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf;* accessed January 2012.

[8] Pennsylvania Game Commission/Pennsylvania Fish and Boat Commission. Accessed December 2008. State Wildlife Action Plan. Available online at *http://www.portal.state.pa.us/portal/server.pt?open=514&objID=622722&mode=2*; accessed January 2012.
IC–Immediate Concern (Tier 1); HC–High Level Concern (Tier 2); R–Responsibility Species (Tier 3);
V- Vulnerable Species (Tier 4); MC–Maintenance Concern (Tier 5)

[9] Clark and Niles. 2000. North American Shorebird Conservation Plan. Atlantic Flyway Priorities. Woodbine, NJ.

[10] James A. Kushlan, Melanie J. Steinkamp, Katharine C. Parsons, Jack Capp, Martin Acosta Cruz, Malcolm Coulter, Ian Davidson, Loney Dickson, Naomi Edelson, Richard Elliot, R. Michael Erwin, Scott Hatch, Stephen Kress, Robert Milko, Steve Miller, Kyra Mills, Richard Paul, Roberto Phillips, Jorge E. Saliva, Bill Sydeman, John Trapp, Jennifer Wheeler, and Kent Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf; accessed January 2012.

[11] Atlantic Coast Joint Venture. February 2007. North American Waterfowl Management Plan: Continental Progress Assessment. Population Trend Data = I–Increasing; D–Decreasing; NT–No Trend

Appendix B

LaVonda Walton/USFWS

Interpretive signs help connect visitors with nature.

Findings of Appropriateness and Compatibility Determinations

Findings of Appropriateness and Compatibility Determinations

603 FW 1
Exhibit 1

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Dog Walking in Designated Areas

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ("no" to [a]), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to [b], [c], or [d]) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✔ No _____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ✔

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Dog Walking in Designated Areas

NARRATIVE:

Dog walking has been authorized on the refuge for many years. We are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Although dogs can increase disturbance to wildlife, the refuge enforces a 6-foot leash restriction to keep the dog localized and under control at all times with the pedestrian. We believe most dog walkers are local residents, who regularly visit the refuge and understand our policy. Limiting the area for dog walking to access roads and parking lot areas open to public use on the refuge would keep potential disturbance to a minimum and provide a valuable service for the local neighborhood, while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. Allowing leashed dog walking on access roads and parking areas would not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

COMPATIBILITY DETERMINATION

USE:

Dog Walking in Designated Areas

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?
The use is dog walking. Dog walking is not a priority public use of National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(b) Where will the use be conducted?
Dog walking would be permitted only on refuge public use access roads and parking lot areas and prohibited on woodland foot paths or off trails (map B.1). The refuge access roads are located atop low habitat value dike perimeter trail outlining the 145-acre fresh water impoundment and along the edge of Interstate 95 between the impoundment and the west end of the refuge at Hwy 420. Refuge staff uses these areas as maintenance roads for the impoundment and they double function as pedestrian access routes for foot and bicycle use to view the refuge and facilitate other public use activities. With only a 6-foot leash, dogs would not be able to access any sensitive areas or disturb birds or other species except on the dike, where fewer interactions are likely to occur.

(c) When will the use be conducted?
Dog walking would be allowed throughout the entire year, during the refuge's normal open hours. The refuge is open daily sunrise to sunset.

(d) How will the use be conducted?
Dog walkers would be allowed to walk their dogs only when the dog is attached to a 6-foot (or less) leash and the dog walker is in control of the leash at all times. This leash law and areas open to dog walking would be strictly enforced to minimize wildlife and visitor disturbance. All dog walkers with properly leashed dogs are restricted to the designated refuge access roads and parking areas at all times. Dog owners would be required to pick up after their dogs. The refuge currently provides doggy bags near the main entrance (8601 Lindbergh Blvd.) for visitor convenience but it is the dog walkers responsibility to bring or obtain such materials.

(e) Why is this use being proposed?
John Heinz NWR is a unique urban environment surrounded by apartments, private homes and industrial areas where local neighbors have little or no other nearby areas of green space. We currently allow dog walking on the refuge and have not had significant negative impacts from this use. It has been a long time tradition for residents of the local community to use these portions of the refuge for this activity building strong local support and allowing an excellent opportunity to educate dog walkers about the refuge and the National Wildlife Refuge System. Local dog walkers have been historically very good about keeping their pets on leashes and cleaning up after them. Regulatory signs and brochure information helps reinforce these rules as well. Through the final CCP we would permit dog walking on designated refuge access roads and parking lot areas as an important service to residents of the local community.

AVAILABILITY OF RESOURCES:

Except for maintaining and periodically updating existing signs explaining the new regulations, minimal costs would be involved. Monitoring of the site for compliance would continue, but would not require significantly more resources beyond those already necessary to patrol the area for compliance with current regulations relating to dog walking and other activities within these designated public use areas of the refuge. Permitting this use is within the resources available to administer our Visitor Services Program. There is no additional staff or material costs incurred to the refuge. Compliance with the leash law is within the regular duties of the Station Law Enforcement Officer. The financial and staff resources necessary to provide and administer this use at its current level and at the level described in the final CCP are now available and we expect them to be available in the future. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public and administration needs	=	$1,000
Resource impacts/monitoring	=	$1,000
Maintenance needs	=	$2,000
Total	=	$4,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Because the refuge access roads and adjacent parking areas follow a dike system with limited habitat value, the potential impacts to wildlife and their habitats are minimal.

The presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that people with dogs on a leash, and loose dogs provoked the most pronounced disturbance reactions from their study animals. The greatest stress reaction results from unanticipated disturbance. Animals show greater flight response to humans moving unpredictably than to humans following a distinct path (Gabrielsen and Smith 1995). Despite thousands of years of domestication, dogs still maintain instincts to hunt and chase. The appropriate stimulus can trigger those instincts. Dogs that are unleashed or not under the control of their owners may disturb or threaten the lives of some wildlife. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog.

The role of dogs in wildlife diseases is poorly understood. However, dogs host endo- and ecto-parasites, and can contract diseases from or transmit diseases to wild animals. In addition, dog waste is known to transmit diseases that may threaten the health of some wildlife and other domesticated animals. Domestic dogs potentially can introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

There would be no impacts to the hydrology, plants, or soils due to the restricted nature of this use. The use would be confined to existing roads and no new construction or vegetation clearing is required. Impacts on wildlife would be minimal since the trails are not close enough to wildlife concentration areas and the dogs would be leashed. Short-term disturbance may occur to wildlife directly adjacent to this road. The use would be confined to existing public use areas and no new construction or vegetation clearing is required.

User conflicts are unlikely to occur since the open areas authorized for dog walking are wide and can accommodate a variety of users. Dog waste can create an unsightly environment to other refuge visitors. Although these negative impacts exist, they are kept to a minimum by restricting dog walking to designated areas of the refuge and strictly enforcing the leash and pick up after pet policies. Standard pet waste bags and disposal sites are available on the refuge.

It is anticipated that leashed dog walking on the designated routes would not cause any direct or indirect impacts to federally listed, threatened or endangered species. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. While bald eagles now nest on the refuge, both species have been delisted under the Federal Endangered Species Act (ESA).

PUBLIC REVIEW AND COMMENT:

This is an existing use of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Only leashed dogs would be allowed on the refuge. The leash would be no more than 6 feet long. Dog walkers would be required to maintain control of their animal while on the refuge, thereby reducing the potential and severity of impacts to wildlife and must refrain from entering closed areas.
- Dog walkers must pick up after their dog(s) and remove or properly dispose of pet waste.
- Agency and public awareness would be increased through interpretive or educational materials about responsible pet ownership in the context of wildlife disturbance during all outdoor recreational pursuits. Information would also address the potential role of domestic dogs in disease transmission to wildlife and vice versa in educational materials; information should include endoparasites and ectoparasites.
- Refuge staff and volunteers would monitor uses to ensure compatibility, refine user estimates, and evaluate compliance. Potential conflicts between user groups would also be evaluated.
- If a high number of reports of negative dog-wildlife interactions on the refuge access roads and parking areas are reported, the refuge would reassess the use.
- If a high number of off-leash incidents are documented, we may consider eliminating dog walking from the refuge altogether.
- Restricting dog walking to the designated access roads and parking areas would reduce the potential disturbance of wildlife.
- Dog walking is restricted to designated refuge access roads and parking areas only (map B.1) and prohibited from all woodland foot trails.

JUSTIFICATION:

We currently allow dog walking on the refuge and have not had significant negative impacts from this use. Although dogs can increase disturbance to wildlife, the refuge enforces a leash law to keep the dog localized with the pedestrian. We believe most dog walkers are local residents, who regularly visit the refuge and understand our policy. Limiting the area for dog walking to public use access roads and parking areas of the refuge would keep potential disturbance to a minimum.

We predict the stipulations (listed above) that we would require of dog walkers would negate or minimize any dog-related wildlife impacts as discussed in the potential impacts section. Dogs would be under the direct control of their owners at all times while on the refuge. This should minimize any potential impacts that could result from the use. We would require all dogs to be on leashes of 6 feet or less, which would prevent dogs from interacting with wildlife in the impoundment areas. The access roads and parking lots are located atop low habitat value dikes entrance areas of compacted soils and/or pavement. With only a 6-foot leash, dogs would not be able to access any sensitive areas or disturb birds or other species except on the dike, where fewer

interactions are likely to occur. To date, no negative dog-wildlife interactions have been reported from the sections of the refuge where dogs have been historically allowed.

Dog walking would add to the number of people partaking in wildlife observation and interpretation, contributing to refuge purposes and to providing opportunities for some of the priority public uses. As a result of the stipulations imposed (specified above), this use is expected to result in only minimal impacts to other refuge purposes. The impacts would be limited to the low quality habitat atop access roads and parking lots only. The use is not expected to have any impact on other refuge purposes.

Dog walking has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Dog walking in designated areas of the refuge is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

Baydack, R. K. 1986. Sharp-tailed grouse response to lek disturbance in the Carberry Sand Hills of Manitoba. Colorado State University, Fort Collins, Colorado.

Gabrielson , G. W. and E. N. Smith. 1995. Physiological responses of wildlife to disturbance. Pages 95-107 in R. L. Knight and K. J. Gutzwiller, ed. Wildlife and Recreationists: coexistence through management and research. Island Press, Washington, D. C. 372pp.

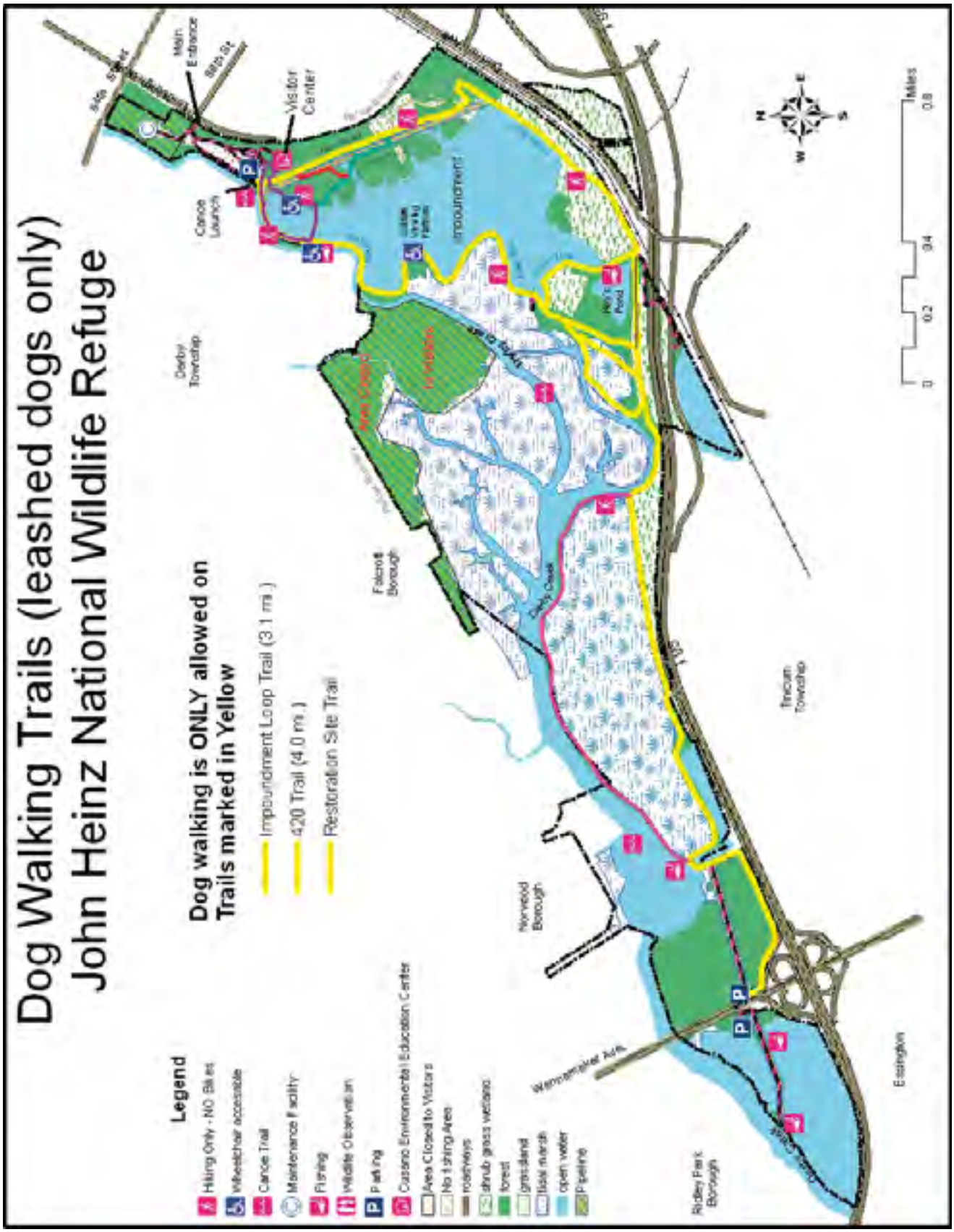
Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. Thesis, University of Massachusetts, Amherst, Massachusetts.

Keller, V. 1991. Effects of human disturbance on eider ducklings *Somateria mollissima* in an estuarine habitat in Scotland. Biological Conservation 58:213-228.

Sime, C. A. 1999. Domestic Dogs in Wildlife Habitats. Pp. 8.1-8.17 in G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society.

Yalden, P. E., and D. Yalden. 1990. Recreational disturbance of breeding golden plovers *(Pluvialis apricarius)*. Biological Conservation 51:243-262.

Map B.1. Access roads where dog walking is allowed at John Heinz National Wildlife Refuge at Tinicum.



603 FW 1
Exhibit 1

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Jogging

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ("no" to [a]), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to [b], [c], or [d]) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✔ No _____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ✔

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Jogging

NARRATIVE:

Jogging has been authorized on the refuge for many years. We are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Because refuge access roads and trails are maintained and open for public use, jogging is a low impact activity on the refuge. Cooke (1980) reported that passerine birds in suburban areas where human activity is ubiquitous, habituate to the activities and are not disturbed as often as birds in rural areas. Burger (1986) found that ducks and shorebirds on the mid-Atlantic coast exhibited sensitivity to joggers. However, Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors reduced human impacts. Because of the existing public use on the refuge and the refuge's location in a highly urbanized environment, disturbances to wildlife are expected to be minimal.

We believe most joggers are local residents, who regularly visit the refuge and understand our rules. Limiting the area for jogging to existing access roads and trails already open to public use on the refuge would keep potential disturbance to a minimum while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with public use of the refuge, nor cause an undue administrative burden.

COMPATIBILITY DETERMINATION

USE:

Jogging

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is jogging on John Heinz NWR. This is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?
Jogging would be permitted on all established roads, foot trails, and parking areas within the refuge which are currently open to public use (see map B.2). There are approximately 10 miles of trails on the refuge.

Refuge roads and trails designated for pedestrian travel are located primarily on already disturbed areas, i.e., old dikes and access roads with compacted soils and fill materials. While direct impact to wildlife and habitat on these trails is very minimal, the roads and trails provide excellent viewing of many of the refuge's wetland and upland areas and were specifically designed to provide access for visitors with little if any disturbance to wildlife. Wildlife species occurring in the vicinity of roads and trails include migratory birds (waterfowl, songbirds, and others), resident mammals, reptiles, and amphibians.

(c) When will the use be conducted?
Designated public use roads and trails would be open to jogging all year, when the refuge is open. The refuge is usually open daily sunrise to sunset, year-round.

(d) How will the use be conducted?
Jogging is limited to designated roads, trails, parking areas, boardwalks and other visitor service facilities within public use areas of the refuge during the open hours of sunrise to sunset. Brochures and maps depicting the roads and trails open for this use are available at the visitor center and on the refuge's Web site. Groups of 15 or more would require a special use permit.

Refuge roads and trails area already maintained for priority public uses to minimize environmental effects such as erosion and sedimentation and to provide safe conditions for travel. Existing potholes that promote off-road detours are routinely filled with gravel. Roads and trails would be monitored annually to determine if they remain compatible. As a step down plan, the refuge trail plan would include an inventory of all existing roads and trails.

(e) Why is this use being proposed?
Jogging is a historic use of the refuge. While refuge trails are built on top of lower quality habitat of old dikes or access roads, they provide exceptional opportunities to view wetland communities because they offer unrestricted views and are relatively level for easy pedestrian travel. We believe most joggers are local residents, who regularly visit the refuge and understand our rules. Limiting the area for jogging to existing access roads and trails already open to public use on the refuge would keep potential disturbance to a minimum while increasing understanding and appreciation of both the refuge and Service mission among gateway community residents. At current use levels, allowing jogging and priority public uses on refuge roads and trails is unlikely to be a safety risk.

AVAILABILITY OF RESOURCES:

Permitting this use is within the resources available to administer our Visitor Services Program. Staff time associated with administration of this use is minimal since pedestrian travel is permitted only on existing refuge roads and trails which are maintained for a wide range of maintenance, biological, and priority public uses. The annualized cost associated with the administration of pedestrian travel on the Refuge is estimated below:

Providing information to the public and administration needs	=	$1,000
Resource impacts/monitoring	=	$1,000
Maintenance needs	=	$2,000
Total	=	$4,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Because pedestrian travel would take place on routes which are currently cleared, maintained and improved; soil, hydrologic, and plant impacts would be minimal.

In general, the presence of humans disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Disturbance varies by wildlife species involved and the type, level, frequency, duration, and the time of year activities occur. Disturbance can cause shifts in habitat use, abandonment of habitat, and increased energy demands on affected wildlife (Knight and Cole 1991). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. In this study, common species (e.g. American robins) were found near trails and rare species (i.e. Blackburnian warblers) were found farther from trails. In some cases there is a clear link between the extent of disturbance and either the survival or reproductive success of individuals (e.g. Schulz and Stock 1993), but in many cases disturbance acts in a more subtle way, by reducing access to resources such as food supplies or nesting sites (Gill et al. 1996). Bird flight in response to disturbance can lower reproductive success by exposing individuals and nests to predators. For recreation activities that occur simultaneously (hiking, biking, and horseback riding) there would likely be compounding negative impacts to wildlife (Knight and Cole 1991).

Wildlife disturbance may be compounded by seasonal needs. For example, some species, like warblers, could be negatively affected by disturbance associated with bird watching particularly during the breeding season. When visitors approach nests too closely, they often cause the adult bird to flush exposing the eggs to weather conditions or predators (Banks and Bryant 2007, Miller et al. 2001). The extent of that disturbance along the trail also depends on visibility and the density of vegetation. For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Disturbance may also affect the reproductive fitness of males by hampering territory defense, mate selection, and other reproductive functions of vocalizations (Arrese 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents, which are time- and energy-consuming in defending territories (Ewald and Carpenter 1978).

As discussed throughout the refuge's draft Comprehensive Conservation Plan, the refuge is located in a highly urban environment, with substantial baseline disturbance associated with the international airport, I-95, several State routes, and numerous houses, businesses, community buildings, and associated human activity. By limiting the presence of humans to refuge trails and infrastructure, refuge visitors are not expected to add significantly to existing disturbance levels of wildlife in upland habitats. Overall, the direct disturbance from public use is expected to have minimal or no adverse effects on wildlife. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

Bennett and Zuelke (1999) summarize several studies indicating recreation activities would have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). We would take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

As discussed previously, it is important to note that the refuge exists within a highly altered area with substantial baseline levels of disturbance associated with interstate traffic, airport activities, adjacent neighborhoods, and roads. Overall, the effects from public use are expected to have minimal adverse effects on birds utilizing open water and wetland habitats. There are few visitor facilities (e.g., trails) in these habitats due to the presence of open water and saturated soils; therefore, they are relatively inaccessible to the public. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species like American bittern against human disturbance (Gibbs and Melvin 1992).

There are no known federally listed species on the refuge; therefore, jogging on the designated access roads and trails would not cause significant impacts to threatened or endangered species. The use would be confined to existing roads and no new construction or vegetation clearing is required. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. Both species have been delisted under the Federal Endangered Species Act (ESA). Bald eagles now nest on the refuge and are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Some impacts such as littering, vegetation disturbance, and wildlife disturbance can be anticipated, but this is not anticipated to be significant. This is an historic use of the refuge, and we are not aware of any conflicts with other public uses or negative effects on refuge resources from this use. Therefore, the use of refuge roads and trails for jogging would not adversely impact refuge purposes and objectives. Public trash receptacles are provided. Problems associated with littering can be countered through an effective law enforcement program and through public education. The roads are maintained for refuge purposes and there should be no consequences from use by jogging. Maintenance of existing interpretative trails would require only minimum attention.

Disturbance of wildlife can be minimized by seasonal or permanent closure of areas if needed to minimize effects of jogging. Interpretive displays and environmental educational programs would be initiated to provide information to visitors of such disturbance issues.

PUBLIC REVIEW AND COMMENT:

This is an existing use of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Jogging is permitted only on existing refuge roads and trails within areas designated open to the public.
- Signs necessary for visitor information, safety, and traffic control are maintained
- Jogging is allowed year-round, between sunrise and sunset.
- Routine law enforcement patrols would enforce refuge regulations regarding jogging off trail and entrance into closed areas to insure protection of wildlife and habitat.
- Groups of 15 or more joggers would require a special use permit.

JUSTIFICATION:

This use has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with public use of the refuge, nor cause an undue administrative burden.

Jogging has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

Arrese, P. 1987. Age, intrusion pressure and defense against floaters by territorial male Song Sparrows. Animal Behavior 35:773-784.

Bennett, K. and E. Zuelke. 1999. The Effects of Recreation on Birds: A Literature Review. Unpublished report. Submitted to: DE Division of Parks and Recreation, DNREC.

Burger, J. 1981. Effect of human activity on birds at a coastal bay. Biol. Conserv. 21:231–241.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Environ. Conserv. 13:123-130. Ducks and shorebirds on the mid-Atlantic coast have exhibited sensitivity to joggers.

Burger, J. and M. Gochfeld. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring and great black-backed gulls. Journal of Comparative Physiological Psychology 95:676–684.

Burger, J. and M. Gochfeld. 1998. Effects of Ecotourists on Birds at Loxahatchee Natural Wildlife Refuge. Environ. Conserv., 25: 13-21.

Burger, J., M. Gochfeld, and L. J. Niles. 1995. Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. Environmental Conservation 22:56-65.

Carlson, L. H.; Godfrey, P. J. 1989. Human impact management in a coastal recreation and natural area. Biol. Conserv. 49(2): 141-156.

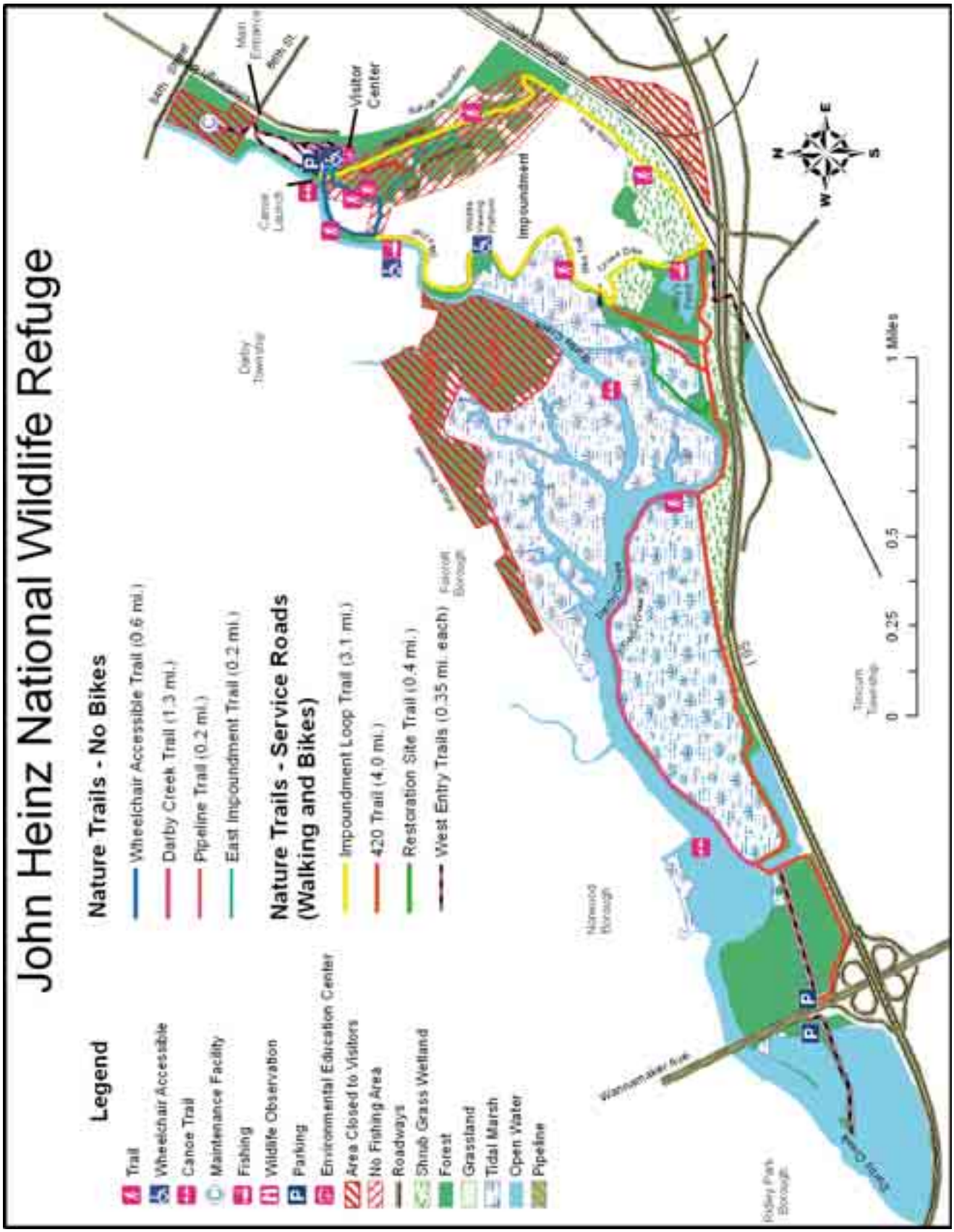
Cooke, A. S. 1980. Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. Biol. Conserv. 18:85-88.

Ewald P. W., and F. L. Carpenter. 1978. Territorial responses to energy manipulations in the Anna hummingbird. Oecologia 31: 277-292.

Gibbs, J.P. and S. Melvin. 1992. American Bittern. Pp 51-88 in Schneider, K. J. and D. M. Pence (eds.) Migratory Nongame Birds of Management Concern in the Northeast. 1992 U.S. Fish and Wildlife Service, Newton Corner, MA. 400p.

U.S. Fish and Wildlife Service (USFWS). 2007. National Bald Eagle Management Guidelines May 2007. Accessed online May 2011 <*http://www.fws.gov/midwest/eagle/guidelines/index.html*>.

Map B.2. Visitor facilities at John Heinz National Wildlife Refuge at Tinicum.



603 FW 1
Exhibit 1

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Non-motorized Boating

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ("no" to [a]), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to [b], [c], or [d]) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✔ No _____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ✔

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Non-motorized Boating

NARRATIVE:

The use of non-motorized watercraft on Darby Creek and associated tidal marsh channels and lagoons of John Heinz National Wildlife Refuge at Tinicum (refuge) would not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established. Often refuge visitors using non-motorized watercraft are also engaged in priority public uses such as fishing, wildlife observation and photography, and interpretation.

COMPATIBILITY DETERMINATION

USE:

Non-motorized Boating

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?
The use is non-motorized boating (canoes and kayaks) on John Heinz NWR including maintenance of a canoe trail on the tidal waters of Darby Creek and Tinicum Marsh and the tidal lagoons within the boundaries of the refuge. Non-motorized boating is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, many boaters engage in viewing, photographing, or interpreting wildlife, which are priority public uses.

(b) Where will the use be conducted?
Non-motorized boating would be allowed in tidal waters of the refuge including the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Highway 420 (map B.3).

(c) When will the use be conducted?
Non-motorized boating would be permitted when the refuge is open to visitors, usually daily, year-round, from sunrise to sunset.

(d) How will the use be conducted?
Non-motorized boaters enter the refuge at the main entrance on Lindbergh Boulevard and launch at the established canoe launch dock adjacent to the lower parking lot. All boaters would be required to operate their craft and possess all safety equipment in accordance with Pennsylvania State and U.S. Coast Guard regulations. As these areas are shallow and tidal, non-motorized boaters are encouraged through the refuge brochures, Web page, and visitor center information to do their canoeing or kayaking within a 2 hour window on either side of peak high tides for best access. Tide charts are distributed at the refuge visitor center for visitor convenience.

(e) Why is this use being proposed?
Interpretation and wildlife oriented recreation are primary purposes for which the refuge was established. Canoeing and kayaking are traditional means of outdoor recreation which is enhanced by the opportunity to view wildlife. Maintenance of a canoe trail and providing visitors with a canoe trail brochure enables the refuge to interpret refuge specific issues and the goals of the Fish and Wildlife Service.

Continued implementation of the refuge recreational boating program would help the Service meet the goal of the National Wildlife Refuge System "... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife...."

AVAILABILITY OF RESOURCES:

We estimate the annual cost of non-motorized boating to be minimal as refuge staff would respond to public inquiries about the program, perform law enforcement patrols, and assist partners with the maintenance of the canoe access site as part of other duties. Refuge staff would continue to receive assistance from the Pennsylvania Fish and Boat Commission and Pennsylvania Department of Environmental Protection who have jurisdiction over navigable portions of these waterways.

We provide a small dock and canoe/kayak launching facility on Darby Creek adjacent to the main visitor center parking lot. There are also nearby off refuge improved launches at commercial marinas further downstream on Darby Creek and Delaware River. We charge no fees for using the refuge canoe launch access area. The annualized cost associated with the administration of non-motorized boating on the refuge is estimated below:

Providing information to the public and administration needs	=	$3,000
Resource impacts/monitoring	=	$2,000
Maintenance needs	=	$1,000
Total	=	$6,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Non-motorized boating can affect refuge resources in a number of ways. Studies show that canoes and rowboats disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders, but their low speed and their use primarily during the warmer months would mitigate those impacts, especially on wintering waterfowl and raptors. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species, like American bittern, against human disturbance (Gibbs and Melvin 1992). Boaters also may try to access closed portions of the refuge, causing additional disturbance of wildlife. Due to the shallowness of refuge waters, which can only be physically floated during high tide windows of non-ice seasons, it is anticipated that this use would most likely remain very limited in scope.

The impacts of non-motorized boating on wildlife include temporary disturbances to species using habitat on Darby Creek and adjacent portions of Tinicum Marsh. These disturbances are likely to be short- term and infrequent based on current levels of use.

There are no anticipated impacts on cultural resources.

Non-motorized boating use of the refuge would not cause significant impacts to threatened or endangered species. The use would be confined to Darby Creek, the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Hwy 420. No new construction or vegetation clearing is required.

Problems associated with littering can be countered through an effective law enforcement program and through public education.

Darby Creek itself is considered to be a navigable waterway. As such, we do not have jurisdiction boating in this creek.

PUBLIC REVIEW AND COMMENT:

This is an existing use of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Boaters must comply with all Pennsylvania State and U.S. Coast Guard requirements. Law enforcement efforts on the refuge would ensure compliance with State laws and refuge-specific regulations.
- Parts of the refuge may be closed by management as needed to provide wildlife sanctuary or prevent habitat damage.
- No boats are permitted on the nontidal waters and ponds of the refuge. Boat traffic in the large lagoon is restricted to “Slow No Wake” speed.

- Boaters must restrict their activity to daylight hours only.
- Boaters must report all accidents and injuries to refuge personnel as soon as possible, but before leaving the refuge.
- For other than emergency purposes, boaters are prohibited from landing or launching on refuge lands other than at the canoe launch by the visitor center parking lot.

JUSTIFICATION:

The use of non-motorized watercraft on the Darby Creek and associated tidal marsh channels and lagoons on John Heinz NWR is unlikely to interfere with the primary purposes for which the refuge was established. Refuge visitors use non-motorized watercraft to participate in such priority public uses as fishing, wildlife observation, photography and interpretation. Non-motorized boating on the refuge has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Non-motorized boating is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

Bouffard S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Trans. North American Wildlife and Natural Resources Conference 47:553-558.

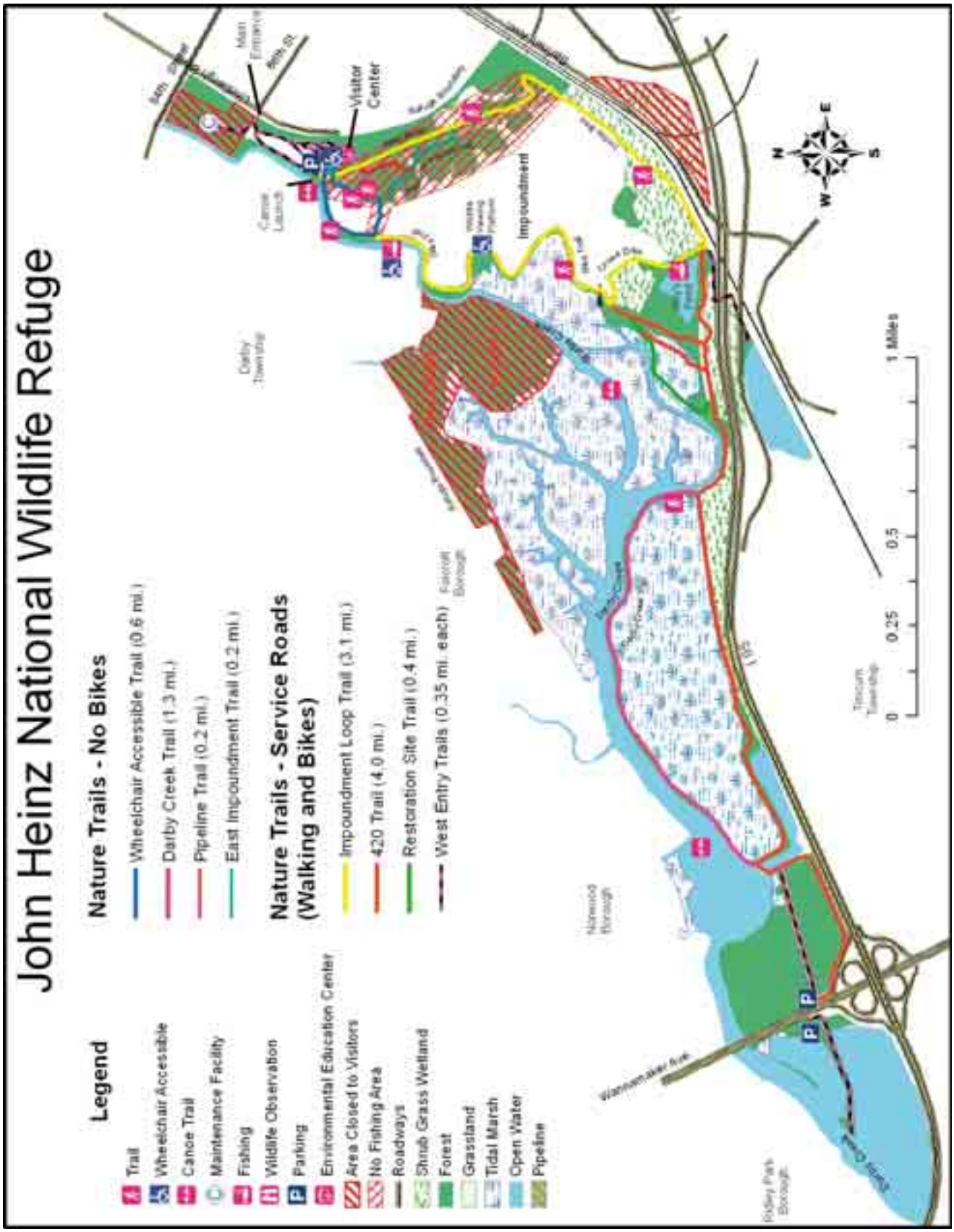
Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. Wildlife Society Bulletin 19:243-248.

Kaiser, M.S., and E.K. Kaiser 1984. Effects of river recreationists on green-backed heron behavior. J. Wildlife Management 48:561-567.

Knight, R.L. 1984. Responses of wintering bald eagles to boating activity. J. Wildlife Management. 48:999-1004.

Gibbs, J.P. and S. Melvin. 1992. American Bittern. Pp 51-88 in Schneider, K. J. and D. M. Pence (eds.) Migratory Nongame Birds of Management Concern in the Northeast. 1992 U.S. Fish and Wildlife Service, Newton Corner, MA. 400p.

Map B.3. Visitor facilities at John Heinz National Wildlife Refuge at Tinicum.



603 FW 1
Exhibit 1

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Bicycling

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ("no" to [a]), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to [b], [c], or [d]) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✔ No _____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ✔

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: John Heinz National Wildlife Refuge at Tinicum

Use: Bicycling

NARRATIVE:

Bicycling is an historical recreational use in John Heinz NWR that occurred long before the refuge was created, and it has occurred on the refuge since its establishment.

Bicycle travel is limited to approximately 7 miles of designated access roads and parking areas only, where road width can accommodate the safe passage of bicyclists and other users. Designated roads also have sufficient viewing distance for bicyclists to detect the approach of other users and maneuver to accommodate them. Because of these accommodations, bicycling occurs concurrently and without conflict with other public uses including priority public uses.

Bicycle travel is an ecologically friendly means of green transportation in line with the conservation mission of the Service. Bicycle travel to and through the refuge (in designated areas) is also consistent with local trail and access partnerships including the Philadelphia Planning Department and East Coast Greenways Coalition, connections to city green space corridors, directional signage, community outreach, and educational programs aimed at reconnecting citizens to the outdoors and nature. Both the refuge and the above partner organizations emphasize that bicycles are encouraged as a citywide green transportation initiative to get to the refuge, where visitors are then also encouraged to park their bicycles and walk on refuge trails.

In addition, because bicycling provides easier and quicker access for many visitors who may not otherwise visit the refuge's habitats and other resources, bicycling can contribute to the public's understanding and appreciation of the refuge's natural and cultural resources. Refuge personnel and volunteers have observed bicyclists with binoculars, cameras, and fishing poles showing that they are used to help facilitate priority public uses of the National Wildlife Refuge System.

This use has been determined to be compatible, as stipulated in the associated compatibility determination. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with public use of the refuge, nor cause an undue administrative burden.

COMPATIBILITY DETERMINATION

USE:

Bicycling

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is bicycling on John Heinz National Wildlife Refuge (NWR) at Tinicum (refuge). Priority public uses of the National Wildlife Refuge System (Refuge System) are hunting, fishing, wildlife observation and photography, environmental education, and interpretation. Bicycling is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, many bicyclists engage in viewing, photographing, or interpreting wildlife, which are priority public uses.

(b) Where will the use be conducted?
Bicycling would be permitted on paved and gravel roads and parking lots within the refuge which are currently open to public use. This is limited to the following road and areas:

- Dike Road
- Haul Road
- Trolley Bed
- PennDOT Access Road
- Refuge Entrance Roads and Parking Areas

These roads total about 7 miles. Roads open for bicycling are shown in map B.4. Refuge roads designated for bicycling are located on the upland areas adjacent to many of the refuge's wetland areas and were specifically designed to provide access.

(c) When will the use be conducted?
Designated roads would be open to bicycling all year. The refuge is open daily sunrise to sunset.

(d) How will the use be conducted?
Bicycling is currently permitted on the refuge. Bicyclists can enter the refuge at public entry points or transport bicycles by vehicle and park at designated parking sites. Visitors accessing the refuge on bicycles are then encouraged to park the bicycles and walk on trails to participate in priority public uses like environmental interpretation and wildlife observation. The use mainly occurs in groups with an average group size of 2 to 4 riders. Bicyclists may gather in larger groups for seasonal events like the viewing of fall colors. Formal groups of 10 or more would need special use permits (SUP) and bicycle races are prohibited on the refuge.

Bicycle travel is limited to designated access roads with paved or gravel surfaces and would not be allowed on woodland foot trails or boardwalks. Designated roads have sufficient viewing distance for bicyclists to detect the approach of other users and maneuver to accommodate them.

Safety and information signs are located at refuge entry points and at appropriate sites on designated bicycling trails and roads. Brochures depicting the roads open for this use are available at the refuge visitor center and on the refuge's Web site. Bicycle racks may be added.

(e) Why is this use being proposed?
Bicycling is an historic use of the refuge and there is a high demand for bicycling opportunities locally. In addition, it is the objective of the refuge to facilitate bicycles as a green transportation method for visitors to reach the refuge. Ongoing partnerships with the with Pennsylvania Clean Air Council, East Coast Greenway Coalition, and other partners would help promote and facilitate green transportation and public access to the refuge.

Lastly, because bicycling provides easier and quicker access for many visitors who may not otherwise visit the refuge's habitats and other resources, bicycling can contribute to the public's understanding and appreciation of the refuge's natural and cultural resources, to goals and objectives presented in John Heinz NWR Draft Comprehensive Conservation Plan, and participation in priority public uses. Refuge personnel and volunteers have observed bicyclists with binoculars, cameras, and fishing poles showing that bicycling is used to help facilitate participation in priority public uses of the Refuge System on the refuge.

AVAILABILITY OF RESOURCES:

Permitting this use is within the resources available to administer our Visitor Services Program. Staff time associated with administration of this use is relatively minimal since bicycling is permitted only on existing refuge roads which are maintained for a wide range of maintenance, biological, and public uses. The most significant cost associated with this public use is associated with enforcing regulations, placing and updating signs, and maintenance of refuge facilities. The annualized cost associated with the administration of bicycling travel on the refuge is estimated below:

Providing information to the public and administration needs	=	$3,000
Resource impacts/monitoring	=	$1,000
Maintenance needs	=	$2,000
Total	=	$6,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

The presence of people bicycling on refuge roads can lead to displacement of animals from the road, although disturbance usually is a negligible influence on large mammal distributions and movements (Boyle and Samson 1985, Purdy et al. 1987). The effects on other forms of wildlife appear to be short term with the exception of breeding bird communities. A study by Miller et al. (1998) indicates that species composition and nest predation was altered adjacent to trails in both forested and grassland habitats. It appears that species composition changes are due to the presence of humans and not the trail or roadway itself. On the other hand, nest predation does appear to be a function of the trail which allows access to mammalian nest predators. Several studies showed that in areas where human activity was common and frequent, birds were less disturbed than those in areas where humans were uncommon (Miller et al. 2001). The refuge would continue its proven management strategies of educating trail users regarding how their activities affect wildlife and how to modify their use to minimize impacts on wildlife (Klein 1993, Miller et al. 1998).

The use of trails and gravel roads could lead to soil compaction, exposure of tree roots, and the modification of plant species 3 to 6 feet on either side of the trail which is a function of soil compaction, invasive species, and direct trampling of plants (Kuss 1986). The refuge would continue its road maintenance and erosion control, and user education to protect plant species and habitats along trails and roadways. Use of the access roads could pose a threat to endangered or threatened species if such were found utilizing habitat near the road location. In this case, the road use would be monitored and evaluated for such threats and management action would be taken to ensure habitat protection. There are no federally listed species along designated bicycle trails at this time. Potential conflict with priority public uses would be minimized by using information/orientation signs, other media, and personal communication with visitors to inform the various users about current public uses. At current levels of use and restricted to designated roads with hardened and modified surfaces, bicycling would cause minimal surface disturbance. and the sharing of designated roads with other users is unlikely to be a safety risk.

The refuge believes that with proper management bicycling would not result in any short-term or long-term impacts that would adversely affect the purpose of the refuge or the mission of the National Wildlife Refuge System.

Roads would be monitored annually to determine if bicycling would remain a compatible use. Bicycling routes and/or other restrictions may be modified if needed with development of a refuge trail plan as a step- down plan to follow the refuge's Comprehensive Conservation Plan. In the interim, the refuge is conducting an inventory of all existing roads and trails.

PUBLIC REVIEW AND COMMENT:

This is an existing use of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Bicycling is permitted only on existing paved and gravel roads and parking lots within areas designated as open to bicycling.
- Parts of the refuge may be closed by management as needed to provide wildlife sanctuary and prevent damage to habitat.
- Bicycling is not permitted on foot trails or boardwalks.
- Signs necessary for visitor information, safety, and traffic control are maintained
- Bicycling is allowed between sunrise and sunset.
- Routine law enforcement patrols would enforce refuge regulations on bicycling.
- Groups of 10 or more bicyclists would require a special use permit.
- Bicycle racing and races are prohibited.
- East Coast Greenway Bicycle Trail overlay would be clearly marked and limited to Dike Road to I-95 and along I-95 corridor to the west entrance of Hwy 420. Partnership publications would clearly define open areas to bicycles and the above refuge specific stipulations.
- Bicycle racks may be added at east and west refuge parking lots as well as appropriate trail heads to foot trails if needed in future.

JUSTIFICATION:

This use has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented for visitor safety and resource protection. This use is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with public use of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

Boyle, S.A., Samson F.B. 1985. Effects of Nonconsumptive Recreation on Wildlife: A Review .13:110-116.

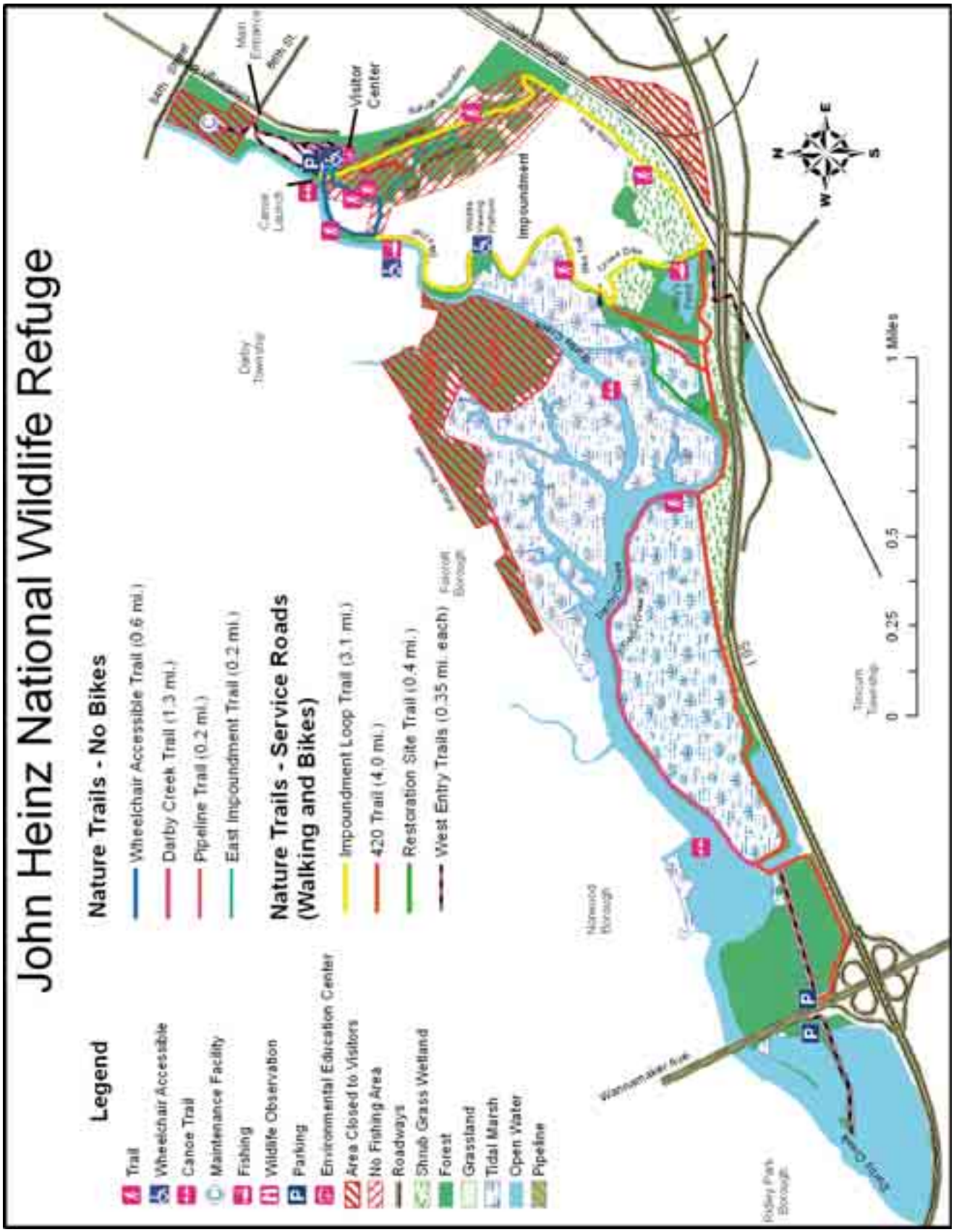
Kuss. F. 1986. A review of major factors influencing plant responses to recreation impacts. Environmental Management 10:638-650.

Miller, S.G., Knight R. L., and Miller C. K. 1998. Influence of Recreational Trails on Breeding Bird Communities. pp. 162-169 (8)1 Ecological Applications.

___.2001. Wildlife Responses to Pedestrians and Dogs. Wildlife Society Bulletin 29(1): 124-132.

Purdy, Goff, Decker, Pomerantz, Connelly. 1987 A Guide to Managing Human Activity on a National Wildlife Refuge. New York Cooperative Fish and Wildlife Research Unit.

Map B.4. Access roads and trails where bicycling is authorized on John Heinz National Wildlife Refuge at Tinicum.



COMPATIBILITY DETERMINATION

USE:

Recreational Fishing

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?
The use is recreational fishing. Recreational fishing is a priority use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?
Recreational fishing access would be allowed in Darby Creek, the Darby Creek side of the 145-acre freshwater impoundment, Long Hook Creek, the main channels of the Tinicum Marsh and the lagoons at the west end of the refuge adjacent to Hwy 420. Recreational fishing would also be allowed at Hoy's Pond and the 16-Acre Pond (map B.5). There is a handicap accessible fishing site located at the northwest section of the Impoundment Loop Trail, and a fishing pier at Hoy's Pond (see map B.5).

A canoe launch and small dock facility on Darby Creek, adjacent to the main visitor center parking lot, allows fishing access on the water. There are also nearby off refuge improved launches at commercial marinas further downstream on Darby Creek and the Delaware River.

(c) When will the use be conducted?
Recreational fishing would be permitted when the refuge is open to visitors, daily, year-round, from sunrise to sunset.

(d) How will the use be conducted?
Anglers enter the refuge at the main entrance on Lindbergh Boulevard or at the Hwy 420 west entrance areas for pedestrian traffic and or bicycle access to areas open for public use activities including fishing. Anglers are allowed to fish from stream banks along established trails and access roads, as well as accessing designated fishing areas by boat. The two fishing facilities identified in section (b) are accessible on foot and the handicap accessible fishing facility can also be accessed with wheelchairs and other mobility assistance devices.

As Darby Creek is shallow and tidal, those anglers using non-motorized boats in Darby Creek are encouraged through the refuge brochures, Web page, and visitor center information, to limit use to the 2-hour window on either side of peak high tides for best access. Tide charts are distributed at the refuge visitor center for visitor convenience.

Anglers must comply with applicable State regulations and any refuge-specific regulations if implemented. There is a State consumption advisory on fish from Darby Creek, and signs are posted encouraging catch and release only.

(e) Why is this use being proposed?
Continued implementation of the refuge fishing program would help the U.S. Fish and Wildlife Service (Service) meet the goal of the National Wildlife Refuge System "... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife...."

The refuge fishing program would also help the Service meet the goals of the newly proposed Branch of Recreational Fisheries as stated by Service Director Beattie, "...to provide fishing and aquatic education opportunities to our nation's increasingly urban population...to give children in urban area more opportunities to fish and to learn about aquatic resources."

AVAILABILITY OF RESOURCES:

The resources necessary to provide and administer this use are available within current and anticipated refuge budgets. Staff time associated with administration of this use would be directly related to responding to public inquiries about the program; perform law enforcement patrols; provide signage, environmental education, and Interpretation related to this use; maintenance of parking areas, access roads, and trails to facilitate this public use; and to continue to provide a fishing tackle loaner program for visitors that do not have fishing equipment. The refuge staff annually hosts a Family Fishing Days event that promotes fishing as a family oriented recreational activity as well as introducing intercity youth to the value of fishing as a healthy pastime. Refuge staff would continue to receive assistance from the Pennsylvania Fish and Boat Commission and Pennsylvania Department of Environmental Protection, who have jurisdiction over navigable portions of these waterways.

A canoe launch and small dock facility on Darby Creek, adjacent to the main visitor center parking lot allows fishing access on the water. There are also nearby off refuge improved launches at commercial marinas further downstream on Darby Creek and the Delaware River. We charge no fees for using the refuge canoe

launch access area. A pedestrian access fishing pier is available at Hoy's Pond and an accessible fishing deck is available on Darby Creek by the main impoundment water structure. Other open areas are available for bank fishing. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public and administration needs	=	$7,000
Resource impacts/monitoring	=	$2,000
Maintenance needs	=	$8,000
Total	=	$17,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

Fishing can affect refuge resources in a number of ways. Studies show that canoes and rowboats disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders, but their low speed and their use primarily during the warmer months would mitigate those impacts, especially on wintering waterfowl and raptors. Boaters while fishing also may try to access closed portions of the refuge, causing additional disturbance of wildlife. Due to the shallowness of Darby Creek, which can only be physically floated during high tide windows of non-ice seasons, it is anticipated that this use would most likely remain very limited in scope.

The impacts of fishing from non-motorized boating on wildlife include temporary disturbances to species using habitat on Darby Creek and adjacent portions of Tinicum Marsh. These disturbances are likely to be short term and infrequent based on current levels of use.

Waterfowl, wading birds, shorebirds and other wildlife may be disturbed by human activities. Klein (1993), in a study conducted at J. N. "Ding" Darling National Wildlife Refuge, observed that individuals fishing and crabbing showed the lowest disturbance of wildlife compared to other refuge visitors, presumably because they did not attempt to approach wildlife for photography or observation.

Korschgen and Dahlgren (1992) reported that mallards at Seney National Wildlife Refuge failed to nest in areas open to fishing. Fishing on the refuge is restricted to certain areas to provide adequate nesting sites for waterfowl and other birds. No boats are permitted on the nontidal waters and ponds of the refuge in order to prevent disturbance of nesting birds in remote locations.

Kaiser and Fritzell (1984) found that the number of green-back herons negatively correlated to the number of recreational boaters on water systems. The refuge impoundment where a wading bird colony (including green-backed herons) is located is closed to boating. Most of the small tidal creeks on the refuge are only passable for an hour or two before and after high tide and are rarely frequented by fisherman.

Morton et al. (1989) suggested that human disturbance of wintering black ducks impairs their physiological conditions, thereby reducing winter survival and nutrient reserves carried to the breeding grounds. Because of the climate, little fishing activity occurs on the refuge from the middle of November through the middle of March.

Concern has been expressed over the potential for lead poisoning of waterfowl and wading birds from lead fishing weights. No indication of lead poisoning has been observed at the refuge during more than 20 years of recreational fishing. Implementation of the U.S. Environmental Protection Agency's proposed regulations on the manufacture of lead fishing weights would virtually eliminate the potential for any impact of lead poisoning resulting from fishing.

Sport fishing should not have any adverse impacts on the fisheries resource at the refuge. Problems associated with site compaction and denuding of vegetation can be addressed by area closures as necessary to protect sensitive areas. Problems associated with littering can be countered through an effective law enforcement program and through public education.

Fishing from shore or non-motorized boats at the refuge would not cause significant impacts to federally listed, threatened or endangered species. The use would be confined to Darby Creek, Darby Creek side of impoundment, Hoy's Pond, 16-Acre Pond, Long Hook Creek, the main channels of the Tinicum Marsh, and lagoons at the west end of the refuge adjacent to Hwy 420. No new construction or vegetation clearing is required. Bald eagles and peregrine falcons (now both delisted) were the only federally listed, threatened or endangered species known to regularly use the refuge for roosting or feeding. Bald eagles are now known (2010) to nest on the refuge. Bald eagles are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Anglers fishing along refuge trails have the potential to impact vegetation through trampling and soil compaction. We anticipate that allowing this use would cause some minor loss of vegetation. However, by restricting visitors to designated trails and roads, we expect these impacts would be negligible. Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors all helped in reducing human impacts to vegetation. Refuge staff would continue to monitor trails and, if any problem areas are identified, would take the appropriate restoration and protection measures.

There are no anticipated impacts on cultural resources.

PUBLIC REVIEW AND COMMENT:

This is an existing use of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

_X_ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- The refuge is closed to all fishing for turtles and frogs to protect the State threatened red-bellied turtle and State endangered coastal plains leopard frog.
- Law enforcement efforts on the refuge would ensure compliance with State laws and refuge-specific regulations including all State fishing license requirements.
- Commercial fishing including crabbing and any take of reptiles or amphibians is prohibited on the refuge.
- Fishing is allowed only during hours when the refuge is open for public use (between sunrise and sunset).
- Parts of the refuge are closed to fishing and additional areas may be closed to provide wildlife sanctuary or prevent habitat damage.

- Vehicle use is limited to parking lot areas. Access to the interior of the refuge (except for designated areas for access for people with disabilities) is limited to foot traffic or bicycling.

- No boats are permitted on the nontidal waters and ponds of the refuge. Boat traffic in the large lagoon and Darby Creek is restricted to "Slow No Wake" speed.

JUSTIFICATION:

Sport fishing is a traditional form of outdoor recreation on the refuge and in the region. Sport fishing on the refuge provides substantial recreational opportunities to the public. A survey conducted by the Service's Gloucester Point, Virginia Fisheries Assistance Office in June 1994 indicated that the refuge presently has a fisheries resource capable of supporting sustained public use. Refuge staff currently recommends that anglers practice catch and release fishing due to the contaminant warnings issued by the Commonwealth of Pennsylvania for the Delaware River Watershed from the mouth of Delaware Bay to Trenton, New Jersey.

Recreational fishing has been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Recreational fishing is a priority public use on the refuge and it is not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

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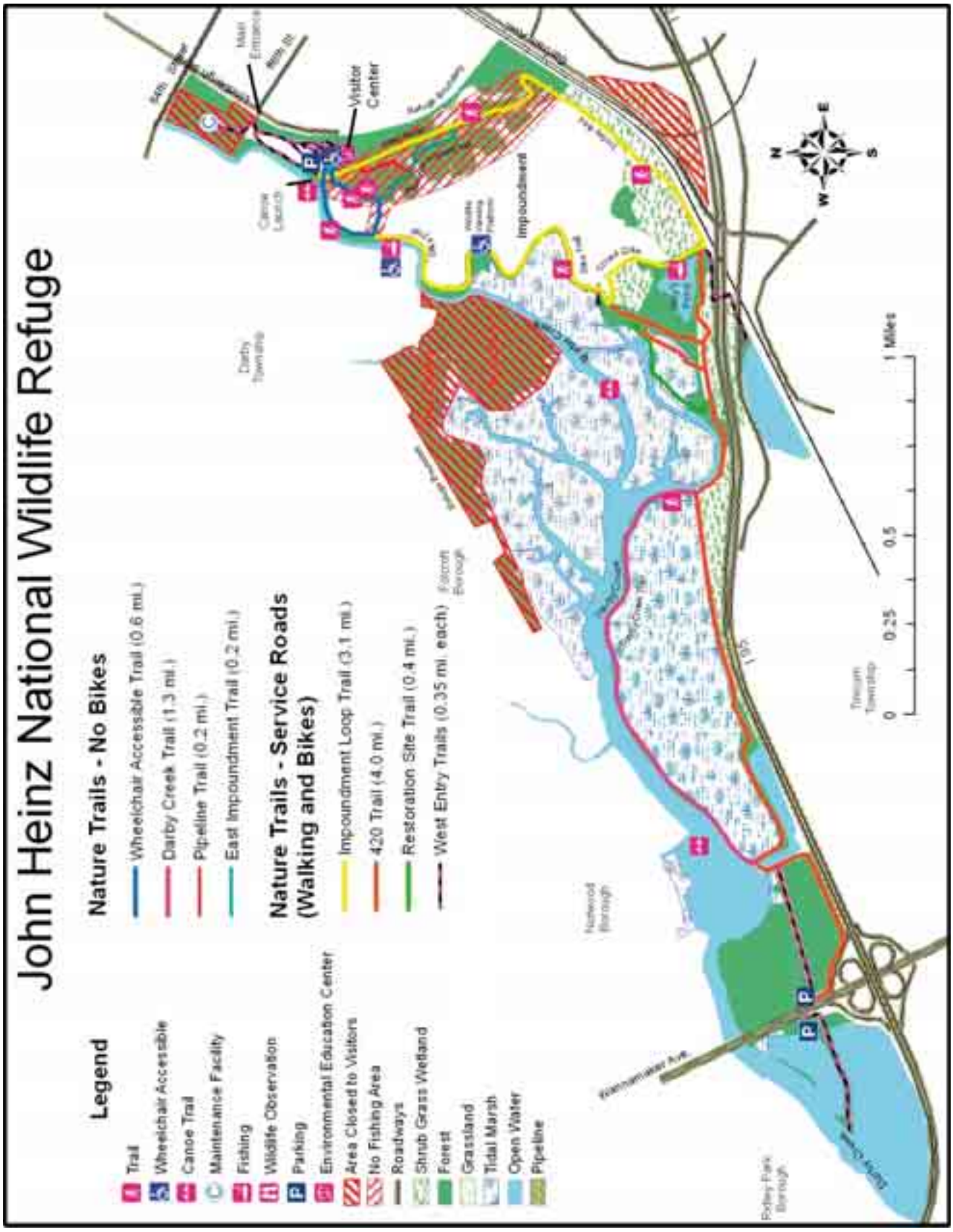
Map B.5. Visitor facilities at John Heinz National Wildlife Refuge at Tinicum.



COMPATIBILITY DETERMINATION

USE:

Wildlife Observation, Photography, Environmental Education, and Interpretation

REFUGE NAME:

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, refuge)

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Public Law 92-326 (as amended)

REFUGE PURPOSE(S):

John Heinz NWR (John Heinz NWR, refuge) was established in 1972 under Special Legislation for the following purposes:

- "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

Additional refuge lands were acquired under the following authorities:

- To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. §667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife);
- "[D]evelopment, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. §742f (a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...." 16 U.S.C. §742f(b)(1) (Fish and Wildlife Act of 1956); and,
- "[F]or use as an inviolate sanctuary, or for any other management purpose, for migratory birds…." 16 U.S.C. §715d (Migratory Bird Conservation Act).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

"The mission of the National Wildlife 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" (Pub. L. 105–57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is this use? Is it a priority public use?
The use is to permit wildlife observation, photography, environmental education and interpretation (formal and non-formal, personal and non-personal) within the boundaries of John Heinz NWR as activities which increase the public's knowledge, understanding, and appreciation of wildlife while contributing to conservation of natural resources. Activities include traditional environmental education activities (teacher-led or staff-led onsite field trips); nature study, such as teacher and student workshops; and interpretation of the wildlife resource and

support facilities such as the visitor center, boardwalks, observation decks, photography blinds, interpretive displays, guided walks, and programs. Wildlife observation, photography, environmental education, and interpretation are all priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(b) Where will the use be conducted?
Wildlife observation, photography, environmental education, interpretation programs, and activities would be allowed along refuge roads, trails, parking areas, and other areas open to public use (e.g., Darby Creek). This also includes facilities such as the visitor center, classrooms, pavilion, boardwalks, wildlife viewing decks, fishing piers, photo blinds, and other onsite facilities that are developed (see map B.6) along with offsite programs within scope of available staff, volunteers and budgets.

(c) When will the use be conducted?
Wildlife observation, photography, environmental education and interpretation would be permitted when the refuge is open to visitors, daily, year-round, from sunrise to sunset. Occasional guided evening programs (some coupled with wildlife population counts) are also offered to include staff or trained volunteer- led, citizen science activities such as surveys for vocalizing anurans and nocturnal avian fauna. Cross-country skiing and snowshoeing occur in winter when there is sufficient snow to allow these activities.

(d) How will the use be conducted?
Visitors are allowed to participate in these activities by walking or hiking, cross-country skiing, snowshoeing, and volunteer or staff-led tours on designated roads and trails. Visitors with limited mobility may also participate using approved mobility assistance devices (i.e., wheelchairs, scooters). Cross-country skiing and snowshoeing are limited to winter when there is sufficient snow to allow these activities. Refuge staff does not groom trails in the winter, so access may be limited.

(e) Why is this use being proposed?
Wildlife observation, photography, environmental education, and interpretation are all priority public uses as authorized under the Refuge Improvement Act, and are included or support the primary purposes for which the refuge was established. Continued implementation of the refuge wildlife observation, photography, environmental education and interpretation programs would help the Service meet the goal of the National Wildlife Refuge System "... to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife...."

Providing opportunities for wildlife observation, photography, environmental education and interpretation is included within the refuge's primary purposes in its establishing legislation (see section entitled "Purpose(s) for which Established" above). Contact with refuge visitors engaged in these activities also provides opportunities for the refuge to interpret refuge-specific issues and the goals of the U.S. Fish and Wildlife Service (Service). Visitors need to access areas of the refuge to participate in these activities, usually by foot (walking, skiing, snowshoeing), or mobility assistance equipment (scooters, wheelchairs etc.).

Continued implementation of these programs would help the Service meet the goal of the National Wildlife Refuge System, "…to provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment...."

AVAILABILITY OF RESOURCES:

Wildlife observation, photography, environmental education and interpretation are all priority public uses directly supporting primary purposes for which the refuge was established. The resources necessary to provide and administer this use are available within current and anticipated refuge budgets. Staff time associated with administration of this use would be directly related to responding to public inquiries about the program; law enforcement patrols; maintenance and construction of adequate facilities for these uses; develop and implement environmental education and interpretive programs; maintenance of parking areas, access roads, and trails

to facilitate this public use; and continuing to provide a binocular loaner program for visitors that do not have necessary equipment. Refuge personnel directly coordinate and maintain these priority public use programs and facilities and are supplemented by numerous volunteers and partner agencies and organizations. We charge no fees for using the refuge facilities. The annualized cost associated with the administration of pedestrian travel on the refuge is estimated below:

Providing information to the public, program development and implementation, and administration needs	=	$250,000
Resource impacts/monitoring	=	$5,000
Maintenance needs	=	$25,000
Total	=	$280,000

Based on existing refuge expenditures for managing visitor use, funding is adequate to ensure compatibility at the current level of use and to administer and manage the subject use.

ANTICIPATED IMPACTS OF THE USE:

The use of onsite, hands-on, action-oriented activities by groups of up to 200 students and teachers to accomplish environmental education objectives may impose a low level of impact on the sites used for these activities.

Effects on Soils and Vegetation: Visitors engaged in these uses along refuge trails have the potential to impact vegetation through trampling and soil compaction. We anticipate that allowing this use would cause some minor loss of vegetation. However, by restricting visitors to designated trails and roads, we expect these impacts would be negligible. Carlson and Godfrey (1989) documented that management strategies such as constructing elevated boardwalks, fencing sensitive areas, and educating visitors all helped in reducing human impacts to vegetation. In addition, cross-country skiing and snowshoeing are limited to winter months and require sufficient snow cover to allow access. Surface water and soils are often frozen for at least a portion of this time, most vegetation is dormant, and sensitive habitat would be protected by a layer of snow. Skis and snowshoes are also designed to distribute weight, decreasing the risk of erosion near waterways. Refuge staff would continue to monitor trails and, if any problem areas are identified, would take the appropriate restoration and protection measures.

Effects on Wildlife: Wildlife observation, photography, environmental education and interpretation use within designated areas open to public use would not cause significant impacts to threatened or endangered species. There are currently no known federally listed species on the refuge. Two recently delisted species, the bald eagle and peregrine falcon, use the refuge for roosting and feeding. Bald eagles also now nest on the refuge.

In general, the presence of humans disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Disturbance varies by wildlife species involved and the type, level, frequency, duration and the time of year activities occur. Disturbance can cause shifts in habitat use, abandonment of habitat, and increased energy demands on affected wildlife (Knight and Cole 1991). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. In this study, common species (e.g. American robins) were found near trails and rare species (e.g., Blackburnian warblers) were found farther from trails. In some cases there is a clear link between the extent of disturbance and either the survival or reproductive success of individuals (e.g. Schulz and Stock 1993), but in many cases disturbance acts in a more subtle way, by reducing access to resources such as food supplies or nesting sites (Gill et al. 1996). Bird flight in response to disturbance can lower reproductive success by exposing individuals and nests to predators. For recreation activities that occur simultaneously (hiking, biking, and horseback riding) there would likely be compounding negative impacts to wildlife (Knight and Cole 1991).

Wildlife disturbance may be compounded by seasonal needs. For example, some species such as warblers, could be negatively affected by disturbance associated with bird watching particularly during the breeding season. When visitors approach nests too closely, they often cause the adult bird to flush, exposing the eggs to weather conditions or predators (Banks and Bryant 2007, Miller et al. 2001). The extent of that disturbance along the trail also depends on visibility and the density of vegetation. For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Disturbance may also affect the reproductive fitness of males by hampering territory defense, mate selection, and other reproductive functions of vocalizations (Arrese 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents to defend territories, which consume more time and energy than singing (Ewald and Carpenter 1978).

The refuge is located in a highly urban environment, with substantial baseline disturbance associated with the international airport, I-95, several State routes, and numerous houses, businesses, community buildings, and associated human activity. By limiting the presence of humans to refuge trails and infrastructure, refuge visitors are not expected to add significantly to existing disturbance levels. Overall, the direct disturbance from public use is expected to have minimal or no adverse effects on wildlife. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

Bennett and Zuelke (1999) summarize several studies indicating recreation activities would have at least temporary effects on the behavior and movement of birds using shallow water habitats adjacent to trails and roads through wildlife refuges (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). We would take all necessary measures to mitigate those effects, particularly where group educational activities are involved. We would evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If the use causes evident and unacceptable adverse impacts, the refuge would rotate the activities to secondary sites, or curtail or discontinue them.

It is important to note that the refuge exists within a highly altered area with substantial baseline levels of disturbance associated with interstate traffic, airport activities, adjacent neighborhoods and roads. Overall, the effects from public use are expected to have minimal adverse effects on birds utilizing open water and wetland habitats. There are few visitor facilities (e.g., trails) in these habitats due to the presence of open water and saturated soils; therefore, they are relatively inaccessible to the public. The size and dense vegetation supported by freshwater tidal marsh and portions of open water should provide adequate buffers to protect wetland bird species like American bittern against human disturbance (Gibbs and Melvin 1992). Boaters that access the refuge from Darby Creek could disturb species using these habitats. The refuge does not own or control access for most of Darby Creek. We do post speed limits for motorized boats within refuge waters to minimize disturbance to wildlife and habitats.

Effects of cross-country skiing and snowshoeing on wildlife are also considered to be minimal. Most mammal species are less active during winter months, and it is not breeding season for any of the wildlife that may be present. Many of the sensitive migratory bird species have already left the refuge, those that remain. Also, while we do not count the number of participants in these activities, refuge staff have observed few visitors skiing or snowshoeing on the refuge. Lastly, annual snowfall averages 20.5 inches in Philadelphia (NOAA 2008). Consequently, disturbance to wildlife associated with these activities is limited to only a few days on the refuge with sufficient snow cover to allow skiing and snowshoeing.

Pedestrian use of the designated access roads and trails would not cause significant impacts to threatened or endangered species. The use would be confined to existing roads and no new construction or vegetation clearing is required. Bald eagles and peregrine falcons are the only former federally listed, threatened or endangered species known to use the refuge for roosting or feeding. Bald eagles now nest on the refuge and both species

have been delisted under the Federal Endangered Species Act (ESA). Bald eagles are still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). To ensure refuge activities and visitors do not disturb nesting bald eagles, we comply with the Service's National Bald Eagle Guidelines (USFWS 2007).

Disturbance of wildlife can be minimized by seasonal or permanent closure of areas, interpretative displays, and inclusion in all visitor service programs and publications provided. Impacts to vegetation and soils can be alleviated by rotation of the areas used for educational activities, scheduling of groups, and providing teachers with information on a variety of activities.

Effects on Cultural Resources: There are no anticipated impacts to cultural resources.

PUBLIC REVIEW AND COMMENT:

These are existing uses of the refuge. This compatibility determination will be available for public review and comment for at least 30 days, in conjunction with the release of the draft Comprehensive Conservation Plan for the refuge.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- Access to the refuge (other than parking areas) is restricted to foot, non-powered transportation, or powered scooters or wheelchairs.
- A limitation of 200 students per day should be retained.
- Impacts must be monitored to identify problems and areas may be closed to provide wildlife sanctuary or prevent habitat damage.
- Other than refuge-specific programs led by staff or volunteers, wildlife observation, photography, environmental education and interpretation would only be allowed ondesignated trails, roads, and facilities. Activities beyond these facilities would only be allowed by individuals that have been issued a special use permit.
- Impacts would be monitored to identify problems and areas may be closed to provide wildlife sanctuary or prevent habitat damage.
- To counter associated problems, we would include enforcing refuge trash disposal guidelines in our law enforcement program and would include information about proper trash disposal in all visitor services programs and publications.

JUSTIFICATION:

Wildlife observation, photography, environmental education and interpretative programs are a primary purpose for which John Heinz NWR was established; therefore, they must be compatible with the purpose for which the refuge was established.

These activities are low impact activities on the refuge. Cooke (1980) reported that passerine birds in suburban areas where human activity is ubiquitous habituate to the activities and are not disturbed as often as birds in rural areas. Waterfowl, wading birds, shorebirds and other wildlife may be disturbed by human activities; however, portions of the refuge are not readily accessible to visitors and provide sanctuary from human activities for wildlife.

Wildlife observation, photography, environmental education and interpretation have been determined to be compatible provided the stipulations necessary to ensure compatibility are implemented, and the use does not exceed thresholds necessary for visitor safety and resource protection. Wildlife observation, photography, environmental education and interpretation are priority public uses on the refuge and are not expected to materially interfere with or detract from the mission of the National Wildlife Refuge System nor diminish the purposes for which the refuge was established, would not pose significant adverse effects on refuge resources, would not interfere with other public uses of the refuge, nor cause an undue administrative burden.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

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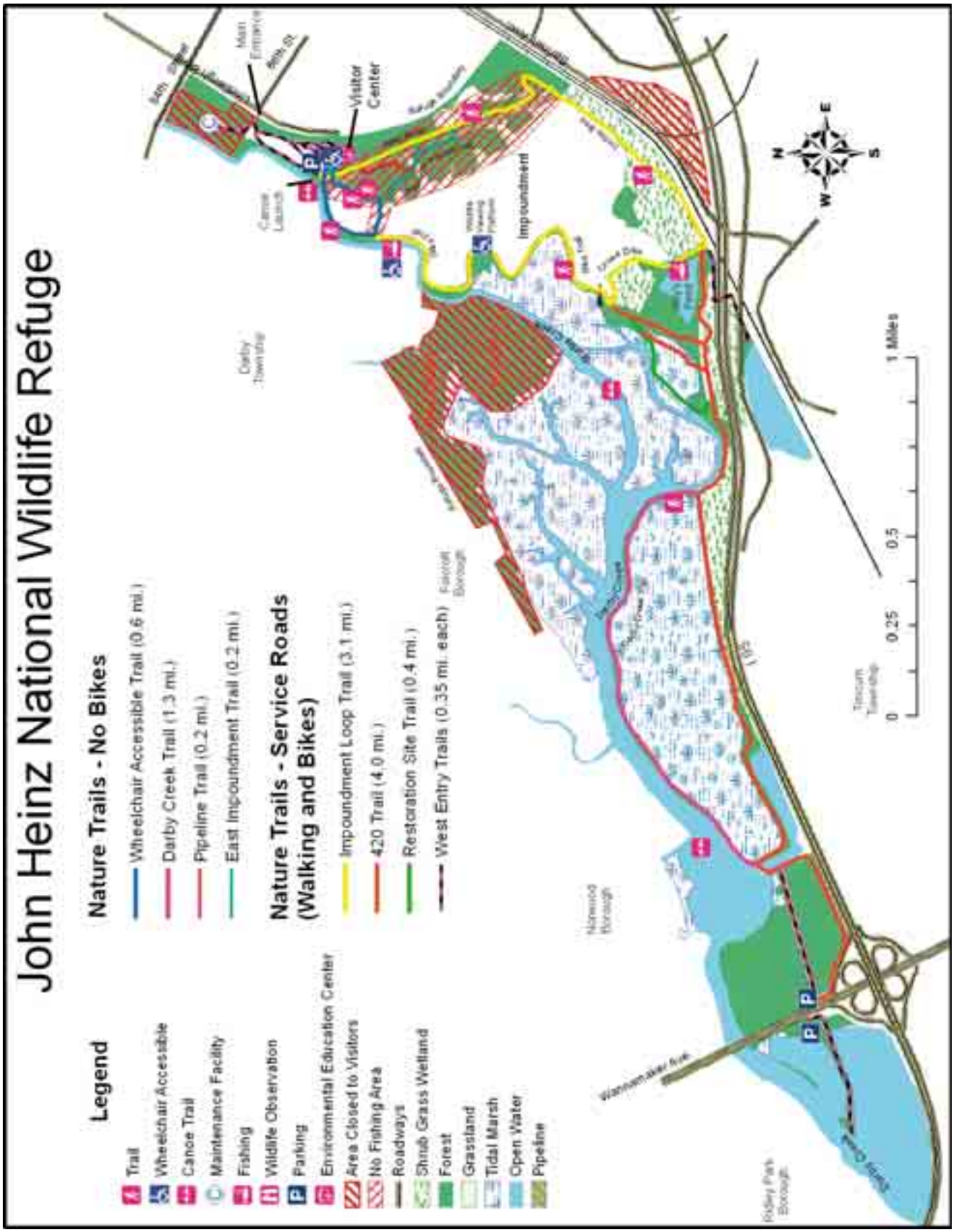
Map B.6. Visitor facilities at John Heinz National Wildlife Refuge at Tinicum.



Appendix C

Frank Miles/USFWS

Yellow-rumped warbler

Draft Habitat Management Plan

John Heinz National Wildlife Refuge at Tinicum
Draft Habitat Management Plan

January 2012

The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife and plants. Since the designation of the first wildlife refuge in 1903, the System has grown to encompass more than 150 million acres, over 550 national wildlife refuges and other units of the Refuge System, plus 37 wetland management districts

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Introduction

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1.2 Legal Mandates
1.3 Relation to Other Plans

1.1 Scope and Rationale

John Heinz National Wildlife Refuge at Tinicum (John Heinz NWR, the refuge) was created in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh. It was created to develop a wildlife interpretative center for the purpose of promoting environmental education and to afford visitors an opportunity to study wildlife in its natural habitat. The refuge protects approximately 200 acres of the remaining freshwater tidal marsh in Pennsylvania and represents an important migratory stopover along the Atlantic Flyway. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen and Johnson 2004).

John Heinz NWR is managed by the U.S. Fish and Wildlife Service (Service, we, our) as part of the National Wildlife Refuge System (Refuge System). The Refuge System maintains the biological integrity, diversity and environmental health of these natural resources for the benefit of present and future generations.

The refuge protects a variety of unique resources and also provides a unique opportunity for the education and outreach near the urban center of the city of Philadelphia, the nation's fifth largest metropolitan area. Sustaining and protecting these resources requires planning, active on-the-ground management, and partnerships with the surrounding communities of the Delaware Valley. This Habitat Management Plan (HMP) provides a long-term vision and specific guidance on managing the habitats for the identified resources of concern at John Heinz NWR. Once approved, the HMP will provide direction for the next 15 years. Interim reviews and use of adaptive management will assess and modify management activities as research, monitoring, and priorities require.

1.2 Legal Mandates

John Heinz NWR was created in 1972 for three primary purposes:

1. "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

2. To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. § 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).

3. "Development, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. § 742f(a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services…(16 U.S.C. § 742f(b)(1)) (Fish and Wildlife Act of 1956).

In 1997, Congress passed the National Wildlife Refuge System Improvement Act (Refuge Improvement Act), establishing a unifying mission for the Refuge System. The Refuge Improvement Act highlights six priority public uses that each refuge should evaluate for compatibility with its wildlife-first mandate. These six public uses include wildlife observation, interpretation, photography, environmental education, hunting, and fishing. The act requires that all refuges prepare a Comprehensive Conservation Plan (CCP) by 2012. John Heinz NWR began the CCP planning process in 2010.

1.3 Relation to Other Plans

Important guidance for wildlife habitat management at John Heinz NWR has already been provided by several important refuge, regional, and national plans.

Refuge Plans

Comprehensive Conservation Plan (CCP)
The Refuge Improvement Act requires that all refuges prepare a CCP by 2012. The CCP guides biological and public use actions on the refuge for a 15-year period. John Heinz NWR is scheduled to complete the CCP planning process in 2012. The goals and objectives developed as part of this HMP will be incorporated into the CCP.

Restoration Management Plan for the Lower Darby Creek with Recommendations for John Heinz National Wildlife Refuge at Tinicum, (Salas et al. 2006)
This Restoration Management Plan was developed in 2006 by the Delaware Riverkeeper Network under a Delaware Estuary Grant awarded to the Friends of the Heinz Refuge and funded by the National Fish and Wildlife Foundation. The purpose of this plan was to initiate an ecological restoration approach to habitat management at the refuge. This plan identified historic disturbances to the site, the ecological communities existing at the refuge, and provided recommendations for the restoration of the more natural ecological composition, structure, and function of these communities. The extensive field and GIS data, along with historic records and information compiled as part of this plan, were used extensively in the development of the HMP.

Pennsylvania Important Bird Area #73: Phase I Conservation Plan (Cohen and Johnson 2004)
John Heinz NWR is designated an Important Bird Area (IBA) by the National Audubon Society for its critical location within the Atlantic flyway and its complex of unique habitats. This Phase I Conservation Plan identifies habitat-based site boundaries, describes the birds and wildlife habitat which occur on the site with special reference to the species for which the site was selected as an IBA, identifies conservation issues and threats to the site, and provides recommendations for conservation actions. Its conservation recommendations are being considered with those of other refuges and regional plans.

Draft Deer Management Plan (D'Angelo 2011)
Refuge staff consulted with U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services to study the deer population present at John Heinz NWR and the effects of deer on refuge habitat, wildlife, and humans. The purpose of the deer management plan is to institute a sound biological program to efficiently manage the deer population within a sustainable and healthy balance within the habitat and objectives of the refuge.

Regional and National Plans

North Atlantic Landscape Conservation Cooperative Operations Plan, (USFWS 2009a)
The Service is developing a coordinated network of landscape conservation cooperatives (LCCs) across the United States, in part to address major environmental and human-related factors that limit fish and wildlife populations at the broadest of scales, including developing adaptation strategies in response to climate change. The LCC is utilizing principles of strategic habitat conservation (SHC) to develop and communicate landscape-scale scientific information to shape conservation across the northeastern United States. This initial plan outlines the regional threats to conservation, priority species and habitats, as well as active regional partnerships.

Mid-Atlantic Coast Bird Conservation Region 30 Implementation Plan (USFWS 2008a)
The Implementation Plan for the Bird Conservation Region (BCR) 30 combines regional plans, assessments, and research completed over the past two decades to develop continental-based bird conservation efforts. John Heinz NWR is located within the narrow portion of the Mid-Atlantic Coastal Plain located in southeastern

Pennsylvania. As such, this coastal zone is unique to the State of Pennsylvania and thus many of the priority species listed for BCR 30 are also species of concern listed within the Pennsylvania Wildlife Action Plan. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

A Natural Heritage Inventory of Philadelphia County, Pennsylvania, (PNHP 2008)
The Philadelphia County Natural Heritage Inventory was compiled by the Pennsylvania Department of Conservation and Natural Resource (PADCNR) Natural Heritage Program and the Western Pennsylvania Conservancy. It provides information on the general locations of rare, threatened, and endangered species, of the highest quality natural areas in the county, and identifies areas in need of restoration. The Pennsylvania Natural Heritage Program also provides State conservation rankings for each species of conservation concern in Pennsylvania. These rankings and the recommendations of the inventory have been considered along with other local and regional conservation priorities.

Pennsylvania Wildlife Action Plan, (PGC and PFBC 2005)
The State Wildlife Action plan was completed in 2005 and updated again in 2008 (Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC) 2008). While creating a strategic focus for State fish and wildlife management agencies, this plan attempts to provide a Statewide perspective on conservation, presenting geographic, species, and habitat priorities. Considering John Heinz NWR's protection of habitats unique to the State of Pennsylvania, species of conservation priority were considered in development of the refuge's resources of concern.

Service Migratory Bird Program Strategic Plan, (USFWS 2004)
The Migratory Bird Program Strategic Plan provides direction for the Service's migratory bird management over the next decade (2004 to 2014). The plan contains a vision and recommendations for the Refuge System's place in bird conservation. It defines strategies for the Service, including the Refuge System, to actively support bird conservation through monitoring, conservation, consultation, and recreation. The refuge-specific HMP, to the extent it is practical, utilizes standard monitoring protocols, habitat assessment and management, and promotes nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

Service Birds of Conservation Concern, (USFWS 2008b)
This report identifies the migratory and nonmigratory bird species (beyond those already designated as federally threatened or endangered) that represent the Service's highest conservation priorities and draws attention to species in need of conservation action. The geographic scope includes the United States in its entirety, including island "territories" in the Pacific and Caribbean. Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, Endangered Species Act candidates, proposed endangered or threatened, and recently delisted species. Assessment scores are based on several factors, including population trends, threats, distribution, abundance, and area importance.

Wildlife Habitat in Pennsylvania, Past, Present, and Future, (Goodrich et al. 2001)
Today, the PADCNR ranks coastal plain habitats as "impaired." The coastal plain region of Pennsylvania includes some of the last remaining habitats for certain wetland species in the State. The 2001 PADCNR report *Wildlife Habitat in Pennsylvania, Past, Present, and Future* (Goodrich et al. 2001), recommends that where possible, wetlands along the Delaware should be restored. Urban forest management is recommended to provide habitat for some tolerant forest wildlife. The reduction of runoff into streams and wetlands is also noted as a top priority, along with restoration of natural communities in undeveloped areas.

Bird Conservation Plan for the Mid-Atlantic Coastal Plain, (Physiographic Area 44), (PIF 1999)
Partners in Flight is a partnership of government agencies, private organizations, academic researchers, and private industry throughout North America focused on coordinating voluntary bird conservation efforts to benefit species at risk and their habitats. BCRs have been developed to guide management on a regional scale.

Version 1.0 of the Mid-Atlantic Coastal Plain BCR was completed in 1999. John Heinz Refuge is located within the Coastal Plain physiographic province and thus is considering the conservation priorities of this plan along with other conservation plans.

Delaware Estuary Comprehensive Conservation Management Plan, (DEP 1996)
The Delaware Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development. To help address these threats, the Delaware Estuary Program worked with many partners to develop the Comprehensive Conservation and Management Plan (CCMP) for the Delaware Estuary (DEP 1996). The CCMP is a comprehensive document describing the existing conditions of the Delaware Estuary and providing seven action plans (land management, water use management, habitat and living resources, toxics, education and involvement, and monitoring) and an implementation plan. While the Delaware Estuary Program has since merged with the Partnership for the Delaware Estuary, this reorganized entity is still active and is now responsible for addressing the various actions identified in the CCMP. We used this plan as a reference in developing habitat management and land protection planning objectives.

Refuge-specific Plans

In addition to these local, State, and regional plans, a number of other refuge program-specific plans have provided guidance either in their draft or final format, including but not limited to the following:

- Annual Habitat Work Plan (most recently completed in 2011, updated annually)
- Wildlife Disease Surveillance and Contingency Plan (completed 2006)
- Fire Management Plan (completed 2006)
- Public Use Plan (currently in draft form, to be completed in 2012)
- Law Enforcement Plan (currently in draft form, to be completed in 2012)
- Hurricane Action Plan (completed 2010)
- Energy Management Plan (completed 2003, updated annually)
- Safety Plan (completed 2010)
- Fishing Plan (to be completed within 3 years of CCP approval)

Chapter 2.
Background

2.1 Refuge Location and Description

The 1,200-acre John Heinz NWR is one of the most urban refuges managed by the Service. It is located within the City of Philadelphia and neighboring Tinicum Township in Philadelphia and Delaware Counties, about one-half mile north of Philadelphia International Airport (map C.1). The freshwater tidal marsh at the refuge now comprises approximately 80 percent of the State's coastal wetland. The refuge represents an important migratory stopover along the Atlantic Flyway that provides a mix of freshwater habitats. It also provides protected breeding habitat for State-listed threatened and endangered species, as well as many neotropical migrants (Cohen and Johnson 2004).

The refuge contains a variety of ecosystems unique to Pennsylvania and the Philadelphia metropolitan area including tidal and nontidal fresh water marsh, freshwater tidal creek, open impoundment waters, coastal plain and riparian forests, and early successional grasslands. Many of the refuge's ecosystems have been degraded, damaged, or (in some cases) destroyed as a result of the numerous historic impacts. However, many of these impacted ecosystems have the potential to be restored or enhanced through various management efforts. Some areas, including portions of the tidal marsh, contain healthy and intact ecological communities. These areas will require a more protection and monitoring-focused approach. Due to the refuge's location within the coastal plain (a small and unique physiographic region within Pennsylvania), many of its ecosystems contain unique plant communities or species of conservation concern.

2.2 Geographical Setting

Bird Conservation Region and Partners in Flight Physiographic Area

The regional planning efforts completed by the North American Bird Conservation Initiative (NABCI) and PIF created a series of regional conservation planning units at a national scale. NABCI efforts seek to unite all bird conservation efforts on a regional scale within Bird Conservation Regions. PIF's planning focus is conservation of landbirds within biologically based regions identified as BCRs. BCRs are generally larger in scale than PIF Physiographic Areas.

John Heinz NWR is located within BCR 30 (Mid-Atlantic Coast) and PIF Physiographic Area 44 (Mid-Atlantic Coastal Plain; see map C.2). Priority habitats identified in BCR 30 that are present at John Heinz NWR include mud flat, estuaries and bays, estuarine emergent wetlands, freshwater emergent wetlands, forested wetlands, rivers and streams, forested uplands, and grasslands. The Mid-Atlantic Coast BCR extends across Coastal Plain regions from northern New Jersey down through Pennsylvania, Delaware, Maryland, and into Virginia. Threats to priority habitats within BCR 30 are largely associated with human impacts as a result of the region being highly populated, first by Native Americans, and then over 300 years of European colonization (USFWS 2008a).

Atlantic Coast Flyway

Flyways are important units for managing waterfowl and other migratory bird populations as they help connect management of breeding, migration, and overwintering areas. The partnership includes 18 states and commonwealths and key Federal and regional habitat conservation agencies and organizations in the joint venture area. It was originally formed as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan in 1988. Since then the focus has broadened to the conservation of habitats for all birds consistent with major national and continental bird conservation plans and the NABCI. John Heinz NWR is located in a unique landscape position along the Atlantic Coast Flyway. Its large open space and diverse habitats located along the Delaware River within a highly urbanized metropolitan area makes it a critical stop for many species.

Watershed Context

John Heinz NWR is located within the Delaware River Basin, which encompasses 13,600 square miles and stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic

Ocean. The Delaware River watershed includes portions of Delaware, Maryland, New York, New Jersey, and Pennsylvania (DRBC 2004).

Within the Delaware watershed, the pre-industrial landscape was predominantly woods and wetlands, with expanses of farmland and nodes of human settlement. Decades of development and harvesting resulted in filled wetlands and a decrease in forests. By 1930, forests had been reduced to 32 percent and wetlands to 3 percent of the landscape. Between 1930 and 1996, urbanized land expanded from 3 to 14 percent (DRBC 2004).

Our project area (the refuge) is situated near the confluence of Darby Creek and the Delaware River located on the southwest boundary of the City of Philadelphia. Most of the 77 square miles of the Darby Creek watershed lies within Delaware County with additional portions found within surrounding Chester, Delaware, Montgomery, and Philadelphia Counties. The watershed is very urbanized, encompassing all (or parts) of 31 municipalities, which are home to approximately 500,000 people, with an average density of nearly 10 persons per acre (DCVA 2005).

Landscape Conservation Context

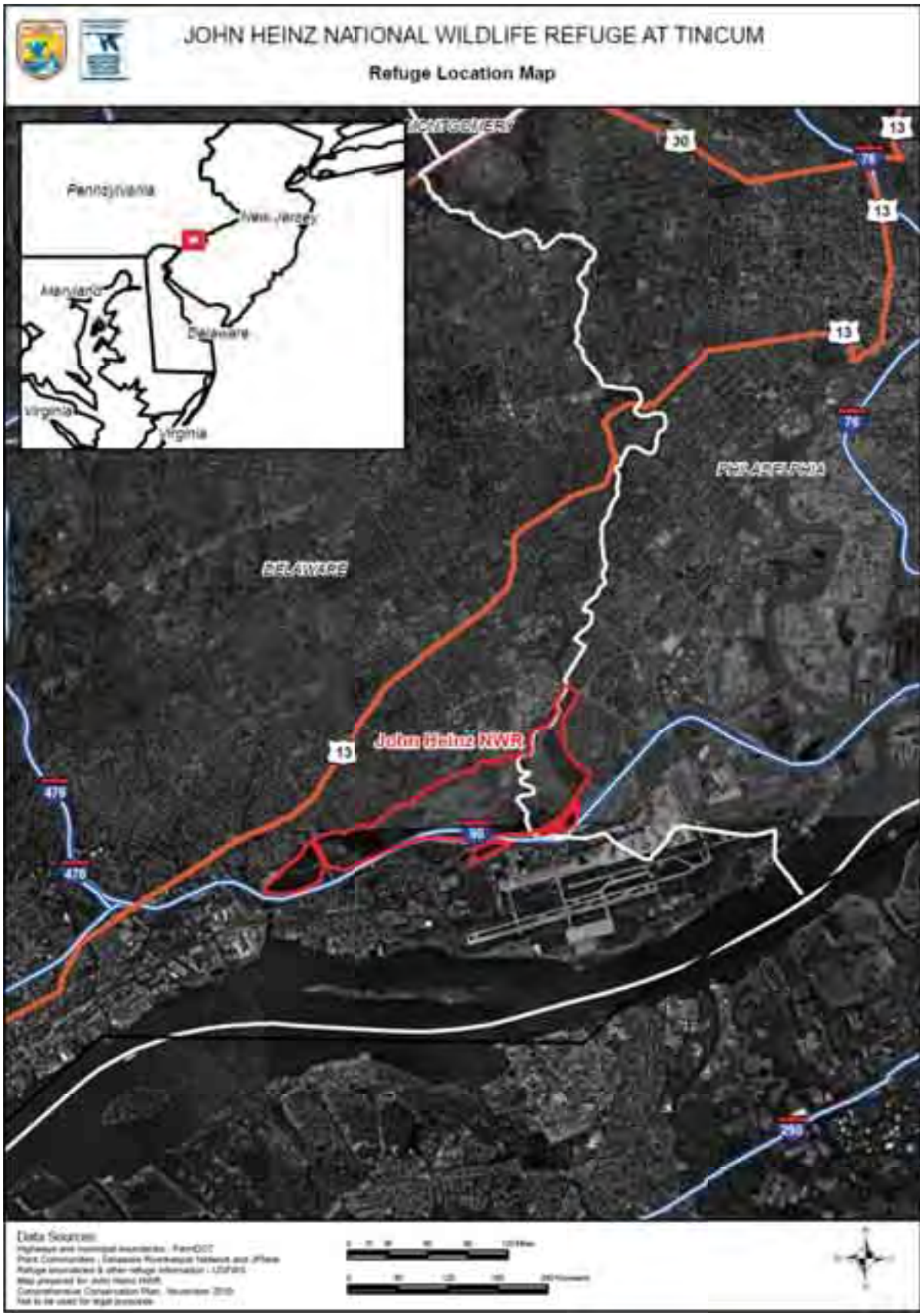
John Heinz NWR protects a variety of unique resources and also provides a unique opportunity for the education and outreach near the urban center of the City of Philadelphia, the nation's 5th largest metropolitan area (map C.1). Connecting children and families with nature is a very high priority national program of the Service. The urban interface of John Heinz NWR provides excellent opportunities for such environmental education and conservation outreach unlike any other refuge in the country. The ecosystems within John Heinz NWR, especially freshwater tidal marsh, support some of our nation's most biologically diverse assemblages of fish, wildlife, and plant species.

John Heinz NWR's location near the confluence of Darby Creek and the Delaware River also plays a significant role in the habitats and species utilizing the refuge. As one of only a few large freshwater marsh expanses along the Delaware River, the refuge provides an important stopover for many species during migration up the Delaware River flyway. The expanse of freshwater tidal marsh also provides critical spawning and nursery habitat for many riverine fish species.

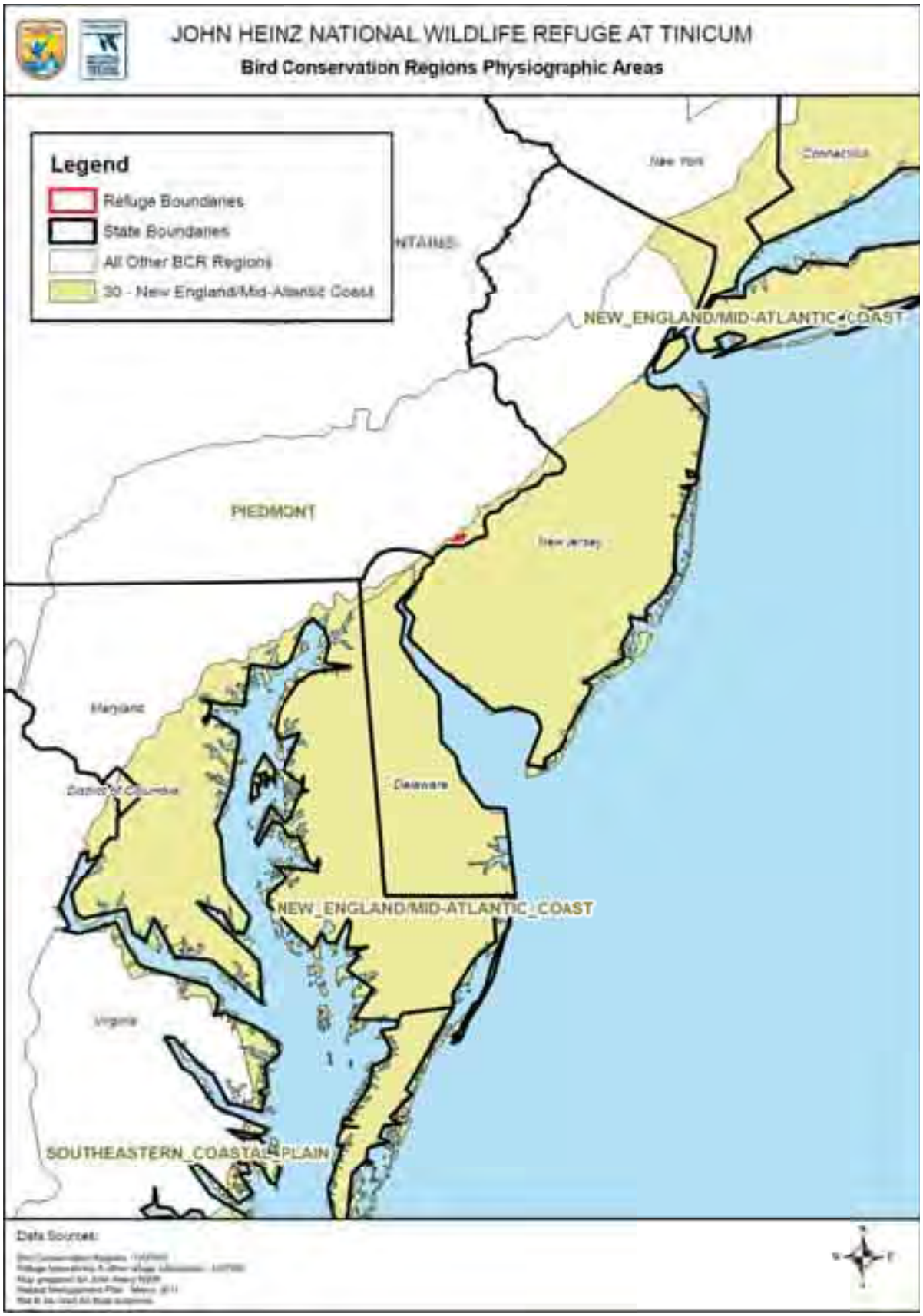
Much of the land surrounding the refuge is, and has been, urbanized for nearly 200 years. Major land use changes over the 20th century, however, brought major impacts to the refuge site and surrounding landscape like never seen before. Interstate highway, international airport, and expanded residential and industrial construction made John Heinz NWR a biological island contrasted amongst a highly urbanized landscape.

This position within a large urban area also provides many opportunities. More than 100,000 visitors from around the Delaware Valley and beyond visit the refuge each year. John Heinz NWR is in a unique position to foster greater community understanding of natural systems, species of conservation concern, the value of the refuge system, and the Service's mission in conserving and protecting those resources.

Map C.1. Location of John Heinz National Wildlife Refuge



Map C.2. Bird Conservation Regions in Relation to John Heinz National Wildlife Refuge



2.3 Historical Perspective

Geologic Development

John Heinz NWR is situated within Pennsylvania's southeastern most physiographic province, the Atlantic Coastal Plain (Low et al. 2002). This province extends from southern Delaware County up into Philadelphia County where it includes all of Philadelphia except the northwestern part. Outside of Pennsylvania, this province extends throughout areas along the Atlantic Ocean from Massachusetts to Florida, including all of southern New Jersey and most of Delaware.

This physiographic region is characteristically flat land with sandy soils. These soils are primarily composed of sand, silt, and gravel resulting from the weathering of very old Paleozoic and Precambrian metamorphic rocks. This rock, originally laid down as sediments 438 to1,600 million years ago, was altered by heat and pressure to form various metamorphic rocks, which in turn weather relatively easily. These rocks can be further described by the minerals they are composed of, the specific process that formed them, and their physical characteristics.

The area is influenced by the Delaware River and is in a different group. It is composed of sand and gravel laid down by periodic flooding over the last 1.6 million years with additional silt and clay deposits where finer material was able to settle. Alluvial sediments in areas along this reach of the Delaware River were deposited over the last 12,000 years (PNHP 2008). These finer alluvial sediments are those which naturally comprise much of the soils throughout the refuge. PADCNR has highlighted Tinicum Marsh as an Outstanding Scenic Geological Feature worth noting within this physiographic province (DCNR 2010).

Pre-European Settlement

The pre-settlement forest of southeastern Pennsylvania was a mixed-aged forest (Latham et al. 2005). In areas along the Delaware River, the coastal plain forest type covered a significant portion of the Philadelphia area. This community supported a suite of species common further south. This community developed in this region because of the sandy soils combined with the warm coastal air blown up from Delaware Bay. This forest type was dominated by sweet-gum (*Liquidambar styraciflua*) and oaks (*Quercus spp.*) intermixed with species such as American beech (*Fagus grandifolia*). The understory would have also included broadleaved evergreen species such as American holly (*Ilex opaca*) (PNHP 2008).

Floodplain forests were also found along many river systems in this part of the State. These forests would have been regularly flooded, for various durations, on an annual basis. In the most frequently flooded areas, fast-growing species such as sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and American and slippery elm (*Ulmus americana and U. rubra* respectively) would dominate. Associated species would include eastern cottonwood (*Populus deltoides*), common hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), green ash (*Fraxinus pennsylvanica*), and box-elder (*Acer negundo*) interspersed among them. Permanently wet or saturated areas, such as backwaters and isolated oxbows, would have supported swamp white oak (*Quercus bicolor*), pin oak (*Quercus palustris*), and red maple (*Acer rubrum*).

Grasslands and native meadows were likely to be found throughout the Philadelphia area prior to colonization. However, it is unlikely that these were self-maintaining systems. Meadows were often managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest partly in order to provide forage for game species such as grouse, turkey, deer, and elk (Latham et al. 2005).

The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained up to 10 to 20 square miles (6,400 to 12,800 acres) of freshwater tidal marsh. Historically, and as it is today, these wetlands provided an important breeding spot for many bird, mammal, fish, amphibian, reptile, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the 1/3 square mile of freshwater tidal marsh that remains in this part of the State (PNHP 2008).

Human occupation of the lower Delaware River drainage likely began as early as 16,000 years ago with the arrival of the ancestors of the Lenni-Lenape people, known to the English as the Delawares. This reach of the river was narrower and nontidal at that time, flowing through forested floodplain and freshwater marshes. Sea level rise had already been initiated by melting of the Wisconsin ice mass far to the north, and continued at a gradually slowing pace until about 5,000 years ago, by which time the local environment had stabilized as a tidal estuary with marshes comprising not only most of the current refuge land, but also a large part of the area now covered by Philadelphia International Airport.

European Settlement

As a result of the destruction caused by intensive historic period development, remarkably few archaeological sites dating from prior to European contact have been found in Philadelphia or its surrounding boroughs. The earliest recorded sites within the city date from approximately 5,000 years ago, although it is likely that earlier ones existed and some may still exist in small and scattered areas of undeveloped land.

Within Tinicum Township, the landscape of the refuge consists entirely of tidal marsh with a system of artificial dikes. Some of the dikes are wide enough to support trees and brush on their edges, but close examination of early maps and photographs reveal no natural islands. The only refuge areas suitable for Native American occupation prior to European contact consist of two narrow strips of terrace on the north side of Darby Creek in the town of Folcroft and a larger area within the Eastwick portion, containing the refuge headquarters and maintenance areas. These areas were farmland in the early 20th century but are now wooded. These areas may retain some archaeological potential, though the immediate vicinity of the refuge headquarters consists of deep and remarkably extensive modern fill.

Figure C.1. Historic Maps of Philadelphia Region (such as the example shown here) document the changes in land use and habitats around the refuge since European settlement (Scull 1752).

Soon after European settlement in the mid-17th century, farmers began to extensively dike and ditch tidal marsh to convert it to hayfields. Portions of the refuge dike system follow the trace of dikes dating from the mid-19th century, and likely considerably earlier. That earlier dike system was modified in the mid-20th century by installation of various water control structures, widening of virtually all dikes for construction of roads atop them, construction of interior dikes at some locations, and erosion of considerable lengths that fell out of use. The ditch system, poorly represented on historic maps but visible in early 20th century photographs, has almost completely vanished due to modern erosion and siltation. There are no standing historic structures on the refuge. The only dwelling sites recorded are two farmsteads established in the 1870s or earlier, both of which were obliterated by bridge construction and widening of South 84th Street in the 1970s.

20th Century Influences

Events that destroyed or highly altered what are now refuge lands over the 20th century are well documented in Two Studies of Tinicum Marsh (McCormick et al. 1970). One of the first impacts of the 20th century was the construction of the Philadelphia and Chester Railway Company, a trolley service that provided direct transit

between Chester and Philadelphia from 1901 to November 1946 (Schieck and Cox 1970). This former trolley bed runs parallel to the refuge's southern access road. While the trolley bed is not within the refuge boundary, its construction impacted current refuge lands with extensive cut and fill operations along its corridor. Aerial photos of the refuge area from 1928 document the presence of extensive marsh as well as several dike and road systems (figure C.2). It continues to affect the hydrology and drainage in the area of the impoundment.

Figure C.2. Aerial photograph of John Heinz National Wildlife Refuge lands in 1928 (prior to refuge establishment). Note the presence of extensive marsh and wetlands surrounded by agriculture.

The 1930s saw numerous, and expensive, repairs and alterations by the U.S. Army Corps of Engineers (ACOE). The Federal Works Program Administration, Pennsylvania legislature, and Delaware County all appointed funds to repair the dikes along the southern edge of Darby Creek. In 1935, a proposal for mosquito control led ACOE to construct a series of ditches throughout Tinicum Marsh. Some of these artificial channels are still visible today in the northern half of the freshwater tidal marsh. From the 1930s until the 1950s, several areas within and around Tinicum Marsh were utilized by ACOE for landfills of dredged material (McCormick et al. 1970).

The early 1970s saw the construction of Interstate 95 (I-95) and an interchange system with State Road 420. These major changes resulted in the dredging and filling of many marsh areas around the refuge. Today, these areas remain as permanent open water features where dredging occurred and as either degraded floodplain forest or wetlands dominated by common reed (*Phragmites australis*).

The Folcroft Landfill operated from the 1950s through the 1970s accepting municipal, demolition, and hospital waste. It was closed in 1973 as a result of permit violations and improper management. Closing activities included regrading of the landfill, reducing steep slopes along with covering and seeding the site (USEPA 2006).

In 1980, Congress authorized the purchase of the Folcroft Landfill to increase the size of the refuge. At this time, the U.S. Environmental Protection Agency (USEPA) remains in discussion with potentially responsible parties regarding investigation of the landfill's contamination (USEPA 2006). The refuge will facilitate the landfill cleanup efforts. In 1991, through a bill sponsored by Congressman Curt Weldon, the Tinicum Wildlife

Preserve officially became John Heinz National Wildlife Refuge at Tinicum in honor of the late Senator who was influential in the marsh's preservation.

In February 2000, a subsurface pipeline owned by Sun pipe Company and operated by Sunoco, Inc. ruptured, releasing 191,982 gallons of crude oil into the 145-acre impoundment in the refuge. At the time of the release, the impoundment contained a thick layer of ice that formed a natural barrier which prevented the oil from spreading throughout the impoundment. At its peak, the area affected by the oil spill encompassed approximately 1.6 acres. This included the oil slick floating under the ice and an area of shoreline adjacent to the slick containing emergent, scrub-shrub, and forested wetlands. Sunoco provided initial response personnel to secure the site and to begin the initial cleanup operation. More than 90 percent (173,799 gallons) of the spilled oil was recovered through the cleanup effort. In addition to the 1.6 acres directly impacted by oil contamination, another 1.25 acres were directly impacted by response vehicles and equipment.

Shortly after the oil leak was discovered and concurrent with the initial cleanup efforts, the Service, the PFBC, and the PADEP initiated a cooperative Natural Resource Damage Assessment (NRDA). Subsequently, the U.S. Environmental Protection Agency, Region III (USEPA) issued a Unilateral Administrative Order for the Abatement of Endangerment that required "restoring all areas, including soils and sediments, to the maximum extent possible, to their condition before the discharge of oil." Sunoco and the participating agencies developed a restoration plan. Restoration efforts were completed and a final report was submitted to the USEPA on June 3, 2005 (Entrix, Inc. 2005).

Habitat loss and degradation is the single greatest cause of loss or decline of species across the globe (and in Pennsylvania), threatening over 80 percent of rare and endangered species (Wilcove et al. 1998). Exotic, invasive species that compete with or reduce populations of native species is the second greatest cause of declines (affecting over 50 percent of terrestrial species). In Pennsylvania, an estimated one-third of all plants are nonnative, and 11 percent of all fish are exotics (Goodrich et al. 2001).

Maps of the refuge area dating back to the late 1700s show an area largely comprised of wetlands–likely freshwater tidal marsh, as it was historically present along the Delaware River. Over the following two centuries, agriculture and urbanization slowly encroached on these wetland areas. John Heinz NWR today is largely an island of habitat within its urban surroundings. As a result, large predators and other species that would have once inhabited the area are now gone.

PADCNR compiled an overall habitat quality rank by using estimates of habitat quality for streams, wetlands, forests, and grasslands index for each physiographic region throughout the State. This ranking highlights coastal plain habitats as the only "impaired" habitats within the State of Pennsylvania and highlights the coastal plain region as being home to some of the last remaining habitats for certain wetland species in the State. PADCNR recommends that where possible, wetlands along the Delaware should be restored (Goodrich et al. 2001). Urban forests could be focal points to provide habitat for some tolerant forest wildlife. Reduction of runoff into streams and wetlands should be top priority, along with restoration of natural communities in undeveloped areas (Goodrich et al. 2001).

The Refuge, the Land, and the People

The cultural history of the region reflects changing societal values in the United States. The Lenape and earlier indigenous people, along with European explorers and settlers, valued the marshes and adjacent uplands for agriculture, fishing, and hunting along with its strategic location for trade and transportation. Undoubtedly, this area's ongoing relationship with different cultures and land ethics throughout the centuries has had many impacts on the refuge as it is known today.

As the Tinicum region developed, the perceived value of marshes diminished for the public, which resulted in the fill or dredging of many acres of wetlands. The history of the refuge over the past 50 years reflects a renewed and refined sense of ecological value in respect to habitat protection and conservation.

2.4 Climate Influences and Natural and Anthropogenic Disturbances

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. The average summer temperature is around 75° Fahrenheit (F), while the average winter temperature is 33°F. Average precipitation totals around 46 inches per year, with an average annual snowfall of around 30 inches (NCDC 2006). July tends to be the warmest and wettest month with an average temperature around 85°F and average monthly rainfall around 4.38 inches. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events (NCDC 2006). In recent years, these large events have caused flooding in and around the refuge.

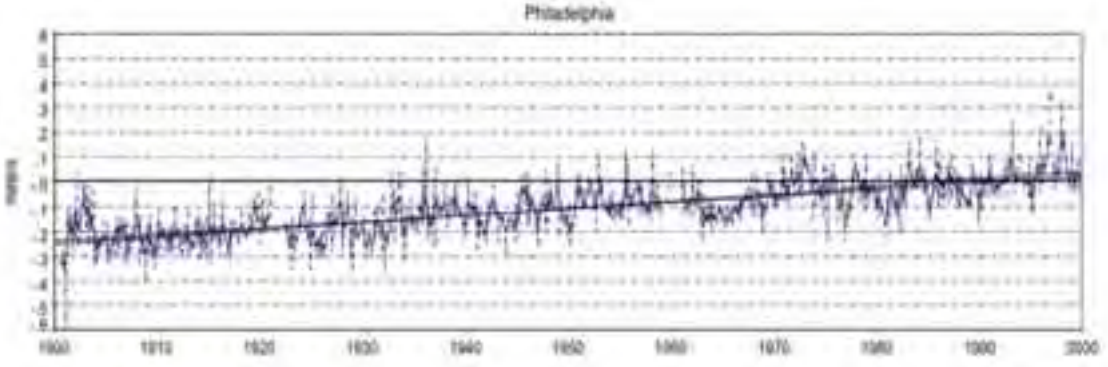
2.5 Current Refuge Conditions

Climate

The coastal climate of the Mid-Atlantic is characterized by seasonal variations from hot and humid summers to cold winters. Along with the moderating effects of the coastal climate, hurricanes, tropical storms, and Nor'easters can provide extreme precipitation events. In recent years, these large events have caused flooding in and around John Heinz NWR.

Like many areas throughout the world, the climate of southeastern Pennsylvania is changing. Over the past century a rise in mean annual temperature of 0.5°F has been recorded. Sea level, as measured by a tidal gauge at Philadelphia, has also risen nearly 1 foot over the past century as shown in figure C.3.

Figure C.3. Monitored sea levels at Philadelphia (1900–2000) displaying nearly a 1-foot rise in sea level over the past century (NOAA/NOS 1999).



Climate change and sea level rise projections for the region will potentially have major influences over the refuge's habitats and their management over the coming decades. The precise ecological impacts to the refuge as a result of a changing climate are largely unknown at this time. Detailed monitoring of habitat conditions and species utilization will be necessary to identify potential shifts in species assemblages or distribution across the refuge and region. However, reports and guidance documents published in recent years provide projections and estimates upon which the refuge can begin to build an understanding of how these potential impacts may manifest themselves and impact the refuge.

According to a recent report released by the Union of Concerned Scientists, temperature projections for the coming decades (2010 to 2039) may make eastern Pennsylvania's climate more closely resemble that of Maryland or northern Virginia as we know it today (UCS 2008). Philadelphia and other large cities already experience extreme heat and air pollution events. The Intergovernmental Panel on Climate Change (IPCC) projects that urban areas throughout North America will experience more severe and longer heat waves and increased impacts from air pollution (UCS 2008; Philadelphia AMS 2008). In their *Summary Report for*

Policymakers, the IPCC warns with "very high confidence" that these extreme temperature events may lead to increasing impacts on forests through disturbances from pests, diseases, and extended periods of high risks of fire. It is important to note that "very high confidence" is defined as a 9 in 10 likelihood of occurrence (IPCC 2007).

Recent sea level rise estimates by the IPCC for global sea level rise could have serious implications for the freshwater tidal marsh within John Heinz NWR. Conservative estimates project a rise between 7 and 14 inches over the next century, while higher estimates range between 10 and 23 inches (UCS 2008). Estimates by Najjar et al. (2000), project global sea level rise between 0.4 to 1.2 inches by 2030 and between 1.6 to 4.0 inches by 2095. Recent estimates compiled by the Climate Adaptation Working Group as part of the Partnership for the Delaware Estuary's report *Climate Change and the Delaware Estuary* (Najjar et al. 2010) indicate relative sea level rise (which accounts for mean sea level rise and land subsidence) may increase 2.6 to 5.6 feet (0.8 to 1.7 meters) by the end of the century.

Sea levels have fluctuated over many millennia. Tidal marshes (both salt and freshwater) typically respond to these fluctuations through two mechanisms: accretion of sediment across the marsh surface (e.g., a rising of the marsh surface elevation) or expansion into nearby (and topographically higher) riparian lands (e.g., conversion of surrounding lands) (Odum et al. 1984). Given the urbanization of the Darby Creek watershed and lands immediately surrounding the refuge, it is unclear which, if either, of these options may allow the necessary adjustment to rising sea levels.

In addition to the rise in water levels alone, the salt line of the Delaware River[1] has potential to shift upstream and into the zone encompassing the refuge. Currently, the refuge is less than 1 mile upstream from the salt line. The intrusion of salt water is problematic for freshwater tidal marshes and freshwater tidal swamps that cannot tolerate salinities greater than 0.5 milligrams per liter. Not only plants, but animal and microbial communities will be altered by salt intrusion (Weston et al. 2006, Craft 2007). As plants with a low salt tolerance become stressed, less productive and die, marsh communities shift to salt-tolerant species.

A major shift in the salinity of waters within the refuge could lead to a major shift in plant communities and species within areas containing freshwater tidal marsh today. Neither the effects of sea level rise on marsh elevations nor salinity levels are well understood within the Delaware Bay at this time, although preliminary analysis shows that the estuary has increased in salinity over time (Kreeger et al. 2010). Monitoring these influences over the coming years will be a major step in developing management options for the refuge in years to come.

In an effort to address the potential effects of sea level rise on United States national wildlife refuges, the Service contracted the application of the Sea Level Affecting Marshes Model (SLAMM) for most refuges in the Service's Northeast Region. This analysis was initiated to inform the decisionmaking process as part of CCP development for each refuge along with other long-term management plans. Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the SLAMM 6.0. This model accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989; *http://www.warrenpinnacle.com/prof/SLAMM*; accessed January 2012).

For John Heinz NWR's analysis, SLAMM 6.0 was run using scenario A1B from the Special Report on Emissions Scenarios (SRES) – mean and maximum estimates (Warren Pinnacle Consulting, 2010). The A1 scenario assumes that the future includes very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPPC 2007) suggests a likely range of 0.7 to 1.6 feet (0.21 to 0.48 meters) of sea level rise by 2090 to 2099 "excluding future rapid dynamical changes in ice flow." The A1B-mean scenario that was run as a part of the refuge-specific analysis falls near the middle of this

[1] This is the zone where low-salinity freshwaters from the Delaware River watershed combine with high-salinity waters from Delaware Bay (characterized as having a concentration of 250 milligrams per liter (mg/L) sodium chloride).

estimated range, predicting 1.3 feet (0.40 meters) of global sea level rise by 2100. To allow for further analysis, SLAMM was also run assuming 1 meter, 1½ meters, and 2 meters of global sea level rise by the year 2100.

According to the SLAMM analysis conducted, John Heinz NWR is predicted to experience significant effects of sea level rise (Warren Pinnacle Consulting 2010). Undeveloped dry land, which makes up roughly one quarter of the refuge, is predicted to be lost at a rate between 24 percent and 54 percent (66 to 145 acres respectively) across the range of sea level rise scenarios. Tidal fresh marsh, which makes up roughly one third of the refuge, is predicted by to be lost at a rate of 9 percent to 84 percent (14 to 352 acres, respectively) once scenarios exceed 0.39 meters of global sea level rise (Warren Pinnacle Consulting 2010). According to these results, the refuge will begin to see the most drastic effects of sea level rise, once it exceeds 0.69 meters. These shifts in habitat type would result in major shifts in the habitat types and species composition across the refuge.

Another concern related to sea level rise is increasing salinity. Increasing sea levels will result in larger tidal volumes that carry more salt water higher up into the estuary. Sea level rise could increase the tidal range in the Delaware system (Walters 1992). Tidal range changes would also likely increase the salinity range over the tidal cycle (Kreeger et al. 2010). A preliminary analysis, completed by Najjar (2010), reviewed existing salinity measurements dating back to 1927 to document trends in salinity within the Delaware Estuary. His results suggest that salinity is increasing at a rate greater than can be explained by streamflow and models of the response of salinity to sea level. This phenomenon could be a result of other forces in the estuary, such as successive channel deepening events that occurred during the period of analysis, which could have also contributed to salinity intrusion due to larger tidal volumes and bathymetric changes (Kreeger et al. 2010). Due to such complexities involved in determining salinity migration at the upper end of the estuary, modeling of potential changes in salinity resulting from sea level rise could not be completed at the time of this writing.

Again, the IPCC warns with “high confidence” (or an 8 in 10 chance) that, “the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers…” (IPCC 2007). Heavy rain and snow events are anticipated for many parts of North America. For John Heinz NWR, being at the base of the Darby Creek watershed, already highly urbanized and experiencing frequent flooding, this prediction will only lead to more frequent flood events over the coming decades.

Over the last century, the annual average temperature in Pennsylvania increased by over 0.5°F (UCS 2008; NOAA 2008). This warming has resulted in many climate-related changes such as more frequent days with temperatures above 90°F, a longer growing season, increased heavy precipitation events, less winter precipitation in the form of snow and more as rain, and rising sea surface temperatures and sea level (Hayhoe et al. 2007).

Being located in a physiographic region where the ranges of many species overlap between northern and southern regions, the piedmont and coastal plain, plant, fish, and animal populations are diverse. These shifts in temperature and precipitation will likely impact the plant and animal populations adapted to the historic climate of the Mid-Atlantic. As summers are projected to become warmer across the Northeast, many plant species are likely to shift ranges northward (Iverson et al. 2008).

As outlined in earlier chapters, the refuge has acted as an ecological oasis within the highly urbanized lands surrounding Philadelphia. It has provided refuge for many species that use its habitats for migratory stopovers, nesting, spawning, and feeding. Habitat fragmentation has long been associated with reductions in habitat quality and resilience. This aspect of the refuge and its habitats will undoubtedly play a role in how they respond to a changing climate.

Hydrology and Geomorphology

John Heinz NWR is located at or slightly above sea level. Consequently, Darby Creek and the freshwater tidal marsh within the refuge contain a daily tidal fluctuation of around 6 feet Darby Creek flows through the refuge just upstream from its confluence with the Delaware River. Collectively, the Darby Creek and Cobbs Creek (a

major tributary of Darby Creek) watersheds drain approximately 74.1 square miles by the time they reach the refuge (USGS 2009).

As part of the *Restoration Management Plan for the Lower Darby Creek* (Salas et al. 2006), baseline geomorphic stream data was collected and analyzed for trends erosion and sinuosity from historic (1965 to 1990) and more recent (2000) aerial photographs along with topographic and other maps displaying the refuge area dating between (1757 and 2004). Darby Creek throughout much of the refuge is characterized by a braided stream channel with variable sinuosity. This channel type is common in coastal tidal streams near river deltas and tends be a relatively stable channel. However, major changes to the stream or watershed such as loss of vegetation, channel alterations, and urbanization, can affect stream morphology and cause the stream channel to adjust significantly (e.g., cause erosion and deposition) (Salas et al. 2006).

The basic geomorphic assessment of Darby Creek and other tributaries within the refuge generally reflect this inherent stability and response to major impacts. The majority of streams within the refuge have remained relatively stable over the past 40 years and longer. Analysis of historic aerial photographs and other maps show Hermesprota and Little Thoroughfare Creeks and portions of Darby Creek appearing relatively unchanged. However, major changes have been noted on Bow Creek and on other portions of Darby Creek.

Bow Creek, which historically connected Darby Creek and the Delaware River across what is now Philadelphia International Airport, is today completely isolated from Darby Creek. Darby Creek itself has displayed several signs of adjustment, most notably during the 1980s. Analysis of aerial photos from 1980 and 1990 show that the multi-channeled Darby's main channel cut through the center of Tinicum Marsh, shortening its total length by nearly half (from 8,400 linear feet to 4,800 linear feet). It is unclear what influenced this dramatic shift or whether the blockage of Bow Creek may have influenced this alteration of Darby Creek. The channel has remained relatively unchanged since this last adjustment period.

Many of the areas in and around the refuge were historically freshwater tidal marsh. As discussed previously, loss and alteration of wetlands dates back centuries, as early as the first Dutch settlements of the 1640s, when many marsh areas around the Tinicum region were diked for agriculture. More recent losses of tidal marsh occurred between the 1950s and early 1970s, when several areas of the refuge were filled or dredged. As a result of these large-scale disturbances, altered hydrology, invasive species introductions, and high levels of deer browse continually impact many of the natural communities within the refuge. As observed as part of the Delaware Riverkeeper Network's field surveys conducted in 2005, these areas are typically dominated by near monocultures of nonnative invasive species, contain fill and debris, un-natural amounts of open water habitat, and lack proper ecosystem structure (Salas et al. 2006).

The refuge also contains a 145-acre open water impoundment. For most visitors to the refuge, the impoundment is the focal point of their visit. Historically, the impoundment was managed as open water with periodic tidal fluctuation. In recent years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl and shorebirds. This periodic drawing down of the impoundment and the presence of mud flats provide some of the best stopover habitat for migrating shorebirds in Pennsylvania. The area also serves as a wintering ground for over 20 species of waterfowl by providing stopover habitat for 1,100 to 1,400 individuals per day between September and March (Green et al. 2008).

Soils

The Soil Survey of Philadelphia County shows the lands of the refuge being comprised of marsh soils and urban land (e.g., organic and mixed fill) (NRCS 2009). As discussed in previous sections, the natural soil composition of most, if not all, of the refuge lands consisted of silty alluvial soils deposited over the last 12,000 years. However, significant soil disturbances that occurred during the 20th century altered the soil structure (and consequently the hydrology) of many areas in and around the refuge. Thus, most upland areas within the refuge are comprised of organic fill material. Despite this significant impact, many of the riparian forest communities that naturally occur within this region (coastal plain and floodplain forests) seemed to have established in many of these areas.

Water Pollution

The refuge is located within highly urbanized and industrial surroundings, making it vulnerable to many factors that could negatively affect ecosystem and wildlife health. Point source and nonpoint source pollution within the Darby Creek watershed and Delaware Estuary affects water quality and available food chain support for ecosystems providing habitat at the refuge.

Water quality in the refuge is the result of the inputs to three major streams: Darby Creek, Cobbs Creek (a major tributary to the Darby), and the Delaware River. For management purposes, the tidal portions of Delaware River tributaries are considered to be part of the river. Twice each day, river water enters the Darby system during high tide. In addition, various fish species freely move between Darby Creek and the Delaware River. Because of these factors, the tidal portion of Darby Creek is considered part of the Delaware River Basin Commission's Interstate Pollution Control Zone 4 (DRBC 2004). A zone-by-zone assessment of the attainment of designated water quality uses by the DRBC indicated that Zone 4 attained its recreational designated uses, but not its aquatic life uses (DRBC 2004). The contribution from each of these sources varies depending upon hydrologic, climatologic and anthropogenic conditions. Thus, the water quality found in the refuge is highly variable and complex. The status of water quality and aquatic life is determined by various chemical, physical and biological parameters.

Data for Darby and Cobbs Creeks have been collected by the Pennsylvania Department of Environmental Protection (PADEP), the U.S. Geological Survey (USGS), the Philadelphia Water Department (PWD), Darby Creek Valley Association (DCVA), the Academy of Natural Sciences (ANS), and others. Long-term monitoring of the tidal Delaware River occurs through the Delaware River Basin Commission (DRBC) with the Delaware Department of Natural Resources and Environmental Conservation (DNREC) conducting the sampling via contract from DRBC. The refuge is fortunate that a number of reports have been produced that describe the status of the Darby Creek watershed based on recent data: the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 EPA Facility Report (NOAA 2000), and PWD's Darby-Cobbs Characterization Report (PWD 2002).

During the early 20th century, the Delaware River in the vicinity of Philadelphia and Camden was the most polluted stretch of river in the United States, if not the world (Albert 1988). In September 1946, no dissolved oxygen was found in this reach of the river; a "dead zone" that extended for a distance of more than 20 miles. In the intervening years, a massive effort was made to clean up the Delaware Estuary. By the mid-1980s, major reductions in nutrient pollution resulted in needed water quality improvements. The reach where Darby Creek enters the Delaware has shown substantial improvement in this regard.

Fish data collected in recent years indicate that Darby Creek has greater species diversity including some pollution intolerant species. Biometric scores suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor" (PWD 2002). Cobbs Creek fish metrics indicate only "fair" or "poor" (PWD 2002).

Environmental Contaminants

Environmental contaminants have a major impact on the health and fitness of wildlife present on the refuge. The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site. The Lower Darby Creek Area includes four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Of the five sites, only Folcroft Landfill is located on the refuge. Coordination with the EPA regarding contaminant remediation is ongoing. Ultimately, the Service will likely take the lead on completing restoration activities on this site.

Over the years, there have been widespread fish advisories in the river and various tidal tributaries, not including Darby Creek. These advisories are the result of contaminants found in fish, including polychlorinated biphenyls (PCBs). In 2003, Service staff collected 31 brown bullheads (*Ameiurus nebulosus*) as part of a habitat assessment related to Folcroft and Clearview Landfills with the main objective being to determine the prevalence of liver and skin tumors, preneoplastic lesions, and barbel abnormalities. Their findings reported a 26 percent prevalence of liver tumors and a 6 percent prevalence of skin tumors in brown bullheads (less than 260 mm in length) from Lower Darby Creek. Liver tumor prevalence is indicative of a contaminated habitat. Levels found were more than five times the Baumann (2002) criteria for distinguishing highly contaminated Areas of Concern from less contaminated Areas of Recovery (Pinkney et al. 2004).

A large crude oil spill in 2000 located on the refuge impacted the reproduction of resident turtle populations. Research was conducted to determine the effect of crude oil exposure on female snapping turtle and painted turtle fertility, reproductive output, and development of offspring (Bell 2005). There was no significant difference in egg fertility between female snapping turtles exposed to oil or control turtles. However, female snapping turtles had significantly lower fertility of eggs in 2002 compared to 2000. There was no difference in reproductive output between exposure groups or years for snapping turtles or painted turtles. Most snapping turtle embryos died early in development, and there were significantly more early deaths for oil exposed snapping turtles than controls. Control painted turtles not only had a higher incidence of abnormality than control snapping turtles, but malformations were more severe in the former than the latter. Oil exposure exacerbated developmental problems in snapping turtles, causing increased incidence and severity of deformity in embryos.

The study noted that both species exhibit high rates of embryonic and adult deformity and that although the refuge offers many advantages to the resident turtle populations, background pollution places a developmental burden on the life history of turtles that was exacerbated by exposure to crude oil. Despite the deformities documented in both oil-exposed and control turtles, exposure to crude oil did not appear to have significantly affected the fertility or relative clutch size of snapping turtles or painted turtles (Bell 2005).

Natural Community Types

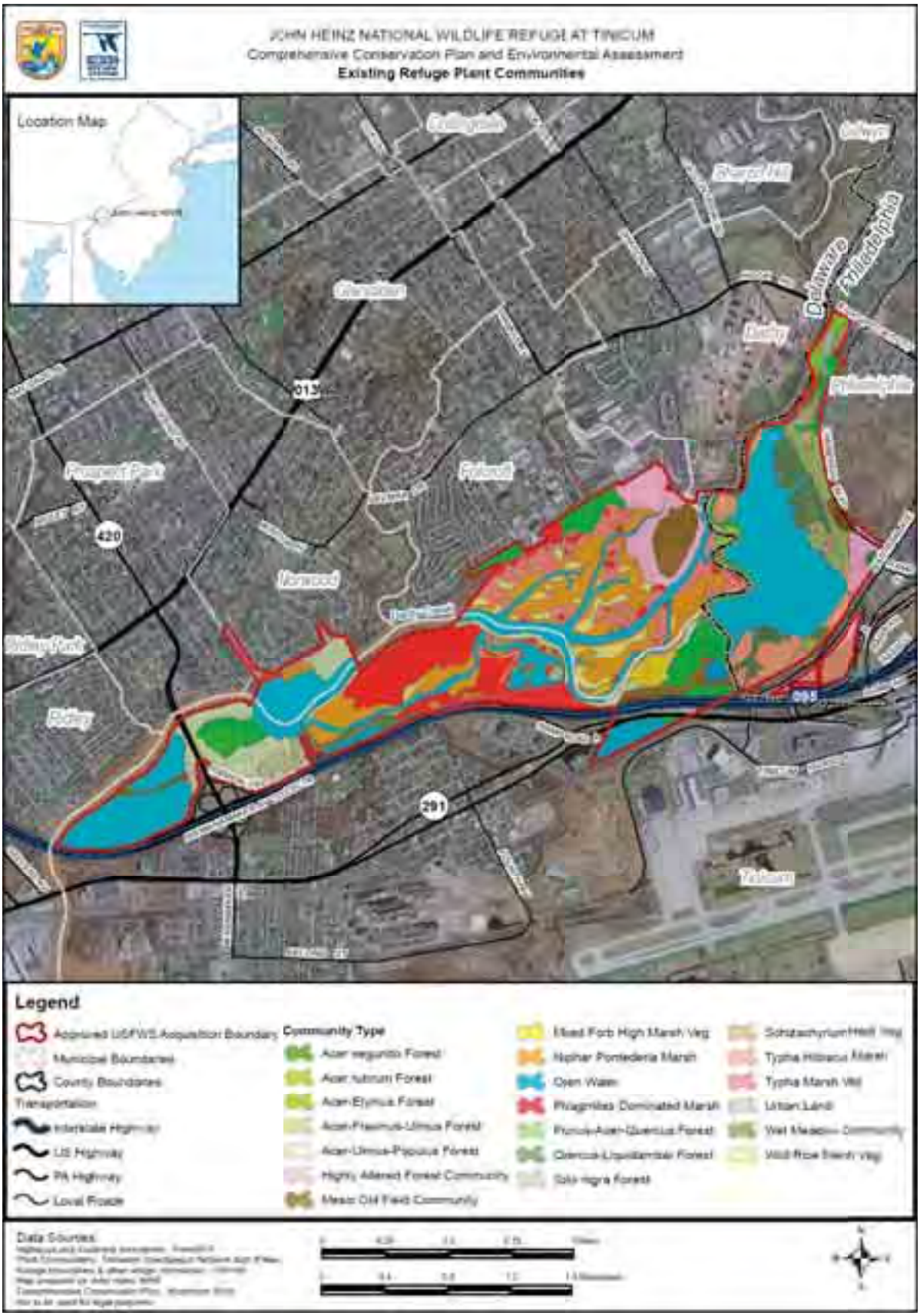
Refuge lands include a variety of ecosystems including open water, forests, grasslands, and tidal and nontidal wetlands. Many of the ecosystems (and the habitats they support) have been degraded, damaged, or destroyed as a result of the numerous impacts previously cited. Despite these alterations, many of these impacted ecosystems have the potential to be restored through various management actions and specific projects. Other areas, including portions of the freshwater tidal marsh, contain healthy and intact plant communities that will require a more protection-focused approach to management. Some ecosystems support plant communities or species of concern.

The Refuge System adopted the National Vegetation Classification System (NVCS) developed by the Nature Conservancy and the Natural Heritage Network as a standard for classifying plant communities. The classification contains hierarchical levels of community specificity. The narrowest level within the classification is the Association. The Restoration Management Plan for the Lower Darby Creek (Salas et al. 2006) included an inventory of the plant communities present at John Heinz NWR. Table C.1 lists the NVCS Associations found within the various broad-scale habitats of the refuge. Some communities were identified only down to the Alliance level, which is a broader category above Associations. Where possible, the conservation status rankings have been indicated as referenced by NatureServe Explorer and the Pennsylvania Natural Heritage Program. Conservation status rankings indicate the degree of imperilment of a species of community on either a global, national, or State level. The location and extent of these plant communities is displayed on map C.3.

Table C.1. Broad Habitat Types and National Vegetation Classification System Associations and Alliances Found Within John Heinz National Wildlife Refuge Based on the National Vegetation Classification System.

Broad Habitat Types	Natural Community Types (Association or Alliance)	Conservation Ranking (Global; State)
Freshwater Tidal Marsh	*Atlantic Coast Wild Rice Tidal Marsh*	*G4; S1*
	Freshwater Intertidal Mudflat	*G3/G4; S1*
	Freshwater Tidal Mixed Forbs High Marsh	*GNR; S1*
	Nuphar lutea Tidal Marsh	*GNR; SNR*
	Peltandra virginica - Pontederia cordata Tidal Herbaceous Vegetation	*G3/G4; S1*
	Phragmites Dominated Marsh	*GNR; SNR*
	Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Eastern Herbaceous Vegetation	*G5; SNR*
Freshwater Nontidal Wetlands	*Phragmites Dominated Marsh*	*GNR; SNR*
	Typha angustifolia - Hibiscus moscheutos Herbaceous Vegetation	*GNR; SNR*
Open Water	*Freshwater Intertidal Mudflat*	*G3; S1*
Coastal Plain Forest	*Quercus palustris - Quercus bicolor - (Liquidambar styraciflua) Mixed Hardwood Forest*	*G3; S2*
Floodplain Forest	*Acer negundo Forest*	*GNR; SNR*
	Acer rubrum Forest	*GNR; SNR*
	Acer saccharinum - Acer negundo / (Elymus virginicus) Forest	*G4; SNR*
	Acer (rubrum, saccharinum) - Fraxinus spp. - Ulmus americana Forest	*G4; S1*
	Acer saccharinum - Ulmus americana - (Populus deltoides) Forest	*G4; S3*
	Salix nigra Temporarily Flooded Shrubland	*GNR; SNR*
	Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus spp. Forest Alliance	*GNR; SNR*

Map C.3. Plant Communities of John Heinz National Wildlife Refuge



These community types are described in more detail within chapter 2 of the draft CCP under development for the refuge.

Rare Plant Species and Exemplary Natural Communities

John Heinz NWR protects the last significant remnant of freshwater tidal marsh within the State of Pennsylvania. Several of the natural communities within the freshwater tidal marsh are ranked as S1 - critically imperiled within the State (typically 5 or fewer occurrences or very few remaining individuals or acres), or S3 - vulnerable in the State either because they are rare and uncommon, or found only in a restricted range, or because of other factors making them vulnerable to extirpation (typically 21 to 100 occurrences). The forested habitats of the refuge also contain communities of significant conservation status. Several coastal plain and floodplain forest communities identified on the refuge are ranked as S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable).

Many of the plant species associated with the freshwater tidal marsh are also unique to Pennsylvania. Pennsylvania DCNR notes that portions of the freshwater tidal marsh support several State rare species such as waterhemp ragweed (*Amaranthus cannabinus)*, field dodder (*Cuscuta pentagona)*, Walter's barnyard-grass (*Echinochloa walteri)*, an unnamed eupatorium (*Eupatorium rotundifolium*), forked rush (*Juncus dichotomus)*, and shrubby camphor-weed (*Pluchea odorata)* (VanDervort-Sneed personal communication 2010).

Wildlife

John Heinz NWR was established in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. The refuge is an important migratory stopover along the Atlantic Flyway. The diverse habitats support a variety of resident and migratory wildlife including 300 species of birds recorded since 1950, as well as many mammals, fish, amphibians, reptiles, insects, and plants. Refer to appendix A for the refuge's comprehensive list of species of conservation concern.

Birds

The refuge is a complex of critical habitats for birds in the highly urbanized landscape of greater Philadelphia. It has been designated as an Important Bird Area by the National Audubon Society. While most of the over 300 bird species identified at the refuge use it as a migratory stopover, more than 80 species have been recorded nesting on the refuge over the years. Several species are also State-listed threatened or endangered species or species of State or national management concern.

State endangered species such as the least bittern (*Ixobrychus exilis*) are known to breed at the refuge. Other Pennsylvania endangered species that have been observed at the site during migration, but are considered occasional or rare in abundance, include: yellow-crowned night-heron (*Nyctanassa violacea*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), king rail (*Rallus elegans*), short-eared owl (*Asio flammeus*) and loggerhead shrike (*Lanius ludovicianus*). The king rail historically nested at the site (prior to 2000). The piping plover (*Charadrius melodus*) listed as extirpated in Pennsylvania, is an occasional "accidental" occurrence during migration.

Bald eagles (*Haliaeetus leucocephalus*), a former federally listed species, have historically used the refuge for hunting and roosting. The first known bald eagle nest on the refuge was built in 2009 with the first two refuge eaglets successfully hatched in 2010. The adult pair returned to breed on the refuge in 2011.

The peregrine falcon (*Falco peregrinus*), another former federally listed species, is often observed from the refuge during its migration. A number of active peregrine nests now occur in the Philadelphia area with these birds also potentially increasing their use of refuge habitats (Cohen and Johnson 2004).

The State–listed, threatened species, upland sandpiper (*Bartramia longicauda*) and yellow-bellied flycatcher (*Empidonax flaviventris*), have been observed at the site, but are considered rare or occasional in abundance, observed primarily during the migratory season. Ospreys (Pandion haliaetus) are present during migration and are frequently observed throughout summer. Two osprey platforms have been added to the refuge in hopes to lure in nesting birds. State species of special concern that utilize the refuge are

the black-crowned night-heron (*Nycticorax nycticorax*) and northern harrier (*Circus cyaneus*). The black-crowned night-heron nested (52 nests reported) at the site prior to 1996 but are now considered transient. Northern harrier is observed less frequently at the site since grassland buffer habitat has disappeared due to habitat successional changes and development. The green-winged teal (Anas crecca) and marsh wren (*Cistothorus palustris*) are State rare that nest at the refuge. The pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), Wilson's snipe (*Gallinago delicata*), Swainson's thrush (*Catharus ustulatus*), prothonotary warbler (*Protonotaria citrea*) and summer tanager (*Piranga rubra*) are other State candidate-rare species that have been observed at the refuge as well (Cohen and Johnson 2004).

Mammals

John Heinz NWR is one of 44 Important Mammal Areas designated by the Pennsylvania Wildlife Federation. The designation was awarded noting the refuge as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat (*Oryzomys palustris*) in the State.

While no formal inventories have been conducted to date, numerous mammals are known to inhabit the refuge. Two nonnative species present include the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*). The gray squirrel (*Sciurus carolinensis*) is a common species found throughout upland habitats of the refuge, where it plays an important role in seed dispersal. Other common open space species supported by the refuge include the northern short-tailed shrew (*Blarina brevicauda*); the meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*) and several other rodent species, as well as raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), eastern cottontail rabbit (*Sylvilagus floridanus*) (PNHP 2008). Woodchuck (*Marmota monax*) and red fox (*Vulpes vulpes*) have been observed damaging the impoundment levee system as they attempt to burrow dens into dikes (Stolz, personal communication 2008). Feral domestic house cats pose a serious invasive mammalian predatory threat to all small native wildlife (birds, mammals, reptiles and amphibians) and need to be removed from the refuge when found.

Muskrat (*Ondatra zibethica*), long-tailed weasel (*Mustela frenata*), and least shrew (*Cryptotis parva*) are fairly common. Recent records also indicate beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) occur occasionally on the refuge. It is also likely that the refuge sees occasional use by coyotes, which have been documented on adjacent property at Philadelphia International Airport (Stolz, personal communication 2008). Bats are frequently observed on the refuge during warmer seasons and a formal species diversity and population survey would provide valuable information with recent declines of these important creatures due to white nose syndrome and habitat disturbances.

White-tailed deer (*Odocoileus virginianus*) are another mammal species supported by the refuge. Refuge staff has conducted on-the-ground deer population surveys for several years. These surveys have been conducted by counting deer driven systematically from various portions of the refuge. Although this method does have potential for error, such as omitting or double counting individuals (McCullough 2001), the results of these surveys consistently record population numbers in the range of 200 to 240 deer per square mile. Given that the refuge currently covers approximately 1,000 acres (about 1.5 square miles) of marsh and upland ecosystems, the refuge's current density ranges between 133 to 160 deer per square mile. Density levels at which a deer population is considered "ecologically sustainable" varies depending on the habitat involved and the variables studied. A separate deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994). Additional research has shown a population density not exceeding 20 deer per square mile is optimal for forest regeneration (Rooney 2001). The Service and the U.S. Department of Agriculture Division of Wildlife Services have drafted a deer management plan. Once finalized, this plan will provide detailed guidance on management of the resident deer population based on observable impacts to (and recovery of) the refuge's habitats, not on a particular density target (D'Angelo personal communication 2009).

Reptiles and Amphibians

While no formal inventories have been conducted, there are eight turtle, three snake, and eight frog and toad species known to inhabit the refuge. Common frog and toad species such as bull frog (*Rana*

catesbeiana), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), pickerel frog (*Rana palustris*), spring peeper (*Pseudacris crucifer*), American toad (*Bufo americanus*), and Fowler's toad (*Bufo woodhousei fowleri*) have all been heard calling during their respective breeding seasons. The State-endangered species, coastal plain leopard frog (*Rana sphenocephala* or *Rana utricularia*), is known to inhabit and breed at the refuge in shallow open water and isolated vernal pools.

The northern water snake (*Nerodia sipedon sipedon*), eastern garter snake (*Thamnophis sirtalis sirtalis*), and northern brown snake (*Storeria dekayi dekayi*) are all found at the refuge. These common species are generally associated with forested habitats and nearby open water.

Numerous turtles are known to use the open water habitats of the impoundment, freshwater tidal marsh, and Darby Creek. Species common to these habitats at the refuge include common musk turtle (*Sternothaerus odoratus*), eastern box turtle (*Terrapene c. carolina*), painted turtle (*Chrysemys picta x marginata*), common map turtle (*Graptemys geographica*), eastern spiny softshell turtle (*Apalone spinifera*) and the nonnative, invasive red-eared slider (*Trachemys scripta elegans*) (USFWS 2009b). The refuge also supports several rare species of turtle such as the formerly State endangered (now considered potenially extirpated in Pennsylvania) eastern mud turtle (*Kinosternon subrubrum*), the northern diamond-backed terrapin (*Malaclemys terrapin*), and a significant population of the State-threatened red-bellied turtle (*Pseudemys rubriventris*). These rare species are more commonly associated with the freshwater tidal marsh and open waters of Darby Creek. However, some of these have been known to move to and from the 145-acre impoundment as well.

Historically, the refuge and surrounding lands supported additional species of reptiles. The wood turtle (*Clemmys insculpta*) has been identified on lands adjacent to the refuge (Sunoco tank farms). Although considered extirpated in Pennsylvania, a gravid female eastern mud turtle was documented in nearby, from a road kill, in Bucks County in 2008. State surveys for the species were then conducted by East Stroudsburg State University including the refuge and two small populations of eastern mud turtles were found in nearby Bucks County with continued hopes that they may still or in the future be rediscovered on the refuge (Stolz, personal communication 2010)

A number of other reptile and amphibian species native to southeast Pennsylvania could potentially be discovered on the refuge where suitable habitat occurs within their native ranges. Such species include black rat snake, black racer, eastern ribbon snake, eastern Milk snake, five-lined skink, eastern fence swift, gray tree frog, eastern chorus frog, red-backed salamander, long-tailed salamander, dusky salamander, red salamander, and spotted salamander. Numerous nocturnal anuran vocalization surveys have been conducted as well as turtle mark-recapture studies with Drexel University and University of Philadelphia. At this time, a herpetological survey that includes terrestrial habitat and breeding areas to establish baseline data is necessary for long-term management of the refuge's reptile and amphibian fauna. Dr. Jim Spotila of Drexel University has indicated turtle nest predation on the refuge may be as high as 98 percent (most likely from raccoon, red fox, skunk and opossum) (Stolz personal communication 2009).

Fish

The refuge provides not only unique terrestrial habitat, but aquatic habitat as well. Freshwater tidal marshes, like Tinicum Marsh, are used by many aquatic species for spawning, year-round food and shelter, and as a nursery and rearing habitat (Mitch and Gosselink 1993). Freshwater tidal marshes are also a mixing zone for various groups of fish typically associated with certain habitats. Freshwater species, such as sunfish (*Lepomis spp.*) and catfish (*Ictalurus spp.*), estuarine species including killifishes (*Fundulus diaphanus*) and mummichogs (*Fundulus heteroclitus*), anadromous species including shad (*Dorosoma spp.*) and herrings (*Alosa spp.*), and the catadromous American eel (*Anguilla rostrata*) can all be found within Tinicum Marsh. A list of fish species observed on the refuge and in adjacent similar marsh areas around the Philadelphia International Airport can be found in table C.2 (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010).

Darby Creek and the open water areas of the freshwater tidal marsh may also provide suitable habitat for the federally and State-listed endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic

sturgeon (*Acipenser oxyrhynchus*) (PNHP 2008; PGC and PFBC 2005). While this species has not been confirmed within the refuge itself, it is known to occur in the nearby Delaware River, thus making protection of suitable habitat within the refuge a priority.

Invertebrates

While no invertebrate inventories have been conducted to date within the refuge or along Darby Creek, recent findings along the nearby Delaware River indicate that invertebrate conservation may be an added focus along Darby Creek. A series of mussel beds was identified in the stretch of river connected to the confluence with Darby Creek. Seven mussel species were identified within the Delaware River, including two species which were thought to be extirpated from Pennsylvania and New Jersey: the alewife floater (*Anodonta implicate*), and the tidewater mucket (*Leptodea ochracea*). Other species included two species considered critically imperiled: the pond mussel (*Ligumia nasuta*), and yellow lampmussel (*Lampsilis cariosa*), two species considered vulnerable: the creeper (Strophitus undulates) and the eastern floater (*Pyganodon cataracta*) and one common species the eastern elliptio (*Elliptio complana*).

Table C.2. Fish Species and Utilization of Lower Darby Creek and Freshwater Tidal Marsh Habitats (Herpetological Associates 2001; NOAA 2000; Sweka and Mohler 2010)

Species		Habitat Use			
Scientific Name	**Common Name**	**Spawning Area**	**Nursery Grounds**	**Shelter**	**Adult Forage**
Freshwater Species					
Ameirus catus	White catfish	~	~	~	~
Ameirus nebulosus	Brown bullhead	~	~	~	~
Catostomus commersoni	White sucker	~	~		~
Cyprinus carpio	Common carp	~	~		~
Etheostoma olmstedi	Tessellated darter	~	~	~	~
Gambusia holbrooki	Eastern mosquitofish	~	~	~	~
Hybognathus regius	Eastern silvery minnow	~	~	~	~
Ictalurus punctatus	Channel catfish	~	~	~	~
Lepomis cyanellus	Green sunfish	~	~		~
Lepomis gibbosus	Pumpkinseed	~	~		~
Lepomis macrochirus	Bluegill	~	~		~
Micropterus salmoides	Largemouth bass	~	~		~
Notemigonus crysoleucas	Golden shiner	~	~	~	~
Notropis hudsonius	Spottail shiner	~	~	~	~
Perca flavescens	Yellow perch	~	~		~
Pimephales notatus	Bluntnose minnow	~	~		~
Poxomis nigromaculatus	Black crappie	~	~		~
Umbra pygmaea	Eastern mudminnow	~	~	~	~
Estuarine-Marine Species					
Brevoortia tyrannus	Atlantic menhaden				~
Fundulus diaphanus	Banded killifish	~	~	~	~
Fundulus heteroclitus	Mummichog	~	~	~	~
Leiostomus xanthurus	Spot	~	~		~
Menedia beryllina	Inland silversides	~	~	~	~

Species		Habitat Use			
Scientific Name	**Common Name**	**Spawning Area**	**Nursery Grounds**	**Shelter**	**Adult Forage**
Estuarine-Marine Species (cont.)					
Micropogonias undulatus	Atlantic croaker	~	~		
Trinectes maculatus	Hogchocker		~	~	~
Anadramous Species					
Alosa aestivalis	Blueback herring	~	~	~	
Alosa mediocris	Hickory shad	~	~	~	
Alosa pseudoherangus	Alewife	~	~	~	
Dorosoma cepedianum	Gizzard shad	~	~		~
Morone saxatilis	Striped bass		~		~
Morone americana	White perch	~	~		~
Mugil cephalus	Striped mullet		~		
Catadromous Species					
Anguilla rostrata	American eel		~	~	~

Nonnative, Invasive Plants

Federal management of nonnative, invasive plant species is guided by the planning efforts outlined in Executive Order 13112 signed into law on February 3, 1999. The Executive Order requires that a Council of Departments dealing with invasive species be created and develop a National Invasive Species Management Plan every 2 years. The first such plan was released in January 2001, providing the basis for Federal management of invasive species. The Executive Order defines an invasive species as a species that is a) nonnative to the ecosystem under consideration and b) whose introduction causes (or is likely to cause) economic or environmental harm to human health.

The planning and inventory work completed as part of the Restoration Management Plan for the Lower Darby Creek in 2005 identified invasive plant species as one of the top impacts to refuge plant communities and a management priority for the coming years. The inventory identified nonnative invasive species present throughout John Heinz NWR and ranked their management priority based on (a) the extent to which the species is established on the refuge, (b) the potential ecological impact of the species on refuge plant communities, and (c) the degree of management difficulty involved in controlling the species. The results of this inventory and prioritization are included in table C.3 (Salas et al. 2006). Management prescriptions for identified invasive species are included in appendix B.

Recent Research and Monitoring Projects

Impoundment Management Study

From 2005 to 2007, John Heinz NWR participated in the Service's Region 3 and Region 5 Impoundment Management Study. The goal of this study was to determine the effects of timed water level management related to use by waterfowl, shorebirds, and wading birds. This study found that waterfowl were observed throughout the year, while shorebirds and waders were observed primarily between April and October. Shorebird frequencies peaked around the spring and fall migration periods, and wader frequencies peaked in mid-summer. Shorebird species composition was dominated by peeps (semipalmated sandpiper, unidentified peep, least sandpiper) in both the spring (approximately 80 percent of all shorebirds observed) and fall (approximately 90 percent). Waterfowl species most abundant during the spring migration period were ducks. Four species (northern shoveler, green-winged teal, mallard, northern pintail) accounted for less than 70 percent of the waterfowl during that period. Species composition was similar during the fall, with mallards and gadwall accounting for 47 percent of the waterfowl seen. Canada geese became the second-most abundant species during this same period. Great egrets and great blue herons dominated the waders observed during the breeding season (Green et al. 2008).

White-tailed Deer Research and Management Plan

In 2008, the Service contracted with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (APHIS-WS) to assist in studying the impacts of the deer population on plant communities within the refuge. Based on their analysis, they reported that the white-tailed deer population at John Heinz NWR was believed to surpass the carrying capacity of available habitat, causing severe ecological damage that negatively affected all other native species of plants and animals.

Table C.3. Invasive Species Identified at John Heinz National Wildlife Refuge and Their Associated Management Ranking.

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Japanese knotweed *Polyganum cuspidatum*	**1**	●	○	●	**High** Prevent New Introductions and Eradicate Localized Occurrences
Porcelainberry *Ampelopsis brevipedunculata*	**2**	◎	○	◎	
Multiflora rose *Rosa multiflora*	**3**	◎	○	◎	
Reed canarygrass *Phalaris arundinacea*	**4**	◎	○	◎	
European privet *Ligustrum arvense*	**5**	○	○	○	
Common Reed *Phragmites australis*	**6**	●	◎	●	
Purple Loosestrife *Lythrum salicaria*	**7**	●	◎	●	
Mile-a-minute weed *Polyganum perfoliatum*	**8**	●	◎	○	**Medium** Eradicate Localized Occurrences and Reduce Size of Existing Populations
Japanese honeysuckle *Lonicera japonica*	**9**	●	◎	●	
Norway maple *Acer platanoides*	**10**	◎	◎	●	
Oriental bittersweet *Celastrus orbiculatus*	**11**	◎	◎	◎	
Tree-of-heaven *Ailanthus altissema*	**12**	◎	◎	◎	
Japanese hops *Humulus japonica*	**13**	◎	◎	◎	
Bush honeysuckle *Lonicera maackii*	**14**	◎	◎	◎	**Low** Focus Primarily on Areas of Conservation Significance
Japanese stiltgrass *Microstegium vimeneum*	**15**	●	●	◎	
Garlic mustard *Alliaria petiolata*	**16**	●	●	●	

● = High

◎ = Medium

○ = Low

Chapter 3.
Resources of Concern

3.1 Introduction

Resources of concern are the focal point of the HMP. The HMP policy (620 FW 1) defines "resources of concern" as: "All plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), [Refuge] System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or state threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts."

The Service is entrusted by Congress to conserve and protect migratory birds, federally listed threatened and endangered species, interjurisdictional fish, and certain marine mammals (trust species). Each refuge also has its own specified purpose(s) for which it was created, which guide its management goals and objectives. Within these purposes, refuges support other elements of biological diversity such as locally rare plants, invertebrate and vertebrate species, natural communities, and the ecological processes that contribute to the biological integrity and environmental health at the refuge, ecosystem, and broader scales (USFWS 1999, 2003).

The first step in developing a habitat management strategy is to define a refuge's resources of concern in light of the multiple mandates, policies, purposes, and regional and national plans applicable to the particular refuge. The resources of concern need to be identified and prioritized in order to best focus the management objectives of the refuge. The following details the resources considered in development of John Heinz NWR resources of concern.

3.2 Potential Resources of Concern

There are many national, regional, State, and local plans and reports that have identified conservation concerns for areas in and around John Heinz NWR. The myriad of species and management recommendations provided in each plan was compiled into a list of potential resources of concern that cross referenced each plan and priority focus with a particular species noted of conservation significance. The final resources of concern were developed based on the priority species of greatest significance that were most likely to be impacted by management, and existing and future habitat at the refuge.

Refuge Purpose
John Heinz NWR was created in 1972 for three primary purposes:

1. "Preserving, restoring, and developing the natural area known as Tinicum Marsh....a wildlife interpretative center for the purpose of promoting environmental education, and to afford visitors an opportunity for the study of wildlife in its natural habitat." (86 Stat. 891, dated June 30, 1972).

2. To be of "particular value in carrying out the national migratory bird management program." 16 U.S.C. § 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife).

3. "Development, advancement, management, conservation, and protection of fish and wildlife resources... (16 U.S.C. § 742f(a)(4))...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services…(16 U.S.C. § 742f(b)(1)) (Fish and Wildlife Act of 1956).

The Service is mandated to manage John Heinz NWR to fulfill the purpose for which it was created. Thus, the resources of concern identified for the refuge must protect Tinicum Marsh, support the migratory bird management program, or protect fish and wildlife resources.

Service Trust Resources

While the refuge purpose is the foremost determinant of a particular refuge's management, managing trust resources is also a priority of refuges. Trust resources include:

Migratory Birds

A list of all species of migratory birds protected by the Migratory Bird Treaty Act (16 U.S.C. 703–711) and subject to the regulations on migratory birds are contained in subchapter B of title 50 CFR §10.13. The Service's Migratory Bird Program also maintains subsets of that list that provide priorities at the national, regional, and ecoregional (bird conservation region) scales. The primary sources of information that the refuge used to identify potential migratory birds species of concern included the following:

- Bird Conservation Region (BCR) 30, PIF Physiographic Area 44
- Continental and regional plans for landbirds, waterfowl, shorebirds, and marshbirds
- Rocky Mountain Bird Observatory Species Assessment Database
- Service Birds of Conservation Concern (USFWS 2008b)
- Status and trend information for refuge bird surveys and regional assessments

Interjurisdictional Fish

Interjusridictional fish include "populations that two or more states, nations, or Native American Tribal governments manage because of their geographic distribution or migratory patterns (710 FW 1.5H)." Examples include anadromous species of salmon and free-roaming species endemic to large river systems, such as paddlefish and sturgeon (Director's Order No. 132, 6[c]). The primary sources of information that the refuge used to identify potential aquatic habitats and fish species of concern included the following:

- Service Regional Fisheries Office List of Priority Fisheries
- National Fish Habitat Action Plan (Sportfishing and Boating Partnership Council 2006)

Wetlands

Wetlands provide habitat for approximately one-third of federally listed species and for migratory waterfowl. The Emergency Wetlands Resources Act of 1986 (Pub. L. 99–645 (100 Stat. 3582), approved November 10, 1986, authorizes the purchase of wetlands from Land and Water Conservation Fund. It requires the Secretary to establish a National Wetlands Priority Conservation Plan, which requires the states to include wetlands in their Comprehensive Outdoor Recreation Plans.

The refuge's wetlands are unique to Pennsylvania as they protect the last one-third square mile of freshwater tidal marsh remaining in the State (PNHP 2008).

Threatened and Endangered Species

The Endangered Species Act (16 U.S.C. 1531–1544, December 28, 1973, as amended 1976 to 1982, 1984 and 1988) states in Sec. 8A.(a) that:

> *"The Secretary of the Interior (hereinafter in this section referred to as the "Secretary") is designated as the Management Authority and the Scientific Authority for purposes of the Convention and the respective functions of each such Authority shall be carried out through the United States Fish and Wildlife Service."*

The act also requires all Federal departments and agencies to conserve endangered species and threatened species and that they shall utilize their authorities in furtherance of the purposes of this act.

To identify federally listed, threatened or endangered species of relevance to John Heinz NWR, we reviewed the following:

- The Federal List of Threatened and Endangered Species
- Recovery Plans for federally listed species in our region

3.3 Biological Integrity, Diversity, and Environmental Health

The Refuge Improvement Act states that, in administering the Refuge System, the Service shall "ensure that the biological integrity, diversity, and environmental health of the System are maintained…" (601 FW 3; also known as the "Integrity Policy"). The Service (2003) defines these terms as follows:

Biological Diversity	The variety of life and its processes, including the variety of living organisms, the genetic differences between 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 the natural biological processes that shape genomes, organisms, and communities.
Environmental Health	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.

Where possible, refuge management restores or mimics natural ecosystem processes or functions that support fish and wildlife and thereby maintain biological diversity, integrity, and environmental health (BIDEH). Given the continually changing environmental conditions and landscape patterns of the past and present (e.g., rapid development, climate change, sea level rise), relying on natural processes is not always feasible, nor always the best management strategy, for conserving wildlife resources. Uncertainty about the future requires that the refuge manage within a natural range of variability rather than emulating an arbitrary point in time. Rather than trying to maintain stability, we will maintain mechanisms that allow species, their genetic strains, and the natural communities they rely upon to evolve with changing conditions.

Meretsky et al. (2006) stated that the Integrity Policy directs refuges to assess their importance across landscape scales and "forge solutions to problems arising outside refuge boundaries." Regional land use problems include habitat fragmentation and lack of connectivity, high levels of contaminants, and incompatible development or recreational activities.

To manage the natural communities and the habitats they support within the natural range of variability, a review of maps, reports, and other resources was completed to assess historic, current, and future potential for the refuge. To assess the historical condition, site capability, current regional landscape conditions, biological diversity, and environmental health data pertinent to the refuge, the following resources were used:

- Maps and associated data on site history and capabilities:
  - Kuchler's (1964) potential natural vegetation
  - 1757 Map of Philadelphia and Parts Adjacent
  - 1850 Map of Philadelphia and Baltimore Railroad routes adjacent to current refuge lands
  - 1898 Topographic Map of Philadelphia and Delaware Counties
  - 1968 Vegetation Survey Map from *Two Studies of Tinicum Marsh* (McCormick et al. 1970)
- Maps of existing landscape conditions displaying watershed boundaries, habitat connectivity, as well as land use conditions and trends surrounding the refuge
- Maps of existing natural communities and invasive species distributions within the refuge
- Soil Survey of Philadelphia and Delaware Counties
- Global and regional trends in climate change and water quality
- Pennsylvania's Natural Heritage Program information on rare, declining, threatened, or endangered species, as well as unique natural communities
- Pennsylvania's Wildlife Action Plan (PGC and PFBC 2005)
- Status and trend information for potential species of concern as documented in regional and State assessments and reports.

Based on a review of the existing and historical data listed above, a list of habitats that contain naturally occurring elements of BIDEH was developed in order to determine those habitats that contain the most ecological and biological integrity (see table C.4).

Table C.4. Summary of Habitats that Represent Existing BIDEH for John Heinz National Wildlife Refuge.

Habitat Type (Plant communities that represent existing BIDEH)	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
Freshwater Tidal Marsh	Mix of several native herbaceous species dominated plant communities: *Atlantic Coast Wild Rice Tidal Marsh; Mixed Forbs High Marsh; Nuphar lutea Tidal Marsh; Peltandra virginica - Pontederia cordata Tidal Marsh; Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Marsh* *Potential Conservation Species: supports a variety of fish, landbirds, waterbirds, waterfowl, and shorebirds.*	Tidal hydrology in combination with marsh surface elevation. Natural accretion of alluvial sediments across marsh surface. Developmentof natural channel morphology within marsh plain.	Altered hydrology; water quality degredation and contamination; invasive species; sea level rise.
Coastal Plain Forest	Pin oak *(Quercus palustris)*- Swamp white oak *(Quercus bicolor)* - sweetgum *(Liquidambar styraciflua)* Mixed Hardwood Forest. General characteristics include: Oaks occupy at least 25 percent of canopy. Shrub and vine species are variable and may include dogwoods (*Cornus spp.),* spicebush *(Lindera benzoin),* virginia creeper *(Parthenocissus quinquefolia),* and elderberry *(Sambucus canadensis)*. Herbaceous species vary but generally include a mix of sedges (*Carex* spp.), wild rye (*Elymus* spp.), bittercress (*Cardamine* spp.), mayapple (*Podophyllum* sp.), and other species. *Potential Conservation Species: American woodcock, northern oriole, wood thrush, coastal plain leopard frog.*	Seasonally wet or saturated silt and clay soils; regeneration of dominant canopy species through a combination of period fire of canopy openings.	Excessive deer browse prevent forest regeneration, reducing species diversity, and loss of native shrub layer; Invasive species outcompete remaining native species.

Habitat Type (Plant communities that represent existing BIDEH)	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
Floodplain Forest	Mix of multiple hardwood forest plant communities. General characteristics include: red and silver maple, and boxelder (*Acer rubrum, saccharinum* and *negundo*), green ash (*Fraxinus pensylvanica*), and willow (*Salix nigra*) canopy. Shrub species may include spicebush *(Lindera benzoin),* winterberry *(Ilex verticillata),* and elderberry *(Sambucus canadensis)*. Herbaceous species vary but generally include a mix of sedges (*Carex* spp.), wild rye (*Elymus* spp.), touch-me-not (*Impatiens* spp.), manna-grass (*Glyceria* sp.), and other species.	Seasonally flooded or saturated silt and clay soils; Regeneration of dominant canopy species through flood-induced canopy openings.	Excessive deer browse prevent forest regeneration, reducing species diversity, and loss of native shrub layer; Invasive species outcompete remaining native species.
	Potential Conservation Species: American woodcock, northern oriole, wood thrush, coastal plain leopard frog.		
Darby Creek	Open, tidal-influenced, flowing water; spawning habitat for estuarine and anadromous; provides fish passage to spawning areas in upper reaches of nontidal reaches of Darby Creek; provides forage for a variety of mammals, reptiles, amphibians, and birds.	Perennial tidal flows and periodic flooding. Open water with periodic mudflats.	Environmental contaminants; Degraded water quality; upstream migration barriers; sea level rise
	Potential Conservation Species: alewife, blueback herring, American eel		

Habitat Type (Plant communities that represent existing BIDEH)	Populations and Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors and Threats
Wet Meadows and Grasslands	Mix of native warm and cool season grasses and forbs including little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), wild rye (*Elymus* spp.), asters (*Symphyotrichum* spp.), goldenrods *(Soldago* spp.), bergamot (*Monarda fistulosum*), and other species.	Naturally maintained by periodic fire; contain seasonal saturation or flooding.	Loss of species and structure due to natural succession; invasive species outcompete native grass and forb species; patch size typically too small to provide nesting opportunities for grassland birds; requires intensive and regular maintenance
	Potential Conservation Species: American woodcock, sedge wren, short-eared owl		

3.4 Priority Resources of Concern

The potential resources of concern table (appendix C) contain a large number of species with a broad array of habitat needs. Prioritizing those species and their habitats is necessary in order to determine where to focus refuge management strategies. This process must consider to which species and habitats the refuge can make the greatest contribution in the context of the Refuge System, its surrounding landscape, and state, regional, and national priorities. To guide this process, the following concepts were considered:

- Achieving refuge purposes and managing for trust resources as well as biological diversity, integrity, and environmental health can be addressed through the habitat requirements of "focal species" or species that may represent guilds that are highly associated with important attributes or conditions within habitat types. The use of focal species is particularly valuable in addressing Service trust resources such as migratory birds.

- Indicator species can be used as a representative of biological integrity and environmental health (BIDEH). Indicator species presence, absence, abundance, or relative well-being in a given habitat niche serves as a marker of overall health of its required habitat type. For example, where the Delmarva Fox Squirrel served as an umbrella species for mixed hardwood forest habitats at Prime Hook NWR, the long-horned beetle (*Prionus laticollis*) can serve as an excellent indicator species of oak-dominated hardwood habitats as it is only found in healthy, mature oak stands with diverse mixed hardwood associates.

- Reference habitats and ecological communities can provide comparison data for habitat management where BIDEH parameters of refuge habitats have been degraded or severely impacted. Reference areas of freshwater tidal marsh (both on and off refuge) that contain intact BIDEH parameters can be utilized to compare both the degree of impacts to degraded marsh areas, as well as provide a measure of management success.

- BCR plans are increasing their effectiveness at ranking and prioritizing those migratory birds most in need of management of conservation focus. Although all species that make it to a ranked BCR priority list are in need of conservation attention, we selected focal species that ranked as High or Moderate in Continental Concern with a High to Moderate BCR Responsibility. See *www.abcbirds.org/nabci.com* for BCR rules used to rank birds.

- Focal species selected that were not birds (e.g. red-bellied turtle, American eel, Coastal Plain leopard frog) were identified as resources of concern due to concern over their population status range wide, because they are under review for inclusion on the Federal List of Endangered and Threatened Species, or because the Pennsylvania Wildlife Action Plan or Natural Heritage Program identified them as conservation priorities. Fish species were reviewed using regional and State conservation priorities and Federal trust species and trends.

- Habitat conditions on or around the refuge may limit its capability to support or manage for a potential species of concern. We evaluated the following site-specific factors:
  - Patch size requirements
  - Habitat connectivity
  - Incompatibility of surrounding land uses
  - Environmental conditions: soils, hydrology, disturbance patterns, contaminants, predation, invasive species
  - Specific life history needs

- The likelihood that a potential species of concern would have a positive reaction to management strategies.

- The ability to rely on natural processes to maintain habitat conditions within a natural range of variability suitable to the focal species.

- The ability to use adaptive management (flexibility and responsiveness of the refuge and the habitats) in the face of changing environmental conditions (e.g., climate change).

Table C.5 lists the priority resources of concern (and their primary focal species) for the refuge based on the information compiled and analyzed for this plan. Priority resources of concern are similar to "conservation targets" and the terms can be used interchangeably.

Table C.5. Priority Resources of Concern and Associated Focal Species for John Heinz National Wildlife Refuge.

Habitat	Species		Utilization By Species
Freshwater Tidal Marsh	Birds	American Bittern	B,M
		American Black Duck	B,M
		Black-bellied Plover	M
		Greater Yellowlegs	M
		King Rail	B,M
		Least Bittern	B,M
		Marsh Wren	B,M
		Sedge Wren	B,M
		Short-eared Owl	B,M
	Reptiles	Red-bellied Turtle	B,Y
Impoundment and Open Water	Birds	Black-crowned Night Heron	B,M
		Great Egret	B,M
		Least Tern	M
		Bald Eagle	M,W
	Reptiles	Red-bellied Turtle	B,Y
Coastal Plain and Floodplain Forests	Birds	American Woodcock	B,M
		Northern Oriole	B,M
		Prothonotary Warbler	M
		Wood Thrush	B,M
		Worm-eating Warbler	M
	Amphibian	Coastal Plain Leopard Frog	B,Y
Darby Creek	Birds	Bald Eagle	M,W
	Fish	Alewife	B, J
		Blueback Herring	B, J
		Striped Bass	B, J, Y
		American Eel	B, J

Utilization Codes:
B - Breeding
M - Migratory
W - Wintering
Y – Year-round
J - Juvenile or nursery habitat

3.5 Priority Habitat Types and Associated Focal Species

Refuge management most often focuses on restoring, managing, or maintaining habitats or certain habitat conditions to benefit a suite of focal species or a suite of plants and animals associated with a particular habitat. The priority habitats of John Heinz NWR were identified (table C.6) based on information compiled (e.g., site capability, historic condition, current vegetation, conservation needs of wildlife associates). As part of that process, we identified any limiting factors that affect the refuge's ability to maintain those habitats. Since all management activities cannot feasibly be undertaken at the same time, we have prioritized habitats (table C.7) based on the following ranking factors:

- Where management actions would provide the greatest conservation benefit to identified priority species
- Current habitat conditions and the urgency of needs for active management
- Landscape-level rankings for particular habitats

Although a habitat may be ranked as "moderate" priority, this should not be interpreted as meaning that the habitat type does not provide valuable habitat to a variety of species or contribute to the overall diversity, integrity, and health of the refuge. In some cases, habitats may not require active management by the refuge, or may represent an area where there is little management capability.

Table C.6. Focal Species, Associated Habitat Requirements, and Other Species Benefitting from Habitat Management at John Heinz National Wildlife Refuge.

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Bittern	Freshwater Tidal Marsh	Platform nests constructed of reeds and grasses near the water. Found in marshes and wetland borders along lakes, ponds, rivers, and streams (Stewart and Robbins 1958, Swift 1987).
Black-bellied Plover		Breeding in northern tundra. Nonbreeding habitat includes mudflats, beaches, wet savanna, shores of ponds and lakes, wet meadows, flooded fields (Stiles and Skutch 1989). Feeds on insects and crustaceans (Terres 1980).
Greater Yellowlegs		Nonbreeding habitat includes marshes, ponds, lakes, stream margins and sand and gravel bars, lagoons, and coastal mudflats (AOU 1983, Stiles and Skutch 1989). Nests in muskeg country or at other wetlands near water.
King Rail		Nest is an elevated platform, often with a canopy and ramp, attached to plants in shallow water or waterside vegetation. Freshwater marshes, upland-wetland marsh edges (Harrison 1978, Meanley 1969).
Least Bittern		Nest is placed near open water in dense vegetation. Freshwater marshes with dense, grass-like vegetation (Palmer 1962, Kushlan 1973, Aniskowicz 1981, Weller 1961).
Marsh Wren		Nests in marsh vegetation. Found in freshwater marshes in cattails, bulrush, and reeds (AOU 1983).
Short-eared Owl		Nests on ground, generally in slight depression, often beside or beneath a bush or clump of grass. Many nests are near water but generally are on dry sites. Hunts in meadows, marshes and open lands (Bent 1938, Clark 1975, Terres 1980).
Sedge Wren		Nesting takes place among dense, tall growths of sedges and grasses in wet meadows/marshes. Breeding habitat includes marshes; moist meadows with scattered low bushes; upland margins of ponds and marshes (AOU 1983, Harrison 1978).
Red-bellied Turtle		Nests dug in soft soil in open areas near water, often in disturbed sites. Resides in relatively large deep bodies of water: creeks, rivers, marshes, ponds (USFWS 1981, DeGraaf and Rudis 1983, Ernst and Barbour 1972).

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Black Duck	Impoundment and Open Water	Nest sites are very diverse; favors wooded swamps and marshes, shallow margins of lakes, streams, bays, mud flats, and open waters (Frazer et al. 1990a and 1990b, Merendino and Ankney 1994).
Bald Eagle		Nest is usually in mature trees near water. Feeds near water, e.g., lakes, reservoirs, large ponds, freshwater marshes, shorelines (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990).
Black-crowned Night Heron		Marshes, swamps, wooded streams, shores of lakes, ponds, lagoons; freshwater situations. Nests in roosts with other heron species (AOU 1983).
Great Egret		Nests are found in adjacent trees or shrubby growth, preferably on islands. Usually in colonies with other heron species. Feeds in shallow rivers, streams, ponds, lakes, marshes (Spendelow and Patton 1988).
Least Tern		Beaches, bays, estuaries, lagoons, lakes, and rivers. Rests on sandy beaches, mudflats, and dikes (AOU 1983, Stiles and Skutch 1989).
Semipalmated Sandpiper		Breeds on grassy and shrubby tundra. Nonbreeding habitat includes mudflats, sandy beaches, shores of lakes and ponds, and wet meadows (AOU 1983). In spring at Delaware Bay, consumes large numbers of horseshoe crab eggs (Castro and Myers 1993, Botton et al. 1994).
Spotted Sandpiper		Nests near freshwater in both open and wooded areas, less frequently in open grassy areas away from water; on ground in growing herbage or low shrubby growth, or against log or plant tuft (Harrison 1978). In Minnesota, successful breeders usually returned to same area to breed the next year (Reed and Oring 1993).

Focal Species	Habitat Type	Habitat - Vegetation Structure
American Woodcock	Coastal Plain and Floodplain Forests	Nests in early and mid successional forests. In Virginia, it has been known to nest in mid-aged, open growth, mixed pine-hardwood forests on lowland flood plains (Roboski and Causey 1981). Nonbreeding habitat includes upper reaches of estuaries and occasionally coastal meadows (del Hoyo et al. 1996)
Northern Oriole		Nests near the outer edge of the tree canopy. Found in open woodland, deciduous forest edge, riparian woodland, partly open situations with scattered trees, shade trees (Stiles and Skutch 1989).
Prothonotary Warbler		Breeds in mature deciduous floodplain, river, and swamp forests; wet lowland forests. In migration, habitat includes dry woodland, scrub, thickets (Bushman and Therres 1988).
Wood Thrush	Coastal Plain and Floodplain Forests	Nests in bottomlands and other wet hardwood forests. Nests usually are placed in a crotch or are saddled on a branch of a shrub, sapling, or large tree (Bertin 1977, Roth 1987, Roth et al. 1996).
Worm-eating Warbler		Nests in well-drained oak forests, oak forests along river terraces, and drier islands of nontidal forested wetlands (Stasz 1996).
Coastal Plain Leopard Frog		Breeds in forested and mixed grassland vernal pools and shallow waters containing submerged plant stems or sticks. Rest of year spent in nearby moist vegetation (Ryan and Winne 2001).
American Eel	Darby Creek	Catadromous: lives in freshwater; spawns in ocean. Matures in freshwater and estuarine streams and rivers. Feeds on insects, worms, crayfish and other crustaceans, and small frogs and fishes (Haro and Krueger 1991, Feunteun et al. 2003).
Alewife		Marine populations spawn in quiet portions of rivers (fresh or brackish water) or in small streams. Juveniles leave freshwater and estuarine nursery areas generally in summer or fall (Fay et al. 1983).
Blueback Herring		Spawns spawns in shallow areas covered with vegetation within freshwater or brackish, tidally influenced portions of coastal rivers (Bozeman and Van Den Avyle 1989). Juveniles emigrate from freshwater in summer or fall (Fay et al. 1983).
Striped Bass		Uses rivers, tidally influenced fresh waters, and estuaries for spawning and nursery areas (Thomson et al. 1978). Young primarily consume zooplankton and other invertebrates; adults are predatory on fish and larger crustaceans (Hassler 1988).
American Woodcock	Wet Meadows and Grasslands	Nests in early and mid successional forests. In Virginia, it has been known to nest in mid-aged, open growth, mixed pine-hardwood forests on lowland flood plains (Roboski and Causey 1981). Nonbreeding habitat includes upper reaches of estuaries and occasionally coastal meadows (del Hoyo et al. 1996)
Northern Oriole		Nests near the outer edge of the tree canopy. Found in open woodland, deciduous forest edge, riparian woodland, partly open situations with scattered trees, shade trees (Stiles and Skutch 1989).
Coastal Plain Leopard Frog		Breeds in forested and mixed grassland vernal pools and shallow waters containing submerged plant stems or sticks. Rest of year spent in nearby moist vegetation (Ryan and Winne 2001).

Table C.7. Priority Habitats and Their Potential Limiting Factors at John Heinz National Wildlife Refuge.

Habitat Type	Reasons for Priority Ranking	Limiting Factors and Threats
Highest Priority Habitats		
Freshwater Tidal Marsh	Supports a globally rare and regionally endangered plant community (ranked S1/G3); supports Federal trust fish and wildlife species, State -listed endangered species as well as many other species labeled as high priority species in BCR 30 and State Wildlife Action Plan. Last intact example of unique remnant natural community in State of Pennsylvania. Supports wetlands, a Federal trust resource, and original purpose of the refuge.	Altered hydrology; water quality degradation and contamination; invasive species; sea level rise.
Coastal Plain Forest	Supports a globally rare and regionally endangered plant community (ranked S1/G3); Important habitat for species labeled as priority species in BCR 30. Supports wetlands, a Federal trust resource, and State-listed endangered species.	Excessive deer browse; invasive species;
Floodplain Forest	Important habitat for species labeled as priority species in BCR 30 and unique community (ranked S1/G3). Supports wetlands, a Federal trust resource, and State-listed endangered species.	Excessive deer browse; invasive species;
Impoundment/Open Water	Important habitat for species labeled as priority species in BCR 30 and as a foraging stopover along Atlantic flyway. Supports wetlands, a Federal trust resource, and original purpose of the refuge.	Requires intensive management and maintenance for optimal ecological benefits; invasive species; inadequate water control structure for water level manipulation
Medium Priority Habitats		
Darby Creek	Supports federally and State-listed endangered species as well as trust species. Requires little or no on-the-ground management at the refuge, but provides opportunities for protection and enhancement work with regional and watershed-based partnerships.	Degraded water quality and environmental contamination; upstream migration barriers; sea level rise
Grasslands	Isolated grassland habitat restorations provide habitat diversity and foraging habitat for landbird species, as well as provides additional habitat for State-listed amphibian and reptile species.	Succession; invasive species; requires regular maintenance

3.6 Conflicting Habitat Needs

Given the diversity of goals, purposes, mandates, and conservation priorities for the Refuge System, it is not uncommon to have conflicting management priorities at a refuge. Balancing the types and proportion of habitats (and their management) requires special consideration and process for determining the best course of action. John Heinz NWR contains habitat and management decisions that require such consideration.

Impoundment Management

The 145-acre impoundment was constructed in the early to middle part of the 20th century, while some portions of the dike system could potentially date back to the mid-17th century. The impoundment, due to its size, location, and potential for waterfowl and shorebird habitat make it the focal point of many refuge visitors. As such, this is an area that the refuge has spent considerable time and resources to determine its best use and appropriate management.

Until the past several years (since 2005), the 145-acre impoundment has largely been managed as an open water habitat for migrating and breeding waterfowl. Some tidal fluctuation occurs when water control structures allow bi-lateral flows in and out of the impoundment. There have been occasional water level drawdowns historically for maintenance purposes throughout this period. However, this type of management had limitations in its ecological benefits. Fish kills resulted from algal blooms and depleted oxygen levels. Management for waterfowl generally excluded potential benefits for other waterbirds and shorebirds. Invasive species such as purple loosestrife (*Lythrum salicaria*) and the native spadderdock (*Nuphar lutea*), have spread aggressively under the proper conditions. Control of these invasive species has largely been addressed through chemical application.

Starting in 2005, as part of their Region 3 and Region 5 Impoundment Management Study, the Service has managed the water levels within the impoundment to benefit migratory waterfowl and shorebirds. This periodic drawing down of the impoundment and the presence of mud flats have provided some of the best stopover habitat for migrating shorebirds in Pennsylvania. The area also has served as a wintering ground for over twenty species of waterfowl during this time documenting from 1,100 to 1,400 individuals per day between September and March (Green et al. 2008). This controlled water level management has also somewhat increased the prevalence of purple loosestrife, but has also increased the richness and diversity of fast-growing annual species on exposed mudflats. The potential for loosestrife colonization has been controlled with chemical application.

The results of the Region 3 and Region 5 Impoundment Management Study point to an increased diversity of plant species present and bird species utilizing the impoundment as a result of well-timed and managed water levels. Conflicting issues arise when trying to manage this 145-acre area for optimal and simultaneous use by shorebirds, waterbirds, and waterfowl. Conflicts between species can be resolved in part through timed water level management according to the migration times of various bird groups. Maintaining water levels to depths suitable for multiple groups during a given period also help reduce management conflicts between species and bird groups. Through continuing and improving this adaptive management started in recent years, the refuge can balance the needs of different species of concern within this area.

One limitation to the effective management of the impoundment appears to be the existing water control structure for the impoundment. Originally installed for periodic maintenance drawdowns, the capacity and elevation of the structure make it difficult to lower water levels quickly and to a level ideal for shorebird utilization. A secondary limitation to water level management would be the growth of invasive plant species such as purple loosestrife. If it cannot be controlled annually by chemical applications, it may require a year or two with no drawdown so it can be sprayed and then the root systems kept flooded to help control spread.

Coastal Plain, Floodplain, and Highly Altered Forests

Many of the areas surrounding the 145-acre impoundment and the freshwater tidal marsh contain floodplain forest communities. These habitats support several of the identified focal species listed as resources of

concern–mainly northern oriole, prothonotary warbler, wood thrush, worm-eating warbler, and coastal plain leopard frog. While management of invasive species and the excessive deer browse will improve habitat conditions for all of these species of concern, conflicts arise when considering large-scale restoration projects that have potential to shift the community type present.

One area within the floodplain forest located in the southeastern portion of the refuge is dominated by an exotic gray poplar (*Populus* x *canescens*). This 19-acre portion of forest also contains other exotic species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine (*Polygonum perfoliatum*). Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Despite the prevalence of nonnative and invasive species, this area does provide habitat utilized by short-eared owls (a focal resource of concern, a Pennsylvania endangered species, and Service trust species) for nesting as well as various warbler species. Under its direction by Congress, the refuge is required to manage for biological integrity, diversity, and environmental health of the entire system. In most cases, this approach will benefit the trust resources of the Service. Occasionally, this directive conflicts with short-term wildlife needs.

Under these circumstances, the refuge ultimately will seek to restore this 19-acre area to a combination of native floodplain or coastal plain forests replicating nearby natural communities. While evaluation of site conditions (soils, hydrology, existing species coverage and utilization), is necessary before large-scale restoration is undertaken, several other considerations will likely be made to balance current habitat needs with long-term ecosystem goals. To the extent feasible, the refuge can undertake a phased approach to removal of the exotic gray poplar and associated invasive species during off-peak utilization periods (ie. winter, summer). Phased clearing and planting will limit the amount of immediate habitat lost, while working toward long-term restoration goals. A full evaluation of species utilization and restoration options will be necessary prior to starting restoration efforts.

Another location where floodplain forest restoration may conflict with habitat management is in the degraded floodplain forest located adjacent to State Road 420 and Darby Creek in the eastern portions of the refuge. Approximately 57 acres of floodplain forest dominated by silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), American elm (*Ulmus americana*), and eastern cottonwood (*Populus deltoides*) are located in this area. These communities were noted in the Lower Darby Restoration Management Plan (2005) as being severely degraded habitats due to excessive deer browse and invasive species, and the plan recommended a portion of this area be restored to freshwater tidal marsh. Historically, this area was freshwater tidal marsh until the early 1970s when the interchange for State Road 420 and Interstate 95 was constructed. The “Two Studies of Tinicum Marsh” documents the vegetation that was present in this area just prior to its alteration (McCormick et al. 1970).

Restoration of a portion of this area could pose a conflict between the management of species utilizing the floodplain forest habitat with those that would benefit from additional freshwater tidal marsh. When comparing habitat types, the number and types of species that would benefit from additional freshwater tidal marsh greatly outnumber those that utilize floodplain forests. Restoration of this site should utilize a combination of data from reference marsh vegetation, hydrology, and elevation, and channel morphology to restore a healthy and intact marsh. Some floodplain forest will likely need to remain due to existing pipeline right-of-ways and as sound and visual barriers. A preliminary estimate of the site indicates that up to 35 acres of freshwater tidal marsh could be restored in this area.

3.7 Adaptive Management

The priority resources of concern and their respective habitat attributes were used to develop specific habitat objectives. Refuge habitat management objectives must be achievable. Many factors, such as the lack of resources, existing habitat conditions, species response to habitat manipulations, climatic changes, and contaminants or invasive species, may reduce or eliminate the ability of the refuge to achieve objectives. Although these limiting factors were considered during the development of management objectives, conditions are likely to change over the next 15 years and beyond. The refuge will use adaptive management to respond to changing conditions that impair our ability to measure and achieve the habitat objectives. That will require the refuge to establish and maintain a monitoring program to ensure that changing conditions can be detected and responded to adequately and efficiently. The monitoring program will be developed in accordance with 701 FW 2 as a step-down plan.

Chapter 4.
Habitat Goals and Objectives

4.1 Background

The goals and objectives in this chapter were developed through collaboration among managers and biologists from John Heinz NWR and Region 5 of the Service. Prior to their development, John Heinz NWR staff and planners solicited input from a variety of government and nonprofit conservation organizations including the Service's Delaware Bay Ecological Services, NOAA Fisheries staff, USDA-APHIS Wildlife Services, Friends of the John Heinz Refuge, Partnership for the Delaware Estuary, and Delaware Riverkeeper Network. The goals written here are broad so that they may be incorporated into the CCP, which we began to draft in 2010. These goals and objectives will be reevaluated during the CCP process with additional public, State, university, and nongovernmental organization involvement. To develop habitat objectives, refuge staff conducted a comprehensive analysis of habitat requirements for each priority resource of concern (table C.5). To facilitate management, all priority resources of concern were grouped into habitat types, and further investigated reviewing limiting factors and threats to each habitat type (table C.6).

The Service requires habitat objectives be developed using the SMART criteria, specifically that objectives be Specific, Measurable, Achievable, Result-oriented, and Time-fixed. A rationale is provided for each habitat objective in order to summarize the scientific information, expert opinion, and professional judgment used to formulate each objective.

4.2 Habitat Goals and Objectives

GOAL 1 Protect, maintain, and restore where possible, the biological integrity, diversity, and environmental health of southeastern Pennsylvania coastal plain ecological communities that are unique to the refuge and sustain native plants and wildlife, including species of conservation concern.

Objective 1.1 Freshwater Tidal Marsh

Protect the existing 282 acres and restore or acquire an additional 173 acres of freshwater tidal marsh communities throughout the refuge within the next 15 years. Restored marsh would be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spadderdock (*Nuphar lutea*), pickerelweed (Pontederia cordata), and tick-seed sunflower (*Bidens spp.*). Restored marshes will reestablish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than 1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Rationale

The Pennsylvania Natural Heritage Program estimates that Philadelphia County at one time contained up to 10 to 20 square miles (6,400–12,800 acres) of freshwater tidal marsh. As it is today, historically, these wetlands provided an important breeding spot for many bird, mammal, fish, and insect species. It was also a critical stopover site for migratory waterfowl and shorebirds during their annual migrations. Today, John Heinz NWR protects the 1/3 square mile of freshwater tidal marsh that remains in this part of the State (PNHP 2008). Freshwater tidal marshes are some of the most biologically productive ecosystems in the world because they contain high plant diversity and support more bird use than any other wetland type (Mitch and Gosselink 1993). Coastal marshes (including freshwater tidal marshes) are among the highest priority habitats within BCR 30 due to pressures, rates of loss, or lack of information on present spatial distribution (USFWS 2008).

Although this remnant area of freshwater tidal marsh has been severely impacted over the years, it still supports a variety of species unique to the surrounding landscape and region. Nine of the 22 priority species of concern are primarily associated with this habitat type. At least another 8 of the 22 also utilize the marsh habitat. Vegetation structure, microhabitat conditions (elevations relative to mean high tide, presence of small channels across the marsh plain, occasional shrubs or small trees), and landscape context (surrounding land

use, size, and contiguousness) are more critical habitat components for species of concern, rather than specific plant species. However, the presence of high marsh, that is, portions of marsh that are at the upper extent of the high tide fluctuation and subject to shorter durations of inundation tend to support a greater variety of plant species and suitable nesting sites for species such as American bittern, least bittern, king rail, and marsh rice rat.

Due to recent reports on the effects of climate change, monitoring freshwater tidal and other coastal marshes is considered to be of high importance for their long-term conservation (USFWS 2008). Due to the unique landscape context of the refuge (within the Philadelphia metropolitan area, within a highly urbanized watershed, at the confluence of Darby Creek and the Delaware River, less than 1 mile upstream from the river's salt line) areas of freshwater tidal marsh are particularly vulnerable to changing sea levels. Alteration in the balance of marsh elevations, sediment accretion rates, sea levels, and salinity can potentially have major impacts on the existing marsh area. At this time, it is unclear to what extent sea levels will rise and how it might affect the refuge (UCS 2008). Due to this uncertainty, the refuge needs to create a marsh monitoring program to document and evaluate local trends in sedimentation rates, vegetative cover and species composition, as well as changes in percent of marsh surface as open water at low tide.

Two rare species listed as Pennsylvania-extirpated include the marsh rice rat and the eastern mud turtle. The eastern mud turtle has been identified at the refuge, but has not been confirmed by the Pennsylvania Natural Heritage Program. The marsh rice rat is believed to be extirpated from Pennsylvania (PNHP 2008). However, the freshwater tidal marsh at John Heinz NWR is the last potential habitat for this secretive small mammal. A series of presence or absence surveys throughout the marsh would provide data necessary to confirm the species presence within the State as well as its inclusion as a resource of concern for the refuge.

Chapter 2 documents the many impacts that have altered the extent and quality of freshwater tidal marsh existing today on the refuge. The Restoration Management Plan for Lower Darby Creek documented and mapped areas of historic tidal marsh that have been severely altered and their approximate date of impact (Salas et al. 2006). Some of these areas are suitable locations for restoration of tidal marsh habitat. Refuge staff has recently completed excavation work associated with restoration of tidal marsh to approximately 10 acres of land previously dominated by *Phragmites australis*.

Areas of freshwater tidal marsh less impacted by dredge and fill activities have been impacted by exotic, invasive species introductions. About 60 acres of tidal marsh are currently dominated by *Phragmites australis*. Many of these populations are smaller than 0.5 acres in size. Marsh vegetation and elevation surveys completed in 2005 documented the correlation between marsh plain elevations and species composition. *Phragmites* were found to generally inhabit the same zone as the highly diverse, Freshwater Tidal Mixed Forbs High Marsh ecological community component of the freshwater tidal marsh habitat. These areas of high marsh provide the most suitable nesting habitats for waterbirds associated with this habitat type.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire or restore up to 18 acres of coastal plain and floodplain forest, and manage the existing 34 acres of coastal plain forest and 261 acres of floodplain forest communities. These communities will provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by: maintaining a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005. Also, we will restore at least 7.7 acres of existing cool-season grass meadows to at least 50 percent cover by native shrub or early successional coastal plain forest species near the 10-acre marsh restoration site and an additional 0.6 acres within the grasslands restored as part of the oil spill wetland mitigation site.

Rationale

Coastal plain and floodplain forests provide important habitat for migrating passerine species. The Mid-Atlantic Coastal Plain in Pennsylvania was historically found only in a 1 to 5 mile-wide strip along the lower 50 miles

of the State's Delaware River frontage. The coastal plain and floodplain forest types covered a significant portion of Philadelphia, supporting a suite of species common to forests further south (PNHP 2008). Focal species of concern identified for this habitat (northern oriole, prothonotary warbler, wood thrush, and worm-eating warbler), other associated species such as the Swainson's warbler, cerulean warbler, Kentucky warbler, Acadian flycatcher, and yellow-throated vireo, are all primarily associated with forested wetlands and have high concern scores within the Mid-Atlantic Coastal Plain (PIF 1999).

The prothonotary warbler and other landbirds utilize mature deciduous floodplain, riverine, and swamp forests primarily for migratory stopover and foraging habitat at the refuge (DeGraaf et al. 1980, Christman 1984). Although this species will utilize the drier portion of the forested wetland gradient, flooded habitats have been shown elsewhere to be preferred and of higher quality (Petit and Petit 1996). Prothonotary warblers are secondary cavity nesters and a good indicator species for permanently flooded forested wetlands. Prothonotary warblers are widespread throughout the extensive swamps and riverine forested wetlands within the Mid-Atlantic region (PIF 1999). However, these habitats are largely unrepresented in this portion of Pennsylvania and along the Delaware River.

Regional conservation plans developed by Partners in Flight and the Atlantic Coast Joint Venture both emphasize the need for inventory and monitoring of nesting sites for forested wetland nesting species such as prothonary warbler, wood thrush, and worm-eating warbler. While these species generally utilize the forest of John Heinz NWR for migratory stopover habitat, other species associated primarily with other habitats sometimes utilize forested areas for forage and nest sites. For example, bald eagles (primarily associated with the impoundment and Darby Creek) require forested areas for nesting sites. The short-eared owl (associated primarily with freshwater tidal marsh) is also known to nest in portions of the coastal and floodplain forests of John Heinz NWR. To better guide forest management at John Heinz NWR, an inventory of existing nesting sites and conditions will provide information to prevent potential damage to nest sites during restoration activities and enhance opportunities in other areas not yet suitable.

Most invasive plants reduce the availability and quality of native habitats, and these can have major impacts on priority bird species (USFWS 2008). The Restoration Management Plan for Lower Darby Creek documented extensive invasive species populations within the coastal plain and floodplain forest ecosystems. Multiflora rose *(Rosa multiflora)*, garlic mustard *(Alliaria petiolata)*, Japanese honeysuckle *(Lonicera japonica)*, Japanese stiltgrass *(Microstegium vimeneum)*, and mile-a-minute vine *(Polygonum perfoliatum)* are the most common invasive plant species found throughout forested habitats (Salas et al. 2006). An abundance of invasive species can result in reduced biodiversity and poor habitat quality. Some herbaceous and vine species (including garlic mustard, Japanese honeysuckle, Japanese stiltgrass, and mile-a-minute vine) can dominate the forest understory and prevent or inhibit tree and shrub regeneration. Many floodplain forest restoration projects in and around the Delaware Valley have resulted in significant degradation or loss as a result of competition with exotic, invasive species (PNHP 2008). Oriental bittersweet, Japanese hops, Japanese knotweed, Chinese wisteria, and bush honeysuckle are also major invasive species in this habitat at John Heinz NWR. In a few cases, some native birds of concern, including northern saw-whet owls, have benefited from the cover provided by entanglements of invasive vines, such as Oriental bittersweet (*Celastrus orbiculatus*) and Japanese honeysuckle (*Lonicera japonica*).

One of the most critical habitat components within forested ecosystems is a well-developed forest structure including canopy trees, sub-canopy trees, understory shrubs, and a diverse ground cover. These structural components provide numerous feeding opportunities as well as protective cover to escape predation. Much of this natural structure has been severely altered within John Heinz NWR as a result of excessive deer browse, as documented in the Restoration Management Plan for Lower Darby Creek (Salas et al. 2006). The impacts of deer on forest ecosystems and their habitat components has been well documented, including their status, trend, and impact within Pennsylvania (Latham et al. 2005). Long-term preservation of nesting habitat, conservation of high-quality habitat, and restoration of degraded areas will not be feasible with continued impacts of an unsustainable deer population.

Reduction of plant species diversity and richness is a commonly noted effect of deer overpopulation. On long affected sites, the establishment and dominance of browse resilient species often is the result. Consequently, deer browse can have a measured effect on the balance between native and introduced species. Studies have repeatedly shown that deer avoid invasive species such as garlic mustard, Eurasian honeysuckle *(Lonicera spp.)*, Japanese barberry *(Berberis japonica)*, and tree-of-heaven *(Ailanthus altissema)* if other sources of food are available (Latham et al. 2005). Deer abundance also alters ecosystem structure by reducing densities of understory trees and eliminating shrubs. Research in central Pennsylvania indicated that the occurrence of canopy gaps increased by 41 percent on lands where deer control efforts were prohibited as compared to State lands where control efforts were undertaken (Pederson and Wallis 2004).

The adverse effects of excessive deer browse are not limited to plant species. It can also alter ecosystems to the extent that they become unfavorable habitats for other wildlife. Gray squirrel, white-footed mouse, and some amphibian species have been shown to decline in areas highly browsed by deer (Elliot 1978; Nixon and Hanson 1987). Subsequently, predators of these species, owls, hawks and other carnivores, decline (Flowerdew and Elwood 2001). At a site in Virginia, a reduction in forest species densities also leads to increased nest predation and lower bird abundance (Leimgruber et al. 1994). These results were reinforced by a study of songbird/deer population relationships in British Columbia that found a 93 percent decrease in bird species dependent on understory vegetation (Allombert et al. 2005).

Refuge biologists have been conducting deer population inventories for more than 5 years. These surveys involve counting deer that are collectively driven systematically from various portions of the refuge. Although this method does have potential for error, such as omitting or double counting individuals (McCullough 2001), the results of these surveys have consistently recorded population numbers in the range of 200 to 240 deer per square mile. By comparison, a deer and songbird population relationship study in northwestern Pennsylvania concluded that the threshold level for negative effects on songbird richness was between 20 and 38 deer per square mile (deCalesta 1994).

Refuge biologists have completed a draft Deer Management Plan in partnership with the U.S. Department of Agriculture's Division of Wildlife Services. This plan will inventory and evaluate the level of deer browse pressure on the refuge habitats and develop a population management plan based on measurable results from browse surveys and vegetation transects. This plan will guide deer management based on its actual on-the-ground impacts to refuge habitats, rather than attempting to achieve an arbitrary density measurement (e.g., deer per square mile or set number of individuals) (D'Angelo and Stolz, personal communication, 2008).

As part of the Deer Management Plan, fenced vegetation plots that exclude white-tailed deer will be incorporated into monitoring. These plots will be used to gauge the potential for natural forest regeneration when browsing by deer is suppressed. Fenced plots will be paired with nearby unfenced plots. Forest regeneration will be deemed within acceptable limits when the number and viability of individuals of desired plant species in unfenced plots is at least 50 percent of fenced plots (D'Angelo personal communication 2009).

Highly altered forests of the refuge consist of existing forested habitats that either have not been completely inventoried to understand and delineate their NVCS community types due to access restrictions (in the case of Folcroft Landfill) or contain substantial variation from natural forest communities typical of the refuge and surrounding region. Management of these habitats focuses on inventory and identification of resources as well as restoration of areas where the need has been identified. As discussed in the prior section, the forests of the refuge are relatively young ecosystems having only been present for the past 20 to 30 years.

This early successional development to forest has led to the development of many coastal plain and floodplain forests typical of the Philadelphia area in most areas. One 19-acre area in particular has resulted in a forest dominated by the fast growing, exotic gray poplar. This portion of forest also contains other exotic species including wineberry (*Rubus phoenicolasius*) and the invasive annual mile-a-minute vine (*Polygonum perfoliatum*). Regeneration within this portion of forest is dominated by new sprouts of gray poplar within canopy gaps. Despite the prevalence of nonnative and invasive species, this area does provide habitat utilized by short-eared owls (a focal resource of concern, a Pennsylvania endangered species, and Service trust

species) for nesting as well as various warbler species.
Evaluation of site conditions (soils, hydrology, existing species coverage and utilization), will be necessary before large-scale restoration is undertaken. Considerations will need to be made to balance current habitat needs with long-term ecosystem goals related to nesting priority species of concern within this area. To the extent feasible, the refuge can undertake a phased approach to the removal of the exotic gray poplar and associated invasive species during off-peak utilization periods (i.e., winter and summer). Phased clearing and planting will limit the amount of immediate habitat lost, while working toward long-term restoration goals.

Objective 1.3 Darby Creek

Over the next 15 years, manage inputs to Darby Creek on the refuge to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous and catadromous fish populations and Federal trust fish and wildlife species, including American eel, striped bass, blueback herring, and alewife.

Rationale

Tidal portions of Darby Creek, in combination with freshwater tidal marsh, provide a unique and productive habitat for many fish species. Some estuarine species, such as killifishes and mummichogs (*Fundulus* spp.) complete their entire life cycle in estuarine portions of rivers, creek, and tidal marshes. Anadromous fish, such as the blueback herring and alewife, tidal streams, and rivers like Darby Creek and its side channels provide nursery habitat for juveniles (Odum et al. 1984). American eel, the only catadromous fish species in Atlantic Coast estuaries, spends most of its adult life in freshwater estuaries and are common in tidal creeks, rivers, and marsh channels (Lippson et al. 1979). Thus, improving water quality and restoring suitable channel morphology where possible is critical to maintaining healthy BIDEH parameters that support fish species.

The National Fish Habitat Action Plan (NFHAP) outlines several management strategies that can help guide aquatic habitat management on the refuge, as well as connecting habitats both up and downstream. Restoration efforts by local and regional organizations within the Darby Creek watershed support components of Strategy 2 (Restoring natural flow and habitat variability to streams and rivers). Dam removal and other fish barrier removal efforts along Darby Creek support Strategy 3 (Reconnecting fragmented river systems and spawning and nursery habitats). While these efforts are mainly located beyond the boundaries of John Heinz NWR, Strategy 3 can be supported at the refuge by freshwater tidal marsh restoration efforts that incorporate the development of shallow, sinuous, marsh surface channels that support spawning and nursery habitat for estuarine and freshwater fish species.

Water quality in the refuge is a highly variable and complex phenomenon resulting from inputs of three major streams: Darby Creek, Cobbs Creek (a major tributary to the Darby), and the Delaware River. The contribution from each of these sources at any given time varies depending upon tidal, hydrological, climatological, and anthropogenic conditions. The refuge is fortunate in that a number of reports have been produced recently that describe and summarize the status of the Darby Creek watershed based on recent data including the Darby Creek Rivers Conservation Plan (DCVA 2005), Lower Darby Creek Area 33 EPA Facility Report (NOAA 2000), and PWD's Darby-Cobbs Characterization Report (PWD 2002).

The Darby Creek watershed has numerous problems, most of which can be characterized as being derived from excessive urbanization. Cobbs Creek, a major tributary of Darby Creek has been found to be an area of significantly lower quality than Darby Creek (DCVA 2005). Urbanization has resulted in large amounts of impervious surface, which in turn is impacting the refuge through increasing stormwater runoff, introducing various toxic metals, resulting in algal-related impacts on in-stream oxygen resources, de-stabilizing stream banks, impairing and decreasing biological habitats, and decreasing stream base flows.

These impairments cause biological impacts. Fish data indicate that Darby Creek has greater species diversity including some pollution intolerant species. Biometric scores suggest that the downstream reach of Darby Creek is "good," although upstream locations were "fair" or "poor." Cobbs Creek fish metrics indicate only "fair"

or “poor” (PWD 2002). Research completed by the Service in 2004 found a significantly higher number (26 percent) of liver tumors and skin lesions in brown bullheads (*Ameiurus nebulosus*) collected from Darby Creek, as compared to those collected from nearby reference sites. The suspected source of this contamination is elevated levels of Polycyclic aromatic hydrocarbons (PAHs) in Darby Creek. According to the study authors, the EPA has identified 19 significant disposal or fill sites adjacent to Darby Creek from 1953 to 1983, including many sites that should still be considered significant potential sources of PAHs to Darby Creek (Pinkney et al. 2004).

The Folcroft Landfill, which became part of the refuge in 1980, is part of the Lower Darby Creek Area Superfund Site, which also includes the Clearview Landfill, located just upstream of the refuge, and four other sites within a 2-mile stretch along Darby Creek (NOAA 2000). Coordination with the EPA regarding contaminant remediation is ongoing. As a result, no restoration activities for the Folcroft Landfill are proposed in this plan. Ecological restoration plans will need to be coordinated with the EPA upon remediation of the contamination.

Due to the complexity and regional-scale of these water quality impacts, there is unfortunately little that can be done to alleviate these concerns through management on the refuge. However, the refuge can play an active role in coordination and technical assistance toward efforts that result in improved water quality on the refuge. The geographic location of the refuge at the base of the Darby Creek watershed and near the Delaware River make it an ideal location for bringing together all parties involved in protection and restoration efforts.

GOAL 2 Contribute to the enhancement of native species diversity in the Delaware Estuary, including migratory birds and other species of conservation concern, within the refuge’s managed open waters and grasslands.

Objective 2.1 Impoundment and Nontidal Open Water

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 66.6-acre impoundment and 56.4-acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods while maintaining essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures will include the following:

1. Annually support migratory shorebirds through a mix of shallow water (less than 6 inches water depth), mudflat with sparse vegetation (less than 10 percent cover), and mudflats with no vegetation, at times of peak migration (spring: May, and fall: mid-August through September).

2. Annually support migratory waterfowl through a mix of shallow (6 to 24 inches water depth) flooded vegetation (*Carex* ssp.*, Polygonum* ssp.*, Peltandra* ssp.) at times of peak migration (spring: late March, and fall: late October).

3. Annually support migratory wading birds through a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

4. Sustain State-threatened red-bellied turtle through protection of hibernation, foraging, basking, and nesting habitat.

Rationale

Dikes around the refuge are believed to have been built as early as the 1640s by either the Swedes or the Dutch in order to create areas suitable for agriculture. The 145-acre impoundment as we know it today was likely constructed sometime during the 1940s or 1950s. The periodic drawing down of the impoundment and the presence of tidal mud flats provide some of the best stopover habitat for migrating shorebirds in

Pennsylvania (Cohen and Johnson 2004). In addition, many waterfowl, wading birds, waterbirds, and landbirds utilize the impoundment as well. The area serves as a wintering ground for over 20 species of waterfowl with 1,100 to 1,400 individuals per day between September and March (Green et al. 2008).

Historically, the impoundment was fed by a combination of groundwater and diversions from Darby Creek and managed as open water with periodic tidal fluctuation. Two former water control structures are still in place along portions of the impoundment dike. However, these structures became unusable as Darby Creek's channel pattern shifted further away from the dike in these locations during the early 1980s–causing the structures to become silted in. Today, the refuge contains an active water control structure in the northeast corner of the impoundment. Over the past several years, the Service has managed the water levels within the impoundment to benefit migratory waterfowl, wading birds, and shorebirds with successful results (Green et al. 2008; Phillips personal communication 2008).

This recent management was completed in conjunction with 23 other national wildlife refuges across the Service's Regions 3 and 5 as part of a 3-year management experiment. Management prescriptions for the timing of water manipulation in impoundments involved drawdowns to coincide with either spring or fall shorebird migration. The effects of this timing on waterbird communities, invertebrate communities, and vegetation communities, throughout the annual wetland cycle, were monitored. In addition to evaluating the effects of traditional habitat management practices on attaining objectives for a suite of trust species, this study provides monitoring protocols, databases, and analytical methods that can be used by refuge staff after the study ends for adaptive management of their impoundments (Lyons et al. 2005).

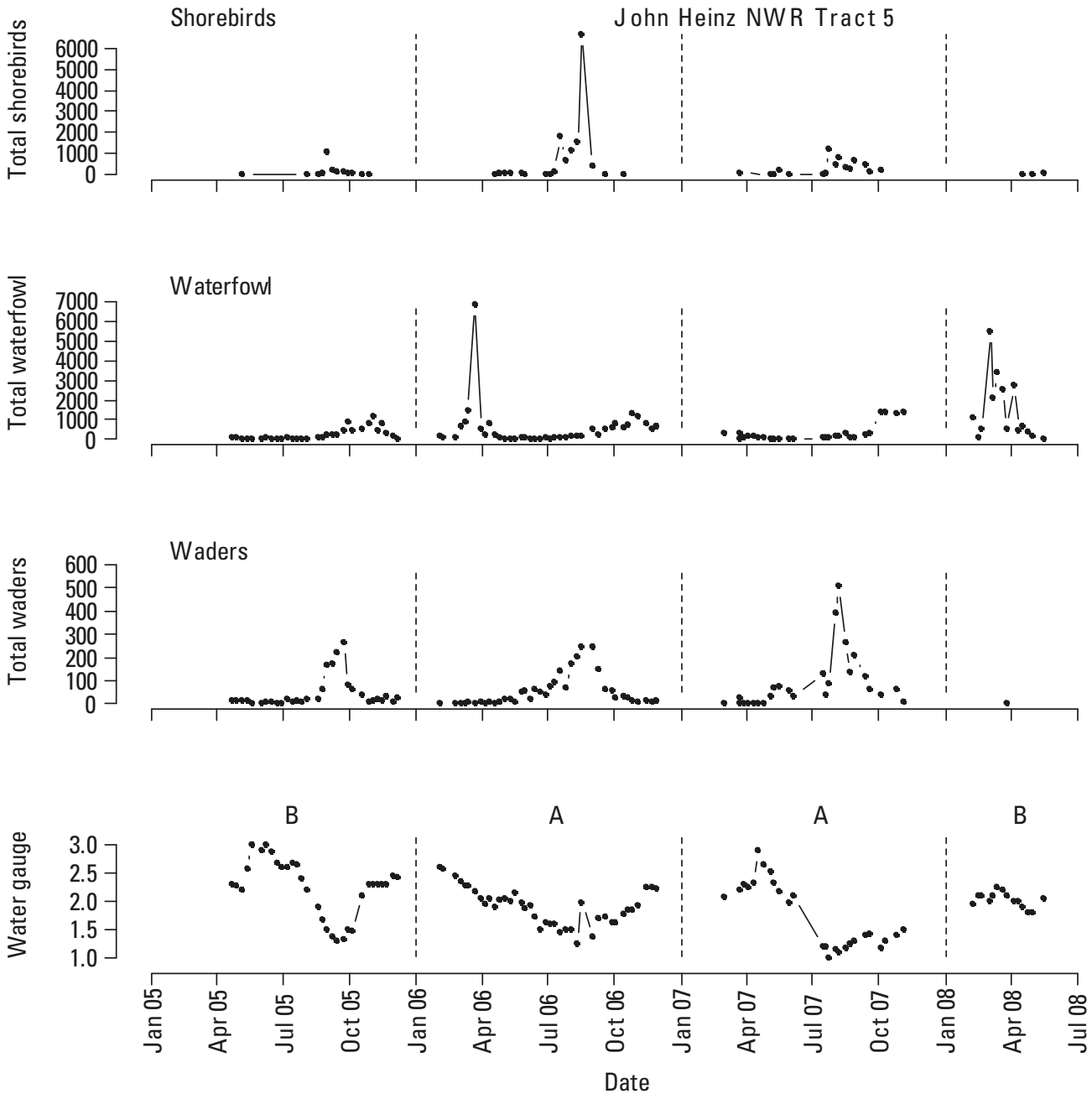
The impoundment study results are completed in draft form at the time of this writing. At this time, it appears that the timed management developed as part of the study has been successful in supporting diverse bird population use of the impoundment area (Green et al. 2008; Phillips personal communication 2008). Draft results indicate that this management should be continued.

These timed drawdowns are focused on providing the most optimal habitat available within the impoundment for various bird groups during their peak migration stopovers in both the spring and fall (figure C.4). The results of this study indicate that the following variations in mean water levels and vegetation composition provide the most benefits for migrating groups. The impoundment area also provides secondary and hibernation habitat use by the State-listed endangered turtle species generally associated with the freshwater tidal marsh and Darby Creek (Stolz personal communication 2005). Management considerations must be made to sustain the use by and protection of these nonbird focal species as well.

Table C.8. Bird Groups and Optimal Conditions for Migratory Stopover and Forage Enhancement within the Impoundment (Based on Results of the Region 3 and Region 5 Impoundment Study).

Bird Groups	Water Depth (inches)	Vegetation Composition and Areal Coverage	Time of Year
Shorebirds	0.0 – 6.0	Mudflats containing less than10 percent vegetative cover.	Spring: May Fall: Mid-August to September
Waterfowl	6.0 – 24.0	Less than10 percent cover of shallow marsh and emergent aquatic species (including *Carex, Polygonum,* and *Peltandra*)	Spring: Late March Fall: Late October
Wading Birds	6.0 – 12.0	Open water containing less than 10 percent vegetative cover.	Spring: Late March Fall: Late August

Figure C.4. Shorebird, waterfowl, and wader abundance (adjusted for partial observability) and water gauge levels within the 145-acre impoundment at John Heinz National Wildlife Refuge (from Green et al. 2008).



Management of the impoundment requires an adaptive approach to reduce, control, or eliminate undesirable plant species such as the invasive, exotic purple loosestrife and the aggressive, native spadderdock, while at the same time promoting the germination of seed producing vegetation such as smartweeds and mudflats

for benthic invertebrates. In some years, it is anticipated that the annual water level management objectives will likely require some variation from the timing most adaptable for migratory birds. To maintain extensive mudflats, annual vegetation, and shallow pools, the impoundment will occasionally require extensive inundation to prevent long-term establishment of perennial invasive species, such as purple loosestrife. Extended inundation periods should be employed when the presence of invasive species becomes larger than feasible for control through herbicide applications. The threshold for this type of management action would be when the impoundment begins to support approximately 10 acres (7 percent) coverage of a nearly monotypic population of invasive exotic species.

Prior to construction, the lands inundated by the 145-acre impoundment were historically freshwater tidal marsh. The Restoration Management Plan for Lower Darby Creek outlined portions of the impoundment for potential tidal marsh restoration opportunities. Refuge staff has been interested in restoring portions of the impoundment to enlarge the total area of freshwater tidal marsh and to improve public accessibility to this unique habitat (Stolz and Woodward personal communication 2009).

Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats

Manage up to 64 acres to create a mix of native grasses and flowering plants, within components including early successional shrubs and trees to sustain stopover foraging and cover for migratory landbirds. Specifically,

1. Annually, manage habitat around Frog Pond and Hoy's Pond fringe as native-species dominated wet meadow to contain less than 15 percent areal coverage of tree and shrub species, and no greater than 5 percent bare ground, and so that at least 90 percent of the total areal cover is comprised of native species.

2. Within 10 years of plan approval, restore biological diversity to the existing 7.1 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.

Rationale

Fewer grasslands are available to birds throughout the Mid-Atlantic region as agricultural lands have been lost to commercial and residential development as well as natural succession. Today, grassland dependent birds within the Mid-Atlantic region depend upon agricultural landscapes and other artificial habitats to maintain populations. Military installations, airports, golf courses, parks, recreational fields and other man-made and maintained grasslands provide some modified types of this habitat today. The New England and Mid Atlantic Coast BCR 30 recommends that opportunities to affect large grassland communities should be implemented, when practical (USFWS 2008).

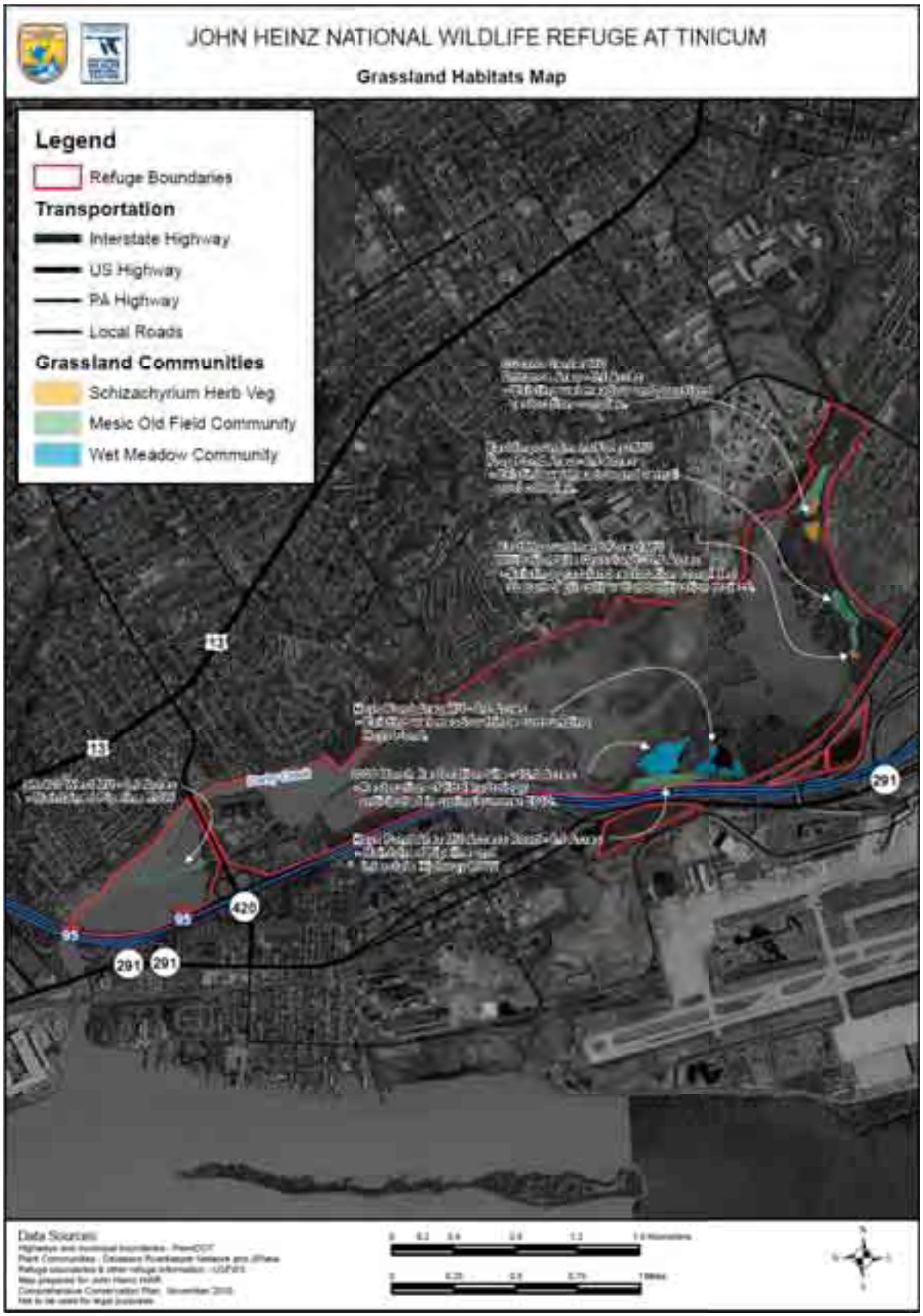
Grasslands and native meadows likely covered a substantial proportion of the Philadelphia area prior to European colonization. It is unlikely that these were self-sustaining ecosystems in this area. There is extensive evidence that meadows were managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest and provide foraging areas for game species such as grouse, turkey, deer, and elk (Latham et al. 2005). These systems supported plant species that are generally common to the extensive grasslands found in Midwestern States despite their diminutive size. As availability of grassland habitats has decreased, these species have experienced population declines and are now considered among the most threatened species within the Mid-Atlantic region (PIF 1999). Several remnant native meadows exist within Philadelphia with active restoration plans. Active management of these areas typically includes the removal of nonnative invasive species, replanting of lost native species, and control of woody species (PNHP 2008).

Until the past few decades, the upland habitats of the refuge were comprised of a substantially greater amount of grasslands than today (McCormick et al. 1970; McMennamin personal communication 2008). The Restoration Management Plan for Lower Darby Creek compared habitat coverages between those documented in the Two Studies of Tinicum Marsh and those identified as part of field inventories conducted in 2005. Many forested areas along the existing dike system and within areas east and south of the 145-acre impoundment contained scattered trees (less than 10 percent cover) and “old field” vegetation in 1968, making the forested habitats of the refuge a relatively recent cover type (Salas et al. 2006).

While the grasslands of John Heinz NWR are generally too small to support nesting of priority grassland species within the region (see map C.4), some grassland areas can provide suitable migratory support habitat. Additionally, these grasslands provide important habitat for focal species of concern such as the short-eared owl, sedge wren, marsh wren, and the Coastal Plain leopard frog. The Coastal Plain leopard frog in particular is known to breed in some of the shallow permanent water and vernal pool habitats found within wet meadow grasslands (Phillips and McMennamin, personal communication 2008).

Despite these benefits, grasslands, being an early successional community type, require significant maintenance and time inputs to be maintained over a long-term period. In some areas, it will be more economically and ecologically beneficial to manage existing grassland habitats in a successional trajectory toward coastal or floodplain forest. Each individual grassland patch will require evaluation based on existing and potential habitat benefits, educational and research value, regulatory requirements (in the case of utility and highway right-of-ways), as well as aesthetic and visitor service goals for grasslands found near the refuge entrance and visitor center. An overview of the grasslands of John Heinz NWR is provided in figure 4.1. Management Units used to describe locations are specified in section 5.1.

Map C.4. Existing Grassland Habitats at John Heinz National Wildlife Refuge



Chapter 5.
Management Strategies and Prescriptions

5.1 Development of Management Strategies and Prescriptions

This chapter outlines management strategies and prescriptions to address the habitat management goals and objectives outlined in chapter 4. Management strategies identify the tools and techniques (e.g. mowing, water level manipulation, chemical application, etc.) utilized to achieve the habitat objectives. Prescriptions provide the details behind the specific means by which the strategies will be implemented (e.g. timing, frequency, duration, and location). A review of available literature related to potential strategies and prescription was incorporated during their development. The identified treatments were selected in consultation with other refuge biologists, managers, and practitioners to ensure their effectiveness. Many environmental factors including wildlife populations, weather, seasonal variations, and habitat conditions affect the selected prescriptions and their ability to achieve objectives from year to year. As such, many of the details of prescriptions will be identified in the Annual Habitat Work Plan. Prescriptions outlined herein are discussed on a conceptual level.

The natural world contains a myriad of extremely complex and dynamic systems. This is especially true in biological refuges such as John Heinz NWR, which contain an array of different habitats that support hundreds of plant, fish, and wildlife species in a relatively small area. It is important to understand as land stewards and habitat managers, that one can never fully understand each aspect of these continually changing systems. Despite the extensive planning efforts undertaken within this HMP, there will undoubtedly be additional need to address changes to physical, ecological, social, political, and financial factors that influence biodiversity and its conservation.

The work outlined within this habitat management plan is intended to be feasible, yet extensive, given the available workload of refuge staff and community support. As such, additions of biological technicians and other staff may help in achieving these management objectives over the next several years. The management prescriptions outlined here represents a comprehensive effort to guide management primarily over the next 5 years. However, it is impossible to predict the full suite of management strategies and prescriptions required over this period. Some additional strategies may need to be added, others listed here may not be utilized at John Heinz NWR.

5.2 Management Units

In order to implement management prescriptions, the refuge is divided into a series of Habitat Management Units (map C.5). These habitat management units were developed as a result of the major habitat types identified throughout the habitat management planning process.

The refuge was first divided into management units in the early 1980s as part of the refuge Master Plan. These management units were created based on projected management and land use for the refuge. While still referenced to some degree, the alpha-numeric identification system tends not to be referenced in day-to-day management.

In 2005, as part of the *Restoration Management Plan for the Lower Darby Creek*, the Delaware Riverkeeper Network and refuge staff also developed a system of 14 management units for the refuge. These units were delineated based on several factors, such as geographic size, location, landscape influences, and existing in-formal designations currently in use by refuge staff. These management units were then subdivided into sub-units based on the ecological community identified for a particular component of that area. While this system aided in dividing portions of the refuge into distinct units for on-the-ground management, actual management conducted by staff is conducted on a more localized and habitat-based scale (Phillips, personal communication 2009).

No single system of management units is likely to capture all the complexities and requirements for planning and management of the refuge. The habitat management units developed under this plan are intended to coincide with these previous efforts as applicable. Table C.9 is provided as a cross-reference between the HMP management units and those others previously developed for John Heinz NWR.

Map C.5. Habitat Management Units as Defined by the Habitat Management Plan

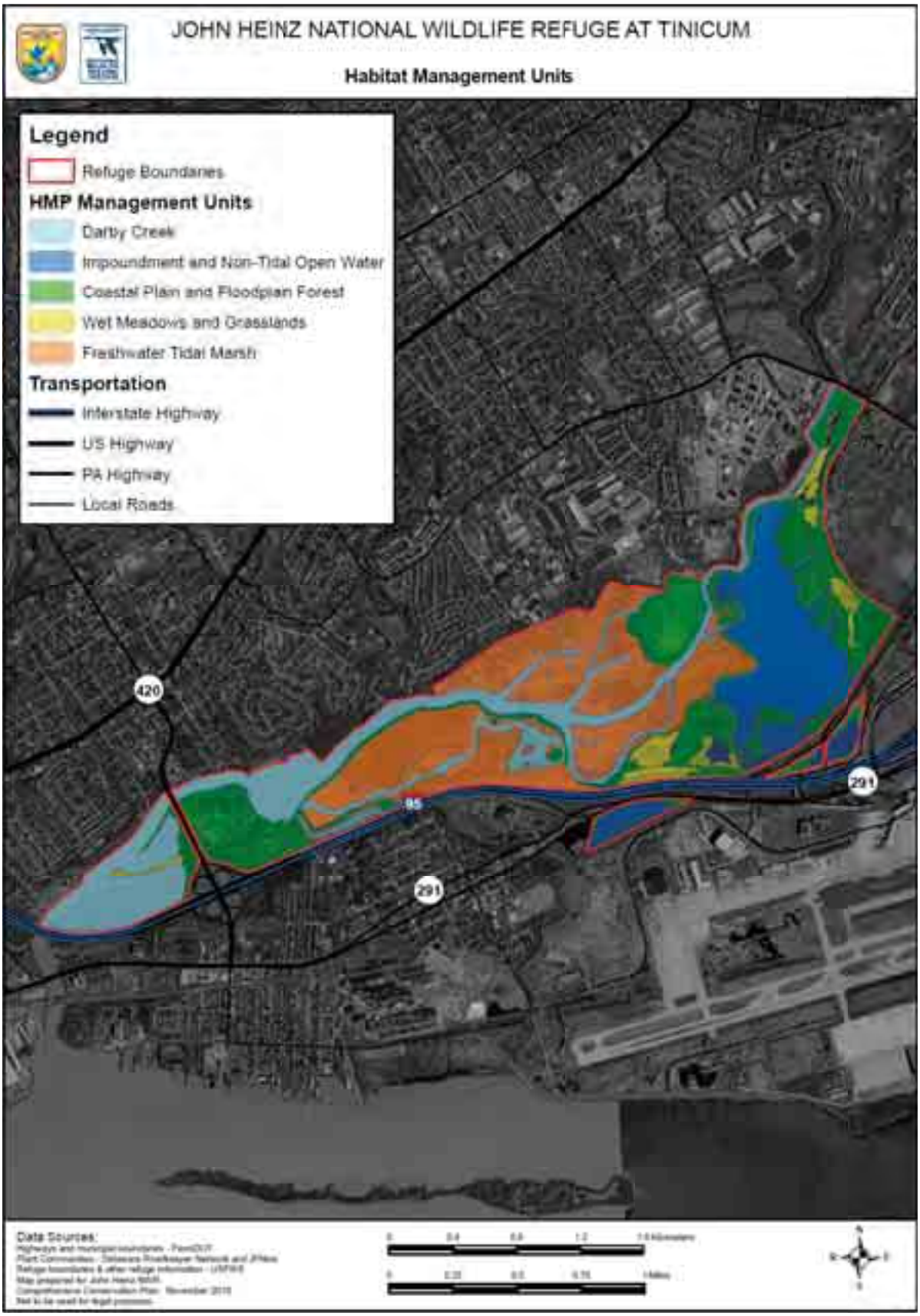


Table C.9. Management Units at John Heinz National Wildlife Refuge (see map 5.1 for locations).

Management Unit (Lower Darby Creek Restoration Plan[1])	Resource Planning Unit (Refuge Master Plan[2])	Treatment Sub-Units (USFWS[3])	HMP Habitat Unit
Cusano Area	FL-1	Lindbergh Berm Woods	Floodplain Forest
		5-Acre Field	Grassland
		CEEC Back Meadow	Grassland
		CEEC Frog Pond Woods	Floodplain Forest
		Frog Pond	Wet Meadow
		Maint/Creek Woods	Floodplain Forest
		Maint/Lindbergh Woods	Floodplain Forest
		Parking Area Meadow	Grassland
East Impoundment Forest	NL-1	Lower Impoundment Woods	Coastal Plain Forest
		Warbler Woods/Middle Impoundment Woods	Coastal Plain Forest
		Spill Site Meadow	Wet Meadow
		Spill Site Restoration Area	Wet Meadow
		Poplar Woods	Floodplain Forest
		Upper Impoundment Woods	Coastal Plain Forest
Impoundment and Dike	MW-1	Creekside of Dike	Darby Creek
		Impoundment	Impoundment and Nontidal Open Water
		Little Horseshoe	Impoundment and Nontidal Open Water
	MM-1	Big Horseshoe	Impoundment and Nontidal Open Water
South Impoundment Forest	FL-2	Trolly Bed Pond	Impoundment and Nontidal Open Water
		Trolly Bed / Bartram Woods	Floodplain Forest
	MM-2	Oak Island	Coastal Plain Forest
		Oak Island Marsh	Coastal Plain Forest
Henderson Dike and Marsh	FL-4	Henderson Trail	Floodplain Forest
		Penn Dot Property	Freshwater Tidal Marsh
		Mitigation Site 2 (Airport Mitigation Site)	Freshwater Tidal Marsh
		Mitigation Site 1 (Blue Route Mitigation Site) Phrag. Islands	Freshwater Tidal Marsh
	TW-2	Mitigation Site 1 Western Tidal Marsh	Freshwater Tidal Marsh

Management Unit (Lower Darby Creek Restoration Plan[1])	Resource Planning Unit (Refuge Master Plan[2])	Treatment Sub-Units (USFWS[3])	HMP Habitat Unit
Darby Creek	TC-1	Darby Creek	Darby Creek
	MW-2	Long Hook Creek	Darby Creek
	TL-1	Eastern 420 Lagoon	Darby Creek
	TW-3		
	TL-2	Northern 420 Lagoon	Darby Creek
	TL-3	Southern 420 Lagoon	Darby Creek
	TW-4	Un-named Area	Darby Creek
Hoys Pond Area	FL-3	Hoys Pond	Impoundment and Nontidal Open Water
		Corps Property	Wet Meadow
		Blue Route Spoils Site	Wet Meadow
		I-95 Underpass	Floodplain Forest
		Cross-Dike Field	Wet Meadow
		Hoy's Pond Area Woods	Floodplain Forest
		Corps Property Woods	Floodplain Forest
I-95 Outliers	MW-1	16-Acre Pond	Impoundment and Nontidal Open Water
	FL-2	Bob's Refuge	Floodplain Forest
North Tidal Marsh	TW-1	North Tidal Marsh	Freshwater Tidal Marsh
South Tidal Marsh		South Tidal Marsh	Freshwater Tidal Marsh
SR 420 East	OF-1	420 woods (Westinghouse Property)	Floodplain Forest
SR 420 West	Un-named	420 Split	Floodplain Forest
Folcroft Landfill	SW-1	Folcroft Landfill	Floodplain Forest and Grassland
		Annex	Floodplain Forest

[1]Salas, D., D.M. Williams, and R.C. Albert. 2006. Restoration management plan for the Lower Darby Creek. Delaware Riverkeeper Network.

[2]U.S. Fish and Wildlife Service. 1980. John Heinz National Wildlife Refuge at Tinicum Master Plan.

[3]Phillips, B. 2009. Personal communication regarding refuge management units. U.S. Fish and Wildlife Service.

5.3 Management Strategies and Prescriptions by Habitat Objective

Objective 1.1 Freshwater Tidal Marsh

Protect the existing 282 acres and restore or acquire an additional 173 acres of freshwater tidal marsh communities throughout the refuge within the next 15 years. Restored marsh would be dominated by native marsh vegetation including, but not limited to, wild rice (*Zizia aquatica*), spadderdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and tick-seed sunflower (*Bidens* spp.). Restored marshes will reestablish greater than 80 percent coverage of native marsh plant species and tidal hydrology that inundates greater than 90 percent of the marsh plain surface with shallow water (less than 1-foot maximum depth) at mean high tide and results in the development of natural channels across the marsh plain surface.

Management Strategies

Continue to:

- Provide technical support to regional corridors and restoration efforts upon request and to targeted projects, such as:
  - Tinicum Township and Long Hook Creek wildlife and riparian corridor restoration
  - Philadelphia International Airport marsh mitigation and restoration
- Utilize existing biological datasets to guide species and habitat management restoration.
- Control nonnative, invasive species focused primarily on phragmites and purple loosestrife through a combination of aerial herbicide application, and spot treatments throughout the growing season when populations exceed greater than 5 percent (10 acres) areal coverage across the existing 284.5 acres of freshwater tidal marsh.
- Pursue the completion of additional marsh restoration projects as funding allows.

Within 2 years of plan approval:

- Utilize partnerships with local universities and regional researchers to define a baseline monitoring plan that continues monitoring of variables related to climate change impacts within the existing marsh. Utilize partners to evaluate monitoring data to verify accuracy of previous and current model results.

Within 5 years of plan approval:

- Work with the Service's Delaware Bay Estuary Project office to complete the restoration of a 55-acre wetland area dominated by phragmites to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species such as pickerelweed, spadderdock, and wild rice. Restored marshes will contain a network of channels across the marsh surface that resemble the pattern, dimension, and profile of channels within reference marsh areas in order to provide aquatic habitat for nursery and juvenile fish.

Within 15 years of plan approval:

- Implement the restoration of a 27.0-acre wetland area dominated by degraded floodplain forest.
- Evaluate restoration of approximately 78 acres of the impoundment to freshwater tidal marsh subject to daily fluctuation in tidal hydrology and dominated by a mix of native species, such as pickerelweed, spadderdock, and wild rice.

Monitoring Components

Continue to:

- Support ongoing research related to sea level rise, marsh accretion rates, and nitrogen removal capacity within tidal marsh by Academy of Natural Sciences.
- Participate in Spill Prevention, Control, and Countermeasure Plans or other environmental emergency action plans as related to the protection of Darby Creek, open water and tidal wetlands on refuge lands.

Within 5 years of plan approval:

- Monitor and adapt marsh restoration projects to climate change impacts to the extent practical.

Within 10 years of plan approval:

- Within 10 years of plan approval, we would begin to reevaluate the refuge's acquisition boundary through the Service's Preliminary Project Proposal process to address rising sea level caused by climate change, as much of what is currently within the refuge boundaries could be under water in the next 50 to 100 years.

Objective 1.2 Coastal Plain and Floodplain Forests

Over the next 15 years, acquire or restore up to 18 acres of coastal plain and floodplain forest, and manage the existing 34 acres of coastal plain forest and 261 acres of floodplain forest communities. These communities will provide healthy foraging and stopover habitat for migratory bird species and provide breeding habitat for the coastal plain leopard frog by: maintaining a canopy dominated by native trees, increasing native understory shrub and sapling cover by 10 percent, and at least a 15 percent reduction in areal coverage of herbaceous, invasive species as compared to levels inventoried in 2005. Also, restore at least 7.7 acres of existing cool-season grass meadows to at least 50 percent cover by native shrub or early successional coastal plain forest species near the 10-acre marsh restoration site and an additional 0.6 acres within the grasslands restored as part of the oil spill wetland mitigation site.

Management Strategies and Prescriptions

Continue to:

- Control exotic, invasive species impacting forested habitats, including Norway maple (Acer platanoides), tree-of-heaven (Ailanthus altissima), garlic mustard (Alliaria petiolata), porcelainberry (Ampelopsis brevipedunculata), Oriental bittersweet (Cephalanthus orbiculatus), Japanese honeysuckle (Lonicera japonica), bush honeysuckle (Lonicera maackii), Japanese stiltgrass (Microstegium vimeneum), and multiflora rose (Rosa multiflora) through a combination of herbicide application, biological controls, hand pulling and cutting, and cut-stump treatments where applicable.

- Maintain existing stands of nonnative poplar. Attempt reforestation of native species in canopy gaps as they develop.

- Install occasional tree plantings to close canopy gaps and supplement poor regeneration due to deer browse pressure. Protect saplings with individual tree exclosures to minimize browse and decrease associated tree mortality.

- Finalize the Deer Management Plan originally drafted by USDA Division of Wildlife Services staff in 2009. No deer management control actions would be implemented, but ongoing evaluation of impacts would continue.

- Restrict public access to eagle nesting areas during the breeding season and limit public access to areas utilized by other rare species during their breeding seasons.

Within 5 years of plan approval:

- Reduce and then maintain resident deer populations through the use of wildlife control specialists, based on recommendations of the finalized deer management plan, in order to reduce deer population densities, improve the available deer habitat, improve tree regeneration, and reduce the relative effects on human populations. Monitor regeneration in plant richness and diversity within established monitoring plots.

- Adapt long-term management plan for forest habitats to create mixed-age stands of hardwood species identified as primary components of coastal plain and floodplain target communities.

Within 10 years of plan approval:

- Initiate restoration actions on 15 acres of nonnative poplar-dominated forest to establish a successional trajectory towards coastal plain and floodplain forest communities containing biological diversity and integrity similar to other forest habitats existing on the refuge.

Monitoring Components

Continue to:

- Complete deer browse impact monitoring using established USDA Division of Wildlife Services protocols including the review of deer population densities, deer habitat characterization, tree regeneration analysis, and relative effects on human populations.

- Conduct annual population monitoring (flushing surveys) to evaluate deer population trends on the refuge. Utilize FLiR counts completed in January 2009 and 2010 to evaluate population levels and trends of flushing surveys.

Within 3 years of CCP approval:

- By fall 2011, establish vegetation monitoring plots and record baseline data in order to track long-term richness and diversity of tree, shrub, and herbaceous vegetation and monitor impacts of management activities on biological integrity and diversity.

- By 2013, conduct an ecological inventory and assessment of the floodplain forest parcel identified within the State Highway 420 East Management Unit to assess the ecological cost and benefit of restoring some or all of the area to freshwater tidal marsh.

Within 10 years of CCP approval:

- By 2020, evaluate effectiveness of sustained reductions in deer populations and the recovery ability of plant communities in order to determine where to supplement with native plant reintroductions, if at all.

Objective 1.3 Darby Creek

Over the next 15 years, manage inputs to Darby Creek on the refuge in order to reduce contaminants, reduce stormwater impacts from the refuge, and provide spawning, nursery, foraging, and cover habitat for anadromous and catadromous fish populations and Federal trust fish and wildlife species, including American eel, striped bass, blueback herring, and alewife.

Management Strategies and Prescriptions

Continue to:

- Maintain existing partnerships to assess and manage for water quality improvements impacting the refuge.

- Annually, review and refresh staff in spill response protocols and emergency protection measures.

- Coordinate with EPA and other stakeholders to close Folcroft and Clearview Landfills and minimize environmental health impacts related to contaminants associated with these sites.

- Assist Delaware Bay Estuary Project Office in coordinating and providing technical assistance to fish passage, stream, and riparian restoration projects within the Darby Creek watershed that have potential to increase available habitat for species utilizing the refuge or improvements to water quality.

Monitoring Components

Continue to:

- Support volunteer-based water quality monitoring along Darby Creek on the refuge as resources allow.

- Support of occasional and ongoing research to evaluate fish tissue surveys, contaminant level accumulation, and other environmental impacts of environmental hazards.

- Complete installation of a water quality monitoring unit along Darby Creek on the refuge to implement long-term and continuous monitoring.

Within 5 years of plan approval:

- Install a network of water quality monitoring equipment along Darby Creek on the refuge to implement long-term and continuous monitoring of salinity, dissolved oxygen, pH, temperature, flow rate, and other parameters.

Objective 2.1 Impoundment and Nontidal Open Water

Restore about half (78 acres) of the 145-acre impoundment to freshwater tidal marsh and manage the remaining 66.6-acre impoundment and 56.4 acres of nontidal open water to enhance habitat available for shorebirds, waterfowl, and wading birds during their peak spring and fall migration periods. Meanwhile, maintain essential habitat for other freshwater species of management concern, such as red-bellied turtles, through a combination of water level management, wetland restoration, and invasive species control.

To the extent practicable, these measures will include the following:

- Annually support migratory shorebirds through a mix of shallow water (less than 6 inches water depth), mudflat with sparse vegetation (less than 10 percent cover), and mudflats with no vegetation, at times of peak migration (spring: May, and fall: mid-August through September).

- Annually support migratory waterfowl through a mix of shallow (6 to 24 inches water depth) flooded vegetation (Carex spp., Polygonum spp., Peltandra spp.) at times of peak migration (spring: late March, and fall: late October).

- Annually support migratory wading birds through a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

- Sustain State-threatened red-bellied turtles through protection of hibernation, foraging, basking, and nesting habitat.

Management Strategies and Prescriptions

Continue to:

- Control invasive species impacting the impoundment and nearby open water habitats as feasible. Purple loosestrife (Lythrum salicaria) and phragmites when they spread over 5 percent (7 acres) of areal coverage across the impoundment and the aggressive native species, spadderdock (Nuphar lutea) when it spreads across greater than 10 percent (14 acres) of areal coverage. Control through a combination of herbicide application, mechanical controls, and water level manipulation treatments where feasible.

- Attempt management of impoundment water levels as conditions allow in order to maximize benefits to migrating shorebirds, waterfowl, waterbirds, and wading birds during each groups' peak migration periods. Adjust drawdown timing and duration to control nonnative, invasive species when herbicide applications become a less cost-effective option against larger populations.

- Enhance and maintain existing dike system to prevent and minimize structural damage sustained to access roads and dikes by flood events and muskrat nesting burrows.

- Close the water control structure into the impoundment during forecasted storm events to minimize stormwater runoff and pollution inputs.

- Partner with Tinicum Township to manage stormwater inputs into the impoundment and open waters along Long Hook Creek.

Within 5 years of plan approval:

- Conduct a series of inventory surveys or reviews of species and habitat use of the 145-acre impoundment and freshwater tidal marsh to evaluate benefits to wildlife of open water, managed mudflat, and tidal marsh habitats.

- Complete a study and restoration plan to determine the optimal size, location, and components for restoration of part of the 145-acre impoundment to freshwater tidal marsh and provide improved water control management and habitat enhancement of the remaining impoundment area.

- Evaluate water quality inputs from neighboring stormwater drainage discharging onto refuge lands and initiate development of improvement measures, such as redirecting stormwater inputs from Philadelphia International Airport to Long Hook Creek.

Within 15 years of plan approval:

- Restore approximately half of the 145-acre impoundment to freshwater tidal marsh, actual area and restoration plan will be based on the study recommendations.

Monitoring Components

Continue to:

- Support annual volunteer frog monitoring.

- Monitor water quality (temperature, pH, and dissolved oxygen) and water level fluctuations within the impoundment throughout the year.

- Conduct weekly inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundment during spring and fall migrations. Use data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.

- Conduct migratory bird surveys for landbirds, waterbirds, and waterfowl.

- Complete fisheries inventory of isolated ponds on refuge lands.

Within 10 years of plan approval:

- Assess potential changes in flood elevations of existing dikes and facilities on and adjacent to the refuge and evaluate adaptation to changes in flood elevations.

- Conduct baseline red-bellied turtle inventory surveys and create a long-term monitoring program within the impoundment, open water areas, and the freshwater tidal marsh to determine forage, hibernaculum, and nesting sites. Where feasible, complete inventories in partnership with local universities and State agencies.

Objective 2.2 Wet Meadows, Grasslands, and Early Successional Habitats

Manage up to 64 acres to create a mix of native grasses and flowering plants, within components including early successional shrubs and trees to sustain stopover foraging and cover for migratory landbirds. Specifically,

1. Annually, manage habitat around Frog Pond and Hoy's Pond fringe as native-species dominated wet meadow to contain less than 15 percent areal coverage of tree and shrub species, and no greater than 5 percent bare ground, and so that at least 90 percent of the total areal cover is comprised of native species.

2. Within 10 years of plan approval, restore biological diversity to the existing 7.1 acres of grasslands surrounding the visitor center and refuge entrance, so that at least 90 percent of the total areal cover is comprised of native species and support a minimum of 7 species of native grasses, and 7 species of native flowering plants.

Management Strategies and Prescriptions

Continue to:

- Annually mow to maintain the existing 72 acres of wet meadow, grassland, and forest opening habitats for wildlife, environmental education, and interpretive purposes.

- Control exotic, invasive species impacting wet meadow and grassland habitats, including Oriental bittersweet, Japanese hops, Japanese honeysuckle, purple loosestrife, phragmites, mile-a-minute vine, and multiflora rose through a combination of herbicide application, hand pulling, and mowing.

- Maintain and create vernal pools and wet meadows for amphibian breeding and grassland bird stopover habitat.

- Promote warm-season grass establishment in areas previously dominated by cool-season grasses.

Within 5 years of plan approval:

- Cease annual mowing of 8 acres of existing grasslands targeted for successional transition into a scrub-shrub dominated habitat type.

- Install supplemental plantings within the grasslands surrounding the visitor center to enhance species diversity to levels targeted.

Within 15 years of plan approval:

- Complete habitat management, compatible use, and public use planning of Folcroft Landfill site within 2 years of site remediation and release.

Monitoring Components

Continue to:

- Annually conduct anuran call surveys of known vernal pools to monitor species and their use of areas for breeding sites. Utilize data to document sensitive breeding areas and long-term effectiveness of management activities in order to adjust management protocols as necessary.

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Appendix B.
Potential Habitat Management Strategies

This section identifies potential management tools or strategies that are available to land managers to achieve desired habitat objectives. These strategies were identified through successful refuge application, literature review and in consultation with other land managers.

Invasive Species Management

Controlling and managing invasive species is a strategy for maintaining the biological integrity and diversity of all habitats. The Fulfilling the Promise National Invasive Species Management Strategy Team developed a national strategy for management of invasive species for the Refuge System in 2002. The strategy recommends the following priority order of action for invasive species management:

1. Prevent invasion of potential invaders.
2. Eradicate new or small infestations.
3. Control and contain large established infestations.

Potential management strategies for preventing invasive species, prioritizing control efforts for established invasive species, and controlling invasive species are described in detail below. Prior to the initiation of invasive species control efforts, the refuge manager must understand the biology of the species to be controlled. A number of resources are available on the internet to assist refuge managers with invasive species management. This is a partial list of helpful Web sites.

- Service Managing Invasive Plants Modules: *http://www.fws.gov/invasives/staffTrainingModule/index.html* (accessed January 2012)
- National Invasive Species Information Center: *http://invasivespeciesinfo.gov/index.shtml* (accessed January 2012)
- National Biological Information Infrastructure Invasive Species Information Node: *http://invasivespecies.nbii.gov/* (accessed January 2012)
- The Global Invasive Species Initiative: *http://tncinvasives.ucdavis.edu/* (accessed January 2012)
- USGS Invasive Species Program: *http://biology.usgs.gov/invasive/* (accessed January 2012)
- Mid-Atlantic Exotic Pest Plant Council (MA-EPPC): *http://www.ma-eppc.org/* (accessed January 2012)
- Weeds Gone Wild: *http://www.nps.gov/plants/alien/index.htm* (accessed January 2012)

Refuge managers should conduct appropriate and applicable pest detection, environmental surveillance, and monitoring before, during, and after any management activity to determine whether pest management goals are achieved and whether the activity caused any significant unanticipated effects. The lowest risk, most targeted approach for managing invasive species should always be utilized (Department of Interior 2007).

Work with Partners

Working with partners is the most effective way to manage invasive species on a refuge. Control efforts on the refuge will have little long-term impact if the surrounding lands and waters are infested with invasive species.

Incorporate Invasive Species Prevention in All Facilities and Construction Projects

Minimize ground disturbance and restore disturbed areas. Require mulch, sand, gravel, dirt, and other construction materials to be certified as free of noxious weed seeds. Avoid stockpiles of weed-infested materials.

To prevent the spread of invasives along transportation corridors, maintain invasive species-free zones along trails, around parking lots and boat launches, and at other related facilities. Inspect these areas often and control new infestations immediately. Minimize the number and size of roads on the refuge.

Remove all mud, dirt, and plant parts from all equipment between projects or when equipment is moved from one location to another.

Incorporate Invasive Species Prevention in Impoundment Design and Management
Minimize infrastructure development in managed wetland units to reduce unnecessary dikes, waterways, and access roads. These often are sources of infestation and pathways to spread invasive species.

Plant a native cool-season grass mix that will establish quickly to stabilize banks and dikes and to prevent the establishment of invasive species. Consider one of the following mixes recommended by the Natural Resources Conservation Service for New York State:

1. Canada wild rye (*Elymus canadensis*) (5 lb. per acre), riverbank wild rye (*E. riparius*) (3 lb. per acre), and Eastern bottlebrush grass (*E. hystrix*) (2 lb. per acre); or
2. Canada wild rye (4 lb. per acre), riverbank wild rye (4 lb. per acre), Virginia wild rye (*E. virginicus*) (4 lb. per acre), and rough bentgrass (*Agrostis scabra*) (1 lb. per acre)

For either mix, consider adding a cover crop of seed oats (*Avena sativa*) or triticale (*Triticale hexaploide*) so bare soil is not exposed to erosion or to invasive plant seeds and rhizomes. This nonnative plant will establish quickly and then drop out of the mix after 1 to 2 years.

Time water manipulation activities, such as flooding and drawdowns, to minimize the germination and spread of invasive plant seeds and to encourage the growth of native species. Flooding can also be used to stunt the growth of some invasive species as described below under water level management.

Early Detection and Rapid Response
Where prevention is not possible, early detection and rapid response is the next best strategy. Success will depend, in part, on participation by all refuge staff, contractors, volunteers, and visitors in efforts to report and respond to invasions. The refuge manager must have access to up-to-date reliable scientific and management information on species that are likely to invade. The following sources for State and regional invasive species information and updates provide an initial list of potential invasive species present within the region:

- PA Invasive Species Council: *http://www.invasivespeciescouncil.com/default.aspx* (accessed January 2012)
- Mid-Atlantic Exotic Pest Plant Council (MA-EPPC): *www.ma-eppc.org* (accessed January 2012)
- WeedUS Natural Area Weed Database of the US: *http://www.invasive.org/weedus/index.html* (accessed January 2012)

These lists, along with identification information for each species, should be distributed amongst refuge staff and volunteers and posted in refuge facilities. In addition to these lists, a list of experts should be maintained by the refuge manager to facilitate rapid and accurate species identification for species that are particularly difficult to identify. The refuge manager should communicate with the PA Invasive Species Council and Mid-Atlantic Exotic Pest Plant Council regarding the status of early detection species in the region.

When small infestations are spotted, they should be eradicated as soon as possible. The site must then be monitored for several years to ensure the control was effective.

Prioritizing Invasive Species Control Efforts
The first step in prioritizing invasive species control efforts is to determine the abundance and distribution of invasive species on the refuge or management unit. However, control efforts should not be delayed to collect statistically rigorous survey data. Baseline data regarding the location of many invasives on the refuge already may be available via observations of staff, volunteers, contractors, and refuge visitors. These observations should be documented and mapped. If a more formalized mapping procedure is desired the North American

Weed Management Association (*http://www.nawma.org;* accessed January 2012) has information on mapping procedures.

There are a number of ranking tools to assist land managers with the daunting task of prioritizing their invasive plant control efforts. The Fulfilling the Promise National Invasive Species Management Strategy Team recommends using the following order of priority to determine appropriate actions:

1. Smallest scale of infestation
2. Poses greatest threat to land management objectives
3. Greatest ease of control.

Table C.3 provides a prioritization summary of known invasive exotic species occurring at John Heinz NWR. The prioritization of species within that table follows the prioritization rankings listed above. Keep in mind that the prioritization in table C.3 is considered for invasive species across the entire refuge. Some species listed as "medium" priority across the refuge, may be a "high" priority for a particular habitat (such as *Phragmites* for the freshwater tidal marsh). This prioritization should be periodically reviewed and updated as necessary to reflect changes in species, distribution, and effectiveness of management.

When limited resources prevent the treatment of entire populations, the following order of priority is recommended:

1. Treat the smallest infestations (satellite populations).
2. Treat infestations on pathways of spread.
3. Treat the perimeter and advancing front of large infestations.

The following ranking systems are available for prioritizing invasive plant species control:

- Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Nonnative Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. Web site: *http://www.natureserve.org/getData/plantData.jsp* (accessed January 2012)
- R. D. Hiebert and J. Stubbendieck, Handbook for Ranking Exotic Plants for Management and Control (Natural Resources Report NPS/NRMWRO/NRR-93/08), U.S. National Park Service, Midwest Regional Office, Omaha, Nebraska, 1993.
- APRS Implementation Team. 2000. Alien plants ranking system version 5.1. Jamestown, ND: Northern Prairie Wildlife Research Center Online. (Version 30SEP2002). Web site: *http://www.npwrc.usgs.gov/resource/literatr/aprs (accessed January 2012)*

Restore Altered Habitats and Reintroduce Native Plants

Restoration is critically important because the conditions responsible for the initial invasion will expose the site to a resurgence of the invasive species, as well as a secondary invasion of one or more different species. Furthermore, restoration of a disturbed area before the initial invasion may preclude the need for further control efforts. The goal is to conserve and promote natural processes that will inherently suppress potential pest populations (Department of the Interior 2007).

If funding or personnel are not available to restore highly disturbed areas in a timely manner, consider planting a cover crop for several years to stabilize the site prior to reintroducing native plants. This will prevent more invasive seeds from entering the environment until the site can be restored. Native plants can then be established by direct seeding or planting with less competition from invasive species in the seed bank. When practical, local genotypes of native species should be used.

Biological Control

Biological control is the use of animals or disease organisms that feed upon or parasitize the invasive species target. Usually, the control agent is imported from the invasive species' home country, and artificially high numbers of the control agent are fostered and maintained. There are also "conservation" or "augmentation"

biological control methods where populations of biological agents already in the environment (usually native) are maintained or enhanced to target an invasive species. The advantages of this method are that it avoids the use of chemicals and can provide relatively inexpensive and permanent control over large areas. Appropriate control agents do not exist for all invasive species. Petitions must be submitted to, and approved by, the USDA Technical Advisory Group on weed biological control before any proposed biological control agent can be released in the United States.

Sometime around 2000, John Heinz NWR participated in USDA APHIS programs that resulted in a release of the purple loosestrife biological control *Galerucella* beetle at two sites within the refuge. The first release site, around Hoy's Pond, has resulted in reduction of loosestrife in this area. The second release within the Impoundment was not as successful due to water levels historically present within the impoundment. At this time, no plan exists to re-release new populations of *Galerucella*, but it should be explored in the near future in combination with potential biological controls for other invasive species (Phillips personal communication 2009).

The refuge biologist and manager should evaluate various biological control agents as they become available for field application for the invasive species documented across the refuge. Discussions with USDA APHIS staff may help provide an overview of available research, development of biological control agents, and potential for application of species-specific controls.

Manual and Mechanical Control

Mechanical removal of invasive organisms can be effective against some herbaceous plants, shrubs and saplings, and aquatic organisms. This is particularly effective for plants that are annuals or have a taproot. Care should be taken to minimize soil disturbance to prevent creating conditions ideal for weed seed germination. Repeated cutting over a growing period is needed for effective control of many invasive plant species. Care should be taken to properly remove and dispose of any plant parts that can re-sprout. Treatments should be timed to prevent seed set and re-sprouting. The following methods are available: hand-pulling, pulling with hand tools (weed wrench, etc.), mowing, brush-hogging, weed-eating, stabbing (cutting roots while leaving in place), girdling (removing cambium layer), mulching, tilling, smothering (black plastic or other), and flooding.

The advantages of mechanical treatment are low cost for equipment and supplies and minimal damage to neighboring plants and the environment. The disadvantages are higher costs for labor and inability to control large areas. For many invasive species, mechanical treatments alone are not effective, especially for mature plants or well-established plants. For some invasive plants, mechanical treatments alone exacerbate the problem by causing vigorous suckering. Mechanical treatments are most effective when combined with herbicide treatments (e.g. girdle and herbicide treatment).

Water Level Management in Impoundments

Water level management is also used to control invasive species and promote desirable plants. Robust plants such as *Phragmites* require air pockets (carbon dioxide) to survive. Flooding of impoundments throughout all (or part) of a growing season, inhibits or prohibits vegetative growth of robust vegetation, particularly after mowing or chemical application. Subsequent drawdown will allow for germination of moist-soil plants preferred by waterfowl. Timing and speed of drawdown affects species diversity, density, and seed production. Slow drawdown (4 to 8 weeks) early in the season creates greater species diversity, while fast drawdown (a few days to less than 2 weeks) results in lush extensive stands of similar vegetation. Late in the season, however, slow drawdown promotes greater diversity and density, whereas fast drawdown promotes undesirable plant composition (Lane and Jensen 1999). Flooding also promotes robust perennial control by muskrats.

Winter drawdowns are also possible, but should be avoided as they have detrimental effects on species overwintering in the impoundments such as invertebrates, reptiles, amphibians, and muskrats. Winter drawdowns have been shown to help control undesirable overpopulations of white water lily and carp, but managers should weigh this benefit with the potential costs before undertaking a winter drawdown.

Deer Control

As discussed in chapters 2 and 3, invasive plant problems often are exacerbated by white-tailed deer overbrowsing native species, and when deer numbers rise above the carrying capacity, biodiversity declines (NY State Department of Environmental Conservation 2007).

John Heinz NWR's proximity to high density residential neighborhoods, Philadelphia International Airport, Interstate 95, regional railways, and other public roads make public hunting a difficult option for control of deer populations at the refuge. Public hunting may be used to reduce the deer population only if it is logistically feasible, provides appropriate public safety and screening procedures, and is biologically efficient. An alternative for John Heinz NWR may be use of wildlife control specialists. While this prohibits the opportunity for a combination of public use and deer population management, it does ensure appropriate safety measures are taken. Wildlife control specialists in other highly urbanized settings around Philadelphia have been successful in controlling pest species. A combination of both approaches may be another consideration depending on resources available, public interest, and population targets. Deer control must be conducted in combination with other invasive plant control measures as deer control alone will not be effective if the invasive plants are already established.

Deer exclosures should be considered only in small highly sensitive areas (e.g., where invasive plants are out-competing rare plants and the rare plants will be extirpated without intervention). This method is labor intensive and costly to employ and should only be used on a very limited basis until the native community is firmly established and the invasive species are controlled.

Herbicides

There are a wide variety of chemicals that are toxic to plant and animal species. They may work in different ways and be very target specific, or affect a wide range of species. Herbicides may be "pre-emergent," that is, applied prior to germination to prevent germination or kill the seedling, or "post-emergent" and may have various modes of action (auxin mimic, amino acid inhibitor, mitosis inhibitor, photosynthesis inhibitor, lipid biosynthesis inhibitor). Products may come in granular, pelleted, dust, or liquid forms. Liquid herbicides are commonly diluted to an appropriate formula and mixed with other chemicals that facilitate mixing, application, or efficacy. Common application methods include foliar spray, basal bark, hack and squirt, injection, and cut stump. The timing of applications is critical to achieve good control, as the growth stage at which an organism will be most effectively controlled varies with different species.

The advantages are that the right chemicals, applied correctly, can produce desired results over a large area for a reasonable cost. The disadvantages are that the chemicals may affect nontarget species at the site (including the applicator) or contaminate surface or groundwater. Proper planning includes using the most target-specific, least hazardous (to both humans and the environment), and most effective chemical for the job. Additionally, one should research minimum effective dosage, as the chemical labels often give higher than necessary concentrations. Herbicides often are most effective when used in combination with mechanical methods described above.

Attention to protective gear, licensing requirements and other regulations is essential. In the Service, all pesticide and other chemical applications (including adjuvants designed to enhance effectiveness) are covered by Service and departmental regulations, and a Pesticide Use Proposal (PUP) is required for all pesticide applications.

Control of Overabundant or Nonnative Waterfowl Populations

Controlling invasive or overabundant waterfowl, such as mute swans, snow geese, and resident population Canada geese is a strategy used to protect native waterbirds and fisheries, and prevent the destruction of wetland habitats on refuges. Control methods include: harassment, egg shaking, sterilization, and removal.

The Atlantic Flyway Council outlines the coordination of state and Federal wildlife agencies "to reduce mute swan populations in the Atlantic Flyway to levels that will minimize negative ecological impacts to wetland habitats and native migratory waterfowl and to prevent further range expansion into unoccupied areas." Target populations of mute swans vary by state and range from 0 to 500 free-flying birds (Atlantic Flyway Council 2003).

In the fall of 2005, the Service completed an Environmental Impact Statement that included a multifaceted approach for managing resident Canada geese. At the recommendation of the Atlantic Flyway Council, the Service approved the use of special regulations beginning in 2007 to help curb the growth of these geese in the Eastern United States included in this approach was the expansion of hunting methods during September seasons (USFWS 2005).

While neither mute swans nor resident Canada geese have been nuisances at John Heinz NWR, control options should be considered if at some point overabundant waterfowl begin to pose impacts to other species of conservation concern or components of BIDEH. The refuge manager should consider implementing appropriate population control measures as necessary.

Protecting Nesting Birds
The seasonal closure of nesting and foraging areas may be necessary to protect sensitive nesting bird species and habitats on the refuge, such as the bald eagle. Posting “no disturbance” or “area closed” signs near bird nesting areas, nesting islands, or individual nest locations, is one way to help prevent disturbance caused by humans and boats. Signs are placed in the appropriate areas as soon as possible in the spring and are maintained throughout the nesting season. If disturbance is noted by refuge staff, additional areas may be posted as well.

Impoundment Management

Water Level Manipulation
Water level management (timed drawdown and flooding) is a strategy used to mimic the dynamic water regime of some natural wetlands, and is typically timed to benefit shorebirds, wading birds, and/or waterfowl. During a draw down, mudflats and shallow waters areas are created to provide foraging habitat for shorebirds, while at the same time concentrating food for wading birds. Some waterfowl (e.g., teal) will also take advantage of the concentrated and more accessible food resources. Eventually, the soils in these mudflat areas begin to oxidize and warm up. This in turn causes moist-soil vegetation to germinate. If the water is removed early in the growing season, moist-soil vegetation will outcompete most perennial emergent vegetation, which requires warmer soil temperatures for germination. When water is removed later in the growing season, perennial emergent vegetation usually dominates. This is often an undesirable outcome of a drawdown and is usually avoided. As moist-soil annual vegetation grows, shallow (not to exceed 1/3 plant height) flooding can be used to irrigate growing vegetation, create shallow water foraging habitat for waterfowl or discourage growth of perennial or invasive plants. Water levels are usually returned to the desired management level prior to fall migration, or the following spring migration if water is not available in the fall. Generally, slow (over several weeks) drawdowns will provide a greater diversity of moist-soil plants than faster (over a few days) drawdowns (Frederickson and Taylor 1982).

Alternatively, drawdowns may occur in fall to provide foraging habitat for fall migrating shorebirds and some waterfowl. Winter drawdowns are also possible, but should be avoided as they have detrimental effects on species overwintering in the impoundments such as invertebrates, reptiles, amphibians, and muskrats. Winter drawdowns have been shown to help control undesirable overpopulations of white water lily, but managers should weigh this benefit with the potential costs before undertaking a winter drawdown.

Water may also be held in an impoundment over the growing season, or several growing seasons, to provide breeding habitat for waterfowl and marsh birds. This is usually done in areas where a healthy perennial emergent component exists in the wetland. Over time, water stress or muskrat activity will often reduce the amount of emergent vegetation until it is no longer a significant component of the impoundment. At this point the impoundment has little value to breeding waterfowl and marsh birds and another drawdown should be considered.

Vegetation Management
Plants that occur in an impoundment can be either desirable or undesirable based on their value to wildlife. Generally, plants that provide cover, energy, or nutritional value for objective wildlife are desirable. Plants that quickly develop monocultures and impede foraging by wildlife are undesirable. Whether a plant is desirable or

not also depends on why the impoundment is being managed. For example, cattail is undesirable to shorebirds and waterfowl because it forms dense monotypic stands, and reduces foraging habitat (mudflats and moist-soil vegetation) of shorebirds and waterfowl. In contrast, it provides cover and breeding habitat for marsh birds, and therefore is desirable if managing for those species. The challenge of impoundment management is balancing the needs of various wildlife guilds. In addition to the water level manipulation techniques listed in the previous paragraphs, below are available strategies for promoting desirable vegetation and controlling undesirable or invasive plants.

Muskrat Population Management
Muskrats are efficient at reducing the cover of robust perennial vegetation. The impoundment should be held high for at least 1 year, and muskrat trapping in the impoundment interior should be prohibited when the cover of robust perennial vegetation needs to be decreased. However, if perennial vegetative cover is lower than desired, muskrat control should be conducted. Muskrat trapping also should be employed when muskrat numbers are high enough to damage impoundment dikes or water control structures. Trapping of muskrats takes place during the fall and winter, during State-established trapping seasons. Muskrat trapping follows State regulations and refuge-specific regulations and is issued through a special use permit. See the refuge trapping plan for more information.

Mowing
Mowing can be used to reduce plant height and deplete energy reserves of invasive and robust plants. Repeated mowing within a growing season is often necessary to successfully control invasive plants. This can be logistically difficult in a habitat that is managed for various resources of concern. However, mowing can be effective when combined with other strategies, such as chemical treatment, spring flooding, and disking. Timing of mowing should be scheduled to occur when the undesirable plants are at maximum above ground energy reserve and have little potential for seed dispersal. This is usually the point between flowering and seed setting. Mowing may also increase plant diversity by creating space (light) for other species to germinate.

Due to the unconsolidated nature of sediments deposited within the bed of the impoundment, mowing is not a likely option for vegetation management in most cases. However, there may be occasional opportunities for mowing and cutting in portions of the impoundment fringe. Accessibility and stability should be carefully considered prior to mowing treatments.

Herbicide
The most commonly used herbicide for controlling invasive and robust vegetation in impoundments is glyphosate. Methods of application include spot-treatment using backpack or ATV mounted sprayer, or aerial application. Spot-treatment is more targeted (avoiding neighboring plants), but can be very labor intensive when treating large areas. Aerial application is less labor-intensive, but is not as target-specific, and requires extensive planning to execute. Herbicides are applied during flowering and prior to seed set to maximize effectiveness.

Seeding and Planting
Most impoundments contain abundant stock of moist-soil plant seeds native to a locality, therefore making seeding and planting unnecessary (Frederickson and Taylor 1982). These seeds may remain viable in the soil for many years, and germinate under suitable environmental conditions (Lane and Jensen 1999). In extreme circumstances, past human activities (such as extensive herbicide use, prolonged flooding, and promoting monotypic plants for many years) may have altered site conditions such that the soil seed bank is inadequate or nonexistent (Weller 1990). In these situations, the seed bank may need to be augmented through planting of seeds, rhizomes, or seedlings to ensure growth of desirable plants. Only native species should be used for seeding and planting. Whenever possible, seeds and other plant material should be obtained from a local reference site, either through direct seed harvest or transplant, or from a nursery that procured their stock locally.

Beaver Control
Because beavers are part of the natural landscape, and can be beneficial in terms of creating wetland habitats, harvest of nuisance beavers will only be conducted when negative impacts are determined to be excessive. Beavers interfere with impoundment management by damaging or clogging water control structures and

altering water levels on surrounding lands so impoundments either cannot be filled or cannot be drained. Whenever possible, water control structures and drainage pipes should be fitted with guards to prevent beavers from clogging the pipes or damaging the structures. Trapping is the most effective method of removing problem beavers and may be conducted either during fur season or by nuisance trappers during other times of the year.

Impoundment Improvement Through Depression Creation

Impoundments are created when an ecological system has been altered and the hydrology has been modified and cannot be restored by other means due to surrounding land uses. Impoundments are managed to mimic natural hydroperiods or to provide the best possible habitat for high-priority wildlife species. Impoundments that do not provide high quality habitat, should be modified to achieve the refuge's highest priority habitat goals and objectives.

Annual and perennial wetland vegetation establishment within impoundments is dependent on site elevation relative to hydrology (inundation or saturation levels). In impoundments with little or no change in bathymetric elevation, enhancing the gradient of elevation changes may be a suitable technique for habitat enhancement. Due to the degree of habitat degradation and the lack of wildlife use, it is beneficial to create depressions to restore these areas to high-quality wetland habitat. Depressions will create a mix of emergent marsh and open water habitat that will improve biological diversity and productivity.

Depressions should be created by physically removing material. Other methods that leave the material onsite create temporary openings that fill in as the displaced muck slumps back in and cattails re-invade. Material should be removed to create open water areas and channels in an irregular pattern. The irregular pattern visually attracts wildlife and creates more edge and interspersion between open water and emergent vegetation. The finished bottom of all excavations should be 6 to 36 inches lower than the managed water level of the rest of the impoundment. A meandering channel should connect the newly created depressions to the rest of the impoundment, thus permitting water flow and water level management by the same structures used to control water levels in the surrounding impoundment. A minimum of 50 percent of the side slopes of the depressions should be at a grade of 6:1 (6 horizontal to 1 vertical) or flatter. Slopes as flat as 10:1 are preferable if possible. The remaining side slope area should have a grade of 3:1 or flatter. The connecting ditches should have side slopes of 2:1 or flatter. Excavated muck should be spread over a nearby upland area on the refuge (Sheila Hess, personal communication, October 2005; USDA-NRCS 2006a).

Construction should be planned for the winter when the ground is frozen or the summer following a spring drawdown when earth moving equipment is least likely to sink in the unconsolidated muck. At John Heinz NWR, the soft substrate of the impoundment bed has prohibited access by most equipment. Additionally, portions of the impoundment are used by red-bellied turtles for winter hibernation. Consideration of these sites needs to be incorporated into any enhancement plan.

Forest Management

Silvicultural Prescriptions

Active management generally has not historically been necessary to maintain forest communities in John Heinz NWR. However, communities such as the coastal plain forest, dominated by oak and sweetgum, may require occasional clearing and thinning in order to promote regeneration of these shade-intolerant canopy species.

If a forested tract is degraded and not meeting habitat objectives, then a silvicultural prescription may be needed. A silvicultural prescription is a detailed set of written instructions for the treatment of a forested property and should be developed prior to the treatment of forested tracts other than invasive species treatments (Adams and Dwyer 2012). A forester should be consulted to develop a prescription based on the site conditions and habitat objectives identified in the HMP.

Forest Establishment and Reforestation

Patch size and distribution on the landscape are important considerations in planning and managing habitats. Forest restoration at John Heinz NWR, as outlined in the HMP should be focused on conversion of existing grassland areas, or exotic species-dominated forest, to a coastal plain forest community. Forest restoration to

a floodplain forest community is also appropriate along rivers and open water as riparian forest corridors are often more diverse than adjacent upland areas despite occupying a small area. These areas should be chosen based on their juxtaposition to currently existing forested tracts.

In grassland and meadow areas, forests may be established by allowing the area to succeed naturally; seeding herbaceous, shrub, and tree species; planting shrub and tree seedlings or saplings; or by a combination of these methods. Shade-tolerant herbaceous species may need to be seeded or planted after a canopy is established as they may not survive full sun conditions. The plants in the surrounding landscape should be surveyed to determine the seed stock. If desirable species are in the surrounding landscape and the invasive species load is low, then natural succession should be allowed to proceed. Invasive or other undesirable species can be selected out with herbicides. It may be desirable to plant only those species that are not already present in the surrounding landscape.

If the area is surrounded by invasive species, then allowing natural succession without seeding or planting natives likely will not be successful. Planting seeds of native species is less expensive than planting seedlings or saplings, but it will take longer for these to become established. A combination of seeding and planting may be the best strategy to "flood" the site with natives to outcompete surrounding invasives. The seedlings and saplings will produce seeds and provide shade more quickly, and the planted seeds will provide competition for invasive seeds already present in the soil. The site must be monitored, and invasive species must be controlled before they become well-established. The invasives in the surrounding landscape also should be controlled as resources permit.

Whenever nursery shrubs and trees are planted, they should be protected from deer and other herbivores. Selection of species and ecotypes is a critical step in seeding and restoration. Using local seed and plant materials is important in restoration as plants have wide genetic diversity across geographic space.

Grassland Management

As noted within the HMP, John Heinz NWR does not have grasslands of large enough size to support breeding sites for many grassland birds. Instead, these habitats tend to provide stopover foraging habitat. Refuge grasslands consist of both cool-season and warm-season grasses. Cool-season grasses start growing in spring as soon as the snow melts and the days start to warm up. They grow best in spring and fall and tend to stop growing during the hot dry days of summer. They are usually relatively short and do not grow as dense as many warm-season grasses. Conversely, warm-season grasses do not start growing until late spring and grow best during the hot dry summer months. They generally grow taller and denser than cool-season grasses.

Currently, most cool-season grasses within John Heinz NWR are exotic species brought over from Europe as forage for livestock. Most warm-season grasses are native to the North American prairie. Some varieties are native to Pennsylvania's historic grasslands and the Northeast as well. Exotic cool-season and native warm-season grasses are readily available from seed companies across the country. Some seed companies are beginning to propagate native cool-season grasses, making them more available for planting, but still at a relatively high price.

Many species of grassland birds require relatively large blocks of habitat for nesting areas. Some species, such as upland sandpiper and Henslow's sparrow are not likely to be found in grassland patches of less than 75 acres. Other species patch size requirements are smaller, but grasslands of less than 25 acres generally do not meet the requirements for most grassland nesting birds and may be better suited to a different habitat type (e.g., shrubland) (Mitchell et al. 2000).

Historically, most of the Northeast was forested, except for a period following European settlement when much of the region was cleared for agriculture and subsequently grasslands and open fields became abundant. In pre-settlement times, permanent, large openings were uncommon, except for selected coastal areas. Scattered openings occurred along large river floodplains, around beaver flowages, in coastal heathlands and in other areas of regular disturbance. Large grasslands are now in decline and the region is becoming more forested (Rothbart and Capel 2006).

Populations of grassland birds are declining as grassland habitats and other agricultural conditions diminish. Norment (2002) notes that despite the relatively recent (last 200 years) rise and fall of grassland habitats and associated birds in New England, the region may still be important for these species given their continental decline and habitat loss in the core of their ranges in the Midwest. While grasslands of John Heinz NWR are not sizable enough to provide suitable breeding habitat, they can be managed to improve their BIDEH and provide quality habitat for species migrating through the refuge.

Mowing

Mowing (or cutting) is very effective at controlling broad leaf forbs and woody species, provided it occurs during the growing season of these plants. Mowing is especially effective in supporting weed control efforts associated with new grassland seeding and establishment. Cutting should be delayed until after the nesting season of most grassland birds (usually mid-July) but should be done as soon as possible after this date to allow for maximum stress on invading forbs and shrubs. Depending on the amount of forb and shrub invasion, some grassland fields may require repeated cutting during any one season. Cutting should be done often enough to keep the grassland in the intended state. Occasionally it is possible to selectively mow small sections of forb and tree encroachment within larger grassland fields, thus saving the refuge resources and reducing disturbance to the grassland as a whole.

Prescribed Fire

If used properly, fire can be a useful tool for maintaining grasslands. Generally, prescribed fire is suitable for controlling woody species and to a lesser extent broad leaf forbs in warm-season grasslands. Cool-season grasslands are difficult to maintain with prescribed fire. To achieve effective control of woody species, fire must be applied late enough in the growing season to allow these species to leaf out, but early enough to ensure that sprouting warm-season grasses are not damaged. Due to the early season growth habits of cool-season grasses, they are often too green to allow a fire during the time when woody plants have leafed out.

Due to health constraints related to urban air quality, as well as safety concerns for Philadelphia International Airport, Interstate 95, and regional rail, fire is an unlikely management tool for applications at John Heinz NWR. Despite these constraints, the refuge manager should have an understanding of fire ecology and its place within the habitats of the refuge and suitable alternatives for management.

Herbicides

Woody plants or broadleaf forbs can be sprayed with herbicide during the growing season to control their spread within grassland habitat. Herbicides can either be specific to a certain type of plant (e.g., dicamba for broad leaf plants) or general (e.g., glyphosate). Herbicides can also be sprayed on individual plants, such as from a backpack sprayer, or broadcast across the grassland, such as from a boom sprayer. The species being controlled and the amount of invasion into the grassland will determine which herbicide is used and how it is applied.

The sensitive nature of many refuge habitats and species dictate that herbicides are used with extreme care. It is illegal to use an herbicide in a manner inconsistent with the label, but refuges should strive to be even more restrictive with their use. Nonchemical management techniques should be considered before deciding to use herbicides. Unfortunately, chemical control is often the only effective control technique available for certain plants, particularly many invasive species. Refuges should select the most benign chemical available to effectively do the job and apply it at the minimum necessary rate.

Grassland Establishment

As stated above, patch size and distribution on the landscape are important considerations in planning and managing habitats. Some cool-season grass dominated meadows of John Heinz NWR can be enhanced through establishment of native warm-season grasslands.

Seeding and planting desirable plants can be used to enhance existing grasslands, in restoration of degraded grasslands, or in conversion of croplands. Selection of species and ecotypes is a critical step in seeding and restoration. While many species are commercially available for grassland restoration, few are native to the Northeast. Using local seed and plant materials is important in restoration as plants have wide genetic diversity across geographic space.

Initial seedbed preparation to decrease the weed seed bank is critical to successful grassland establishment. Former agricultural fields are ideal sites for grassland establishment if weed problems are already under control. The field should only need to be disked or sprayed with herbicide in spring prior to seeding as soon as the soil is dry enough.

In fallow fields, a controlled burn the summer or fall prior to seeding decreases surface weed seeds and litter. By the following March or April, spring disking or tilling will reduce the number of winter-growing weeds which set seed. The area should be left fallow during summer and tilled or sprayed with herbicide (glyphosate or pre-emergent herbicide), as necessary, to eliminate late-germinating weeds. One advantage of this spring-summer fallow technique is that deep soil moisture is conserved for the following fall planting. Finally, seedbed preparation may require smoothing with a land plane or scraper and roller if soil clods are large. Rolling with a ring roller provides compaction that will maintain good soil moisture following the first rains.

Broadcast seeding followed by shallow harrowing and cultipacking is very effective, especially on well-prepared soil. A small flexible tine harrow (Fuerst) can be pulled by a standard ATV to easily and rapidly harrow soil to cover the broadcast seed. In small or inaccessible areas, four pronged cultivator rakes can be used to agitate the soil and cover the seed. The preferred method of seeding warm-season grasses is with a no-till drill. When using a drill in recently tilled seedbeds, it is best to cultipack the tilled soil before seeding. Whether drilling or broadcasting on tilled soil, it is essential to cultipack after seeding. It is further recommended to cultipack twice after broadcasting, with the second cultipacking 90 degrees from the first (USDA- NRCS 2006b).

Because warm-season grasses are slow to germinate and have less seedling vigor than cool-season grasses, weed and sod control, both before and after planting, is much more critical than when establishing cool-season grasses. For establishing warm-season grasses, weed control throughout the growing season is just as critical as it is before planting. It usually takes at least two growing seasons to establish a warm-season grass stand which makes weed control during the first growing season critical. Because warm-season grasses are not shade-tolerant, weed canopies will reduce seedling vigor. Moisture competition from weeds and cool-season grasses may also further reduce seedling vigor (NRCS-USDA 2006).

To establish warm-season grasses, weeds are usually controlled by clipping with a sicklebar mower set at a height where only the leaf tips of the warm-season grass seedlings are cut, and the growing point is not damaged. This will reduce the shading competition but not hurt the emerging seedlings. Mowing weeds before flowering will prevent seed production. Mowing two to three times may be necessary during the establishment year; however, if clipped too frequently, weeds may “stool out” (grow out instead of up) (NRCS-USDA 2006).

Appendix B References

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Appendix C.
Resources of Concern for John Heinz National Wildlife Refuge

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 4[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Waterbirds																
American Bittern	c	r	o	r	Y		PE	M	2		X		HC			
American Coot	c	o	c	o	Y								MC			
Black Tern	o	r	o												M	
Black-crowned Night Heron	a	a	a	o	Y		PE	M					V		M	
Bonaparte's Gull	o	r	o	r											M	
Caspian Tern	o	r	o						5						L	
Cattle Egret	o	o	r												NR	
Common Gallinule	u	u	u	r	Y				5				MC			
Common Tern	r	r	r					M					V		L	
Double-crested Cormorant	c	r	c	r											NR	
Forster's Tern	r	o	c						5						M	
Glaucous Gull	r		r	r											NR	
Glossy Ibis	o	o	o					H	5						L	
Great Blue Heron	a	c	a	c					5				MC		NR	
Great Egret	a	a	a	r	Y		PE		5				V		NR	
Gull-billed Tern			r					HH	2	X	X				H	
Herring Gull	c	o	c	c											L	
Horned Grebe	r		r	r				H			X					
Iceland Gull	r		r	r											L	
King Rail	o	o	o	r	Y		PE	M	1B				V			
Laughing Gull	o	o	c	r											NR	
Least Bittern	o	c	o		Y		PE		2		X		V			
Least Tern	r	r	r					H	2		X				H	
Little Blue Heron	o	c	c					M	5						H	
Northern Gannet			r	r				H							NR	
Pied-billed Grebe	c	r	c	o	Y				5		X		MC			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Red-throated Loon			r	r				HH			X					
Ring-billed Gull	c	o	c	c											NR	
Royal Tern			r					M	5						M	
Snowy Egret	a	a	a		Y			M			X				H	
Sora	o	o	o	r	Y			M					MC			
Tricolored Heron	o	o	o					M	5						H	
Virginia Rail	o	o	o	r	Y								HC			
White Ibis	r		r												M	
Yellow-crowned Night Heron	r	r	r				PE	M	5				V		M	
Waterfowl																
American Black Duck	a	c	a	c	Y			HH	1B	X			MC			D
American Wigeon	o		o	o				M								I
Blue-winged Teal	c	c	c	r	Y											I
Brant	r		r	r						X						
Bufflehead	o		o	r				H								I
Canada Goose	a	a	a	c	Y					X						
Canvasback	o		o	r				H								I
Common Goldeneye	r	r	r	r				M								
Common Merganser	o		o	o												I
Gadwall	o	r	o	o				M								I
Greater Scaup	c	r	o	o				H								I
Green-winged Teal	c	o	a	c	Y			M					V			I
Hooded Merganser	o	r	o	r	Y			M								I
Lesser Scaup	o		o	o				H								D
Mallard	a	a	a	c	Y			H								NT
Northern Pintail	c	o	c	c	Y			M								D

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Northern Shoveler	c	r	c	o	Y											I
Red-breasted Merganser	o		r	r				M								I
Redhead	r	r	r	r												NT
Ring-necked Duck	o	r	o	o												I
Ruddy Duck	c	o	c	c				M					MC			I
Tundra Swan	r		r	r				H					R			
Wood Duck	a	c	a	o	Y			M								I
Landbirds																
Acadian Flycatcher	r	r	u						1B				MC			
Alder Flycatcher	o	o	u		Y								MC			
American Kestrel	c	c	c	c	Y				2							
Bald Eagle	u	r	u	u			PT	M	5		X		HC			
Bank Swallow	c	o	c						5				MC			
Barn Owl	c	c	c	c	Y		CR		2				MC			
Barred Owl	r	r	r	r					5							
Bay-breasted Warbler	c	r	c					H		X	X					
Black-and-white Warbler	c	r	c	r				H								
Black-billed Cuckoo	o	o	o		Y								MC			
Blackburnian Warbler	c	r	c					M					MC			
Blackpoll Warbler	c	r	c										V			
Black-throated Blue Warbler	c	r	c										MC			
Black-throated Green Warbler	c	r	c										MC			
Blue-winged Warbler	o	o	o					HH	1B	X	X		R			
Bobolink	o	r	c						5							
Brewer's Blackbird			r	r												

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 4[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Broad-winged Hawk	o	o	c	r				H					MC			
Brown Creeper	c		c	c												
Brown Thrasher	c	c	c	o	Y			H	2				MC			
Canada Warbler	c	r	c					M		X	X		MC			
Cerulean Warbler	r	r	r					M	1B		X		HC			
Chimney Swift	c	c	c					H	2				MC			
Cliff Swallow	o	r	o						5							
Common Nighthawk	c	o	c										MC			
Cooper's Hawk	o	r	o	o					5							
Dickcissel	r	r	r	r					3				HC			
Eastern Kingbird	c	c	c		Y			H								
Eastern Meadowlark	o	r	o	r									MC			
Eastern Wood Pewee	o	r	o						1B							
Field Sparrow	c	o	c	c	Y			H	2							
Golden Eagle	r		r	r									V			
Golden-winged Warbler	r	r	r					M			X		HC			
Grasshopper Sparrow	r		r					M					MC			
Gray Catbird	c	c	c	o	Y			M	2							
Great Crested Flycatcher	o	r	o		Y			H								
Henslow's Sparrow	r		r						1B		X		HC			
Kentucky Warbler	r	r	u					H	1B		X		MC			
Loggerhead Shrike	r	r	r	r					5		X		IC			
Long-eared Owl	r		r	r			PU						HC			
Louisiana Waterthrush	r	r	u					H	1B				R			
Marsh Wren	c	c	c	r	Y		CR	H					HC			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Northern Bobwhite	r	r	r	r				H	2				IC			
Northern Flicker	c	c	c	o	Y			H								
Northern Goshawk	r		r	r									V			
Northern Harrier	c	o	c	c	Y		CA		5				HC			
Northern Oriole	c	o	c	r	Y			H								
Olive-sided Flycatcher	r		u								X		IC			
Osprey	o	o	o				PT		5				V			
Peregrine Falcon	r	r	r	r			PE		5		X		HC			
Pine Siskin	r	r	o	o									V			
Prairie Warbler	c	r	c					HH	1B	X	X		MC			
Prothonotary Warbler	r	r	u					H	1B				HC			
Red Crossbill				r									V			
Red-headed Woodpecker	r	r	r					M	2		X					
Red-shouldered Hawk	o	r	o	o					5				MC			
Rusty Blackbird	c	r	c	o				H			X					
Savannah Sparrow	c	r	c	r	Y				5							
Scarlet Tanager	c	r	c					H	2				R			
Sedge Wren	r	r	r		Y		PE	M	1B		X		IC			
Sharp-shinned Hawk	o	r	o	r									MC			
Short-eared Owl	o		o	o			PE	M	5		X		IC			
Summer Tanager	r	r	r										HC			
Swainson's Thrush	c	o	c								X		V			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 4[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Vesper Sparrow	c	o	o	o					5							
Whip-poor-will	r	r	r					H			X		MC			
White-eyed Vireo	c	c	c		Y				1B							
Willow Flycatcher	c	c	u		Y								MC			
Winter Wren	o		c	r									MC			
Wood Thrush	c	c	c	r	Y			HH	1B	X	X		R			
Worm-eating Warbler	r	r	u					H	1B		X		R			
Yellow-bellied Flycatcher	r	r	u										V			
Yellow-breasted Chat	c	c	c	r	Y				2				MC			
Yellow-throated Vireo	o	r	o					H	1B				MC			
Shorebirds																
American Woodcock	c	c	c	r	Y			HH		X			MC	X		
Black-bellied Plover	o	r	c	r				H								
Buff-breasted Sandpiper			r					H			X					
Common Snipe	c	r	c	o				M								
Dunlin	o		o	r				H								
Greater Yellowlegs	c	o	c	r				H								
Hudsonian Godwit			o					H			X					
Killdeer	a	a	a	o	Y			M								
Least Sandpiper	o	o	o	r				M								
Lesser Yellowlegs	o	o	0	r				M			X					
Marbled Godwit			r					H			X					
Piping Plover	r		r			E		HH	1A	X				X		

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Red Knot	r		r					HH		X	X			X		
Red-necked Phalorope	r		r							X						
Ruddy Turnstone	r	r	r					HH								
Sanderling	r		r					HH		X						
Semipalmated Plover	c	r	c					M								
Semipalmated Sandpiper	c	o	c	r				H		X	X					
Short-billed Dowitcher	o	r	o	r				H			X					
Solitary Sandpiper	c	o	c								X		MC			
Spotted Sandpiper	c	c	c		Y			M								
Upland Sandpiper	r	r	r				PT	M	1B		X		IC			
Western Sandpiper		r	o	r				M								
Whimbrel	r		r					HH		X	X			X		
White-rumped Sandpiper	o	o	o					H								
Willet	r		r					H	3							
Wilson's Phalarope	r	r	r					H								
Mammals																
Marsh rice rat	nc	nc	nc	nc			SX									
Northern river otter	nc	nc	nc	nc			CA						MC			
Amphibians																
Coastal plain leopard frog	c	c	c	c	Y		PE						V			
Reptiles																
Eastern mud turtle	nc	nc	nc	nc	Y		PX									
Red-bellied turtle	u	u	u	u	Y		PT						HC			

Species	Seasons/Abundance at John Heinz NWR[1]				Nesting[1]	Federal T&E[2]	PA T&E[3]	BCR 30[4]	PIF 44[5]	USFWS North Atlantic LCC Priority List[6]	USFWS Birds of Conserv. Concern[7]	Federal Trust Fish	PA SWAP Priority[8]	North Atlantic Shorebird Plan[9]	North American Waterbird Plan[10]	Watefowl Management Plan[11]
	Spr	Sum	Fall	Win												
Fish																
American eel	p	p	p	p								X	MC			
Alewife	p	p	p	p						X		X				
Blueback Herring	p	p	p	p								X				
Eastern mudminnow	p	p	p	p			CR									
Hickory shad	p	p	p	p			PE					X				
Striped Bass	p	p	p	p						X		X				
Shortnose sturgeon	nc	nc	nc	nc		E	PE			X		X	IC			
Plants																
Waterhemp Ragweed	p	p	p	p			PR					X	MC			
Field Dodder	p	p	p	p			PT									
Walter's Barnyard-grass	p	p	p	p			PE									
A Eupatorium	p	p	p	p												
Forked Rush	p	p	p	p			PT									
Shrubby Camphor-weed	p	p	p	p						X		X				

Sources

[1] U.S. Fish and Wildlife Service. John Heinz NWR at Tinicum Web site. Available online at: *http://www.fws.gov/heinz/index.html*; accessed January 2012. a - abundant; c- common; u - uncommon; o - occasional; r - rare; nc - not confirmed on refuge, but potential habitat; p - present (from surveys) but seasonal abundance unknown

[2] U.S. Fish and Wildlife Service. Endangered Species Program Web site. Available online at: *http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp*; accessed January 2012. E - Endangered; T - Threatened; R - Rare

[3] Pennsylvania Natural Heritage Program. Pennsylvania Natural Heritage Program Web site. Available online at: *http://www.naturalheritage.state.pa.us/;* accessed January 2012. PE - Endangered; PT - Threatened; PR - Rare; PX/SX - Extripated; CA - Candidate at Risk; CR - C

[4] U.S Fish and Wildlife Service. 2008. New England Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. Atlantic Coast Joint Venture, Hadley, MA: Regoin 5, Fish and Wildlife Service, U.S. Department of the Interior. *http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf*; accessed January 2012. HH - Highest Priority; H - High Priority; M - Moderate Priority

[5] Partners in Flight. April 1999. Partners in Flight: Mid-Atlantic Coastal Plain Bird Conservation Plan (Physiographic Area #44) Version 1.0. Williamsburg, VA. Prioritization Rankings = 1 (Highest) - 5 (Lowest).

[6] U.S. Fish and Wildlife Service. December 2009. North Atlantic Landscape Conservation Cooperative Development and Operations Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Northeast Region. Hadley, MA. 38 pp.

[7] U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. Division of Migratory Bird Management, Arlington, Virginia. 93 pp. Online version available at: *http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf*; accessed January 2012.

[8] Pennsylvania Game Commission/Pennsylvania Fish and Boat Commission. Accessed December 2008. State Wildlife Action Plan. Available online at *http://www.portal.state.pa.us/portal/server.pt?open=514&objID=622722&mode=2*; accessed January 2012. IC - Immediate Concern (Tier 1); HC - High Level Concern (Tier 2); R - Responsibility Species (Tier 3); V- Vulnerable Species (Tier 4); MC - Maintenance Concern (Tier 5)

[9] Clark and Niles. 2000. North American Shorebird Conservation Plan. Atlantic Flyway Priorities. Woodbine, NJ.

[10] James A. Kushlan, Melanie J. Steinkamp, Katharine C. Parsons, Jack Capp, Martin Acosta Cruz, Malcolm Coulter, Ian Davidson, Loney Dickson, Naomi Edelson, Richard Elliot, R. Michael Erwin, Scott Hatch, Stephen Kress, Robert Milko, Steve Miller, Kyra Mills, Richard Paul, Roberto Phillips, Jorge E. Saliva, Bill Sydeman, John Trapp, Jennifer Wheeler, and Kent Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC. Online version available at: *http://www.waterbirdconservation.org/pdfs/plan_files/complete.pdf*; accessed January 2012.

[11] Atlantic Coast Joint Venture. February 2007. North American Waterfowl Management Plan: Continental Progress Assessment. Population Trend Data = I - Increasing; D - Decreasing; NT - No Trend.

Appendix D.
Known Vegetation of John Heinz National Wildlife Refuge

Known vegetation data is compiled from meander surveys conducted throughout John Heinz NWR in summer and fall of 2005. It is not intended as an exhaustive list or survey of the refuge, but provided for informational purposes.

Species identified as “invasive” are those listed as such by Pennsylvania Department of Conservation and Natural Resources. Additional species listed as “nonnative” may be ecologically aggressive and may require management.

Scientific Name	Common Name	Native/Nonnative/Invasive
Acer negundo	boxelder	Native
Acer platanoides	Norway maple	Invasive
Acer rubrum	red maple	Native
Acer rubrum	red maple	Native
Acer saccharinum	silver maple	Native
Acer saccharinum	silver maple	Native
Aesclepius syriaca	common milkweed	Native
Aesclepius incarnata	swamp milkweed	Native
Ailanthus altissema	tree-of-heaven	Invasive
Alliaria petiolata	garlic mustard	Invasive
Ambrosia artimisiifolia	common ragweed	Native
Amorpha frutescens	wild false indigo	Native
Ampelopsis brevipedunculata	porcelainberry	Invasive
Andropogon gerardii	big bluestem	Native
Andropogon virginicus	broomsedge	Native
Apocynum cannabinum	dogbane	Native
Artemisia vulgaris	mugwort	Nonnative
Aster divaricatus	white wood aster	Native
Aster novae-angliae	New England aster	Native
Baccharis halmifolia	groundsel-tree	Native
Bidens laevis	tickseed sunflower	Native
Boehmeria cylindrica	false nettle	Native
Calamagrostis canadensis	bottlebrush grass	Native
Carex stricta	tussock sedge	Native
Carex. spp.	unidentified sedge species	Native
Celtis occidentalis	hackberry	Native
Cephalanthus occidentalis	buttonbush	Native
Celastrus orbiculatus	Oriental bittersweet	Invasive
Cirsium vulgare	bull thistle	Invasive
Clematis spp.	unidentified clematis species	Unknown
Commelina communis	Asiatic dayflower	Nonnative
Conyza canadensis	horseweed	Native

Scientific Name	Common Name	Native/Nonnative/Invasive
Cornus amomum	silky dogwood	Native
Crategus spp.	hawthorn	Native
Dactylis glomerata	orchardgrass	Nonnative
Daucus carota	Queen Anne's lace	Nonnative
Digitaria sanguinalis	crabgrass	Nonnative
Echinacea purpurea	purple coneflower	Native
Elymus riparius	riparian rye	Native
Elymus virginicus	Virginia wild rye	Native
Erigeron spp.	daisy fleabane	Native
Eupatorium rugosum	white snakeroot	Native
Gleditsia triacanthus	honey locust	Native
Helianthus giganteus	swamp sunflower	Native
Heteranthera spp.	unidentified mud-plantain	Native
Hibiscus moscheutos	hibiscus	Native
Humulus japonica	Japanese hops	Invasive
Ilex verticillata	winterberry	Native
Iris versicolor	blue flag iris	Native
Juglans nigra	black walnut	Native
Juncus effusus	dark green bulrush	Native
Juncus tenuis	path rush	Native
Lamium amplexicaule	henbit	Nonnative
Ligustrum vulgare	Chinese privet	Invasive
Lindera benzoin	spicebush	Native
Liquidambar styraciflua	sweetgum	Native
Liriodendron tulipfera	tulip poplar	Native
Lonicera maackii or tartarica	shrub honeysuckle	Invasive
Lonicera japonica	Japanese honeysuckle	Invasive
Ludwigia palustris	marsh-purslane	Native
Lythrum salicaria	purple loosestrife	Invasive
Malus spp.	unidentified crabapple species	Unknown
Microstegium vinemeum	Japanese stiltgrass	Invasive
Monarda fistulosum	wild bergamot	Native
Morus alba	white mulberry	Nonnative
Morus papyrifera	paper mulberry	Nonnative
Nuphar lutea	spadderdock	Native
Nyssa sylvatica	blackgum	Native
Onoclea sensibilis	sensitive fern	Native
Panicum virgatum	switchgrass	Native
Parthenosis quinquifolia	Virginia creeper	Native
Paulownia tomentosa	Paulownia tree	Nonnative
Phytolacca americana	pokeweed	Native

Scientific Name	Common Name	Native/Nonnative/Invasive
Pinus strobus	eastern white pine	Native
Platanus occidentalis	American sycamore	Native
Pluchea odorata	marsh fleabane	Native
Polyganum cespitosum	long-bristled smartweed	Native
Polyganum cuspidatum	Japanese knotweed	Invasive
Polyganum lapthifolium	white smartweed	Native
Polyganum perfoliatum	mile-a-minute vine	Invasive
Polyganum sagittatum	arrow-leaved tearthumb	Native
Pontederia cordata	pickerelweed	Native
Populus canescans	gray poplar	Nonnative
Populus deltoides	eastern cottonwood	Native
Populus grandidentata	big-toothed aspen	Native
Prunus serotina	black cherry	Native
Quercus alba	white oak	Native
Quercus palustris	pin oak	Native
Quercus phellos	willow oak	Native
Rhus glabra	smooth sumac	Native
Robinia pseudoacacia	black locust	Native
Rosa multiflora	multiflora rose	Invasive
Rubus allegheniensis	blackberry	Native
Rubus occidentalis	raspberry	Native
Rubus phoenicolasius	wineberry	Nonnative
Rudbeckia triloba	gray-headed coneflower	Native
Salix fragilis	crack willow	Nonnative
Salix nigra	black willow	Native
Sambucus canadensis	elderberry	Native
Sassafras albidum	sassafras	Native
Scirpus cyperinus	woolgrass	Native
Setaria spp.	unidentified foxtail species	Nonnative
Solidago spp.	unidentified goldenrod species	Native
Sonchus oleraceus	sow thistle	Nonnative
Sorghastrum nutans	Indiangrass	Native
Toxidendron radicans	Poison ivy	Native
Typha angustifolia	narrow leaved cattail	Native
Typha latifolia	broad leaved cattail	Native
Ulmus americana	American elm	Native
Urtica dioica	common nettle	Native
Viburnum dentatum	arrowwood viburnum	Native
Vicia spp.	crown vetch	Nonnative

Scientific Name	Common Name	Native/Nonnative/Invasive
Vinca minor	periwinkle	Nonnative
Vitis spp.	unidentified grape species	Native
Wisteria floribunda	Chinese wisteria	Nonnative
Ziziania aquatica	wildrice	Native

Composition of Species	Number	Percent
Native	82	67
Nonnative	17	14
Invasive	15	12

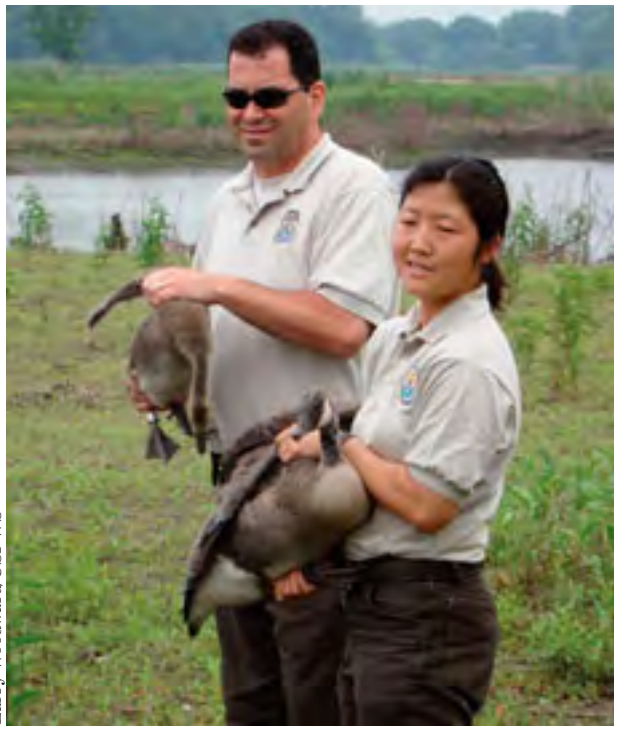
Appendix E.
Nonbird Animal Species of John Heinz NWR

Species included in this list are those observed onsite by refuge staff and volunteers as well as additional species found commonly throughout Philadelphia County according to the Pennsylvania Natural Heritage Program.

Scientific Name	Common Name
Reptiles	
Thamnophis sirtalis	eastern garter snake
Chrysemys picta	painted turtle
Chelydra serpentina	snapping turtle
Sternotherus odoratus	stinkpot turtle
Pseudemys rubriventris	red-bellied turtle
Trachemys scripta elegans	red-eared slider
Kinosternon subrubrum	eastern mud turtle
Terrapene c. carolina	eastern box turtle
Malaclemys t. terrapin	northern diamond-backed terrapin
Storeria dekayi dekayi	northern brown snake
Nerodia sipedon	northern water snake
Amphibians	
Lithobates catesbeianus	bullfrog
Lithobates clamitans	green frog
Plethodon cinereus	red-backed salamander
Anaxyrus americanus	American toad
Pseudacris crucifer	spring peeper
Anaxyrus fowleri	Fowler’s toad
Lithobates palustris	pickerel frog
Lithobates sphenocephalus	Coastal Plain (southern) leopard frog
Mammals	
Blarina brevicauda	northern short-tailed shrew
Castor canadensis	beaver
Cryptotis parva	least shrew
Didelphis virginiana	opossum
Lontra canadensis	northern river otter
Marmota monax	Woodchuck or groundhog
Mephitis mephitis	skunk
Microtus pennsylvanicus	meadow vole
Mus musculus	house mouse
Mustela frenata	long-tailed weasel
Odocoileus virginianus	white-tailed deer
Ondatra zibethicus	muskrat
Peromyscus leucopus	white-footed mouse

Scientific Name	Common Name
Procyon lotor	raccoon
Rattus norvegicus	Norway rat
Sciurus carolinensis	gray squirrel
Sylvilagus floridanus	eastern cottontail
Tamias striatus	eastern chipmunk
Vulpes vulpes	red fox

Appendix D

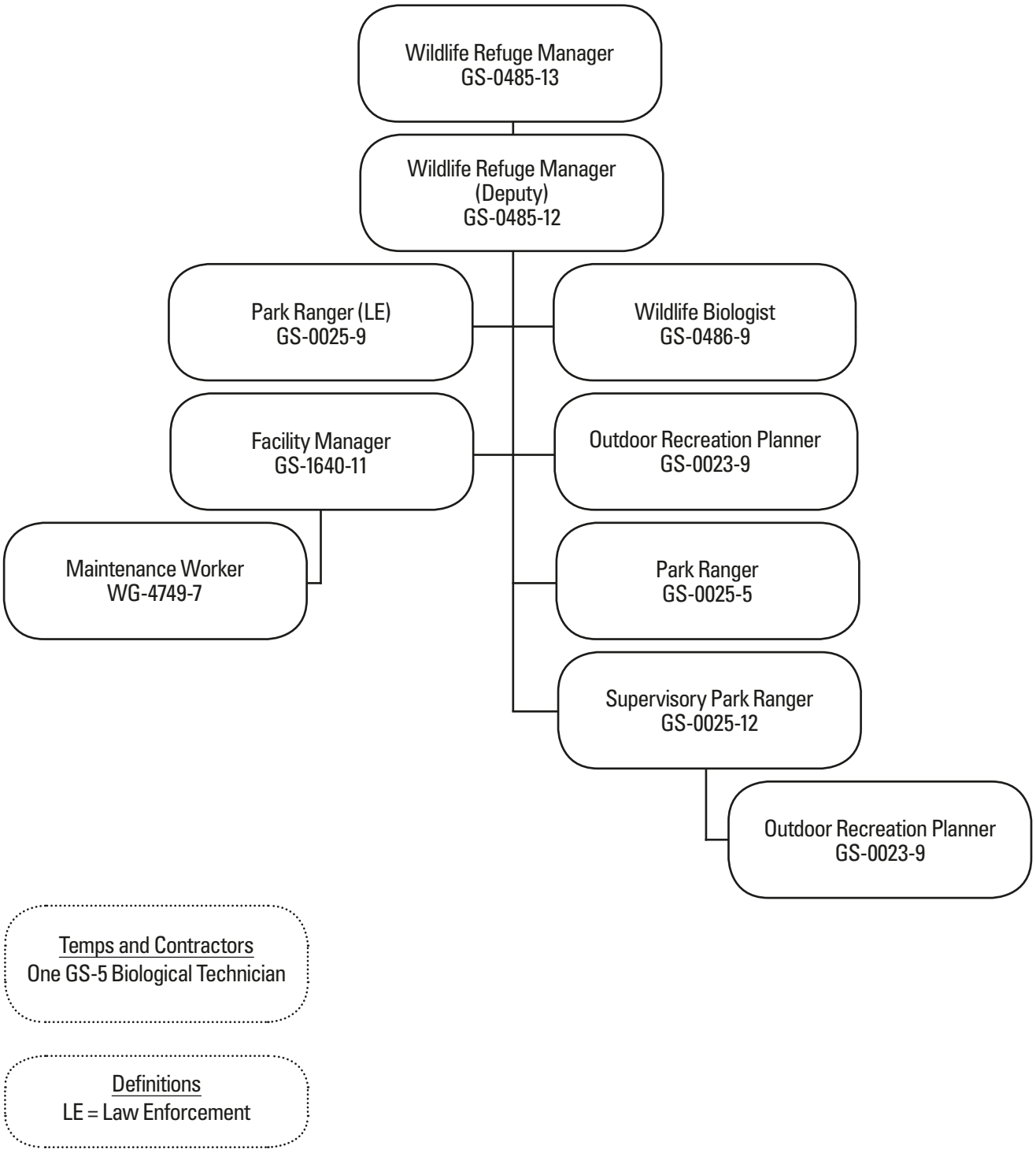


Larry Woodward/USFWS

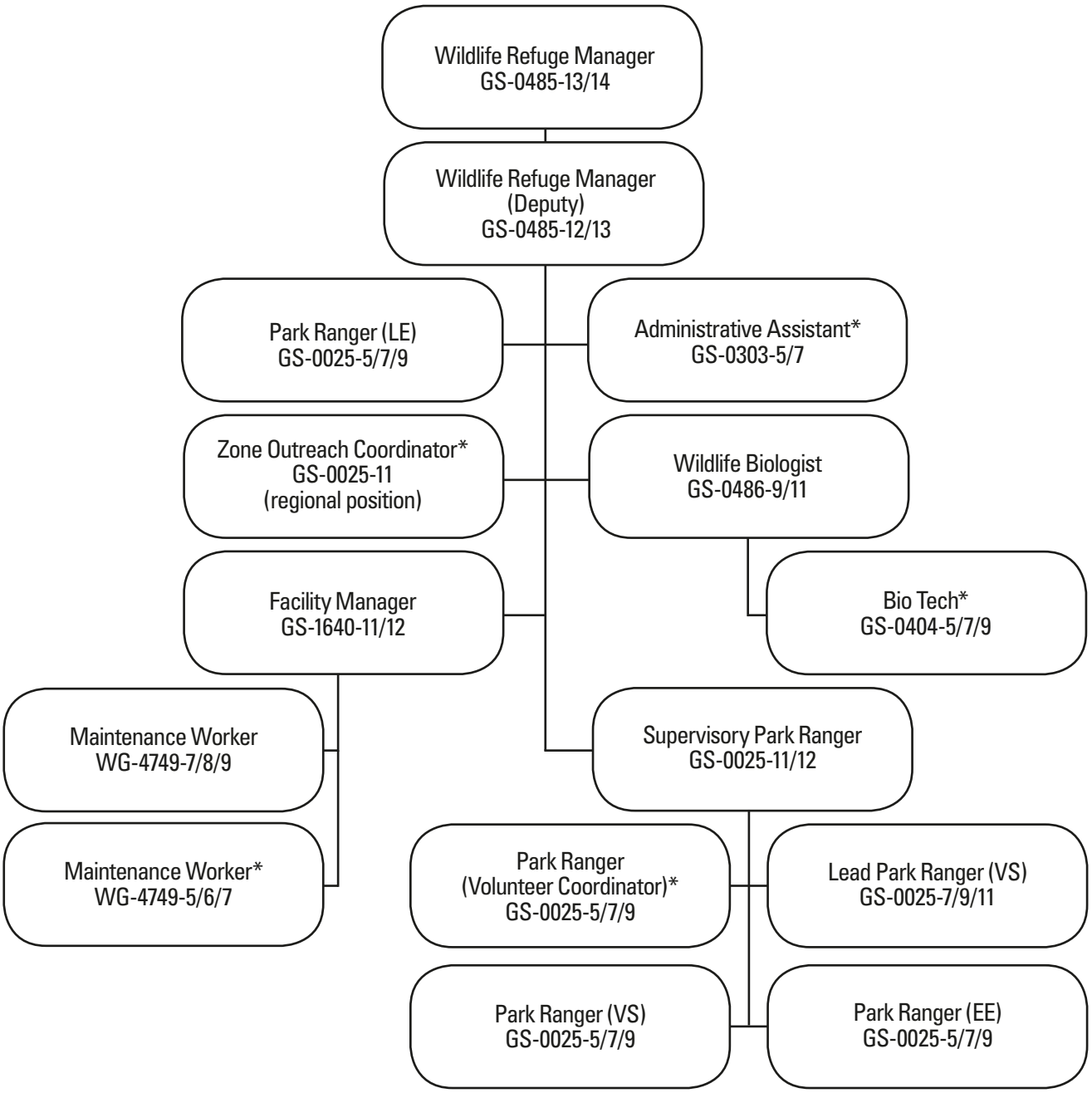
Refuge staff assisting with waterfowl removal during a restoration project construction

Refuge Staffing Charts

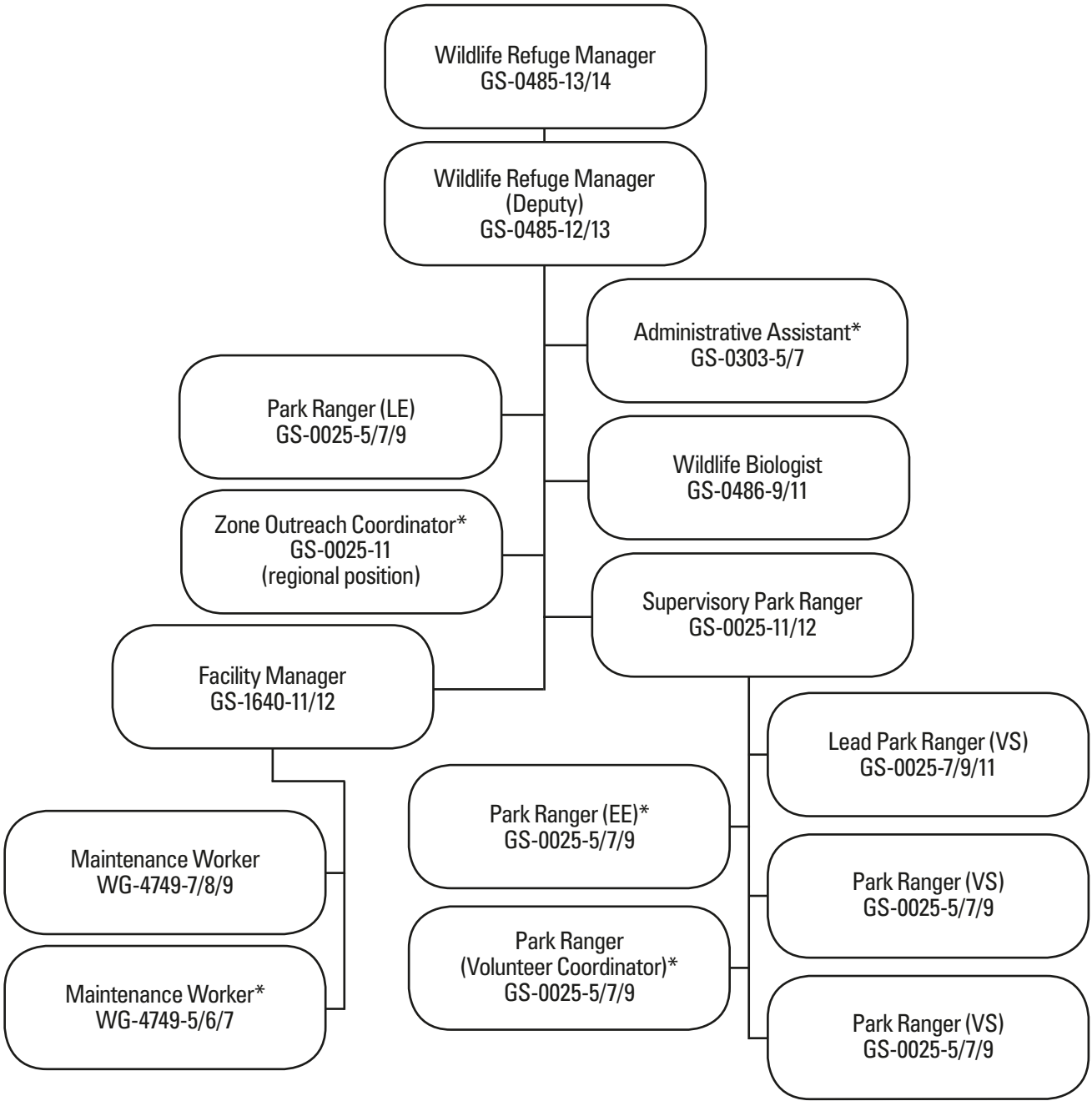
Alternative A: Staffing



Alternative B: Staffing



Alternative C: Staffing



Definitions
LE = Law Enforcement
VS = Visitor Services
EE = Environmental Education

One Biological Technician GS-0404-5 (STEP)

One Park Ranger GS-0025-5 (STEP)

One Biologist GS-0401-12 (25% Heinz NWR/ 75% Great Swamp NWR

* = new position

Appendix E

Larry Woodward/USFWS

Marsh restoration project construction

Refuge Operating Needs System (RONS) and Service Asset Maintenance Management System (SAMMS)

Budget and Refuge Operations Needs System (RONS) Projects for John Heinz National Wildlife Refuge at Tinicum

Staffing Model Positions-Non LE

Predicted	Currently Authorized	New
14	9	5

Staffing Model Positions-LE

Predicted	Currently Authorized	New
2	1	1

RONS Project Positions-Non LE

Number	Cost
5	$524,189

RONS Project Positions-LE

Number	Cost
1	$150,000

Table E.1. Refuge Operations and Needs System (RONS) table.

Project Type	Project #	Project Title	Complete	Station Rank	One-Time	Recurring Cost	Total First Year Need
Project	FY08-4184	Park Ranger-Outreach/Education/ Resource Management	Yes	1		$104,267	$104,267
Project	FY08-4154	Staff Education Center and Improve administrative efficiencies	Yes	2		$85,243	$85,243
Project	FY08-3634	Remove and control 112 acres of invasive species	Yes	3	$80,000	$5,000	$132,357
Project	FY08-3678	Conduct long term monitoring and management of deer herd	Yes	5	$45,000	$15,000	$98,231
Project	FY-08-4171	Provide Metro Educational Programs and Public Outreach	Yes	6		$126,146	$126,146
Project	FY08-4168	Increase capacity of refuge volunteer program	Yes	7		$104,267	$104,267
Project	FY08-4166	Increase capacity of refuge volunteer and visitor program	Yes	8		$104,267	$104,267
Project	FY08-3666	Create/maintain habitat for endangered leopard frog	Yes	9	$40,000	$20,000	$96,231
Project	FY10-1446	Provide Visitor, Resource, and Facility Protection (Law Enforcement	Yes	10		$150,000	$150,000
Project	FY10-2445	Address Superfund and other refuge contaminant issues	Yes	12		$15,000	$99,000
Draft	FY10-2332	Superfund Contaminants Biologist	Yes	13		$151,200	$151,200

Service Asset Maintenance Management Systems (SAMMS) Projects for John Heinz National Wildlife Refuge at Tinicum

Table E.2. Service Asset Maintenance Management Systems (SAMMS) table.

Work Order #	Description	Estimated Costs	Additional Comments
04133625	Replace water control structure	$363,000.00	
04133628	repair asphalt roads and parking lot @ maintenance compound	$85,000.00	
2005256644	Rehab Cross-Dike slope	$88,000.00	
2005256667	Replace trail kiosk and blinds	$37,500.00	
2005256677	Rehab Trolley Bed Dike and Dike Road	none	
2006422797	Rehab CEEC exhibit wing flooring	none	
2006506784	Construct low impact boardwalk / trail	$71,200.00	Project note: 5/29/09 $209,000.00 to $200,000.00 reduce allocation requested in FY 2012
2006506791	Construct 30 acres of filled tidal marsh	none	
2007716434	Rehab storage bldg. by replacing doors, windows, gutters	$10,744.40	
2007726677	Replace SR 420 fishing pier	none	
2007731479	Construct visitor information kiosk @ both sides of SR 420	none	
2007732327	Construct interpretive sign panels	none	
2007732861	Construct accessible trail connection & fishing pier	none	
2008867335	Deteriorated 16 Acre Pond parking lot	none	
2009917687	Construct energy efficient housing	$1,303,000.00	
2009942946	Construct pavillion at visitor facility	$100,000.00	
2009945308	Rehab CEEC exhibit wing electrical system, plan year 2013	$303,900.00	Approval date 9/28/09
2009956544	Environmental Ed. Center 20 KW solar PV system, plan year 2011	$225,000.00	
2010121803	Rehab CEEC leaking metal roof	$125,000.00	
91104568	Rehab Trolley Bed Dike slope	$51,000.00	
93104560	Rehab Cross Dike slope	$88,000.00	
98104566	Replace Trail kiosks and blinds, plan year 2015	$37,500.00	

Appendix F

USFWS

Prescribed fire is an important management tool for a variety of habitats.

Fire Management Plan

WILDLAND FIRE MANAGEMENT PLAN
John Heinz National Wildlife Refuge at Tinicum

Prepared by: Brandalee Phillips — 1/20/2006
Brandalee Phillips — Date
Refuge Biologist
John Heinz National Wildlife Refuge at Tinicum

2/15/2006
Michael G Durfee — Date
Zone Fire Management Officer – Wallkill River NWR
Region 5 Central Zone, US Fish and Wildlife Service

Concurred by: for — 1/20/2006
Kate McManus — Date
Refuge Manager
John Heinz National Wildlife Refuge at Tinicum

3/13/2006
Allen Carter — Date
Fire Management Branch Chief – Region 5
Northeast Region, US Fish and Wildlife Service

3-24-06 3/24/06
Susan McMahon — Date
Deputy Chief, National Wildlife Refuge System
Northeast Region, US Fish and Wildlife Service

Approved by: — 3-29-06
Marvin Moriarty — Date
ACTING
Regional Director
Northeast Region, US Fish and Wildlife Service

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I. Introduction

A. Need and Reason for the Plan

The Department of the Interior (Department, DOI) fire management policy requires that all refuges with vegetation that can sustain fire must have a Fire Management Plan (FMP) that details fire management guidelines for operational procedures and values to be protected / enhanced. The FMP for John Heinz National Wildlife Refuge (NWR, refuge) at Tinicum will provide guidance on preparedness, wildland fire suppression, fire prevention, and interface and fuels management. Values to be considered in the FMP include: protection of visiting public, refuge properties, structures and improvements, cultural and historical sites, protection of neighboring private properties, protection of endangered / threatened / and species of concern, and enhancement of refuge habitats. The FMP will be reviewed periodically to ensure the fire program advances and evolves with the U.S. Fish and Wildlife Service (Service, USFWS) and John Heinz NWR at Tinicum mission.

B. Fire Management Plan as related to Refuge Management Objectives.

- Uncontrolled wildfire has the potential for negative impacts (out of season, wind events, fire trespass, destruction of real property, burning onto neighboring properties, diminished visibility on bordering Philadelphia International Airport and Interstate Highway 95 (smoke cover may endanger aircraft and vehicular traffic)).
- Nonfire treatments are an important tool for reducing hazardous fuels in the urban interface while restoring and maintaining refuge habitats. It also affords the opportunity to interpret the treatments to the visitors to the refuge.
- The majority of hazardous fuels on the refuge are invasive species; nonfire treatments, along with other tools of an Integrated Management Plan, will reduce invasive species and make areas available for growth of native vegetation and/or possible restoration.
- In existing restoration areas on the refuge, removal of the invasive species *Phragmites austrialis,* has allowed State-listed species of concern to recur, including *Cyperus engelmannii, Pluchea odorata, Echinochloa walteri, Zizania aquatica,* and *Sagittaria calycina.*
- Interpretive displays can be set up to inform the general public of the threats from invasive species and the treatments being used to control them.

C. Annual Fire Management Plan Review

The refuge manager will review the FMP annually to determine if additions, deletions, or changes warrant reapproval of the plan.

Upon completion of the CCP and Habitat Management Plan (HMP), the FMP will be reviewed to determine if any goals, objectives, or strategies need to be revised in light of the decisions resulting from the HMP process.

D. NEPA Compliance.

This initial FMP for John Heinz NWR addresses protection from wildfire through preparedness, suppression actions, and nonfire fuel treatments. Wildland fire is an unplanned event and as such, involves no decision for public input on environmental effects. Nonfire fuel treatments are addressed in other management plans and documents. This plan qualifies for a Categorical Exclusion under the National Environmental Policy Act (NEPA). The plan is not anticipated to individually or cumulatively have significant adverse impacts on the environment. Activities above are included in the Services actions designated as NEPA categorical exclusions in 516 DM 6 Appendix 1, 1.4 B. (5) and would not be exceptions to categorical exclusions (516 DM 2, Appendix 2). This plan also meets requirements of the National Historic Preservation Act and the Endangered Species Act.

The bald eagle is the only known federally listed threatened or endangered species which occurs on the refuge. The bald eagle does not nest on the refuge but does feed in the refuge impoundment and marshes throughout the year. When the refuge initiates a fire management activity, it will comply with Section 7 requirements (Appendix A).

Staff will continue to consult with the Service's Regional Historic Preservation Office (RHPO) and State Historic Preservation Officer (SHPO) in identifying sensitive cultural resource sites, and ensuring that known or suspected sites are not disrupted.

E. Collaborative Opportunities.

Development of the FMP has been a collaborative process with Federal, State, and local partners including the Service, PA Department of Conservation and Natural Resources, Bureau of Forestry, and various local fire departments. Partner involvement will continue to be critical to implementing successful wildland fire prevention, suppression, and other nonfire fuels treatments.

F. Authority and Guidance.

- Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C.594): authorizes the Secretary of the Interior to protect from fire, lands under the jurisdiction of the Department directly or in cooperation with other Federal agencies, states, or owners of timber.
- Economy Act of June 30, 1932: authorizes contracts for services with other Federal agencies.
- Reciprocal Fire Protection Act of May 27, 1955 (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b): authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency lands in suppressing fires when no agreement exists.
- Disaster Relief Act of May 22, 1974 (88 Stat. 143; 42 U.S.C. 5121): authorizes Federal agencies to assist state and local governments during emergency or major disaster by direction of the President.

- National Wildlife Refuge System Administrative Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd et seq.: defines the National Wildlife Refuge System as including wildlife refuges, areas for the protection, and conservation of fish and wildlife which are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas. It also establishes a conservation mission for the Refuge System, defines guiding principles, and directs the Secretary of the Interior to ensure that biological integrity and environmental health of the system are maintained and that growth of the system supports the mission.
- Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat. 1535; 15 U.S.C.2201): provides for reimbursement to state or local fire services for costs of firefighting on Federal property.
- Wildfire Suppression Assistance Act of 1989. (Pub.L. 100-428, as amended by Pub.L 101- 11, April 7, 1989).
- Departmental Manual, Part 620 DM Chapter 1, Wildland Fire Management General Policy and Procedures (April 10, 1998): defines Department of Interior Fire Management Policies.
- National Environmental Policy Act of 1969: regulations implementing NEPA encourages the combination of environmental comments with other agency documents to reduce duplication and paperwork (40 CFR 1500.4(o) and 1506.4).
- Clean Air Act (42 United State Code (USO) 7401 et seq.): requires states to attain and maintain the national ambient air quality standards adopted to protect health and welfare. This encourages states to implement smoke management programs to mitigate the public health and welfare impacts of wildland and prescribed fires managed for resource benefit.
- Endangered Species Act of 1973.
- Federal Fire policy of 1995.

II. Relationship to Refuge Management Planning/Fire Policy

A. Agency Policy

The U.S. Fish and Wildlife Service fire policy is tiered to 620 DM 1 of the Departmental Manual (April 1998) and is contained in 621 FW 1 of the Service Manual (February 2000) and the Fire Management Handbook. The following key points summarize the information contained in these manuals:

- Firefighter and public safety is the first priority of the Fire Management Program.
- Only trained and qualified people will conduct fire management duties.
- Trained and certified employees will participate in the wildland fire management program as the situation demands. Agency administrators are responsible and accountable, and will make employees available to participate in the program.
- Fire management activities will be conducted on an interagency basis with the involvement of all partners when appropriate.
- An approved FMP must be in place for all of our lands with burnable vegetation.

- We will integrate fire as an ecological process into resource management plans and activities on a landscape scale, across bureau boundaries, based on the best available science.
- We will use wildland fire to meet identified resource management objectives when appropriate and the FMP contains such direction.
- We will employ prescribed fire whenever it is an appropriate tool for managing our resources, and will protect against unwanted wildland fire whenever it threatens human life, property, and natural or cultural resources. Once we commit people to an incident, these human resources become the highest value we protect. If we must prioritize between property and natural or cultural resources, we will base the decision on relative protection values, commensurate with fire management costs.
- Regions will provide safe, cost-effective fire management programs in support of land, natural, and cultural resource management plans through appropriate planning, staffing, training, and equipment.
- Management actions we take on wildland fires will consider firefighter and public safety, be cost effective, consider benefits and protection values, and be consistent with natural and cultural resource objectives.

B. Relationship of FMP to Enabling Legislation and Purpose

Under Public Law 92-326 (86 Stat. 392), passed by Congress in June,1972, authorization was given to the Secretary of the Interior to acquire 1,200 acres to establish the Tinicum National Environmental Center to be administered as a unit of the National Wildlife Refuge System. In November 1991, the name of the refuge was changed to John Heinz National Wildlife Refuge at Tinicum to honor the late Senator who helped preserve Tinicum Marsh. The refuge currently holds title to a little over 993 of the authorized 1,200 acres (Figure 1).

John Heinz NWR at Tinicum was established to preserve and restore the natural resources of Tinicum Marsh, which represents the largest freshwater tidal marsh that remains in Pennsylvania. It is an urban wildlife refuge located in southeastern Pennsylvania within Delaware County and the City and County of Philadelphia (Figure 2). The areas surrounding the refuge are highly urbanized and include Philadelphia International Airport and industrial, commercial, and residential areas. Over the years, the refuge has been a resting and feeding area for more than 300 species of birds, 80 of which nest on the refuge. Fox, deer, muskrat, turtles, fish, frogs, and a wide variety of wildflowers and other plants also call the refuge "home." The refuge is a designated Important Bird Area and an Important Mammal Area. The refuge adjoins or includes portions of six municipalities within Delaware County - Tinicum Township, Ridley Township, Borough of Prospect Park, Borough of Norwood, Borough of Folcroft, and Darby Township.

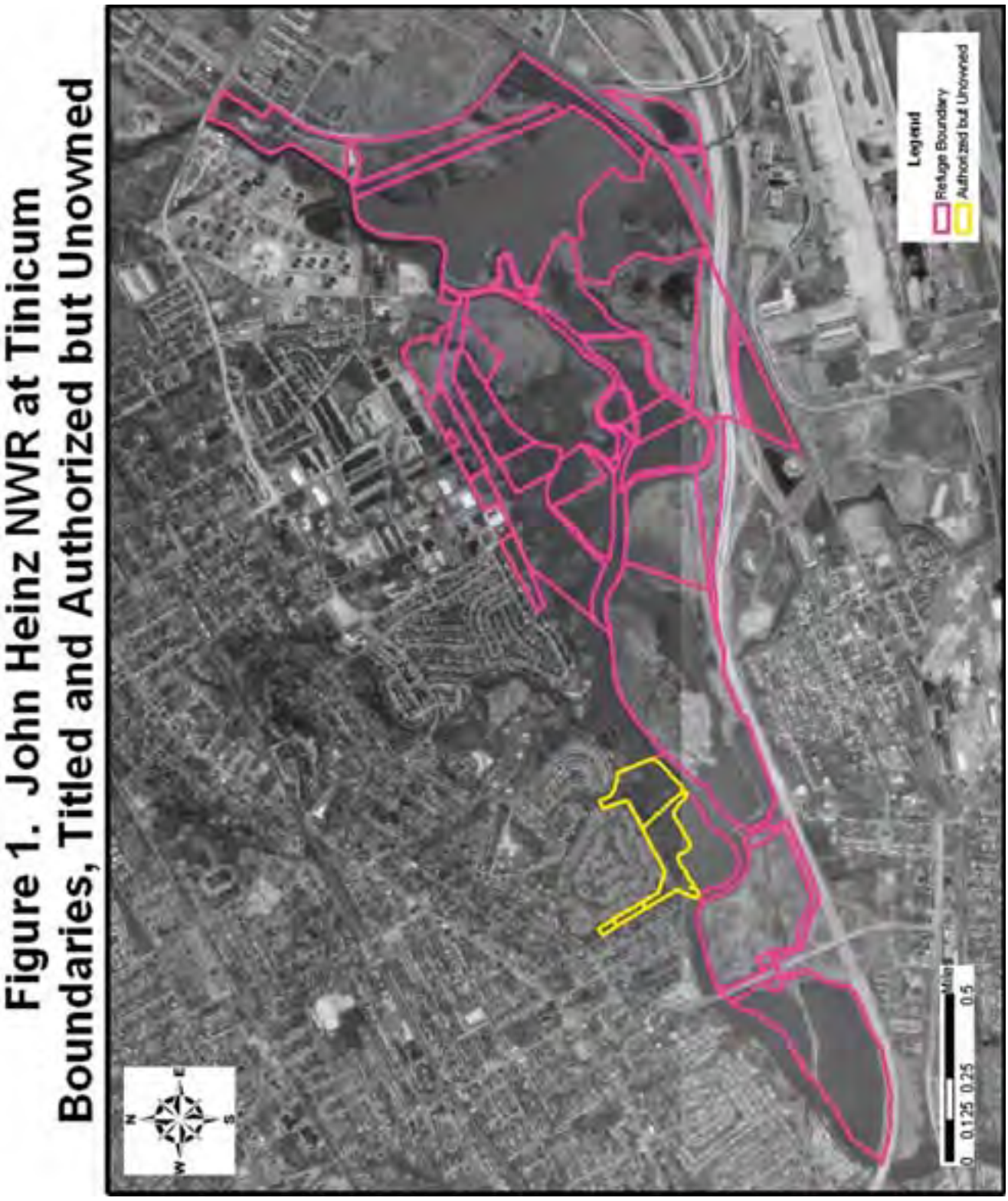


Figure 1. John Heinz NWR at Tinicum
Boundaries, Titled and Authorized but Unowned
Legend
Refuge Boundary
Authorized but Unowned
N
E
S
W
0 0.125 0.25 0.5

Figure 2. John Heinz NWR at Tinicum and surrounding communities

C. Significant Resources and Values

John Heinz NWR at Tinicum was established to preserve and restore the remaining 200 acres of Tinicum Marsh and its associated habitats. Tinicum Marsh is the largest remaining freshwater tidal marsh in Pennsylvania. Its location on the Atlantic flyway makes it important to migrating waterfowl and shorebirds.

Cusano Environmental Education Center, which opened in January 2001, is a multi-million dollar "green" building that has won numerous awards for its' design. The mission of the Cusano Environmental Education Center is to demonstrate, within an urban setting, the importance of the natural world to the human quality of life and inspire visitors to become responsible stewards of the environment. The Center features a resource library, classrooms for study, public meeting space, and exhibits on Tinicum Marsh, wetlands, watersheds, citizen action, and the Service. The Center is visited by over 6,000 school children and other visitors annually.

D. Other Management Plans

The refuge's 1980 master plan implemented the goals and objectives of habitat restoration, habitat enhancement, and environmental education.

E. Refuge Goals

The Service, to fulfill the intent of Congress and in keeping with its overall mission for the National Wildlife Refuge System, have recognized three major purposes of John Heinz NWR:

- To preserve and restore the natural resources of the Tinicum Marsh, which represents the largest freshwater tidal marsh that remains in Pennsylvania.
- To provide environmental education opportunities for the schools and residents of the surrounding region.
- To provide quality wildlife-oriented recreation opportunities for the enjoyment of people in the surrounding region when it will not interfere with the primary purpose for which the area was established.

III. Wildland Fire Management Strategies

A. General Management Considerations

1. 10-Year Comprehensive Strategy

The National Fire Plan identifies the three core principles of collaboration, priority setting, and accountability. This plan addresses these principles in the following manner:

a. Collaboration –
John Heinz NWR is surrounded by the wildland urban interface which requires a collaborative approach at all levels to achieve the goals of the fire management program. The refuge recognizes that the key to successful fire management activities (suppression and prevention) lies with the surrounding fire departments. The fire departments provide the closest forces capable of responding safely to a wildland fire incident, since the refuge itself does not maintain an initial attack suppression force. The refuge and the region will continue to support and foster these relationships by encouraging collaborative meetings for training and information sharing, and requesting their input into the fire management decisionmaking process.

Fire suppression for the refuge is covered under several cooperative agreements (Appendix B).

The Service agrees to delegate responsibility and authority of incident commander to the fire departments, in consultation with the refuge designated resource advisor, to suppress wildland fires on John Heinz NWR lands. The Service agrees to reimburse the departments for suppression costs based on a rate schedule agreed to on an annual basis. The cooperative agreement is effective for five years from date of signing.

Surrounding fire departments that provide for the suppression of all wildland fires at John Heinz NWR:

Fire Department or District	**Agreement**	**Date**
PA Bureau of Forestry, Division of Forest Fire Protection, District 17, Valley Forge		
City of Philadelphia Fire Department	X	02/25/2005
Borough of Prospect Park Fire Department	X	07/02/2004
Borough of Norwood Fire Department	X	07/20/2004
Borough of Folcroft Fire Department	X	06/28/2004
Tinicum Township		
○ Essington Fire Department	X	07/12/2004
○ Lester Fire Department	X	07/06/2004

The refuge has separate signed agreements with each fire department listed above.

b. Priority Setting –
Emphasis of the fire management program will be protection of human life and property, specifically the local community. Other priorities include the following:

- Protection of watersheds, such as the various tributaries of the Delaware River, from the undesirable effects of wildland fire
- Hazard fuel treatments to reduce fire prone invasive vegetation and maintenance of roads and trails for equipment access
- Wildland fire prevention and education programs

c. Accountability –
Establish uniform and cost-effective measures, standards, reporting processes, and budget information in implementation plans that will fold into the Government Performance and Results Act (GPRA) process. The primary GPRA performance measure relevant here is to control 95 percent of unplanned and unwanted wildland fires during initial attack.

2. Safety

The refuge manager and zone Fire Management Officer (FMO) will ensure that all fire management actions and activities are completed with safety being the first priority.

3. Endangered Species Act

Wildland fire size-up and nonfire treatments would include an assessment of the threat to State-listed and federally listed endangered, threatened, and special concern species and their habitats. Any planned activity that could affect listed or threatened species will require a section 7 consultation, unless covered by a previous consultation.

4. Clean Air Act

Prescribed fire is not planned as a management tool for the refuge, thus will be in compliance with all applicable Federal, State, and local air pollution control requirements as specified by Section 118 of the Clean Air Act, as amended in 1990.

5. Clean Water Act

Fire retardants and foams may be used within the guidelines established through the cooperative agreements and delegation of authority. Direct application of these solutions into waterways such as impoundments, inflows, stream channels, or drainage ditches should be avoided. Federal guidelines implemented in June 2000 require that application of retardants and Class A foams be avoided within a 300-foot buffer zone of waterways.

6. National Historic Preservation Act

Wildland fire size-up and nonfire treatments require an assessment of the threat to cultural resources. In the event of a new sensitive resource is discovered during any fire activity, the area will be noted and protected from further disturbance. A report will be made and the proper agencies notified. Any preplanned activities causing significant ground disturbance will have a consultation with the Regional Historic Preservation Office.

B. Wildland Fire Management Goals

The goals of John Heinz NWR fire management program support the interim goals of the refuge as outlined in II.E., and also support the principles outlined in the USDA/DOI National Fire Plan, 10-Year Comprehensive Strategy, and Cohesive Strategy:

- Ensure firefighter and public safety is the highest priority of all fire and fuels management activities.
- Suppress all wildland fires in a safe and cost-effective manner consistent with resources and values at risk.

- Develop and implement a comprehensive nonfire fuels/vegetation management program to reduce hazardous fuels and invasive species.
- Protect sensitive biological communities from the effects of wildfire.
- Utilize Minimum Impact Suppression Tactics (MIST) whenever feasible, commensurate with firefighter safety and resources to be protected to minimize opportunities for invasive species introductions when utilizing heavy equipment on wildfires, or when assessing rehabilitation and restoration needs following wildfire occurrence.
- Collaborate with local, State, and Federal partners when planning and implementing wildland fire preparedness, prevention, and suppression actions.
- Educate employees and the public about the scope and effect of wildland fire management, including fuels management, resource protection, prevention, hazard/risk assessment, mitigation and rehabilitation, and fire's role in ecosystem management.
- Identify fire management research needs, work with partners to develop proposals and obtain funding, and apply research results to fire planning through the adaptive management process.

C. Wildland Fire Management Options

Normally a fully-evolved fire management program on Department of Interior lands includes a variety of options for dealing with wildland fire:

- Wildland Fire – Full Suppression.
- Wildland Fire Use - Allow fire to assume its natural role in a fire-adapted ecosystem or to achieve resource benefits.
- Prescribed Fire - Intentionally igniting fire under carefully controlled conditions and according to an approved plan, to achieve a management objective.
- Hazard Fuels Reduction - Reduction of fuel accumulations around structures or other values at risk by mechanical, herbicide, or fire means.

The fire management program at John Heinz NWR will employ the following management options:

- Wildland Fire – Full suppression.
- Hazard Fuels Reduction - Reduction of fuel accumulations around structures or other values at risk by mechanical, herbicide, or fire means.

Associated actions needed to take effective wildland fire suppression include: preparedness, prevention, and operational planning meetings with cooperators. These will be discussed in some detail later in the plan.

Prescribed fire and wildland fire use are not considered an appropriate fire management option at John Heinz NWR due to the wildland urban interface issues associated with the Philadelphia Metropolitan Area, limited smoke management options, and low frequency of natural caused fire.

D. Wildland Fire Management Objectives and Strategies by Fire Management Unit

1. Fire Management Units

John Heinz at Tinicum NWR will be considered as one Fire Management Unit (FMU) based on size, common fuel types, expected fire behavior, suppression strategies, and management objectives. The refuge is identified as a component of the PA Fire Planning Unit (FPU) which includes all Service, National Park Service, and Forest Service land in PA used for the Fire Program Analysis (FPA).

2. Objectives

- Reduce hazardous fuel loads in the wildland urban interface through available mechanical, chemical, or biological means.
- All fires will be managed as wildland fires.
- Strive to contain 95 percent of all fires during the initial attack phase at one acre or less with no firefighter or public injuries.
- Acquire resources for a maximum response time of one half hour from time fire is reported.
- Employ MIST when possible, with special consideration given to protecting sensitive habitat and biological communities from suppression activities and fire encroachment.
- Prepare and implement an effective fire prevention plan to minimize fires and prevent human-caused wildland fires
- Prepare and present programs to educate the public regarding fire management practices and prevention within the refuge and Refuge Systemwide.

3. Strategies

- Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations.
- The incident commander, working in collaboration with the refuge manager or resource advisor, will determine the appropriate level of suppression and tactics to be employed based on considerations of human safety, actual and potential fire behavior, values to be protected, access, and expected suppression costs.
- Maintain cooperative agreements with local paid and volunteer fire departments to promote cooperative prevention and suppression activities. Provide assistance to local or Federal cooperators under the “closest resources” principles in accordance with Service policy.
- Identify areas of concern and develop response plans and tactics to expedite the initial attack and full suppression of the fire.
- MIST tactics will be employed to the maximum extent possible, given the considerations of safety, fire behavior, values, access, and cost.
- Use of dozers, skidders, and other heavy equipment will be undertaken only within the guidelines established through the cooperative agreements and delegation of authority.
- Avoid use of retardants near waterways and wetland areas.

- Develop a fuels treatment plan annually or as needed.
- Use nonfire mechanical methods and/or herbicide treatments in combination to reduce hazardous fuels in the wildland urban interface while protecting and restoring refuge habitats to natural fuel loads and native vegetation.
- Initiate cost-effective monitoring to ensure treatment objectives are being met.
- In collaboration with local and other partners, prepare and implement a fire prevention program to inform the public about wildland fire.
- Integrate fire ecology, management, and prevention themes into existing interpretive and education programs.

4. Fuel/Habitat, Weather, and Fire Behavior Characteristics

a. Fuel/Habitat Types

The generalized vegetation map (Figure 3) and table 1 offers some indication of the National Fire Danger Rating System (NFDRS) fuel models used to estimate potential fire behavior on a more localized scale and corresponding Northern Forest Fire Laboratory (NFFL) fuel models used for fire danger purposes. Particularly for the NFFL fuel models, this discussion is intended only to give a very generalized idea of the type of fire behavior which can be expected; the actual fuel model appropriate for a given acre of ground requires first-hand observation of the conditions present on the scene.

Table 1: Fuel/Habitat Types – John Heinz at Tinicum National Wildlife Refuge

Fuel/Habitat Types	Acres	%
Tidal Marsh/Tall Grass (NFFL Model 3)	580	59%
Short Grasslands (NFFL Model 1)	101	10%
Hardwood Forest (NFFL Model 9)	110	11%
Open Water/Mudflat	202	20%
Total	**993**	**100%**

b. Weather and Climate Patterns

The Delaware River moderates the area's micro-climate, and the Atlantic Ocean influences the overall weather pattern for all of southeastern PA creating a humid, temperate climate. Days below zero degrees and above 100 degrees Fahrenheit are rare. The average frost-free period runs from late April to early October. Precipitation averages about 41 inches annually and snowfall averages about 21 inches. Rainfall is heaviest during July, August, and September. Prevailing winds are from the northwest during the winter and from the southwest during the summer. Annual wind speed averages 9.3 mph with March the windiest month, and July, August, and September the least windy months. Generally, the area's weather diminishes the likelihood of a catastrophic wildfire with its high humidity, moderate rainfall, and relatively calm winds.

c. Fire Season (Occurrence) and Fire Danger Indices

The largest numbers of fires in the general area of John Heinz NWR occur in late fall and spring months (i.e. February through May and October through December). Most of the fires recorded in the DOI Fire Reporting Database occurred in March and April with some occurring in early June. However, there is potential for wildfires year-round. All fires on the refuge have been human caused and adjacent to many of the developed trails or the edge of the refuge. Most fire activity is also found in the *Phragmites* dominated areas of the refuge. All fires have been extinguished by the nearest fire department. The largest fire was in fall 1988 at 17.2 acres in the old landfill section of the refuge (appendix C).

National Fire Danger Rating System (NFDRS) data is compiled by the zone FMO for daily fire danger indices. No historical weather data is available from a refuge NFDRS weather station. Daily fire danger indices will use data compiled and averaged from the NFDRS Weather stations located at Forsythe NWR in New Jersey and Prime Hook NWR in Delaware, then compared to the indices used by the New Jersey State Forest Fire Service. Daily runs of the NFDRS grass fuel models N (sawgrass – tall) and A (annual grass-short) best represent the daily changes in the light flashy fuels due to constantly changing weather conditions. Fire danger severity and long term drought trends are best reflected using NFDRS hardwood fuel models (R and E). Fuel Model R (summer - hardwood forest) is used approximately May 15 to October 15 and Fuel Model E (winter – hardwood forest) is used approximately October 15 to May 15. These calculated indices will be used to determine the daily fire-danger rating.

d. Fire Regime

A natural fire regime is a general classification of the role fire would play across a landscape. The five natural (historical) fire regimes are classified based on the average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes include:

- I – 0 to 35 year frequency, low to mixed severity (less than 75 percent overstory replaced)
- II – 0 to 35 year frequency, high severity (greater than 75 percent overstory replaced)
- III – 35 to 100 year frequency, low to mixed severity (less than 75 percent overstory replaced)
- IV – 35 to 100 year frequency, high severity (greater than 75 percent overstory replaced)
- V – 200+ year frequency, high severity (greater than 75 percent overstory replaced)

Using the FIREMONv1.1, Fire Regime and Condition Class Field Procedures-Standard and Scorecard Methods, John Heinz NWR has two fire regime classes:

- For the grass and emergent marsh vegetation, the fire regime is II.
- The hardwood forests have a regime of III.

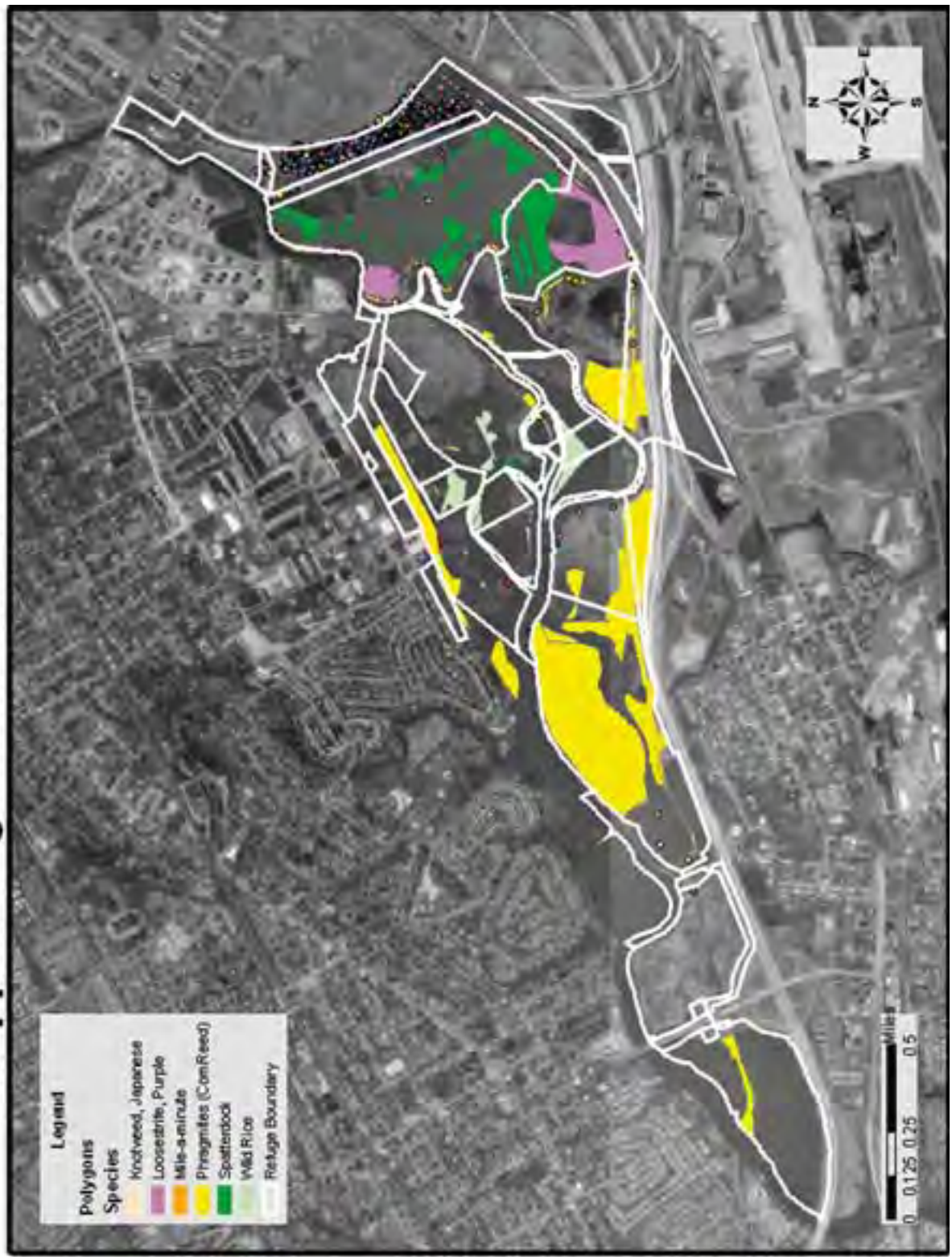


Figure 3. John Heinz NWR at Tinicum Mapped Vegetation as of December 2005

e. Potential Fire Behavior

The following fire behavior outputs are based on the average conditions found during a normal fire season using the 14:00 weather observations. These averages ranges include: temperature – 55 to 70 degrees Fahrenheit, relative humidity – 25 percent to 35 percent, mid-flame wind speed of 6 mph, and 6 percent average 1 hr (less than 1/4 inch diameter) fine dead fuel moisture. The slope is 0 to 2 percent and the rate of spread is for a head fire. The outputs are calculated from the BEHAVE - Fire Behavior Prediction Models algorithms (appendix D).

Fuel Model 3 (N) - Tidal Marsh/Tall Grass: Fires in this model display high rates of spread under the influence of wind. Wind may drive fire into the uppers heights of the grass and across standing water. Stands are tall, averaging about 3 to 6 ft., but considerable variation may occur. Approximately 1/3 or more of the stand is considered dead or cured and maintains the fire. Fuel loading is 3.0 tons/acre and consists of up to ¼ inch 1 and 10 hr dead fuel component. Fire behavior is directly related to the fuel moisture and windspeed. Short-range (up to 200 foot) spotting usually occurs and causes high to extreme control problems. The behavior output includes:

- Rate of Spread – 148.4 chains/hr (1.9 mph)
- Flame Length – 14.9 feet

Fuel Model 1 (A) - Field Grasslands: Fire spread is governed by the fine and continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material. The fire behavior is directly related to the fuel moisture and windspeed. Fuel loading is 0.74 tons/acre and consists of 1/4 inch or smaller (1 hour) dead fuel component. Spot fires are generally not produced because fuels are consumed too quickly and thoroughly. Resistance to control is low to moderate, depending on windspeed. The behavior output includes:

- Rate of Spread - 135 chains/hour (1.7 mph)
- Flame Length - 5.4 feet

Fuel Model 9 (E/R) - Deciduous Hardwood Forest: Fires are carried by dead, loosely compacted leaves and understory grasses. Wind tumbled leaves and torching trees may cause short to mid-range spotting that may increase the rate of spread above the predicted value. Fuel loading is 3.5 tons/acre and consists of less than 3 inches of dead and live fuel. Fire behavior is directly related to the fuel moisture and fuel loading with windspeed in exposed areas. Resistance to control is moderate except during drought conditions when extreme fire conditions are present. The behavior output includes:

- Rate of Spread – 11.7 chains/hr (0.2 mph)
- Flame Length – 3.4 feet

f. Historic Role of Fire

Pyne (1982) summarizes the evidence for fire in the Northeast and concludes that it is predominantly a phenomenon associated with human activity. Where human-caused fire is common, fire incidence is strongly correlated with population density, so interpreting fire history in the Northeast becomes, to some extent, a matter of interpreting human populations and trends.

One of the establishment objectives of the refuge is to protect the last remnants of the Tinicum Marsh along the Delaware River. The area has had multiple types of disturbance resulting in an altered vegetative complex and fire regimes, behavior, and occurrence.

5. Management Considerations Affecting Operational Implementation

a. Safety

Firefighter and public safety (urban interface) is always of the highest priority when determining suppression strategy and tactics. No natural resource or property value is worth exposing humans to high-risk situations. Fuels in the grasslands are light and flashy (models 3 and 1) and can pose a significant danger and is one factor of fatality fires.

b. Values at Risk

Once human safety is assured, the values to be protected play into the decision of the strategy and tactics to be employed. The most significant values at risk are the adjacent private properties. These properties include an industrial complex (oil tank farm), several light industrial facilities, multiple single and multi family houses, and the Delaware County Emergency Response Training Academy. Other areas or values that would be at risk include Interstate 95 and the Philadelphia Airport, refuge structures and improvements, and wildlife habitat.

c. Protection of Resources

Natural and cultural resources will be protected to the maximum extent feasible, but their protection will not be the highest priority. Appropriate suppression action will first and foremost ensure firefighter and public safety. When no threat to human life or damage to improvements and private property exists, protection of natural and cultural resources from fire or suppression damage will be the next highest priority. Foam suppressants or retardants should not be used within 300 feet of waterways to protect various water related resources. If new natural or cultural resources of concern are discovered during fire suppression activities, the refuge manager/resource advisor will ensure, to the extent appropriate and possible, their protection from damage related to fire-suppression activities. The refuge manager will consult with the regional historic preservation officer to avoid, minimize, or mitigate potential or actual damage to cultural resources.

d. Wildlife

Wildlife will be protected to the maximum extent feasible, but their protection will not be the highest priority. Appropriate suppression action will first and foremost ensure firefighter and public safety. When no threat to human life or damage to improvements and private property exists, protection of natural and cultural resources from fire or suppression damage will be the next highest priority. Once these concerns are protected, wildlife will be protected to the extent possible. Both birds and reptiles nest on the refuge and the areas in which the nests occur will be protected to the extent appropriate and possible. The adult birds would fly away, but the eggs and chicks still in the nests would be vulnerable to fire. Adult and hatchling turtles would most likely be in or near the water resources on the refuge, but again, the eggs in the nests would be vulnerable to the heat from the fire. Nesting for all of these species occurs primarily in spring and summer months. Mammals also breed on the refuge, but they would hopefully be able to move their young out of danger. The refuge manager and wildlife biologist would advise the incident commander of the areas of concern.

e. Minimum Impact Suppression Tactics Guidelines (MIST)

All personnel involved with fire management are expected to have an understanding of minimum impact suppression tactics Suppression efforts can sometimes cause more resource damage than the actual fire. Efforts to minimize resource damage must be a consideration with all suppression actions and shall be outlined in the cooperative agreements or delegation of authority. As a general rule, the assigned incident commander, with the input from a resource advisor, while minimizing the threat to human life and property, will evaluate the suppression resource needs and seek alternatives to mechanized equipment, limit soil movement, maintain natural water courses, and minimize land degradation. Further guidelines can be found in the Fire Management Handbook, FM 3.2.6.

The resource advisor should be an employee with resource management knowledge to advise the incident commander on issues related to mitigating the affects of suppression operations on cultural and natural resources.

f. Air Quality

Visibility and clean air are valued natural resources for John Heinz NWR and the protection of them will be given full consideration in fire management planning and operations. The station will comply with all applicable Federal, State, and local air pollution control requirements, as specified within Section 118 of the Clean Air Act, as amended (42 USO 7418). Further guidance is in the Services Fire Management Handbook.

John Heinz NWR has not been designated as a Federal area where visibility is an important issue (Federal Class I Area) under the Clean Air Act Amendments of 1977. However, due to the proximity of sensitive and critical smoke areas (i.e. the City of Philadelphia, PA, Interstate 95, and Philadelphia International Airport), smoke management and impacts became the decisive factor for not conducting prescribed burning on the refuge.

g. Access

The refuge has a series of roads and trails that provide vehicular access to most areas of the refuge. Due to the large percentage of wetlands, ground conditions need to be assessed and considered in the initial size-up before sending vehicles off the main roads. Tracked low-ground pressure vehicles or indirect tactics should be considered. Fire department personnel are authorized to use bolt cutters if necessary to remove locks for the purpose of emergency access. (Figure 4)

h. Barriers

Barriers to fire spread exist on the refuge as roads, trails, tidal marsh and wetlands, and fuel type changes (flashy grass to hardwood forest) and can be used effectively to hasten construction of control lines and minimize the impacts of constructed lines. Barriers can also be used effectively for indirect attack, as a safe location to make a stand, or as a secure place to burn out by removing fuels in front of an advancing fire.

i. Cost

The refuge manager, with input from the zone FMO or incident commander, should weigh the relative costs of various suppression and fuel treatment strategies in comparison to values at risk, being sure not to compromise safety concerns. Too many resources on an incident can elevate the costs unnecessarily. Aircraft can be an effective resource under some circumstances, but may also be unnecessary or ineffective in many situations and can greatly escalate the cost of suppression operations. The zone FMO should be consulted prior to the major expenditures of fire operation funds.

Wildland fire suppression actions require a cost code from FIRECODE. Those numbers will be generated by the zone FMO and activated by the Denver Finance Center.

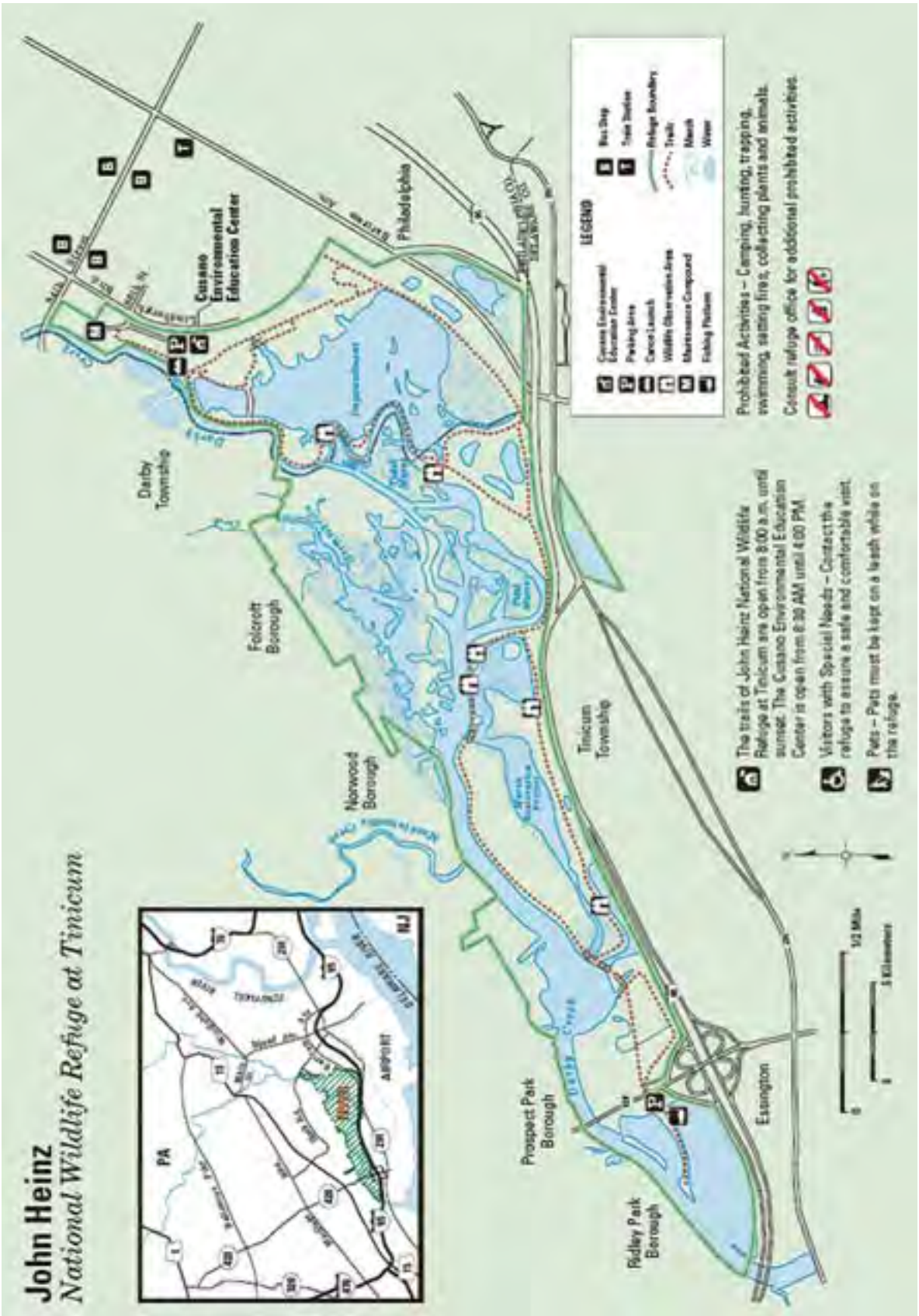
The refuge manager is responsible to assure the costs of all fire operations are properly spent and accounted for through the Federal Financial System (FFS) and Budget Tracking System (BTS) accounting systems. A quarterly expenditure report should be submitted to the zone FMO for tracking and accountability of fire operation funds.

j. Regional and National Concerns

The regional preparedness level tends to follow the national preparedness level unless the eastern seaboard is experiencing very dry conditions and a high potential for wildfire. Expect normal refuge operations to occur through National Preparedness Level IV.

At National Preparedness Level V, when local fire conditions permit, and subject to supervisory approval, all qualified individuals should be made available to meet regional and national needs.

Figure 4. John Heinz NWR at Tinicum Roads & Trails



IV. Wildland Fire Management Program Components

The full range of fire management program elements were reviewed and considered when developing this fire management plan. These include wildfire suppression (and with it the associated elements of preparedness, training, prevention, and detection), wildland fire use, prescribed fire, nonfire fuel applications, and emergency rehabilitation and restoration.

As outlined in III.C, John Heinz will implement the following elements:

- Suppression of unwanted wildland fire (wildfire).
- Reduction of fuel accumulations around structures or other values at risk by mechanical, chemical, or fire means (hazard fuels reduction).

A. Wildland Fire Suppression

1. Suppression/appropriate management response.

All fires will be appropriately suppressed. A well-established mutual aid program will be utilized for suppression operations on the refuge with procedures for local responding agencies to report the incident to the refuge manager at the John Heinz NWR office. All suppression efforts will be dictated by the following priorities:

- Life and safety
- Natural resources and property, both refuge and private

Although resource impacts of suppression alternatives should be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter and public safety and protection of the resources.

Suppression strategies should be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon the natural and cultural resources. MIST should be considered to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction should be conducted in such a way as to minimize long-term impacts to resources.

Suppression in some of the tidal marsh areas is virtually impossible from the ground. These areas are characterized by patches of marsh vegetation connected by channels and ditches producing an island-like appearance. Some of these islands have small pockets of hardwood forests. Access is the main problem to these areas; they are accessible by boat only at high tide, and virtually inaccessible at low tide. Fire suppression in these areas will occur along the perimeters to protect private property and other improvements and habitat.

2. Preparedness

a. Readiness

The refuge staff should meet with area fire department personnel semi-annually to review cooperative agreements, contact information, and fire suppression policies and procedures. They should meet with the zone FMO yearly to review and update fire management activities, plans, and updated fire program information.

b. Step-Up Actions

Due to the low level of fire occurrence, the lack of historic archived weather data upon which to calculate NFDRS indices and breaking points, the preparation of a site-specific step-up plan is not essential. However, a calculation of NFDRS indices and step-up plan break points is implemented throughout the Central Fire Management Zone (section III D 4 c.)(Appendix E).

c. Detection

Most fires on the refuge will be discovered and reported by local residence and members of the public using the area for recreation. These may or may not be reported directly to the refuge manager; it is expected that often the individual will directly contact 911 or the fire department and refuge staff may not find out about the fire until after suppression actions are completed. Environmental outreach and posted public information efforts should include information on the preferred procedures for reporting wildfires.

d. Communication

Cell phone service within the refuge is good for emergency communications purposes. A refuge radio communication system consisting of several mobile units, portable handhelds, several base stations, and a repeater tower are in place and functioning well. The system is not compatible with local fire department and State radio frequencies as many of the local departments do not wish to have outside users on their frequencies. All efforts will be made to work with the local fire departments to use a compatible form of communications during fire or related operations.

e. Training and Qualifications

The refuge will conform strictly to Service-specific guidelines as well as the National Wildfire Coordinating Group (NWCG) Publication 310-1, “Wildland and Prescribed Fire Qualification System Guide” (January 2000). Service employees participating in any wildland fire activities on Service lands must meet these requirements as well as those for fitness and personal protective equipment (PPE). More information about training, fitness, and PPE is provided in Chapter 1.5 of the Service Fire Management Handbook, and the Central Zone FMO at Wallkill River NWR. Consult with the zone FMO on arranging fire training for refuge staff.

The refuge relies on Philadelphia Metro area fire departments for initial attack response and all department members may not meet NWCG standards. This will not be a limiting factor for the first burning period of initial attack, as Federal agencies have agreed to honor the qualifications standards of assisting entities during this initial phase. Should the fire extend into additional burning periods, then by policy, all suppression personnel will need to meet NWCG standards.

Red card qualification information, such as training records, fire assignments, and physical fitness test results, are maintained through the Incident Qualifications and Certification System (IQCS). The refuge manager will submit updated qualification information annually, which is verified by the zone FMO and entered into the IQCS data base. The zone FMO will maintain a file on fire-qualified refuge personnel; the file should document the training, experience, and qualifications an individual. Each fire qualified individual should maintain a personal qualifications file.

Refuge staff with fireline qualifications must complete an annual Fireline Safety Refresher and meet required fitness level for the position qualified. For red carded fireline personal a fitness rating of arduous (pack test) is required prior to any initial or extended attack action.

f. Prevention

Most fire starts at John Heinz NWR and in the surrounding area are human caused. A documented fire history for the refuge exists in the FMIS database. The refuge has a low fire occurrence, with high to extreme fire potential on old field sites, and in monotypic stands of *Phragmites*. The borders of these areas should contain fire breaks to reduce the potential for wildfires to spread from refuge lands to adjacent private property and structures.

During periods of extreme or prolonged fire danger emergency restrictions regarding refuge operations or area closures may become necessary. Such restrictions, when imposed, will usually be consistent with those implemented by PA Division of Forest Fire Protection and local fire departments. Closures will be authorized by the project leader.

It is essential that employees be well informed about fire prevention and the objectives of the refuge's fire management program. Further, employees must be kept informed about changes in existing conditions throughout the fire season.

An active fire prevention program is, and will be, implemented in conjunction with other fire agencies to protect human life and property, and prevent damage to cultural resources or physical facilities. A program of internal and external education regarding potential fire danger will be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of preventing fires and other related fire hazards. "Smokey Bear" and other fire prevention and education materials may be obtained with the assistance of the zone and regional fire management offices

g. Public Education

The refuge, through the Cusano Environmental Education Center, has the opportunity to develop and present educational programs and exhibits educating the public on the value of fire as a natural process, and the need to prevent unwanted wildfires. Fire awareness education is important to increasing public understanding and support for fire management activities within the refuge system and other land management agencies. The refuge outreach staff should use the most appropriate and effective means to explain the overall program to include interpretive presentations addressing fire and its role in the environment, internal and external education regarding potential fire danger, bulletin board materials, and handouts

h. Community Grant Assistance

The local qualifying fire departments will be notified of any program opportunities, deadlines, and procedures.

i. Aviation

All aviation activities used at the refuge will conform to Service and Department aviation policies and the Interagency Helicopter Guidelines (IHOG). Due to the proximity of the Philadelphia International Airport and the city, all air operations must be coordinated with the Federal Aviation Administration (FAA) to avoid air traffic hazards and/or restrictions. All aviation activities will be pre-planned with a hazard/risk analysis to justify the need for the aviation resources and will be reviewed by both the regional safety officer and appropriate fire management personal prior to implementation. All aviation activities will require a pre-flight/ project safety briefing to identify any hazards or special procedures to the operation.

3. Initial Attack

All wildland fires will be suppressed with firefighter and public safety as the highest priority. Fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce smallest resource/acreage adverse impacts. Generally direct attack is the most cost-effective tactic, provided it can be done safely. Otherwise indirect tactics are necessary, as determined by the incident commander. In most cases, the local fire departments will be the primary initial attack responder to wildfires on refuge as covered under the cooperative agreements and delegation of authority (Appendix F).

a. Refuge Response

The refuge manager or designee will contact the local fire department with a request to commence initial attack action. The refuge manager will also inform the zone FMO. Qualified and available refuge staff should respond as well, performing such tasks as securing the fire origin, checking for visitors at risk, and implementing public closure at the scene. If the fire threatens to burn outside the refuge boundary, the manager will notify adjacent landowners.

b. Incident Commander

The refuge will use the Incident Command System (ICS) as a guide for suppression organization. When the responding fire department arrives, the senior officer of that department will serve as the incident commander responsible for the fire. The incident commander will brief the refuge manager on the location and status of the fire. The refuge manager will provide pertinent details on location and protection of special natural or cultural resources. The incident commander will do the following:

- Locate, size-up, and coordinate suppression actions, including briefing subordinates, directing their actions, and providing work tools.
- Provide public and firefighter safety.
- Considering current and predicted fire conditions assess need for additional suppression resources and estimate the final size of the fire. The potential for spread outside of the refuge should be predicted, as well as the total suppression force required to initiate effective containment action.
- Assess the need for law enforcement personnel for traffic control, investigations, evacuations, etc.
- Keep refuge manager informed.
- Provide information to the refuge manager so that a fire report can be prepared and provided to the zone FMO.
- Notify refuge manager when initial attack is not successful, so that planning for extended attack can begin and a Wildland Fire Situation Analysis can be developed for the next operational period.
- Other duties of the incident commander are described in the National Wildfire Coordinating Group Fireline Handbook.

c. Public Safety

Public safety will require coordination between all refuge staff and the incident commander. Notices should be posted to warn visitors, areas may be closed, and traffic control will be necessary if smoke crosses roads. Where wildland fires cross roads, burned areas adjacent to the road should be mopped up and dangerous snags felled. If needed, individuals not involved in suppression efforts may be evacuated.

4. Extended Attack

The incident commander will notify the refuge manager whenever it appears that a fire will exceed initial attack efforts, threaten Service/private lands, or when fire complexity will exceed the capabilities of command or operations. The refuge manager will be responsible for coordinating with the incident commander all extended attack actions including the following:

- Notifying the zone FMO.
- Completion and daily review of a wildland fire situation analysis (WFSA)(Zone FMO to be contacted for software and participation).
- Assignment or ordering of appropriate resources.
- Completion of delegation of authority.

5. Fire Investigation

After a wildland fire has been detected, refuge personnel should be wary of suspicious individuals or vehicles. Personnel should not disturb a fire location in the event an investigation is needed. Personnel from the responding fire department will attempt to locate and protect the probable point of fire origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene, and report findings to the incident commander. All suspicious fires will be promptly and efficiently investigated. Individuals should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel from other agencies may investigate wildland fire arson or fire incidents involving structures. All fire investigations should follow guidelines in section 4.1-2 of the Services Fire Management Handbook. The Central Zone FMO should be contacted if needed.

6. Required Reporting

The refuge manager must report all wildland fires to the Central Zone FMO who will add the fire to the Fire Management Information System (FMIS). The incident commander will be responsible for documenting decisions and completing a fire report (e.g., ICS-214, Agency Wildland Fire Report). Fire reviews will be documented and filed with the final fire report. The Zone FMO will retain a copy and will be responsible for additional required reports such as an annual regional fire summary report and meeting national fire performance measures. This report will document fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects (Appendix G).

B. Wildland Fire Use

As mentioned previously under section III.C, Wildland fire use is not considered a viable management option.

C. Prescribed Fire

As mentioned previously under section III.C, Prescribed fire is not considered a viable management option.

D. Nonfire Fuel Applications

Due to the proximity of the Philadelphia metropolitan area nonfire fuel treatments (mechanical and chemical) will be the main method to reduce fuel loads and maintain fire breaks, access, and improve the habitat by reducing the more flammable invasive and exotic vegetation. Fuels removal should be calculated in acres and reported to the Zone FMO for inclusion in the National Fire Plan Operating and Reporting System (NFPORS) as accomplished acres.

E. Emergency Rehabilitation and Restoration

Post-fire repairs will fall into one of three categories: fire suppression activity damage, emergency stabilization, and rehabilitation (620 DM 3). Fire suppression activity damage is damage to resources, lands, and facilities resulting from wildland fire suppression actions, in contrast to damages resulting from the fire itself. Repair actions are planned and performed primarily by the suppression incident organization as soon as possible prior to demobilization. The incident management team, during transition back to the local unit, must document the fire suppression activity damage repair actions accomplished and those which are still needed. Fire suppression activity damage is paid by the same Wildland Fire Suppression Operations subactivity (9141) and project code as the fire suppression effort.

Emergency stabilization may be defined as planned actions to stabilize and prevent unacceptable degradation to natural and cultural resources, to minimize threats to life or property resulting from the effects of a fire, or to repair/replace/construct physical improvements necessary to prevent degradation of land or resources. Emergency stabilization actions must be taken within one year following containment of a wildland fire. Stabilization actions must be documented in an approved plan which will describe in detail the actions proposed and costs, provision for monitoring of results, delineation of funding, and responsibilities for implementation. Funding is provided under the Wildland Fire Suppression Operations account, but using a different subactivity (9142, Emergency Stabilization) than suppression only. Funding up to $500,000 may be approved at the regional director level. Larger requests must be approved by the director. Examples of emergency stabilization actions that may be permitted include replacing or repairing minor facilities essential to public health and safety when no other options are available; placing structures to slow soil and water movement; stabilizing soils; increasing road drainage frequency and/or capacity to handle additional post-fire runoff; installing protective fences or barriers to protect treated or recovering areas; seeding to prevent establishment of invasive plants, and direct treatment of invasive plants; using integrated pest management techniques to minimize the establishment of nonnative species within the burned area; and monitoring of treatments and activities for up to 3 years.

Rehabilitation efforts are undertaken within three years of containment of a wildland fire to repair or improve fire-damaged lands unlikely to recover naturally to management approved conditions, or to repair or replace minor facilities damaged by the fire. These are long-term actions that have been already identified in approved land management plans. A rehabilitation plan will be written as a separate plan, independent of an emergency stabilization plan. Funding must be approved on a priority basis by the National Burned Area Emergency Rehab (BAER) Coordinators in consultation with the Office of Wildland Fire Coordination. Funds will fall under a burned area rehabilitation subactivity, not the Wildland Fire Operations account. Allowable actions may include chemical, manual, and mechanical removal of invasive species, and planting of native species to restore or establish a healthy, stable ecosystem; tree planting to reestablish burned habitat, reestablish native tree species lost in fire, and prevent establishment of invasive plants; and repair or replace fire damage to minor operating facilities such as campgrounds, interpretive signs and exhibits, and fences.

V. Organization and Budget

A. Organization

The organizational structure for meeting fire program needs within this plan is based on a Service zone concept. The zone FMO, located at Wallkill River National Wildlife Refuge in New Jersey is the principal contact for technical support and assistance in fire management. In addition, there are other fire-funded positions in the zone that could assist in plan implementation.

1. Refuge Manager

The refuge manager is responsible for the full range of management duties within the refuge including fire management activities that implement an effective fire management program. Appropriate action will be taken by the refuge manager for fires on or adjacent to refuge lands. Related fire management activities include delegation of authority, designation of resource advisors on incidents, implementing extended initial attack organizations, developing cooperative agreements with local fire departments and State agencies, and authorizing the use of vehicles and heavy equipment within designated resource sensitive areas of the refuge.

2. Refuge Wildlife Biologist

The refuge wildlife biologist acts as resource advisor on initial and extended attack or project-size wildfires.

3. Regional Fire Management Branch Chief (RFMC)

Provides coordination, training, evaluation, and technical guidance, as requested, to the refuge staff, approves fire preparedness and fuels treatment budget requests. The RFMC will be informed of all wildfire suppression activity occurring on the refuge through the zone FMO.

4. Zone Fire Management Officer

The zone FMO, stationed at Wallkill River National Wildlife Refuge, advises the refuge manager or staff on matters relative to fire planning, fire preparedness, suppression, and prescribed burning. The zone FMO supplies technical assistance and experience relative to fire management activities and also advises the refuge manager on priorities, strategies, and tactics to reduce adverse fire impacts. The zone FMO coordinates fire training for refuge staff, enters fire reports into the computerized database, maintains staff qualifications through the IQCS system, and enters refuge base information and requests into the Fire Base/Fire Program Analysis (FPA) workload analysis and budgeting systems. The zone FMO makes recommendations to the RFMC on fire budget allocations to the refuge. The zone FMO may be called upon to gather additional resources necessary to implement this plan.

B. Budget

1. Refuge Fire Funding

No fire funds are specifically earmarked to conduct fire management activities at John Heinz NWR. However, funds can be requested to meet wildland urban interface/hazard fuel treatment, prevention, or minor equipment and personal protective equipment needs through the zone FMO on an annual basis. Other funds from regional fire program sources are available to cover training and associated travel and physical exams. In addition, costs of emergency suppression to local cooperators are reimbursable from the national fire management emergency operations funding. The surrounding Philadelphia Metro Fire Departments, through cooperative agreements, serve to meet suppression needs and suppression objectives of this plan.

2. Fire Program Analysis (FPA)

FPA is an interagency fire management workload analysis and budgeting system that will replace the existing FWS Firebase system beginning in fiscal year 2006. All Federal land ownerships within a given Fire Planning Unit (FPU) will be subject to a common optimization model that will determine optimum levels of resources by unit for a given funding level. Inputs to the system and running of the optimization model will take place during the remainder of fiscal year 2004 and 2005. John Heinz is part of the Pennsylvania FPU which includes all Service, National Park Service, and Forest Service land in PA. It is unknown at this time what effect, if any, FPA will have on allocation of fire resources to John Heinz NWR and other zone refuges.

VI. Monitoring and Evaluation

The following fire research is needed at John Heinz NWR:

- Comprehensive inventory and assessment of the refuge's hazard fuels, and the identification and prioritization of hazard fuel units
- Assessment of hazard fuel management options and their effects upon refuge resource objectives
- Assessment of long and short-term fire effects in the habitats of the refuge with recommendations for treatment activities
- Assessment of treatment affects monitoring needs and preparation of monitoring plan

A. Monitoring and Research

The effects of fuel treatments upon the refuge's plant and animal population's needs to be better understood. Through applied research and careful application nonfire treatments, data collected can provide managers with a better understanding of the natural ecological effects, and the information needed to refine treatment types to meet resource objectives.

Monitoring will comply with accepted scientific methods. This data, along with information gathered through research studies, will be used to improve the effectiveness of the fire management program. Levels of data collection, from least expensive and intensive to the most elaborate, are as follows:

- Minimum levels (photo points)
- Intermediate (NPS Fire Effects Monitoring Handbook)
- Volume/weight removed measurements
- Maximum levels – integrate with other refuge monitoring programs to support adaptive management

B. Evaluation

1. After Action Review

Wildland fire responses with be evaluated by the incident commander and the refuge manger in the form of an After Action Review (AAR) as outlined in the Incident Response Pocket Guide.

2. Significant Wildland Fire Event Review

The regional fire management branch chief, refuge manager, incident commander, and zone FMO will conduct formal fire reviews in the event of the following, as outlined in the FWS FMHB 3.6:

- Significant injury/accident
- Significant property or resource damage
- Significant safety concerns

3. National Wildland Fire Performance Measures

The refuge manager and zone FMO will conduct a yearly review of the overall fire management program. The review will cover project funding and expenditures, nonfire treatment accomplishments, and program review. This information will be complied for inclusion in the yearly Regional Fire Management Government Performance Results Act (GPRA) goals.

Definitions

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices, or services of the Department.

Burning Index (BI). A number combining the spread and energy release component related to the contribution of fire behavior to the effort of containing a fire.

Class of Fire (as to size of wildland fires):
Class A - ¼ acre or less.
Class B - more than ¼ but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC). A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.
Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Keetch - Byram Drought Index (KBDI). An indicator of drought on the availability of fuel to burn in the heavier fuels and litter and duff layers.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the U.S. Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by U.S. Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention. Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation. (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Spread Component (SC). A rating of the forward rate of spread of a head fire

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.
Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decisionmaking process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire. A wildland fire that threatens or involves structures.

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CONSULTATION AND COORDINATION

All fire management program activities will be implemented in cooperation and coordination with Federal, State, county, and local agencies. The following individuals were contacted and contributed during the development of this plan:

Allan Carter, RFMC – Region 5, U.S. Fish and Wildlife Service
Michael Durfee, Region 5 Central Zone FMO, Wallkill River National Wildlife Refuge
Kate McManus, Refuge Manager, John Heinz National Wildlife Refuge at Tinicum
Gary Stolz, Deputy Refuge Manger, John Heinz National Wildlife Refuge at Tinicum
Brendalee Phillips, Wildlife Biologist, John Heinz National Wildlife Refuge at Tinicum
Laura Mitchell, Regional Fire Ecologist, Region 5, U.S. Fish and Wildlife Service

Figures

Appendices

APPENDIX A: Section 7 Consultation

INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

Originating Person and Station Name: Brendalee Phillips, John Heinz National Wildlife Refuge at Tinicum, Philadelphia, PA.

Telephone Number: (215) 365-3118 Facsimile Numbers: (215) 365-2846

Date: December 12, 2005

Project Title: Fire Management Plan

I. Service Program: Fire Management at John Heinz National Wildlife Refuge at Tinicum

II. Geographic Area Including Name of County/City and State and Specific Project Location: John Heinz National Wildlife Refuge at Tinicum lies within both Delaware County and Philadelphia County, Pennsylvania at 8601 Lindbergh Blvd. (N 39°53'31", W 75°15'31').

See attached maps.

III. Proposed Activity:

The Fire Management Plan (FMP) for John Heinz National Wildlife Refuge (NWR) at Tinicum describes how the refuge will respond to a wildland fire on the property. No prescribed fire burning is proposed. All wildfires on the refuge will be suppressed. Currently no employees of the refuge are qualified to suppress wildland fire, so all suppression efforts will be done by outside responders such as the local departments. A dispatch plan in the FMP outlines steps the refuge will take to respond to a fire, which include notifying the local fire department, refuge staff, adjacent landowners, the zone fire management officer, and the appropriate agency responsible for road conditions if smoke obscures highways.

Firefighter and public safety will be the first priority of fire suppression efforts. Values at risk will be the next priority, and they will be protected to the maximum extent possible without compromising firefighter and public safety. Significant values at risk are the Cusano Environmental Education Center and adjacent private properties. These properties include an industrial complex (oil tank farm), several light industrial facilities, multiple single and multi family houses, and the Philadelphia Fire Academy. Other areas or values that would be at risk include Interstate 95 and the Philadelphia Airport, refuge structures and improvements, and wildlife habitat. The use of heavy equipment such as crawlers, tractors, bulldozers, or graders requires approval of the refuge manager. Such equipment will not be used within the refuge boundaries to suppress fire unless their use is necessary to prevent a fire from destroying privately-owned and/or government buildings. If new natural or cultural resources of concern are discovered during fire suppression activities, the refuge manager will ensure their protection from damage related to fire activities to the extent appropriate and possible.

IV. Pertinent Species and Habitat Within Action Area

A. Action area: The action area includes the entire refuge (993 acres).

B. List of listed species/critical habitat, proposed species/critical habitat, and candidate species known to occur or potentially occurring within the action area. Include species/habitat occurrence on a map (preferably a U.S.G.S. quad.), when known, such that their relationship to the project location can be determined.

Bald eagles are regularly seen feeding in refuge impoundment and marsh year-round.

V. Determination of Effects

A. Explanation of the adverse and beneficial effects of the action on species and/or critical habitat listed above.

The FMP is not expected to have adverse or beneficial effects on bald eagles which do not nest on the refuge. Most fire management activities on the refuge, including small scale mowing and hand application of herbicide are not anticipated to affect bald eagles feeding in refuge waters. Aerial spraying of refuge marshes with herbicide may occur once a year and it is anticipated that large parts of the refuge will remained undisturbed and available for feeding bald eagles. Wildland fire and suppression on the refuge would constitute an emergency and therefore trigger emergency consultation procedures if they affected listed species.

B. Explanation of actions to be implemented to reduce adverse effects:

As stated above, wildland fire suppression on the refuge would occur under emergency circumstances. The FMP includes measures that could protect listed species if they were in the area. However, because the first priority of the plan is firefighter and public safety, these measures may not be taken if firefighter or public safety is at risk. As stated in the plan, adverse effects to natural resources will be minimized to the extent that firefighter and public safety is ensured.

VI. Effect Determination and ES Response Requested

A. Listed species/designated critical habitat:

Field Station Determination	Species Name(s)	Ecological Services Response Requested (check one)
No effect	Bald eagle	____X___None Needed
Is not likely to adversely affect		_____Concurrence
Is likely to adversely affect		_____Formal Consultation

Field Station Determination	Critical Habitat For NONE	Ecological Services Response Requested (check one)
No effect		_____None Needed
Is not likely to destroy or adversely modify		_____Concurrence
Is likely to destroy or adversely modify		_____Formal Consultation

B. Proposed species/proposed critical habitat/candidate species:

Field Station Determination	NONE	Ecological Services Response Requested (check one)
No effect		_____None Needed
Is not likely to adversely affect		_____Concurrence
Is likely to jeopardize		_____Conference

Field Station Determination	Critical Habitat For NONE	Ecological Services Response Requested (initial/check one)
No effect		_____None Needed
Is not likely to adversely affect		_____Concurrence
Is likely to destroy or adversely modify		_____Conference

VII. Reviewing Ecological Services Field Office Evaluation

A. Concurrence_____ Nonconcurrence_____

B. Formal consultation required_____

C. Conference required_____

D. Informal conference required_____

E. Remarks:

_____ _____

Supervisor, ES Field Office Date

APPENDIX B: Cooperative Agreements

See Following Documentation Pages

APPENDIX C: Fire and fuel treatment occurrence at John Heinz NWR

YEAR	WF	ACRES	RX	ACRES	WUI*	ACRES (m,c,f)
1983		11				
1985	3	3.6				
1986	5	0.9				
1987	5	3.7				
1988	1	17.2				
1989	2	7.3				
1992	1	1				
1996	1	0.1				
1999	1	10				
2001	2	0.3				

* Wildland Urban Interface Treatment Types (WUI) Codes - (m) - mechanical (c) - chemical (f) – fire

APPENDIX D: Behave Runs

Direct Inputs	
Dominant fuel model	3
Percent cover	100
Other fuel model	3
1-h fuel moisture (%)	6
10-h fuel moisture (%)	9
100-h fuel moisture (%)	15
Herbaceous fuel moisture (%)	
Woody fuel moisture (%)	
Mid flame wind speed (mph)	6
Cardinal wind direction (°)	NW
Terrain slope (%)	0
Aspect of slope (°)	SE
Calc maximum spread rate	Yes
Directions are relative to the	
Dir.for spread calculation (°)	

Direct Outputs	
Rate of spread (ch/hr)	148.4
Heat per unit area (Btu/ft²)	742
Fireline intensity (Btu/ft/s)	2,019
Flame length (feet)	14.9
Reaction intensity (Btu/ft²/m)	2,900
Effective windspeed (mph)	6
Direction of maximum spread (°)	135

Direct Inputs	
Dominant fuel model	1
Percent cover	100
Other fuel model	3
1-h fuel moisture (%)	6
10-h fuel moisture (%)	9
100-h fuel moisture (%)	15
Herbaceous fuel moisture (%)	
Woody fuel moisture (%)	
Mid flame wind speed (mph)	6
Cardinal wind direction (°)	NW
Terrain slope (%)	0
Aspect of slope (°)	SE
Calc maximum spread rate	Yes
Directions are relative to the	
Dir.for spread calculation (°)	

Direct Outputs	
Rate of spread (ch/hr)	135
Heat per unit area (Btu/ft²)	91
Fireline intensity (Btu/ft/s)	224
Flame length (feet)	5.4
Reaction intensity (Btu/ft²/m)	826
Effective windspeed (mph)	6
Direction of maximum spread (°)	135

Direct Inputs	
Dominant fuel model	9
Percent cover	100
Other fuel model	3
1-h fuel moisture (%)	6
10-h fuel moisture (%)	9
100-h fuel moisture (%)	15
Herbaceous fuel moisture (%)	
Woody fuel moisture (%)	
Mid flame wind speed (mph)	6
Cardinal wind direction (°)	NW
Terrain slope (%)	0
Aspect of slope (°)	SE
Calc maximum spread rate	Yes
Directions are relative to the	
Dir.for spread calculation (°)	

Direct Outputs	
Rate of spread (ch/hr)	11.7
Heat per unit area (Btu/ft²)	370
Fireline intensity (Btu/ft/s)	79
Flame length (feet)	3.4
Reaction intensity (Btu/ft²/m)	2,391
Effective windspeed (mph)	6
Direction of maximum spread (°)	135

APPENDIX E: Step-up Plan

Daily fire danger indices will be compiled and averaged using the NFDRS stations located at Forsythe NWR in New Jersey and Prime Hook NWR in Delaware, then compared to the indices used by the NJ State Forest Fire Service.

Fuel Model R - May 15 to October 15

Adjective Class	KDBI	Burning Index
Low	less than 140	0 to 10
Moderate	141 to 260	11 to 15
High	261 to 380	16 to 20
Very High	381 to 500	21 to 25
Extreme	over 500	over 25

Fuel Model E - October 15 to May 15

Adjective Class	KDBI	Burning Index
Low	less than 140	0 to 30
Moderate	141 to 260	31 to 38
High	261 to 380	39 to 47
Very High	381 to 500	48 to 53
Extreme	over 500	over 54

PREPAREDNESS ACTIONS	STAFFING LEVELS		
	Low and Medium	High	Very High and Extreme
REFUGE STAFF/COLLATERAL FIREFIGHTERS			
Carry PPE with them while on duty (Including Nomex and boots)		X	X
May be assigned to an engine at a station or patrol			X
Work weeks and/or tours of duty may be extended			X
FIRE EQUIPMENT			
Engines in ready status (15 min or less)	0	1	1
FIRE PREVENTION ACTIVITIES			
Post fire danger signs at high public use areas			X
Restrict vehicles to paved/gravel parking areas, remain within boats and close select trails and public use areas			X
MISCELLANEOUS EMERGENCY PRESUPPRESSION ACTIONS			
Notify Zone FMO and open emergency preparedness account			X
Preposition FWS and interagency resources as needed			X

APPENDIX F: Delegation of Authority

Name of Incident Commander is assigned as Incident Commander of the ***Name of Incident***, ***Name of Refuge or Unit*** for the US Fish and Wildlife, effective ***Time and Date.***

The Incident Commander has full authority and responsibility for managing the fire suppression activities within the framework of the law and Fish and Wildlife Service policy and direction as provided by this office. The Resource Advisor will provide habitat Management Plans and other appropriate documents.

Names of Resources Advisors and contact Information are assigned as Resource Advisors. They or the Refuge Manager will be consulted in situations where natural resource decisions or tradeoffs are involved unless life safety issues require immediate attention and those actions will be documented.

Specific direction and fire suppression priorities for the ***Name of Incident*** are as follows, and are in priority order:

1. Provide for firefighter and public safety.

2. Use of minimal impact techniques should be employed to reduce habitat damage. Use natural barriers and roads if possible for burnout operations.

3. Use of dozers or tractors requires approval of the Refuge Manager of their designate (resource advisors) prior to implementation.

Turn Back Standards

1. All ***Name of Incident*** contracts, agreements, bills, medical problems, equipment repairs, and fire cache re-supply shall be closed out prior to team being released.

2. Road or levee damage during suppression efforts will be repaired prior to the teams departure.

3.Fire perimeter mopped-up ***Specify*** and all lines checked for heat and integrity.

4. Rehabilitation Plan will be completed in Coordination with the Refuge Biologists and Resource Advisors.

5. Fire perimeter mapped by GPS and loaded into the Refuges GIS Database.

6. Tort claims reviewed by Refuge Manager or their designee.

The Deputy Refuge Manager, Fire Program Manager, or their designate will represent the Refuge Manager on any occasion where Refuge Manager is not immediately available.

Refuge Manager, _____

Name of Refuge or Unit, _____

Date and Time_____

APPENDIX G: FMIS WILDLAND FIRE REPORT

GENERAL TAB

(1) Fire Type:
(2) Org. Code:
(3) Fire Name:
(4) Discovery Date:
(5) County: Code:
(6) Cong. District:
(7) Fire Subtype:
(8) Measurement Method:
(9) Ignition Owner:
(10) Ignition State:
(11) Ignition Cause:
(12) WFSA? Yes or No
(13) If WFSA = yes, Date:

(14) Burn State:
Burn State:
(15) Burn Owner:
Burn Owner:
(16) Burn Acres:
Burn Acres:

(17) Management Level:

(18) **Resource Type**	(19) **Quantity**	**Resource Type**	**Quantity**

Values at Risk

(20) **Type**	(21) **Subtype**

(22) Discovery Date: (23) Time: (24) Initial Attack Date: (25) Time:
(26) Control Date: (27) Time: (28) Out Date: (29) Time:

LOCATION TAB

(30) Latitude: (31) Longitude:
(32) Aspect: (33) Lay of Land: (34) Slope:
(35) Position of Slope: (36) Elevation:
(37) Special Area Type:

EMISSIONS TAB

(38) Fire Danger Index: (39) Value:

FINAL TAB

(40) Person Completing Form: (41) Title: _____ (42) Date:
(43) I.C.:
(44) Narrative:

APPENDIX H - DISPATCH PLAN – JOHN HEINZ NWR AT TINICUM

1. When a report of smoke or fire is received the following information should be recorded:

Location of smoke or fire: _____

Location of person reporting: _____

Name of person reporting fire: _____

Telephone number of person reporting fire: _____

Size of fire: _____

Are any persons or structures in immediate danger from fire?: No Yes- How many? ___

Character of fire (running, creeping, direction, etc.): _____

Type of fuel/ vegetation: _____

Color of smoke: _____

Anyone fighting fire?: _____

Did they see anyone in vicinity or vehicles leaving area?: _____

Time since caller first noticed fire to time call placed: _____

2. Notify personnel in the following order:

1. Fire Department-911
2. Refuge Manager: Gary Stolz — Wk: (215) 365-3118, Cell: (610) 804-3552

If not reached, notify (all Wk #'s same as Manager)

Deputy Refuge Manager: Larry Woodward	Cell: (610) 842-3673
Facility Manger: Mike McMenamin	Cell: (484) 571-6962
Refuge Biologist: Brendalee Phillips	Cell: (610) 842-4363

Have the following respond to the fire:

Resource Advisor= Highest grade staff member on Duty from the Refuge

Incident Commander= Person determined by Refuge Manager when contacted as above.

APPENDIX I – John Heinz NWR at Tinicum Communications List (Last Updated October 13, 2010)

Title	Last Name	First Name	Address	Work Number	Cell Number
Refuge Manager	Stolz	Gary	8601 Lindbergh Blvd. Philadelphia, PA 19153	215-365-3118	610- 804-3552
Deputy Manager	Woodward	Larry			610-842-3673
Facility Manager	McMenamin	Mike			484- 571-6962
Refuge Biologist	Phillips	Brendalee			610-842-4363
Refuge Officer (LE)	Pinsonneault	Derick			484-571-7110
Title	Last Name	First Name	Address	Work Number	Cell Number
Folcroft Co. No. 1 Chief	Weber	Tom Sr.	1647 Delmar Dr. Folcroft, PA 19032	610-461-2256	Folcroft Co. No. 1 Chief
Norwood Co. No. 1 Chief	Davis	Joe	26 W. Winona Norword, PA 19074	610-461-1111	Norwood Co. No. 1 Chief
Norwood Co. No. 1 Deputy Chief	Bradley	Jim Sr.			Norwood Co. No. 1 Deputy Chief
Norwood Co. No. 1 Deputy Chief	Givens	Chris			Norwood Co. No. 1 Deputy Chief
Philadelphia Commissioner	Ayers	Lloyd	240 Spring Garden St., Philadelphia, PA 19123	215-686-1300	Philadelphia Commissioner
Prospect Park Chief	Signora	Michael	1001 Lincoln Ave. Prospect Park, PA 19076	610-522-1830	Prospect Park Chief
Tinicum Township Fire Company - Chief	Lee	Walter	99 Wanamaker Ave. Essington, PA 19029	610-521-3944	610-637-6669

Appendix G

Larry Woodward/USFWS

Philadelphia skyline visible over Darby Creek and Tinicum marsh

Wilderness Review

- G.1 Introduction
- G.2 Minimum Wilderness Criteria
- G.3 Inventory Conclusions
- G.4 Service Summary and Conclusion of Wilderness Inventory Findings

G.1 Introduction

The purpose of a wilderness review is to identify and recommend to Congress lands and waters of the National Wildlife Refuge System (Refuge System) that merit inclusion in the National Wilderness Preservation System (NWPS). Wilderness reviews are required elements of comprehensive conservation plans, are conducted in accordance with the refuge planning process outlined in the Fish and Wildlife Service Manual (602 FW 1 and 3), and include compliance with the National Environmental Policy Act (NEPA) and public involvement.

The wilderness review process has three phases: (I) inventory; (II) study; and, (III) recommendation. In the inventory phase, we create wilderness inventory areas (WIAs) after mapping all Service fee-owned lands and waters on the refuge. Any WIAs meeting the minimum criteria for a federally designated wilderness are identified as wilderness study areas (WSAs).

The purposes of the wilderness inventory phase are to

a) identify Refuge System lands and waters with wilderness character and establish those areas as Wilderness Study Areas (WSAs);

b) identify areas of Refuge System lands and waters that do not qualify as WSAs; and

c) document the inventory findings for the planning record.

G.2 Minimum Wilderness Criteria

A WSA is required to be a roadless area or an island of any size, meet the size criteria, appear natural, and provide for solitude or primitive recreation.

Size — The size criteria can be satisfied if an area has at least 5,000 acres of contiguous roadless public land, or is sufficiently large that its preservation and use in an unimpaired condition is practicable.

Roadless — Roadless refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. A route maintained solely by the passage of vehicles does not constitute a road. Only Federal lands are eligible to be considered for wilderness designation and inclusion within the NWPS.

Naturalness — The Wilderness Act, Section 2(c), defines wilderness as an area that "generally appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable." The area must appear natural to the average visitor, rather than "pristine." The presence of historic landscape conditions is not required.

Solitude or Primitive and Unconfined Recreation — A WSA must provide outstanding opportunities for solitude or primitive and unconfined recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criterion. Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means nonmotorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport.

Supplemental Values — The Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area's suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

G.3 Inventory Conclusions

Evaluating Roadless Criteria

The John Heinz National Wildlife Refuge does not meet the roadless criteria. Refuge lands are bounded or divided by roads. A major highway, Interstate 95, runs east-west across the southern refuge boundary. The refuge is also includes several service roads.

Evaluating Size Criteria

The total approved acquisition boundary for the refuge is 1,200 acres, thus it cannot include any roadless areas of at least 5,000 acres. Due to the presence of access roads, adjacent roads, and remnants of historic disturbance (dikes, fences, and former water control structures), there is no smaller acreage of sufficient size to preserve and use in an unimpaired condition.. Furthermore, no lands within the refuge are contiguous to other agency-owned lands under review for wilderness areas.

Evaluating Naturalness Criteria

The refuge does not satisfy the naturalness criteria, as the area has been highly modified for human use with the arrival of European settlers. Prominent features of human origin are the remnants of a trolley railbed, dikes around the impoundment, presence of a landfill, a managed impoundment, and other remnants of older infrastructure. Currently, over 2 miles of dikes and at least three water control structures are found on the refuge.

In addition to water control structures and dikes, refuge infrastructure includes buildings and roadways that require regular maintenance. There are also a wildlife observation tower, trails, signs, parking areas, viewing blinds, and boundaries that are maintained. Facilities currently include the refuge headquarters and visitor center, as well as two maintenance buildings.

In addition to the roads described in the “Evaluating Roadless Criteria” section, two railroads pass along the southeastern boundary of the refuge. Furthermore, gas and oil pipelines transect or run adjacent to refuge lands. Several telephone, gas, oil, and other utilities also run adjacent or through the refuge.

Evaluating Solitude or Primitive and Unconfined Recreation Criteria

The refuge does not meet criteria for solitude and primitive/unconfined recreation criteria. The number of annual visits to the refuge is currently estimated at almost 135,000 and is expected to increase over the next 15 years. The refuge consists primarily of inaccessible/off-limit wetlands with relatively few upland areas, and visitor use is concentrated on dike roads, and upland trails. Consequently, even during times of the year when visitation is typically at its lowest, one is likely to see other people on the refuge, regardless of location. Waterways and other areas that can be accessed by boat consist of canals or flooded impoundments, neither of which are sufficiently large to allow visitors to experience solitude.

G.4 Service Summary and Conclusion of Wilderness Inventory Findings

We utilized the refuge in its entirety, as owned by the Service in fee title, within the approved acquisition boundary as the basis for our WIA. We then evaluated the refuge to determine if it met the minimum criteria for wilderness as identified in Section 2(c) of the Wilderness Act.

Based on our review, the 1,193-acre John Heinz National Wildlife Refuge does not meet the size criteria for a WSA. It is less than 5,000 acres and its size is not sufficient to preserve natural ecological processes unique to a wilderness setting. Chapter 2 maps show the current refuge-owned lands, easements and proposed acquisition boundaries. We will reevaluate this determination in 15 years with the revision of this CCP, or sooner if significant new information warrants a reevaluation. In summary, at this time additional study is not warranted.

Appendix H

Dan Salas/Cardno JFNew

Darby Creek

Wild and Scenic Rivers Designation Review

H.1 Introduction

The Wild and Scenic Rivers Act, (Public Law 90-543 as amended: 16 U.S.C. 1271-1287) (Act) establishes a method for evaluating and providing Federal protection for certain free-flowing rivers, preserving them and their immediate environments for the use and enjoyment of present and future generations. One outcome of that Act is a national system of designated wild, scenic, or recreational rivers included in the National Wild and Scenic River System (NWSRS). Section 5(d) (1) of the Act states in part: In all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential national wild, scenic, and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potential.

H.2 Wild and Scenic River Review

The purpose of this wild and scenic river review is to inventory and study the rivers, river segments and their immediate environments within the refuge planning area to determine if they merit inclusion in the NWSRS.

As part of the Section 5(d) (1) review process, we are required to include all river segments that are within the planning area and listed in the Nationwide Rivers Inventory (NRI). The NRI is maintained by the National Park Service (NPS) and lists more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance.

H.3 Service Summary and Conclusion of Wild and Scenic River Review

Darby Creek is the only major waterway that flows through refuge lands. We reviewed the Nationwide Rivers Inventory and found no record of Darby Creek within its listing. As a result, the portion of Darby Creek within the refuge is not considered by the NRI as having outstanding remarkable values or potential for special designation. Despite its habitat and recreation values to the refuge, Darby Creek is not eligible for a wild and scenic designation.

Appendix I

Katherine Whittemore/USFWS

Students enjoying the open water and marsh habitats of the refuge

USGS Phase I Environmental Education Report

USGS
science for a changing world

John Heinz National Wildlife Refuge Environmental Education Stakeholder Analysis—Phase I Report

By Marcella Wells, Diane White, and Natalie R. Sexton

Photo by Frank Doyle, U.S. Fish and Wildlife Service Volunteer

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Figures

Tables

John Heinz National Wildlife Refuge Environmental Education Stakeholder Analysis—Phase I Report

By Marcella Wells,[1] Diane White,[1] and Natalie R. Sexton[2]

Introduction

The John Heinz National Wildlife Refuge (John Heinz Refuge, refuge) is located in Philadelphia and Delaware Counties, Pennsylvania, and has so far acquired 997 acres of 1,200 authorized by Congress. The purpose of the refuge is to:

- protect, preserve, and restore wildlife and habitat in the natural area known as Tinicum Marsh;
- create an Environmental Education Center and provide for compatible wildlife-oriented recreation opportunities; and
- develop, advance, manage, conserve, and protect fish and wildlife resources.

Recently, the refuge initiated a Comprehensive Conservation Planning (CCP) effort to help guide the management of the refuge over the next 15 years. As part of that planning process, a Visitor Services Review was conducted in August 2009, by refuge managers and visitor service specialists external to this refuge. Concurrently, and as part of the public involvement requirement for the CCP effort, this stakeholder assessment, related specifically to environmental education, was commissioned. This status report provides the findings of Phase I of the two phase project. Discussion of findings from Phase I, contained in this report, will serve to guide the second phase of the project.

Purpose of this Project

This Environmental Education Stakeholder Assessment (EESA) is a collaboration between the consultants at Wells Resources, Inc., the Refuge Manager Gary Stolz and staff, and the U.S. Geological Survey's (USGS) Policy Analysis and Science Assistance (PASA) Branch.
The current purpose of the project is to:

- define and refine the environmental education niche for the refuge,
- help prioritize goals for environmental education that might be included in the CCP process and future planning, and
- propose methods for maximizing the use of the refuge facilities for environmental education and interpretation.

Definitions

Throughout this project and report, two terms are used: stakeholder and partner or potential partner. *Stakeholder* is a broader term encompassing any individual or group having a vested interest in the refuge, its planning, or management (for example, visitors, special interest groups, user groups,

[1] Wells Resources, Inc., Fort Collins, CO 80524
[2] US Geological Survey Fort Collins Science Center, Fort Collins, CO 80526

and so forth). A *partner* or *potential partner*, in the context of this project and report refers to those entities who have (or could have) an interest in the refuge in terms of environmental education or interpretation (as defined by the U.S. Fish and Wildlife Service as priority public uses), but with an emphasis on curriculum-based environmental education. Partners or potential partners are categorized by providers and consumers (further discussed in this report).

Context

Geographic Context

The boundaries of John Heinz Refuge are within Philadelphia, a city of approximately 1.5 million people, and southeastern Delaware County (fig. I.1). The greater Delaware Valley or the Philadelphia-Camden-Wilmington Metropolitan Statistical Area (MSA) is also served by this refuge (fig. I.2). This MSA is comprised of 11 counties (table I.1) and is the fifth-largest metropolitan area in the country with a population of nearly 6 million people (2010 Census data).

Table I.1. Delaware Valley Counties.

States	Counties
Pennsylvania	Bucks, Chester, Delaware, Montgomery, and Philadelphia
Delaware	New Castle
Maryland	Cecil
New Jersey	Burlington, Camden, Gloucester, and Salem

Figure I.1. Map of John Heinz National Wildlife Refuge.

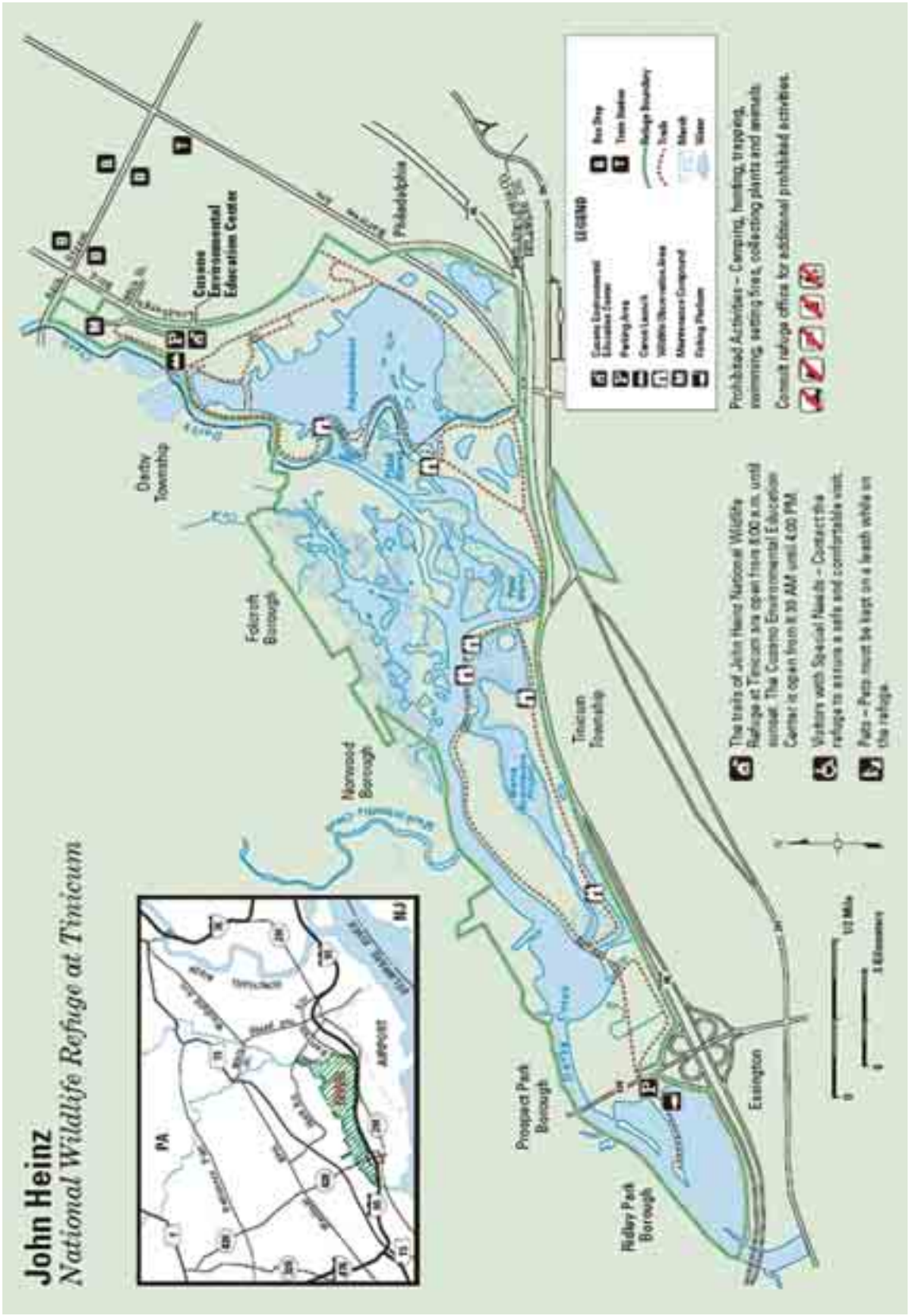
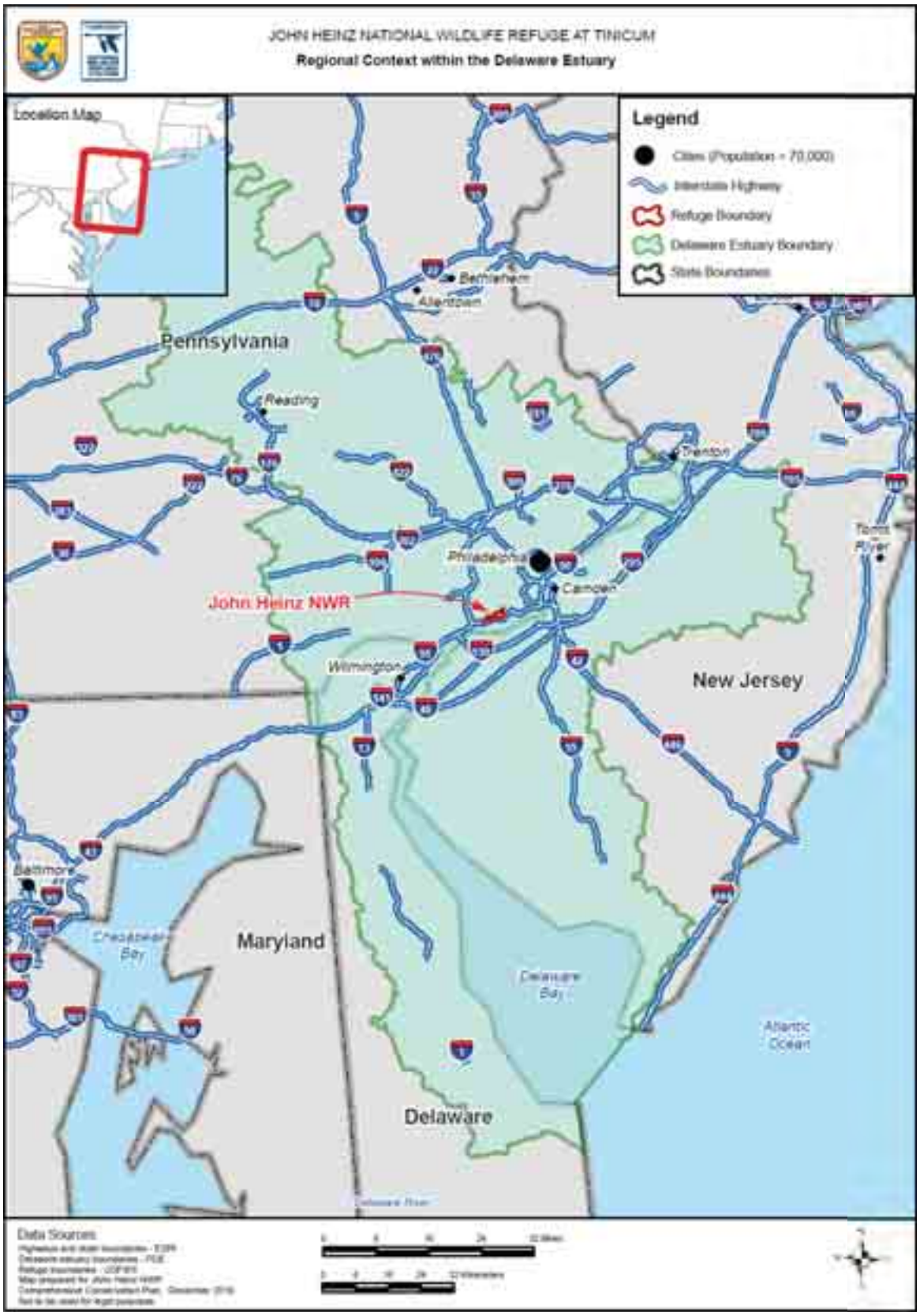


Figure I.2. John Heinz National Wildlife Refuge in reference to Philadelphia as the center of the Pennsylvania Greater Metropolitan Area.



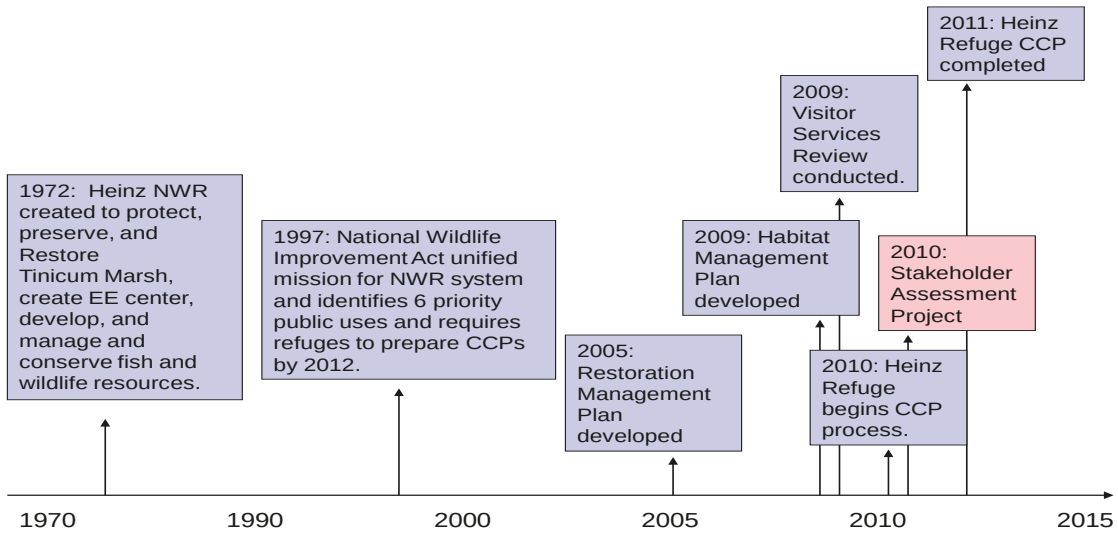
Planning Context

The Refuge was established in 1972 to:

- protect, preserve, and restore wildlife and habitat in the natural area known as Tinicum Marsh;
- create an Environmental Education Center for the purpose of providing education about the environment, and provide for compatible wildlife-oriented recreation opportunities; and
- develop, advance, manage, conserve, and protect fish and wildlife resources.

In 2006, as part of the Strategic Downsizing Plan for the National Wildlife Refuge System, environmental education and interpretation were identified by the U.S. Fish and Wildlife Service (the Service) Region 5 office and the refuge as the refuge's areas of emphasis.

This project is an assessment of audiences and potential stakeholders for the refuge to inform subsequent planning processes related to or associated with the Comprehensive Conservation Plan to be completed by 2011. Figure I.3 illustrates where this project fits into recent planning initiatives of the refuge.



Note: Diagram limited to select refuge-specific plans only. Other regional or national plans are not included here.

Figure I.3. Planning Context for Stakeholder Assessment Project.

In fall 2009, a Visitor Services Review (VSR) was completed by an external review team. That document provides recommendations for each of ten visitor services criteria (see Appendix A) and suggests additional planning , which includes: finalization of the current Visitor Services Plan, an Outreach Plan, a Fishing Plan, an Environmental Education Plan, and an Interpretive Plan.

The VSR also provides an inventory of the existing conditions at the refuge. Some of the inventory and recommendations in that report overlap with issues raised in this project, so every effort is made here to complement rather than repeat the work of that external review team.

Staffing

The current staffing is represented by Figure I.4.

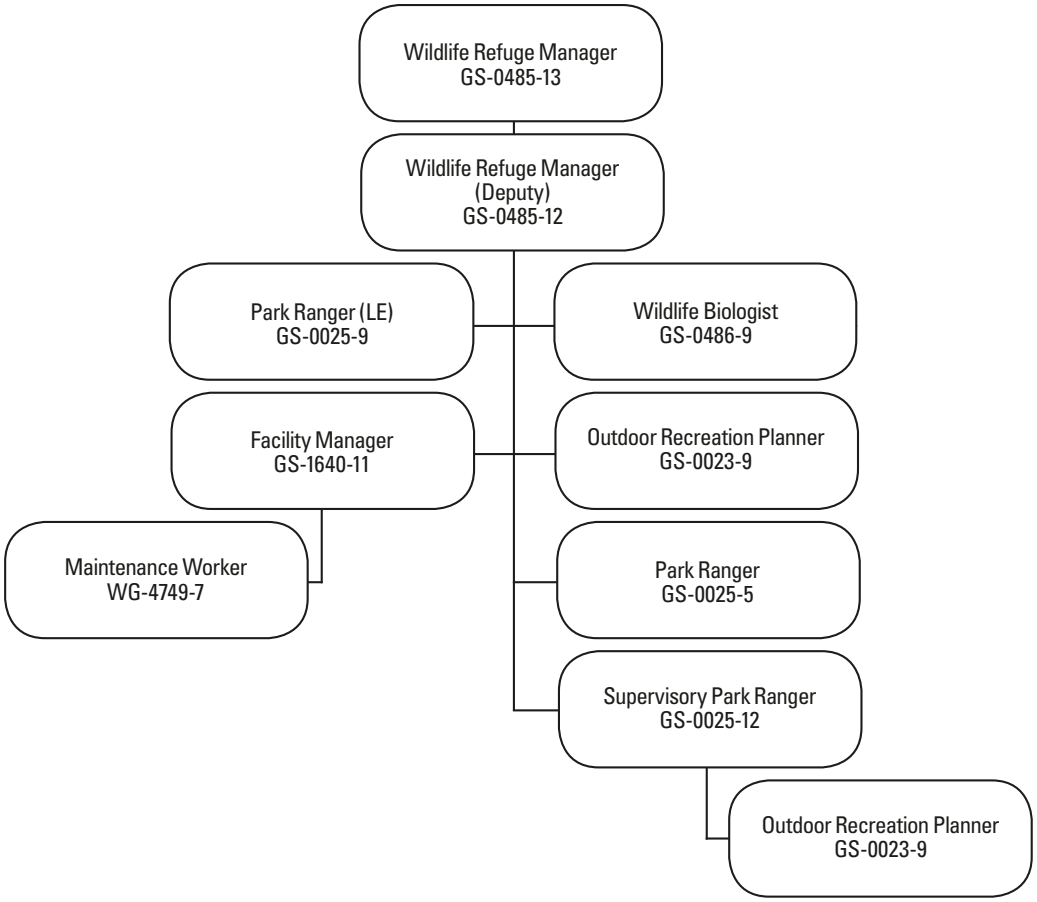


Figure I.4. Current John Heinz National Wildlife Refuge Staffing.

Procedure

The first phase of this project focused on diagnostics and document review, with the intent of understanding the planning context and identifying available sources of information about visitors, programs, and stakeholders. During this phase, the project team worked with the refuge manager and staff in onsite interviews, through email, and over the phone. Two focused but informal face-to-face meetings with the refuge manager (one of which also involved some face-to-face communication with both outdoor recreation planners) were conducted during July and August. Four follow-up phone interviews were conducted, in conjunction with multiple email exchanges, to ask several program- and visitor-related questions of both the park ranger (EE) and the supervisory park ranger (EE). In addition, a number of refuge-specific documents and sources were reviewed (see Appendix C) for content relevant to this project. Findings are presented below.

Findings

This section reports preliminary findings pertaining to this stage of the project (Phase I) and contains data from document review and staff communication. An Excel file with five separate worksheets (referred to hereafter as original data worksheets) was developed after the initial site visit and an interview with the refuge manager. In the absence of any immediately available written data, these worksheets were designed by the researchers to provide a framework for the refuge manager and staff to enter as much information about audiences, visitors, partners, and stakeholders as possible. These forms were used iteratively over the next several weeks to capture information from refuge staff. At times, the researchers re-categorized and organized the data provided by staff, but the final versions of the original data worksheets were reviewed by the refuge manager and staff for accuracy, and were approved. For clarity, what is reported below is an abbreviated summary and re-categorization of that data in anticipation of future discussions and management of audience information. Original data worksheets can be found in Appendix B of this document.

Below, data about refuge audiences and visitors are presented first, followed by the refuge's approach to environmental education, and then data related to programs and partnerships. Finally, a brief summary of select marketing and educational materials is provided. A discussion of these findings and recommendations for next steps are provided in the final sections of this report.

Refuge Audiences and Visitors

The 2009 Visitor Services Review document suggests that the refuge receives approximately 125,000 visitors per year. The refuge uses a multiplier of five on the actual count of visitors to the Visitor Center to determine approximate annual usage of all facilities. Table I.2 summarizes annual refuge visitation for the years 2001 to 2010. Table I.3 provides a partial breakdown of annual visitation from 2004 to 2010 into different types of people served and programs provided related to environmental education and/or interpretation.

Table I.2. Annual Number of Visitors to the John Heinz National Wildlife Refuge.[1]

Year[2]	Total number of annual visitors into visitor center (counts)[3]	Total visitors to refuge (using multiplier)
2010	20,185 (Oct–July)	100,925 (Oct–July)
2009	26,566	132,830
2008	23,306	116,530
2007	23,819	119,095
2006	21,298	106,491
2005	20,184	100,920
2004	20,861	104,305
2003	18,460	93,200
2002	23,656	118,280
2001	21,658	108,290
Average Annual Visitation	**25,847**	**137,285**[4]

1. All data were provided by staff (see Appendix B for complete data sets).

2. Data are reported by fiscal year (Oct. –Sept. 30).

3. The refuge counts the number of people who visit the Visitor Center, then uses a multiplier of 5 to estimate the total visitors to the refuge. For 2001 to 2009, staff provided researchers with number of Total visitors to refuge. Researchers divided this number by 5 to generate the numbers used in the table for Total visitors to Visitor Center.

4. Average annual visitation was calculated from 2001–2009 annual visitation data only, since 2010 was partial year data.

Table I.3. Annual Visitation by Other Types of Effort at the John Heinz National Wildlife Refuge.[1]

Year[2]	Field trip visitors[3]	Visitors who received guided tours (by staff /volunteer)[4]	Total programs delivered (by staff/volunteers)[5]	People served offsite (by staff/volunteers)
2010	8223	1,335	30	1,165
2009	8196	13,283	30	1,800
2008	7797	2,450	25	500
2007	7087	4,765	25	500
2006	6729	2,130	20	400
2005	5823			
2004			176	24,364

1. All data, except for field trip data, were provided by staff (see Appendix B – Original Data Worksheets for complete data sets).

2. Data are reported by fiscal year. Data for 2010 are for October 2009 to July 2010 only.

3. All field trip visitors were school children participating in organized environmental education programs. Field trip visitor data is from Draft John Heinz NWR at Tinicum Environmental Education Plan 2010.

4. These numbers may include field trip visitors as well as other visitors.

5. All programs were delivered offsite, with the exception of 15 programs in 2010 for which the locations were unknown.

John Heinz National Wildlife Refuge Current Approach to Environmental Education

To understand the refuge's current approach to environmental education, several sources were consulted, including refuge staff and the Visitor Services Review. The refuge uses a "Train the Trainer" approach to environmental education with recent expansion into direct student teaching. Staff offers teacher trainings and is well-versed in delivering Project WET, WILD, and Learning

Tree workshops. Pre-service and master level teachers are also a target audience through the refuge's partnership with Widener University. The Refuge Environmental Education Development (REED) team, a group of teacher volunteers, developed a curriculum specific to the refuge that is available for teachers, as are loan boxes and other digital media. Field trips coming to the refuge are generally guided by the teacher and/or chaperones that accompany the group. Visitors coming to enjoy the refuge grounds generally visit on their own time, though weekend volunteer-led walks, talks, and programs are offered.

Programs and Partnerships

Data from the staff interviews and several iterations and verifications of the original data worksheets provide current documentation of programming at the refuge. There are many ways to look at visitor trends and refuge use. One approach is to consider onsite experiences (visitation) and offsite experiences (outreach). Table I.4 organizes the refuge's specific programming into these two major categories.

Table I.4. Refuge Programming.

Onsite experiences	Offsite experiences
Events and festivals (table I.5)	Events and festivals (table I.10)
Programs (table I.6)	Presentation and programs (table I.11)
Training (table I.7)	
Research (table I.8)	
Meetings and retreats (table I.9)	

In anticipation of further environmental education discussion and decision making, tables I.5–I.11 were created to further analyze the program and stakeholder data captured in the Original Data Worksheets. Appendix B contains full documentation of all program and partner data provided by the refuge to date. Blanks within the charts below indicate data that is unknown, was not provided, or was not requested by researchers. For example, the *Frequency* column was not a category solicited in the Original Data Worksheets, but data for this category was surmised, when possible, from the descriptions provided by staff. This category was added to these tables as it was deemed a useful category for understanding total visitor participation. The column *Proximity of audience to Refuge* was also added by the researchers. When possible, best guesses were made by the researchers for categorizing proximity based on information provided by the refuge. For the purposes of tables I.5–I.11, the following definitions were deemed useful for organizational purposes and for possible future segmentation and planning:

- **Neighbor:** less than 1 mile of refuge; walkable
- **Local:** within 1 to 5 miles from refuge; likely requires transportation
- **Area:** 6 to 20 miles from refuge; requires transportation
- **Region:** more than 20 miles from refuge; requires transportation
- **National:** out-of-state visitors
- **International:** out-of-country visitors

Table I.5. Onsite Events and Festivals.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of events/ festivals
Cradle of Birding Wildlife Conservation Festival: annual booth and program festival	varies, see Partner List in Original Data Worksheets	community and families	neighbors, locals, area and regional residents	1300	once per year in September
Federal Junior Duck Stamp Competition: annual youth art competition	Refuge	K-12 students	statewide	300–700	once per year
Art Exhibits: nature based art exhibits of regional artists	Refuge	community and families	local, regional		throughout the year
Darby Creek Clean Up: annual Refuge Earth Day clean-up	Waste Management, Friends of Refuge	community and families	neighbors, locals, area residents	~200	once per year (April – Earth Day)
International Migratory Bird Day: annual booth/program birding event	Partners in Flight, National Audubon and FWS Office of Migratory Bird Management	community and families	neighbors, locals, area residents	100	once per year
National Wildlife Refuge Week: annual booth/program festival and art show	Varies, see Partner List in Original Data Worksheets	community and families	neighbors, locals, area residents	200	once per year
Pathways to Fishing: 2 free fishing days at Refuge	PA Fish and Boat Commission	community and families	neighbors, locals, area residents	75–150	two times/year with Statewide free fishing days

Table I.6. Onsite Programs–Facilitated Learning Experiences.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Family Nature Program: monthly 2 hr lecture/hands-on experience	Refuge	families with youth 8–14 yrs old	neighbors, locals, area residents	25–40/year	monthly
Green Building Tours: tours of VC and Marsh Machine	Refuge	University Architecture students	locals and area residents	100/year	as requested
Nature walks: birds, trees, flowers, butterflies, owls	Refuge	community members and families	neighbors, locals, area residents	~600/year	periodic: weekly and monthly, seasonal; some evenings
Story Time: monthly story time for kids	Refuge	families of 4–7 year olds	neighbors, locals, area residents	25–40/year	12/year
Through the Lens, Summer Nature Photography Program: two photography programs	Refuge (staffing),Friends of Refuge photo group (funding and mentoring)	12–18 year olds	neighbors, locals, regional	10–50/ program	TTL 1/yr and Summer camp 1/yr
YMCA Fishing Camps: onsite fishing camps	YMCA	youth	area	300	10 camps of 30 youth in 2010
YMCA Conservation Camps	YMCA	youth		80	
“Bigs and Littles”: field trip to introduce kids to the Refuge	Big Brother/Big Sister Program	youth and mentors	area	881 with major BBBS event in 2010	
Scout Badges Programs: conservation activities for scout merit badges and Refuge patch	Boy/Girl Scouts	youth	neighbors, local, area, regional residents	75–100 plus 2,000-3,000 more offsite per year	
Micro-Adventures: mentoring program, collect samples, ID, use microscopes; extensions back in classroom	Interboro School District, Philly Mennonite MS and HS, NJ Middle School	middle school and high school students	local, area, regional students	350	as requested. 2010 ran 10/yr

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Spring break and summer camps: 3–4 day camps in the summer and during school breaks	Elementary Schools – Patterson, Widener, Longstreth	3rd and 4th graders	local and area youth	10–20/camp in 2010 with Refuge goal of 30/camp (classroom size)	
Summer camps	Philadelphia Academy of Natural Sciences: Natural History Museum	outside partner-run camps with overlapping conservation missions			held 6 times
Saturday Ecology Academy: mentor program for teen girls	Widener University	pre-service teachers develop curriculum and teach underserved teen girls	Chester area	20–40/year	5 Saturdays repeated with same 20 youth for depth of program
Field trips	Cobb Creek Community EE Center	K-5 students			
Field trips	Delaware Earth Force				
Field trips	Wagner Free Institute				
Field trips: science field trips for K-4 students	Interboro, Longstreth Elementary; Patterson Elementary; Widener Charter	K-4 students			Interboro: 500–1000 Widener Charter: 24/year Patterson: couple times a year
Field trips: sustainability, green building, watershed content	PA Resources Council				
Field trips	PA Sea Grant	school groups	local		400
Field trips	Philadelphia Horticulture Society				
Field trips: brings summer camp kids to Refuge	Philadelphia Zoo	youth		90	
SCA	SCA	Youth, counselors, adults		76 (55 kids, 10 counselors, 10 adults)	

Table I.7. Onsite Training for Teachers and Pre-service Teachers.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Professional Development: teacher training	Interboro School District; Patterson Elementary School	teachers	area	70	
Project Wet, Wild, Learning Tree Training, PA Songbirds, and so forth: teacher training in specific EE curricula	Penn State and University of Penn (pre-service teachers); area schools (in-service teachers)	teachers (pre-service and in-service)	local and area	100–200/ year	
Summer Teacher Institute: week long workshops for K-5 teachers	Widener Partnership Charter School	K-5 teachers	Chester area	20–30/year	week long

Table I.8. Onsite Research.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Water research: water research with Refuge biologists	Philadelphia Academy of Natural Sciences: National History Museum				
Bird Inventory: biological (bird and bird strikes) inventory with Refuge staff	Delaware Valley Ornithological Club				
University Biology field trips: college research field trips	Delaware Valley College, Drexel University, UPenn, and so forth	university biology students and graduate researchers	area		
Frog Watch USA: volunteers collect frog data at Refuge	Philadelphia Zoo, National Wildlife Federation	volunteers; citizen scientists			

Table I.9. Onsite Meetings and Retreats.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Annual staff retreat	Bartram Gardens	garden staff			
Staff meetings	EPA	staff			
Staff meetings	PA Research Council (PRC)	staff			

Table I.10. Offsite Events or Festivals in which John Heinz National Wildlife Refuge Participates.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Green Recycling Festival	Philadelphia Airport	community and families	local and area residents; national and international travelers		once per year
Bucks County Sportsman Show	local Sportsman Group	community and families	local area residents	2,000	annual

Table I.11. Offsite Presentations or Programs Presented by John Heinz National Wildlife Refuge Staff.

Title and description	Organizations involved	Audiences served	Proximity of audience to Refuge	Numbers served	Frequency of programs
Guest speaker	Refuge	University students	area universities		
Requested programs	Refuge	Rotary Clubs, Senior Centers, Career Days, Disabled Adult Centers	local and area residents	100-300/ year	

Refuge Partnerships

This section reports on two different aspects of refuge partnerships: (a) existing partnerships, and (b) potential partners.

Current Partnerships

There are three highly developed partnerships at the refuge worthy of special note. Two of them involve elementary schools and/or elementary school teachers, and one is at the University Level.

- *Nature of Learning* is a multi-faceted partnership with the entire Interboro School District that includes professional development, integration of refuge resources into science curriculum, field-trips by all K–5 students, and offsite visits by refuge staff. This partnership is longstanding and mature. All of staff seems to agree it is ripe for replication to other school districts.
- *Widener University* students are trained by refuge staff in Project WET, WILD, and Learning Tree. Graduate (master's level) students also participate in the 5-week Saturday Ecology Academy for teen girls as part of their field study requirement. Stemming from the University partnership, The Widener Partnership Charter School is becoming a refuge partner through field trips (funded by Friends of Heinz Refuge), some requests for staff training, and utilization of loan boxes.
- *Refuge Environmental Education Development (REED) Team* is a consortium of teachers from Interboro School District, Patterson Elementary, Longstreth Elementary, and others who have written refuge-specific curriculum. This group is currently inactive, though according to staff they could be easily engaged if there was a project for them to embrace.

Potential Partners

Table I.12 lists potential environmental education partners for the refuge.

Table I.12. Potential Environmental Education Partners for John Heinz National Wildlife Refuge.[1]

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
12 District Advisory Council	C	P	
American Philosophical Society			E
Art Organizations (Local)	C	P	E
Aurora Academy (online)			
Bailey Foundation Exotic Bird Rescue			E
Birding Club of Delaware County		P	E
Boys and Girls Club	C	P	
Brandywine Zoo		P	E
Clean Air Council	C	P	
Commonwealth Academy (online)			
Conservation Fund			E
Darby Creek Valley Association		P	E
Delaware Bay Estuary		P	E
Delaware County Herpetological Society	C	P	
Delaware County Libraries			E
Delaware Department of Natural Resources and Environmental Conservation		P	
Delaware Museum of Natural History		P	E
Delaware River Basin Commission		P	E
Delaware Riverkeeper Network			E
Delaware Valley Ornithological Club (DVOC)		P	E
DELCO Bird Club			
East Coast Greenway		P	
Energy Coordinating Agency of Philadelphia		P	E
Fairmount Park	C	P	
Forest Partners International			E
Forgotten Friend Reptile Sanctuary			E
Fort Mifflin		P	E
Franklin Institute		P	E
Friends of Wissahickon and other Friends Groups		P	E
Great Valley Nature Center		P	E
Hawk Mountain		P	E

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
Keep Your Cats Indoors			
Kinder Garden native Seed Project			
Local colleges and University science and education departments	C	P	
Longwood Gardens		P	E
Mill Grove Audubon Center		P	E
Morris Arboretum		P	E
National Audubon Society –PA		P	E
Nature Conservancy		P	
New Jersey Adventure Aquarium		P	E
New Jersey Audubon – Cape May Bird Observatory		P	E
New Jersey Audubon – Rancocas Nature Center		P	E
North American Butterfly Association			E
Pennsylvania Association for EE		P	
Pennsylvania Dept of Conservation and Natural Resources		P	
Pennsylvania Dept of Education		P	
Pennsylvania Dept of Environmental Protection		P	E
Pennsylvania Fish and Boat Commission		P	E
Pennsylvania Game Commission		P	E
Pennsylvania Natural Heritage Program			E
Pennsylvania State Commission on Higher Education		P	
Pennsylvania State Parks (Ridley Creek)			E
Pennsylvania Environmental Council		P	E
Philadelphia Dept Parks and Rec.	C	P	
Philadelphia (City of)	C		
Philadelphia County			
Philadelphia Library System	C	P	
Philadelphia Trail Club	C		E
Philadelphia Water Department		P	E
Police Athletic League (PAL)	C	P	
School: Pepper Middle School	C		
School Districts: Penn-Delco, Philadelphia, Ridley, Southeast Delaware County, Upper Darby, William Penn	C	P	
Schuylkill Center for EE		P	E
The Avian Promise			E

Agency name	Consumer of EE (Audience) (C)	Provider of EE (P)	Exhibitor at Refuge events (E)
Tri-State Bird Rescue and Research, Inc.			E
Tyler Arboretum		P	E
U.S. Coast Guard		P	E
U.S. Sportsman's Alliance Trail Blazer Program			E
USDA – APHIS/Wildlife Services			E
Western Pennsylvania Conservancy			E
YMCA	C	P	

1. Extracted from Original Data Sheets- see Appendix B.

Outreach Materials

Although the primary focus of this project is on audiences, visitors, and potential partners, it is difficult to ignore existing outreach materials that help convey the image of the refuge and serve to attract, inform, and educate the visitors. This section briefly reviews select printed material and website information that are relevant to the purpose of this project.
Table I.13 is a list of printed refuge materials as provided by the refuge. The refuge also hosts a Web site that serves visitors to and audiences of the refuge.

Table I.13. Summary of Select Refuge Outreach Printed Material.

Title	Brief description
John Heinz National Wildlife Refuge at Tinicum	multi-page, 4-color, agency brochure of refuge with foldout map
Special event flyers	announcement for the annual festivals
Environmental education at John Heinz National Refuge at Tinicum	1 page, tri-fold brochure (black and white copy on salmon paper) summarizing programs, provisional development and field trip opportunities.
Quarterly walk schedules	1 page (legal), 4-fold brochure summarizing quarterly guided nature programs
Visitor Center	1 page (legal), tri-fold brochure (black and white copy on bright green paper) describing the green building design elements of the visitor center.
Impoundment trail map	1 page (letter) map of refuge trails (black and white copy)
10th Annual Friends of Heinz Refuge photo group photo contest	1 page (letter) flyer/application for photo contest (black and white copy)
Heinz Refuge scouting award	1 page (legal), tri-fold flyer application and description of the Award program (accompanied by a 1 page flyer entitled "Notes to all Refuge Staff and Volunteers announcing this New Program – July 11, 2010)
Fishing opportunities brochure	
Canoe trail brochure/map	
Marsh musings	Friends quarterly newsletter (also friends membership brochure)

Title	Brief description
Online curriculum	http://www.fws.gov/heinz/ee.htm
Wildlife checklists	

Discussion

The refuge clearly makes connections with a large and diverse audience. It serves more than 125,000 visitors annually through onsite and offsite programs as well as self-guided visitors coming to enjoy the refuge. The variety of programs at the refuge reflects the interests, passions, and skills of staff, volunteers, and area stakeholders and partners.

The CCP process provides an excellent opportunity to craft a vision for the refuge's expanded role in the region's environmental education. The refuge will be positioned to develop its priorities and an action plan to achieve its preferred goals. As the refuge expands its environmental education efforts, it will need to expand its approach as well. The current "Train the Trainer" approach will need to become one of several strategies.

Staff is well versed about the unique environments of and issues related to the refuge. As such, they have the potential for significant environmental education impact through increased direct contact with visitors. Sharing their expertise with field trips through "meet and greets," guided tours, and end-of-trip debriefs would result in thousands of children having a satisfying and enriching experience that may entice them to bring friends and family back to the refuge. Utilizing staff's expertise for the development and delivery of programs specific to the refuge's identified niche would provide a perceived quality and depth of experience for participants. The orchestration of a formal volunteer program, complete with high quality training and evaluation, could provide additional needed resources. In this way, volunteers can directly assist the refuge in achieving its prioritized goals while the content, quality, and consistency of programs are ensured.

To successfully expand the refuge's role in environmental education, it is critical to look both inside and outside the organization. Internally, a focus on existing organizational strengths and capacity will shape what is possible to deliver. Externally, it will be important to learn who the refuge's stakeholders and potential partners are and to gain a clear picture of what is currently being done regarding environmental education in the region.

Gaining an Internal Perspective

Consideration No. 1 – Understanding Strengths

The refuge can leverage its position in environmental education by understanding its strengths. The refuge has natural features like its fresh water tidal marsh ecosystem that many people have not experienced. The urban location of the refuge is also unique and lends itself, like few other wildlife refuges, to connections with a huge and diverse population. As part of the CCP process, the refuge staff will want to articulate the uniqueness of the refuge in terms of its natural features, wildlife, and environmental issues. This will also help inform Phase II of this Stakeholder Analysis and the refining of the refuge's niche in environmental education.

Consideration No. 2 – Expanding Partnerships

Building on the strengths of the organization's existing partnerships will help achieve environmental education goals while maximizing resources. The refuge has at least three mature partnerships that

demonstrate the power of mutually-beneficial collaboration. Seeking ways to expand and replicate these alliances could produce dramatic results with considerably less effort and resources than would be necessary to capture a brand new audience with a newly developed program. *The refuge staff may consider identifying partners most aligned to REED and to the partnerships with Interboro School District and Widener University with the intent to replicate existing efforts with other partners.*

Consideration No. 3 – Understanding Internal Capacity

Understanding the refuge's capacity will help refine how to best grow environmental education programming. Capacity can, and should be, looked at in two ways—first with regard to limits on visitation and program participation, second with regard to internal resources. Growth in environmental education programming will most likely necessitate growth and/or the redefining of internal capacity. *Simultaneous to Phase II interviews, refuge staff may want to brainstorm answers to internal capacity questions such as:*

1. What does the refuge have to offer that nobody else can offer? For example, an answer may be the actual refuge property, the ability to offer free programs, or access to government agencies.
2. How many people can be accommodated onsite hourly, daily, annually, and in programs?
3. How many people can be reached offsite and online?
4. With our current staff, what are we capable of delivering?
5. What do we wish we could do in environmental education?
6. What are the barriers to achieving those wishes and how can we overcome them?
7. Do we have additional financial, staff, or volunteer resources available to us? Are there ways to attain any or all of them? How can we incorporate these anticipated resource needs into CCP planning?
8. When we decide on what programs we are going to deliver, how will we get our desired audience to come/participate? What promotional strategies do we need to employ? Will it be Web-based, mailing list, neighborhood flyers, e-mail?
9. When people come to our newly developed programs, how will we track attendance?
10. How will we measure if we are successful and if people's expectations were met, or what input they might have regarding improvement and future opportunities?
11. What types of technologies do we want to incorporate into our environmental education program (for example, in-house videos, live broadcasts, using satellite equipment now installed to expand programs, cell phone tours, and/or social networking)?

Gaining an External Perspective

Consideration No. 4 – Understanding Stakeholders

Understanding the region's stakeholders is a complex task. Not only is it important to know who they are and what they want, but ultimately it is desirable to craft a plan that truly responds to the needs of the area. In thinking about a refined vision for environmental education at the refuge that is responsive to the needs of the environmental education community, it is important to better understand these stakeholders: not only the other providers of environmental education in the area, but the current or potential consumers as well (for example, students and nonprofits such as Boys and Girls Club). For environmental education consumers, Phase II will explore overarching questions such as:

1. Are they aware of the refuge and to what extent?
2. Are they aware of the Refuge System mission, for example, "Wildlife First?"
3. Have they visited the refuge? If so, what was their impression?
4. If they have not visited, why not? What are the barriers?
5. Have they gone to other similar places for environmental education/interpretation?
6. Have they ever participated in a program or event at the refuge or at other similar places like nature centers and so forth?
7. What type of program or event would they attend?
8. Have they ever seen any marketing materials for the refuge or visited the website?
9. How would it be best to inform potential visitors of the refuge and its programs?

Consideration No. 5 – Inventorying Existing Regional Environmental Education

The public has many options in the region for environmental education. Refuge staff has often indicated that there are more than 40 entities nearby that all offer different approaches to environmental education. Carefully surveying other organizations with similar missions regarding their existing environmental education efforts will help sharpen the focus on what gaps exist in regional offerings. Information can also spawn creative thinking regarding options for partnering. With a subset of these environmental education providers, Phase II will explore questions such as:

1. Which other organizations in the region conduct environmental education?
2. What are the program strengths?
3. What are the perceived weaknesses?
4. Who is the audience? How have they been segmented and/or prioritized?
5. What are the challenges?

6. Who do they wish they could serve but cannot engage?
7. What do they see as the refuge's greatest opportunity to complement other environmental education initiatives in metropolitan Philadelphia?
8. Is there a way to collaborate to surmount challenges, to engage an audience who is difficult to reach, or to achieve something together that neither could achieve alone?

Next Step: Phase II Stakeholder Interviews

Phase II of this project will continue with the researchers conducting a series of interviews to explore the questions proposed in Considerations 4 and 5, above. The following steps are proposed to begin this process:

1. Build a list of potential interviewees from the information captured so far in Phase I (see Appendix B). This list will likely be more than can be accommodated in this study. Researchers will work with planning and refuge staff to narrow down this list to 15 to 30 interviewees.
2. As discussed above, partners/potential partners will be identified under both of the categories and sectors below:

    I. Environmental Education Consumers (refuge is seeking an audience from these groups; Consideration No. 4)

    A. Grades Pre-K to 12
    - Pre-K to 3
    - Grades 4 to 8
    - Grades 9 to 12
    - Special Education
    - Administrators
    - Teachers
    - School districts likely to replicate Interboro partnership
    - Homeschoolers

    B. Universities and Colleges
    - Faculty in Pre-service Teacher program
    - Faculty in Architecture/Green Building/Sustainability programs
    - Faculty in Environment Resources/Water Quality programs
    - Universities likely to replicate Widener University partnership

C. Other Entities with Overlapping Audiences
   - Youth organizations
   - Birding organizations
   - Senior citizen organizations/centers
   - Libraries

II. Environmental Education Providers (refuge is seeking partnerships with these groups or wants to learn what is being done already by these groups; Consideration No. 5)

A. Aquariums

B. Nature Centers

C. Museums

D. Gardens/arboreta

E. Zoo

III. Other

A. Funders (such as Conservation Fund)

B. Government Agencies

C. Representative Organizations for:
   - low-income populations
   - ethnic populations
   - teen, senior, or other demographic sector

3. Create a sampling strategy that allocates resources and effort fairly across these sectors. For example, a proportional sample of each of the sectors by grade level or type of organization may be appropriate. Snowball sampling may also be used as necessary to identify the most appropriate interviewee(s) representing each group.

4. Develop draft interview protocols for interviews. These protocols would draft procedures and actual questions to be used with each sector. At least two pilot interviews would be conducted prior to finalizing the protocols and proceeding with interviews.

5. Conduct interviews, compile and organize data, and report findings.

Appendix A

Summary of Recommendations from Visitor Services Review by Ten Visitor Services Criteria

As a reference and reminder only, the following phrases summarize recommendations made by the Review Team in the 2009 Visitor Services Review. Reader should reference the full report for additional level of detail.
Bold = VSR recommended planning efforts

Underline = refuge additions

1. Develop a Visitor Services Plan.

- Finalize **current VSP draft.**
- Clear strategy
- Refuge's issues and message
- Two new staff (supplement with high quality trained volunteer program)

2. Welcome and orient visitors.

- Move directional signs.
- Clarify visitor entrance.
- Provide basic information when closed.
- Replace canoe launch sign.
- Replace fishing signs.
- New approach on Route 420 and maintain 420 parking areas
- Replace kiosk on Route 420.
- Explore new media (Facebook, Twitter) as well as coordinate with External Affairs and Friends group who are currently using social media.

3. Provide quality hunting opportunities.

- Consider sharpshooters for deer management.
- Include **Outreach planning** in deer management.
- Consider public hunt (later)—youth, women, accessible.
- Address deer management in CCP.

4. Provide quality fishing opportunities.

- Develop **Fishing Plan.**
- Post regulations.

- Improve fishing access with signage.
- Replace bulletin board with interpretation signs.
- ID fishing areas on maps and brochures—consistency.
- Link fishing webpage to regulations and maps.
- Promote fishing activities.
- Create new fishing area–accessible.
- Info about live bait.
- First time fishing tip sheet.
- Tackle box supplies.
- Volunteer cleanup of fishing areas; current info.

5. Provide quality wildlife observation and photography opportunities.

- Clear bench areas.
- Renovate and maintain photo blinds; remove old blinds.
- Replace benches; place strategically.
- Add spotting scopes, seating, and bird ID interpretation at tower.
- Provide info and interpretation about wildlife watching.
- Link remote viewing area to monitor in Visitor Center.
- Install scopes with focusable lenses.
- Ensure at least one blind is accessible.
- Ensure one or both photo blinds are accessible.
- Ensure photo blinds are accessible.
- Photo group workshops, tours, and programs.
- Create web sites links to NANPA and other partner photo organizations.
- Continue annual photo camps, photo contest, and TTL programs.

6. Develop and implement a quality environmental education program.

- Develop **Environmental Education Plan** (revise/update).
- Encourage staff collaboration.
- Interns.
- Visitor-staff interaction.
- Increase visitor-staff interaction with staff led programs.
- Mentor more new educators through leading environmental education programs by example.

- Evaluation.
- Email communication about programs.
- Recruit youth and volunteers, mentors.
- Form partnerships with informal education entities.
- Schoolyard Habitat Program.
- Heinz family foundation philanthropies.
- Have more science and career fairs.
- Expand environmental education efforts beyond Philadelphia and Delaware Counties.

7. Provide quality interpretation of key resources and issues.

- Develop **Interpretation Plan.**
- Add site signs with maps.
- Improve native plant garden.
- Develop trail guide brochure with map.
- Improve canoe trail brochure.
- Expand topics of walks/talks; include refuge management activities.
- Include Refuge System information in all programs.
- Work with Friends group to take active role in preparing and presenting programs.
- Work with volunteers and Friends group to increase programs.
- Develop cell phone tours.
- Increase range of programs to other ages (ages 3 to 7)
- Add synopsis to list of programs.
- Interpretation training for staff.
- Increase programs given by staff.
- Explore funding for women in outdoors.

8. Manage for other recreational use opportunities.

- Link recreation to refuge resources.
- Educate all refuge visitors about Refuge System.
- Personal contact with visitors to refuge.

9. Communicate key issues with offsite audiences.

- Finalize **Outreach Plan** (internal and external needs assessment)—ID range of audiences, ID key messages, match message and media, include evaluation.

- Formalize partnerships to maintain and grow programs for at-risk youth.
- Enhance connection with neighborhood block party, visit classes, teen docents.
- Email communication with visitors to Visitor Center.
- Tech outreach—podcasts, websites, videos, cable TV, and so forth.
- Refuge blog.
- Elected officials—press kits, guided tours, personal connections.
- Partnership with Philly Zoo.
- Partnerships with transportation, hotels, Liberty Bell, local events, Philly Eagles.
- Connect to tourism agencies.
- Develop/host specific media days for reporters, editors, producers, and so forth.

10. Build volunteer programs and partnerships with Friends organizations.

- Maintain current volunteer agreements.
- Use NCTC scholarships.
- Pursue advanced volunteer training (NCTC).
- Volunteer handbook, recognition, and database program
- Add volunteer positions—teen docent, refuge host, coordinator, restoration team.
- Improve staff and Friends communication.
- Clarify refuge mission for Friends.
- Friends-only programs, trips, tours, events; Train Friends—books, materials, listserv/e-mail info, and so forth.

Appendix B

Original Data Worksheets

(Also available in the original Excel file format)

This appendix contains the following four Excel worksheets used in the initial data capture for this project.

- *Visitor Data*: the master file used for several iterations of data gathering related to actual visitation to the Visitor Center and the refuge at large.
- *Current Programs*: the master file for all programs provided by staff (refuge manager, visitor services supervisor, environmental education specialist, and public affairs staff).
- *Festival List*: electronic format of the hard-copy list provided by refuge manager in initial interview describing agencies who have had a booth or done a presentation at refuge festivals such as Cradle of Birding. When creating the electronic format, researchers added information regarding websites, some contact information, and distances from the refuge.
- *Current and Potential Partners*: master file for partnership information gathered from interviews and communication with staff, Refuge Management Habitat Plan, and 2002 EETAP Report.

Current Visitor Data for John Heinz Refuge (July 2010)				Gray areas are alternative ways to consider visitor data. If data exists please fill in otherwise leave blank. Add additional columns as needed to capture data you have.[1]										
FISCAL YEAR (Oct-Sept)	Total # of visitors to Refuge (based on 5x visitor center)	Total # of visitors into Visitor Center	Total # of offsite visitor contacts	Total # adults visiting	Total # children visiting	Total # field trip children visiting	Total # non-field trip children visiting	# of visitors receiving guided tours	# of teachers trained	# of classes taught	# of classes hosted (space only provided)	# of equip borrows	# offsite programs delivered	# of offsite people serviced offsite
2010 Oct thru July	100925	20185				4111		1335 S & V	140 S	15 V		~10	15 S & V	1165 S
2009	132830	26566				FY 09 - 8196		13283 S & V	FY - 305				30 S & V	1800
2008	116530					FY 08 - 7797		2450 S & V	FY - 266				25 S & V	500
2007	238190					FY 07 - 7087		4765 S & V	FY - 293				25 S & V	500
2006	106491							2130 S & V					20 S & V	400
2005	100920													
2004	104305												176 S & V	24364
2003	93200													
2002	118280													
2001	108290													

[1]S and V indicate Staff and Volunteer

Current Programs at John Heinz Wildlife Refuge (July 2010)

Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area[1]	Staff Contact
Art Exhibits	Nature-based art exhibits hosted in Multipurpose Room throughout the year featuring regional artists		local community				Unknown	I	visitor services
Big Brothers Big Sisters Intro Program	600 "Bigs and Littles" hosted at refuge to introduce them to opportunities available at the refuge	Big Brothers, Big Sisters	Big Brother & Big Sister "big/little" duos	600	develop and deliver program	staff and volunteers	Unknown	I	visitor services
Cradle of Birding Wildlife Conservation Festival	Annual wildlife outreach event hosted at refuge with 36 exhibitors	see festival list	local community	600-800	host and coordinate event	all staff effort	out-reach	I	refuge manager
Darby Creek Clean Up	Annual refuge clean up	Waste Management, Friends of Heinz Refuge	local community	150-250	logistics, lunch, event coordination	staff and volunteers	both	I	visitor services
Earth Day Darby Creek Clean-up	litter clean at refuge that results in pick up of 5-8 tons of trash each year	Waste Management, Friends of Heinz Refuge	local community	200	host and coordinate event	staff and volunteers	out	I	visitor services
Family Nature Program	monthly 4 hour family program that includes a lecture then hands-on experience in refuge		8-14 year olds	25-40	create and run program	staff and volunteers	both	I	visitor services
Federal Junior Duck Stamp Program	K-12 art competition. Refuge serves as the collection and judging site for Pennsylvania entrants with the refuge's manager serving as State coordinator.		students K-12 Statewide	450	coordinate State level competition		out	I	refuge manager
Fishing Camps	YMCA brings their youth fishing camps (with their own staff and equip) to use refuge	YMCA			provide use of refuge	YMCA	In-reach	F	visitor services
Green Building Tours	tours of Marsh Machine and explanation of green technology used in building Visitor Center		university architecture classes	100	develop and deliver program	staff and volunteers	In-reach	I	visitor services

Current Programs at John Heinz Wildlife Refuge (July 2010)

Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area[1]	Staff Contact
Guest Speaker	provide guest lectures	area universities/ colleges	college students		provides guest speaker	refuge manager	In-reach	I	refuge manager
Heinz Scouting Award	Conservation awareness and activity guide for scouts that culminate in a Heinz Refuge patch award	Boy Scouts, Girl Scouts	Scouts	new	provides curriculum, Friends group provides patch	Scouts do it themselves	out	I	visitor services
International Migratory Bird Day	Festival type booths and programs hosted at refuge	varies from festival list	local community	100	host and coordinate event	staff and volunteers	out	I	visitor services
Micro Adventures	Older students mentor younger students when brought to refuge to collect samples and learn to use microscopes. They take samples back to classroom for longer term observation.	Interboro School District, Philadelphia Mennonite High School, and a middle school from NJ	entire 5th grade from Interboro School District, students from Philadelphia Mennonite HS (primarily intercity youth), and students from a middle school from NJ	350	hosts and delivers program	Public Affairs & AV	In-reach	EE	Public Affairs & Media
National Wildlife Refuge Week	Festival type booths and programs hosted at refuge. Also includes waterfowl carving demos and State's Junior Duck Artists.	varies --see festival list	local community	100	host and coordinate event	staff and volunteers	out	I	visitor services
Nature of Learning	A multi-faceted partnership with entire school district that can include offsite visits from refuge staff, professional development for teachers, and the integration of refuge resources into the science curriculum.	Interboro School District (4 elem schools)	Teachers and K-5 grade students come every year	500-1,000	host field trips, conduct teacher trainings, school visits	EE Specialist	Unknown	EE	EE Specialist

Current Programs at John Heinz Wildlife Refuge (July 2010)

Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area[1]	Staff Contact
Nature walks	weekly/monthly programs on birds, trees, flowers, butterflies, etc.		local community	500-600	hosts and delivers program	staff and volunteers	both	I and WO	visitor services
Off site programs	programs as requested such as speaking at Rotary Clubs, afternoon programs for disabled adults, senior center programs, career days for universities,		local organizations	100-300	develop and deliver program	staff and volunteers	In-reach	I	visitor services
Owl Walks	seasonal evening bird walks		local community	30-40	create and run program	staff and volunteers	both	I	visitor services
Pathways to Fishing	Two annual free fishing days at refuge that coordinate with Statewide free fishing days. Free loaner fishing equipment provided.	PA Fish & Boat Commission	local community	75-150	provide free fishing rods, reels, bait, and fishing instruction	staff and volunteers	both	F	visitor services
Professional Development	Teacher Training for Interboro School District and Patterson Elementary School	Interboro School District, Patterson Elementary School	teachers	70	conduct professional development				
Project WET	science methods class from Penn State is put through Project WET each year	Penn State	Pre-service teachers	10	conduct teacher training	EE Specialist	Unknown	EE	EE Specialist
Project WET/ WILD/ Learning Tree, etc	Teacher Training/National Curriculum	area school districts, individual teachers, preservice teachers at universities	k-12 teachers and pre-service teachers	100- 200	conduct teacher training both on and offsite	EE Specialist	both	EE	EE Specialist
Saturday Ecology Academy	12-15 teen girls from underserved area of Chester are matched with Master degree program teachers and pre-service from Widener University (part of science methods class) for 5 Saturdays at the refuge. Teachers are evaluated on how well they deliver the curriculum to girls.	Widener University	Pre-service teachers and underserved teen girls	20	help develop curriculum for teen girls, host the program at the refuge, help evaluate pre-service teachers' delivery of curriculum	Dr. Nadine McHenry from Widener assisted by EE Specialist	both	EE	EE Specialist

Current Programs at John Heinz Wildlife Refuge (July 2010)

Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area[1]	Staff Contact
Scout Programs	programs designed to fulfill merit badge requirements	Scouts	Boy and Girl Scouts	75-100	create and run program	staff and volunteers	In-reach	I	visitor services
Spring Break/ Summer Camp	3 or 4 day camps for schools involved in Nature of Learning for 3rd and 4th grade students	Patterson, Widener, Longstreth Elementary Schools	3rd & 4th grade students	10 to 20 students per camp	host and lead camp	EE Specialist	both	EE	EE Specialist
Story Time	monthly family program		4-7 year olds	25-40	hosts and delivers program	staff and volunteers	both	I	visitor services
Summer Institute	Week-long intensive workshop at the refuge for all K-5 teachers from Widener Partnership Charter School (WPCS), a "lab" school for Widener University	Widener University & Widener Partnership Charter School	K-5 teachers	20 -30	host, co-teach	EE Specialist and Widener Faculty	both	EE	EE Specialist
Summer Nature/ Photography Camps	two 4.5 day nature and/or nature photography camps for 8-14 yr. olds	Friends of Heinz Refuge for funding	8-14 years old	30-50	create and run program	staff and volunteers	both	I	visitor services
Through the Lens	Nature photography program			10	develop and deliver program	Public Affairs & AV	out-reach	NP, WO	visitor services
Woodcock Walks	seasonal evening bird walks		local community	30-40	create and run program	staff and volunteers	both	I	visitor services
Field Trips/ Meeting Space	**These groups all use refuge as a field trip destination and/or meeting space**	**ALL OF THE BELOW**			host field trip, provide use of facilities				
		Academy of Natural Sciences							
	Zoo brings their summer camp kids to refuge.	Philadelphia Zoo							
		Wagner Free Institute							
		Pennsylvania Resources Council							

Current Programs at John Heinz Wildlife Refuge (July 2010)

Program Name	Brief Description	Partner(s)	Target Audience	# of people served annually	Refuge's Role	If it's a deliverable program, who delivers it?	Program Origin: In- or Outreach?	CCP Focus Area[1]	Staff Contact
		PA SEA Grant							
		Cobbs Creek Community Environmental Ed Center							
	They bring their youth programs here; refuge also provides facility for staff meetings	EPA - Philadelphia							
		Forest Service - Newtown Square							
		Bartrams Garden	K-4	200+			Unknown	EE	EE Specialist
	There's one science teacher for all students K-4 in this school…he brings a couple of the grades each year.	Patterson Elem School							
	They focus on sustainability; they do field trips here due to the green building and water shed. They are facility challenged use the refuge's meeting space.	PA Resources Council (PRC)							
		Schuylkill Center for Environmental Education (SCEE)/Green Woods Charter School (onsite)							
		Delaware Valley Earth Force							
	field trips for biology students and graduate researchers	Drexel University							
	24 field trips per year	Widener Partnership Charter School							
	field trips for undergrad biology students	Delaware Valley College							

[1]EE = Environmental Education, I = Interpretation, NP = Nature photography, WO = Wildlife observation, F = Fishing

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	American Philosophical Society	http://www.amphilsoc.org	19	11	National	NGO	O	Promotes useful knowledge in the sciences and humanities through excellence in scholarly research, professional meetings, publications, library resources, and community outreach. This country's first learned society, the APS has played an important role in American cultural and intellectual life for over 250 years	104 South Fifth Street Philadelphia, PA 19106-3387 215-440-3400
FL	Bailey Foundation Exotic Bird Rescue	http://www.bailey-foundation.org	19	13	Regional	NGO	B	Dedicated to enhancing the life of Companion Birds through Education, Rescue, Rehabilitation and Adoption	The Bailey Foundation P.O. Box 2122 Boothwyn, PA 19061 Phone: (484) 882-0101
FL	Bartram's Garden	http://www.bartramsgarden.org	8	4	City	NGO	P, E	America's oldest living botanical garden features an 18th century farmstead, native plants, wildflower meadow, and wetland.	5400 Lindbergh Boulevard Philadelphia, PA
FL	Bird Banding Demos				City		B	Bird Banding Demos	
FL	Birding by Ear		16	6	Regional	NGO	B	Bird ID by song	University of. Pennsylvania Philadelphia, PA
FL	Birding Club of Delaware County	http://www.bcdelco.org	24	17	Regional	NGO	B, R	a birding club in Delaware County, Pennsylvania with the purpose to expand the individual interest and study of wild birds.	Meeting Location: Marple Township Library Meeting Room located at the intersection of Sproul and Springfield Roads in Broomall, PA

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Brandywine Zoo	http://www.brandywinezoo.org	29	22	City	public	A	Today, the Brandywine Zoo covers almost 13 acres of land and houses 150 animals. The Brandywine Zoo is managed by the Delaware Division of Parks and Recreation with the support of the Delaware Zoological Society. The Brandywine Zoo continues to be a fully-accredited member of the American Zoo and Aquarium Association,	1001 North Park Drive Wilmington, DE 19802-3801 (302) 571-7788
FL	Delaware Bay Estuary Project	http://www.fws.gov/delawarebay	82	65	Regional	public	E	The Delaware Bay Estuary Project is an office of the U.S. Fish and Wildlife Service (Service). The mission of the Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Our office's specific mission is to: Work with partners to identify, restore, and protect regionally important habitat in the Delaware River drainage basin and the Delmarva Peninsula area.	Delaware Bay Estuary Project US Fish and Wildlife Service 2610 Whitehall Neck Rd. Smyrna, Delaware 19977-2910 (302) 653-9152
FL	Delaware County Herpetological Society	http://dvherps.wordpress.com	30	21	Regional	public	A	To promote education about and conservation of wildlife in general and herpetofauna in particular as well as to achieve a closer cooperation and understanding between amateur and professional herpetologists.	Maple Shade Soccer Club 895 E. Main St. Maple Shade, NJ
FL	Delaware Museum of Natural History	http://www.delmnh.org	36	26	State	NGO	E	To excite and inform people about the natural world through exploration and discovery.	4840 Kennett Pike Wilmington, DE 19807-1827 (302) 658-9111
FL	Delaware Valley Ornithological Club	http://www.dvoc.org/Main.htm	31	19	Regional	NGO	B	The Delaware Valley Ornithological Club (DVOC) is the organization for birders and bird enthusiasts in the Delaware Valley region.	Meeting held at Palmyra Cove Nature Park, Palmyra NJ

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Dept. of Bio Sciences, Univ of the Sciences in Philadelphia	http://www.usp.edu/academics/collegesDepts/BiologicalSciences	12	5	City		B, A, E	offers majors in biology, environmental science and microbiology	600 South 43rd Street Philadelphia, PA 19104-4418 (215) 596-8919
FL	Earth Force	http://www.earthforce.org	41	21	National	NGO	O	Earth Force engages young people as active citizens who improve the environment and their communities now and in the future.	100 Greenwood Avenue Wyncote, PA 19095 Phone (215) 884-9888
FL	Energy Coordinating Agency of Philadelphia	http://www.ecasavesenergy.org	**19**	9	City	NGO	O	The mission of the Energy Coordinating Agency (ECA) is to help people conserve energy and to promote a more sustainable and socially equitable energy future for the Philadelphia region.	1924 Arch Street Philadelphia, PA 19103-1404 (215) 988-0929
FL	EPA (Prentiss Ward-Children's Health Initiatives)	http://yosemite.epa.gov/ochp/ochpweb.nsf/content/whereyoulive2.htm			National	public	O	Protecting children's health from environmental risks...EPA Region 3 Children's Health Web Site: Learn about environmental issues that may affect children in the Mid-Atlantic. EPA Region 3's children's health coordinator is Prentiss Ward (ward.prentiss@epa.gov) at (215) 814-2813.	
FL	Forest Partners International		46	35	National	NGO	P	To promote sustainable natural resource management practices globally in regions of high biodiversity through partnerships that address biodiversity and human needs.	302 Poplar Road Flourtown, PA 19031
FL	Forgotten Friends Reptile Sanctuary (Forgotten Friend, Inc – 501(c)(3) nonprofit)	http://www.forgottenfriend.org	99	69	Regional	NGO	A	Nonprofit reptile rescue and education organization based out of Lancaster County, PA, with supporting members nationwide. Focused on educational outreach in the community and prevention of cruelty to animals.	Lancaster, PA

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Fort Mifflin	http://www.fortmifflin.us	6	3	City	public	E	The Fort is home to 14 restored historic structures constructed from 1778 to 1875, including an Enlisted Barracks, Officer's Quarters, Blacksmith Shop and the casemates (or as the students like to call them, the dungeons.) The Fort is situated on the beautiful banks of the Delaware River, where you can eat a picnic lunch and watch the abundant fauna and flora or investigate the ancient moat, which is home to all sorts of aquatic life.	1 Fort Mifflin Rd Philadelphia, PA 19153-3990
FL	Franklin Institute	http://www2.fi.edu	18	9	City	public	E, O	In the spirit of inquiry and discovery embodied by Benjamin Franklin, the mission of The Franklin Institute is to inspire an understanding of and passion for science and technology learning.	222 North 20th Street Philadelphia, PA 19103 215.448.1200
FL	Great Valley Nature Center	http://www.gvnc.org	46	27	City	NGO	E	Fosters an appreciation and understanding of the natural world and promotes a sense of responsibility for its care. A colonial-era fieldstone bank barn serves as the education building, having undergone renovations in 1986 and 2001. A converted farmhouse provides admin, teaching and meeting space, and houses the executive director and his family. A nearby two-storied springhouse probably predates the barn. The Nature Center's 10½-acre site includes a stream, a pond, and wetland, field, and woodland habitats. Also featured is a Birds of Prey Center, a replica Native American Lenape village, a Pennsylvania wildflower garden, a maple sugar house, and a please-touch exhibit area.	PO Box 82 Rt. 29 & Hollow Rds. Devault, PA 19432 Phone 610.935.9777

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Hawk Mountain	http://www.hawkmountain.org	108	91	Regional	NGO	E	Hawk Mountain is the world's first refuge for birds of prey. Open year-round, visitors enjoy scenic vistas, 8-miles of ridge and valley trails, a Visitor Center, Bookstore, and native plant garden, and each autumn, the chance to observe large numbers of hawks, eagles and falcons as they migrate past our lookouts.	1700 Hawk Mountain Rd Kempton, PA 19529 Phone: (610) 756-6961
FL	Keep Your Cats Indoors	http://www.njaudubon.org/SectionCatsIndoors/CatsIndoors.aspx			Regional	NGO	A	Millions of birds, small mammals, reptiles and amphibians are killed every year by domestic cats. Join Educator Walt Jennings and local students from Interboro School System to learn important ways that you can protect wildlife from these silent domestic and often feral predators.	
FL	Kinder Garden Native Seed Project – Longstreth Elementary School	http://www.riverfrontramble.org/heinz-schedule-2.pdf	12	5	City	public	P	Meet Chuck Lafferty and local students from Longstreth Elementary School's Kinder-Garden Seed Company to find out how they grow organic native seeds for wildlife habitat right here in Philadelphia.	Longstreth Elementary School N. E. Corner of 57th & Beaumont St Philadelphia 19143
FL	Longwood Gardens	http://www.longwoodgardens.org	37	26	City	NGO	P	Longwood Gardens is the living legacy of Pierre S. du Pont, inspiring people through excellence in garden design, horticulture, education and the arts.	Longwood Gardens 1001 Longwood Road Kennett Square, PA 19348
FL	John James Audubon Center at Mill Grove (The first home of John James Audubon in America)	http://pa.audubon.org/centers_mill_grove.html	44	33	Regional	NGO	B	Today, the National Audubon Society strives to connect people with nature within the special context of a national historic site and through the appreciation of John James Audubon's life and art. In the future the Center will tell the story of the stirring of the American conservation movement and the protection of birds, wildlife and habitat through the compelling art of Audubon.	John James Audubon Center at Mill Grove 1201 Pawlings Road Audubon, PA 19403 Telephone: 610-666-5593

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Morris Arboretum (UPENN)	http://www.business-services.upenn.edu/arboretum/index.shtml	42	31	Regional	public	P	An interdisciplinary center that integrates art, science and the humanities. Thousands of rare and lovely woody plants, including some of Philadelphia's oldest, rarest, and largest trees, are set in a romantic, 92-acre, Victorian landscape garden of winding paths, streams, flowers and special garden areas.	100 E. Northwestern Avenue Philadelphia, PA 19118
FL	National Audubon Society-PA				National	NGO	B		See Mill Grove above
FL	Cape May Bird Observatory, New Jersey Audubon Society (NJAS)	http://www.birdcapemay.org/contact.shtml	114	91	State	NGO	B, E, R	Founded in 1976 by the NJAS*, the Cape May Bird Observatory (CMBO) is a leader in research, environmental education, bird conservation, and recreational birding activities. Our mission: to understand and instill appreciation of the needs of resident and migrating birds so that human ambitions do not undermine them. *The NJAS is a privately supported, not-for profit, statewide membership organization. Founded in 1897, and one of the oldest independent Audubon societies, NJAS has no affiliation with the National Audubon Society.	The Northwood Center 701 East Lake Drive Cape May Point, NJ 08212 Ph: 609.884.2736
FL	NJ Adventure Aquarium	http://www.adventureaquarium.com	24	14	State	NGO	F		1 Riverside Drive Camden, NJ 08103-1060 (856) 365-3300

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	NJ Audubon, Rancocas Nature Center, (Susan Buffalino-Director)	http://www.njaudubon.org/SectionCenters/SectionRancocas/Introduction.aspx	40	31	State	NGO	B, E, R	New Jersey Audubon has no connection with the National Audubon Society. New Jersey Audubon fosters environmental awareness and a conservation ethic among New Jersey's citizens; protects New Jersey's birds, mammals, other animals, and plants, especially endangered and threatened species; and promotes preservation of New Jersey's valuable natural habitats.	794 Rancocas Road Mount Holly, NJ 08060 609-261-2495
FL	North American Butterfly Association	http://www.naba.org	120	98	National	NGO	A	Working to increase public enjoyment and conservation of butterflies.	4 Delaware Road Morristown, NJ 07960
FL	PA Fish & Boat Commission	http://www.fish.state.pa.us	126	117	State	public	F, R	The mission of the Pennsylvania Fish and Boat Commission is to protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.	1601 Elmerton Avenue PO Box 67000 Harrisburg, PA 17106 717-705-7800
FL	PA Fish & Boat Commission	http://www.fish.state.pa.us	126	117	State	public	F, R	The mission of the Pennsylvania Fish and Boat Commission is to protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.	1601 Elmerton Avenue PO Box 67000 Harrisburg, PA 17106 717-705-7800
FL	PA Game Commission	http://www.portal.state.pa.us/portal/server.pt/community/education/9110	126	117	State	public	F, A, R	Managing wildlife and its habitat for current and future generations	2001 Elmerton Ave Harrisburg, Pennsylvania 17110 717-787-4250
FL	PA Game Commission	http://www.portal.state.pa.us/portal/server.t?open=512&objID=9115&mode=2	126	117	State	public	F, A, R	Managing wildlife and its habitat for current and future generations	2001 Elmerton Ave Harrisburg, Pennsylvania 17110 717-787-4250

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	PA State Parks, Ridley Creek State Park	http://www.dcnr.state.pa.us/stateparks/parks/ridleycreek.aspx	29	18	State	public	E, R	Ridley Creek State Park encompasses over 2,606 acres of Delaware County woodlands and meadows. The gently rolling terrain of the park, bisected by Ridley Creek, is only 16 miles from center city Philadelphia.	351 Gradyville Road Newtown Square, PA 19073-2803 (610) 892-3900
FL	Pennsylvania Sea Grant	http://seagrant.psu.edu/seagindex.htm	13	8	State	public	O	Promotes the ecological and economic sustainability of PA's coastal resources through research and outreach. Our activities include science-based extension, education, applied research, and communication focusing on the Lake Erie and Delaware River drainages of PA.	Delaware River Office 1350 Edgmont Avenue Suite 2570 Chester, PA 19013 Phone: (215) 806-0894
FL	Philadelphia Academy of Natural Sciences, Natural History Museum	http://www.ansp.org	17	19	City	NGO	A, E	"The encouragement and cultivation of the sciences." The Academy's collection of more than 17 million cataloged natural history specimens and artifacts is among the ten largest in the United States.	1900 Benjamin Franklin Parkway Philadelphia, PA 19103-1101 (215) 299-1000
FL	Philadelphia Trail Club	http://m.zanger.tripod.com/index.htm	56	44	City	NGO	R	The Club (PTC) started in 1931 with 15 members who hiked 6 miles near West Chester, PA. The Club has been hiking ever since. In a recent year 163 members participated in 93 hikes for a total of 6207 miles. Hikes are led each Sat and Sun all year long except for July & Aug. In mid-summer, activities emphasize swimming, canoeing and picnics.	2142 Bristol Road Warrington, PA 18976
FL	Refuge REED Team (Resource EE Development)							A group of teachers working with refuge on formal EE curriculum development.	

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	The Schuylkill Center for Environmental Education	http://www.schuylkillcenter.org	36	18	City	NGO	E	The mission of The Schuylkill Center is to promote, through environmental education, the preservation and improvement of our natural environment by: Fostering appreciation, understanding and responsible use of the ecosystem; Disseminating information on current environmental issues; Encouraging appropriate public response to environmental problems and; To maintain the facilities of The Schuylkill Center and conserve its land for the purpose of environmental education.	8480 Hagy's Mill Road Philadelphia, PA 19128
FL	The Avian Promise	http://theavianpromise.org	49	37	City	NGO	B	Education and the coordination of information about wild birds.	8785 Duveen Dr Wyndmoor, PA 19038 215-518-5029
FL	The Conservation Fund	http://www.conservationfund.org/node/210	162	136	National	public	O	Nonprofit that treats conservation as our business. Provide the skills, strategies and funds that partners need to fulfill conservation priorities swiftly and successfully. Partner with community, gov't and corporate leaders to protect America's outdoor places and to conserve resources for healthy, sustainable communities. No formal membership, charitable endowment or political agenda.	NATIONAL HEADQUARTERS 1655 N. Fort Myer Drive, Suite 1300 Arlington, VA 22209-3199 Phone: (703) 525-6300
FL	Tri-State Bird Rescue & Research, Inc.	http://www.tristatebird.org/about/history	48	36	Regional	NGO	B	To achieve excellence in the rehabilitation of injured, orphaned, and oiled native wild birds, with the goal of returning healthy birds to their natural environment. We do this through compassionate care, humane research, and education.	110 Possum Hollow Road Newark, Delaware, 19711

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Tyler Arboretum	http://www.tylerarboretum.org/index.asp	28	19	City	NGO	P	To preserve, develop, and share our diverse horticultural, historic, and natural site resources in order to stimulate stewardship and an understanding of our living world. Tyler encompasses 650 acres of horticultural collections, rare plant specimens, ancient trees, historic buildings, and extensive hiking trails.	515 Painter Road Media, PA 19063
FL	US Sportsman's Alliance Trail Blazer Program	http://www.ussportsmen.org/Page.aspx?pid=261			National	NGO	R	The Trailblazer Adventure Program was designed to expose families to outdoor activities during the Trailblazer Adventure Day and offer them the chance to engage in the activities through the year-long Trailmaster mentoring program.	801 Kingsmill Parkway Columbus, OH 43229
FL	USDA-APHIS/ Wildlife Services	http://www.aphis.usda.gov/about_aphis/programs_offices/wildlife_services/	140	126	National	public	A	Wildlife Services (WS) provides Federal leadership and expertise to resolve wildlife conflicts and create a balance that allows people and wildlife to coexist peacefully.	USDA/APHIS/ LPA 4700 River Road Riverdale, MD 20737
FL	Wagner Free Institute of Science	http://www.wagnerfreeinstitute.org	24	13	City	public	F, A, P, E	Nineteenth century exhibit hall houses an extraordinary collection of natural history specimens. Gathered largely during the nineteenth century, the collections are displayed in cherry-wood and glass cabinets dating from the 1880s. Originally assembled to teach science, the specimens are arranged for study. The exhibit is one of the largest systematically arranged collections on display in the country and remains in active use as a key educational tool of the Institute's free science programs. It also serves as a resource for scholarly research.	1700 West Montgomery Avenue Philadelphia, PA 19121-3298 (215) 763-6529

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
FL	Western PA Conservancy	http://www.paconserve.org			Regional	NGO	E	Our Mission: The Western Pennsylvania Conservancy protects and restores exceptional places to provide our region with clean waters and healthy forests, wildlife and natural areas for the benefit of present and future generations. The Conservancy creates green spaces and gardens, contributing to the vitality of our cities and towns, and preserves Fallingwater, a symbol of people living in harmony with nature.	Allegheny Regional Office 40 West Main Street Ridgway, PA 15853-1634 (814) 776-1114
HMP	PA Fish and Boat Commission (PFBC)								
HMP	Partners in Flight								
HMP	PA Department of Conservation and Natural Resources (DCNR)								
HMP	Pennsylvania Natural Heritage Program								
HMP	Union of Concerned Scientists								
HMP	Intergovernmental Panel on Climate Change (IPCC)								
HMP	Philadelphia County								
HMP	Delaware Riverkeeper Network								

Festival List for John Heinz National Wildlife Refuge

Source[1]	Organization	Website	Minutes from Refuge	Miles from Refuge	Reach	Sector	Primary Content-Focus[2]	Mission	Agency Address (may not be contact address)
HMP	PA Department of Environmental Protection (PADEP)								
HMP	Philadelphia Water Department (PWD)								
HMP	Darby Creek Valley Association (DCVA)								
HMP	Delaware River Basin Commission								
HMP	Delaware Department of Natural Resources and Environmental Conservation (DNREC)								

[1]FL = Festival List from Gary, ED = EETAP Document, HMP = Habitat Management Plan

[2]B = Birds/birding, F = Fish, A = Animals (non-bird/fish), P = Plants/flora, E = Ecology/natural history, R = Recreation, O = Other

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
12 District Advisory Council	Y	Potential	C, P			
American Philosophical Society		Potential	E			
Art Organizations (Local)	Y	Potential	C, P, E			Nature-oriented art classes at refuge
Aurora Academy (online)		Potential				
Bailey Foundation Exotic Bird Rescue		Potential	E			
Birding Club of Delaware County		Potential	P, E			
Boys and Girls Club	Y	Potential	C, P			Refuge could do programs there. But, can they get here for programs or field trips as a group?
Brandywine Zoo	Y	Potential	P, E			
Clean Air Council		Potential	C, P			
Commonwealth Academy (online)		Potential				
Conservation Fund		Potential	E			
Darby Creek Valley Association		Potential	P, E			
Delaware Bay Estuary		Potential	P, E			
Delaware County Herpetological Society	Y	Potential	C, P			
Delaware County Libraries		Potential	E		Public library facilities currently doing reading programs for children. They serve large numbers of people interested in informal learning.	Develop a nature-oriented reading program for kids, complete with awards to earn (via Friends of Heinz Refuge). Also, to expand number and scope of programs refuge does at the libraries.
Delaware Department of Natural Resources and Environmental Conservation		Potential	P			
Delaware Museum of Natural History	Y	Potential	P, E			
Delaware River Basin Commission		Potential	P, E			
Delaware Riverkeeper Network		Potential	E			

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Delaware Valley Ornithological Club (DVOC)		Potential	P, E			
DELCO Bird Club		Potential				
East Coast Greenway	Y	Potential	P			
Energy Coordinating Agency of Philadelphia		Potential	P, E			
Fairmount Park	Y	Potential	C, P			
Forest Partners International		Potential	E			
Forgotten Friend Reptile Sanctuary		Potential	E			
Fort Mifflin	Y	Potential	P, E			
Franklin Institute	Y	Potential	P, E			
Friends of Wissahickon and other Friends Groups	Y	Potential	P, E			
Great Valley Nature Center		Potential	P, E			
Hawk Mountain	Y	Potential	P, E			
Keep Your Cats Indoors		Potential				
Kinder Garden native Seed Project		Potential				
Local colleges and University science and education departments	Y	Potential	C, P	Specifically Neumann University and St. Joe's	Pre-service teaching program	Integration of educational materials/workshops provided by the refuge into pre-service education programs
Longwood Gardens	Y	Potential	P, E			
Mill Grove Audubon Center		Potential	P, E			
Morris Arboretum	Y	Potential	P, E			
National Audubon Society –PA	Y	Potential	P, E			
Nature Conservancy		Potential	P			
New Jersey Adventure Aquarium	Y	Potential	P, E			
New Jersey Audubon – Cape May Bird Observatory	Y	Potential	P, E			

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
New Jersey Audubon – Rancocas Nature Center		Potential	P, E			
North American Butterfly Association		Potential	E			
Pennsylvania Association for EE	Y	Potential	P			
Pennsylvania Dept of Conservation & Natural Resources		Potential	P			
Pennsylvania Dept of Education	Y	Potential	P			
Pennsylvania Dept of Environmental Protection		Potential	P, E			
Pennsylvania Fish and Boat Commission	Y	Potential	P, E			
Pennsylvania Game Commission		Potential	P, E			
Pennsylvania Natural Heritage Program		Potential	E			
Pennsylvania State Commission on Higher Education		Potential	P			
Pennsylvania State Parks (Ridley Creek)	Y	Potential	E			
Pennsylvania Environmental Council		Potential	P, E			
Philadelphia Dept of Parks and Recreation	Y	Potential	C, P			
Philadelphia (City of)		Potential	C			
Philadelphia County		Potential				
Philadelphia Library System	Y	Potential	C, P		Public library facilities currently doing reading programs for children. They serve large numbers of people interested in informal learning.	Develop a nature-oriented reading program for kids, complete with awards to earn (via Friends of Heinz Refuge). Also, to expand number and scope of programs refuge does at the libraries.
Philadelphia Trail Club		Potential	C, E			

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Philadelphia Water Department	Y	Potential	P, E			
Police Athletic League (PAL)	Y	Potential	C, P		Their athletic programs target at-risk youth.	Programs for youth incorporating hiking, maybe fishing, maybe biking (though impact would have to be kept to a minimum).
School: Pepper Middle School	Y	Potential	C			
School Districts: Penn-Delco, Philadelphia, Ridley, SE Delaware County, Upper Darby, William Penn	Y	Potential	C, P			
Schuylkill Center for EE		Potential	P, E			
The Avian Promise		Potential	E			
Tri-State Bird Rescue and Research, Inc.		Potential	E			
Tyler Arboretum		Potential	P, E			
U.S. Coast Guard		Potential	P, E			
U.S. Sportsman's Alliance Trail Blazer Program		Potential				
USDA – APHIS/Wildlife Services		Potential	E			
Western Pennsylvania Conservancy		Potential	E			
YMCA		Potential	C, P			
Academy of Natural Sciences	Y	Current	P			They bring summer camp groups here, they do "booths" at refuge festivals, refuge reciprocates for their festivals, they're doing water research at refuge with refuge biologist.
Bartram's Garden	Y	Current	P	54 & Lindbergh Blvd. Phila., PA 19143		Nearby nature center--only 2 miles away--so easy to call on. They host a retreat at refuge for their staff; both agencies may invite each other's volunteers to general volunteer trainings (not site specific content); agencies share kudos such as behind the scenes tours for volunteers.

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Big Brothers Big Sisters	Y	Current	C, P	1341 N Delaware Ave		They help market refuge programs to their audience; September Intro Program hosted for 600 "bigs and littles" at refuge to introduce them to refuge opportunities.
Cobbs Creek Community Environmental Educ Center (CCCEEC)	Y	Current	C, P			Bring field trips here and they promote refuge programming. Refuge has done some workshops for them.
Delaware Valley College	Y	Current	C, P			They bring undergrad biology students for field trips, they provide volunteers and interns.
Delaware Valley Earth Force	Y	Current	C, P	100 Greenwood Ave Wyncote, PA 19095		Field trips
Delaware Valley Ornithological Club		Current	E			Works with refuge on biological inventory on birds and bird strikes (windows).
Drexel University		Current	C, P			Field trips for biology students and graduate researchers.
EPA	Y	Current	P, E			They bring youth programs here; refuge provides facility for staff meetings.
Friends of Heinz Refuge (FOHR)	Y	Current	P			Raises money for and financially supports refuge environmental education efforts and biological functions.
Friendship Circle Senior Center		Current	C, P	Mercy/Fitzgerald Hospital, Lansdowne, PA 19050		Refuge does offsite programs for them.
Girl Scouts of Southeastern Pennsylvania (SEPA)	Y	Current	C, P	PO Box 27540, Phila. PA 19118		They do a camp at refuge; refuge does badge programs for them on request; refuge periodically does adult training regarding available resources at refuge; they promote refuge and refuge programs
Interboro School District	Y	Current	C			Nature of Learning: Refuge provides professional development for teachers, field trips, works with schoolyard habitat
Longstreth Elementary School		Current	C			Field trips
PA Dept. of Education, Env. & Eco. Office		Current	P			They provide materials for Project Wet and Project Learning Tree (State organizer)
PA Game Commission		Current	P			They provide materials for Project Wild workshops (State organizer)

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
PA Resources Council (PRC)		Current	P			They focus on sustainability; they do field trips at refuge focused on the green building and water shed. They use the refuge's meeting space.
PA Sea Grant	Y	Current	C, P	4601 Market St. 2nd fl, Phila, PA 19139		They bring their EE programs and school groups to the refuge for field trips
Patterson Elementary School	Y	Current	C			Refuge provides professional development/field trips
Pennsylvania Environmental Education (PAEE)	Y	Current	P			They provide refuge workshop advertisement; refuge staff can go there for professional development
Pennsylvania State						Pre-service workshop--Project WET one day once a year
Philadelphia International Airport		Current	C	Terminal E, Phila. PA 19153		Refuge participates in Green Recycling Festival at airport each year and sometimes other festivals there; refuge is a frequent stop for people arriving early at airport to pick people up so front desk sometimes checks on incoming flights for those visitors (time permitting); airport staff uses refuge facilities as meeting space
Philadelphia Horticulture Society	Y	Current	C, P			They initiate a teacher training and use refuge resources when they bring field trip.
Philadelphia Zoo	Y	Current	C, P			Zoo brings summer camp kids to refuge. Refuge is a site where volunteers can collect data for Frog Watch USA, the Association of Zoos and Aquarium's "flagship citizen science program". Refuge brings live animals to refuge for festivals.
Refuge Environmental Education Development (REED) Team	Y	Current	P			A consortium of volunteer teachers from Interboro School District, Patterson Elementary School, Longstreth Elementary School and others. In the past they wrote curriculum specific to refuge for visiting groups (posted on web site). They are currently awaiting a new project.
Retired Senior Volunteer Program (RSVP)	Y	Current	C, P	609 W. State Street, Media, PA 19063		They are resource for refuge to get new volunteers.

Current and Potential Partners at John Heinz Wildlife Refuge

Agency Name	Survey	Potential or Current Partner	Type of EE Partner[1]	Address	Description of current mission, purpose, facility, or resources	In what capacity COULD THEY BE or ARE THEY a partner?
Schuylkill Center for Environmental Education (SCEE)/Green Woods Charter School (onsite)		Current	C			Field trips
Student Conservation Association (SCA)	Y	Current	C, P			Refuge hosts 1 summer work camp, and coordinate 4 others in Philly area for 11 HS students and 2 group leaders for 6 weeks; 3 interns for 3 months each.
University of Pennsylvania		Current	C, P			Pre-service workshop--Project Learning Tree one day
US Coast Guard		Current	P	234 S. Davis Ave. Audubon, NJ 08106		Refuge just started to connect with them. Refuge provides an outlet for their boating and safety info; they are participating at refuge's festival; refuge has offered space for their boating class in hopes of reaching an audience that might not otherwise know about or come to the refuge.
US Forest Service		Current	P	11 Campus Blvd. Suite 200 Newtown Square, PA 19073		Refuge uses their Woodsie Owl and Smokey Bear costumes; on each other's radar screen--can always call them
Widener Partnership Charter School	Y	Current	C			Field trip participants 24 times per year
Widener University	Y	Current	C, P			Refuge provides teacher training for EE/ has been a guest instructor there. Students are exposed to Tool Kit. To fulfill the field study component for Master's Degree course, students participate in Saturday Ecology Academy for teen girls.

[1]C = Consumer of EE (Audience), P = Provider of EE, E = Exhibitor at Refuge events

Appendix C

Documents and Sources Reviewed for this Project

U.S. Fish and Wildlife Service Documents

- U.S. Fish and Wildlife Service Visitor Services Planning: Spelling it Out
- U.S. Fish and Wildlife Service Writing Refuge Management Goals and Objectives: A Handbook (draft and final)

Refuge-specific Documentsv

- John Heinz at Tinicum National Wildlife Refuge Purposes, Draft Vision, Draft Goals
- John Heinz National Wildlife Refuge at Tinicum Habitat Management Plan July 2009
- John Heinz National Wildlife Refuge at Tinicum Visitor Services Review
- CCP Pre-planning for visitor services
- John Heinz National Wildlife Refuge organizational chart

Environmental Education and Interpretation-specific Documents

- Education Contacts From Festivals at John Heinz National Wildlife Refuge 2010
- Draft John Heinz National Wildlife Refuge at Tinicum Environmental Education Plan 2010
- John Heinz National Wildlife Refuge draft Environmental Education and Interpretation Goals, Objectives, and Strategies

Appendix J

Dan Salas/Cardno JFNew

Wild rice and spadderdock within Tinicum marsh

Sea Level Affecting Marshes Model (SLAMM) Report

Application of the Sea-Level Affecting Marshes Model (SLAMM 6) to John Heinz NWR

Prepared for:

U. S. Fish and Wildlife Service
National Wildlife Refuge System
Division of Natural Resources and Conservation Planning
Conservation Biology Program
4401 N. Fairfax Drive - MS 670
Arlington, VA 22203

December 9, 2010

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Application of the Sea-Level Affecting Marshes Model (SLAMM 6) to John Heinz NWR

Contents

Introduction

This is the second application of the SLAMM model to John Heinz NWR. Since December of 2009, a new higher-vertical resolution elevation data set became available as well as additional information about the extent of diked and impounded portions of the study area.

Tidal marshes are among the most susceptible ecosystems to climate change, especially accelerated sea level rise (SLR). The Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) suggested that global sea level will increase by approximately 30 cm to 100 cm by 2100 (IPCC 2001). Rahmstorf (2007) suggests that this range may be too conservative and that the feasible range by 2100 is 50 to 140 cm. Rising sea levels may result in tidal marsh submergence (Moorhead and Brinson 1995) and habitat "migration" as salt marshes transgress landward and replace tidal freshwater and irregularly flooded marsh (R. A. Park et al. 1991).

In an effort to address the potential effects of sea level rise on United States national wildlife refuges, the U. S. Fish and Wildlife Service contracted the application of the SLAMM model for most coastal refuges. This analysis is designed to assist in the production of comprehensive conservation plans (CCPs) for each refuge along with other long-term management plans.

Model Summary

Changes in tidal marsh area and habitat type in response to sea-level rise were modeled using the Sea Level Affecting Marshes Model (SLAMM 6) that accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989; *www.warrenpinnacle.com/prof/SLAMM*).

Successive versions of the model have been used to estimate the impacts of sea level rise on the coasts of the U.S. (Titus et al. 1991; Lee et al. 1992; Park et al. 1993; Galbraith et al. 2002; National Wildlife Federation & Florida Wildlife Federation 2006; Glick et al. 2007; Craft et al. 2009).

Within SLAMM, there are five primary processes that affect wetland fate under different scenarios of sea-level rise:

- **Inundation:** The rise of water levels and the salt boundary are tracked by reducing elevations of each cell as sea levels rise, thus keeping mean tide level (MTL) constant at zero. The effects on each cell are calculated based on the minimum elevation and slope of that cell.
- **Erosion:** Erosion is triggered based on a threshold of maximum fetch and the proximity of the marsh to estuarine water or open ocean. When these conditions are met, horizontal erosion occurs at a rate based on site- specific data.
- **Overwash:** Barrier islands of under 500 meters width are assumed to undergo overwash during each specified interval for large storms. Beach migration and transport of sediments are calculated.
- **Saturation:** Coastal swamps and fresh marshes can migrate onto adjacent uplands as a response of the fresh water table to rising sea level close to the coast.
- **Accretion:** Sea level rise is offset by sedimentation and vertical accretion using average or site-specific values for each wetland category. Accretion rates may be spatially variable within a given model domain or can be specified to respond to feedbacks such as frequency of flooding.

SLAMM Version 6.0 was developed in 2008/2009 and is based on SLAMM 5. SLAMM 6.0 provides backwards compatibility to SLAMM 5, that is, SLAMM 5 results can be replicated in SLAMM 6. However, SLAMM 6 also provides several optional capabilities.

- Accretion Feedback Component: Feedbacks based on wetland elevation, distance to channel, and salinity may be specified. This feedback will be used in USFWS simulations, but only where adequate data exist for parameterization.
- Salinity Model: Multiple time-variable freshwater flows may be specified. Salinity is estimated and mapped at MLLW, MHHW, and MTL. Habitat switching may be specified as a function of salinity. This optional sub-model is not utilized in USFWS simulations.
- Integrated Elevation Analysis: SLAMM will summarize site-specific categorized elevation ranges for wetlands as derived from LiDAR data or other high-resolution data sets. This functionality is used in USFWS simulations to test the SLAMM conceptual model at each site. The causes of any discrepancies are then tracked down and reported on within the model application report.
- Flexible Elevation Ranges for land categories: If site-specific data indicate that wetland elevation ranges are outside of SLAMM defaults, a different range may be specified within the interface. In USFWS simulations, the use of values outside of SLAMM defaults is rarely utilized. If such a change is made, the change and the reason for it are fully documented within the model application reports.
- Many other graphic user interface and memory management improvements are also part of the new version including an updated *Technical Documentation*, and context sensitive help files.

For a thorough accounting of SLAMM model processes and the underlying assumptions and equations, please see the SLAMM 6.0 *Technical Documentation* (Clough et al. 2010). This document is available at *http://warrenpinnacle.com/prof/SLAMM*

All model results are subject to uncertainty due to limitations in input data, incomplete knowledge about factors that control the behavior of the system being modeled, and simplifications of the system (Council for Regulatory Environmental Modeling 2008). Site-specific factors that increase or decrease model uncertainty may be covered in the *Discussion* section of this report.

Sea Level Rise Scenarios

SLAMM 6 was run using scenario A1B from the Special Report on Emissions Scenarios (SRES) – mean and maximum estimates. The A1 family of scenarios assumes that the future world includes rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. In particular, the A1B scenario assumes that energy sources will be balanced across all sources. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPCC 2007) suggests a likely range of 0.21 to 0.48 meters of sea level rise by 2090-2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of this project falls near the middle of this estimated range, predicting 0.39 meters of global sea level rise by 2100. A1B-maximum predicts 0.69 meters of global SLR by 2100.

The latest literature (Chen et al. 2006; Monaghan et al. 2006) indicates that the eustatic rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations. A recent paper in the journal *Science* (Rahmstorf 2007) suggests that, taking into account possible model error, a feasible range by 2100 of 50 to 140 cm. This work was recently updated and the ranges were increased to 75 to 190 cm (Vermeer and Rahmstorf 2009). Pfeffer et al. (2008) suggests that 2 meters by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. A recent US intergovernmental report states "Although no ice-sheet model is currently capable of capturing the glacier speedups in Antarctica or Greenland that have been observed over the last decade, including these processes in models will very likely show that IPCC AR4 projected sea level rises for the end of the 21st century are too low." (Clark 2009). A recent paper by Grinsted et al. (2009) states that "sea level 2090-2099 is projected to be 0.9 to 1.3 m for the A1B scenario…" Grinsted also states that there is a "low probability" that SLR will match the lower IPCC estimates.

To allow for flexibility when interpreting the results, SLAMM was also run assuming 1 meter, 1½ meters, and 2 meters of eustatic sea-level rise by the year 2100. The A1B- maximum scenario was scaled up to produce these bounding scenarios (Figure J.1).

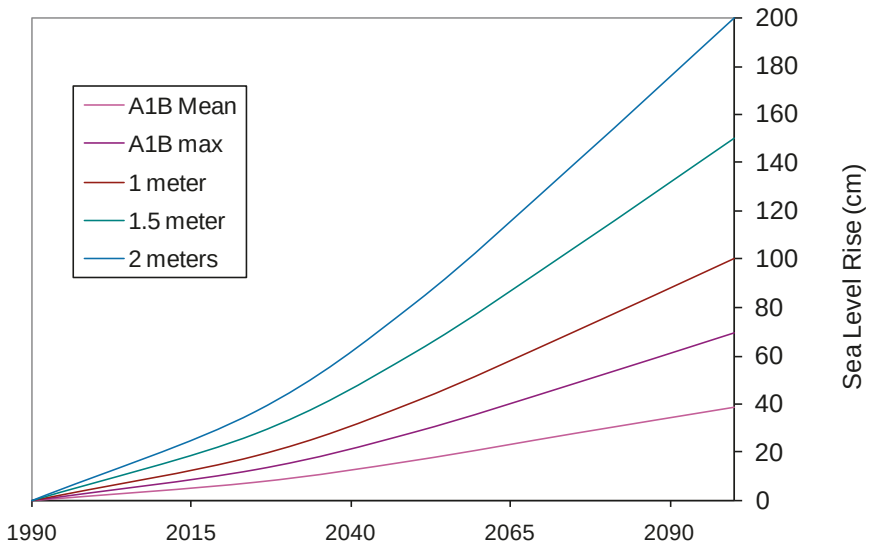
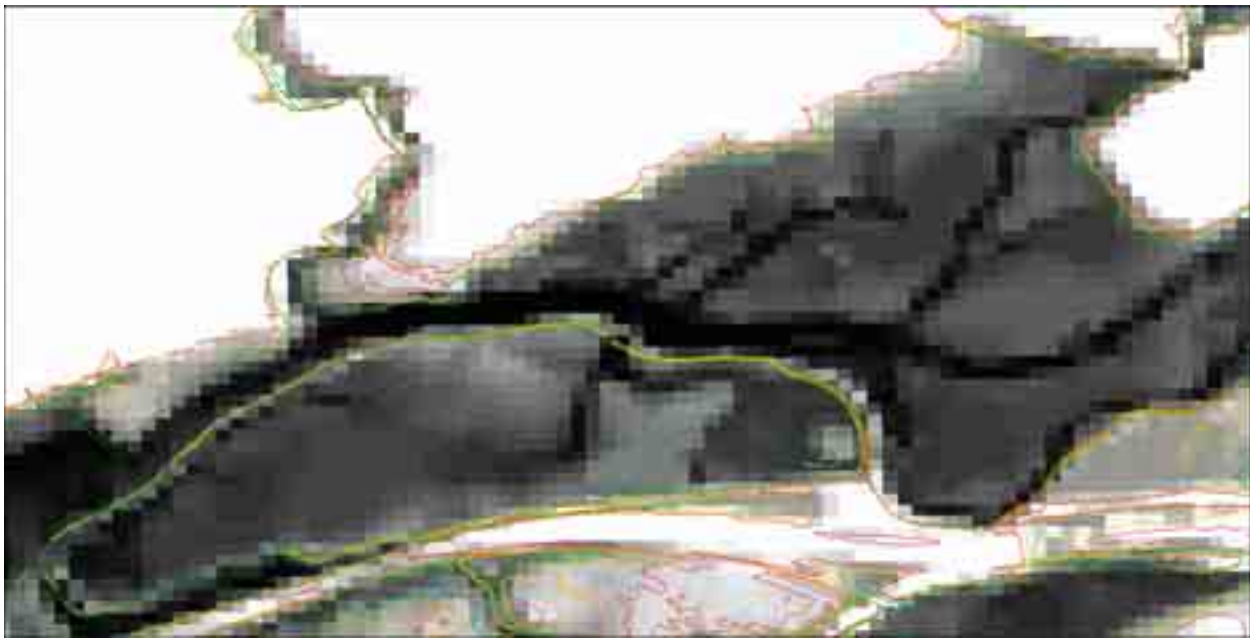


Figure J.1: Summary of SLR scenarios utilized

Methods and Data Sources

The digital elevation map (DEM) used in this model simulation is 2008 LiDAR-derived 2 foot contours originating from the City of Philadelphia Water Department (Figure J.2). A higher vertical resolution LiDAR DEM developed by the Pennsylvania Department of Conservation and Natural Resources for the PAMAP project was not available at the time of writing.

Figure J.2: Contours at 0 feet (green) through 6 feet (red) over DEM of John Heinz NWR.



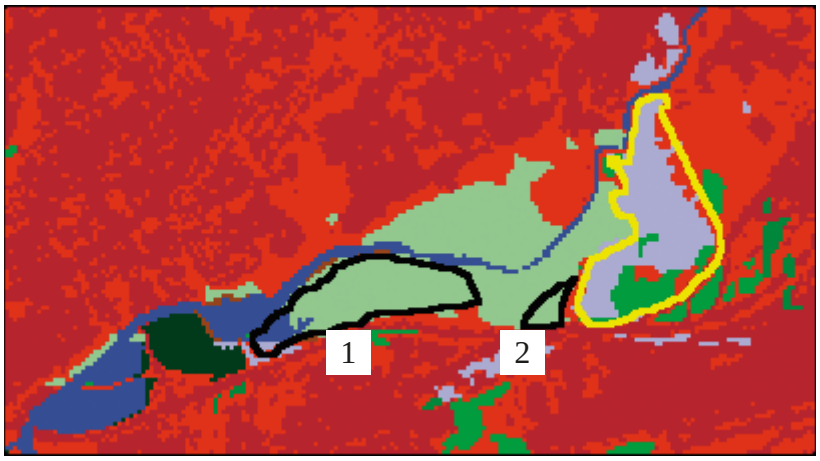
The National Wetlands Inventory (NWI) for John Heinz is based on photo dates of 1989. Several changes were made to the wetland layer based on communication with Brendalee Phillips and Larry Woodward, both from the John Heinz NWR, and Dan Salas, an ecologist from JFNew. Inland fresh marsh in Corps property and Henderson were both changed to tidal fresh marsh based on this communication (Figure J.3).

Converting the NWI survey into 30-meter cells indicates that the approximately 1,200- acre refuge (approved acquisition boundary including water) is composed of the categories as shown below:

	Tidal Fresh Marsh	35.2%
	Undeveloped Dry Land	22.4%
	Inland Open Water	15.5%
	Riverine Tidal	12.1%
	Inland Fresh Marsh	5.6%
	Tidal Swamp	5.2%
	Developed Dry Land	3.5%

There is only one impounded area within John Heinz NWR, that being the freshwater pond at the east of the refuge. Since the previous run, the above-mentioned communication led to the removal of diked status for Henderson and Corps property (Figure J.3).

Figure J.3: Current impoundments (yellow outline) and removed impoundments (black) at Henderson (1) and Corps property (2).



The historic trend for sea level rise was estimated 2.79 mm/year using the nearest NOAA gage (8545240, Philadelphia, PA). The rate of sea level rise for this refuge is somewhat greater than the global average for the last 100 years (approximately 1.7 mm/year).

The tidal range for the John Heinz NWR was specified to vary spatially with two input sites (Figure J.4) using three NOAA tide gages (8542425, Wanamaker Bridge, Darby Creek, PA; 8542699, Norwood, Darby Creek, PA; 8543024, Tinicum 3, Darby Creek, PA) (Figure J.5). Based on these gages, the diurnal range of tide (GT) was estimated at 1.92 meters for the western portion of the refuge and a range of 1.50 meters was utilized in the east.

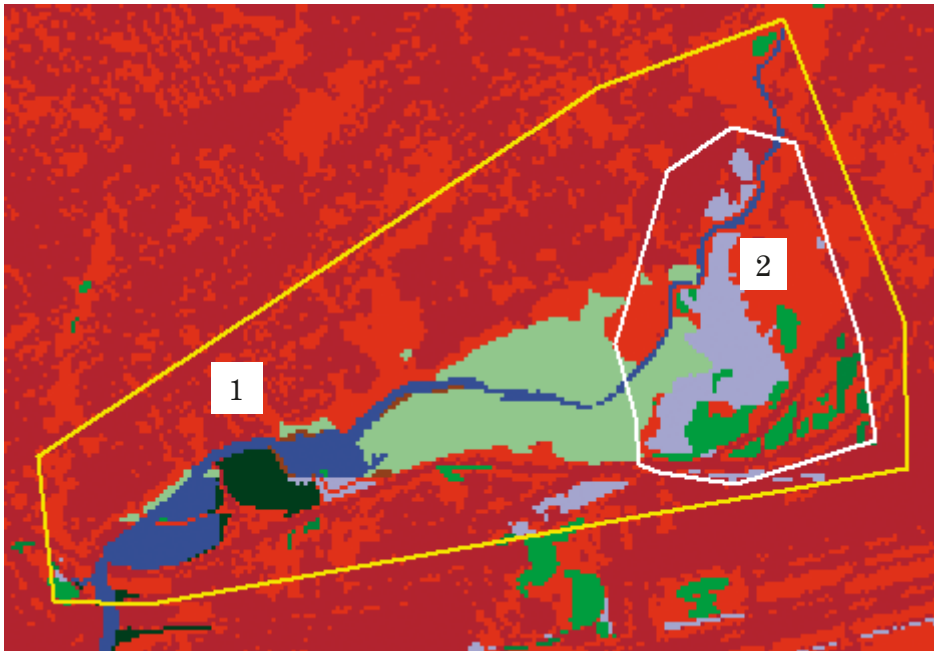


Figure J.4: Input sub-sites.

Figure J.5: NOAA Gage Relevant to the Study Area.

No site-specific marsh accretion data were located for this refuge. The marsh accretion values used were based on a rough average of three different calculations:

- The marsh accretion study located nearest to this study area (Port Mahon DE, Kraft, 1992) measured accretion rates as 4.05 mm/year;
- Based on a large analysis of accretion studies within the mid-Atlantic region (Reed 2008), the average Delaware salt marsh accretion value was calculated at 3.88 mm/yr (n=9);
- Based on data in this same paper (Reed 2008), the average accretion value within Delaware estuaries was calculated at 4.28 mm/yr (n=15)

As these three different calculations are quite similar, accretion rates in regularly flooded marshes were set to 4 mm/year, irregularly flooded marshes to 4 mm/year and tidal fresh were also set to 4 mm/year.

Dan Salas of JFNew indicated that a review of 60-year-old aerial photos indicated that channel erosion was likely lower than 1 foot per year. As a result, marsh erosion was reduced to 1 foot per year (or 0.3048 meters). Swamp and tidal-flat erosion rates for this refuge were set to 2 horizontal meters per year based on long-term measurements of coastal erosion rates in Delaware as presented in Kraft (1992).

Based on site-specific LiDAR-derived elevations, the elevation range for tidal swamp and tidal fresh marsh were altered slightly. Based on an elevation analysis, the minimum elevation for tidal swamp and tidal fresh marsh was set to 0.26 and -0.4 half-tide units respectively. (One half-tide unit is half of the diurnal range of tide or ½ GT.)

The vertical datum used for the available DEM contours is the Philadelphia Vertical Datum (PVD), not NAVD88. Instead of using MTL-NAVD88 for elevation correction values, MTL-PVD was used in this model application. As reported in a paper by Jim Titus, NAVD is 4.63 feet (1.41 meters) lower than PVD (Titus and Strange 2008). The nearest MTL to NAVD correction along the Delaware River was determined to be 0.024 meters, so the MTL-PVD correction used in the model was -1.387 meters (-1.41 + 0.024).

Modeled U.S. Fish and Wildlife Service refuge boundaries for Pennsylvania are based on Approved Acquisition Boundaries as published on the FWS National Wildlife Refuge Data and Metadata website. The cell-size used for this analysis was 30 meter by 30 meter cells. Additionally, the SLAMM model will track partial conversion of cells based on elevation and slope.

SUMMARY OF SLAMM INPUT PARAMETERS FOR JOHN HEINZ NWR

Parameter	Global	SubSite 1	SubSite 3
Description		John Heinz	John Heinz 2
NWI Photo Date (YYYY)	1995	1989	1989
DEM Date (YYYY)	1989	2008	2008
Direction Offshore [n,s,e,w]	East	West	West
Historic Trend (mm/yr)	3	2.79	2.79
MTL-NAVD88 (m)	0	-1.387	-1.387
GT Great Diurnal Tide Range (m)	1.65	1.923	1.502
Salt Elev. (m above MTL)	1.45	1.35	1.05
Marsh Erosion (horz. m /yr)	0.3048	0.3048	0.3048
Swamp Erosion (horz. m /yr)	2	2	2
T.Flat Erosion (horz. m /yr)	2	2	2
Reg. Flood Marsh Accr (mm/yr)	4	4	4
Irreg. Flood Marsh Accr (mm/yr)	4	4	4
Tidal Fresh Marsh Accr (mm/yr)	4	4	4
Beach Sed. Rate (mm/yr)	0.5	0.5	0.5
Freq. Overwash (years)	25	25	25
Use Elev Pre-processor [True,False]	TRUE	FALSE	FALSE

Results

John Heinz NWR is predicted to experience some significant effects due to sea-level rise. Refuge tidal fresh marsh – comprising roughly one-third of the refuge – is predicted to be most impacted in SLR scenarios above 0.69 meters. Loss of refuge undeveloped dry land ranges from roughly one quarter to slightly more than one half of its initial acreage.

SLR by 2100 (m)	0.39	0.69	1	1.5	2
Tidal Fresh Marsh	3%	9%	32%	67%	84%
Undeveloped Dry Land	24%	34%	39%	46%	54%
Inland Fresh Marsh	6%	29%	34%	37%	61%
Tidal Swamp	7%	11%	18%	72%	94%
Developed Dry Land	17%	22%	26%	35%	43%
Inland Shore	41%	59%	73%	82%	93%

Predicted Loss Rates of Land Categories by 2100 Given Simulated Scenarios of Eustatic Sea Level Rise

Refined initial-condition elevations and improved dike and habitat maps have resulted in some differences in model simulations as compared to the previous model run. For example, more tidal-fresh marsh loss is predicted across the range of scenarios run than in the previous set of simulations. Dry-land loss rates range from 24% to 54% as opposed to the previous predicted range of 12-64%. There is less inland fresh marsh acreage in the model due to information about the removal of impoundments at the Henderson and Corps properties; unlike the previous model simulations, the remaining inland fresh marsh is predicted to be vulnerable to sea-level rise, with up to 61% predicted lost.

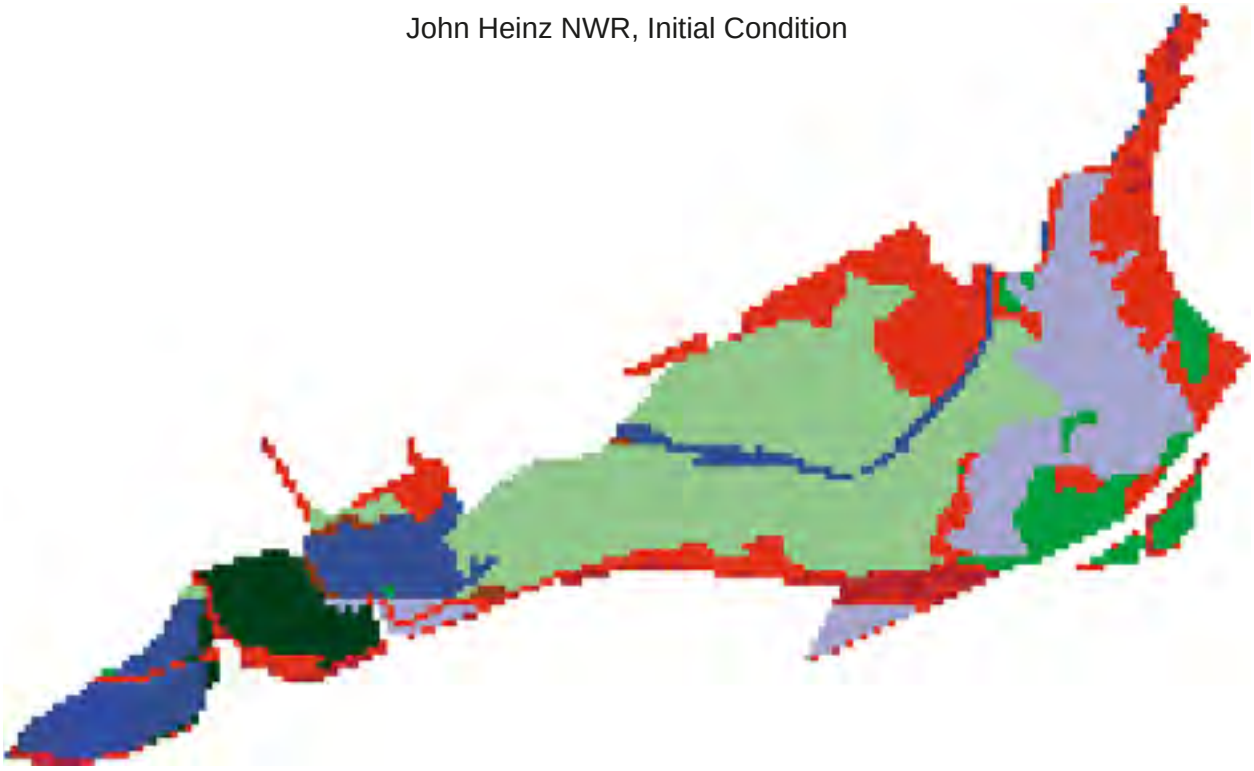
John Heinz NWR

IPCC Scenario A1B-Mean, 0.39 M SLR Eustatic by 2100

Results in Acres

		Initial	2025	2050	2075	2100
	Tidal Fresh Marsh	419.7	410.1	412.2	409.4	406.3
	Undeveloped Dry Land	268.0	219.0	211.9	206.9	202.5
	Inland Open Water	184.6	164.7	164.5	164.3	164.3
	Riverine Tidal	145.0	68.9	68.1	67.2	63.4
	Inland Fresh Marsh	66.5	62.5	62.5	62.5	62.3
	Tidal Swamp	61.6	58.9	58.6	58.0	57.4
	Developed Dry Land	41.6	36.6	36.1	35.3	34.6
	Inland Shore	7.8	7.0	6.3	5.3	4.6
	Estuarine Open Water	0.0	97.1	102.7	108.9	116.4
	Tidal Flat	0.0	0.0	25.4	22.2	21.1
	Regularly Flooded Marsh	0.0	52.3	24.2	25.5	29.8
	Transitional Salt Marsh	0.0	17.4	21.4	25.5	29.3
	Irregularly Flooded Marsh	0.0	0.2	0.9	3.7	2.8
	Total (incl. water)	**1194.7**	**1194.7**	**1194.7**	**1194.7**	**1194.7**

John Heinz NWR, Initial Condition



John Heinz NWR, 2050, Scenario A1B Mean

John Heinz NWR, 2100, Scenario A1B Mean

John Heinz NWR

IPCC Scenario A1B-Max, 0.69 M SLR Eustatic by 2100

Results in Acres

		Initial	2025	2050	2075	2100
	Tidal Fresh Marsh	419.7	406.7	401.2	395.7	381.2
	Undeveloped Dry Land	268.0	217.5	209.8	200.4	176.2
	Inland Open Water	184.6	164.5	164.6	164.4	163.9
	Riverine Tidal	145.0	68.9	67.6	60.7	59.6
	Inland Fresh Marsh	66.5	62.5	62.5	62.3	47.3
	Tidal Swamp	61.6	58.7	58.0	56.6	54.8
	Developed Dry Land	41.6	36.3	35.4	34.2	32.6
	Inland Shore	7.8	6.7	5.5	4.2	3.2
	Estuarine Open Water	0.0	97.6	104.9	123.3	140.2
	Tidal Flat	0.0	0.0	28.6	23.9	20.1
	Regularly Flooded Marsh	0.0	55.2	25.9	33.5	38.1
	Transitional Salt Marsh	0.0	18.1	22.2	26.0	60.0
	Irregularly Flooded Marsh	0.0	1.9	8.6	9.6	17.7
	Total (incl. water)	**1194.7**	**1194.7**	**1194.7**	**1194.7**	**1194.7**

John Heinz NWR, Initial Condition

John Heinz NWR, 2050, Scenario A1B Maximum

John Heinz NWR, 2100, Scenario A1B Maximum

Discussion

In moderate SLR scenarios, only the lowest-elevation areas of the refuge, such as portions of the tidal-fresh marsh bed and water-bordering dry lands, are predicted to be lost to SLR inundation. The pattern of predicted losses within refuge tidal fresh marsh appears to accurately reflect the reality within the refuge as depicted in satellite imagery (Figure J.6).

Figure J.6: Satellite image of central portion of John Heinz NWR.

Opening Henderson and the Corps property to tidal influence increases the predicted risk most significantly to the western portion of Henderson. Notably, the Corps property is predicted to be essentially unchanged by sea level rise even though it is now open to tidal influence due to its high initial-condition elevation. The resilience of the Corps property to inundation carries some uncertainty due to a variety of factors including elevation-data vertical accuracy and predicted marsh accretion rates.

The best-available elevation data for this site were based on a two-foot contour map which means that wetland elevations remain somewhat uncertain. Additionally, site-specific accretion data would provide information about local sediment supplies and how effectively marshes will be able to keep up with accelerated sea level rise. Accretion data were derived based on regional averages.

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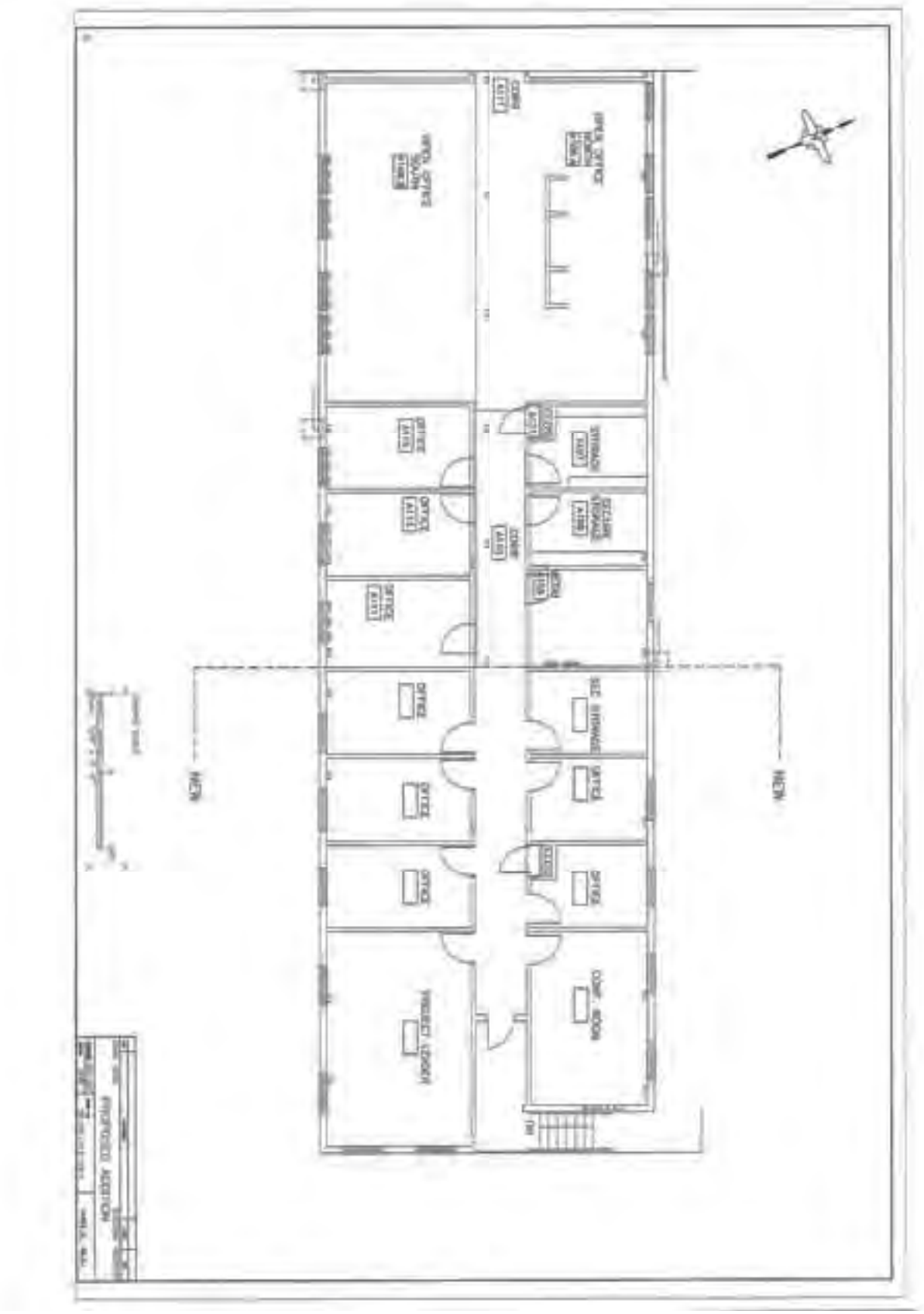
Appendix K

LaVonda Walton/USFWS

Audience inside the refuge's auditorium and large meeting room

Facility Design Plan



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U.S. Fish & Wildlife Service
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For Refuge Information
1 800/344 WILD

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