Finding of No Significant Impact

Environmental Assessment and Comprehensive Conservation Plan for Sherburne National Wildlife Refuge, Minnesota

An Environmental Assessment has been prepared to identify management strategies to meet the conservation goals of the Sherburne National Wildlife Refuge (Refuge). The Environmental Assessment examined the environmental consequences that each management alternative could have on the quality of the physical, biological, and human environment, as required by the National Environmental Policy Act of 1969 (NEPA). The Environmental Assessment presented and evaluated five alternatives for managing fish, wildlife and plant habitats, as well as visitor services, on the Refuge over the course of the next 15 years:

The Environmental Assessment identifies five possible alternatives primarily centered on habitat management. The Alternatives are 1) Current Management, 2) Pre-settlement Processes, 3) Enhanced Off-Refuge Coordination, 4) Migratory Water Bird Emphasis (preferred alternative), and 5) Priority Wetland and Grassland Birds Emphasis. The preferred alternative, Migratory Water Bird Emphasis, will see 1) an increase in changes in the water impoundment system and upland management to create a diversity of wetland types and historic upland plant communities, 2) increased opportunities for all types of wildlife-dependent recreation, and 3) outreach, private lands, and partnership activities that will emphasize natural processes, including native habitat restoration and protection, to form ecologically functioning connections to and from the Refuge.

For reasons presented above and below, and based on an evaluation of the information contained in the Environmental Assessment, we have determined that the action of adopting Alternative 4 as the management alternative for the Refuge CCP is not a major federal action which would significantly affect the quality of the human environment, within the meaning of Section 102 (2)(c) of the National Environmental Policy Act of 1969.

Additional Reasons:

1. Future management actions will have a neutral or positive impact on the local economy.
2. This action will not have an adverse impact on threatened or endangered species.

Supporting References:

Environmental Assessment
Comprehensive Conservation Plan

Regional Director

DEC 23 2005

Date

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Chapter 1: Purpose and Need for Action

1.1 Introduction

The U.S. Fish and Wildlife Service is mandated by the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, to prepare and implement a comprehensive conservation plan (CCP) for each unit in the National Wildlife Refuge System. This environmental assessment provides information to Service officials and the general public before decisions are made and actions are taken as required by the National Environmental Policy Act of 1969, as amended.

1.2 Proposed Action

The proposed action is to implement a CCP for the Sherburne National Wildlife Refuge that will guide management for the next 15 years. The action includes management direction that will focus on benefiting water birds in migration while encouraging other species of concern such as threatened and federally endangered species. Management will also emphasize oak savanna, a globally endangered plant community. The proposed action will expand visitor use of the Refuge through enhanced environmental education and interpretation, construction of a visitor center, expanded hunting, and wildlife viewing and photography opportunities.

1.3 Purpose of Action

The purpose of the environmental assessment is to select a management direction for Sherburne National Wildlife Refuge for the next 15 years that best achieves the Refuge's purpose, vision and goals. The direction that is chosen should also contribute to the mission of the National Wildlife Refuge System, be consistent with principles of sound fish and wildlife management, and address relevant mandates and major issues identified during scoping. The selected management direction is further defined in the CCP.

The CCP will serve as a management tool to be used by Refuge staff and partners in guiding the habitat management and public use activities on the Refuge. The document will guide management decisions and activities on the Refuge over the next 15 years. Staff from various programs of the Service, Minnesota Department of Natural Resources and many non-governmental groups, universities and interested citizens participated in developing this plan.

In addition to the CCP, the Environmental Assessment addresses the adoption of a new Sherburne NWR Fire Management Plan.

1.4 Need for Action

For Sherburne NWR, there is a need to recognize the desired use by the public and the Refuge's role in providing habitat for migratory water birds as well as other important migratory species of regional concern and federally threatened and endangered species. In addition, the plan is needed to satisfy the legislative mandates of the National Wildlife Refuge System Improvement Act of 1997, which requires the Service to develop and implement a comprehensive conservation plan for all national wildlife refuges.

The critical needs for completing a comprehensive conservation plan for Sherburne National Wildlife Refuge have been developed from the issues raised during scoping and are identified as follows:

- # To conserve, protect and enhance wildlife populations that use the Refuge, particularly water birds in migration.
- # To provide habitat for endangered and threatened species within the Refuge.
- # To conserve and restore native plant communities, especially oak savanna on the edge of an expanding urban population.
- # To provide habitat for a functioning watershed and wetland diversity within the altered St. Francis River valley.
- # To promote and encourage habitat conservation on private land.
- # To establish partnerships and promote public awareness of the value of oak savanna and wetland habitat for the continuing benefit of wildlife.
- # To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography.

1.5 Decision to be Made

The Regional Director for the Great Lakes-Big Rivers Region of the U.S. Fish and Wildlife Service will select an alternative to implement as the Sherburne National Wildlife Refuge Comprehensive Conservation Plan. The Regional Director's decision will be made with an understanding that environmental consequences of all alternatives have been considered.

1.6 Background

1.6.1 U.S. Fish & Wildlife Service

The United States Fish and Wildlife Service (Service) is the primary Federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife resources and their habitats for the continuing benefit of the American people. Some responsibilities are shared with Federal, state, tribal, and local entities, but the Service has specific responsibilities for “trust resources” – which include endangered species, migratory birds, interjurisdictional fish, and certain marine mammals – as well as managing and protecting lands and waters administered by the Service.

The Service's mission is “Working with others to conserve, protect, enhance and, where appropriate restore fish, wildlife and plants and their habitats for the continuing benefit of the American people.”

The Service is guided by four principal mission goals:

Sustainability of fish and wildlife populations: Conserve, protect, restore and enhance fish, wildlife and plant populations entrusted to our care.

Habitat Conservation: A Network of Land and Waters: Cooperating with others, we will conserve an ecologically diverse network of lands and waters of various ownerships providing habitats for fish, wildlife and plant resources.

Public Use and Enjoyment: Provide opportunities to the public to enjoy, understand and participate in use and conservation of fish and wildlife resources.

Partnerships in Natural Resources: Support and strengthen partnerships with tribal, state and local governments and others in their efforts to conserve and enjoy fish, wildlife, plants and their habitats.

1.6.2 National Wildlife Refuge System Mission, Goals and Principles

The U.S. Fish and Wildlife Service is the principal federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages over 94 million acres in the National Wildlife Refuge System with more than 540 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 66 national fish hatcheries, 64 fishery resource offices and 78 ecological services field stations. The agency enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

The administration, management, and growth of the System are guided by the following goals:

- To fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.
- To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- To perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- To conserve a diversity of fish, wildlife, and plants.
- To conserve and restore where appropriate representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- To foster understanding and instill appreciation of native fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

1.6.3 Ecosystem Goals

1.6.3.1 Mississippi Headwaters/Tallgrass Prairie Ecosystem

The Service has adopted an ecosystem approach to conservation and designated 53 ecosystem units. The ecosystem units delineate portions of the landscape where the Service and its partners can set ecosystem wide resource goals and work together to achieve these goals. The Refuge is located in the Mississippi Headwaters/Tallgrass Prairie Ecosystem as delineated by the Service. The ecosystem is primarily located in Minnesota and North Dakota with small sections extending into Wisconsin and Iowa. The CCP addresses the details of other ecosystem and landscape plans affecting Sherburne National Wildlife Refuge such as The North American Waterfowl Management Plan, North American Bird Conservation Initiatives (NABCI), including Partners in Flight (PIF), The U. S. Shorebird

Conservation Plan and the North American Water bird Conservation Plan, The Resource Conservation Priorities (RCP) list Endangered Species program's preliminary draft "Species of Concern" list for the Region.

1.6.4 History of Refuge Establishment and Acquisition.

Final approval of the Refuge was received from Migratory Bird Conservation Commission on May 18, 1965, and land was purchased with Federal Migratory Bird Hunting Stamp (Duck Stamp) funds. The history of the St. Francis River Valley and the Refuge is outlined in detail in Chapter 1 of the CCP.

1.6.5 Refuge Purpose, Legislation, and Policy and Their Relationship to Management Direction

The purpose of a refuge is derived from the legislation under which the lands are acquired. Some refuges are established by legislation passed by Congress specifically for the refuge being established. However, most refuges are established under more general legislation already in existence. Sherburne National Wildlife Refuge was established in 1965 under the general authority of the Migratory Bird Conservation Act of 1929 (16 U.S.C. 715d). The Act states that lands may be acquired "... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

It appears the intention of the Migratory Bird Conservation Commission when they approved the Refuge was primarily to provide habitat for migratory waterfowl. Considering the wording of the establishing legislation, along with recent policy and legislation, the Refuge purpose is interpreted to include all migratory birds as identified in the Code of Federal Regulations (50 CFR 10.13).

The Refuge purpose describes the authorized use of the Refuge as "... an inviolate sanctuary, or for any other management purpose, for migratory birds." The term "inviolate sanctuary", as interpreted by the Service, means that the Refuge will be managed to promote the health and well-being of migratory birds and their habitats. Other activities may also be accommodated, provided they are compatible with the Refuge purpose (as per Service Compatibility Policy, Federal Register 65 (202): 62484-62496).

The above interpretation of the migratory bird purpose of the Refuge was the first consideration in determining management actions in the CCP. However, development of the CCP also considered the full diversity of native species that make up and depend upon healthy ecosystems. This is in accordance with the National Wildlife Refuge System Improvement Act of 1997 and the Service Policy on Maintaining the Biological Integrity, Diversity, and Environmental Health of the National Wildlife Refuge System; Notice (Federal Register 66 (10): 3810-3823).

1.6.6 Refuge Vision Statement

> In a region where citizens treasure natural areas managed by national, state, and local governments, the Refuge is celebrated for its wildlife and the extraordinary opportunities it provides for visitors. The Refuge conserves a diverse mosaic of restored, quality, native Anoka Sandplain communities and protected cultural resources. The upland habitats are dynamic, ranging from grasslands to oak savanna to forest. These are interspersed with a variety of wetland and riverine habitats ranging from sedge meadow to deep water marsh. The Refuge's hydrologic regime includes a functional St. Francis River riparian system, with clean water flowing into and out of the Refuge. Wildlife and habitat are in balance, and management reflects an adaptive response to climatic change and other changing conditions, using pre-European settlement vegetation as a guide.
>
> Visitors have quality experiences that provide personal and societal benefits, including heightened awareness and support of a strong conservation ethic. Refuge staff, visitors,

and the community understand and value the cultural history of the area. Visitor use and management activities are consistent with the maintenance of sustainable populations of wildlife and their associated habitats. The Refuge is part of the community and the community claims ownership of, actively supports, and advocates for the Refuge mission, purpose, and programs. The surrounding lands are recognized as valuable to the integrity of the Refuge by providing green corridors and habitat continuity to adjacent natural areas.

1.6.7 Refuge Goals

The goals are designed to meet the purposes of the Refuge and the mission of the National Wildlife Refuge System. The following goals were established for Sherburne NWR and will form the direction for the Refuge over the next 15 years.

Goal 1: Upland Anoka Sandplain habitats approximate mid-1800s conditions, contributing to the preservation of these declining ecotypes and their associated Service priority species.

Goal 2: A diverse mosaic of riverine and wetland habitats meets the needs of Service priority riparian and other wetland dependent species.

Goal 3: A balanced diversity of native migratory birds and other native wildlife reflects an emphasis on Service priority species appropriate to Refuge habitats.

Goal 4: A complex of natural areas, corridors, and watershed conservation practices in the surrounding landscape complements Refuge habitat and wildlife goals.

Goal 5: Visitors enjoy wildlife dependent opportunities that further an appreciation of Refuge wildlife and habitats.

Goal 6: Visitors and local citizens demonstrate a strong conservation ethic that leads to support of the Refuge, conservation of the surrounding landscape, and global environmental awareness.

Goal 7: The cultural resources and cultural history of the Refuge are valued and preserved, and connect Refuge staff, visitors, and the community to the area's past.

1.7 Scoping and Public Involvement

Our planning process follows eight basic steps described in the Service's planning policy. The steps are:

Preplanning: Planning the Plan
Initiate Public Involvement and Scoping
Review Vision Statement and Goals and Determine Significant Issues
Develop and Analyze Alternatives, Including the Proposed Action
Prepare Draft Plan and NEPA Document
Prepare and Adopt Final Plan
Implement Plan, Monitor, and Evaluate
Review and Revise Plan

1.7.1 Public and Technical Group Meetings

Details of the Public and Technical Group Meetings are included in the CCP (Table 1 on page 14 and Table 2 on page 14).

1.7.2 Planning Issues

The following issues are summarized and addressed in the EA as "critical needs."

Wildlife

Critical Need: To restore, conserve, and enhance wildlife populations that use the Refuge.

Issue: How do we expand management focus to ecosystem restoration without losing the original Refuge mission as outlined in the enabling legislation? When the Refuge began, management for 'migratory birds" focused on waterfowl, now the focus has expanded to include shorebirds, neotropical migrants, grassland birds, and endangered and threatened species.

Issue: Change in availability of neighboring croplands used as food by cranes.

Issue: Which declining species will benefit from oak savanna restoration?

Issue: Local species/gene pool reservoir may be lost by the Refuge's isolation.

Issue: What is the definition of migratory birds in 2001 as opposed to 1965?

Issue: Local and regional concern about diminishing waterfowl populations.

Issue: Is the Refuge waterfowl monitoring program adequate?

Issue: We need more information about reptiles and amphibians on the Refuge.

Issue: We need to monitor human disturbance of wildlife on the Refuge.

Issue: Should we consider re-introduction of historic large mammals, especially elk and bison?

Endangered and Threatened Species

Critical Need: To provide habitat for endangered and threatened species within the Refuge.

Issue: We need to consider conducting searches of the Refuge for federally listed and state-listed endangered and threatened species.

Issue: How do we manage Refuge land to conserve and restore threatened and endangered species, rare and declining species, and address regional priority species?

Issue: Why are Bald Eagles not expanding off the Refuge to surrounding habitats?

Issue: Should artificial nesting platforms be provided for Bald Eagles to supplement loss of trees?

Issue: Under what circumstances should we reintroduce rare, native species to the Refuge?

Upland Management

Critical Need: To conserve and restore native plant communities, especially oak savanna on the edge of an expanding urban population.

Issue: Should we return the uplands to pre-1850's habitat quality?

Issue: Do we have the right burning prescriptions? Have we integrated the Cedar Creek prescribed burning research into our plans?

Issue: Is there a net loss of "snag" trees and natural cavities due to prescribed burning. What is the impact on Bald Eagle and cavity nesters?

Issue: Increased urbanization has resulted in a loss of surrounding cropland for cranes, ducks and geese.

Issue: Is oak wilt native to the region and should it be controlled?

Issue: We need to address a negative public perception about prescribed burning and conifer removal.

Issue: How do we get Regional resource dollars for oak savanna restoration when dollars are focused on species management.

Issue: What species should we concentrate on in Big Woods, forested wetlands, etc.?

Issue: What is the historic distribution and prevalence of aspen clones within Refuge uplands?

Issue: How do we deal with invasive species, both exotic and native, that are negatively impacting the natural ecological balance of Refuge habitats.

Issue: How do we control undesirable plant species (Norway pine, purple loosestrife, leafy spurge, Siberian elm, black locust, white spruce, box elder, scotch pine, jack pine, Colorado spruce, buckthorn).

Wetland Management: Impoundments, River Valley, and Other Wetlands

Critical Need: To provide habitat for migrating waterfowl and other water birds that depend on the marshes and sedge meadows of this area.

Critical Need: To plan for a functioning watershed and wetland diversity within the altered St. Francis River valley.

Issue: Is the quality of the water entering the Refuge changing due to changing land use in surrounding areas?

Issue: Why was the St. Francis River valley historically considered prime waterfowl habitat?

Issue: What is the best strategy for managing impoundments for migratory water birds?

Issue: Should the Refuge maintain impoundments given the goal of restoration to pre-1800's conditions?

Issue: What is the impact of the impoundments on the historic flooding regime? Have they inadvertently caused a decline in the quality of natural river bottom wetlands?

Issue: What is the effect of impoundments on water levels and vegetation on nearby uplands?

Issue: Is carp control possible or desirable on managed and unmanaged impoundments?

Issue: Does the Refuge need further protection of water rights (minimum flow?)

Issue: What is the original ground water state in Anoka Sand Plain? Baseline study needed.

Issue: Need to monitor fish populations within the impoundments.

Issue: Is it possible to maintain a northern pike spawning run?

Landscape

Critical Need: To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife.

Issue: How to deal with the fact that Sherburne NWR will be an island and must become its own buffer. Specifically, management of healthy wildlife populations while at the same time dealing with increasing expectations and pressures from the public.

Issue: How do we deal with the loss of connectivity between the Refuge and surrounding or nearby habitat?

Issue: How do we increase the "effective habitat size" of the Refuge? Should we expand the Refuge boundaries?

Issue: Increase in complaints from neighbors about wildlife damage.

Issue: How can we use the partners for Fish and Wildlife Programs and USDA, DNR and private programs to further Refuge goals?

Issue: Urbanization/adjacent land use places constraints on management tools and movement of wildlife and plants and their gene flow.

Issue: Working with local planning to engender sustainable ecosystem in face of human population growth, dispersion, use and politics.

Issue: The Refuge lacks contingency plans relative to urban encroachment, climate change, pollution, and funding uncertainties.

Promoting Wildlife-dependent Recreation

Critical Need: To provide opportunities for wildlife-dependent recreation activities, particularly hunting and fishing, environmental education and environmental interpretation, wildlife observation and wildlife photography.

Access and Legal Issues

Issue: Trash dumping, vandalism of signs, snowmobile trespass and unleashed pets may increase on the Refuge.

Issue: The old schoolhouse is an inadequate space for special events, schools groups.

Issue: The spruce plantation on Blue Hill trail: to cut or not to cut.

Issue: Conflicts may occur between cross-country skiers and people on snowshoes on trails.

Issue: Providing public education on resource issues such as prescribed burning, tree removal and exotics.

Issue: Safety concern over high number of deer hunters during opening weekend of firearms season.

Issue: Refuge lacks appropriate visitor service infrastructure to accommodate large groups, which limits environmental education opportunities.

Issue: Zoning of all uses, including environmental education and hunting, is not formalized and needs to be reviewed during CCP process.

General Comments/Issues

Issue: What will be the impact of full use of road right-of-ways by the county and state?

Issue: Inviolate sanctuary versus public use: How much should be open and where?

Issue: Is there unequal access to the Refuge by hunters as opposed to people interested in other activities such as wildlife observation and photography?

Issue: Snowmobiles have access to county and state road right-of-ways. Can this be controlled within the Refuge boundaries?

Issue: What will the environmental impacts be of ATV access to state and county right-of-ways?

Issue: How do we deal with improper chemical application on road right-of-ways?

Issue: Does the Refuge have an adequate oil spill contingency plan for the underground pipeline?

Issue: We need to maintain a working relationship with the tribes.

Issue: Can we determine a carrying capacity for the number of people on the Refuge?

Issue: Recreation – Conflicted desires i.e., some people want more recreational use while others want less use of the Refuge.

Outreach

Issue: Do we want to expand our outreach? Is a staff increase needed?

Environmental Education and Interpretation

Issue: Are enough areas on the Refuge open for environmental education?

Issue: Need more environmental education in the context of expanded urban development.

Issue: The current focus is on schools, do we need new facilities to accommodate school groups?

Issue: Where should a possible new visitor center be located and what should it provide to the public?

Issue: How can we increase public understanding of the prescribed burning and conifer removal programs?

Issue: Space for indoor classrooms is needed to bridge the transition between the school room and the outdoors.

Issue: Teaching exhibits are needed with an area in front for kids to sit.

Issue: Marketing of the Refuge environmental education program is needed on an ongoing basis to get more teachers to "buy into" taking field trips to the Refuge and doing teacher-led activities.

Issue: Staff are needed for teaching students on the Refuge, for leading teacher in-service training sessions, and for doing ongoing marketing of the Refuge EE program.

Issue: An outdoor amphitheater is needed to provide a teaching area for large groups.

Issue: Funding from corporate sponsors is needed to assist schools with transportation costs for field trips to Refuge.

Issue: View of wetland, oak savanna, and prairie opening habitats are needed from an indoor facility to lead the students gradually into their field studies.

Issue: There is a need to establish the carrying capacity of the areas designated for environmental education to assure quality environmental education studies and minimal impact to habitat and wildlife. It is also important to establish the number of groups per day and the number of people in each group.

Issue: Oak savanna study sites are needed to provide locations for implementing the oak savanna curriculum.

Issue: Encourage the township park boards to fund and offer environmental education programs on the Refuge for township children.

Issue: Need to send introductory materials to teachers to encourage them to come out to the Refuge.

Issue: There is a need for more trained volunteers to lead interpretive programs.

Issue: There is a need for Refuge-specific educational materials.

Issue: There is a need for display and storage space for books for sale, free brochures, etc.

Issue: Refuge management programs should be addressed through interpretation: prescribed burning, removal of non-native vegetation (pines), water level management, restoration to native oak savanna habitat, land use planning on private lands, cultural history, geologic history and land forms and how they shaped the present landscape.

Issue: Other potential themes include the National Wildlife Refuge System and how we are different from other natural resource agencies, environmental ethics and visitor etiquette.

Issue: Water management can be demonstrated through a video production or time series photography.

Issue: Environmental ethics can be demonstrated through placing a camera monitoring on an active eagle nest and letting visitors view the action from inside a visitor center.

Issue: Interpretive programs highlighting wildlife management and including resource issues on the Refuge can be offered to community organizations.

Wildlife Observation and Photography

Issue: There are too many people. Are restrictions needed for the number of vehicles on the tour route?

Issue: Does the observation drive optimize the viewing of wildlife? Should there be different drives for viewing wildlife and for scenic observation, such as flowers?

Issue: Are the observation decks useful? Are they in the right place?

Issue: People need training to see wildlife, how do we provide it?

Issue: Photography blinds are not being provided, should they be? Should people be able to use portable blinds?

Issue: The wildlife drive has too many signs, many of them are not informative.

Issue: Do we have adequate facilities for wildlife viewing such as observation decks, trails and auto tour routes?

Issue: Are there too many signs and leaflets on the Refuge?

Issue: People should feel like they've been in a pristine area, wild country; many say they feel that now.

Issue: Refuges should show management, and signs could be useful for this purpose.

Issue: Wildlife drive does not open until mid-April.

Issue: Increased visitation may reduce quality of personal experience by seeing others; perceived crowding.

Issue: Noise interference from other activities, e.g., hunting. Birding tours via motorcoaches (another example of noise interference).

Issue: Should we consider reintroduction of extirpated species as a viewing opportunity, e.g. Karner blue butterfly.

Issue: Fund raisers for Friends of Sherburne (e.g., bird-a-thon) to support more opportunities and action.

Hunting and Fishing

Firearms Deer Hunt

Issue: The antlerless deer quota does not agree with the DNR model. The scale of their model is too large for the size of our block.

Issue: This is the only hunt that is biologically justified.

Issue: Safety. Between 800 and 1000 hunters participate on the opening day of the firearms deer season. Safety among hunters and other users is perceived as a real or potential problem. The safety concern will also apply to other hunts.

Issue: Any future restriction on hunter numbers would be due to safety concerns. Quality of hunt is a bigger concern. The CCP should address the number on opening days.

Issue: Look to the future, increasing development promises problems with deer.

Issue: Are there ways to arrive at a more accurate deer herd size? (red oak cause a problem with aerial counts as well as pellet counts).

Issue: Should hunter registration for deer at the Refuge be mandatory? That would mean a commitment of staff for 9 days.

Issue: How can we manage a herd that moves on and off the Refuge?

Issue: Are there browse problems on the Refuge?

Issue: Should we allow a muzzle-loader season? A muzzleloader deer hunt would provide another deer hunting opportunity but may not be necessary from a population management standpoint. There are conflicts with the muzzle-loader season and other uses (example: cross country skiing).

Issue: Firearms season may limit access of waterfowl hunters (road to the boat landing is closed). In most years, this is not a concern as the water is frozen (but not every year).

Issue: Ethical versus non-ethical hunters. Examples: Leaving stands overnight, infringing on stands, etc. This is perceived as primarily a law enforcement issue.

Issue: Disruption of non-hunting visitor's quality of Refuge experience and safety perceptions. Some non-hunting visitors may be unaware that firearm hunters are in the field (no blaze orange required for non-hunters).

Archery Deer Hunt

Issue: Is archery hunt purely a recreational hunt and difficult to justify as population control? If so, why are bow hunters allowed greater access?

Issue: How do we address issue of injured deer? Are deer injury rates greater than during the firearms season?

Issue: Potential disturbance of migratory birds, such as roosting cranes, being pushed from preferred areas on the west side of the Refuge.

Issue: Consider closing the Refuge (especially the west side) once the gun season is over.

Other Hunting

Issue: Is the Refuge open too long for small game?

Issue: Prey base for predators may be negatively impacted by small game harvest.

Issue: Small game hunters and other recreational users can spoil an archer's hunt.

Issue: Disturbance to migratory birds, such as bowhunters walking on dikes in a closed waterfowl hunting area.

Issue: Potential Turkey Hunt: There is a conflict between the State spring hunt and other Refuge functions. There are also safety and zoning problems. A fall hunt may not conflict with other Refuge programs.

Issue: Consider a turkey hunt for hunters with disabilities.

Issue: All types of hunting access should be limited, not because of safety but because of the quality of the hunt.

Issue: Hunting during the early goose season may be viable on the Refuge if the over-water restriction is removed.

Issue: Disturbance of other migratory birds is a problem, especially along the river corridor.

Issue: Consider predator hunting and trapping consistent with state regulations.

Fishing

Issue: Could over-fishing lead to a lack of fish for eagles?

Issue: Limited access for anglers with disabilities.

Issue: We need to deal with litter, tackle left at site, trampling vegetation, monofilament line, lead sinkers.

Issue: Is there a possible solution to control carp.

Issue: Do we need to expand access to the river?

Issue: Do we need interpretive panels at access points?

1.8 Legal and Policy Guidelines

In addition to the Refuge's establishing legislation, several laws, executive orders, and regulations govern its administration. See Appendix E for a list and discussion of the guiding laws and orders.

1.8.1 Wilderness Review

Refuge planning policy mandates that wilderness reviews be conducted through the comprehensive conservation planning process (602 FW 3). The wilderness review process consists of three phases: inventory, study, and recommendation. In the inventory phase we look at Service owned lands and waters within the Refuge that are not currently designated wilderness and identify those areas that meet the criteria for wilderness established by Congress. The criteria are size, naturalness, opportunities for solitude or primitive recreation, and supplemental values. Areas that meet the criteria are called Wilderness Study Areas (WSAs). In the study phase we develop and evaluate a range of management alternatives for the WSAs to determine if they are suitable for recommendation for inclusion in the National Wilderness Preservation System. In the recommendation phase we forward the suitable recommendations in a Wilderness Study Report that moves from the Director through the Secretary and the President to Congress. On Sherburne National Wildlife Refuge, there were no areas that qualify for the WSA criteria, so none were developed during this planning exercise.

Chapter 2: Description of Alternatives

2.1 Introduction

This chapter describes the alternative management scenarios developed in response to the issues and concerns discussed in Chapter 1. The preferred alternative, or proposed action, is also identified. Objectives and management strategies are used to describe what the Service will do over the next 15 years to implement each of these alternatives. A major concern was the lack of knowledge regarding the hydrologic regime on the Refuge. To address this concern, a hydrologic study is proposed under each alternative with the understanding that the information gained may require refining and revising water management objectives. Table 1 summarizes the five alternatives by Refuge goal.

2.2 Elements Common to All Alternatives

2.2.1 Environmental Justice

Executive Order 12398 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Bill Clinton 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 directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment.

2.2.2 Archeological and Cultural Values

Lands administered by the Service come under the several federal cultural resources laws (and executive orders and regulations), in addition to policies and procedures established by the Department of the Interior and the Service to implement the laws. Thus cultural resources on federal lands receive protection and consideration that would not normally apply to private or other government lands.

Undertakings accomplished on the Refuge have the potential to impact cultural resources. The presence of cultural resources including historic properties cannot stop a Federal undertaking, the several laws require only that adverse impacts on historic properties be considered before damage occurs.

The Refuge Manager will, during early planning, provide the Regional Historic Preservation Officer (RHPO) a description and location of all undertakings (projects, activities, routine maintenance and

operations that affect ground and structures, and request for permitted uses); and of alternatives being considered. The RHPO will analyze these undertakings for potential to affect historic properties and enter into consultation with the State Historic Preservation Officer (SHPO) and other parties as appropriate. The Refuge Manager will notify the pubic and local government officials to identify concerns about impacts by the undertaking; this notification will be at least equal to, preferably with, public notification accomplished for NEPA and compatibility.

2.2.3 Trust Responsibility Species, Endangered and Threatened Species.

Appendix I lists the Regional Conservation Priority species.

2.2.4 Fire Management

Under all alternatives, fire management is an integral part of habitat management and critical to the restoration and maintenance of native prairie and oak savanna habitats. The use of prescribed fire suppresses non-native cool season grasses, promotes the growth of native grasses and forbs which evolved through periodic fires, restores and maintains oak savanna habitat, can open wetland basins choked by cattail and other emergent plants, and helps to recycle nutrients which benefits soil fertility and plant diversity and growth.

2.2.4.1 Historical Role of Fire

Understanding the historical and ecological role of fire at Sherburne NWR and on the larger Anoka Sandplain is not difficult. The area is a tension zone between hardwood forests to the east, and prairie to the west. This zone moves east or west over time, influenced by climate. Two other influences that historically played a major role in shaping the ecology of this area were fire and grazing (Wovcha, Delaney & Nordquist, 1995).

With sufficient precipitation to support forest vegetation, fire played an important role in keeping the forest canopy open. This allowed sun loving prairie species to occupy much of the herbaceous vegetation layer. Lightning fires surely would have occurred, but human caused fires greatly increased the frequency of fires in this area.

2.2.4.2 Prescribed Fire

The Refuge is required to have a comprehensive Fire Management Plan before conducting either prescribed burning or wildfire suppression. The Plan describes in detail fire management, objectives, strategies, responsibilities, personnel and public safety, monitoring of effects, fire planning, air quality and smoke management, and compliance with Fish and Wildlife Service fire management policies, including Section 7 of the Endangered Species Act. This plan is available at the Refuge Office for public review. In addition to the Fire Management Plan, each prescribed burn must have an individual plan which describes in detail the unit to be burned, objectives, weather parameters, safety, crew size, equipment, contingency, and smoke management.

Of major concern to the public with the use of prescribed fire is smoke and the risk of fire escape onto private property. As noted above, smoke management is a part of each unit burn plan and burns are not conducted if smoke-drift will cause a safety hazard to traffic or adjacent private dwellings. Neighbors are notified prior to burns to ensure precautions should some smoke drift over residences. Burn plans are designed to minimize escape of fires onto private property through use of fire breaks, and burning within strict weather parameters and fire behavior models. Each plan also describes contingency plans in case of fire escape, including pre-burn notification of local fire departments and other units of government such as Minnesota Department of Natural Resources fire crews.

2.2.5 Climate Change

World temperatures are rising rapidly and scientists are no longer debating this fact. The most recent government report acknowledges the growing evidence for global warming. In the last 17,000 years

temperatures have risen 8 to 10 degrees, but with escalating climate change, temperatures are predicted to rise an additional 4 to 11 degrees in the next 100 years according to the United Nations Intergovernmental Panel on Climate Change.

Minnesota is particularly sensitive to climate warming because it sits on the boundary of three major air masses, the humid air from the Gulf of Mexico, the dry Pacific air, and the polar air. These air masses have influenced the vegetation that grows resulting in three major biomes, the prairie, deciduous forest, and northern coniferous forest. The edge is sensitive to change: a shift in the air masses will result in rapid shifts in vegetation. This makes Minnesota more vulnerable to climate change than many areas in the nation. Shifts in less than 4 degrees in temperature and six inches in moisture will create a shift in forest and prairie borders (Weflen, 2001 based on research of John Tester). Lisa Sorenson conducted a 1998 study of drought scenarios found that 11 of the 12 hot weather scenarios would lead to drought in central and western Minnesota. By 2050 the number of ponds and ducks could drop by about half their current averages.

This change could happen within the next 20 to 50 years. Some changes are already being seen; for example, in the Boundary Waters Canoe Area the conifer blow-down areas are growing oak and maple instead of conifer seedlings. The changing wildlife landscape has also already brought new species north, such as cardinals now winter in Duluth as do opossums and true katydids,

Soil also affects the vegetation and will impact what grows as the climate changes. Sandy soils like that of Sherburne NWR hold less water and will give way to brush and grasslands.

2.2.6 Carbon Sequestration

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's "A Carbon Sequestration Research and Development"(U.S. DOE, 2002) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere".

The land is a tremendous force in carbon sequestration. Terrestrial biomes of all sorts grasslands, forests, wetlands, tundra, perpetual ice and desert are effective both in preventing carbon emission and acting as a biological 'scrubber' of atmospheric carbon monoxide. The Department of Energy report's conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Preserving natural habitat for wildlife is the heart of any long range plan for national wildlife refuges. The actions proposed in this comprehensive conservation plan would conserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

2.3 Formulation of Alternatives

Draft alternatives were developed during the four workshops conducted by CBSG of IUCN and refined based on other comments received from the public and experts in the field. These workshops were open to the public and were attended by citizen groups such as Friends of Sherburne, as well as experts from the Minnesota Department of Natural Resources, University of Minnesota, USGS

Biological Resources Division, and Service biologists and public use specialists from the Washington D.C. and regional office and the Refuge staff (see Chapter 6). Alternatives were written to address the many issues that came up during meetings and each alternative is designed to meet the Refuge vision and goals.

2.4 Summary of Alternatives

2.4.1 Alternative 1: Current Management Through Landscape Plan (No Action)

The Council of Environmental Quality's regulations for implementing the National Environmental Policy Act require that all environmental assessments include the alternative of taking no action or, in other words, continuing on the present course.

Current management is focused on upland habitats to approximate 1850s conditions based on the Refuge Landscape Plan as a guiding document. Wetlands are actively managed to benefit migratory birds. The Landscape Plan also allows for a re-evaluation and possible removal of the impoundment water control as the structures deteriorate. Interpretive and environmental education programs compare the biology of natural landscapes to managed systems and the native cultural history and the transition to European settlement. Opportunities for hunting, fishing, wildlife observation, and wildlife photography are provided at levels consistent with existing plans and guidance. Cultural resources of the Refuge are valued, interpreted and preserved as appropriate. Off-Refuge restoration programs are focused on the objectives of the Partners for Fish and Wildlife Program.

2.4.2 Alternative 2: Pre-settlement (1800-1850) Ecological Processes

Refuge management will approximate ecological processes that promoted the native Anoka Sandplain communities present prior to European settlement, emphasizing the restoration of natural hydrological and fire regimes. Vegetative communities and wildlife diversity will then be expected to resemble pre-settlement conditions. Opportunities for hunting, fishing, wildlife observation, and wildlife photography will give visitors a personal experience with wildlife and native habitats. Environmental interpretation and education programs will emphasize the role of ecological processes in creating natural pre-European settlement habitats and cultural history. Off-Refuge outreach, private lands, and partnership activity will emphasize natural processes, corridors, and restoration. Cultural resources of the Refuge will be valued, interpreted and preserved as appropriate.

2.4.3 Alternative 3: Enhanced off-Refuge Coordination with Current on-Refuge Management Direction

This alternative recognizes that the Refuge is part of a larger and rapidly changing landscape. The current management direction will be maintained on the Refuge but new programs and staff will focus on off-Refuge land conservation efforts. This alternative will emphasize the pursuit of a strong land conservation ethic through partnerships with local communities, conservation groups, and government organizations. Outreach will focus on native habitat restoration and conservation to form ecologically functioning connections to and from the Refuge. Restoration of native vegetation and wetlands on the Refuge will be used as demonstration areas. Opportunities for hunting, fishing, wildlife observation, and wildlife photography will give visitors a personal experience with wildlife and native habitats. Environmental interpretation and education programs on and off the Refuge will compare the biology of managed systems to the biology of natural landscapes and the culture history of pre-European settlement with European settlement. Cultural resources of the Refuge and the watershed will be valued, interpreted and preserved as appropriate.

2.4.4 Alternative 4: Pre-European Settlement Processes and Habitat in Context of Providing Migratory Waterbird Habitat (Preferred Alternative)

Refuge management will maintain a portion of the current water impoundment system to provide migratory habitat for water birds. This would create a diversity of wetland types to support water-dependent species. Vegetation communities and hydrology on the remainder of the Refuge would approximate conditions typical of the Anoka Sandplain in the mid-1800s. Management of upland habitats will focus on maintaining and restoring these plant communities through the use of ecological processes that shaped these communities prior to European settlement. Environmental interpretation and education programs on and off-Refuge will compare the biology of managed systems to that of natural landscapes and the cultural history of pre-European settlement to post-European settlement. Opportunities for hunting, fishing, wildlife observation, and wildlife photography will give visitors a personal experience with wildlife and native habitats. Off-Refuge outreach, private lands, and partnership activity will emphasize natural processes, and native habitat restoration and conservation to form ecologically functioning connections to and from the Refuge. Cultural resources of the Refuge will be valued, interpreted and preserved as appropriate.

2.4.5 Alternative 5: Focused Management for Priority Wetland and Grassland Birds

The focus of this alternative will be management for the migration and production of U.S. Fish and Wildlife Service Region 3 priority wetland and grassland birds. Wetland management for priority bird species will include a mixture of high water for emergent vegetation control and drawdowns that vary spatially and temporally to favor the seasonal occurrence of various bird groups. The current impoundment system will be maintained and managed to meet the objectives of priority bird species. Where possible, water management will mimic natural processes to provide for a diverse wetland bird community. Upland management will emphasize the more open end of the prairie-oak savanna continuum to create large blocks of prairie to benefit the priority grassland birds. Environmental interpretation and education programs on and off the Refuge will focus on the importance of managing for Service priority wetland and grassland birds and their habitats. Opportunities for hunting, fishing, wildlife observation, and wildlife photography give visitors a personal experience with wildlife and native habitats. Outreach activities will focus on habitat restoration and conservation with an emphasis on grasslands and wetlands, encouraging contiguous grassland habitat. Cultural resources of the Refuge will be valued, interpreted and preserved as appropriate.

2.5 Alternatives and their Relationship to Goals, Objectives and Strategies

The vision for a Refuge is a broad statement of the desired future condition, the goals are general directions to realize the vision. The alternatives are different management scenarios to reach the goals and the objectives are specific statements of what will be accomplished under each alternative. Strategies give greater detail to the objective. The hierarchy is as follows:

Vision
- Goals
  - Alternatives
    - Objectives
      - Strategies

All of the alternative management scenarios are designed to result in a future for the Refuge that is described in the vision statement. They meet every goal. Some of the alternatives place a stronger emphasis on one goal over another, thus objectives and strategies differ among alternatives.

2.5.1 Description of Alternatives

Alternatives are “alternative management scenarios” designed to result in a landscape and in conditions that meet the Refuge vision. The Alternatives differ in emphasis but every alternative will fulfill all the goals. Appendix N summarizes how the alternatives will be achieved through objectives and strategies and how they compare to each other. The table form is designed to allow comparison across all alternatives. Table 1 summarizes the alternatives by goal.

Table 1: Summary of Alternatives by Goal, Sherburne NWR

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Goal 1: Upland Anoka Sandplain habitats approximate mid-1800s conditions, contributing to the preservation of these declining ecotypes and their associated Service priority species.					
Big Woods	100 acres	540 acres	Same as Alt. 1	Same as Alt. 2	0 acres
Dry Oak Forest	5,600 acres	5,500 acres	Same as Alt. 1	Same as Alt. 2	4,600 acres
Oak Savanna	3,400 acres	3,900 acres	Same as Alt. 1	Same as Alt. 2	1,900 acres
Oak/White Pine Forest	60 acres	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Grassland	5,700 acres	5,000 acres	Same as Alt. 1	Same as Alt. 2	8,300 acres
Invasive Species	Reduce by 50 percent	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Prescribed Fire	5,000 burnable acres annually.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
Goal 2: A diverse mosaic of riverine and wetland habitats met the needs of Service priority riparian and other wetland-dependent species.					
Tamarack Swamp	Maintain 200 acres and restore 730 acres.	Maintain 200 acres and restore per hydrologic study.	Same as Alt. 1	Restore 730 acres.	Maintain 200 acres, no restoration.
Tamarack Swamp Off-Refuge	N/A	N/A	Identify and promote regionally.	N/A	N/A
Sedge-meadow	70 acres	80 acres	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Sedge-meadow Off-Refuge	N/A	N/A	Identify and promote regionally.	N/A	N/A
Lowland Brush	High water used to reduce lowland brush.	Hydrology study needed.	Identify and promote regionally.	1,250 acres	2,500 acres
Refuge Hydrology	Follow Water Management Plan	Develop a hydrologic study for the river and wetland system on the Refuge.	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2
Regional Watershed Hydrology	N/A	N/A	Coordinate and promote understanding of hydrology.	Same as Alt. 3	N/A
Cattail Habitat	2,500 acres	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Regional Cattail Habitat	N/A	N/A	Identify and promote regionally.	N/A	N/A

Table 1: Summary of Alternatives by Goal, Sherburne NWR (Continued)

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Spring Open Water	1-3 pools	Same as Alt. 1	Same as Alt. 1	2 pools or more	Same as Alt. 1
Fall Open Water	Long Pool plus two other pools	Same as Alt. 1	Same as Alt. 1	Four pools	Same as Alt. 1
Migrating Fall Waterfowl Habitat	50-150 acres	Same as Alt. 1	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
Migrating Fall Waterfowl Habitat Regionally	N/A	N/A	Optimize management regionally.	N/A	N/A
Seed-eating Fall Migrant Habitat	50-150 acres across at least 2 basins.	Same as Alt. 1	Same as Alt. 1	100-200 acres across at least three basins.	Same as Alt. 4
Wild Rice for Seed-eating Fall Migrants	500 acres	Same as Alt. 1	Same as Alt. 1	700 acres	1,500 acres
Wild Rice for Seed-eating Fall Migrants Regionally	N/A	N/A	Identify and promote regionally.	N/A	N/A
Spring Draw-down Habitat	N/A	N/A	N/A	30-50 acres	Same as Alt. 4
Spring Draw-down Habitat Regionally	N/A	N/A	Identify and promote regionally.	N/A	N/A
Fall Draw-down Habitat	30-50 acres	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Fall Draw-down Habitat Regionally	N/A	N/A	Identify and promote regionally.	N/A	N/A
Wetland Diversity	Manage impoundments to maximize wetland diversity within the capabilities of the system. Create wetlands that vary from temporary to permanent by varying the water regime.	Same as Alternative 1.	Same as Alternative 1.	Emphasize semi-permanent wetlands for the benefit of water birds in migration.	Emphasize semi-permanent wetlands for the benefit of water birds in breeding season.

Table 1: Summary of Alternatives by Goal, Sherburne NWR (Continued)

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Goal 3: A diversity of native migratory birds and other native wildlife reflects an emphasis on Service priority species appropriate to Refuge habitats.					
Regional Conservation Priority Species	At least 60 percent species associated with historically occurring habitats are present.	Same as Alt. 1.	Same as Alt. 1	Same as Alt. 1	At least 80 percent species associated with historically occurring habitats are present.
Roosting Habitat for Sandhill Cranes	5,000 cranes	Same as Alt. 1.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Wildlife Monitoring Plan	Follow current Monitoring Plan.	Develop a new plan within 5 years	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2
Source Populations of Birds	N/A	Initiate study of populations levels and breeding productivity.	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2
Deer Populations	16-18 deer/square mile	Density based on carrying capacity of the habitat.	Same as Alt. 1	Same as Alt. 2	7-13 deer/square mile
Extripated Species	Feasibility study	Same as Alt. 1	Same as Alt. 1	N/A	N/A
Threatened and Endangered Species	Encourage and Enhance	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Goal 4: A complex of natural areas, corridors, and watershed conservation practices in the surrounding landscape complements Refuge habitat and wildlife goals.					
Landscape Conservation	Within watersheds surrounding the Refuge.	In the landscape surrounding the Refuge.	Same as Alt. 2	Same as Alt. 2	Within the watershed above and adjacent to the Refuge.
Functioning Watershed	N/A	Functional St. Francis River riparian system.	Same as Alt. 2	Same as Alt. 2, with emphasis on migratory bird habitat.	Same as Alt. 2 with emphasis on priority wetland birds.
Wetlands on Private Land	400 wetlands with emphasis within St. Francis River watershed and Refuge Management District.	400 wetlands with emphasis within the St. Francis River watershed.	600 wetlands within the Refuge Management District.	Same as Alt. 2	Same as Alt. 2
Native Uplands on Private Lands	100 areas of grasslands within the Refuge Management District.	100 areas of grassland/oak savanna above the Refuge within the St. Francis watershed.	150 areas of grassland/oak savanna within the St. Francis watershed.	100 areas with priority given within 15 miles of the Refuge.	Link upland restoration on 100 areas within the St. Francis River Watershed.

Table 1: Summary of Alternatives by Goal, Sherburne NWR (Continued)

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Native Habitat on Private Land Development	N/A	Annually, native habitat included in 2 new development plans.	Annually, native habitat included in 5 new development plans.	Same as Alt. 2	Same as Alt. 2
Open-water-dependent Breeding Birds Habitat	N/A	N/A	Identify and promote regionally.	N/A	N/A
Goal 5: Visitors enjoy wildlife-dependent opportunities that further an appreciation of Refuge wildlife and habitats.					
Hunting Opportunities	At the 2004 level	Same as Alt. 1 with addition of muzzleloader hunt, spring turkey hunt, predator hunting and trapping and support for youth hunting opportunities.	Same as Alt. 1	Increase hunting opportunities by including a spring turkey hunt and supporting youth hunting opportunities.	Same as Alt. 2
Fishing Opportunities	At the 2004 level	Same as Alt. 1	Same as Alt. 1	Increase with addition of assessable fish platform and support for youth fishing opportunities.	Same as Alt. 4.
Wildlife Observation Opportunities	At the 2004 level, plus construction of 2 miles of hiking trails in conjunction with new visitor center.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Photography Opportunities	At the 2004 level	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Environmental Education	10 percent increase over 2004 level within 5 years; construct new Visitor Center.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1

Table 1: Summary of Alternatives by Goal, Sherburne NWR (Continued)

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Understanding of Management Through Environmental Education	Continue at 2004 levels.	70 percent of visitors and students understand and appreciate ecological processes and pre-settlement habitat.	70 percent of visitors and students understand and appreciate regional landscape wildlife issues.	70 percent of visitors and students understand and appreciate migratory water birds, pre-settlement habitats, and wildlife management activities.	70 percent of visitors and students understand and appreciate grassland birds and prairies.
Environmental Interpretation	At least 10 programs annually with emphasis on oak savanna, wetlands, and migratory birds, ecological processes, and pre-settlement conditions.	Same as Alt. 1	At least 10 programs annually with emphasis on regional landscape planning and the need for networked parks and greenspace.	At least 10 programs annually with emphasis on oak savanna and wetlands and migratory birds, ecological processes and pre-settlement conditions and wildlife management.	At least 10 programs annually with emphasis on priority grassland and wetland birds and their habitats.
Understanding of Management Through Environmental Interpretation	Continue at 2004 levels.	80 percent of visitors understand Refuge mission, purpose, and management actions as assessed every 5 years.	Same as Alt. 1	Same as Alt. 2	Same as Alt. 2
Goal 6: Visitors and local citizens demonstrate a strong conservation ethic that leads to support of the Refuge, conservation of the surrounding landscape, and global environmental awareness.					
Community Outreach	2,000 students to participate in programs; 50 teachers to participate in training programs, 800 people to volunteer at the Refuge, and 160 people to be members of a supporting friends group.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Community Awareness	N/A	Sixty percent of neighbors, community leaders, and residents of nearby communities are aware of Refuge mission and need for increased local conservation.	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2

Table 1: Summary of Alternatives by Goal, Sherburne NWR (Continued)

	Alternative 1 Current Management (No Action)	**Alternative 2** Pre-settlement (1800-1850) Ecological Processes	**Alternative 3** Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	**Alternative 4** Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	**Alternative 5** Focused Management for Priority Wetland and Grassland Birds
Technical Assistance	Continue at 2004 levels.	Focus within the Sherburne NWR wildlife management region.	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2
Private Landowners	Continue at 2004 levels.	20 contacts within the St. Francis River watershed.	Same as Alt. 2	Same as Alt. 2	Same as Alt. 2
Goal 7: The cultural resources and cultural history of the Refuge are valued and preserved, and connect Refuge staff, visitors, and the community to the area's past.					
Cultural Resources	Emphasize pre- and early European settlement of the area.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Cultural Resource Appreciation	Continue at 2004 levels.	70 percent of visitors understand and appreciate the cultural history of the Refuge, with emphasis on pre- and early European settlement of the area.	Same as Alt. 2	70 percent of visitors understand and appreciate the cultural history of the Refuge, with emphasis on use of the Refuge landscape throughout time and changes caused by recent watershed manipulations.	Same as Alt. 4

Chapter 3: Physical Environment

3.1 Geography, Topography, and Hydrology

The Refuge lies within the deciduous forest-woodland zone of Minnesota on the Anoka Sandplain a large flat sandy outwash area now thought to be lacustrine in origin, with small dune features and low moraines exposed above the outwash (Wright, 1972). This zone in Minnesota is transitional between tallgrass prairie and deciduous forest. The uplands within the Refuge predominantly consist of these flat sandy areas with some rolling small sand dune areas, interspersed with wetlands and four natural lakes. Upland soils are predominantly Zimmerman, Lino and Isanti loamy fine sand, offering severe limitations for crops, but suitable for pasture or range (USDA, Soil Conservation Service, 1968). These soils are placed in the Zimmerman-Lino-Isanti-peat Soil Association and possess many small scattered peat bog inclusions. The predominant presettlement vegetation on the uplands throughout the Anoka Sandplain was oak barrens and openings (Minnesota DNR, 1996b).

The Mille Lacs upland subsection intersects the northern edge of the Refuge. Here, maple-basswood forest was present on the uplands (MNONR 1996b). The vegetation at pre-European settlement times consisted of a mosaic of forest types. Soils in the portion of this subsection which lies in the Refuge belong to the Milaca-Mora-Ronneby Soil Association. These nearly level to undulating soils overlay slightly acid, red, glacial till and range from the fine sandy loam Milaca soils to the somewhat poorly drained loam Ronneby soils. Uncleared areas still support fair stands of mixed hardwoods (USDA, 1968). Soils in this association make up three percent of the Refuge's total area, while soils in the Zimmerman-Lino-Isanti-peat Association make up the other 97 percent of the Refuge lands (USDA, 1968).

The majority of the Refuge is located within the St. Francis River Watershed, which extends northward into Benton County. The Refuge was developed along a portion of the St. Francis River Valley, historically known for its wildlife resources. The St. Francis River begins in Benton County, about 18 miles from where it enters the northwest corner of the Refuge. After travelling through the Refuge, the St. Francis River exits the Refuge's south spur and drains into the Elk River just north of the City of Big Lake which drains into the Mississippi River within the city limits of Elk River. The middle one-third of the Refuge's western boundary follows the boundary of the Snake River Watershed which lies to its west. A small portion of the Refuge lies within the Snake River Watershed, including the waterbodies of Johnson Slough and Orrock Lake. Figure 8 in the CCP shows the relationship of the Refuge to these watersheds.

3.2 Climate

The climate in east central Minnesota is classified as a subhumid continental type characterized by significant variations between summer and winter temperatures. The region has four distinct seasons with moderate spring and fall weather. Summer is comfortable because lakes and trees serve as

natural air conditioners. In contrast, nearby Minneapolis is the second coldest city in the United States with an average daily temperature of 35 F (1.8 C).

The mean temperature during December, January, and February is 13.3 degrees F. The temperature can drop to between -20 degrees and -30 degrees on several days each winter. The June, July and August mean temperature is 68.2 degrees. Frost is likely to occur until mid-May, and to return by the end of September. The latest recorded occurrence of a freezing temperature in spring is June 9, and the earliest in fall is September 3. The freeze-free period is long enough that such crops as corn, soybeans, small grain, and vegetables generally have time to reach maturity.

Precipitation is well distributed throughout the growing season. About 17.4 inches, or 60 percent of the total annual precipitation, falls during the period from May through September. (U.S.D.A., 1968). The average annual precipitation ranges from around 26 to 31 inches. In 1976, a total of only 13.07 inches of precipitation fell during the entire year, at the DNR reporting station in nearby Zimmerman. During the following 7 months, from January to July 31, 1977, 21.08 inches had fallen, thus indicating the substantial variation that can occur.

3.3 Context and Natural History

3.3.1 Background

The predominant presettlement vegetation on the uplands throughout the Anoka Sandplain was oak barrens and openings (MN-DNR, 1996). Following Euro-American settlement, beginning around 1850, fire was suppressed, changing vegetative communities that had developed under a fire regime dictated by weather and Native Americans.

3.3.2 Social and Economic Context

Minnesota's population grew nine percent from 1990 to 1998 according to the State Demographic Center at Minnesota Planning. The population is expected to increase 14 percent over the next 25 years with the most dramatic increase in the Brainerd lakes area and the counties around the Twin Cities. The City of St. Cloud and surrounding urban areas expect 35 percent rise in population between 1998 and 2020. Sherburne County is in the heart of this suburban expansion. From 1990 to 2000, the townships surrounding the Refuge experienced population increases ranging from 74 to 106 percent.

3.4 Natural Resources

3.4.1 Plant Communities

Following establishment of the Refuge in 1965, old agricultural fields began to be seeded into native warm season grass species. Fire began to be used as a tool, primarily to stimulate grassland plantings for dense nesting cover. An impoundment system installed in the early 1980's re-flooded, and expanded previously drained, wetlands. Relative percent cover and distribution of vegetative cover types when the Refuge was established are shown in Chapter 3 of the CCP.

3.4.1.1 Oak Savanna

In pre-European settlement times, the distribution of Oak Savanna in the Midwest was widespread. It occupied up to half of Midwestern landscape, especially along the prairie-forest border and extended over portions of Minnesota, Iowa, Missouri, Illinois, Wisconsin, Indiana, and Ohio, covering 11 to 13 million hectares (27.5 to 32.5 million acres) (Nuzzo, 1985). Since then, these places have become fragmented and lost entirely in many areas. A survey of this plant community by Nuzzo in 1985 found

about 0.02 percent of the pre-European oak savanna remaining, in scattered remnants. Losses of oak savanna were due to timber cutting, fire suppression (which converted it to oak woodland and forest), and conversion to homesteads and/or farming (pasture and crop fields). Today, oak savanna and open oak woodlands are among the world's most threatened plant communities. The Nature Conservancy ranks Midwest savannas as "globally endangered" (Leach and Ross, 1995) and the U.S. Environmental Protection Agency chose Midwestern Oak Savanna for its first Ecosystem Recovery Project (Leach and Ross, 1995). As stated before, 95 percent of the Refuge's upland was considered oak savanna by Marschner (1930) at the approximate time of European settlement (Marschner, 1930). Today, remnants of this habitat type, totalling only 730 acres, exist on the Refuge. Other upland acres are in transition toward oak savanna.

3.4.1.2 Grasslands

Prior to European settlement prairie grasslands occurred in Sherburne County along the Mississippi River but not within the Refuge boundaries.

Native grassland restoration has occurred on some upland sites of the Refuge since its inception to convert old cropfields to natural vegetation. In addition, grassland restoration has been undertaken on private lands in the area through the Partners for Fish and Wildlife Program for many years. Former croplands are typically planted to native grass mixtures consisting of big bluestem, little bluestem, and switch grass. A mixture of forbs are also included in this mixture to enhance the biological diversity of many of these sites.

3.4.1.3 Wetlands

Refuge units contain a variety of wetlands ranging from shallow wet meadows to permanently flooded mixed emergent marshes. Originally, the St. Francis River ran a winding path along the gentle slope of the valley. Surrounding the river but within the watershed were numerous small basins that were separate from the river and connected dynamically to the ground water of the watershed. Many shallow and seasonal wetlands were drained as farmers attempted to clear the land for agriculture. Since the Refuge was established, water control structures were installed on some of the ditches creating 23 impoundments. These impoundments allow some water level manipulation, depending on their location within the system of impoundments. Many species of waterfowl, marsh, and water birds are attracted to the resulting marshes in search of food and cover. Purple loosestrife, although not found universally, does occur in some of these wetlands and is a major concern. There are still many natural wetlands on Sherburne NWR, in addition to the impoundments. The Nature Conservancy has listed Sherburne National Wildlife Refuge as a priority site in their Ecoregional Planning Efforts in part because of the presence of sedge meadow as a rare and diminishing plant community region-wide.

Federally listed threatened Bald Eagle are known to breed on the Refuge. In 2004, there were seven active Bald Eagle nests. Since eagles first nested on the Refuge in 1983, almost 100 eagles have been produced. Transient individuals of the federally listed gray wolf also frequent the Refuge, but no established packs occur within Refuge boundaries.

3.4.2 Fish and Wildlife Communities

The habitats described above support an array of wildlife species that are common to east central Minnesota. A rich diversity of birds, mammals, fish, reptiles, and amphibians inhabit lands administered by the Refuge. These species are addressed in greater detail in the CCP (See "Fish and Wildlife Communities" on page 46) and in Appendix C.

3.5 Cultural Resources

3.5.1 Context

Archeological evidence for human occupation in west-central Minnesota extends back 10,000 years when the last glaciers retreated to the north. Small bands of hunters moved into the tundra and boreal forest and left behind their distinctive Clovis and Folsom fluted lanceolate spear points and other tools. Now identified as PaleoIndians, these people lived in diverse settings and often on the margins of lakes and wetlands. The long Archaic period began with a warmer and drier climate that peaked with the altithermal around 4700-3000 B.C. Surface waters evaporated and rivers shriveled; bison herds dwindled, and so did the human population. In the harsh conditions, the people developed an array of stone, bone, and copper tools, The human population expanded after the altithermal (Anfinson 1998).

A private collection (Gordon W. Wold) reportedly from the north side of the Refuge contains Paleo-Indian points. And the artifact placed at the Refuge headquarters in 1980 was either a late Paleo or early Archaic knife base. Paleo-Indian sites in Minnesota are very rare, are evidence of the first people in Minnesota following the glaciers, and can be extremely important sites. Evidence for the following Archaic culture (6000-500 B.C.) is also found in the Wold collections as well as from Refuge collections. Many questions remain abut the little-known people of this long pre-ceramic culture and intact sites are very important. A probable bison kill site at the Pool 3 dam is from people of the Archaic culture.

The subsequent Woodland period commenced around 500 B.C. The climate and vegetation were similar to 20th century conditions. The people of this period constructed pottery and burial mounds, used the bow and arrow, and adopted agriculture. Some people lived in larger, even fortified summer villages. The seasonal round included bison hunting, maple sugar collection, and wild rice harvesting. Exotic trade items came from more complex societies to the south and from other sources.

The major prehistoric culture represented at the Refuge is the Woodland. The Honker and the Refuge sites containing burial mounds and suspected villages on the shore of Rice Lake are considered important Woodland sites. Several other sites, not having been investigated for their significance, are identified as being from the Woodland period. Wild rice harvesting, processing, and storing sites should be found on the Refuge. The Woodland period extended to the protohistoric period and the coming of Western (Euro-American) culture in the early 17th century. In the Refuge area the Indians encountered by Euro-Americans were the Dakota, probably the Santee or Eastern Dakota.

Natural and human events disrupted the traditional patterns and tribal locations. The Little Ice Age began about A.D. 1550 and caused many prairie tribes to relocate. Arrival of Europeans with western cultural goods and practices also caused tribes to change traditional cultural patterns and territory. Thus connecting modern Indian tribes with prehistoric antecedent cultures found in the archeological record is problematic.

The first Westerners into the Refuge area were probably fur traders. The Clear Lake fur trade post dated to 1797 was located west of the Refuge. The Wold collection contains historic metal trade items. But little is known about the early historic period; most historic period cultural resources are farmstead sites dating from the late 19th century and 20th century; and bridges and roads. The schoolhouse is the only standing structure on the Refuge that is more than 50 years old.

The most important structure identified on the Refuge is the Glidden-Fox house. The very unusual vertical-plank construction of this house dating to at least 1880 was sufficient to place it on the National Register of Historic Places on April 10, 1980. The house could not be protected in its original isolated location, so it was transferred to the Sherburne County Historical Society and moved to the Town of Becker in 1981.

The Refuge has been the location of 27 cultural resources studies. Most have been identification-inventory (Phase I or reconnaissance) studies for Section 106 (National Historic Preservation Act) requirements. Early studies were research conducted under Antiquities Permits. Other studies have dealt with collections and curation issues. To date, the identification-inventory studies in response to 17 undertakings have covered 380 acres of the Refuge; one other study covered 579 acres of land that were divested from the Refuge. Studies have located 22 archeological sites within the current Refuge boundaries and have produced almost 17,000 artifacts. Through these studies and other sources such as informants, 53 sites have been reported on the Refuge.

The Federal government (National Park Service) recognizes 21 Indian tribes as having a potential concern for traditional cultural resources, sacred sites, and cultural hunting and gathering areas in Sherburne County. Although Chippewa tribes are listed, the Chippewa never had a prehistoric or early historic presence on the Refuge area; and subsequent Chippewa tribal presence has been non-existent or minuscule. Even of the recognized Dakota tribes, only the following listed seem to have cultural association with the Refuge land:

- Flandreau Santee Sioux Tribe of South Dakota
- Santee Sioux Tribe of the Santee Reservation of Nebraska
- Sisseton-Wahpeton Sioux Tribe
- Lower Sioux Indian Community in Minnesota
- Shakopee-Mdewakanton Community
- Upper Sioux Community of Minnesota

Although Indian tribes are generally understood to have concerns about traditional cultural properties, other groups such as church congregations, civic groups, and county historical societies could have similar concerns.

With just over one percent of the Refuge having been subjected to archeological survey, little is really known abut the archeological potential on the Refuge. Beyond the required surveys under the Section 106 process, areas subject to erosion along the St. Francis River and discharge outlets for the several pools should be investigated. A probable bison kill site at the outlet for Pool 3 is indicative of the potential for unreported sites that could be eroding. The bison kill site requires further investigation to determine if it is a site and if it needs to be protected or mitigated against further erosion. In addition, the potential for Native American Graves Protection Act cultural items and other missing artifacts needs attention.

Cultural resources are important parts of the Nation's heritage. The Service is committed to protecting valuable evidence of human interactions with each other and the landscape. Protection is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

3.5.2 Existing Conditions and Cultural Resources Potential

Several hundred archaeological and cultural sites exist in the Mississippi River, Elk River, and St. Francis River Valley and some are located on Refuge lands. In light of the large number of archaeological and cultural sites on or near Refuge lands, considerable care will be exercised to avoid any potential impact. If needed, site-specific archaeological surveys will be completed before any significant ground disturbance occurs.

Chapter 4: Environmental Consequences

4.1 Effects Common to All Alternatives

4.1.1 Economics of the Region

Economic effect categories include changes in: (1) activity days, (2) consumer surplus, (3) total expenditures, (4) economic output, (5) employment, and (6) employment income. For the most part, none of the proposed alternatives would have a quantitative impact on recreational visitation. Each alternative would most likely increase the quality of the recreational visit, due to changes such as the proposed new visitor center and more outreach programs.

The only quantitative impact on recreational visitation due to the proposed alternatives (2, 3, 4, & 5) is the proposal to permit the spring turkey hunt for hunters with disabilities. The additional hunters would add approximately $500 annually to total hunting expenditures, representing less than 1 percent of upland game hunting. Because this impact would be marginal, the additional economic effects are not quantified.

4.1.2 Environmental Justice

None of the alternatives disproportionately place an adverse environmental, economic, social, or health impacts on minority or low-income populations. Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Bill Clinton 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 directed Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment.

4.1.3 Archaeological and Cultural Values

The consequences of each alternative in terms of cultural resources are the same:

Undertakings accomplished on the Refuge have the potential to impact cultural resources. Although the presence of cultural resources including historic properties cannot stop a Federal undertaking, the undertakings are subject to Section 106 of the National Historic Preservation Act and sometimes other laws.

Thus the Refuge Manager will, during early planning, provide the Regional Historic Preservation Officer a description and location of all projects, activities, routine maintenance and operations that

affect ground and structures, and requests for permitted uses; and of alternatives being considered. The RHPO will analyze these undertakings for potential to affect historic properties and enter into consultation with the State Historic Preservation Officer and other parties as appropriate. The Refuge Manager will notify the public and local government officials to identify concerns about impacts by the undertaking; this notification will be at lease equal to, preferably with, public notification accomplished for NEPA and compatibility.

Archeological investigations and collecting are performed only in the public interest by qualified archeologists or by persons recommended by the Governor working under an Archaeological Resources Protection Act permit issued by the Regional Director. The Refuge Manager has found this third-party use of Refuge land to be compatible. (The requirements of ARPA apply to FWS cultural resources contracts as well: the contract is the equivalent of a permit.) Too, the Refuge Manager issues a special use permit. Refuge personnel take steps to prevent unauthorized collecting by the public, contractors, and Refuge personnel; violators are cited or other appropriate action taken. Violations are reported to the Regional Historic Preservation Officer.

The Refuge Manager will, with the assistance of the RHPO, develop a step-down plan for surveying lands to identify archeological resources and for developing a preservation program to meet the requirements of Section 14 of the Archaeological Resources Protection Act and Section 110(a)(2) of the National Historic Preservation Act.

The Refuge Manager should have and implement a plan for inspecting the condition of known cultural resources on the Refuge and report to the RHPO changes in the conditions.

The Refuge Manager will initiate budget requests or otherwise obtain funding from the 1 percent O&M program base provided for the Section 106 process compliance:

- # Inventory, evaluate, and protect all significant cultural resources located on lands controlled by the Service, including historic properties of religious and cultural significance to Indian tribes.
- # Identify and nominate to the National Register of Historic Places all historic properties including those of religious and cultural significance to Indian tribes.
- # Cooperate with Federal, state, and local agencies, Native American tribes, and the public in managing cultural resources on the Refuge.
- # Integrate historic preservation with planning and management of other resources and activities. Historic buildings are rehabilitated and adapted to reuse when feasible.
- # Recognize the rights of Native American to have access to certain religious sites and objects on Refuge lands within the limitations of the Service mission.

4.1.4 Climate Change Impacts

The actions proposed in this environmental assessment would conserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's “Carbon Sequestration

Research and Development" (U.S. DOE, 1999) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

Terrestrial biomes of all sorts - grasslands, forests, wetlands, tundra, perpetual ice and desert - are effective both in preventing carbon emission and acting as a biological "scrubber" of atmospheric carbon monoxide. The Department of Energy report's conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Preserving natural habitat for wildlife is the heart of any long range plan for national wildlife refuges.

4.1.5 Impacts of Prescribed Fire as a Management Tool

4.1.5.1 Social Implications of Using Fire

Prescribed burns will have an effect on the local public. Public concern increases every time a fire is set. A prescribed burn will effect and benefit the local community in many ways. These benefits must be explained to the public at every opportunity. The Refuges Fire Management Plan (FMP) provides additional detail beyond what is captured in this section and will be adopted through this EA.

A prescribed burn on the Refuge will be a direct benefit to the public in creating recreational opportunities through increased wildlife populations for hunting and observation. If a wildfire is started on or near Refuge land, the areas that were previously prescribed burned and the firebreaks intended for prescribed burning will be of extreme benefit in controlling the fire.

The aspect of the fire that will solicit the most public concern is the smoke. Smoke from a Refuge fire can impair visibility on roads and become a hazard. Actions to manage smoke include: use of road guards and pilot car, signing, altering ignition techniques and sequence, halting ignition, suppressing the fire, and use of local law enforcement as traffic control. Burning will be done only on days that the smoke will not be blown across the community or when the wind is sufficient as not to cause heavy concentrations.

If the State of Minnesota institutes smoke management regulations, the FMP will be amended to ensure consistency with those regulations. Combustion of fuels during prescribed fire operations may temporarily impact air quality, but the impacts are mitigated by small burn unit size, the direction of winds the burns are conducted with, and the distance from population centers. All efforts will be taken to assure that smoke does not impact smoke sensitive areas such as roads and local residences. In the event of wind direction changes, mitigative measures will be taken to assure the public safety and comfort. Refuge staff will work with neighboring agencies and in consultation with State air quality personnel to address smoke issues that require additional mitigation.

The fire prescription portion of the Annual Prescribed Fire Plan will have specific measures to deal with unexpected smoke management problems. This will included identified problems that unforeseen wind changes may cause and measures to be employed to protect the public.

The emotional impact of a prescribed fire on the local residents must also be considered. A great deal of public concern may arise with any kind of smoke from the Refuge. This concern can be relieved only by a concerted effort by Refuge personnel to carefully inform the local citizens about the prescribed burning program. Emphasis will be placed on the benefits to wildlife as well as the safety precautions in effect. Formal interpretive programs both on and off the Refuge, explaining the prescribed burning program, will be encouraged.

4.1.5.2 Prescribed Fire and Cultural and Archaeological Resources

There may be archaeological sites within prescribed burn units. When these units are burned, it is doubtful that the fire will have any adverse impact on the sites. The fire will be only a temporary disturbance to the vegetation in the area and in no way destroy or reduce the archaeological value. All artifacts are buried well beneath the surface. No above ground evidence exists. No known sites will be impacted by prescribed burning operations.

4.1.5.3 Prescribed Fires Impact on the Flora

The prescribed burning program will have a visible impact on vegetation and the land. Immediately after a fire the land will be blackened on the majority of the area burned. There will be no grasses or ground forbs remaining and most of the higher brush such as oak sprouts and willow will be bare of leaves. Trees may be scorched up to 20 feet above the ground. This will be particularly noticeable on the light colored bark of aspen and birch. There may be large areas up to one acre in size interspersed throughout the burn that are untouched by the fire. This may be a result of wet ground conditions or a break in fuel continuity.

Generally, within 3 days after the burn the grasses and forbs will begin to grow. The enriched soil will promote rapid growth such that after two or three weeks the ground will be completely covered. The willow and oak will, in many cases, re-sprout. The bases of the trees as well as the burned slash and stumps will be partially or completely covered by the new growth. Some of the less fire resistant trees will show signs of wilting and may succumb within a month or two. Generally speaking, after one seasons regrowth, any sign of the prescribed burn will be difficult to detect without close examination. After two or three years it will be virtually impossible to detect the presence of the fire.

Other more long lived signs of the burn will remain for an indefinite period of time. The firebreaks will not be allowed to grow over as their benefit could be realized in a wildfire situation as well as in future prescribed burns. Vehicle tracks through the burn are visible on the freshly burned ash and may be longer lived if the vehicle became stuck or created tire grooves in the ground. Travel across the burn area will be kept to a minimum. Vehicle travel is necessary in some instances, such as lighting the fire lines or quickly getting water to an escape break-over point. A fire plow will be used only in the event that a break-over does occur and cannot be controlled by any other method. The deep trench of the plow would leave a very long lived scar. This trench could be repaired by filling, which would eliminate it from view after 5 to 10 years.

4.1.5.4 Prescribed Fire and its Impact on Listed Species

The potential impacts of fire on listed species is likely to be beneficial due to the fire-dependent nature of our natural habitat.

4.1.5.5 Impact of Prescribed Fire on Soils

The effect of fire to the soil is dependent largely on the fire intensity and duration. On areas with high fuel loads, a slow backing fire is usually required for containment and desirable results. The intense heats generated by this type fire to kill unwanted plant species or remove slash will have a greater effect on the soils than fast, cool head-fires. The cool, moist soils of wetter areas in the burn units or areas with little fuel will be unaffected by the fire.

The severity of damage to the soil depends also to a great degree on the thickness and composition of the organic mantle. In many cases where only the top layer of the mantle is scorched or burned, no damage will result to the soil below. This is usually experienced in the forested areas of the burn units.

On open areas such as dry grassland or wet meadow sites, the blackening of the relatively thin mantle will cause greater heat absorption and retention from the sun. This will encourage earlier germination during the spring growing season.

Nutrient release occurs as a result of the normal decomposition process. Fire on the soil will greatly speed up the process. The rate and amount of nutrients released will again be dependent on the fire duration and intensity as well as the amount of humus, duff and other organic materials present in the mantle. The increase, immediately after a burn, of calcium, potash, phosphoric acid and other minerals will give the residual and emergent vegetation a short term boost. However, the rapid leaching through the sandy soils will cause rapid runoff of these nutrients and only short term benefits. The increased nutrification of the soil by the emergent vegetation and increased nutrient release result in rapid regrowth of grasses and other succulent vegetation on the sites.

There is no evidence to show that the direct heating of the soil by the burning of material above it with a fire of low intensity has any significant adverse affect. Fire on these types of soil has little total affect on the soils, and in most cases would be beneficial.

4.1.5.6 Escaped Fire

With any prescribed fire there always exists the possibility of its escape into the surrounding area. This can be caused by one or more factors which may be preventable or non-preventable. Inadequate firebreaks, too few personnel, unpredicted changes in weather conditions, peculiar fuel type, being in too big a hurry, and insufficient knowledge of fire behavior are a few factors which could cause loss of control. There is no doubt that an escaped fire could turn into a very serious situation. The damage that could result would be much less severe on the Refuge than if it encroached on private land where buildings, equipment, and land improvements would be involved. Extreme care, careful planning, and adherence to the unit prescription will be exercised when prescribed burning all units with emphasis employed when burning areas that are near or adjacent boundaries.

In the event that a prescribed fire does jump a firebreak and burn into unplanned areas, there is a high probability of rapid control with minimal adverse impact. The network of firebreaks and roads will greatly assist in rapid containment. In most cases all of the Refuge fire fighting equipment will be immediately available at the scene with all nearby water sources previously located. The applicable DNR fire suppression crews and local fire departments will always be notified prior to prescribed burn. Thus, maximum numbers of experienced personnel and equipment are immediately available for wildfire suppression activities should they be needed.

4.2 Comparison of Alternatives

4.2.1 Introduction

The Refuge goals are derived from the vision statement and the Refuge's legal purpose. Each alternative provides a slightly different approach to accomplishing the vision and goals. On the ground, the alternatives differ in the way habitats are managed, the way the water impoundments are manipulated and the "message" that is taken into the community and presented in our educational and outreach programs.

Important mandates of the Fish and Wildlife Service will be met under all alternatives.

- # Wildlife and their habitats will be conserved.
- # Federally listed threatened and endangered species will be protected.
- # Cultural resources will be protected.
- # The Refuge will cooperate with the State of Minnesota, Department of Natural Resources, Tribal Governments and other important partners.
- # Relationship with nearby communities will strengthen through communication and community participation.

4.2.2 Overview of Upland and Wetland Habitat Management

Alternatives 1 and 3 have a mixed strategy of upland management resulting in a mosaic of habitats from prairie openings to oak savanna, old fields to dry oak forest. Alternatives 2 and 4 focus on oak savanna restoration in the uplands converting the landscape to the time of European settlement. In contrast, Alternative 5 focuses on creating grasslands in the uplands. In particular, an effort would be made to create large grassland blocks to benefit ground-nesting birds, three of which would be completed in 15 years. Differences between the alternatives in upland management is most easily seen in the 100-year projections for upland habitat (Figure 1)

In the past, water in the impoundment system has been held high, creating more open water habitat, raising the water table into surrounding uplands in an effort to provide habitat for migratory waterbirds. No one knows how changing the water regime will impact habitat. For this reason, every alternative calls for a detailed hydrological study. For the purposes of planning, however, the intention of Alternatives 1, 2 and 3 is to increase the diversity of impounded wetlands by artificially drawing the water down to simulate temporary, seasonal, and semi-permanent hydrological regimes. These alternatives would attempt to maximize wetland diversity within the limits of the impoundment system. Alternatives 4 and 5 attempt to maximize the number of semi-permanent wetlands while also maintaining a diversity of wetland types. Semi-permanent wetlands are the most productive wetlands for both breeding and migrating water birds.

4.2.3 Changes in Habitats from Current Values

All habitats on the Refuge will be affected by the alternative scenarios presented for managing the Refuge. Each alternative will have differing impacts over the next 15 and 100 years (Table 2). Many of the changes require more than 15 years (the duration of the CCP) to complete and the alternatives can best be distinguished by their impact over 100 years.

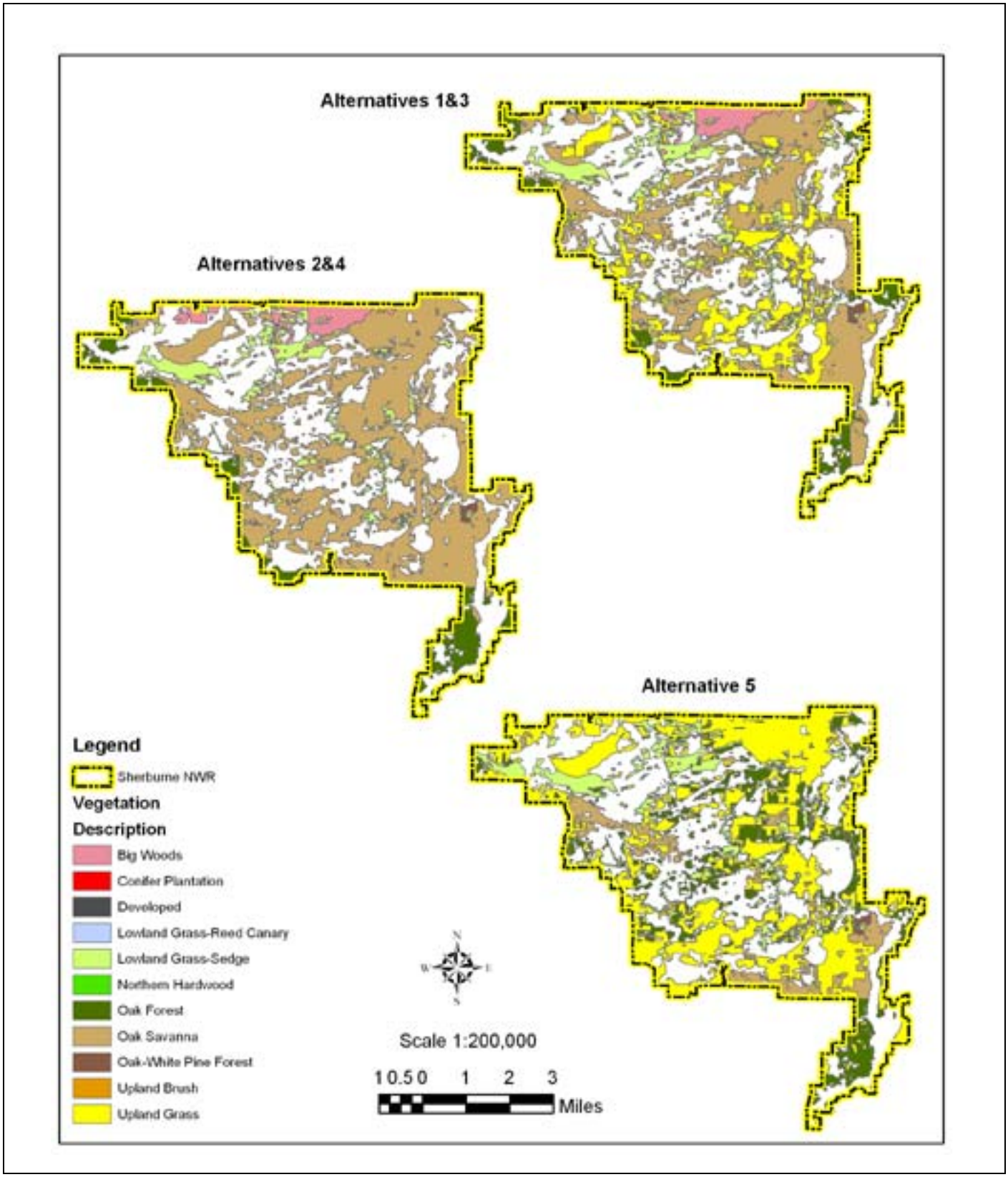
4.2.3.1 Big Woods

Also known as Maple-Basswood Forest, this community once covered 10 percent of the Anoka Sandplain (Wovcha, et al. 1995). It is generally thought to be a climax community. It is a deciduous forest of maple and basswood associated species (slippery elms, northern red oak, white ash, green ash, American elm). The canopy is dense and the understory is patchy and multi-layered comprising of saplings and seedlings of the over story trees. It also contains a diverse forb layer dominated by spring ephemerals and winter annuals that bloom, produce seeds and die back before the tree canopy leaves are fully developed. The soils where this forest type occurs are moist and often mixed with clay. The presence of the forest type suggests a history of restricted burning and wet, humid conditions.

On the Refuge, this habitat will require hundreds of years to completely restore, so we identified the 100 year projected goal and then, determined what could be initiated in the 15-year duration of the CCP. Alternatives 1 and 3 follow the Landscape Plan, with similar impacts on Refuge habitat coverage. Ultimately, in 100 years, big woods will increase to approximately 790 acres, but only about 100 acres will be designated in the 15 years duration of the CCP. Under Alternative 2 and Alternative 4, the focus is on ecological processes so, soils and native habitats were used as a guide. Under these alternatives, big woods will increase about 1,050 acres in 100 years with about 540 acres managed for this habitat type in 15 years. The restoration will occur along the northern border of the Refuge where the soils change in nature to more of a clay base and where survey notes record big woods stands in the mid-1850s. In Alternative 5, the focus is on maximizing grassland and big woods will not be restored.

Oak Forest
Dry oak forests of the Anoka Sandplain are typically dominated by multiple stemmed pin oak or pin oak-red oak hybrids. At least 30 percent of the canopy is made up of oaks. The canopy may also contain black cherry, paper birch, and quaking or big-toothed aspen. Minnesota oak forests on well-

Figure 1: 100-Year Upland Habitat Comparison, Sherburne NWR



drained sandy soils have relatively open canopies (70 to 80 percent cover) and shrub layer which is often dense. Canopy species according to the Minnesota Department of Natural Resources are: Northern pin oak, red oak, bur oak and quaking aspen, with a subcanopy of black cherry, red maple and bur oak. The shrub layer can consist of American hazelnut, gray dogwood, June berries, chokecherry, and raspberry.

This habitat type has increased on the Refuge in the absence of burning and so the focus will be to ultimately reduce the amount of oak forest on Refuge land for all Alternatives. Different Alternatives will accomplish the 100 year goals at different rates (see Table 2.)

Oak Savanna
The habitat type was once common throughout the Anoka Sandplain and is characterized as open oak woodlands interspersed with prairie and shrubs. The overall affect is park-like and it was often the first landscape to be settled by new arrivals from Europe. Most oak savanna habitat has become suburban and as a result, it is very rare in the state today. The habitat is a continuum from open to closed, the tree canopy is broken to scattered (10 to 70%) surrounding a matrix of either brush or prairie.

Oak savanna on the Refuge will increase under all alternatives from the 730 acres that are currently present on the Refuge. Under Alternatives 1 and 3, the acreage will ultimately increase to 8,500 acres in 100 years with 2,670 converted during the life of the CCP. Alternatives 2 and 4 emphasize a return to ecological processes and native conditions, oak savanna will ultimately increase to over 12,400 acres in 100 years with 3,165 acres converted during the life of the CCP. Under Alternative 5, grassland is emphasized, so the oak savanna that is restored will have a more open appearance with only 1,170 additional acres converted.

4.2.3.2 Upland Prairie

The habitat type was common along the rivers where Native Americans often burned the grasses. It was characteristic in the Mississippi River valley but not on the Refuge land itself. This habitat type is open grassland, mature trees are absent (< 10 percent total coverage), vascular plant cover < 30 percent brush. Many species of native prairie grass plants occur including, little blue stem, big blue stem, Indian grass, side-oats gramma, and forbs such as, dotted blazing star, pasque flower, and prairie golden-aster.

Upland grassland will decrease from the current 8,000 acres under all alternatives except Alternative 5 where it will increase an additional 2,000 acres. Alternatives 1 and 3 will decrease prairie habitat 2,000 acres in 100 years with a decrease of 2,300 in 15 years. Alternatives 2 and 4 will convert open grassland habitat to oak savanna on the Refuge in 100 years with a 15-year decrease of 3,000 acres.

4.2.3.3 Conifer Plantation

This habitat type was planted throughout Sherburne County during the drought years of 1930 to 1940 to stabilize the sandy soil common in this area. This habitat type will be eliminated in 100 years under all alternatives. The rate of elimination varies within the 15 years planning horizon of the CCP (see Table 2.

4.2.3.4 Cottonwood Plantation

This habitat type was often planted in shelter belts and blocks by early homesteaders. The cottonwood grew naturally in the river corridor and was an easy tree to plant to meet the woodland acreage requirement common to homesteading rules. It was also an easy tree to use as a shelter around homes. This habitat will be eliminated in all alternatives within the 15-year life of the CCP.

4.2.3.5 Developed

This category includes the headquarters building, roads, maintenance buildings, and any construction on the Refuge. It will increase with the addition of the Visitor Center under all alternatives.

4.2.3.6 Lowland Brush

This is the brushy habitat that grows in the stream beds and marshy low ground. It dominates in areas of moist and saturated soils and has encroached throughout the Refuge since the wetlands were drained in the 1930s.

4.2.3.7 Lowland Grass-Reed Canary

This habitat type is common in the marshy areas of the Refuge in areas that were sedge meadow, along the St. Francis River and in areas that are flooded as a result of impoundment flooding. Reed canary grass forms dense mats of roots and is hard to control once it has invaded the low, moist soils near the marshes. The grass if relatively unproductive and disrupts that natural productivity common to a sedge meadow.

Both lowland brush and reed canary grass habitats will be decreased under all alternatives.

4.2.3.8 Lowland Grass-Sedge

These areas are also known as sedge meadows and they were very productive and are now rare. This rare habitat will be increase under all alternatives but the beginning of the restoration will be slow and experimental. Small test plots will be conducted of less than 100 acres to determine how to restore sedge meadow and control invading reed canary grass.

4.2.3.9 Lowland Hardwood

These are the hardwoods of the river bottoms and include red oak, silver maple, ash and elms. There is currently 70 acres of lowland hardwood and this acreage will not change under any alternative.

4.2.3.10 Oak/White Pine Forest

According to surveyors records, white pine occurred sporadically across the northern portion of the Anoka Sandplain, most often as white pine-hardwood forests (Wovcha, et al. 1995). This forest type is a dry to dry mesic community that has a tall canopy of white pines (20 to 80% cover) with a shorter canopy of oak, aspen or maple. In mature stands, the white pine forms a super canopy (greater than 80 feet tall) over a deciduous canopy (50 to 80 feet tall).

This habitat type currently occurs on 60 acres and would be increased 7.5 acres under Alternatives 1 and 3. It will remain the same under all other alternatives.

4.2.3.11 Tamarack Swamp

These are the wetlands that supported tamaracks, they were often boggy and acidic. Early surveyors reported them in their notes and uncommon but present on the Refuge land. There is currently 200 acres of tamarack on the Refuge, and Alternatives 1-4 call for an increase of 730 acres over the next 100 years. There would be no increase in tamaracks under Alternative 5.

4.2.3.12 Water, Cattail and Bog

These categories along with the lowland brush, the lowland hardwoods, and tamarack swamp make up the wetlands of the Refuge. The classification used for uplands do not follow the National Wetland Classification System used in the National Wetland Inventory (NWI), the accepted federal wetland classification system is Cowardin et al. 1979. We compared the hydric soils of Sherburne NWR with NWI classification which was flown in the early 1970's and found that they match closely. We concluded the NWI can be used as an indicator of the original wetland diversity at Sherburne NWR

Table 2: Comparison of Alternatives, Sherburne NWR

	Current Vegetation	Alternatives 1 and 3, 15-Year		Alternatives 1 and 3, 100-Year		Alternatives 2 and 4, 15-Year		Alternatives 2 and 4, 100-Year		Alternative 5, 15-Year		Alternative 5, 100-Year	
	Total Acres	Total Acres	Acres Change from Current	Total Acres	Acres Change from Current	Total Acres	Acres Change from Current	Total Acres	Acres Change from Current	Total Acres	Acres Change from Current	Total Acres	Acres Change from Current
big woods	0	100	100	790	790	540	540	1050	1050	0	0	0	0
conifer plantation	400	40	-360	0	-400	40	-360	0	-400	0	-400	0	-400
cottonwood plantation	5.0	0	-5.0	0	-5.0	0	-5.0	0	-5.0	0	-5.0	0	-5.0
developed	3	3	0	3	0	3	0	3	0	3	0	3	0
lowland brush	4,800	4,800	0	4,400	-400	4,800	0	4,400	-400	4,800	0	4,800	0
lowland grass-reed canary	2,200	2,130	-70	0	-2,200	2,130	-70	0	2,200	2,130	70	0	-2,200
lowland grass-sedge	0	70	70	2,000	2,000	80	80	2,000	2,000	80	80	2,200	2,200
lowland hardwood	70	70	0	70	0	70	0	70	0	70	0	70	0
northern hardwood	1,100	910	-190	0	-1,100	820	-280	0	-1,100	1,100	0	0	-1,100
oak forest	5,600	5,600	0	1,700	-3,900	5,500	-100	1,900	-3,700	4,600	-1,000	3,900	-1,700
oak savanna	730	3,400	2,670	8,500	7,770	3,900	3,170	13,000	12,270	1,900	1,170	1,900	1,170
oak-white pine forest	60	60	0	60	0	60	0	60	0	60	0	60	0
tamarack swamp	200	200	0	930	730	200	0	930	730	200	0	200	0
upland brush	280	280	0	0	-280	260	-20	0	-280	240	-40	0	-280
upland grass	8,000	5,700	-2,200	5,100	-2,900	5,000	-3,000	0	-8,000	8,300	300	10,000	2,000
TOTAL													
			= Increase in acreage										
			= Decrease in acreage										

(See Historical Look at Wetlands in the CCP). But, for the purpose of this alternative comparison, we have limited the analysis to the impoundment system.

4.2.3.13 Impoundment Management

All of the alternatives require a hydrologic study to determine how management can result in the goal of watershed diversity and function. Theoretical impoundment management was developed by subject matter experts based on the philosophical goals of each alternative. This allowed us to use a quantitative method to compare wetland management between alternatives.

We determined the capability of water manipulation in the impoundment system. We looked at the impoundment system first by looking at the direction of flow through the system and then determining which impoundments depended on others, which could be managed independently, and which needed to function as water reservoirs for the others. Then, we identified the possible ways we could change the management of the impoundments to meet the requirements of the alternatives. Alternatives 1, 2, and 3 would result in greater wetland diversity with more acreage in seasonal and temporary ponds. Alternatives 4 and 5 would result in more semi permanent wetlands, which are the most productive for both breeding and migratory water birds. The water impoundment acreage comparison for all alternatives is presented in Table 3.

Table 3: Impoundment Acreage Comparison

	Alternatives 1,2, and 3	Alternatives 4 and 5
Open Water	2,900	2,900
Semipermanent	2,800	3,500
Seasonally Flooded	2,400	1,800
Temporarily Flooded	210	20

4.3 Comparison of Alternative: An Objective Analysis

The following habitat comparison of alternatives is based on an analytical approach developed by Upper Midwest Environmental Science Center (USGS) (Fox et al. 2003). This approach determines a Potential Species Occurrence (PSO) score that is weighed by the habitats available on the Refuge. The technique is unique because it provides managers with a comparison of the impact of habitat change across all alternatives.

We used the National Vegetation Classification System (NVCS) (Grossman et al. 1998) and the National Wetland Inventory System (NWI) (Cowardin et al. 1979) in an Arc View 3.2 GIS application of tools developed specifically for alternative comparison of Comprehensive Conservation Plans (Fox et al. 2003).

The objectives and strategies were determined through a series of workshops involving experts from across the country (Tables 1 and 2 in the CCP). These objectives included estimates of habitat change necessary for the alternative management scenarios.

The bird / habitat matrices were developed using Migratory Birds and Refuge experts to determine the bird scores across all habitats identified in the GIS maps for both upland and wetland birds (Appendices K and L). These matrices are the key to determining the impact of habitat changes recorded in the mapping exercise for each alternative.

The PSO scores range from 0 to 3 and were derived in separate mapping workshops with UMESC at La Crosse. These workshops proved useful in calculating the PSO scores as well as testing the

Table 4: Potential Species Occurrence Scores for Upland RCP Bird Species

Upland Alternatives	Current	Alternatives 1 and 3		Alternatives 2 and 4		Alternative 5	
		15-Year	100-Year	15-Year	100-Year	15-Year	100-Year
Forest	0.60	0.64	0.51	0.67	0.61	0.56	0.46
Grassland	0.89	0.75	0.86	0.69	0.49	0.96	1.18
Savanna	0.72	0.86	1.14	0.88	1.86	0.79	0.81
Shrub	0.58	0.64	0.64	0.65	0.76	0.58	0.51

Table 5: Comparison With Grasslands Weighted by Size

Upland Alternatives	Current Vegetation	Alternative 5, Grassland Area-Weighted	
		15-Year	100-Year
Forest Species	0.60	0.56	0.46
Grassland Species	0.80	0.87	1.11
Savanna Species	0.64	0.71	0.74
Shrub Species	0.58	0.58	0.51

Table 6: Comparison of Alternatives for Water birds

		Alternatives 1,2 and 3	Alternatives 4 and 5
Wetland Alternatives	Current Value		
Priority Breeding Water Birds	1.90	1.99	2.05
Priority Migrating Water Birds	1.76	1.78	1.80
All Breeding Water Birds	1.65	1.71	1.79
All Migrating Water Birds	1.63	1.64	1.70

"reasonableness" of the objectives and strategies for 15-year and 100-year projections into the future. For example, when we actually mapped acreages to be burned or planted, sometimes, the objectives were too optimistic for what could be reasonably accomplished in 15 years. The mapping exercise allowed us to look at what we could do in 15 years then project what the Refuge would look like in 100 years following a specific kind of management.

4.3.1 Potential Species Occurrence Score

We compared the impact of habitat acreage changes on the priority birds using the potential species occurrence score (PSO) weighted by area (Fox et al. 2003). This approach gives a comparative score for each group of species that inhabit key habitats. Because the upland and wetland habitat classifications are so different, we chose to separate them for the following analysis. The upland analysis includes all upland acres and the Region 3 Resource Conservation Priority (RCP) bird species (See Appendix K). An expert committee decided which RCP species would be a priority for the CCP. The committee determined the matrix values for each species (on a scale of 0 to 3, 0=not found in the habitat type, 3= important habitat for this species). Each habitat category was scored and a summary statistic was developed for species that inhabit forests, grasslands, savanna and shrubs.

The wetland analysis was limited to the impoundments. We used a matrix that included all wetland birds that have been observed at Sherburne National Wildlife Refuge (Appendix L). We divided this group of birds into those that migrate and those that breed at Sherburne NWR and then we further narrowed the division to include only Region 3 Resource Conservation Priority (RCP) bird species.

The PSO scores for upland habitats and for RCP bird species are summarized in Table 4 and Table 5. The PSO scores for breeding and migratory water birds and for priority (RCP) breeding and migratory water birds are summarized in Table 6.

4.3.2 Upland Habitat Comparison

Alternatives 1 and 3: The forest and grassland birds will ultimately decrease in 100 years while the savanna and shrub species will increase for these alternatives. This is due to the current Landscape Plans emphasis on oak savanna in the uplands. Because forest management is long term, the decrease should not impact forest species during the 15 years of the CCP (Figure 2).

Alternatives 2 and 4: All species of birds, except grassland birds, will increase over current levels with these alternatives. The grassland birds will not increase because large open fields will be transitioned over time to oak savanna under these alternatives. The decline in grassland birds for Alternatives 2 and 4 will not be as great as the decline of grassland birds under Alternatives 1 and 3 (Figure 3).

Alternative 5: This alternative focuses on increasing grasslands and so the PSO score for grassland and savanna species increase while forest and shrub species decrease. This initial analysis does not consider the size of the grasslands. Often, for grassland species, the size of contiguous habitat plays an essential role in nesting success for many 'area dependent' grassland birds. So, we rated the size of the grasslands in a second analysis (Table 5). Here, grasslands greater than 25 hectars were given a higher score and grasslands less then 25 hectars were given a lower score. The results show that Alternative 5 still improves the conditions for grassland and savanna species, but not by as much. So considering the size of the grassland patches lowered the long term score of this alternative (Table 5). The size of a grassland units relates to its value for ground nesting birds and affects the PSO score (Figure 4.)

Overview: The combined scores for the RCP species in the upland habitats, forest, grassland, savanna, and shrub species, are higher under Alternatives 2 and 4 (the preferred alternative).

4.3.3 Wetland (Impoundment) Comparison

This analysis is limited to the impoundments and does not consider the diversity of wetlands that exist outside the impoundment system. The analysis also does not consider the diversity of habitats caused by differences in elevation within the impoundment system. In addition, we are really only estimating what might happen if an attempt were made to change the water cycle from drawdown to full pool on different time regimes. For example, a semi-permanent wetland might result if the water were drawn down every 3 to 5 years, a seasonal wetland might result if the water is drawn down annually. The true vegetation response can not be known without detailed hydrological data which does not exist at this time. For these reasons, we have only done 15 years comparisons and have cited the need for an extensive hydrological study of the impact of water management on vegetation changes at Sherburne NWR.

All of the alternatives will increase the habitat for all water birds at Sherburne NWR because all will introduce more water management than is currently being practiced. The alternatives differ because Alternatives 1,2 and 3 will have more temporary and seasonal management while Alternatives 4 and 5 will emphasis semi-permanent wetland management with drawdowns every 3 to 5 years. The semi-permanent goal, if achieved will result in higher PSO scores for both migratory and breeding wetland birds as well as the migratory and breeding RCP wetland species of Region 3 (Table 6).

4.3.4 Conclusion

For both upland and wetland birds, the combination of habitats in Alternative 4 gives the highest overall Potential Species Occurrence for species that are particularly important to Region 3. In addition, managing the uplands to increase oak savanna habitat will increase regional biodiversity by

Figure 2: Upland Vegetation Description, Alternatives 1 and 3

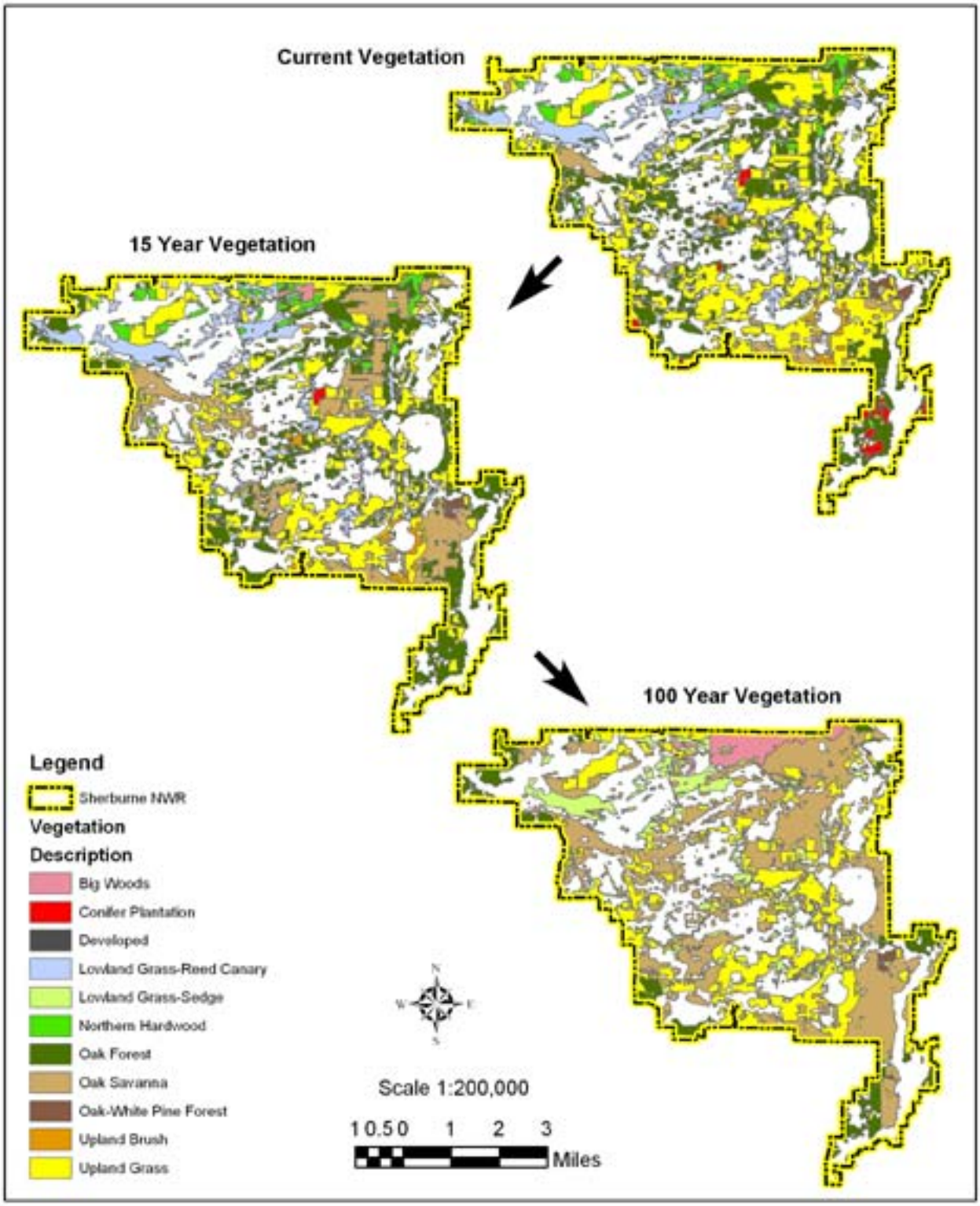


Figure 3: Upland Vegetation Description, Alternatives 2 and 4

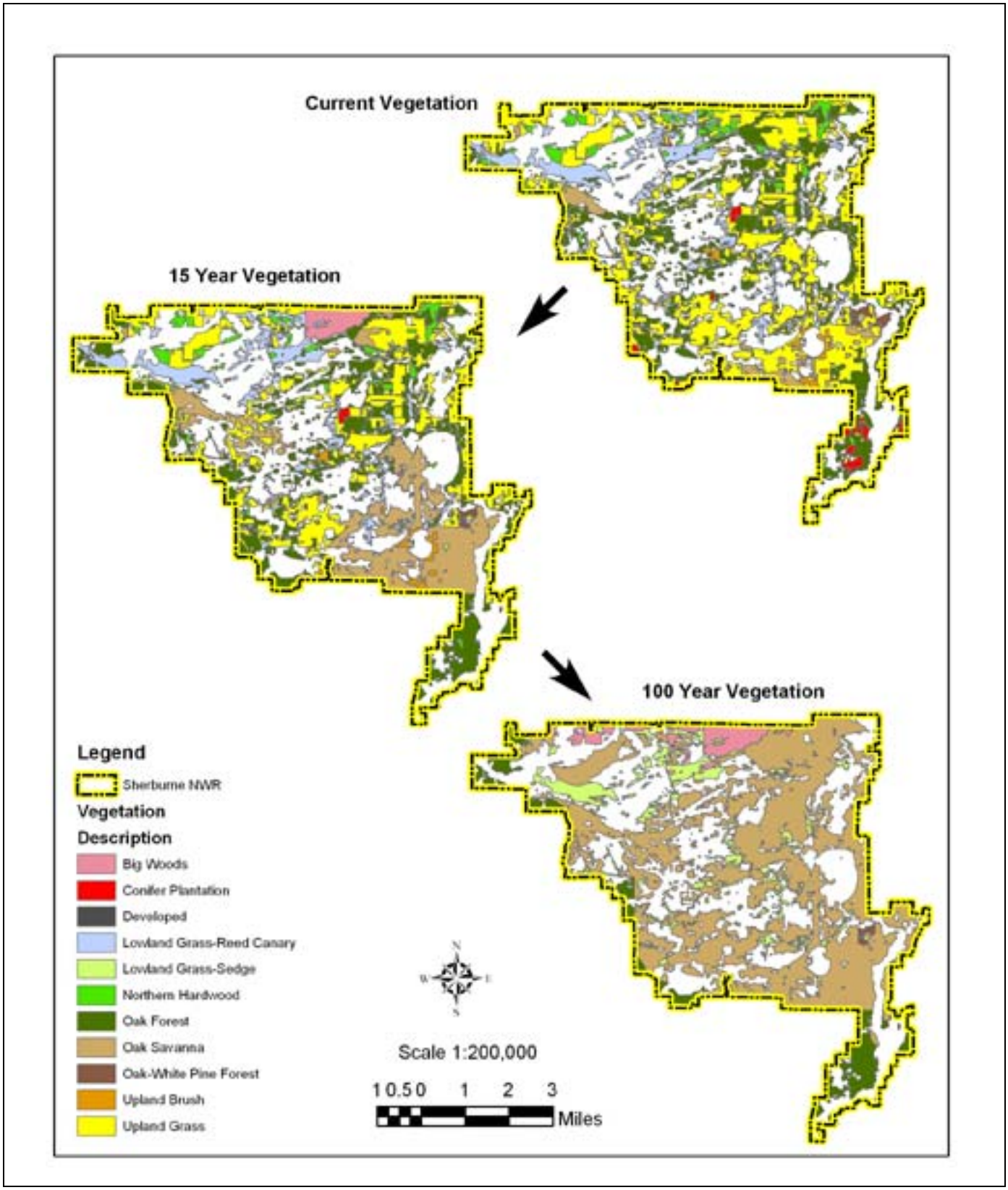
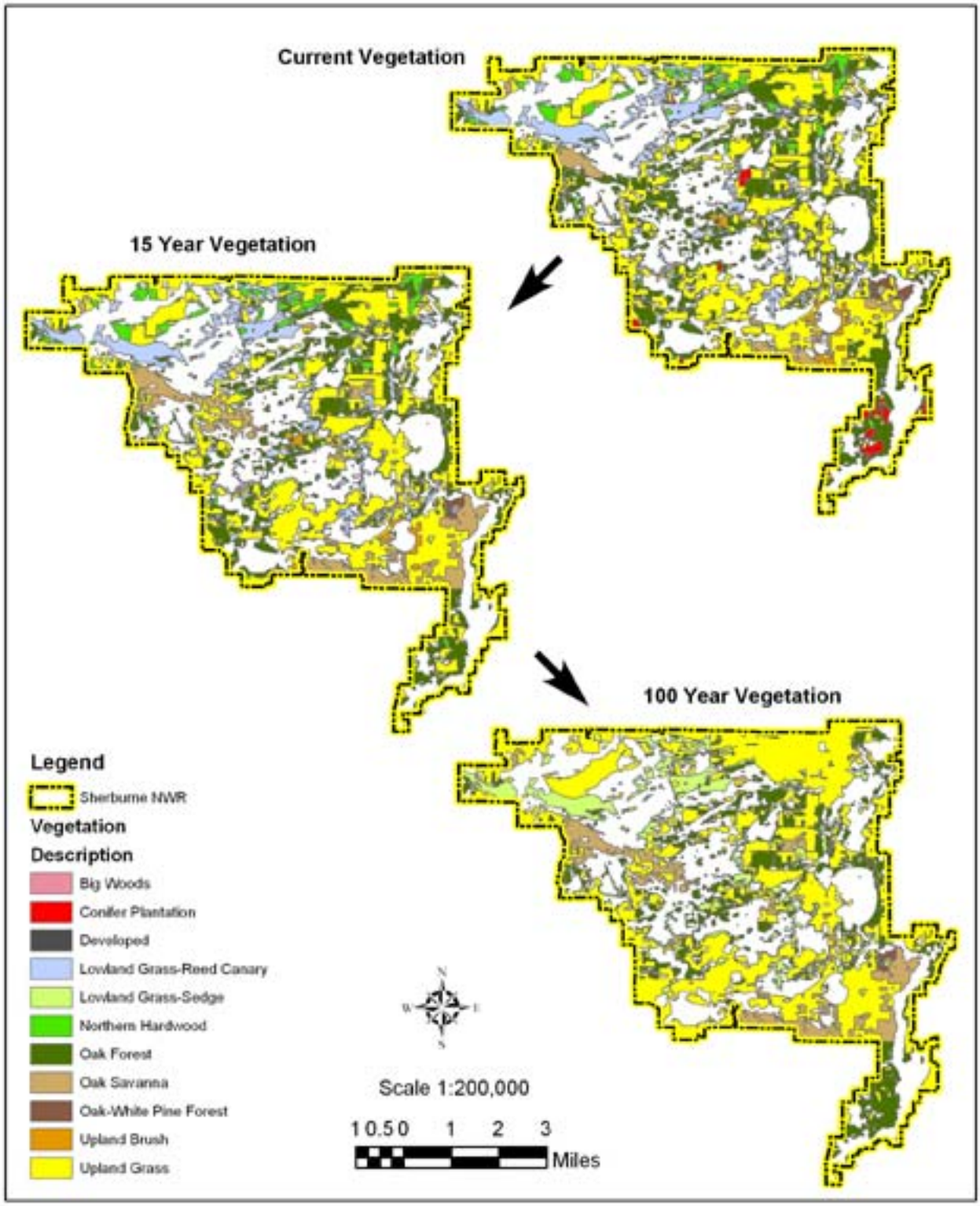


Figure 4: Upland Vegetation Description, Alternative 5, Sherburne NWR



increasing the overall acreage of this rare habitat in the region. Focusing on oak savanna in the uplands and semi-permanent wetlands in the impoundment system will also increase RCP species and migratory water birds such as waterfowl.

4.4 How the Alternatives Relate to Critical Issues

The critical issues identified through scoping with the Minnesota Department of Natural Resources, the public and the Refuge staff are as follows (See CCP):

- # To restore, conserve and enhance wildlife populations that use the Refuge, particularly water birds in migration.
- # To provide habitat for endangered and threatened species within the Refuge.
- # To conserve and restore native plant communities, expecially oak savanna on the edge of an expanding urban population.
- # To provide habitat for a functioning watershed and wetland diversity within the altered St. Francis River valley.
- # To promote and encourage habitat conservation on private land.
- # To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife.
- # To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography.

4.4.1 Alternative 1: Current Management through Landscape Plan

To restore, conserve and enhance wildlife populations that use the Refuge, particularly water birds in migration: This alternative will restore the uplands to habitats present on the Refuge at the time of European settlement and will attempt to restore natural processes to the land. The diversity of wildlife present on the land at the time of settlement will be restored within the limits outlined in the CCP. The PSO score (3=prime, 0=not used) for priority upland species an average score for current upland management is 0.70; with this alternative it would increase to an average of 0.72 in 15 years for an expected 100 year increase to an average of 0.79. This alternative will also diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. If drawdown frequency can simulate wetlands diversity, the PSO score for priority water birds (including waterfowl and all Refuge water birds) will increase from 1.90 to 1.99 for breeding priority water birds and from 1.76 to 1.78 for migrating priority water birds for the life of the CCP.

To provide habitat for endangered and threatened species within the Refuge: Under this alternative, federally listed species will be protected to the maximum ability of the Refuge.

To promote and encourage habitat conservation on private lands: Under this alternative, efforts on private lands will be increased, the goal will be to restore 400 wetlands and 100 uplands on private land. Priority will be given to sites within the St. Francis River watershed.

To conserve and restore native plant communities, expecially oak savanna on the edge of an expanding urban population: An effort will be made to restore all native plant communities to their original native coverage at the time of European settlement. This alternative will increase oak savanna from the current 730 acres to 3,400 acres in 15 years with the goal of 8,500 acres in 100 years. The Potential Species Occurrence (PSO) score on a scale of 0 to 3 will increase from 0.72 to 0.86 in 15 years to a 100 year potential of 1.14.

To provide a functioning watershed and wetland diversity within the altered St. Francis River valley: All of the alternatives require a detailed hydrological study to determine how management can result in the goal of watershed diversity and function. For this reason, the objectives are guidelines based on our best assessment of the potential of impoundment management for the next 15 years. Under this alternative, the impoundments will be managed to decrease the amount of high water, flooded uplands and open water. The St. Francis River will be monitored and an attempt will be made to decrease the amount of scouring in spring flooding events. Theoretical impoundment management under this alternative resulted in a PSO score for priority breeding water birds from 1.9 to 1.99 in 15 years.

To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife: Under this alternative, partnerships and public awareness will continue on the current schedule. The focus of the public education will be on the goals of the landscape plan and the need for burning. There would be a slight increase in public use opportunities based on growing area population. The expanded uses will be centered around the new Visitor Center.

To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography: Most activities will continue at the 2004 level.

4.4.2 Alternative 2: Pre-settlement (1800-1850) Ecological Processes

To restore, conserve and enhance wildlife populations that use the Refuge, particularly water birds in migration: This alternative will diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. If drawdown frequency can simulate wetlands diversity then the PSO score for priority water birds (including waterfowl and all Refuge water birds) will increase from 1.90 to 1.99 for breeding priority water birds and from 1.76 to 1.78 for migrating priority water birds for the life of the CCP.

To provide habitat for endangered and threatened species within the Refuge: Under this alternative, federally listed species will be protected to the maximum ability of the Refuge.

To promote and encourage habitat conservation on private lands: Under this alternative, efforts on private lands will be increased, the goal will be to restore 400 wetlands and 100 uplands on private land. Priority will be given to sites within the St. Francis River watershed.

To protect and restore native plant communities, expecially oak savanna on the edge of an expanding urban population: Oak savanna was the original vegetation of the Refuge during the early 1800s and this alternative would restore this vegetation type. The restoration would be accomplished by returning ecological processes such as burning and possibly grazing to the landscape to maintain the restorations. Under this alternative, oak savanna will increase from the current 730 acres to 3,900 acres in 15 years with a goal of 13,000 acres in 100 years. The PSO score for priority savanna birds would increase from 0.72 currently to 0.88 in 15 years with a potential 1.36 in 100 years.

To conserve habitat for a functioning watershed and wetland diversity within the altered St. Francis River valley: All of the alternatives require a detailed hydrological study to determine how management can result in the goal of watershed diversity and function. For this reason, the objectives are guidelines based on our best assessment of the potential of impoundment management for the next 15 years. Under this alternative, the impoundments will be managed to decrease the among of high water, flooded uplands and open water. The St. Francis River will be monitored and an attempt

will be made to decrease the amount of scouring in spring flooding events. Theoretical impoundment management under this alternative resulted in a PSO score for priority breeding water birds from 1.9 to 1.99 in 15 years.

To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife: Under this alternative, partnerships and public awareness will continue on the current schedule. The focus of the public education will be on the goals of the landscape plan and the need for burning.

To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography: Most activities will continue at the 2004 level.

4.4.3 Alternative 3: Enhanced Off-Refuge Coordination with Current On-Refuge Management Direction

To restore, conserve and enhance wildlife populations that use the Refuge, particularly water birds in migration: The focus of this alternative is for off-Refuge coordination with private land owners to encourage wildlife habitat particularly for waterfowl and water birds through wetland restoration and planting of native species in the uplands surround wetlands. On the Refuge, this alternative will follow the landscape plan and the water management outlined for Alternative 1. This will diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. If increasing drawdown frequency can stimulate natural wetland diversity, then the PSO score for priority water birds (including waterfowl and all Refuge water birds) will increase from 1.90 to 1.99 for breeding priority water birds and from 1.76 to 1.78 for migrating priority water birds for the life of the CCP.

To provide habitat for endangered and threatened species: Under this alternative, federally listed species will be protected to the maximum ability on the Refuge. In addition, an effort will be made to monitor threatened and endangered species in the landscape and watersheds surrounding the Refuge. The goal will be to inform and educate the public on the importance of preserving rare, threatened and endangered species especially when they occur on private land.

To promote and encourage habitat conservation on private lands: This is the focus of this alternative; efforts on private lands will be increased, the goal will be to restore 600 wetlands and 200 native upland areas on private land. Priority will be given to the entire Refuge District.

To conserve and restore native plant communities, expecially oak savanna on the edge of an expanding urban population: On the Refuge, this alternative will increase oak savanna from the current 730 acres to 3,400 acres in 15 years with the goal of 8,500 acres in 100 years. The Potential Species Occurrence (PSO) score will increase from 0.72 to 0.86 in 15 years to a 100-year potential of 1.14. Off the Refuge, native plant communities, expecially oak savanna will be identified and an effort will be made to educate and inform private land owners about their important role in conserving native habitats.

To provide a functioning watershed and wetland diversity within the altered St. Francis River valley: All of the alternatives require a detailed hydrological study to determine how management can result in the goal of watershed diversity and function. For this reason, the objectives are guidelines based on our best assessment of the potential of impoundment management for the next 15 years. Under this alternative, the impoundments will be managed to decrease the among of high water, flooded uplands and open water. The St. Francis River will be monitored and an attempt will be made to decrease the amount of scouring in spring flooding events. Theoretical impoundment management under this alternative resulted in a PSO score for priority breeding water birds from 1.9 to 1.99 in 15 years.

In addition, a focused effort will be made in the surrounding watersheds to encourage habitat preservation and restore wetlands. The goal is 600 off-Refuge wetlands restored and 200 native uplands.

To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife: Under this alternative, partnerships and public awareness will be the main focus of all new activities on the Refuge. An attempt will be made to increase the public awareness of the value of greenways. Refuge staff will work with developers in the area to increase and extend the "park-like" habitat of the Refuge into the neighboring developments for the benefit of all. The focus of the public education will be on the goals of community action and working together to create a livable landscape.

On the Refuge public outreach will continue on the current schedule. The focus of the public education will be on the goals of the landscape plan and the need for burning. There would be a slight increase in public use opportunities based on growing area population. The expanded uses will be centered around the new Visitor Center.

To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography: Activities will continue at the 2004 level.

4.4.4 Alternative 4: Pre-European Settlement Processes and Habitat in Context of Providing Migratory Waterfowl Habitat (Preferred Alternative)

To conserve, protect and enhance wildlife populations that use the Refuge, particularly water birds in migration: This alternative will restore the uplands to habitats present on the Refuge at the time of European settlement and will attempt to restore natural processes to the land. The diversity of wildlife present on the land at the time will be restored within the limits outlined in the CCP. The PSO score (3=prime, 0=not used) for priority upland species an average score for current upland management is 0.70; with this alternative it would increase to an average of 0.87 in 15 years for an expected 100 year increase to an average of 1.40. This alternative will also diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. This alternative will focus on increasing the amount of semi-permanent wetlands in the impoundment system by maximizing the number of impoundments that are drawn down on a schedule of 3 to 5 years. The PSO score for priority breeding water birds will increase from 1.90 to 2.05 and for priority migrating water birds and from 1.76 to 1.80 for the life of the CCP.

To Provide habitat for endangered and threatened species within the Refuge: Under this alternative, federally listed species will be protected to the maximum ability of the Refuge.

To promote and encourage habitat conservation on private lands: Under this alternative, efforts on private lands will be increased, the goal will be to restore 400 wetlands and 100 uplands on private land. Priority will be given to sites within the St. Francis River watershed.

To conserve and restore native plant communities, expecially oak savanna on the edge of an expanding urban population: Oak savanna was the original vegetation of the Refuge during the early 1800's and this alternative would restore this vegetation type. The restoration would be accomplished by returning ecological processes such as burning and possibly grazing to the landscape to maintain the restorations. Prescribed burns are essential to the oak savanna restoration but can be controversial in areas that are becoming suburban. It will require coordination, safety, and public education to pursue this goal. Under this alternative, oak savanna will increase from the current 730 acres to 3,900 acres in 15 years with a goal of 13,000 acres in 100 years. The PSO score for priority savanna birds would increase from 0.72 currently to 0.88 in 15 years with a potential 1.36 in 100 years.

To provide habitat for a functioning watershed and wetland diversity within the altered St. Francis River valley: All of the alternatives require a detailed hydrological study to determine how management can result in the goal of watershed diversity and function. For this reason, the objectives are guidelines based on our best assessment of the potential of impoundment management for the next 15 years. Under this alternative, the impoundments will be managed to decrease the among of high water, flooded uplands and open water. The St. Francis River will be monitored and an attempt will be made to decrease the amount of scouring in spring flooding events. Theoretical impoundment management under this alternative resulted in a PSO score for all breeding and migratory water birds will increase from a low of 1.63 for migratory water birds to a high of 2.05 for priority breeding water birds and 1.80 for priority migrating water birds in 15 years.

To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife: Under this alternative, partnerships and public awareness will increase. The focus of the public education will be on the value of oak savanna, the goals of the landscape planning, the value of fire, and the importance of water management.

To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography: Opportunities for wildlife dependent public use will increase under this alternative with a springwild turkey hunt for disabled hunters and the new facilities such as the Visitor Center.

4.4.5 Alternative 5: Focused Management for Priority Wetland and Grassland Birds

To conserve, protect and enhance wildlife populations that use the Refuge, particularly water birds in migration: This alternative will create prairie grasslands in the uplands to benefit ground-nesting grassland species. The average PSO score (3=prime, 0=not used) for priority upland species for current upland management is 0.70; with this alternative it would increase to an average of 0.71 when the size of continguous grassland units are considered. This alternative will also diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. This alternative will focus on increasing the amount of semi-permanent wetlands in the impoundment system by maximizing the number of impoundments that are drawn down on a schedule of 3 to 5 years. The PSO score for priority breeding water birds will increase from 1.90 to 2.05 and for priority migrating water birds and from 1.76 to 1.80 for the life of the CCP.

To provide habitat for endangered and threatened species within the Refuge: Under this alternative, federally listed species will be protected to the maximum ability of the Refuge.

To promote and encourage habitat conservation on private lands: Under this alternative, efforts on private lands will be increased, the goal will be to restore 400 wetlands and 100 uplands on private land. Priority will be given to sites within the St. Francis River watershed.

To conserve and restore native plant communities, expecially oak savanna on the edge of an expanding urban population: Oak savanna will not be the emphasis of this alternative, rather grasslands and prairie restoration will increase for the benefit of grassland birds. The oak savanna will increase slightly from the current 730 acres to 1,900 acres in 15 and 100 years. The PSO score for priority savanna birds would increase from 0.72 currently to 0.79 in 15 years with a potential 0.81 in 100 years.

To provide habitat for a functioning watershed and wetland diversity within the altered St. Francis River valley: This alternative will diversify the management of the wetland impoundments on the Refuge by increasing the frequency of drawdowns and monitoring the vegetation and water bird response. This alternative will focus on increasing the amount of semi permanent wetlands in the

impoundment system by maximizing the number of impoundments that are drawn down on a schedule of 3 to 5 years. If drawdown frequency can simulate wetland diversity as shown in Figure 19, then the PSO score for priority water birds (including waterfowl and all Refuge water birds) will increase from 1.90 to 2.05 for breeding priority water birds and from 1.76 to 1.80 for migrating priority water birds for the life of the CCP.

To establish partnerships and promote public awareness of the value of oak savanna and marsh habitat for the continuing benefit of wildlife: Under this alternative, partnerships and public awareness will increase. The focus of the public education will be on the value of oak savanna, the goals of the landscape planning, the value of fire, and the importance of water management.

To provide opportunities for wildlife dependent public use, particularly hunting and fishing, environmental education and interpretation, wildlife observation and wildlife photography: Opportunities for wildlife dependent public use will continue at the current levels.

4.5 Cumulative Impact Analysis

"Cumulative impact" is a term that refers to impacts on the environment that result from the incremental impact of the proposed action when added to other past, present and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. In this section, the cumulative impacts of each of the three alternatives are discussed in terms of grassland habitats and environmental education.

4.5.1 Habitat for Wildlife, Waterfowl and Other Water Birds

Wetlands throughout the Mississippi and Central Flyway have been dramatically reduced by agricultural drainage and the losses continue (Dahl 1990). Many water birds during the breeding season and migration need additional habitat and most are experiencing population declines. Under all alternatives, wetland habitats will be conserved both on and off the Refuge. Waterfowl and water birds benefit under all alternatives. Habitat for breeding and nesting water birds will increase. The preferred alternative (Alternatives 4) and Alternative 5 maximize this increase by focusing on semi-permanent wetlands. Wetland management and restoration by the Refuge will greatly add to habitat in this region. This will benefit wildlife but also improve the ground water, improve the hydrologic function of the St. Francis River and contribute to clean water in the county for the people who live there.

Under the preferred alternative habitats present on the Refuge at the time of European settlement will be restored and species of migratory birds that originally occurred on the Refuge will increase as well and species important the Region and RCP bird species. This alternative will focus on oak savanna in the uplands which will increase regional biodiversity by increasing this rare and declining habitat type. At one time, oak savanna was the most common community in this portion of Minnesota, now most of the spreading oak savanna tress adorn people's back yards. In an expanding suburban/ urban interface, all habitat is at risk. The habitat restoration proposed in the preferred alternative will greatly increase the amount oak savanna. Restoring this habitat will not only benefit the wildlife, it will also provide people with a window on the post and an appreciation of the park-like beauty of an oak savanna.

Habitat is being lost throughout this portion of Minnesota through urban development and the expanding metropolitan areas of Minneapolis and St. Cloud. With housing development occurring around the Refuge border, all habitat provided on the Refuge will increase green space within this region of the state.

4.5.2 Habitat for Endangered and Threatened Species

Under all alternatives, endangered and threatened species would be protected and actions that might harm them would be avoided. Habitat loss is a factor in the population declines that led to these species being listed. All alternatives proposed ways to maintain and expand these habitats both on and off the Refuge.

4.5.3 Partnerships and Public Awareness

Because Sherburne NWR is located in an expanding suburban area, the outreach programs within the area are particularly important. Close and compatible relationships with partners such as the State of Minnesota Department of Natural Resources, the Sherburne Friend's Association, and other Non-profit conservation organizations such as Nature Conservancy and Audubon Society will be important to maintain a positive present in the public arena. It will be important to include community leaders in the Refuge plans for habitat restoration so they can help in carrying the message; for example about the importance of wildlife habitat, wetland management and oak savanna restoration.

A new Refuge visitor center would be constructed and become the central focus area for environmental education and interpretation. This center will benefit the surrounding and growing suburban community. A separate NEPA document will cover this construction when details and funding for the center are finalized.

Table 7: Summary of Environmental Consequences for Management Alternatives and Sherburne National Wildlife Refuge

Issues	Alternative 1: Current Management (No Action)	Alternative 2: Pre-settlement Processes	Alternative 3: Enhanced Off-Refuge Coordination	Alternative 4: Migratory Water Bird Habitat (Preferred Alternative)	Alternative 5: Priority Wetland and Grassland Birds
Wildlife, Particularly Water birds in Migration	PSO* score increases from 1.90 to 1.99 breeding and 1.76 to 1.78 migrating	Same as Alternative 1	Same as Alternative 1	PSO* score increases from 1.90 to 2.05 breeding and 1.76 to 1.80 migrating	Same as Alternative 4
Endangered and Resource Conservation Priority Species	All trust species protected to the maximum ability of the Refuge.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Upland Management and Oak Savanna	Increased by 1,930 acres over 15 years	Increased by 2,430 acres over 15 years	Increased by 1,930 acres over 15 years	Increased by 2,430 acres over 15 years	Increased by 400 acres over 15 years
Management of Impoundments & Hydrology	Stable manipulation, with pools on a cycle of high, low, and drawdown conditions depending on the response of emergent vegetation.	Same as Alternative 1	Same as Alternative 1	Increased manipulation based on results of hydrologic study.	Increased manipulation based on results of hydrologic study.
Landscape and Off-Refuge Habitat Protection	Increased. Restore 400 off-Refuge wetlands and 100 upland sites. Priority will be given to sites within the St. Francis Watershed.	Same as Alternative 1	Increased. Restore 600 off-Refuge wetlands and 200 native upland areas within the Refuge District.	Same as Alternative 1	Same as Alternative 1
Wildlife-dependent Uses Promoting Priority Visitor Services	Slight increase in public use opportunities based on growing area population. Expanded uses centered around future visitor center.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1 with new spring wild turkey hunt for disabled hunters.	Same as Alternative 1
Partnerships and Public Awareness	Stable. Focus on goals of landscape plan and the need for burning.	Same as Alternative 1	Increased awareness of the value of greenways, community action and "livable" landscapes.	Same as Alternative 1	Same as Alternative 1

Chapter 5: List of Preparers

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Chapter 6: List of Agencies, Organizations, and Persons Contacted

Nearly 5,000 CCP announcement letters were sent to individuals, government officials, tribal leaders, and non-government organizations. In addition, the following individuals were invited to participate in preparing this environmental assessment. This document incorporates the results of many meetings and workshops and benefited from the creative involvement of the public, state, university and federal participants.

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Chapter 7: References

Please see Appendix J of the CCP.

Appendix 1: Summary of Goals, Objectives and Strategies by Alternative

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Goal 1: Upland Anoka Sandplain habitats are approximate mid-1800s conditions, contributing to the preservation of these declining ecotypes and their associated Service priority species.					
Objective 1.1 Restore Big Woods: In 15 years initiate restoration efforts on ___ acres with an expected total restoration of ___ acres in 100 years. Although it can take hundreds of years for full canopy to development, composition and placement of key trees should simulate Big Woods canopy.	15 Years: 100 acres 100 years: 790 acres	15 years: 540 acres 100 years: 1,050	Same as Alt. 1.	Same as Alt. 2.	No big woods.
Strategies:					
Exclude fire to replicate a natural return interval of greater than 100 years.	✓	✓	✓	✓	
Plant desirable species such as maple, basswood, elm, red oak, green ash.	✓	✓	✓	✓	
Protect seedlings by excluding herbivores.	✓	✓	✓	✓	
Objective 1.2 Manage Dry Oak Forest: Allow __acres dry oak forest to develop in outlying areas that can not be burned effectively given the urban development that is occurring around the Refuge.	15 Years: 5,600 acres 100 Years: 1,700 acres	15 Years: 5,500 acres 100 Years: 1,900 acres	Same as Alt. 1.	Same as Alt. 2.	15 Years: 4,600 acres 100 Years: 3,900 acres
Strategies:					
Prescribed burning with longer return burn intervals (50 years or more) and lower intensity burns.	✓	✓	✓	✓	✓
Plant areas to native vegetation.	✓	✓	✓	✓	✓
Objective 1.3 Restore Oak Savanna: Restore oak savanna in the uplands with a 15-year goal of ___ acres and a 100-year goal of ___ acres.	15 Years: 3,400 acres 100 Years: 8,500 acres	15 Years: 3,900 acres 100 Years: 13,000	Same as Alt. 1.	Same as Alt. 2.	15 Years: 1,900 acres 100 Years: 1,900 acres
Strategies:					
Convert grassland patches greater than 40 acres in size by planting trees. Do not actively plant trees in grassland openings that are currently 40 acres or less.	✓	✓	✓	✓	

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Rotational burning every 3 years as a goal but not letting anything go more than 10 years as outlined in the Fire Management Plan.	✓	✓	✓	✓	✓
Mechanical followed by chemical treatments can be used to get to the goal acres, but once goal is achieved natural process will be used to maintain.	✓	✓	✓	✓	✓
Grazing will be considered and experimental grazing will be evaluated.		✓			
Convert woodlands to oak savanna.	✓	✓	✓	✓	✓
Convert old field and cropland to oak savanna.	✓	✓	✓	✓	
Convert cottonwood and pine plantations to oak savanna.	✓	✓	✓	✓	
Convert old grassland plantings (planted with non-local ecotypes), replant all acres of planted grassland with local ecotype seeds and ultimately convert to oak savanna.	✓	✓	✓	✓	
Convert northern hardwood to oak savanna in 15 years.	✓	✓	✓		
Maintain current oak savanna.	✓	✓	✓	✓	✓
Objective 1.4 Oak/White Pine Forest: Maintain __ acres of oak/white pine forest.	15 Years: 60 acres 100 Years: 60 acres	15 Years: 60 acres 100 Years: 60 acres	15 Years: 60 acres 100 Years: 60 acres	15 Years: 60 acres 100 Years: 60 acres	15 Years: 60 acres 100 Years: 60 acres
Strategies:					
Protect the area from fire because its natural fire return interval is 200 to 300 years.	✓	✓	✓	✓	✓
Objective 1.5 Grassland Management: Manage __ acres of upland grasslands.	15 Years: 5,800 acres 100 Years: 5,100 acres	15 Years: 5,000 acres 100 Years: 0 acres	15 Years: 5,800 acres 100 Years: 5,100 acres	15 Years: 5,000 acres 100 Years: 0 acres	15 Years: 8,300 acres 100 Years: 10,000
Strategies:					
Burn each unit on rotation every 3 to 10 years as outlined in the Fire Management Plan.	✓	✓	✓	✓	✓
When burning is not effective in controlling brush, use mechanical treatments such as brush cutting and hydro-axe. Use chemical treatments if burning and mechanical control are not effective.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Provide a minimum of three grassland management blocks of at least 200 acres each.					✓
Convert old fields and cropland to native grassland.					✓
Convert conifer and cottonwood plantations to grassland.					✓
Convert upland brush to grasslands.					✓
Convert northern hardwoods to grassland.					✓
Convert grassland patches greater than 40 acres in size by planting trees. Do not actively plant trees in grassland openings less than 40 acres in size.		✓		✓	
Convert old grassland plantings (planted with non-local ecotypes), replant all acres of planted grassland with local ecoytype seeds and ultimately convert to oak savanna.		✓		✓	
Upland and Wetland Management					
Objective 1.6 Invasive Species Control: Inventory and actively reduce invasive species throughout the Refuge. Reduce invasive species locations by 50 percent from 2004 levels and eliminate new infestations as they occur.	✓	✓	✓	✓	✓
Strategies:					
When available, use biological control as a preferred strategy.	✓	✓	✓	✓	✓
If effective biological control techniques have not been developed, use chemical and mechanical means to control infestations.	✓	✓	✓	✓	✓
Fire can often be effective in controlling invasive plant species.	✓	✓	✓	✓	✓
Monitor the infestations and effectiveness of control measures through field work.	✓	✓	✓	✓	✓
To protect Refuge habitat, monitor exotic/invasive plant species within a 15-mile radius and continue to work with partners and landowners on a control program.	✓	✓	✓	✓	✓
Document the location and size of invasive populations with GIS mapping.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 1.7 Apply prescribed fire on an average of 5,000 burnable acres annually as determined by the Fire Management Plan and monitor its effect.	✓	✓	✓	✓	✓
Strategy:					
Follow the *Fire Management Plan.*	✓	✓	✓	✓	✓
Goal 2: A diverse mosaic of riverine and wetland habitats meet the needs of Service priority riparian and other wetland-dependent species.					
Tamarack Swamp					
Objective 2.1 Tamarack Swamp: Maintain a minimum of 200 acres of existing tamarack swamp and undertake restoration of tamarack swamp on 730 acres occurring after the 15-year planning horizon.	✓	✓	✓	✓	
Objective 2.1 Tamarack Swamp: Conduct hydrological study and restoration experiments for tamarack restoration.		✓			
Objective 2.1 Tamarack Swamp: Maintain a minimum of 200 acres of existing tamarack swamp with no additional restoration.					✓
Strategies:					
Planting seedlings in specified areas.	✓	✓	✓	✓	
Aerial seeding of seeds.	✓	✓	✓	✓	
Fire prevention. Fire breaks will be installed around seeded areas.	✓	✓	✓	✓	
Objective 2.2 District Monitoring of Tamarack Swamp (Refuge and District only): Identify the existence of this habitat throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Use existing databases to determine a reasonable goal.			✓		
Collaborate with other agencies.			✓		
Education			✓		

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 2.2 Sedge Meadow (Reed Canary Grass Conversion): Assess the feasibility of converting reed canary dominated areas to native species. By the end of the 15-year planning period, increase native sedge meadow/lowland graminoids by a minimum __ acres.	70 acres	80 acres	Same as Alt. 1	20 acres	Same as Alt. 2
Strategies:					
Initiate a research project to study feasibility of converting reed canary to native species (cord grass and native sedges, etc.).	✓	✓		✓	✓
Manipulate habitat and develop test plots.	✓	✓			
Experiment with a variety of ways to recreate sedge meadow habitat and to control reed canary grass.				✓	
Encourage sedge meadow in basins that are allowed to return to pre-ditched water levels. Monitor reed canary grass domination.				✓	
Use prescribed fire to reduce bush encroachment or combination with drawdown.	✓	✓	✓	✓	✓
Manipulate water level, depending on where sedge meadows are located relative to the impoundments.	✓	✓	✓	✓	✓
Objective 2.2 Regional Monitoring of Sedge Meadow: Recognize that sedge meadow is a rare habitat within the region due to habitat destruction, therefore an attempt made to identify and protect similar habitat off Refuge. Identify the existence of this habitat throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this .			✓		
Strategies:					
Use existing databases to determine a reasonable goal for regional conservation of sedge meadow.			✓		
Collaborate with other agencies on conservation of sedge meadow regionally.			✓		
Offer education on the value of sedge meadow.			✓		

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 2.3 Regional Monitoring of Lowland Brush (Refuge and District only): Identify the existence of lowland brush throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Use existing databases to determine a reasonable goal for regional conservation of lowland brush.			✓		
Collaborate with other agencies to conserve lowland brush.			✓		
Educate about the value of lowland brush.			✓		
Objective 2.3 Maintain Lowland Brush: For the benefit of brush-associated marsh birds, maintain a minimum of ___ acres of lowland brush.				1,250 acres	2,500 acres
Strategies:					
Manipulate water levels to encourage shrub germination.				✓	✓
Develop a monitoring protocol to track long-term trends in diversity of this wetland type.				✓	✓
Wetland Restoration					
Objective 2.4 Understanding the Refuge's Hydrology: Develop a hydrologic study for the river wetland systems within 5 years of the CCP approval. Based on the outcome, identify and implement management actions necessary to maintain progress toward achieving habitat expectations. The hydrology study should result in an understanding of impoundment management and water movement between pools in relation to the ground water.		✓		✓	✓
Strategies:					
Conduct research (through staff or contract).		✓		✓	✓
Based on the outcome of a hydrologic study, identify and implement management actions necessary to maintain progress toward achieving habitat expectations.		✓		✓	✓
Objective 2.5 Understanding Regional Watershed Hydrology: Coordinate and promote understanding of hydrology within the watersheds surrounding the Refuge.			✓	✓	

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Use existing databases to determine a reasonable goal for understanding the regional watershed.			✓	✓	
Collaborate with other agencies in managing the watersheds.			✓	✓	
Educate on the importance of regional watershed conservation.			✓	✓	
Objective 2.6 Dynamic Cattail Habitat Management: For the benefit of marsh nesting birds, annually manage 2500 acres of cattail marsh; less than 70 percent of cattail is desirable on any one basin but this will be achieved through a natural, dynamic process, not as a static target. Maintain 20-40 percent of the cattail acreage with a VOR of 50-80 cm.	✓	✓	✓	✓	✓
Strategies:					
Water level manipulation to flood cattail and if possible, burn openings in cattail beds where roots are compacted.	✓		✓	✓	✓
Encourage a healthy muskrat population to facilitate cattail control and to create cattail openings.	✓	✓	✓	✓	✓
Objective 2.6 Identification of Cattail Habitat on Private Lands (Refuge and District only): Identify the existence of this habitat throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Use existing databases to determine a reasonable goal for regional conservation of this habitat.			✓		
Educate about the importance of a dynamic wetland habitat.			✓		
Impoundment Management					
Objective 2.7 Open Water Management in the Spring: For the benefit of open water dependent breeding birds, provide open water in __ pools annually, from mid-April to July, in those years that weather conditions allow.	1-3 pools	1-3 pools	1-3 pools	2 pools or more	2 pools or more

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Manipulate water according to the Annual Water Management Plan.	✓	✓	✓	✓	✓
Objective 2.8 Open Water Management in the Fall: Long Pool is managed annually to provide full pool conditions in the fall for waterfowl hunting. At least two other pools will be managed at full pool in the fall. During summer water levels are varied from one year to the next to encourage annual and emergent plants. An edge of emergent native vegetation on at least 50% of the perimeter is desirable to provide food and cover for a variety of bird species.	✓		✓		✓
Objective 2.8 Open Water Management in the Fall: Provide at least four pools with predominately open water annually from August through November, in those years that weather conditions allow.		✓		✓	
Strategies:					
Manipulate water according to the Annual Water Management Plan.		✓		✓	
Objective 2.9 Fall Migrating Waterfowl and Other Seed-eating Birds in Migration: For the benefit of fall migrants, from mid-July to mid-September, provide 50-150 acres of sparsely distributed (<20 percent cover), short, native vegetation (<20 cm) flooded to depths ranging from moist soil to 12 cm of water.	✓		✓	✓	✓
Strategies:					
Annual Water Management Plan calls for at least two pool to be in drawdown during the year, then water will be returned in the fall.	✓		✓	✓	✓
Objective 2.9 Fall Migrating Waterfowl and Other Seed-eating Water Birds (Refuge and District only.): Optimize management for fall migrants on private lands in the Refuge Management District.			✓		
Strategies:					
Use existing databases to determine a reasonable goal.			✓		
Collaborate with other agencies to provide habitat for fall migrants.			✓		
Educate on the value of wetlands to fall migrants.			✓		

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 2.10 Wild Rice Management: For the benefit of seed-eating fall migrants, manage schedule to obtain __acres total across at least 3 basins of seasonal wetland habitat dominated (70-90 percent) by native annual plants including wild rice.	500	Same as Alt. 1	Same as Alt. 1	700 acres	1,500 acres
Strategies:					
Water level manipulation of pools (pools in drawdown change from year to year in accordance with the Refuge Annual Water Management Plan).	✓	✓	✓	✓	✓
Active removal of beaver dams on Orrock and Buck lakes.	✓		✓	✓	✓
Objective 2.10 Regional Wild Rice Monitoring (Refuge District Only): Identify the existence of this habitat on private lands in the District, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Use existing databases to determine a reasonable goal.			✓		
Collaborate with other agencies.			✓		
Objective 2.11 Spring Drawdown: To benefit spring migrant shorebirds and pre-breeding dabbling ducks, manage impoundments to provide 30-50 acres annually of shallow water habitat characterized by sparsely distributed (<20% cover) short vegetation (<20cm) flooded to depths ranging from moist to 12 cm in a way that would encourage invertebrates.				✓	✓
Strategies:					
Year 1: Manage the wetland as a moist soil unit by encouraging germination of annual vegetation in the first year, (could also increase nutrients by introducing hay).				✓	✓
Year 2: Then raise water to a level of 12 to 30 cm during the second year to drown the vegetation and encourage decomposition of vegetation.				✓	✓
Year 3: Finally, manage a slow drawdown beginning in April and continuing through June 15 of the third year.				✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 2.11 Spring Drawdown (Refuge District Only): Identify the existence of potential habitat throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Manipulate Refuge habitat in response to the availability of shorebird habitat off-Refuge. For example, in extreme drought or extreme flooding, Refuge habitat maybe useful.			✓		
Use existing databases to determine a reasonable goal for shorebird management.			✓		
Collaborate with other agencies with water management capabilities.			✓		
Educate on the importance of wetland habitat for shorebird migration.			✓		
Objective 2.12 Fall Drawdown: For the benefit of fall migrating shorebirds provide 30-50 acres of sparsely vegetated (<20 percent cover), seasonal wetland habitat with water levels ranging from 12 cm to mudflat in slow drawdown from June 15 to August 30. Each drawdown requires 3 years of preparation.	✓	✓	✓	✓	✓
Strategies:					
Year 1: Manage the wetland as a moist soil unit by encouraging germination of annual vegetation in the first year, (could also increase nutrients by introducing hay).	✓	✓	✓	✓	✓
Year 2: Then raise water to a level of 12 to 30 cm during the second year to drown the vegetation and encourage decomposition of vegetation,	✓	✓	✓	✓	✓
Year 3: Finally, manage a slow drawdown beginning in June of the third year).	✓	✓	✓	✓	✓
Objective 2.12 Fall Drawdown (Refuge District Only): Identify the existence of potential habitat throughout the District, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Manipulate Refuge habitat in response to availability off-Refuge. For example, in extreme drought or extreme flooding, Refuge habitat maybe useful.			✓		
Use existing databases to determine potential shorebird habitat in the region and establish a reasonable goal.			✓		
Collaborate with other agencies that have water management capabilities.			✓		
Educate on the value of fall shorebird habitat.			✓		
Objective 2.13 Manage Wetland Diversity: Manage the impoundments to maximize wetland diversity within the capabilities of the system. Create wetlands that vary from temporary to permanent by varying the water regime. Focus on semi-permanent wetlands to provide optimal habitat for waterbirds in migration.	✓	✓	✓	✓	✓
Strategies:					
Manipulate water in water impoundments according to the annual Water Management Plan.	✓		✓	✓	✓
Develop wetland/habitat allocation tracking system.		✓	✓	✓	✓
Goal 3: A diversity of native migratory birds and other native wildlife reflects an emphasis on Service priority species appropriate to Refuge habitats.					
Objective 3.1 RCP Species: Within 15 years of CCP approval, at least __ percent of the Region's RCP species associated with historically occurring habitats will be present.	60 percent	60 percent	60 percent	60 percent	80 percent
Objective 3.1 RCP Species (Refuge District Only): Compare Refuge populations of key RCP species to populations within the Refuge management district (up to 10 percent of the RCP species) through a focused management and monitoring plan.			✓		
Strategies:					
Monitor population trends (point counts, waterfowl surveys, breeding bird survey) according to the Wildlife Inventory Plan.	✓	✓	✓	✓	✓
Support research activities that are directed toward these species.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Focus on RCP species within the private lands program.			✓		
Hire private lands biologists (at least 2).			✓		
Have a regular monitoring protocol for off-Refuge RCP species.			✓		
Objective 3.2 Sandhill Cranes: Provide roosting area for up to 5,000 Sandhill Cranes. Public use is prohibited between September 1 and December 1. The area is characterized by 200 acres of shallow water (less than 46 cm) with 150 m buffer of open space surrounding the roost for a total roost and buffer area of 500 acres.	✓		✓	✓	✓
Strategies:					
Water level management to provide this habitat somewhere within the Refuge.	✓		✓	✓	✓
Provide a food resource off-Refuge by working with local land owners.	✓		✓	✓	✓
Objective 3.3 Monitoring Plan: Develop a new monitoring plan within 5 years of CCP approval.		✓	✓	✓	
Strategies:					
Management changes will revolve around established thresholds based on long-term averages from a variety of sources (regional, Refuge based, literature, BBS, etc). The initial thresholds will be established with the best available information and revised through the monitoring process.		✓		✓	✓
Periodically, as identified in the Inventory and Monitoring Plan, determine the variety and abundance of native, migratory birds and other native wildlife with an emphasis on Service priority species.		✓		✓	✓
We will use the data we acquire through monitoring wildlife numbers as an indicator of the appropriateness of our habitat objectives or our success at meeting habitat objectives (as stated in habitat goals).		✓		✓	✓
Through adaptive management we will reevaluate habitat objectives and the effectiveness of strategies used to meet the objectives.		✓		✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 3.4 Source Populations: The Refuge will determine if oak savanna and wetland birds are reproducing successfully.		✓		✓	✓
Strategies:					
Within 2 years of plan approval, initiate a 10-year study to assess population levels and breeding productivity of wetland and oak savanna species.		✓		✓	✓
Determine if the habitat is sufficient to sustain a source population of birds, define what constitutes source populations on the Refuge, and establish baseline information regarding breeding productivity.		✓		✓	✓
Use the data we acquire through monitoring wildlife numbers as an indicator of the appropriateness of our habitat objectives or our success at meeting habitat objectives (as stated in habitat goals).		✓		✓	✓
Management changes will revolve around established thresholds based on long-term averages from a variety of sources (regional, Refuge based, literature, BBS, etc).		✓		✓	✓
Coordinate with off-Refuge monitoring.			✓		
Objective 3.5 Deer Populations: Maintain deer population densities that are less than or equal to numbers sustainable by the habitat. Our present information indicates that a spring population of no more than 16 per square mile meets this objective.	✓	✓	✓	✓	✓
Strategies:					
Control through annual hunt (See public use objectives).	✓	✓	✓	✓	✓
Identify the deer densities that impact habitat.		✓		✓	✓
Educational program for Refuge neighbors that are impacted by deer grazing.			✓		
Management hunt (if necessary).		✓		✓	✓
Consider using alternative treatments to control deer.				✓	✓
Introduce and/or encourage wolf packs.		✓			
Monitor chronic wasting disease.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Develop a chronic wasting disease contingency plan.	✓	✓	✓	✓	✓
Objective 3.6 Within 10 years support a study to determine the feasibility of reintroducing extirpated species such as bison, elk or prairie buterflies onto the Refuge as a part of the proposed habitat restoration efforts.	✓	✓	✓	✓	
Strategy:					
Develop a feasibility study for the reintroduction of extirpated speices.	✓	✓	✓	✓	
Research the literature.	✓	✓	✓	✓	
Interview people that have experience managing and/or reintroducing these animals to identify successes, challenges and potential contstraints.	✓	✓	✓	✓	
Perform small-scale experimentation on the Refuge.	✓	✓	✓	✓	
Collaborate with other agencies, organizations, and natural area managers with similar habitat types and reintroduction interests to examine portions of the problem on their areas.	✓	✓	✓	✓	
Goal 4: A complex of natural areas, corridors, and watershed conservation practices in the surrounding landscape complements Refuge habitat and wildlife goals.					
Objective 4.1 Landscape Conservation: Emphasize opportunities for restoration of native habitats within the watersheds surrounding the Refuge.	✓				
Objective 4.1 Landscape Conservation: Participate in development of a plan to coordinate conservation of a complex of natural areas, corridors, and watersheds in the landscape surrounding the Refuge.		✓	✓	✓	
Objective 4.1 Landscape Conservation(Refuge District Only): Participate in developing a plan to ensure the restoration of native wetland and grassland habitats within the watersheds above and adjacent to the Refuge.					✓
Strategies:					
Coordinate a green infrastructure plan to ensure the preservation of a complex of natural areas, corridors and watershed conservation practices in the landscape surrounding the Refuge.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Within 2 years of plan approval, map natural and managed areas.		✓		✓	✓
Within 2 years of plan approval, map natural and managed areas and obtain fundamental hydrologic data for the entire St. Francis watershed, the Snake River watershed (between the Refuge and Elk River), and sub-watersheds adjacent to the Refuge.			✓		
Obtain fundamental hydrologic data for the entire St. Francis watershed, the Snake River watershed (between the Refuge and Elk River), and sub-watersheds adjacent to the Refuge.		✓		✓	
Work with local, county and state planning for coordinating with other green infrastructure and development plans (I-94 corridor plan, and open space plan).			✓		
Identify potential corridors to facilitate wildlife movement between protected areas.	✓	✓	✓	✓	✓
Work with zoning boards for SMART development.			✓		
Work with private land developers to encourage native plantings and coordinated placement of natural areas to benefit wildlife.			✓		
Use existing programs such as green infrastructure and Partners for Fish and Wildlife Program and conservation easements.	✓	✓	✓	✓	✓
Objective 4.2 Functioning Watershed: Determine what level of function can be restored to the Refuge's hydrologic regime.		✓	✓	✓	✓
Strategies:					
Facilitate to completion, a Watershed Management Plan emphasizing for the entire St. Francis watershed, the Snake River watershed in partnership with local governments and landowners. Implement using the results of the hydrological study.		✓		✓	✓
Facilitate to completion, a Watershed Management Plan for the watersheds within the Refuge management district in partnership with local governments and landowners.			✓		
County Water Plan and other existing documents will be used for guidance.	✓				

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Review and consider existing plans and DNR stewardship plans.		✓	✓	✓	✓
Use the private lands program to restore wetlands and improve hydrology in the District.			✓		
Use the private lands program to restore wetlands and riverine habitat within the watersheds identified.		✓		✓	✓
Objective 4.3 Restore Wetlands on Private Land: Restore 400 wetlands off-Refuge, with priority given to those within the St. Francis River Watershed.	✓	✓		✓	✓
Objective 4.3 Restore Wetlands on Private Land: Restore 600 wetlands off-Refuge through the partners for Fish and Wildlife or other programs, expanded to all watersheds within the Refuge's Wildlife Management Region.			✓		
Strategies:					
Use the standard approach to restoration including: plugging ditches, breaking tile, and building dikes.	✓	✓	✓	✓	✓
Excluding grazing from riverbanks	✓	✓	✓	✓	✓
Planting native aquatics	✓	✓	✓	✓	✓
Develop demonstration areas	✓	✓	✓	✓	✓
Encourage research into wildlife response to restorations.	✓	✓	✓	✓	✓
Monitor response to wetland restoration.		✓	✓		✓
Encourage research into water quality and contamination of wetlands.		✓	✓		✓
Encourage research into the relationship between the restored wetland and groundwater flow.		✓	✓		✓
Use the Partners for Fish & Wildlife Program.	✓	✓	✓	✓	✓
Objective 4.4 Restore Native Uplands on Private Lands: Restore __ native uplands of a minimum of 10 acres to create contiguous habitats, priority given to the areas indicated:	100 areas of grasslands within the Refuge Management District.	100 areas of grassland/oak savanna above the Refuge within the St. Francis watershed.	150 areas of grassland/oak savanna within the St. Francis watershed.		

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Objective 4.4 Restore Native Uplands on Private Lands: Restore 100 areas with priority given to _____.				Areas within 15 miles of the Refuge	Areas within the St. Francis River Watershed
Strategies:					
Follow Mississippi Headwaters/Tallgrass Prairie ecosystem team's recommendation on species composition in restorations.	✓			✓	
Expand on Mississippi Headwaters/Tallgrass prairie ecosystem team's recommendation on species composition in restorations.		✓	✓		✓
Link upland and wetland restoration.	✓	✓	✓	✓	✓
Annually, recommend to an average of __ new private landowner participants within the Sherburne NWR Wildlife Management Region that they use prescribed burning to manage native grasslands and savanna.		3 new private landowners participants	10 new private landowners participants	3 new private landowners participants	3 new private landowners participants
Work with NGOs to buy development rights and then assist in restoration of larger blocks (250 acres) for _____ habitat.		✓ Oak savanna and interspersed prairie	✓ Same as alternative 2	✓ Same as alternative 2	✓ Prairie habitat
Work with NGOs to protect and cost share restorations.	✓	✓	✓	✓	✓
Loan equipment for restoration to private landowners.	✓	✓	✓	✓	✓
Provide technical assistance.	✓	✓	✓	✓	✓
Use of permanent easements	✓	✓	✓	✓	✓
Encourage ____ plantings by private individuals.	Prairie and oak savanna	Same as alternative 1	Same as alternative 1	Same as alternative 1	Prairie
Restoration of demonstration areas in conjunction with schools.	✓	✓	✓	✓	✓
Objective 4.5 Encourage Native Habitat on Private Land Development: The Refuge will coordinate with an average of ___ new land developments within the upper St. Francis watershed to encourage the inclusion of no more than 15 percent impervious surfacing within developed areas and include native habitat for wildlife within development plants.		2 new land developments	5 new land developments	2 new land developments	2 new land developments

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Partnerships include Sherburne County Soil and Water Conservation District and Sherburne County Planning and Zoning.		✓	✓	✓	✓
Ensure habitats are connected to other habitats and use native plants.		✓	✓	✓	✓
Provide seed source.		✓	✓	✓	✓
Provide technical expertise and equipment.		✓	✓	✓	✓
Objective 4.6 Regional Review of Open-water Habitat for Breeding Birds: Identify the existence of this habitat throughout the region, coordinate and promote conservation efforts off-Refuge to increase the total regional availability of this habitat.			✓		
Strategies:					
Use existing databases to determine a reasonable goal.			✓		
Collaborate with other agencies.			✓		
Education on the importance of conservation for open-water-dependent breeding birds.			✓		
Objective 4.6 Monitor current land easements in the region surrounding the Refuge and visit all Refuge easements annually.	✓	✓	✓	✓	✓
Develop database for easement monitoring.	✓	✓	✓	✓	✓
Determine future direction of easement management.	✓	✓	✓	✓	✓
Goal 5: Visitors enjoy wildlife-dependent opportunities that further an appreciation of Refuge wildlife and habitats.					
Hunting					
Objective 5.1 Hunting: Continue hunting opportunities at the level offered in 2004.	✓		✓		
Objective 5.1 Hunting: Increase hunting opportunities from the level offered in 2004.		✓		✓	✓
Strategies:					
Annually provide at least four blinds for hunters with disabilities for deer and waterfowl.	✓	✓	✓	✓	✓
Reserve blinds for exclusive disability use on a first come/first serve basis.	✓	✓	✓	✓	✓
Assist hunters with disabilities.	✓	✓	✓		✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Provide annual firearms deer hunt within the framework of the Minnesota State Department of Natural Resources (DNR) on at least 70% of the Refuge lands.	✓	✓	✓	✓	✓
Provide muzzleloader hunt in an area west of Highway 5 (to prevent conflict with auto tour route and hiking trails) within the state framework to be outlined in the hunting step-down plan.		✓			✓
Continue small-game hunting opportunities as defined by state regulations on areas identified in the Refuge hunting brochure.	✓	✓	✓	✓	✓
Provide spring turkey hunting for hunters with disabilities in designated blinds in specific areas.		✓		✓	✓
Continue waterfowl hunting within the state framework on areas identified in the Refuge hunting brochure.	✓	✓	✓	✓	✓
Continue archery deer hunting within the state framework on areas identified in the Refuge hunting brochure.	✓	✓	✓	✓	✓
Provide predator hunting and trapping.		✓			
Provide turkey hunting for able-body hunters.					✓
Open trapping program to include other species.		✓			✓
Develop operational definition of success and measures for hunting through a survey of hunter satisfaction. Include indicators directed toward recreational users with disabilities.		✓		✓	✓
Within 5 years, develop a survey instrument to measure success.		✓			✓
Fishing					
Objective 5.2 Fishing: Increase fishing opportunities at the level offered in 2004.	✓	✓	✓	✓	✓
Strategies:					
Provide an accessible fishing platform.	✓	✓	✓	✓	✓
Provide fishing opportunities on St. Francis River at a minimum of four access points; reassess the program every 5 years.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Develop operational definition of success and measures for fishing through a survey of angler satisfaction. Include indicators directed toward recreational users with disabilities.		✓		✓	✓
Provide opportunities for youth fishing.	✓	✓	✓	✓	✓
Wildlife Observation					
Objective 5.3 Wildlife Observation: Increase wildlife observation opportunities from the level offered in 2004.	✓	✓	✓	✓	✓
Strategies:					
Maintain 10 miles of hiking trails, but not to exceed 25,000 visits per year (re-evaluate at threshold).	✓	✓	✓	✓	✓
Construct a maximum of 2 miles of hiking trails in association with a new visitor center.	✓	✓	✓	✓	✓
Manage the existing 7.3-mile auto tour route and the two fully accessible observation platforms on the Prairie's Edge Wildlife Drive such that it will accommodate at least 15,000 visits per year, but no more than 35,000, with no more than 20 vehicles on the route at one time (max. twice per year).	✓	✓	✓	✓	✓
Photography					
Objective 5.4 Photography: Continue photography opportunities at the level offered in 2004.	✓	✓	✓	✓	✓
Strategies:					
During the sanctuary time (spring and summer), photography will be restricted to the tour route and trails, but special permits, blinds, and areas, are possible. At other times of the year nature photography is permitted few restrictions.	✓	✓	✓	✓	✓
Develop operational definition of success and measures for photography through a survey of photographers. Include indicators directed toward recreational users with disabilities.		✓		✓	✓
Environmental Education					
Objective 5.5. Environmental Education: Target a 10 percent increase in participation in environmental education programs over present level within 5 years of CCP approval.	✓	✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Provide facilities and a program for teacher-lead environmental education activities for area schools, and other Refuge visitors, with a message emphasis on __.	management activities.	ecological processes and presettlement habitats.	landscape conservation and the needs for green space and networked parks, and regional planning.	migratory water birds, presettlement habitats and wildlife management activities.	grassland birds, prairies and wetland habitat
Provide new visitor center to facilitate environmental education and interpretation.	✓	✓	✓	✓	✓
Train volunteers to assist with environmental education programming	✓	✓	✓	✓	✓
Partner with Department of Education at nearby universities and colleges to recruit student teachers to develop and lead environmental education programs.	✓	✓	✓	✓	✓
Reach out to a variety of audiences (example, K-12, colleges, elderhostels, etc.)	✓	✓	✓	✓	✓
Encourage partnerships with local schools.	✓	✓	✓	✓	✓
Provide teacher workshops.	✓	✓	✓	✓	✓
Increase level of programming to increase use of the Refuge by schools and other community organizations.	✓	✓	✓	✓	✓
Objective 5.6 Environmental Education: Annually, 70 percent of visitors and students participating in Refuge sponsored environmental education understand and appreciate the management emphasis of ___.	Management activities	ecological processes and presettlement habitats.	landscape conservation and the needs for green space and networked parks, and regional planning.	migratory water birds, presettlement habitats and wildlife management activities.	Measurement of wetland and grassland birds, prairies and wetland habitats.
Strategies:					
Develop operational definition of success and measures for environmental education. Include indicators directed toward recreational users with disabilities.		✓		✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Environmental Interpretation					
Objective 5.7 Environmental Interpretation: Interpretation will emphasize _____.	oak savanna, wetlands and migratory birds, ecological processes, and pre-settlement conditions.	Same as Alt. 1.	regional landscape planning and the need for networked parks and greenspace.	wetlands and migratory birds, ecological processes, and pre-settlement conditions and wildlife management.	management of wetlands and grassland birds, prairie and wetland habitat.
Strategies:					
Provide 6 kiosks that help visitors interpret Refuge habitats, wildlife and regulations.	✓	✓	✓	✓	✓
Annually, provide programs, events, festivals and/or tours to enhance visitor understanding of the Refuge and its mission.	✓	✓	✓	✓	✓
Conduct at least 10 programs or events each year.	✓	✓	✓	✓	✓
Provide for a changing demography and address new audiences about the issues raised with urban expansion	✓	✓	✓	✓	✓
Provide special programs and seminars for continuing education and train volunteers to act as roving interpreters.	✓	✓	✓	✓	✓
Provide interpretive panels on hiking trails and auto tour route.	✓	✓	✓	✓	✓
Construct interpretive panels at fishing access points and high-use hunter parking areas.	✓	✓	✓	✓	✓
Objective 5.7 Environmental Interpretation: 80 percent of visitors understand Refuge mission, purpose, and management actions as assessed every 5 years.		✓		✓	✓
Strategies:					
Develop operational definition of success and measures for environmental interpretation. Include indicators directed toward recreational users with disabilities.		✓		✓	✓
Develop a survey instrument to measure success in meeting expectations of recreational user groups.		✓		✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Goal 6: Visitors and local citizens demonstrate a strong conservation ethic that leads to support of the Refuge, conservation of the surrounding landscape, and global environmental awareness.					
Objective 6.1 Community Outreach: Increase awareness of Refuge management within surrounding areas by annually providing opportunities for at least 2,000 students to participate in programs; 20 teachers to participate in training programs, 600 people to volunteer at the Refuge, and 300 people to be members of a supporting friends group.	✓	✓	✓	✓	✓
Strategies:					
Provide 10 programs, events and tours annually. These would include the Winter Fest, Film Festival, Migratory Bird Day, and guided nature tours.	✓	✓	✓	✓	✓
Offer training programs for teachers centered on the Refuge's place in the landscape and the importance of management.	✓	✓	✓	✓	✓
Train volunteers to assist in Refuge programs.	✓	✓	✓	✓	✓
Support and cooperate with the Friends group.	✓	✓	✓	✓	✓
Increase membership of Friends on the Refuge by 10 percent from 2004 level.		✓	✓	✓	✓
Offer student programs centered on the Refuge's place in the landscape and the importance of management.	✓	✓	✓	✓	✓
Participate in off-site community events.	✓	✓	✓	✓	✓
Issue regular news releases.	✓	✓	✓	✓	✓
Maintain a Refuge website with current information about Refuge management and events.	✓	✓	✓	✓	✓
Increase community partnerships.	✓	✓	✓	✓	✓
Support an active volunteer program.	✓	✓	✓	✓	✓
Objective 6.2 Community Awareness: Sixty percent of neighbors, community leaders, and residents of nearby communities express an awareness of the Refuge's mission and the need for increased local conservation.		✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Strategies:					
Develop a community assessment survey and conduct the survey every 5 years to determine community awareness of the Refuge's mission and the importance of local conservation efforts.		✓	✓	✓	✓
Contract with a University to develop the assessment survey.		✓	✓	✓	✓
Increase partnerships with community businesses and organizations.		✓	✓	✓	✓
Objective 6.3. Provide Technical Assistance: 95 percent of the residents within the Sherburne Management District who seek technical assistance receive a response within 1 week of their request and feel good about their experience with the Service.		✓	✓	✓	✓
Strategy:					
Provide technical assistance or information to inquiring private landowners in the Sherburne Management District within annual budget constraints.	✓	✓	✓	✓	✓
Inform residents within the Sherburne Management District about the Partners for Fish & Wildlife Program through one or more formats such as radio addresses, brochures, news releases, talks to community organizations and the Refuge website.		✓	✓	✓	✓
Objective 6.4 Private Landowner Contacts: Make 20 contacts with private landowners each year to provide technical restoration assistance with emphasis on landowners residing in _____.	Sherburne Management District	St. Francis River Watershed	Same as Alternative 1	Same as Alternative 2	Same as Alternative 2
Strategy:					
Provide technical assistance and information to inquiring private landowners in the St. Francis River watershed within the annual budget constaints.	✓	✓	✓	✓	✓
Inform residents within the St. Francis River watershed about the Partners for Fish & Wildlife Program through one or more formats such as radio addresses, brochures, news releases, talks to community organizations and the Refuge website.		✓	✓	✓	✓

Table 1: Goals, Objectives and Strategies Listed By Alternative, Sherburne NWR (Continued)

Goals, Objectives and Strategies	Alt. 1 Current Management (No Action)	Alt. 2 Pre-settlement (1800-1850) Ecological Processes	Alt. 3 Enhanced Off-Refuge Coordination With Current On-Refuge Mgmt. Direction	Alt. 4 Pre-European Settlement Process and Habitat in Context of Providing Migratory Water Bird Habitat (Preferred Alt.)	Alt. 5 Focused Management for Priority Wetland and Grassland Birds
Goal 7: The cultural resources and cultural history of the Refuge are valued and preserved, and connect Refuge staff, visitors, and the community to the area's past.					
Objective 7.1 Cultural Resources Protection: Ensure archeological and cultural values are described, identified, and then taken into consideration prior to implementing undertakings.	✓	✓	✓	✓	✓
Strategies:					
Complete a cultural resources management plan by 2005 that incorporates all existing surveys and investigations and identifies future needs. The plan will emphasize pre- and early European settlement of the area.	✓	✓	✓	✓	✓
Develop an oral cultural history to preserve the "community memory" about the circumstance of the Refuge establishment.	✓	✓	✓	✓	✓
Objective 7.2 Cultural Resources Appreciation: Seventy percent of visitors will understand and appreciate the cultural history of the Refuge.		✓		✓	✓
Strategies:					
Incorporate cultural history messages into programs, exhibits and other media with emphasis on _____.		Pre- and early European settlement of the area		Use of the Refuge landscape throughout time.	Use of the Refuge landscape throughout time.

Appendix A: Matrix Used for Area-weighted Average Potential Species Occurrence Score (PSO Score)

Appendix A: Matrix Used for Area-weighted Average Potential Species Occurrence (PSO) Score

The species named in this list were provided by the Division of Migratory Birds. The species were selected using a variety of criteria based on expert opinion. The species are considered important for a variety of reasons. Every comprehensive conservation plan in the Region considers implications of management on species such as the ones identified in this list. Each species is scored for each habitat type, with "0" signifying not important and "3" signifying very important. Scores were determined through expert opinion by the Division of Migratory Birds and the Regional Biologist.

"*"indicates that species was used in analysis.

SPECIES	bog	cattail marsh	conifer plantation	developed	flooded dead timber	lowland brush	lowland grass-reed canary	lowland grass-sedge	lowland hardwood	northern hardwood	big woods	oak savanna	oak woodland brushland	oak-white pine forest	oak forest	cottonwood plantation	tamarack swamp	upland brush	upland grass	water	riverine
Whip-poor-will*	0	0	1	0	0	0	0	0	1	2	2	3	2	2	2	1	0	3	1	0	0
Wood Thrush*	0	0	0	0	0	0	0	0	1	3	3	0	1	3	3	0	0	0	0	0	0
Upland Sandpiperl*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0
Grasshopper Sparrow*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0
Bobolink*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0
Eastern Meadowlark*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0
Western Meadowlark*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0
Loggerhead Shrike*	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1	3	0	0
Field Sparrow*	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	2	1	0	0
Sedge Wren*	0	1	0	0	0	0	1	3	0	0	0	0	0	0	0	0	2	0	1	0	0
American Woodcock*	1	0	0	0	0	3	0	1	3	2	1	1	2	1	1	0	1	2	0	0	1
Red-headed Woodpecker*	0	0	0	0	2	1	0	0	1	1	1	3	2	2	2	1	0	1	0	0	0
Northern Flicker*	0	0	1	0	2	1	0	0	2	3	2	3	3	2	2	2	1	2	1	0	0
Black-billed Cuckoo*	0	0	0	0	0	3	0	0	2	2	1	1	2	1	1	2	1	2	0	0	0
Brown Thrasher*	0	0	0	0	0	1	0	0	1	1	1	2	3	1	1	2	0	2	0	0	0
Golden-winged Warbler*	0	0	0	0	0	3	0	0	1	1	0	0	1	0	0	0	2	3	0	0	0
Common Loon	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0

"*"indicates that species was used in analysis.

SPECIES	bog	cattail marsh	conifer plantation	developed	flooded dead timber	lowland brush	lowland grass-reed canary	lowland grass-sedge	lowland hardwood	northern hardwood	big woods	oak savanna	oak woodland brushland	oak-white pine forest	oak forest	cottonwood plantation	tamarack swamp	upland brush	upland grass	water	riverine
American Bittern	0	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	1	0	1	0	0
Canada Goose (residents)	0	3	0	0	3	0	1	2	0	0	0	0	0	0	0	0	1	0	0	3	2
Trumpeter Swan	0	3	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1
Wood Duck	0	2	0	0	3	1	0	0	3	2	3	1	1	2	2	1	1	0	0	1	3
Mallard	0	3	0	0	2	2	1	2	1	0	0	1	2	0	0	0	1	2	1	3	2
Blue-winged Teal	0	3	0	0	2	0	1	2	0	0	0	1	0	0	0	0	0	0	3	3	1
Bald Eagle	0	2	0	0	3	0	0	0	2	1	1	1	1	1	1	1	0	0	0	3	3
Forster's Tern	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Black Tern	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Marsh Wren	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Swamp Sparrow*	0	3	0	0	0	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1
Northern Harrier*	1	3	0	0	0	1	1	2	0	0	0	1	0	0	0	0	1	1	3	0	0
Sandhill Crane*	2	3	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	2	1	1
Double-crested Cormorant	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Northern Rough-winged Swallow	0	2	0	0	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	3	3
Least Bittern	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1
Henslow's Sparrow*	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0

"*"indicates that species was used in analysis.

SPECIES	bog	cattail marsh	conifer plantation	developed	flooded dead timber	lowland brush	lowland grass-reed canary	lowland grass-sedge	lowland hardwood	northern hardwood	big woods	oak savanna	oak woodland brushland	oak-white pine forest	oak forest	cottonwood plantation	tamarack swamp	upland brush	upland grass	water	riverine
Dickcissel*	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	3	0	0
Red-shouldered Hawk*	0	0	0	0	1	1	0	0	3	2	3	0	0	1	1	0	0	0	0	0	1
Blue-winged Warbler*	0	0	0	0	0	3	0	0	2	1	0	0	2	0	0	0	0	2	0	0	0
Wilson's Phalarope	0	3	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0
Northern Goshawk*	0	0	1	0	0	0	0	0	1	2	2	0	1	2	2	1	2	1	0	0	1
Black-crowned Night-Heron	0	3	0	0	2	2	1	1	2	0	0	0	0	0	0	0	0	0	0	0	2
Cerulean Warbler*	0	0	0	0	0	0	0	0	2	1	3	0	0	2	2	0	0	0	0	0	0
Northern Pintail	0	3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	3	2	0
American White Pelican	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0

Appendix B: Matrices for Comparing Water Bird Response Using the PSO Score

Appendix B: Matrices for Comparing Water Bird Response Using the PSO Score

The list used for this analysis includes all water birds that use the Refuge at some point during the year. This list is more comprehensive than the one used in Appendix K but is focused on water birds either in migration or during the breeding season. Each species is scored for each habitat type ("0" signifies not important and "3" signifies very important). Scores were determined through expert opinion by the Division of Migratory Birds and the Regional Biologist.

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Loon, Common	0	0	0	2	3	0	0	0
Grebe, Pied-billed	0	0	1	3	3	0	0	0
Grebe, Horned	0	0	1	2	3	0	0	0
Grebe, Red-necked	0	0	0	3	3	0	0	0
Grebe, Eared	0	0	1	2	3	0	0	0
Grebe, Western	0	0	0	1	3	0	0	0
Pelican, American White	0	0	0	2	3	0	0	0
Cormorant, Double-crested	0	0	0	2	3	0	0	0
Bittern, American	0	3	3	2	0	1	0	0
Bittern, Least	0	3	3	2	0	1	0	0
Heron, Great Blue	1	1	2	3	0	1	0	0
Egret, Great	1	1	2	3	0	1	0	0
Egret, Snowy	1	2	3	2	0	1	0	0
Egret, Cattle	1	2	2	1	0	1	0	0
Heron, Green	1	1	2	2	0	3	1	0
Heron, Black-crowned Night-	0	0	1	3	0	2	1	0
Swan, Tundra	0	0	0	2	3	0	0	0
Swan, Trumpeter	1	1	1	2	3	0	0	0
Goose, Greater White-fronted	1	1	1	2	3	0	0	0
Goose, Snow	0	0	2	2	3	0	0	0
Goose, Ross's	1	1	1	2	3	0	0	0
Goose, Canada	1	1	2	3	3	1	0	0

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Duck, Wood	3	3	3	3	2	3	1	0
Teal, Green-winged	3	3	3	3	2	2	1	0
Duck, American Black	3	3	3	3	2	2	1	0
Mallard	3	3	3	3	2	2	1	0
Pintail, Northern	3	3	3	3	2	1	0	0
Teal, Blue-winged	3	3	3	3	2	1	0	0
Shoveler, Northern	3	3	3	3	2	2	0	0
Gadwall	2	3	3	3	2	1	0	0
Wigeon, American	2	2	3	3	2	2	0	0
Canvasback	1	1	1	3	3	0	0	0
Redhead	1	1	1	3	3	0	0	0
Duck, Ring-necked	1	1	2	3	3	3	1	0
Scaup, Greater	1	1	1	3	3	0	0	0
Scaup, Lesser	1	1	1	3	3	0	0	0
Goldeneye, Common	0	0	0	3	3	0	0	0
Bufflehead	0	0	1	3	3	0	0	0
Merganser, Hooded	0	0	2	3	3	2	1	0
Merganser, Common	0	0	0	3	3	0	0	0
Merganser, Red-breasted	0	0	0	3	3	0	0	0
Duck, Ruddy	0	0	1	3	3	0	0	0

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Osprey	0	0	1	3	3	0	0	0
Eagle, Bald	0	0	1	2	3	0	0	0
Harrier, Northern	1	1	2	2	0	1	0	2
Hawk, Red-shouldered	0	0	0	0	0	0	0	0
Falcon, Peregrine	0	0	1	2	3	0	0	0
Rail, Virginia	0	0	3	2	0	0	1	1
Sora	0	0	3	2	0	1	0	1
Moorhen, Common	0	0	3	3	0	1	0	0
Coot, American	2	2	3	3	3	1	0	0
Crane, Sandhill	2	2	2	3	0	0	0	0
Plover, Black-bellied	2	2	1	1	0	0	0	0
Plover, Black-bellied	0	0	0	1	0	0	0	0
Plover, Semipalmated	2	2	1	1	0	0	0	0
Killdeer	3	1	0	0	0	0	0	0
Avocet, American	1	2	3	1	0	0	0	0
Yellowlegs, Greater	2	2	2	1	0	0	0	0
Yellowlegs, Lesser	2	2	2	1	0	0	0	0
Sandpiper, Solitary	0	0	0	1	0	0	0	0
Willet	1	1	1	2	0	0	0	0
Sandpiper, Spotted	0	0	0	1	0	0	0	0
Sandpiper, Upland	2	2	1	0	0	0	0	0
Turnstone, Ruddy	0	0	0	2	0	0	0	0

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Sanderling	1	1	1	2	0	0	0	0
Sandpiper, Semipalmated	1	1	1	2	0	0	0	0
Sandpiper, Western	1	1	1	2	0	0	0	0
Sandpiper, Least	2	2	2	1	0	0	0	0
Sandpiper, White-rumped	1	1	1	2	0	0	0	0
Sandpiper, Baird's	2	2	2	1	0	0	0	0
Sandpiper, Pectoral	2	2	2	1	0	0	0	0
Dunlin	1	2	2	1	0	0	0	0
Sandpiper, Stilt	1	2	2	1	0	0	0	0
Sandpiper, Buff-breasted	0	0	0	1	0	0	0	0
Dowitcher, Short-billed	1	2	2	1	0	0	0	0
Dowitcher, Long-billed	1	2	2	1	0	0	0	0
Snipe, Common	2	2	3	3	0	1	0	0
Woodcock, American	2	2	1	0	0	3	2	1
Phalarope, Wilson's	0	0	2	2	1	0	0	0
Gull, Franklin's	1	1	1	3	2	0	0	0
Gull, Bonaparte's	0	0	1	2	3	0	0	0
Gull, Ring-billed	3	3	2	3	3	0	0	0
Gull, Herring	0	0	0	2	3	0	0	0
Tern, Caspian	0	0	0	2	3	0	0	0

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Tern, Common	0	0	1	2	3	0	0	0
Tern, Forster's	0	0	3	3	3	0	0	0
Tern, Black	0	1	2	3	2	0	0	0
Kingfisher, Belted	0	0	1	3	3	1	0	0
Flycatcher, Alder	0	0	1	1	0	3	1	0
Martin, Purple	0	1	2	3	3	1	0	0
Swallow, Tree	0	1	2	3	3	1	1	1
Swallow, Northern Rough-winged	0	1	2	3	3	1	1	1
Swallow, Bank	0	1	2	3	3	1	1	0
Swallow, Cliff	0	1	2	3	3	1	1	0
Wren, Sedge	1	3	2	1	0	0	0	1
Wren, Marsh	0	1	3	3	0	0	0	0
Pipit, American	0	0	0	0	0	0	1	1
Warbler, Golden-winged	0	0	0	0	0	0	2	0
Waterthrush, Northern	0	0	0	1	0	2	3	2
Yellowthroat, Common	0	2	3	3	0	3	2	2
Sparrow, Le Conte's	0	3	1	1	0	0	0	0
Sparrow, Song	0	1	2	1	0	3	2	2
Sparrow, Swamp	0	0	3	3	0	3	2	2
Blackbird, Red-winged	0	1	3	3	0	3	1	1
Blackbird, Yellow-headed	0	0	3	3	0	1	0	0
Blackbird, Rusty	0	2	2	2	0	1	3	1

Water Bird Wetland Migration Matrix[1]

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
na	2	2	2	1	0	0	0	0
na	2	2	2	1	0	0	0	0

1. Score ranges from 0-3, with) indicating not used to 3, indicating critical habitat.

Water Bird Breeding Matrix

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Loon, Common	0	0	0	2	3	0	0	0
Grebe, Pied-billed	0	0	1	3	2	0	0	0
Grebe, Red-necked	0	0	0	3	3	0	0	0
Pelican, American White	0	0	0	3	3	0	0	0
Bittern, American	0	3	3	3	0	2	0	0
Bittern, Least	0	3	3	3	0	1	0	0
Heron, Great Blue	0	1	2	3	0	1	0	0
Egret, Great	0	1	2	3	0	1	0	0
Heron, Green	0	1	2	2	0	3	2	0
Heron, Black-crowned Night-	0	0	2	3	0	3	1	0
Swan, Trumpeter	0	0	2	3	2	0	0	0
Goose, Canada	0	3	3	3	2	1	0	0
Duck, Wood	3	2	2	2	1	3	1	0
Teal, Green-winged	3	3	3	3	1	1	0	0
Mallard	3	3	3	3	2	2	1	0
Teal, Blue-winged	3	3	3	3	2	2	0	0
Shoveler, Northern	0	2	2	3	1	1	0	0
Duck, Ring-necked	0	0	1	3	2	1	0	0
Merganser, Hooded	0	1	1	2	1	3	1	0
Duck, Ruddy	0	0	1	3	3	0	0	0
Eagle, Bald	0	0	0	3	3	0	0	0
Harrier, Northern	0	2	2	2	0	1	0	1

Water Bird Breeding Matrix

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Hawk, Red-shouldered	0	0	0	0	0	1	0	0
Falcon, Peregrine	0	0	1	2	3	0	0	0
Rail, Virginia	0	0	3	3	0	0	0	0
Sora	0	1	3	3	0	0	0	0
Coot, American	0	0	2	3	1	0	0	0
Crane, Sandhill	0	3	3	3	0	1	0	0
Killdeer	3	1	2	1	0	0	0	0
Sandpiper, Spotted	0	0	2	1	0	0	0	0
Sandpiper, Upland	0	0	0	0	0	0	0	0
Snipe, Common	0	2	3	2	0	2	0	0
Woodcock, American	0	0	0	0	0	3	1	0
Gull, Ring-billed	0	0	0	3	3	0	0	0
Tern, Black	0	1	2	3	2	0	0	0
Kingfisher, Belted	0	0	1	3	2	1	0	0
Flycatcher, Alder	0	1	1	1	0	3	2	0
Martin, Purple	0	1	2	3	2	1	0	0
Swallow, Tree	0	1	2	3	2	1	1	1
Swallow, Northern Rough-winged	0	1	2	3	2	1	1	1
Swallow, Bank	0	1	2	3	2	1	0	0
Swallow, Cliff	0	1	2	3	2	1	0	0

Water Bird Breeding Matrix

Common Name	Ephemeral Wetland	Temporary Wetland	Seasonally Flooded Wetland	Semipermanently Flooded Wetland	Open Water	Flooded Willow Alder	Forested Wetland	Scrub-Shrub Saturated (Bog)
Wren, Sedge	1	3	1	0	0	0	0	0
Wren, Marsh	0	0	3	3	0	0	0	0
Warbler, Golden-winged	0	0	0	0	0	0	2	0
Yellowthroat, Common	1	2	3	3	0	3	2	2
Sparrow, Song	1	1	2	2	0	3	2	2
Sparrow, Swamp	0	2	3	3	0	2	1	1
Blackbird, Red-winged	1	3	3	3	0	3	0	1
Blackbird, Yellow-headed	0	0	3	3	0	1	0	0

Appendix C: National Wetland Inventory Classification and Acreages on Sherburne National Wildlife Refuge

Appendix C: National Wetland Inventory Classification and Acreages on Sherburne National Wildlife Refuge

Attribute[1]	Acreage
Lacustrine Unconsolidated Bottom	
L1UBH	247.7
L2UBFh	197.9
L2UBG	318.4
Subtotal	*764.0*
Palustrine Unconsolidated Bottom/Emergent Wetlands	
PUB/EMF	13.4
PUB/EMFh	167.4
PUB/EMFx	5.5
PEM/UBF	93.7
PEM/UBFd	65.3
PEM/UBFh	181.8
Subtotal	*527.2*
Palustrine Emergent Wetlands	
PEM1C	1.8
PEMA	16.7
PEMAd	2.3
PEMB	43.4
PEMBd	150.3
PEMBg	882.9
PEMBgd	205.8
PEMC	404.2
PEMCb	0.3
PEMCd	655.7
PEMCh	55.3
PEMF	903.9
PEMFd	141.9
PEMFh	236.5
PEMG	25.5
Subtotal	*3726.4*
Palustrine Emergent/Scrub-Shrub Wetlands	
PEM/SS1B	165.3
PEM/SS1Bg	878.6

Attribute[1]	Acreage
PEM/SS1C	741.0
PEM/SS1Cd	264.7
PEM/SS1Ch	336.7
PEM/SS6C	38.5
PEM/SS6Cd	16.5
PSS1/EMA	7.6
PSS1/EMB	41.8
PSS1/EMBd	11.7
PSS1/EMBg	276.7
PSS1/EMBgd	57.1
PSS/EM1C	6.7
PSS1/EMC	528.4
PSS1/EMCd	256.4
Subtotal	*3627.7*
Palustrine Emergent/Forested Wetlands	
PEM/FO1Bg	81.8
PEM/FO1C	1.1
PEM/FO1Cd	4.2
PFO1/EMA	14.1
PFO1/EMC	5.1
PFO1/EMCd	2.3
Subtotal	*108.5*
Palustrine Forested Wetlands	
PFO1A	143.1
PFO1Ah	3.3
PFO1B	53.5
PFO1Bd	11.1
PFO1Bg	173.2
PFO1Bgd	53.9
PFO1C	79.0
PFO1Cb	1.7
PFO1Cd	18.1
PFO1Ch	219.2
PFO2Bg	44.2
PFO1/2Bg	1.1
Subtotal	*801.3*
Palustrine Forested/Scrub-Shrub Wetlands	
PFO/SS1B	163.6
PFO/SS1C	95.6

Attribute[1]	Acreage
PFO/SS1Ch	95.8
PFO/SS5B	25.8
PFO/SS5Fh	96.3
PSS/FO1B	396.5
PSS/FO1Bd	94.4
PSS/FO1Bg	160.8
PSS/FO1C	17.6
PSS/FO1Cd	39.5
PSS/FO1Ch	88.3
PSS1/FO2Bg	68.6
PSS1/FO2Bgh	44.3
Subtotal	*1387.2*
Palustrine Scrub-Shrub Wetlands	
PSS1A	0.6
PSS1B	86.0
PSS1Bd	29.7
PSS1Bg	383.4
PSS1Bgd	8.4
PSS1C	483.7
PSS1Cd	60.8
PSS1Ch	264.4
PSS6/EMC	0.4
PSS6C	1.7
Subtotal	*1319.3*
Palustrine Unconsolidated Bottom Wetlands	
PUBF	38.4
PUBFb	8.8
PUBFd	0.5
PUBFh	138.0
PUBFx	16.8
PUBG	53.9
PUBGb	2.9
PUBGd	1.4
PUBGh	4.0
PUBGx	25.5
Subtotal	*290.0*
Palustrine Unconsolidated Shore Wetlands	
PUSCx	7.5
Subtotal	7.5

Attribute[1]	Acreage
Riverine Unconsolidated Bottom	
R2UBH	57.5
Subtotal	*57.5*
Riverine Unconsolidated Shore	
R2USC	0.2
Subtotal	*0.2*

1.Cowardin, L.M, et al., 1979.