

# **Draft Comprehensive Conservation Plan and Environmental Assessment**

*Sand Lake National Wildlife Refuge*

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Prepared by the U.S. Fish and Wildlife Service

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# Summary

This is a summary of the environmental assessment (EA) that evaluates alternatives for management of the Sand Lake National Wildlife Refuge, South Dakota. The draft CCP for the refuge is described in alternative 3 of the EA and is the proposed action of the U.S. Fish and Wildlife Service.

## THE HEART OF THE PRAIRIE

The Sand Lake National Wildlife Refuge was established in the mid-1930s as a refuge and breeding ground for migratory birds and other wildlife. The 21,498-acre refuge lies in the James River basin within Brown County, South Dakota. This northeastern area of South Dakota is in the heart of the prairie-pothole region of the northern Great Plains and plays a major role for migratory birds.

The refuge has been designated as a Globally Important Bird Area and a Wetland of International Importance. The refuge supports the largest nesting colony of Franklin's gulls in the world, along with thousands of snow geese and other waterfowl, white pelicans, shorebirds, and colonial-nesting birds.



*American Avocet*

The occurrence of 48 species of mammals illustrates the importance of the area for nongame, as well as game species such as white-tailed deer. Despite the

frequent occurrence of adverse conditions, the James River maintains a substantial fish population including 60 species.

## HABITAT

The refuge's nutrient-laden waters are contained in 11,450 acres of marsh and open water. Dams form the two main bodies of water—Mud and Sand lakes.

Most of the more than 8,000 acres of grassland is infested with invasive plant species including Canada thistle, leafy spurge, Russian olive, and wormwood sage.

Of the estimated 424 acres of woodlands, most occur as deteriorated shelterbelts planted by the Civilian Conservation Corps (CCC) in the late 1930s to control wind erosion and provide wildlife habitat. Historically, woody vegetation occurred along riparian corridors and around some wetlands.

## CULTURAL RESOURCES

Although there are no known prehistoric resources on the refuge, documented occupation of the general area spans a 10,000-year period.

The refuge contains clear ties to the Depression-era period based on the original landscape design and presence of buildings built by the CCC. The focus of many CCC projects was to preserve water in ponds, link channels, and build habitat islands for migratory birds.

## PUBLIC USE

Each year, about 50,000 people recreate at the refuge. Areas open to visitors include a small visitor area, a 15-mile auto tour route with a viewing platform, a 20-mile loop road, an observation tower, and two day use areas.

Hunting for waterfowl, white-tailed deer, ring-necked pheasant, sharp-tailed grouse, and gray partridge is popular on the refuge. Fishing is offered year-round.

## THE PLANNING PROCESS

The CCP process consists of a series of steps including environmental analysis. Public and partner involvement are important throughout the process. Management alternatives are developed to meet the

purposes, vision, and goals of the refuge. Implementation of the CCP will be monitored throughout its 15-year effective period.

## ISSUES

Public scoping initiated in 2001, along with refuge information, indicated that there are four major issues regarding refuge management, which are summarized below.

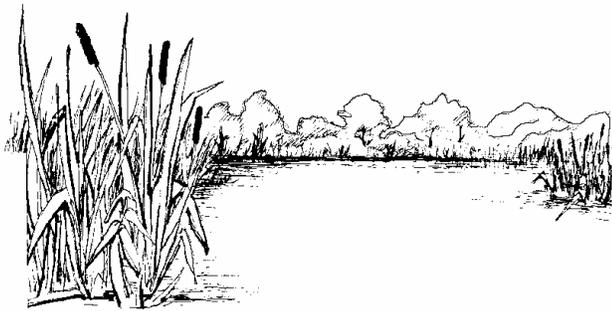
### WILDLIFE AND HABITAT

The quality of upland grassland habitats is important for providing the needs of migratory birds and meeting the establishment purposes of the refuge. Prior to the refuge's establishment, the native prairie within the vicinity of Sand Lake National Wildlife Refuge was almost entirely broken up and converted to cropland.

Refuge users want a great diversity of wildlife, including game species, supported by a variety of habitats. Waterfowl and deer are important recreational resources. The farm program on the refuge helps maintain populations of white-tailed deer and pheasant. Some refuge neighbors are losing crops of corn and alfalfa to foraging deer.

### WATER MANAGEMENT

The refuge must use, maintain, and protect its water rights for the use of James River water. Control of water levels on the refuge to manage wetlands is extremely dependent on river flows. Demands on the water resources of the James River require collaboration between many stakeholders.



The water cycle affects the wildlife and the fishery and subsequent recreational opportunities. There was some public concern that water management for waterfowl may have a detrimental impact on the fishery.

Water levels on the refuge may affect water tables on neighboring lands. Salt is surfacing on lands within Brown County.

### PUBLIC USE

Recreational opportunities on the refuge and the James River are very important to local residents. There is public support for an education center. There is some public interest in camping and recreational trapping.

Hunting is a priority public use, when determined compatible with the refuge's purposes. Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge.

People want more fishing opportunities, but the ability of the refuge to provide fishing that is compatible with management for migratory wetland birds is very limited.

### INVASIVE PLANTS

Invasive plants, especially Canada thistle, are dominating plant communities and impacting habitats in some areas. Without intensive management, the refuge would become a sea of smooth brome and Canada thistle, incapable of providing habitat for a diversity of grassland-dependent wildlife.

Neighbors view the refuge as a source of invasive plant expansion onto their lands.

Chemicals used for control are of concern from the standpoint of environmental contamination and negative impacts on desirable plant species.

## THE FUTURE OF THE REFUGE

The issues, along with resource conditions, were important considerations during the development of the vision and goals for the Sand Lake National Wildlife Refuge.

### THE REFUGE VISION

Provide habitat for the production, maintenance, and basic life requirements for threatened and endangered species, migratory birds, and other wildlife species.

Promote the natural biological diversity of the region through preservation, management, and enhancement of refuge lands and waters.

Provide the public with the opportunity for wildlife-dependent recreation and the enjoyment and appreciation of America's wildlife resources.

## GOALS

These goals were developed to meet the refuge vision.

### BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

#### Threatened and Endangered Species Subgoal:

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

**Waterfowl Resources Subgoal:** Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.

[Addressed only in alternative 1.]

#### Waterfowl and Grassland-nesting Birds Subgoal:

Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

[Addressed only in alternatives 2 and 3.]

**Colonial Birds Subgoal:** Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

**Resident Wildlife Subgoal:** Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

**Grassland Habitat Subgoal:** Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

**Wetland Habitat Subgoal:** Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.

### WILDLIFE-DEPENDENT RECREATIONAL USE GOAL

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

**Consumptive Use Subgoal:** Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

**Nonconsumptive Use Subgoal:** Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

### PUBLIC EDUCATION AND OUTREACH GOAL

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.



A school group “dip-nets” for invertebrates during a field trip.

USFWS

## MANAGEMENT ALTERNATIVES

The restoration of a historical, well-functioning riverine system and provision of quality habitat for grassland-dependent birds were the key factors driving development of the alternatives.

### ACTIONS COMMON TO ALL ALTERNATIVES

Fire management would be used to protect life, property, and other resources from wildfire by safely suppressing all wildfires on the refuge. Prescribed fire would be used for habitat management, as well as for protection of property through fuel reduction.

Recreational opportunities would include wildlife-dependent and wildlife-compatible uses legislated by Congress and outlined in the National Wildlife Refuge System Improvement Act of 1997—hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. Hiking has also been deemed a compatible use during limited times of the year.

The building of an education center would allow visitors a quality experience and provide a focus point for public use including education.

### ALTERNATIVE 1

#### CURRENT MANAGEMENT—NO ACTION

Current management would continue and would not involve extensive restoration of habitat or improvements to roads and facilities.

Management tools such as burning, farming, mowing, grazing, and herbicides would be used to maintain the quality of grassland habitat for upland-nesting waterfowl. Shelterbelt woodlands would die out, which would benefit grassland-nesting birds while decreasing species of migratory birds that use fringes.

Cropland would be maintained to control invasive plants and to provide food for resident wildlife such as deer and pheasant. The extent of invasive plant infestation may increase or decrease, depending on environmental conditions. Using herbicides would reduce the quality of grasslands, and may spread persistent chemicals into the environment.

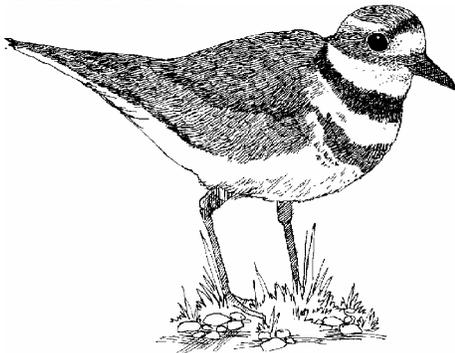
Sedimentation rates near the Mud Lake dike are expected to remain elevated, thereby continuing to degrade the lake's wetland functions. Reduced invertebrate production may impact wetland productivity, as well as limit a major food source for waterfowl.

All hunting and fishing seasons would continue as presently managed.

## ALTERNATIVE 2

### MAXIMIZE BIOLOGICAL POTENTIAL FOR GRASSLAND-NESTING BIRDS

There would be intense management of upland habitat to maximize numbers of migratory birds. The amount of grassland habitat would be maximized by the elimination of croplands, decreased wetland acreage, and the elimination of shelterbelts.



*Killdeer*  
© Cindie Brunner

Grassland-dependent birds would benefit from increased grassland. The number of woodland- and edge-dependent species would be reduced. With the elimination of all cropland, deer depredation on neighboring crops may increase.

Sedimentation rates in wetlands would decline with the removal or breaching of the dikes on Mud and Sand lakes, resulting in long-term benefits to water quality. Invasive plants might increase due to lower water levels. The diversity of wetland-dependent species would decline. Use of the refuge by

waterfowl and overwater-nesting colonial birds would decline.

Conflicts between human and bird activities would be moderated through restriction or elimination of nearly all spring and summer recreational use and some fall recreational use of the James River within the refuge.

Accessibility of deer and upland game to hunters would likely decrease. Migrating waterfowl may pass through the refuge more quickly during the fall. Hunter satisfaction may be lowered as harvest opportunities decrease.

Fall and winter fishing would be allowed. Spring and summer fishing would be eliminated to avoid direct conflicts with nesting migratory birds.

## ALTERNATIVE 3

### INTEGRATED MANAGEMENT—PROPOSED ACTION

This is the draft CCP for the refuge, which maximizes the biological potential for migratory birds and finds a balance with reducing cropland, while ensuring depredation is minimized. The vegetative diversity of grasslands would be greatly enhanced by reseeding for native plants or rejuvenated dense nesting cover. Some shelterbelts, isolated trees, and invading Russian olives would be removed.

The five subimpoundments would be managed as shallow-water wetlands for waterfowl breeding pairs and broods, nesting black terns and pied-billed grebes, and foraging water birds and shorebirds. The ability to cycle vegetation and create interspersed cover and water through current water level manipulations would be hindered. Reduced invertebrate production may impact wetland productivity, as well as limit a major food source for waterfowl.

Watershed-level conservation efforts through partnerships may result in a long-term reduction of sediment entering the James River and refuge.

Cropland acreage would be reduced. The size and location of remaining cropland would be based on the need to control invasive plants, especially Canada thistle, and would be coordinated with the South Dakota Department of Game, Fish and Parks (SDGFP) to address resident wildlife issues. Canada thistle would be much more contained than it is currently, reducing the potential for a seed source to invade adjacent or downstream private lands.

All hunting and fishing seasons would continue as presently managed. Support facilities would be improved.

Wildlife-dependent recreational and educational activities would be expanded and improved on- and off-refuge.

# 1 Purpose and Need

This document presents an environmental assessment (EA) that evaluates alternatives for, as well as expected consequences of, management of the Sand Lake National Wildlife Refuge in northeastern South Dakota (figure 1).

The draft comprehensive conservation plan (CCP) for the refuge is represented by alternative 3 (chapter 4).

The Sand Lake National Wildlife Refuge manages the Sand Lake Wetland Management District (WMD), which contains 162 waterfowl production areas (WPA). This entire area is known as the Sand Lake National Wildlife Refuge complex.



Scaup

© John Jave

This draft CCP does not address management of areas other than the refuge itself, because a separate CCP will be developed to guide management of the WMD.

The National Wildlife Refuge System Administration Act, as amended by the National Wildlife Refuge System Improvement Act (1997), requires that CCPs be in place for all national wildlife refuges within 15 years of enactment (2012).

A CCP is needed to guide the conservation and use of resources on the refuge for the next 15 years.

In general, a CCP serves to do the following:

- Ensure that the purpose of the refuge and mission of the National Wildlife Refuge System are being fulfilled.
- Ensure that national policy direction is incorporated into refuge management.
- Ensure that opportunities are available for interested parties to participate in the development of management direction.

- Provide a systematic process for making and documenting decisions.
- Establish broad strategies for programs and activities.
- Provide a basis for evaluating accomplishments.

## AGENCY GUIDANCE

The U.S. Fish and Wildlife Service is the principal agency responsible for conservation of our Nation's fish, wildlife, and plant resources. This responsibility is shared with other federal agencies and state and tribal governments.

*The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.*

The Service manages a diverse network of more than 540 national wildlife refuges within the National Wildlife Refuge System, which encompasses 95 million acres of lands and waters. Sand Lake is one of six national wildlife refuges in South Dakota and was the 71<sup>st</sup> national wildlife refuge established.

*The mission of the National Wildlife Refuge System is to administer a network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.*

Operation and management of national wildlife refuges are influenced by a wide array of laws, treaties, and executive orders (appendix A). The primary guidance comes from these laws:

- National Wildlife Refuge System Administration Act of 1966, as amended
- National Wildlife Refuge System Improvement Act of 1997

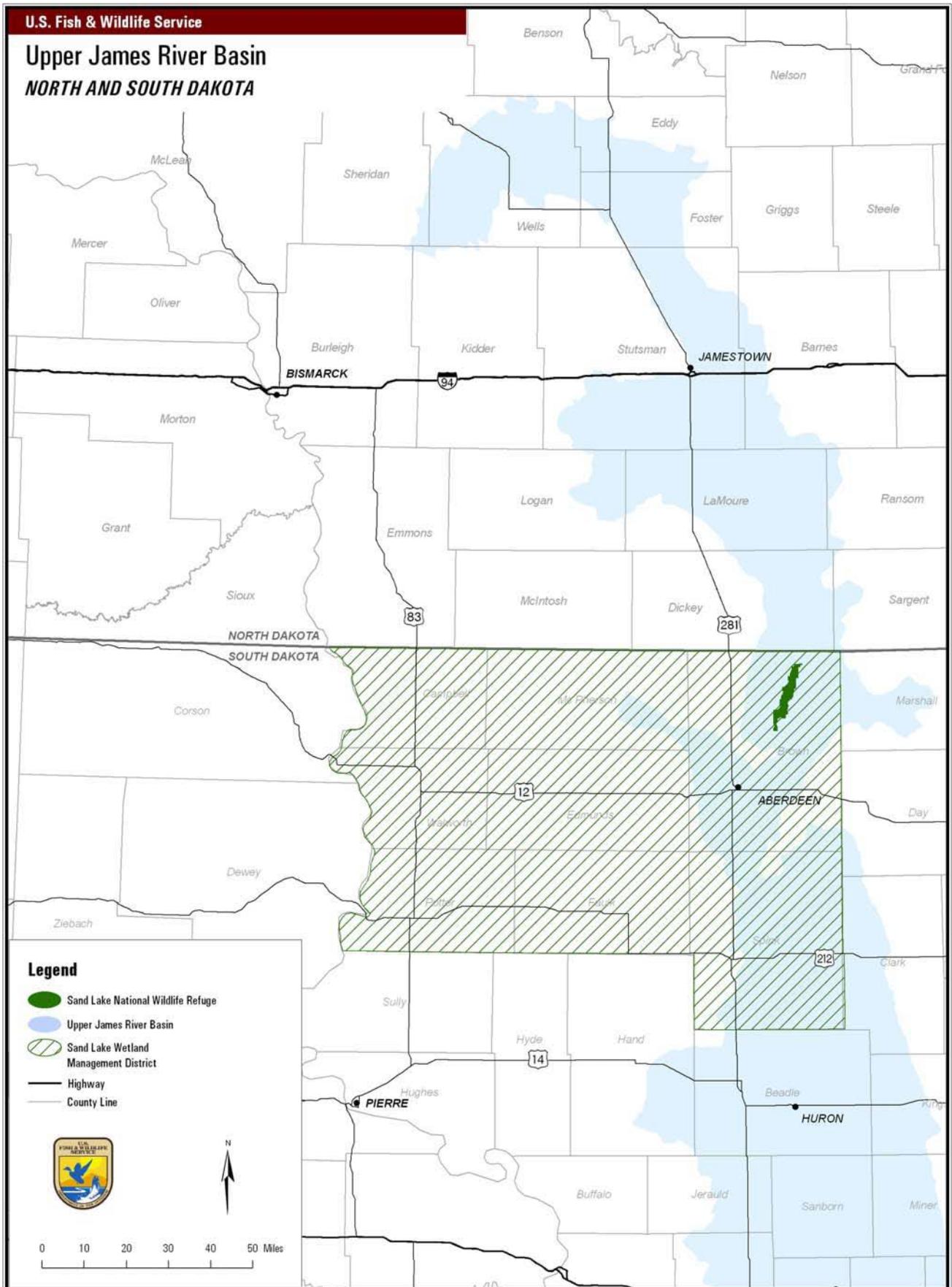


Figure 1. Vicinity map, Sand Lake National Wildlife Refuge, South Dakota

- All national wildlife refuges are established with these national goals (Service Director’s Order No. 132):
  - Fulfill our statutory duty to achieve refuge purpose(s) and further the Refuge System mission.
  - Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
  - Perpetuate migratory bird, inter-jurisdictional fish, and marine mammal populations.
  - Conserve a diversity of fish, wildlife, and plants.
  - Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
  - Foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, environmental education, and interpretation.

These goals help support the Refuge System mission and principles of the 1997 amendments to the National Wildlife Refuge System Administration Act. These goals serve as a foundation for stewardship of the Refuge System and define its role among various federal land systems.



*Bobolink*

© John Jave

The Improvement Act calls for making opportunities for wildlife-dependent recreation, as long as they are compatibly managed with other purposes and do not conflict with other use. Service policy allows use if it is appropriate (appendix B).

An appropriate use

- contributes to the Refuge System mission, the refuge’s major purposes, or refuge goals or objectives
- is a priority public use (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation)
- supports the safe and effective conduct of a priority public use

It is the policy of the federal government—in cooperation with other nations and in partnership with states, local governments, Indian tribes, and private organizations and individuals—to administer federally owned, administered, or controlled prehistoric and historic resources in a spirit of stewardship for the benefit of present and future generations.

To maintain the health of individual national wildlife refuges, and the Refuge System as a whole, managers must anticipate future conditions—to avoid adverse effects and take positive actions to conserve and protect refuge resources. Effective management also depends on knowledge of larger systems and resource relationships.

## REFUGE OVERVIEW

Sand Lake National Wildlife Refuge was established in 1935 as a refuge and breeding ground for migratory birds and other wildlife.

The marshes and open water impoundments of the refuge are surrounded by prairie grasslands, cultivated fields, and scattered woodlands along the James River. The refuge was formed primarily from farms and homesteads that failed during the drought of the 1930s.

The original purchase of 21,451 acres was completed by 1939. Since that time, several land exchanges with neighboring landowners and the South Dakota Department of Game, Fish and Parks (SDGFP) have resulted in boundary changes. An inholding along the west edge of the refuge was purchased in 1985, bringing the fee- title ownership to 21,498 acres. The refuge also has approximately 320 acres under agreement, lease, or easement, bringing the total acreage under refuge management to 21,820 acres.

## PURPOSES OF ESTABLISHMENT

Management is dictated, in large part, by legislation that created the refuge and defines the purposes for which the refuge was established.



Five authorities exist for the acquisition and establishment of Sand Lake National Wildlife Refuge:

- Executive Order 7169 (September 4, 1935), "...as a refuge and breeding ground for migratory birds and other wild life..."
- Migratory Bird Conservation Act, "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds..."
- The Fish and Wildlife Act, "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..."
- National Wildlife Refuge System Administration Act, "...conservation, management, and ...restoration of the fish, wildlife, and plant resources and their habitats...for the benefit of present and future generations of Americans..."
- The Refuge Recreation Act, "...for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..."

The refuge was specifically established to improve and maintain habitat for nesting and resting waterfowl and other migratory birds, such as diving and puddle ducks, geese, grebes, herons, egrets, gulls, and terns. Management continues to be directed toward meeting the habitat requirements of these priority species as well as other migratory and resident wildlife, such as white-faced ibis, double-crested cormorant, tundra swan, American white pelican, perching birds, ring-necked pheasant, white-tailed deer, and furbearers. A complete list of vertebrate species that are known to occur on the refuge can be found in appendix C.

## PURPOSE OF AND NEED FOR ACTION

As directed by the National Wildlife Refuge System Improvement Act, CCPs will be developed for all units of the National Wildlife Refuge System. These plans must include public involvement in their development. A CCP needs to set goals and objectives that meet the establishment purposes for the refuge, as well as contribute to the mission of the Refuge System. Wildlife has first priority in the management of national wildlife refuges.

The purpose of developing this CCP is to provide a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats on the refuge, while providing opportunities for compatible wildlife-dependent recreational uses.

The CCP, when fully implemented, should

- achieve refuge purposes
- maintain and restore the ecological integrity of the refuge
- help fulfill the Refuge System mission
- meet other mandates

## VISION STATEMENT

As part of the planning process, the refuge staff and planning team developed the following vision statement for the Sand Lake National Wildlife Refuge.

*Provide habitat for the production, maintenance, and basic life requirements for threatened and endangered species, migratory birds, and other wildlife species.*

*Promote the natural biological diversity of the region through preservation, management, and enhancement of refuge lands and waters.*

*Provide the public with the opportunity for wildlife-dependent recreation and the enjoyment and appreciation of America's wildlife resources.*

## GOALS

A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units. Goals will direct work at carrying out the refuge's mandates and achieving the purposes. Each management alternative is designed to meet all the goals for the refuge, with

the exception of one subgoal noted below that differs between alternatives.

These goals are derived from the purposes and vision statement for the refuge to reflect the refuge's contribution to the National Wildlife Refuge System. The goals reflect the core mission of the U.S. Fish and Wildlife Service to protect fish, wildlife, and plant resources while providing compatible opportunities for the public to appreciate and enjoy the natural environment of the region.

### **BIOLOGICAL DIVERSITY GOAL**

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of Sand Lake National Wildlife Refuge.

#### **Threatened and Endangered Species Subgoal:**

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

**Waterfowl Resources Subgoal:** Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.

*[Addressed only in alternative 1.]*

#### **Waterfowl and Grassland-nesting Birds Subgoal:**

Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

*[Addressed only in alternatives 2 and 3.]*

**Colonial Birds Subgoal:** Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

**Resident Wildlife Subgoal:** Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

**Grassland Habitat Subgoal:** Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

**Wetland Habitat Subgoal:** Provide and maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.

### **WILDLIFE-DEPENDENT RECREATIONAL USE GOAL**

Provide opportunities for quality, wildlife-dependent, recreation for visitors to Sand Lake National Wildlife Refuge.

**Consumptive Use Subgoal:** Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and that contribute to a quality outdoor hunting or fishing experience.

**Nonconsumptive Use Subgoal:** Provide wildlife-dependent, compatible, nonconsumptive, recreational activities that increase public understanding and appreciation of wildlife and its conservation.

### **PUBLIC EDUCATION AND OUTREACH GOAL**

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

## **AN ECOSYSTEM APPROACH**

The Service has adopted an ecosystem approach to conservation to enable it to fulfill its federal trust resource responsibility with greater efficiency and effectiveness. Through this holistic approach to resource conservation, the Service can accomplish its mission to conserve, protect, and enhance the Nation's fish and wildlife and their habitats for the continuing benefit of the American people. Landscape-level goals have been developed within several wildlife conservation plans for North America (appendix D).

An ecosystem approach to fish and wildlife conservation means protecting or restoring function, structure, and species composition of an ecosystem, while providing for its sustainable socioeconomic use. Key to implementing this approach is recognizing that partnerships are an essential part of a diverse management plan.

The Service has adopted watersheds as the basic building blocks for implementing ecosystem conservation. Sand Lake National Wildlife Refuge is located in the Mainstem Missouri River ecosystem, which includes the Dakotas and northeastern Montana. This ecosystem is depicted in figure 2.



*Northern Pintail*

Dave Menke/USFWS

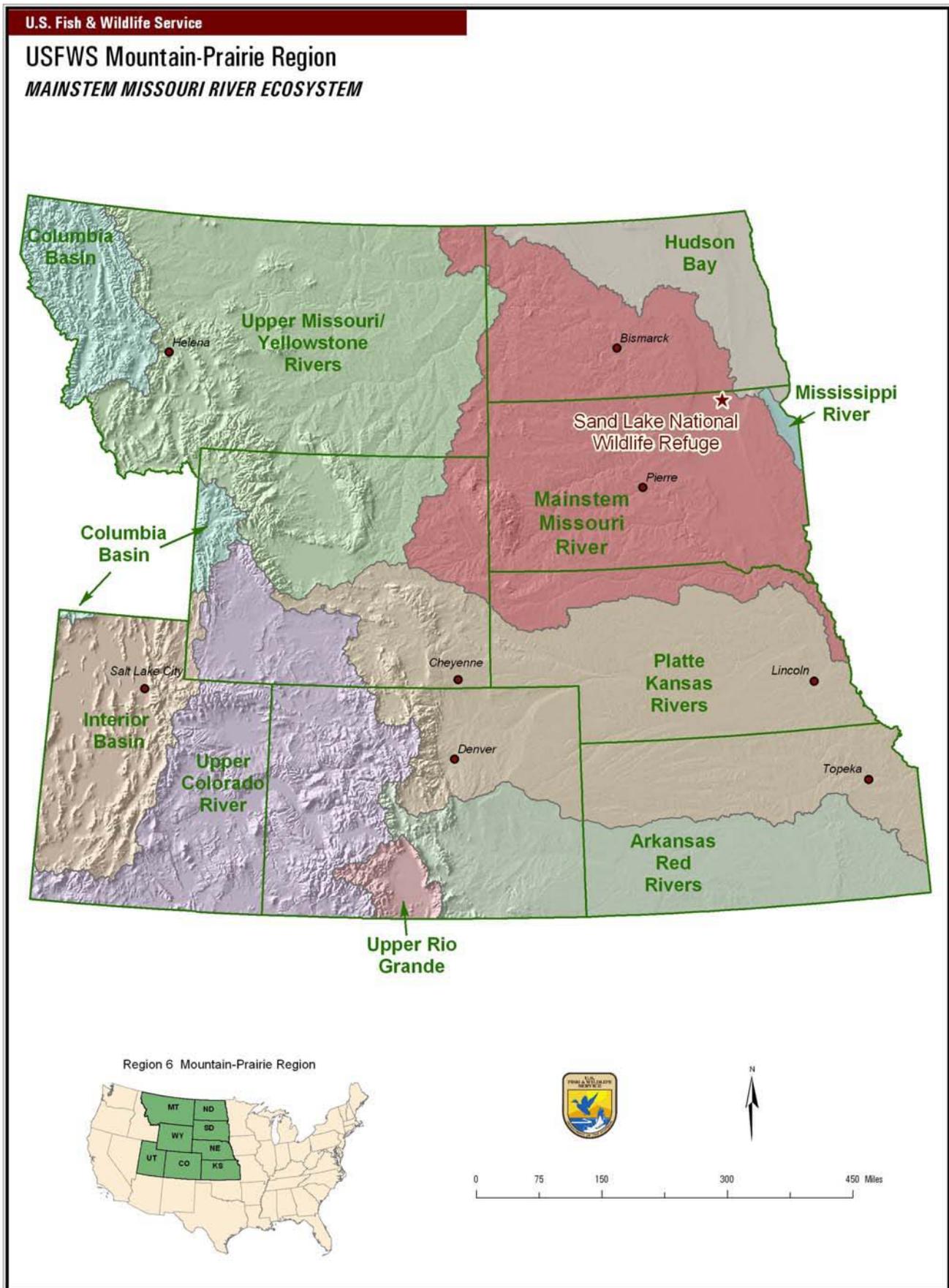


Figure 2. Mainstem Missouri River ecosystem

Planning for the Mainstem Missouri River ecosystem sets forth visions and goals for prairies, wetlands, and rivers to conserve fish and wildlife by protecting and restoring the natural ecosystem

(appendix E). The habitat and wildlife goals and objectives for the refuge will contribute to meeting the mission for the Mainstem Missouri River ecosystem.



## 2 Planning Process

The National Wildlife Refuge System Improvement Act of 1997 directs the U.S. Fish and Wildlife Service to manage refuges in accordance with an approved CCP.

This section describes the planning process and issues specific to Sand Lake National Wildlife Refuge.



*Birdwatching is popular on many national wildlife refuges, including Sand Lake.*

### THE PROCESS

The Service is following the planning steps listed below to determine the future management of the refuge, in a thorough manner that meets requirements of the National Environmental Policy Act (NEPA) and Service policy.

The CCP process consists of a series of steps that are displayed sequentially; however, CCP planning, along with NEPA analysis and documentation, occur simultaneously. Although public involvement is listed as part of two steps, the Service will take public input at any point in the planning process.

- Preplan—form a planning team, review available data, organize efforts.
- Initiate public involvement and scoping—gather public input on issues.
- Develop draft vision and goal statements.
- Develop and analyze draft alternatives, including a proposed action—includes developing draft objectives.
- Prepare documentation of the NEPA analysis, including the draft plan (proposed action alternative).

- Conduct internal review (Service, state and tribal partners) and gather public input on draft document.
- Analyze and respond to public comments.
- Select one of the alternatives, which becomes the CCP.
- Make revisions as necessary and prepare the final CCP.
- Approve and implement the CCP.
- Monitor and evaluate actions and results.

The planning team for the CCP (appendix F) is carrying out the process and has prepared this draft CCP and EA.

Coordination with the public, local groups, and other agencies has been essential in developing a realistic, meaningful plan.

### DECISIONS TO BE MADE

Based on the analysis documented in this EA, the following decisions will be made by the Service's regional director for region 6 (Mountain–Prairie Region), headquartered in Lakewood, Colorado.

- the type and extent of management and public access that will occur on the Sand Lake National Wildlife Refuge
- whether or not the management and public access on the Sand Lake National Wildlife Refuge would have a significant impact on the quality of the human environment

### DOCUMENTATION

As part of the decision-making process of the Service, this document has been developed in accordance with the NEPA. Three alternatives provide options for addressing management concerns and for resolving issues. The draft CCP is described in alternative 3 (the Service's proposed action) of this EA.

This document displays the results of planning to date to develop the CCP for the refuge. It includes a description of the existing environment, the alternatives for management, and an assessment of the effects of carrying out the alternatives.

## STEP-DOWN MANAGEMENT PLANS

The CCP is intended as a broad umbrella plan that provides general concepts and specific wildlife, habitat, endangered species, public use, and partnership objectives. The purpose of step-down management plans is to provide greater detail than what is in the CCP to managers and employees who will implement the strategies described in the CCP.

Step-down management plans describe strategies, procedures, methods, and tasks for specific resources or functions. Often these plans require their own compatibility determinations, environmental assessments, or other justification before they can be implemented.

The preparation and execution of these plans is dependent on funding and the availability of staff or technical expertise. Additional step-down plans will need to be developed, revised, or amended as a result of this CCP (table 1). Plans will be completed or revised, as needed, within 2 years of funding and necessary staff becoming available.

**Table 1. Step-down management plans for Sand Lake National Wildlife Refuge, South Dakota**

<i>Step-down Management Plan</i>	<i>Completed Plan, Year Approved</i>	<i>New or Revised Plan, Completion Year</i>
Deer management plan	—	2006
Fire management plan	1999	—
Habitat management plan	—	2010
Integrated pest management plan	1996 (obsolete)	2005
Law enforcement plan	—	2010
Predator management plan	1992	—
Safety plan	2003	2010
Visitor services plan	1990 (obsolete)	2010
Water management plan	2001	—

## PLAN REVISION

Plans are dynamic—management strategies need to be reviewed and updated periodically. The CCP will be reviewed at least annually to determine if it requires any revisions.

Monitoring and evaluation will determine whether management activities are achieving the refuge purposes, vision, and goals. When significant new information becomes available, ecological conditions change, major refuge expansions occur, or other needs are identified, the CCP can be revised.

Revision will occur, at a minimum, every 15 years. If the plan requires a major revision, the CCP process starts anew. Plan revisions require NEPA compliance. The public will continue to be informed of, and involved with, any revision to the CCP.

## PUBLIC INVOLVEMENT

The NEPA process is being used by the Service to engage the public in refuge planning, while determining whether the proposed action for management of the refuge would have significant effects.

“Scoping” is the term for requesting input from the public, in this case, regarding management of a refuge. The primary thrust for the planning process is to provide a forum for ideas and issues to be shared, reviewed, and evaluated among agency staff and the public.

Comments are reviewed to identify issues and public concerns about, or advocacies for, future management of the refuge. These issues are addressed in the EA and draft CCP, other plans, and decision documents.

Public scoping was initiated in a Notice of Intent published in the Federal Register (August 1, 2001), announcing the availability of an issue workbook and dates for open houses to be held for public input on management of the refuge. The open houses were held in October 2001. A summary of the public involvement is in appendix G.

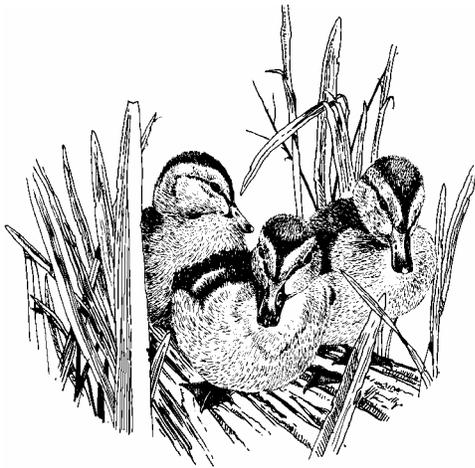
## PLANNING ISSUES

The public scoping meetings, issues workbooks, and refuge information indicated that there are four major issues of concern regarding refuge management. This document uses these issues to describe what was addressed during the planning process, as well as for the format to display environmental consequences of the alternatives (chapter 5).

## WILDLIFE AND HABITAT

The quality of upland grassland habitats is important for providing the needs of migratory birds and meeting the establishment purposes of the refuge. Prior to the refuge’s establishment, the

native prairie within the vicinity of Sand Lake National Wildlife Refuge was almost entirely broken up and converted to cropland.



Today, the uplands largely consist of smooth brome, a cool-season grass that lacks structural diversity and tends to form a less vigorous species monoculture as the stand ages. Dense nesting cover (DNC)—tame, introduced cool-season grasses with sweetclover and alfalfa—was planted on the uplands as nesting cover for migratory birds. Grazing has been the primary tool used to manage these stands. Eventually DNC needs intensive management to restore the best wildlife habitat. Either these uplands are replanted to DNC or native grass can be reestablished.

Refuge users want a great diversity of wildlife, including game species, supported by a variety of habitats. Game species, especially waterfowl and deer, are important recreational resources. Maintaining the farm program would help maintain resident game species (white-tailed deer and pheasant). Some refuge neighbors are losing crops of corn and alfalfa to foraging deer.

## WATER MANAGEMENT

The refuge must use, maintain, and protect its water rights for the use of James River water. Refuge management strategies are impacted by the extremely low gradient of the James River in northern South Dakota. Water levels are manipulated on Sand and Mud lakes and five subimpoundments to modify emergent vegetation to help meet wetland objectives. During the nesting period, the refuge attempts to hold water levels steady to protect the nests of colonial, overwater-nesting birds. The critical period is May 15–August 1, during which sudden changes place nesters at risk.

With the refuge being located on the James River, control of water levels to manage wetlands is extremely dependent on river flows. Demands on the water resources of the James River require

collaboration between a diversity of stakeholders including the Army Corps of Engineers, Bureau of Reclamation, Arrowwood National Wildlife Refuge, Kulm Wetland Management District, Oakes Test Area, Garrison Diversion District, North Dakota State Water Commission, South Dakota Department of Environment and Natural Resources, James River Water Development District, and many private irrigation interests.

The water cycle affects the wildlife and the fishery and subsequent recreational opportunities. There was some public concern that water management for waterfowl may have a detrimental impact on the fishery. For example, water drawdowns to winterkill rough fish also kill game fish.

Water levels on the refuge may affect water tables on neighboring lands. Salt is surfacing on lands within Brown County. It was asserted that water should be moved through the system as quickly as possible.

## PUBLIC USE

Recreational opportunities on the refuge and the James River are very important to local residents.

Hunting is a priority public use to be considered on national wildlife refuges, when determined compatible with the refuge's establishment purposes. Hunting, especially of deer, waterfowl, and pheasant, is very popular on Sand Lake National Wildlife Refuge.

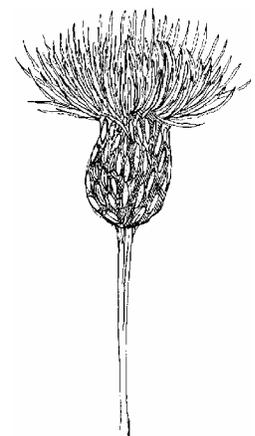
There is demand for fishing, particularly ice fishing. People want more fishing opportunities, but the ability of the refuge to provide fishing that is compatible with the purposes of the refuge (i.e., migratory wetland birds) is very limited. Insufficient fishing access occasionally creates minor traffic congestion at one access point when anglers use the road right-of-way for fishing.

There is public support for an education center. In addition, there is some public interest in camping and recreational trapping.

## INVASIVE PLANTS

Invasive plants, especially Canada thistle, are dominating plant communities and impacting habitats in some areas.

Canada thistle is a serious invasive species problem on the refuge. This plant tends to form monocultures in the absence of management actions such as herbicide application, haying, or replanting.



*Canada Thistle*  
© Cindie Brunner

Without intensive management, the refuge would become a sea of smooth brome and Canada thistle, incapable of providing habitat for a diversity of grassland-dependent wildlife.

Invasive plants on the refuge are particularly troublesome for neighbors who are required by state and local laws to control invasive species on their

lands and view the refuge as a source of invasive plant expansion onto their lands.

Chemicals used to control invasive plants are of concern from the standpoint of environmental contamination and negative impacts on desirable plant species.

# 3 Affected Environment

The Sand Lake National Wildlife Refuge is located in Brown County, South Dakota, approximately 25 miles northeast of Aberdeen. To get to the refuge, visitors must travel 5 miles east of Aberdeen on South Dakota Highway 12, and then 20 miles north on Brown County Highway 16.

The refuge lies in north-central South Dakota and covers 21,498 acres (figure 3). This area of South Dakota is in the heart of the prairie-pothole region of the northern Great Plains and plays a major role for migratory birds associated with the Central Flyway. Since the refuge is located near the 100<sup>th</sup> meridian, both eastern and western migratory bird species may be found.

This chapter describes the current physical and socioeconomic environment of the refuge:

- Geographic setting
- Special management areas
- Physical resources
- Biological resources
- Fire regime and fire history
- Natural resources
- Population and habitat monitoring
- Cultural resources
- Wilderness review
- Socioeconomic setting
- Public use
- Partnerships

## GEOGRAPHIC SETTING

The Sand Lake National Wildlife Refuge is located in the upper James River basin (figure 1). The 21,116-square-mile area of the James River basin is divided between North Dakota (6,688 square miles) and South Dakota (14,428 square miles). The South Dakota portion of the basin is 350 miles long, with a maximum width of about 100 miles. The river begins west of Fessenden, North Dakota, flows east for a short distance, then follows a general southerly course through North Dakota and South Dakota to its confluence with the Missouri River east of Yankton, South Dakota.

The upper James River basin is a flat plain bounded by the Missouri River escarpment on the west and the Altamont, Antelope, and Gary moraines on the

east. The basin contains extinct glacial lakes whose beds are distinguishable by the extremely flat topography. The basin slopes from an elevation of 1,630 feet above sea level in the headwaters, down to 1,300 feet above sea level at the North Dakota-South Dakota line, and to 1,170 feet above sea level at the mouth of the James River. The river follows 747 miles of winding channel across the 350-mile length of the basin (within South Dakota). This meandering stream lies in a shallow flood plain that varies from a few hundred feet to three miles in width.



*Wetlands fill the backdrop behind the Sand Lake National Wildlife Refuge's sign.*

The James River lowlands are bordered by the Missouri Coteau, which extends from the Missouri River on the west and the prairie coteau to the east. The major land features associated with this area of South Dakota are products of the Pleistocene glaciations that formed the Missouri River and the prairie potholes sometime between 12,000 and 40,000 years ago. This area of the prairie-pothole region provides important habitat for waterfowl production and other prairie birds (figure 4).



**Figure 4. The prairie-pothole region**

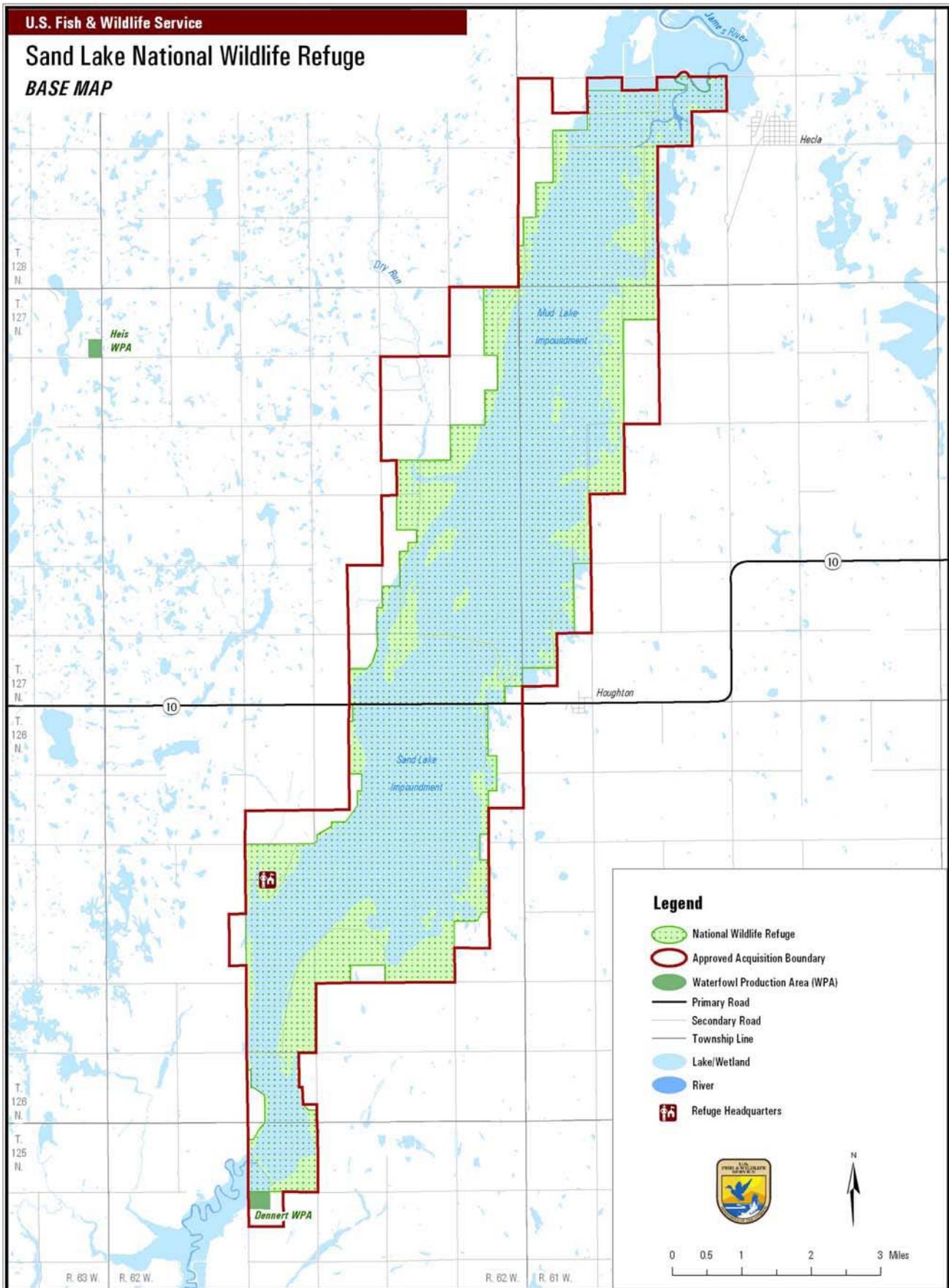


Figure 3. Base map, Sand Lake National Wildlife Refuge, South Dakota

The refuge is located in these rich lowlands along the James River. The James River bisects the refuge north and south and has the flattest gradient of any river its size in North America. From its source to its mouth, its average gradient is only 3 inches per mile. Through the refuge and most of Brown County, the river has a drop of only 1 inch per mile.

Two dams, with water-control structures, were built across the James River during the 1930s by the Civilian Conservation Corps (CCC). These structures impound and enhance two main pools, Mud Lake (containing 5,300 surface acres when full) and Sand Lake (containing 6,100 acres surface acres). Several other impoundments provide additional wetland habitat.

This region of South Dakota was once dominated by native prairie vegetation. The tall-grass prairie is located primarily east of the James River, and the mixed- and tall-grass transition dominates most of the James River basin physiographic region. Much of this zone has been farmed, but some prairie still exists, particularly in areas with numerous shallow wetlands or poor quality soils.

The Service has adopted watersheds as the basic building blocks for implementing ecosystem conservation. The Mainstem Missouri ecosystem includes portions of the Missouri River and Hudson Bay watersheds.

## SPECIAL MANAGEMENT AREAS

In recognition of its value to the conservation of birds and their habitats, Sand Lake National Wildlife Refuge has been designated as both a Globally Important Bird Area (GIBA) by the American Bird Conservancy (March 17, 2001), and a Wetland of International Importance (WII) (Convention on Wetlands of International Importance 1971).



*A Franklin's gull lands on a refuge lake.*

© John Jave

The refuge has supported the largest nesting colony of Franklin's gulls in the world, with up to 150,000 breeding individuals. At the time, this amounted to about 50 percent of the entire population of this at-risk species (National Audubon Society 2002). In addition, many thousands of Franklin's gulls gather on the refuge in the fall.

Other colonial-nesting birds on the refuge include white-faced ibis, black-crowned night-heron, eared and western grebes, and Forster's and black terns. One large, mixed-species, heron rookery hosts up to 6,000 pairs.

The marbled godwit and the willet nest on the refuge, as do the short-eared owl, the bobolink, the Nelson's sharp-tailed sparrow, and the clay-colored sparrow.

Fall migrations of snow geese may reach peaks of 250,000 individuals, whereas the spring migration has been documented at more than 1.2 million. Hundreds of thousands of ducks also stop over on migration.

As many as 12,000 American white pelicans are found on the refuge seasonally. When mud flats are exposed during spring and fall migration, the refuge hosts thousands of shorebirds.

## PHYSICAL RESOURCES

Soil and water resources largely determine habitat communities, along with climatic factors. Mineral resources and air quality, other important resources, are also described in this section.

### SOILS

The refuge is located along the James River within the Dakota Lake plain, a lowland physiographic division of South Dakota. The area is characterized by the sandy bottom of an ancient lake, glacial uplands, and alluvial flood plains. Soil composition is strikingly different on opposite sides of the refuge. To the east, the soils are characteristically sandy and loamy soils similar to the lake plain. To the west and beyond the refuge, the soil is characteristically silty and sodium-affected silty soils (U.S. Department of Agriculture 1993).

### WATER RESOURCES

The upper James River is a unique portion of the total James River ecosystem in South Dakota. At the refuge, the flow of the sluggish James River is interrupted by two natural pools (Mud and Sand lakes) that have been regulated by low, earthen dams and water control structures. Both lakes are shallow; Mud Lake averages about 1.5 feet in depth and Sand Lake averages about 2.75 feet in depth

with current management. The maximum depths of the pools are approximately 6 feet. Margins and other shallow areas of both impoundments produce dense stands of emergent vegetation.

The principal water right at the refuge is withdrawal number U.S. 1-3 (October 16, 1934). The withdrawal covers 61,062 acre-feet of water (27,021 acre-feet storage and 34,041 acre-feet seasonal use) from the James River. The water's principal use is for migratory waterfowl use, supplemental use, game and fish propagation, and public recreation.

The refuge also holds water license number 4225-3 (February 2, 1978), for 0.67 cubic feet per second (totaling 150 acre-feet annually) from a well at headquarters, with supplemental pumping to a marsh.

Water license number 4258-3 (March 24, 1978) allows 63 acre-feet of water storage and sufficient water annually to maintain the water level at outlet elevation 1291.0 feet mean sea level from Dry Run for waterfowl production.

Water permit number 5516-3 (March 8, 1991) allows for impoundment of 295 acre-feet with sufficient water annually to maintain water level to the outlet elevation of 1288.5 feet mean sea level in Columbia Marsh. This water is diverted from James River overflow during high, spring runoff events to provide habitat for fish and wildlife production.

The refuge also holds a vested right for an artesian well drilled in 1935 by the CCC. The well flows approximately 5 gallons per minute and the water is used for domestic purposes.

## CLIMATIC CONDITIONS

Large seasonal fluctuations of climate in the region are the rule, rather than the exception. Extreme cold in the winter, with mean minimum temperatures of -2.7 °F in January, is normal. During the summer, mean maximum temperatures are commonly near 83.5 °F in July. Precipitation averages 20.3 inches annually, but cycles of drought and heavy precipitation are evident (NOAA 2002).

## MINERAL RESOURCES AND RESERVED RIGHTS

During the withdrawal of lands establishing the refuge in 1935, and as additional lands were acquired, there were no reservations of surface or subsurface mineral rights (to other than the federal government) on all the land owned fee-title by the federal government. Purchase of some land tracts were subject to existing rights-of-way at the time of acquisition. These rights-of-way include a buried telephone line, an electric distribution line, and three highway easements to the South Dakota Department of Highways.

## AIR QUALITY

Visibility and clean air are primary resource values. The protection of these resources must be given full consideration in fire management planning and operations. Additionally, smoke can have serious health and safety effects that must be considered. The management of smoke will be incorporated into the planning of prescribed fires and, to the extent possible, in the suppression of wildfire. South Dakota does not have a permit system for air quality, but does have regulations concerning agricultural burning.

The Environmental Protection Agency's (EPA) air quality index rates air quality in Brown County, South Dakota as "good" (U.S. EPA 2004). In 2001, Brown County ranked among the best, i.e., cleanest, 20 percent of all counties in the U.S. in terms of total environmental releases.

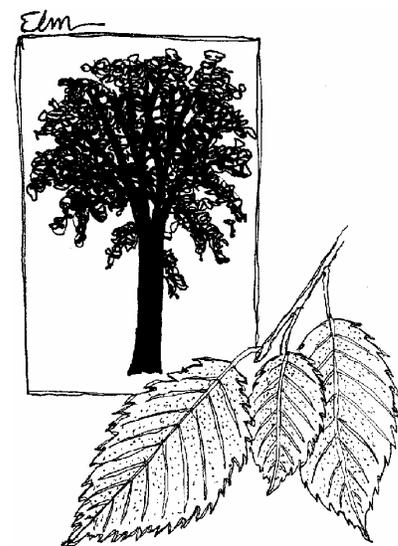
Based on the EPA's most current data, Brown County ranked among the cleaner 40 percent of all counties in the U.S. in terms of an average individual's added cancer risk from hazardous air pollutants (Environmental Defense Network 2004). Conversely, Brown County ranked among the worst, i.e., dirtiest, 20 percent of all counties in the U.S. in terms of aerial emissions of fine particles (Environmental Defense Network 1999), 70 percent of which is a result of agricultural practices (U.S. EPA 1999).

## BIOLOGICAL RESOURCES

This section describes the existing plant and animal communities on the refuge. Figure 5 shows existing habitat conditions, which are also the expected habitat conditions for the no-action alternative (alternative 1).

## HABITAT

The nutrient-laden waters contained in the 11,450 acres of marsh and open water form the heart of the 21,498-acre Sand Lake National Wildlife Refuge. The remaining 10,000 acres of uplands consist of 424 acres of shelterbelts, 1,217 acres of croplands, and more than 8,000 acres of grasslands.



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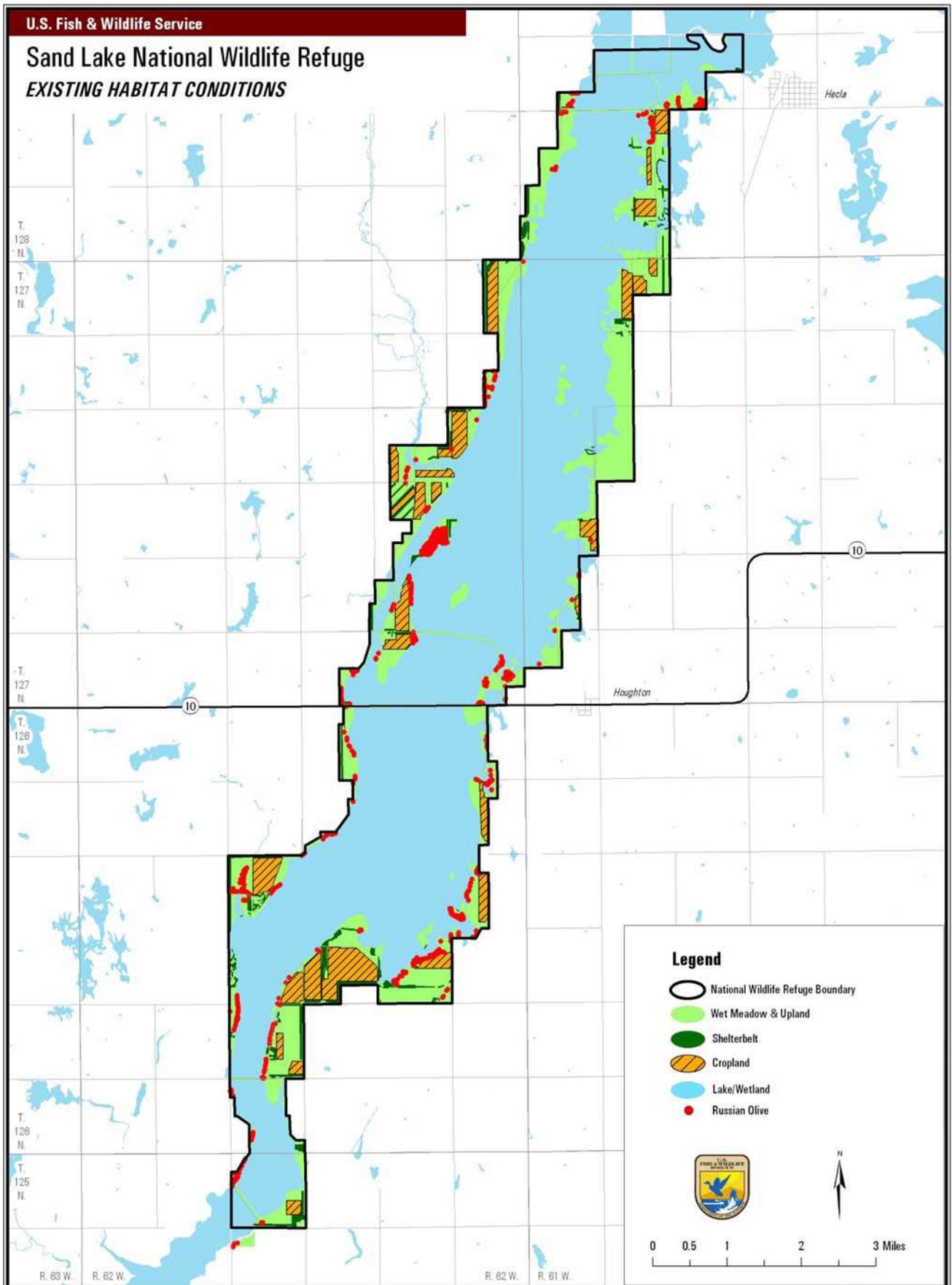


Figure 5. Existing habitat conditions, Sand Lake National Wildlife Refuge, South Dakota

Downstream from the refuge, the meandering, wooded channel provides a scenic contrast to the surrounding agricultural landscape. Terrestrial habitat associated with the upper James River channel is generally characterized by a hardwood corridor, interspersed with thickly vegetated marshes and brushy fields. The existing natural woodland and forest habitat consists primarily of mature, mixed stands of American elm, green ash, boxelder, and willow. This habitat offers scenic beauty and provides the diverse habitat necessary for wildlife to reproduce and survive in the typical prairie environment that surrounds it.

## GRASSLANDS

Grassland vegetation makes up 8,600 of the 21,498-acre refuge. These grassland acres are primarily composed of reseeded exotic grass and forb species, mainly smooth brome and alfalfa with some fields of intermediate wheatgrass and sweetclover.

Grasslands are managed with emphasis on providing optimum nesting cover for upland-nesting waterfowl.

Approximately 8,000 acres of tame grass and legumes (DNC) and restored native grass plantings are on the refuge. Most DNC fields have degraded to smooth brome. These fields have not been recently restored by farming and reseeding to maintain stand vigor. Because Canada thistle tends to invade new grass-seeded areas, the breakup of DNC fields slowed. Instead, management actions such as grazing or haying, followed by a disking, were used to improve the existing stands by encouraging the forb component.

Nearly 500 acres of cropland has been removed from production and planted to restored native grass. These native sites generally consist of six or seven grass species, which may include big and little bluestem, green needlegrass, western wheatgrass, Indiangrass, sideoats grama, and switchgrass. The seeding of forbs in the restoration process has been limited due to high seed costs, difficulty in acquiring seed, and problems associated with the control of Canada thistle in the plantings.

Grasslands are managed using grazing, haying, and prescribed burning. The management tool selected is dependent on the availability of water, fences, livestock, ease of firebreak construction, and suitability for haying. Management is focused on obtaining the maximum height and density of grasslands with some type of management action occurring every 4–5 years.

The refuge has been divided into management zones; individual units are selected each year within a zone depending on the monitoring results. Grazing is used most commonly to reduce litter, stimulate forb species, and promote active healthy growth of the grasslands. Grazing is also used help control invasive

species. Permittees for all grassland management actions are selected by the bid process and only farmers and ranchers who operate on land within 2 miles of the refuge boundary are eligible to bid.

## WETLANDS

The wetland component is comprised of two main bodies of water, Mud and Sand lakes. The construction of the two low-lying dams changed the habitat conditions of these historical marshes.

Wetland habitat on the marsh is characterized by open water, submergent vegetation (e.g., sago pondweed and coon's tail), emergent vegetation (e.g., cattail and common reed), and temporary and seasonal vegetation (e.g., rush, sedge, and prairie cordgrass).

Water management on the refuge is greatly dependent on flows in the James River, largely due to the low gradient. Spring flows are generally allowed to fill Mud and Sand lakes to full-pool level by early May. The pools are held near full-pool level through mid-August. Water levels are dropped 1 foot below full-pool level prior to freeze-up to protect the water control structures and dikes from ice damage. Summer drawdowns are scheduled when needed to reestablish emergent vegetation within the pools.

In addition to the two main impoundments, there are five subimpoundments and many smaller, natural wetlands scattered throughout the uplands. Management of the subimpoundments is opportunistic, being dependent on water levels in the James River or local runoff. Efforts are made to draw down the subimpoundments when wetlands surrounding the refuge are full. The subimpoundments are reflooded during periods of drought to provide quality habitat when it is most beneficial to wetland-dependent wildlife.

## WOODLANDS

Most of the estimated 424 acres of woodlands are in shelterbelts planted by the CCC in 1937–38 to control wind erosion and provide wildlife habitat. The shelterbelts have been deteriorating and no active management has been done to restore them. Most of these plantings consist of American and Chinese elms and green ash. Dutch elm disease has been gradually killing the American elms in these plantings (figure 6).

Historically, woody vegetation occurred along riparian corridors and around some wetlands. Native cottonwood seedlings have colonized naturally into many of the marsh edges due to flood conditions on the James River during much of the 1990s. These isolated, scattered trees, with an understory of cattail and Canada thistle, have been allowed to grow naturally in the flood plain, except where controlled by upland management activity.

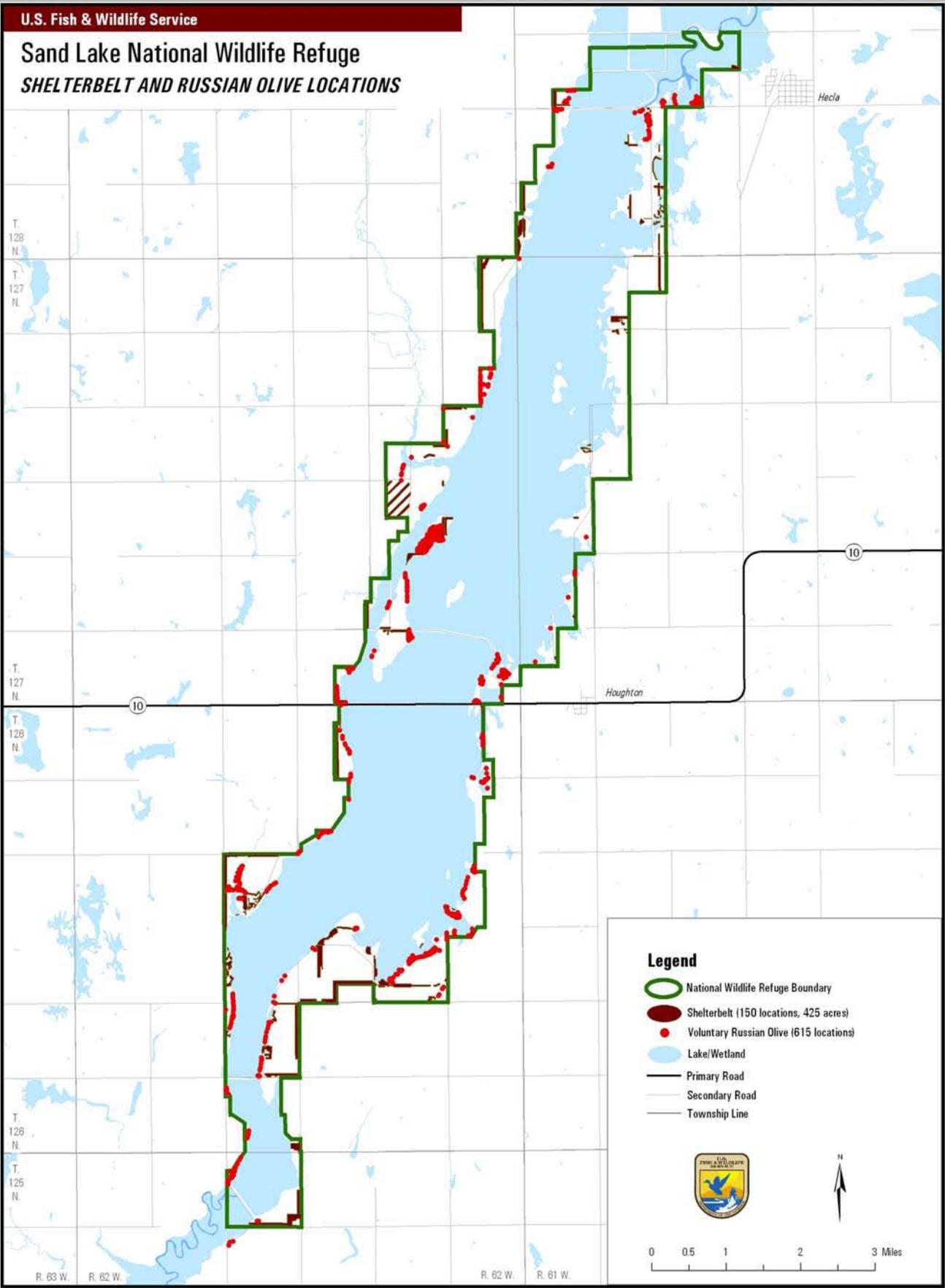


Figure 6. Shelterbelt and Russian olive locations, Sand Lake National Wildlife Refuge, South Dakota

Management of native woodland vegetation has not been emphasized in previous habitat management efforts.

## CROPLANDS

The uplands have a long history of agricultural crop production and virtually all native prairie on the refuge has been lost to the plow. Approximately 3,146 acres of cropland was farmed on the refuge in 1952. In response to a variety of factors, including complaints of short-stopping geese from the southern states, management emphasis for uplands has shifted from providing food for migrating snow geese to waterfowl production. Much of the cropland was replanted with DNC.

Beginning in the late 1990s, additional cropland was replanted to grassland because of the lack of use by the snow geese, and because the midcontinent population of lesser snow geese were well above objectives set for the species. The planting of agricultural crops was not needed for the management of migratory birds.

A total of 1,217 acres of cropland is currently farmed by 8 cooperators on the refuge. Farming is conducted to restore native grass on deteriorating tame grasslands, to reduce use of nonselective broadleaf herbicides, to control invasive plants and to provide, indirectly, food for white-tailed deer.

Fields are typically rotated between corn and spring wheat or soybeans. Refuge cooperators maintain the food plots on a 25:75 sharecrop basis. The kinds of herbicides permitted are limited and no insecticides are allowed. The refuge's share is taken in corn, which is left standing to provide food for wintering white-tailed deer.

## INVASIVE PLANTS

Canada thistle, leafy spurge, Russian olive, and wormwood sage are the primary invasive species in the grasslands on the refuge. At least 3,000 acres of uplands and wetlands are heavily infested with Canada thistle. Most control efforts are directed at Canada thistle using grazing, haying, mowing, and biological methods. This species is a pervasive pest, partly because control measures are limited and generally require repeated application.

Canada thistle has infested almost all wetland margins in northeastern South Dakota, providing an endless seed source. The James River just ended an unprecedented, extended period of flooding during the 1990s. During this period, above-normal precipitation provided ideal germination and growing conditions for this species.

On the refuge, Canada thistle colonizes the wetland margins, spreading from there into the grasslands. Areas identified for treatment have generally been

grazed, mowed, or burned prior to chemical application. To keep infestations in check, an average of 800 acres has been chemically treated annually. The uplands are often reinfested within 4–5 years.

While efforts are made to limit the amount of herbicide used on the refuge, control efforts are never complete because of the tolerance of Canada thistle to control efforts. In addition, an endless seed source from public and private lands makes reinfestation highly likely.

Prescribed fire is an important tool for grassland management; however, Canada thistle usually responds well to fire. Application of herbicides following prescribed burns is essential. There are 2,900 acres of wet meadows. While such areas often have the most severe infestations, these areas are extremely difficult to burn effectively.

Herbicides used to control invasive plants have a disastrous impact on the forb/legume component of a plant community. Chemical control is driving vegetative “succession” toward a chemical-tolerant grass community. The high water table on the refuge is problematic for herbicide application, particularly in the lower wet areas where infestations are the most severe.

Four species of insects were introduced on the refuge for biological control of Canada thistle, two of which have been found to overwinter. However, no reduction in thistle stands has yet been observed. Flea beetles have been introduced to control leafy spurge, with mixed results.

Russian olives have invaded many wetland margins and lowland areas. While annual herbicide treatments control new seedling growth, scattered mature trees continue to serve as seed sources.

Mowing prevents seed germination and dispersal. In addition, mowing prepares areas for subsequent herbicide application if needed. Hundreds of acres are mowed every year.

Grazing is used on a limited scale as part of the integrated approach to invasive plant control; however, the availability of interested cooperators is limited. Grazing serves as a site preparation prior to herbicide applications.

## FIRE REGIME AND FIRE HISTORY

Wildfire is one of the primary natural disturbances of native prairie. Historical records describe huge prairie fires started by lightning or humans. Fires burned millions of acres, as there were few natural fuel breaks and no suppression. Wright (1980) and others believe that fire frequency in the prairie

grasslands is 5–10 years. Other studies indicate that a longer frequency of 10–20 years may be more accurate (Jave 1999).

Prior to the 20<sup>th</sup> century, the role of fire in the northern plains had been one of continued perpetuation of the prairie ecosystem. Fire restored vigor to plant growth, increased seed production, released nutrients, and reduced accumulations of litter (Higgins 1986a, b). This included the area now designated as the Sand Lake National Wildlife Refuge.

Since the early 20<sup>th</sup> century and the establishment of the refuge, nearly all fires within the boundaries have been suppressed and adjacent habitat has been fragmented by agricultural practices. These activities have significantly reduced the role fire plays as a vital element of the prairie ecosystem in north–central South Dakota. In addition, grassland composition and structure have changed (i.e., exotics). This has influenced fuel type, extent, and micro-environmental factors (moisture). Recently, there has been an accumulation of knowledge, now being translated into management practices, that recognizes fire as an essential process of the mixed-grass prairie.

Over a 20-year period (1977–97), only 16 wildland fires, burning a total of 517 acres of Service and non-Service lands, have been reported. This limited acreage burned is partly attributed to barriers such as roads, plowed fields, lakes, ponds, or rivers that serve as breaks. Remaining areas within the refuge had been mostly hayed or grazed, making them less fire prone.

## NATURAL RESOURCES

The upper James River provides aquatic habitat for a wide range of plants and animals that have persisted through the years, despite multiple human alterations and fluctuating conditions. The James River basin is one of few major north–south migration corridors in the northern Great Plains with relatively intact riparian vegetation. This draws large numbers of migratory birds to move through the Dakotas in spring and fall.

The James River, running more than 600 miles through North Dakota and South Dakota, forms a natural flight path for migrating birds—one of the most heavily used in the Central Flyway. The upper James River is an important migration route for many species of songbirds, marsh birds, and other nongame birds.

As part of the only continuous north–south corridor of woodland habitat in South Dakota, at least 161 species of birds have been identified in this area during migration periods, many of which remain there to nest. Schneider (1978) identified 138 species

on his census routes, including 103 in woodlands, 71 in savannahs, 67 in marshes, and 62 in grasslands. In addition, a minimum of 48 species of mammals have been identified. The bird and mammal diversity demonstrate the importance of the river system (including the refuge) to both nongame and game species.

Mud and Sand lakes are managed for intensive use by waterfowl and other migratory birds during the spring, summer, and fall and for rough fish control during the winter. Production of sago pondweed and other submergents that are important food resources for birds are encouraged.

## WATERFOWL

The prairie–pothole region is the primary breeding grounds for waterfowl in the United States. Mallards, wood ducks, and blue-winged teal are the most common breeding ducks (Schneider 1978). Populations are variable, peaking in high-water years. Studies conducted by the Service found concentrations as high as 15 breeding pairs per square mile. Wood duck densities of two breeding pairs per square mile use the refuge woodlands. Breeding densities on the river were the highest in Brown County, primarily at the Stratford Slough area.



*Snow Geese*

Dave Menke/USFWS

Large concentrations of migrating waterfowl use the flood plain and temporary and seasonal wetlands in the area for resting and feeding. On the refuge, waterfowl populations have averaged approximately 184,000 ducks and 216,000 geese annually.

## COLONIAL BIRDS

Colonial-nesting grebes, gulls, ibises, terns, and herons are found on the refuge. Fall concentrations of Franklin's gulls and ring-billed gulls have peaked at 150,000 and 5,000, respectively.

Information gathered by the Service (USFWS 1985) indicates that use of the James River by colonial-

nesting species, including the great blue heron and double-crested cormorant, may be greater than previously realized. The preliminary list includes 24 rookery sites below the refuge, 9 of which are in Brown County. These birds depend on trees for nesting and on aquatic habitats for food, mostly fish.

## SHOREBIRDS

Shorebird surveys have been conducted annually since 2000. Refuge data contributes to Manomet's International Shorebird Survey and the U.S. Geological Survey prairie-potholes shorebird survey. Analyses of shorebird numbers in conjunction with records of water levels in Mud and Sand lakes may be helpful in making future decisions regarding management of impoundments for shorebirds.

## FISH

The upper James River, from the North Dakota border to near Redfield, South Dakota (including the refuge), is an important fish production area for the James River.

Currently, 60 species of fish have been identified as occurring in the James River and at least 22 in the upper reaches in South Dakota. Owen and others (1981) collected 41 species in the river. Primary game fish species are black bullhead, walleye, northern pike, yellow perch, channel catfish, and crappie. The majority of fish biomass in the river is made up of nongame species such as carp, buffalo, and freshwater drum.

The upper James River, which includes the refuge, provides excellent spawning habitat and has highly productive rearing areas during spring floods. Occasional test-netting by SDGFP showed an annual influx of fish during the spawning season.



Northern Pike  
Tom Kelley/USFWS

There is important reproductive and rearing habitat for the northern pike, which is probably the only game fish that occurs on the refuge.

Fish greatly influence relationships of species in aquatic systems. In the upper

James River, fish are an important food source for birds such as cormorants and herons and mammals such as mink and raccoon. In turn, fish depend on a rich supply of aquatic insects, crustaceans, and other organisms for food. Collectively, these organisms are dependent on the diverse environment of pools, riffles, brush piles, and overhanging vegetation that the upper James River provides.

The quality of the aquatic habitat is directly related to stream flow characteristics. The James River is a typical prairie stream, subject to heavy organic and sediment loads, low oxygen levels, and wide fluctuations in stream flow. Historical flows range from zero in dry years to several hundred-thousand acre-feet.

Generally, stream flow is at a minimum in winter and reaches maximum in the spring (March–June). Dissolved oxygen levels sometimes reach zero in stretches of the river, usually during periods of low flow, resulting in fish kills. Despite frequent occurrence of these adverse conditions, the upper James River maintains a substantial fish population with its diversity of habitat types—deepwater pools (protective areas) and spawning sites (reproductive areas)—and the migration of fish from other areas.

## DEER

The white-tailed deer population in Brown and Spink Counties largely depends on the James River for production and survival.



© John Jave

*Doe with Fawn*

Data gathered on the Oahe Irrigation Project (Solomon 1982) showed that deer sightings ranged from 0.117 to 0.431 adults per mile in the irrigation areas and from 0.477 to 1.555 adults per mile on the James River. In this study, 91.2 percent of the sightings were along the river's flood plain.

A standardized spotlight survey was developed to obtain total deer counts and doe/fawn ratios for the pre-hunting population of deer on the refuge in 1990.

A post-season spotlight survey was standardized to provide comparative data. This data was collected by Bill Antonides of the South Dakota Game, Fish and Parks, with annual assistance from refuge staff. The data provides an index of the total deer population used by SDGFP and refuge staff to set hunting licenses for population control.

## OTHER WILDLIFE

The upper James River's marsh habitat (Brown and Spink Counties) is important to the pheasant population as protection from winter storms. Winter concentrations of more than 1,000 birds have been reported in this area (SDGFP 1976). In addition, the brushy, wooded cover provides roosting and loafing areas.

Furbearing mammals are closely tied to the river ecosystem, depending on both the terrestrial and aquatic habitat. Mink, raccoon, and beaver thrive and fox and badger make use of available cover.

The importance of the natural river habitat for wildlife is also indicated by the diversity of species found there. In addition to game species, many nongame species including the belted kingfisher, red-headed woodpecker, white-breasted nuthatch, and bank swallow are found in this area. These species, although not important from a harvest perspective, are a vital part of the total ecosystem. Their presence indicates the unique nature of the upper James River.

### TRAPPING FOR MANAGEMENT PURPOSES

The refuge has had a furbearer trapping program for both recreation and management purposes throughout most of its history. Interest in trapping has decreased in recent years partially because of a decrease in fur prices. Consequently, the knowledge and skills are being passed on to fewer young people.

Most interest is in trapping muskrats after freeze-up. Trapping success is based on the muskrat population, which fluctuates depending on hydrologic conditions of the James River. Wetter conditions following a period of drought provide resources such as flooded stands of cattails and adequate water depths for lodges that allow muskrat populations to flourish. Fall trapping can be used to remove muskrats causing damage to dikes and roads.

Fall trapping of furbearers on national wildlife refuges for recreation is discouraged by the Service. Trapping was not included in the wildlife-compatible uses legislated by Congress and outlined in the National Wildlife Refuge System Improvement Act of 1997. The fall trapping of fox, raccoon, and skunk does not increase the spring nesting success of upland-nesting species of waterfowl.

A 90-acre predator enclosure was constructed near the refuge headquarters as a Ducks Unlimited project in 1990. Waterfowl nest depredation is reduced by trapping predators inside the enclosure and along the perimeter. These species include red fox, raccoon, striped skunk, mink, and Franklin's ground squirrel. Nest success is 60–80 percent, with a record number of 220 nests recorded in 2000. As a

result, a spring trapping program was initiated on Mud Lake Island during periods of high water in the James River.

## POPULATION AND HABITAT MONITORING

Population monitoring of migratory and breeding birds occurs annually. Nest dragging is conducted to determine preferred habitat use by upland-nesting waterfowl and to determine waterfowl production in the predator enclosure. Other on-going monitoring is achieved through the cooperation of various agencies, volunteers, and individuals.

Sand Lake National Wildlife Refuge is an official banding station as part of the North American Duck Banding Program. More than 51,000 ducks were banded on the refuge from 1982 through 2004.



Bill Schultze/USFWS

*Refuge staff on an early morning duck-banding excursion.*

Nesting activity of various bird species is monitored. Waterfowl-nesting success is monitored within the 90-acre predator enclosure. Refuge staff monitors the use of wood duck boxes, bluebird boxes, goose tubs, and mallard baskets, and checks for signs of bald eagle-nesting activity.

Until recently, habitat monitoring has not received the primary emphasis or the attention as population monitoring. A grassland-monitoring plan was developed in 2003–4 and a program of formal habitat monitoring was begun. Upland grassland habitats were classified and are monitored annually by refuge staff. The results are used to make future management decisions and to evaluate past techniques.

Monitoring of wildlife diseases is limited primarily to detection of waterfowl botulism outbreaks in wetlands. Other diseases of recent concern include West Nile virus, avian chlamydiosis, and chronic-wasting disease.

## CULTURAL RESOURCES

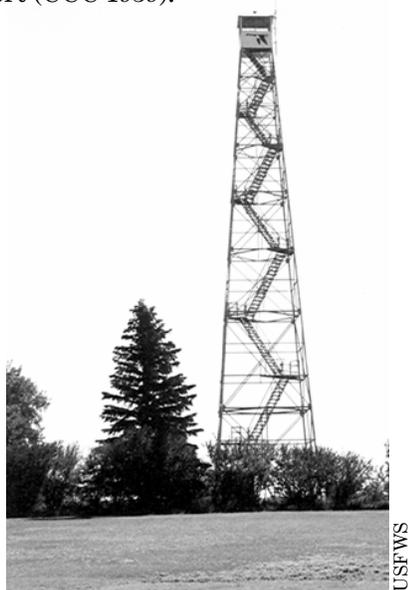
Documented occupation in the vicinity of Sand Lake National Wildlife Refuge spans a 10,000-year period, thus there is potential for presence of archeological resources on the refuge. There are no known cultural resources on the refuge; however, a comprehensive cultural resource inventory has not been conducted. Individual sites that may be affected by management activities are surveyed for cultural resources prior to disturbance.

As indicated on a plaque, the Columbia Day Use Area is the location of the first Catholic mass in South Dakota in 1845.

The refuge contains clear ties to the Depression-era period, based on the original landscape design and presence of all but one of the original buildings. An evaluation of the historical context of structures built during the Depression-era identified one historical site; however, the buildings have been altered. The eight-stall vehicle building is probably the most intact and unique. In addition, the entrance sign represents the standard sign originally designed for refuges.

In South Dakota, most refuges were established in the 1930s, during the Depression. The CCC, formed during the Depression years, performed early construction activities on Sand Lake National Wildlife Refuge. Projects focused on holding water, linking channels, and creating habitat islands for migratory birds.

CCC Camp BF-2, for Company #2749 was opened in June 1935 and closed in July 1939. Various works were accomplished, as described in the following excerpt from a report (CCC 1939).



The 108-foot observation tower at refuge headquarters, in the 1930s.

*"Forty miles of very satisfactory refuge trails provide travel facilities to almost any part of the area.*

*Seventy miles of fence surround the refuge.*

*More than one-half million new trees are now thriving on the area and enhancing its appearance.*

*Two major and seven minor dams have been constructed or reconstructed.*

*Where 17 sets of farm buildings once existed, a portion of three now remain.*

*More than 200 miles of undesirable and run down farm fences have been removed.*

*Nesting and resting islands, a network of low water system channels and a complete set of water controls now are in evidence on the large marsh area that used to be marked only by hay stacks.*

*The foundations of two public picnic grounds have been laid.*

*New buildings have been constructed on the headquarters and secondary residence sites.*

*Large signs are located in strategic locations near the refuge, proclaiming the purpose and sponsor of the refuge.*

*Many upland game shelters are observed as one tours the refuge.*

*Large areas have been seeded to aquatic plants and an abundance of natural cover growth is present.*

*As a result of the display pool dam, the first CCC project, a small lake with pinioned geese and many broods of wild ducks swimming around on it is the first picture seen when entering."*



Looming over a small wetland, the tower continues to be a favorite with visitors.

USFWS

Beth Ullenberg/USFWS

## WILDERNESS REVIEW

To be designated a wilderness area, lands must meet certain criteria as outlined in the Wilderness Act of 1964:

- generally appears to have been affected primarily by the forces of nature, with the imprint of human work substantially unnoticeable
- has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition
- may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value

The Sand Lake National Wildlife Refuge meets the size and scientific, scenic, and ecological value criteria for wilderness. However, roads, fences, grazing, agriculture, and wetland drainage have modified the refuge. These alterations prevent designation as a wilderness area.

## SOCIOECONOMIC SETTING

This section is a summary of the socioeconomic setting. The complete economic analysis is in appendix H.

The refuge is located in Brown County, South Dakota. The county is part of the glacial lakes and prairies region of South Dakota and is sometimes called the heart of the prairie–pothole region of North America. Brown County has a total area of 1,713 square miles (1,096,320 acres).

Brown County offers such attractions as the Dacotah Prairie Museum, the Centennial Village, pari-mutuel horse racing, the Brown County Fair, and the Richmond Lake Youth Camp (Brown County 2004).

Aberdeen, the third largest city in South Dakota, is the county seat and the center of commerce for the region. Aberdeen was nicknamed the "Hub City" because it served as an important intersection for many busy railroad lines. Today's "Hub City" has grown into a diverse, regional trade center with service and manufacturing industries, attractive retail shopping opportunities, convention facilities, a private college, a state university, and two large medical centers (Aberdeen Area Chamber of Commerce 2004).

## POPULATION, EMPLOYMENT, AND INCOME

The 2000 census estimated Brown County's population at 35,460 persons (U.S. Census Bureau 2002). Approximately 70 percent of the county's residents reside in Aberdeen (Discover Aberdeen 2004).

While South Dakota experienced a 7.8 percent population increase from 1990 to 2000, Brown County's population decreased 0.4 percent over the same time frame (U.S. Census Bureau 2002). In 2000, Brown County averaged 21 persons per square mile; the state average was 10 persons per square mile.

The 2000 Census reported the following for the county's population:

- 95.1 percent are white persons not of Hispanic/Latino origin
- 2.7 percent are American Indian and Alaska Native persons
- 0.7 percent are persons of Hispanic or Latino origin
- 0.4 percent are Asian persons
- 0.3 percent are Black or African American persons

Approximately, 86 percent of the county population 25 years and older were high-school graduates and 24 percent were college graduates (U.S. Census Bureau 2002). There are two colleges in Aberdeen—Northern State University and Presentation College.

South Dakota's major exports include computers and electronic production, machinery manufactures, processed foods, and crop production (U.S. Department of Commerce 2002).

In 2000, 83.5 percent of county jobs were in private wage and salary employment (people who work for someone else) as compared to 79.2 percent for South Dakota. According to the Discover Aberdeen website, the major employers in Aberdeen are health services, education, manufacturing, hotel reservations, agriculture, higher education, the call center, and support services.

## RECREATIONAL ACTIVITIES

The refuge offers a wide variety of year-round accessible recreational opportunities that are wildlife dependent. Hunting, fishing, wildlife observation (e.g., bird watching), wildlife photography, and education are all popular activities.

The refuge is a nationally recognized wildlife sanctuary and offers opportunities for big game, upland game, and waterfowl hunters. Pheasant hunting draws outdoorsmen and women from across the country each fall. Fishing is allowed year-round at five locations on the refuge.

Major visitor expenditure categories include lodging, food, and supplies. Current visitors to the refuge spend about \$655,500 annually in the Brown County economy. The current level of visitor spending directly generates more than \$152,000 in personal income and 9.4 jobs for local businesses accommodating visitors including hotels, restaurants, supply stores, and gas stations. The associated indirect and induced effects generate an additional 4.3 jobs and more than \$102,000 in personal income throughout the Brown County economy. This has a total economic impact of 13.7 jobs and more than \$254,000 in personal income associated with the current level of refuge visitation.

## REFUGE STAFFING AND BUDGETING

Current refuge staffing and budgeting generates 13 permanent and 4 temporary and seasonal employees. The current staff accounted for an annual payroll, including salaries and benefits, of \$910,600 in 2003.

In addition to providing salaries and benefits, the refuge purchased goods and services totaling \$165,200 in 2003, approximately 65 percent of which was spent locally in the Brown County economy.

## PUBLIC USE

In addition to the various fish and wildlife habitats, the James River provides a scenic contrast to the agriculturally dominated prairie. An appreciation of this value was shown with the nomination of the upper James River as a Scenic and Recreational River by the SDGFP (1976).

Studies have documented the recreational value of the river. Hanson (1981) surveyed recreational and other uses of the river from 1975 to 1979. He divided the river into three segments beginning at Sand Lake National Wildlife Refuge. The upper section, just south of the refuge, included the river from Columbia to Fisher Grove State Park. In 1 year, this upper section had an estimated 357,590 hours of recreation, including 27 different activities. Camping and fishing were the highest uses. In Hanson's discussion, he stated:

“The number and variety of uses observed are proof that the James River is truly a multi-use resource. Uses such as sightseeing, that do not directly consume a product of the river, were

consistently important to the total recreational value. Impacts upon this total recreational value, rather than a single use or value, must be considered in any management plans for the river.”

The refuge offers a variety of public use activities (figure 7). Approximately 50,000 people visit annually to participate in some form of recreation. Activities include hunting, fishing, wildlife observation, wildlife photography, environmental education, interpretation, and hiking.

Interpretive displays, a book sales outlet, various brochures, and accessible rest rooms are located at refuge headquarters; the visitor area and main office are open year-round.

A small room adjacent to the lobby serves as space for educational activities and as a small visitor area housing exhibits, displays, wildlife mounts, and audio equipment. This space also holds two employee offices.



Beth Ullenberg/USFWS

*Students look in wonderment at items on the “discovery table” in the visitor center during a field trip.*

Maximum capacity is 20–25 elementary students and 20 or fewer junior and high school students. Classes of more than 25 students find it difficult to use the facility because of the limited size; it also has no classroom or laboratory-type space.

Educational programs are limited to videos or floor activities. The current facility can accommodate only one school group at a time and, during peak use, groups have to be turned away. In addition, this space is used for special refuge events, which are also limited due to the facility's small size.

The Columbia Day Use Area is often used for birding and it provides accessible restrooms and parking, a hiking trail, tables, and a sun shelter.

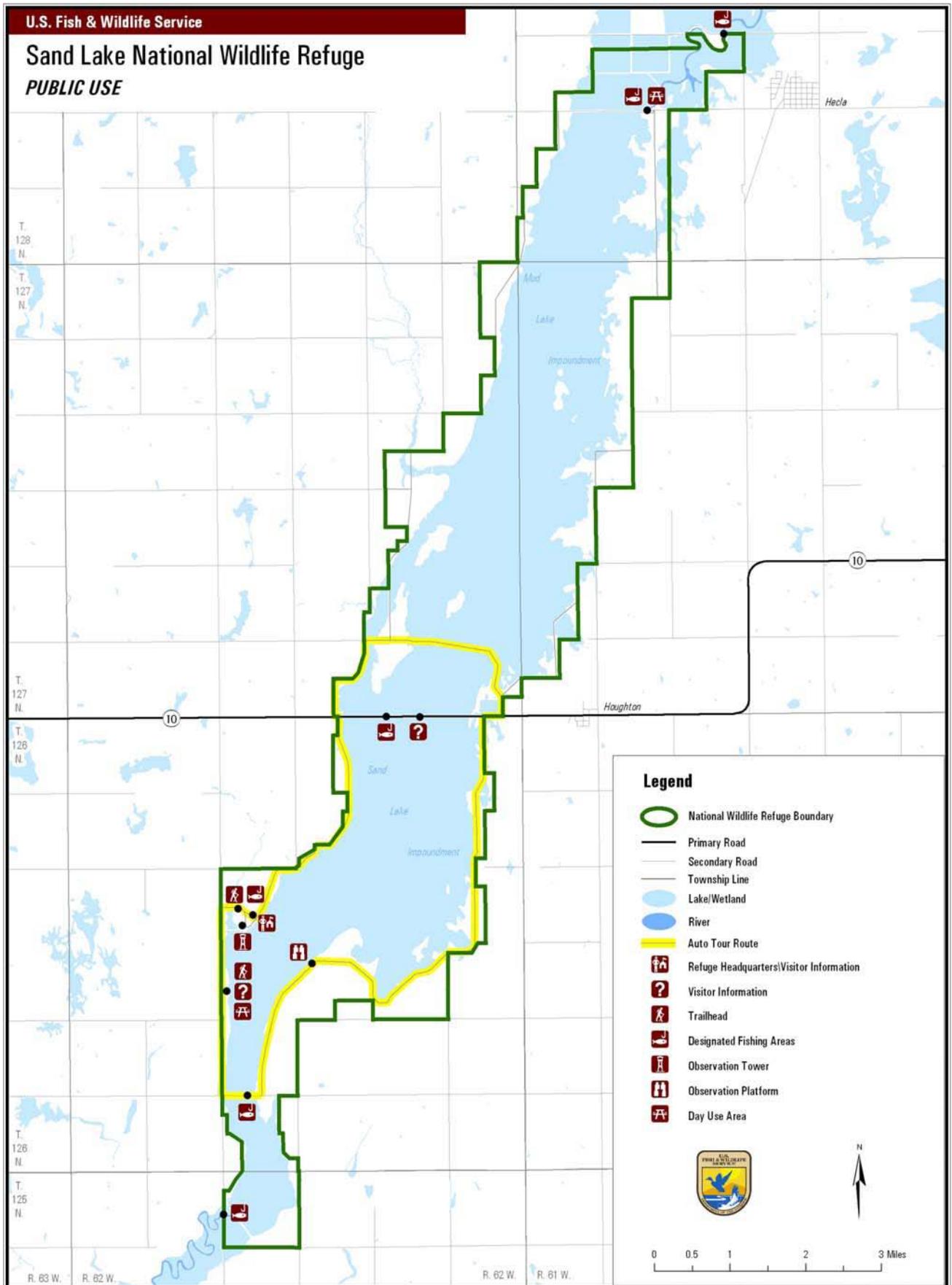


Figure 7. Public use, Sand Lake National Wildlife Refuge, South Dakota

Public access to the interior of the refuge is limited during hunting seasons from mid-October to February 1. During this time, gates and roads are closed and access is limited only to hunters to avoid user conflicts and ensure safety.

Wildlife observation, wildlife photography, environmental education, interpretation, and hiking are best from April 1 through mid-October when wildlife is more prevalent and roads and gates are open.

Areas open to visitors include the 15-mile “wildlife drive” auto tour route, the 20-mile North Loop Road, and the Columbia and Hecla day use areas.

## HUNTING

The refuge has long been famous for waterfowl hunting and huge fall concentrations of snow geese. In fiscal year 2004, there were approximately 1,100 waterfowl-hunting visits.

Pass shooting for waterfowl is offered from approximately 200 waterfowl blinds placed around the refuge perimeter (figure 8). This program was set up in response to the article, “Carnage at Sand Lake,” published in the National Audubon Society magazine (1970), documenting excessive crippling of waterfowl.

In 1970, in cooperation with the state of South Dakota, certain road rights-of-way were closed to hunting to reduce waterfowl crippling, reduce road congestion, and space hunters in blinds for a higher quality hunt. In recent years, the hunting from these blinds has been less productive. Many blinds on the northern portion of the refuge receive very little use because of changed use-patterns of snow geese. It is anticipated that the number and locations of these blinds may change in the future, if the lack of use continues.

The refuge is a popular area for white-tailed deer hunters, with archery, muzzleloader, and rifle seasons occurring in November and December. In fiscal year 2004, there were approximately 2,200 deer-hunting visits.

The local agri-business community is appreciative of the refuge’s efforts to provide for additional deer harvest, in addition to what is available in Brown County surrounding the refuge. Cooperative plans and strategies have been ongoing for years with SDGFP to address the dynamics of the regional deer herd.

Upland game birds include ring-necked pheasant, sharp-tailed grouse, and gray partridge. A December season for upland birds, primarily ring-

necked pheasant, is offered each year at the close of the rifle seasons. In fiscal year 2004, there were approximately 900 upland game-hunting visits.



*Ring-necked Pheasant*

© John Jave

## FISHING

The angling pressure on the upper and middle sections of the James River is significant, comparing favorably to the better lakes in northeastern South Dakota. Fishery resources on the James River in the vicinity of Jamestown Reservoir and isolated reaches upstream are also important fishery resource areas.

Fishing on the refuge is offered year-round at five locations, where road rights-of-way cross the James River. Motorized and nonmotorized boating is not allowed and no facilities for fishing exist. Angler preferences include walleye, northern pike, yellow perch, and rough fish. In fiscal year 2004, there were approximately 1,200 angler visits.

The fisheries are not actively managed and fishing is opportunistic. Fish populations flourish during wet cycles and decline (winterkill) during periods of low flow or when lower water levels occur in Mud and Sand lakes. Sand Lake is generally too shallow to support a viable game fishery. Water depths at full-pool level pool are less than 6 feet, which is not enough to overwinter game fish. However, during years of high flow, the James River may provide winter fish habitat.

Anglers are limited to ice fishing within a close proximity of the designated fishing areas. Ice shacks are allowed, but must be removed daily. Vehicles are not allowed on the ice.

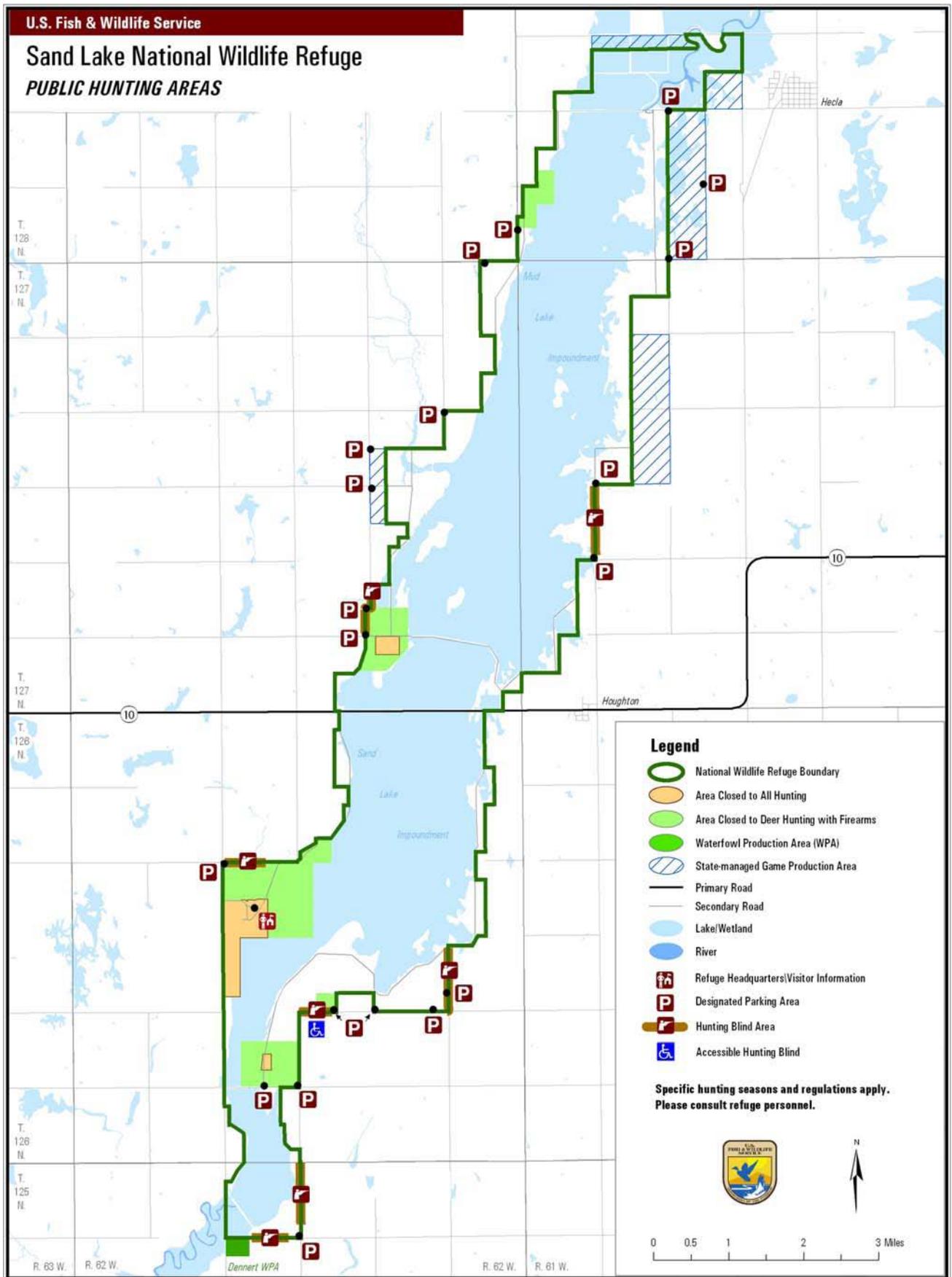


Figure 8. Public hunting areas, Sand Lake National Wildlife Refuge, South Dakota

## WILDLIFE OBSERVATION AND WILDLIFE PHOTOGRAPHY

Several state and county highways traverse the refuge and offer excellent viewing opportunities. Most activity is in spring and fall, when thousands of people visit to see large concentrations of birds when migrations are at their peak.

## ENVIRONMENTAL EDUCATION

The Sand Lake National Wildlife Refuge has an active on- and off-site environmental education program. Special events include several water festivals, Scout camps, 4-H camps, local fairs, and a free fishing day.

Each year, more than 600 students visit the refuge on school field trips. This use is dropping due to budget constraints within local school districts, which includes the elimination of busing for nonessential activities and decreased funding for field trips and outdoor education. Refuge staffs are exploring creative ways to assist schools with busing issues to help bring field trips to the refuge.

Due to constraints on school budgets, off-site environmental education programs have flourished. More than 3,000 students are reached through staff- and educator-led programs and special events each year. Classroom programs use The Prairie Learning Trunk, The Shorebird Trunk, and other teaching kits.



*Eagle Day visitors learn about birds of prey through a live bird exhibit.*

## INTERPRETATION

Refuge facilities for public use are somewhat limited. Interpretive kiosks on Highway 10, at the refuge headquarters, and in the Columbia Day Use Area provide visitors with information about wildlife and the Sand Lake National Wildlife Refuge.

A small visitor area, located within the headquarters building, provides information and exhibits. The

building is open during regular work hours (Monday–Friday, 8:00 am–4:30 pm). During the spring waterfowl migration, volunteers staff the visitor area on weekends. A 100-foot observation tower that is open for public use in the headquarters area provides panoramic views of the refuge and the surrounding area.

A self-guided auto tour route, known as the “wildlife drive,” is available for the public to learn about the refuge and its wildlife. The route has 12 numbered stations and is open, when conditions permit, from April through mid-October. A viewing platform along the route overlooks Sand Lake.

A 0.75-mile-long, self-guided hiking trail with interpretive signs is located in the Columbia Day Use Area. A second nature trail is planned for the headquarters display pool area along with a shelter to be used for environmental education.

No photography blinds are maintained for the public. However, special-use permits are issued to professional photographers who are working on specific photographic projects.

## PARTNERSHIPS

The refuge has a long history of fostering partnerships to help accomplish its mission and goals. These partners include city, county, state, and federal agencies; nongovernmental organizations; conservation groups; and private citizens.

The refuge’s partners have assisted in wildlife and habitat management, public use and recreational activities, and community outreach. Many of these relationships have developed into formalized partnerships that have written agreements or understandings, while others remain more informal. Existing partners are listed below.

## ORGANIZATIONS

- 4-H Clubs of Brown County
- Aberdeen Bird Club
- American Bird Conservancy
- Aberdeen Chamber of Commerce
- Aberdeen Convention and Visitors Bureau
- American Rivers
- Booth Society
- Boy Scouts–Sioux Council
- Dacotah Prairie Museum
- Ducks Unlimited
- Girl Scouts–Nyoda Council
- Glacial Lakes and Prairies Tourism
- Hecla Sportsmen’s Club
- Manomet Center for Conservation Sciences
- National Audubon Society
- National Wildlife Refuge Association
- Pheasants Forever
- South Dakota Ornithologists’ Union

South Dakota Wildlife Federation  
 Sportsmen's Club of Brown County  
 The Nature Conservancy—Ordway Prairie  
 The Wildlife Society—South Dakota Chapter  
 Whitetail Bowmen  
 Whitetails Unlimited

## EDUCATIONAL INSTITUTIONS

Northern State University  
 South Dakota State University

## GOVERNMENTAL GROUPS

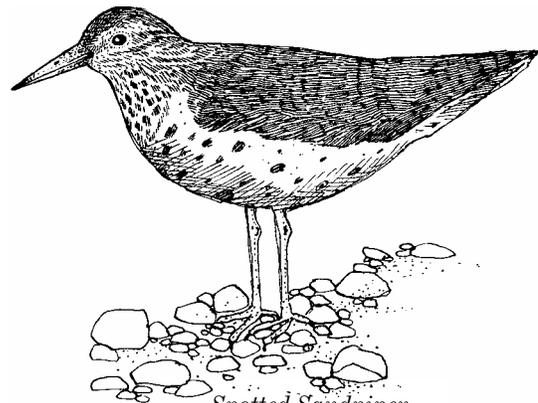
Aberdeen Parks, Recreation and Forestry  
 Brookings Wildlife Habitat Office  
 Brown County Commission  
 Brown County Emergency Manager  
 Brown County Extension Service  
 Brown County Farm Service Agency  
 Brown County Highway Department  
 Brown County Natural Resources Conservation  
 Service  
 Brown/Marshall Conservation District  
 Bureau of Reclamation—Dakotas Area Office  
 Convention on Wetlands of International  
 Importance  
 Garrison Diversion Conservancy District  
 Local and Regional School Districts  
 Lower Crow Creek Watershed District  
 National Weather Service  
 Northern Prairie Wildlife Research Center  
 Patuxent Wildlife Research Center  
 South Dakota Department of Agriculture  
 South Dakota Department of Environment and  
 Natural Resources

South Dakota Department of Game, Fish and Parks  
 South Dakota Water Rights Program  
 South Dakota Division of Forestry  
 South Dakota State Historic Preservation Officer  
 U.S. Army Corps of Engineers—Omaha District  
 U.S. Fish and Wildlife Service (international  
 conservation, ecological services)  
 U.S. Geological Survey (water resources)

## POTENTIAL PARTNERS

A refuge “friends group” within the community  
 could be established and other potential partners  
 include:

American Fisheries Society—Dakota Chapter  
 Wildlife Management Institute  
 Northeast South Dakota Walleye Club  
 Izaak Walton League



*Spotted Sandpiper*  
 © Cindie Brunner



# 4 Alternatives



© John Jave

*Pied-billed Grebe*

A challenge for natural resource managers is to anticipate and resolve potential conflicts involving various aspects and levels of resource management and protection.

Each alternative in this EA meets the purposes and goals of the refuge. However, each has a unique set of objectives that involve different management strategies and form options for addressing ecosystem and resource needs and public use.

Three alternatives for management of the refuge are considered in this document. Current management is described in the no-action alternative (alternative 1). Alternative 2 would maximize the biological potential for grassland-nesting birds. The proposed action (alternative 3) describes the draft CCP for the refuge and takes an integrated approach that maximizes the biological potential for migratory birds and finds a balance with reducing cropland, while ensuring depredation is minimized.

This chapter provides the following information:

- Summary of alternatives
- Descriptions of alternatives 1–3
- Operations to carry out alternatives

The rationale for each objective includes background information, assumptions, and technical details used to formulate the objective. The rationale provides context to enhance comprehension and facilitate future evaluations. [Because alternative 1 describes current management (no action) with no specific changes to the way the refuge is currently managed, the text does not contain rationale for the objectives or discussion of the management strategies.]

## SUMMARY OF ALTERNATIVES

Three management alternatives have been developed to meet the purposes, vision, and goals of the refuge. The goals are described in chapter 1. A goal is a descriptive, broad statement of *desired future conditions* that conveys a purpose, but does not define measurable units.

An objective is a concise statement of *what* is to be achieved, *how* much is to be achieved, *when* and *where* it is to be achieved, and *who* is responsible to achieve it. Strategies are ways to achieve an objective.

Table 2 displays how each alternative would meet the goals through its unique set of objectives.

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<p><b>ALTERNATIVE 1</b> <i>Current management—no action</i></p>	<p><b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i></p>	<p><b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i></p>
<p><b>Biological Diversity Goal.</b> Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.</p>		
<p><b>Threatened and Endangered Species Subgoal:</b> Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.</p>		
<p><i>Threatened and Endangered Species Objective</i>—Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.</p>	<p><i>Threatened and Endangered Species Objective</i>—Same as alternative 1.</p>	<p><i>Threatened and Endangered Species Objective</i>—Same as alternative 1.</p>
<p><b>Waterfowl Resources Subgoal:</b> Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.</p> <p><i>Waterfowl Objective</i>—Provide quality breeding pair and nesting habitat for the annual production of 15,000 ducks. Manage islands and the headquarters enclosure to maximize waterfowl production.</p>	<p><b>Waterfowl and Grassland-nesting Birds Subgoal:</b> Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.</p> <p><i>Waterfowl and Grassland-nesting Birds Objective</i>—Maintain or develop 8,000–12,000 acres of nesting habitat for waterfowl and grassland-nesting, nongame birds within 10 years of CCP approval, as conditions change due to dike breaching.</p>	<p><i>Waterfowl and Grassland-nesting Birds Objective</i>—Maintain or develop a minimum of 8,000 acres of nesting habitat for waterfowl and grassland-nesting nongame birds within 10 years of CCP approval.</p>
<p><b>Colonial Birds Subgoal:</b> Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.</p>		
<p><i>Colonial Birds Objective</i>—Manage the emergent vegetative zones using water level manipulation to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.</p>	<p><i>Colonial Birds Objective</i>—If natural flooding or high flows attract colonial-nesting birds, protect and provide for their well-being.</p>	<p><i>Colonial Birds Objective</i>—Same as alternative 1.</p>

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<b>Biological Diversity Goal.</b> Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.		
<b>Resident Wildlife Subgoal:</b> Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.		
<p><i>Resident Wildlife Objective—</i>Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.</p> <p><i>Deer Management Objective—</i>Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.</p>	<p><i>Resident Wildlife Objective—</i>Same as alternative 1.</p> <p><i>Deer Management Objective—</i>Same as alternative 1.</p>	<p><i>Resident Wildlife Objective—</i>Same as alternative 1.</p> <p><i>Deer Management Objective—</i>Same as alternative 1.</p>
<b>Grassland Habitat Subgoal:</b> Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.		
<p><i>Grassland Habitat Objective—</i>Maintain 7,600 acres of grassland habitat.</p> <p><i>Vegetative Structure and Composition Objective—</i>Keep native grasses and forbs, and tame grass stands, in a vigorous and diverse condition using upland management techniques. Vary treatments and frequency of treatments among fields, as determined by monitoring criteria.</p>	<p><i>Grassland Habitat Objective—</i>Maintain or develop 8,000–12,000 acres of grassland habitat with a minimum of 80 percent of grassland habitat managed in blocks of at least 300 acres within 15 years of CCP approval.</p> <p><i>Vegetative Structure and Composition Objective—</i>Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15).</p>	<p><i>Grassland Habitat Objective—</i>Manage at least 8,000 acres of grassland habitat with a minimum of 80 percent of the grassland habitat managed in blocks of at least 160 acres within 15 years of CCP approval.</p> <p><i>Vegetative Structure and Composition Objective—</i>Same as alternative 2.</p>

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<p><b>ALTERNATIVE 1</b> <i>Current management—no action</i></p>	<p><b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i></p>	<p><b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i></p>
<p><b>Biological Diversity Goal.</b> Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.</p>		
<p><b>Grassland Habitat Subgoal:</b> Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.</p>		
<p><i>Introduced, Cool-season Grasses Objective—None.</i></p> <p><i>Seeded Natives Objective—None.</i></p>	<p><i>Introduced, Cool-season Grasses Objective—Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15).</i></p> <p><i>Seeded Natives Objective—Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15).</i></p>	<p><i>Introduced, Cool-season Grasses Objective—Same as alternative 2.</i></p> <p><i>Seeded Natives Objective—Same as alternative 2.</i></p>
<p><b>Wetland Habitat Subgoal:</b> Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.</p>		
<p><i>Impoundment Objective—Provide 750 acres of nesting and roosting habitat for colonial-nesting birds on Mud and Sand lakes and the five subimpoundments (flood control pool #1, flood control pool #2, Dry Run, Display Pool, and Columbia Marsh).</i></p>	<p><i>Impoundment Objective—Remove or breach the Mud Lake dike and water control structure and the Sand Lake dike and water control structure to reduce sedimentation within the boundaries of the refuge to an average of 0.08 inch or less per year within 10 years of CCP approval.</i></p>	<p><i>Impoundment Objectives</i> —Manage the Mud Lake impoundment for 30–50 percent emergent vegetation within the area from Mud Lake dike to 2 miles north of the dike, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.</p> <p>—Manage the Sand Lake impoundment to provide 30–60 percent emergent vegetation within the area from State Highway 10 to 2 miles south of the highway, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.</p>

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<b>Biological Diversity Goal.</b> Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.		
<b>Wetland Habitat Subgoal:</b> Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.		
<i>Subimpoundment Objective</i> —See previous impoundment objective.	<i>Subimpoundment Objective</i> —Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounces per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15.	<i>Subimpoundment Objective</i> —Same as alternative 2.
<b>Wildlife-dependent Recreational Use Goal.</b> Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.		
<b>Consumptive Use Subgoal:</b> Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.		
<i>Hunting Objectives</i> —Conduct an annual program to permit white-tailed deer and pheasant hunting. Vary the number and composition of the deer tags annually as necessary to meet management needs.  —Provide and maintain hunting blinds, including one universally accessible blind, for waterfowl hunting until the blinds are deemed unnecessary.  —Provide law enforcement during the waterfowl, deer, and pheasant hunting seasons to ensure that game laws are followed and visitors have a safe, quality hunting experience.	<i>Hunting Objective</i> —Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.	<i>Hunting Objective</i> —Same as alternative 2.

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<p><b>Wildlife-dependent Recreational Use Goal.</b> Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.</p>		
<p><b>Consumptive Use Subgoal:</b> Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.</p>		
<p><i>Fishing Objective</i>—When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.</p>	<p><i>Fishing Objective</i>—When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating. Restrict or eliminate fishing at one or more (or all) of the designated areas to minimize disturbance to migratory bird areas.</p>	<p><i>Fishing Objective</i>—Same as alternative 1.</p>
<p><b>Nonconsumptive Recreation Subgoal:</b> Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.</p>		
<p><i>On-site Visitors Objective</i>—None.</p>	<p><i>On-site Visitors Objective</i>—Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.</p>	<p><i>On-site Visitors Objective</i>—Same as alternative 2.</p>
<p><i>Nonconsumptive Recreation Objective</i>—Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.</p>	<p><i>Nonconsumptive Recreation Objective</i>—Provide opportunities for wildlife observation, wildlife photography, and interpretation annually. Confine these activities to the headquarters area during the breeding season to reduce human impact on migratory grassland-nesting birds and other breeding wildlife.</p>	<p><i>Nonconsumptive Recreation Objective</i>—Same as alternative 1.</p>

**Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<b>Public Education and Outreach Goal.</b> Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.		
<p><i>Public Education and Outreach Objectives</i></p> <p>—Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.</p> <p>—Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.</p> <p>—Construct an education center.</p>	<p><i>Public Education and Outreach Objectives—Same as alternative 1.</i></p>	<p><i>Public Education and Outreach Objectives—Same as alternative 1.</i></p>
<p><i>Local School Districts Objective—</i> Provide off- and on-site presentations and school programs when requested. Serve as a source for educational materials and other information to schools and organizations.</p>	<p><i>Local School Districts Objective—</i> Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.</p>	<p><i>Local School Districts Objective—</i> Same as alternative 2.</p>
<p><i>Communities Objective—None.</i></p>	<p><i>Communities Objective—</i>Promote awareness of and generate support for the refuge, the Refuge System, and general conservation within local and regional communities by creating five new partnerships with local and regional interest groups. Continue weekly media contacts with the “Refuge Corner Update.”</p>	<p><i>Communities Objective—</i>Promote awareness of, and generate support for, the refuge and the Refuge System within local and regional communities through participation in a minimum of 3 additional off-site special events within 5 years of funding.</p>

## ALTERNATIVE 1

### CURRENT MANAGEMENT—NO ACTION

The no-action alternative would continue current management and would not involve extensive restoration of cropland, grassland, and wetland habitat, or improvements to roads, interpretive, and administrative facilities. No new funding or staff

levels would occur and programs would follow the same direction, emphasis, and intensity as they do at present.

## MANAGEMENT SUMMARY

Sand Lake National Wildlife Refuge is currently managed to maintain and improve habitat for nesting and resting waterfowl and other migratory birds such as diving and puddle ducks, geese, grebes, herons, egrets, gulls, and terns.

Management would remain focused on the habitat requirements of these priority species, as well as other migratory and resident wildlife such as pied-billed grebe, white-faced ibis, double-crested cormorant, tundra swan, American white pelican, perching birds, ring-necked pheasant, white-tailed deer, and furbearers.

The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.

## MANAGEMENT DIRECTION

Because alternative 1 describes only current management (i.e., no action) with no specific changes to the way the refuge is currently managed, the following text does not contain rationale or discussion for the objectives and strategies.

### BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

#### Threatened and Endangered Species Subgoal:

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

#### *Threatened and Endangered Species Objective:*

Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.

*Strategy*—Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities.

**Waterfowl Resources Subgoal:** Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.

*Waterfowl Resources Objective:* Provide quality breeding pair and nesting habitat for the annual production of 15,000 ducks. Manage islands and the headquarters enclosure to maximize waterfowl production.

#### *Strategies*

- Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.
- Allow riparian zone trees to grow, except where affected by habitat management activities.

- Maintain the predator enclosure in serviceable condition and monitor nest success annually.
- Allow shelterbelts to die out.

**Colonial Birds Subgoal:** Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

*Colonial Birds Objective:* Manage the emergent vegetative zones using water level manipulation to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.

*Strategy*—Manipulate water levels in the major impoundments.

**Resident Wildlife Subgoal:** Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

*Resident Wildlife Objective:* Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.

*Strategy*—Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.

*Deer Management Objective:* Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.

*Strategy*—Allow the refuge's share of the farm program crop to remain in the field and available during winter months.

**Grassland Habitat Subgoal:** Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

*Grassland Habitat Objective:* Maintain 7,600 acres of grassland habitat.

*Strategy*—None.

*Vegetative Structure and Composition Objective:* Keep native grasses and forbs, and tame grass stands, in a vigorous and diverse condition using upland management techniques. Vary treatments and frequency of treatments among fields, as determined by monitoring criteria.

### Strategies

- Control invasive plants with integrated pest management (IPM) techniques, primarily chemical, where infestations are seriously affecting grassland habitats or neighboring landowners.
- Control pioneering Russian olives in grasslands.
- Apply a grassland treatment of grazing, haying, or prescribed burning to units every 4–5 years.
- Continue informal habitat monitoring.

**Introduced Cool-season Grasses Objective:** None.

**Seeded Natives Objective:** None.

**Wetland Habitat Subgoal:** Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.



© John Jave

*Cattail Wetland*

**Impoundment Objective:** Provide 750 acres of nesting and roosting habitat for colonial-nesting birds on Mud and Sand lakes and the five subimpoundments (flood control pool #1, flood control pool #2, Dry Run, Display Pool, and Columbia Marsh).

### Strategies

- Maintain the predator enclosure and monitor nest success annually.
- Drop water levels to 1 foot below full-pool level prior to freeze-up to protect structures and dikes from ice damage.

- Perform managed drawdowns to reinvigorate wetlands habitat.
- Maintain consistent water elevations for colonial-nesting birds.
- Periodically flood subimpoundments to control emergent vegetation.

**Subimpoundment Objective:** See previous impoundment objective and strategies.

## PUBLIC USE

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

## WILDLIFE-DEPENDENT RECREATIONAL USE GOAL

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

**Consumptive Use Subgoal:** Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

### Hunting Objectives:

- Conduct an annual program to permit white-tailed deer, waterfowl, and pheasant hunting. Vary the number and composition of the deer tags annually as necessary to meet management needs.
- Provide and maintain hunting blinds, including one universally accessible blind, for waterfowl hunting until the blinds are deemed unnecessary.
- Provide law enforcement during the waterfowl, deer, and pheasant hunting seasons to ensure that game laws are followed and visitors have a safe, quality hunting experience.

### Strategies

- Vary number and composition of deer tags annually depending on population.
- Permit archery deer hunting seasons to conform to state regulations.
- Permit refuge firearm deer seasons based on consultation with the state, local landowners, and hunters.
- Allow waterfowl hunting from spaced blinds.
- Open the refuge to upland bird hunting after the close of rifle deer seasons on the refuge, according to state regulations.

**Fishing Objective:** When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.

**Strategy**—None.

**Nonconsumptive Recreation Subgoal:** Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

**On-site Visitors Objective:** None.

**Nonconsumptive Recreation Objective:** Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.

#### **Strategies**

- Maintain facilities to provide visitors with safe, pleasurable experiences.
- Maintain information kiosks with leaflet dispensers and interpretation near the headquarters and the Columbia Day Use Area.
- Provide education center exhibits and information within the headquarters building during regular work hours.
- Provide volunteer staffing of the education center on weekends during the spring migration.
- Open the self-guided auto tour route from April to mid-October, conditions permitting.
- Maintain the self-guided hiking trail at Columbia Day Use Area. Create a second nature trail near the display pool, along with a shelter.
- Maintain the observation tower in the headquarters area.
- Issue special-use permits to professional photographers working on specific photography projects.

### **PUBLIC EDUCATION AND OUTREACH GOAL**

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

#### **Public Education and Outreach Objectives:**

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.
- Construct an education center.

**Strategies**—None.

**Local School Districts Objective:** Provide off- and on-site presentations and school programs when requested. Serve as a source for educational materials and other information to schools and organizations.

#### **Strategies**

- Provide on-site environmental education programs.
- Explore ways to assist schools with busing issues to continue bringing field trips to the refuge.
- Provide off-site environmental education programs for more than 3,000 students through staff- and teacher-led programs and special events each year. Provide learning trunks and teaching kits for classroom programs. Participate in special events including water festivals, camps, local fairs, and free-fishing day.

**Communities Objective:** None.

## ALTERNATIVE 2 MAXIMIZE BIOLOGICAL POTENTIAL FOR GRASSLAND-NESTING BIRDS

This alternative would maximize the biological potential of the refuge for species of grassland-nesting birds. This would be accomplished through the following:

- Intense management of upland habitat for nesting migratory birds
- Minimal management of habitat for resident species
- Minimization of public use that may interfere with migratory bird production

### **MANAGEMENT SUMMARY**

Upland habitat would be managed to provide tall DNC for migratory birds, especially waterfowl. This would be accomplished through an intense management program of grazing, prescribed burning, haying, reseeding, and aggressive invasive plant control, with an active habitat-monitoring program.

- Cropland acreage would be eliminated and seeded back to grassland cover.
- All shelterbelts would be removed and seeded back to grass to increase grassland block size.
- All grasslands would be managed according to normal protocol and evaluated before and after treatment according to the grassland monitoring plan. Management activities would include

prescribed fire, haying, grazing, invasive plant control, light disking, reseeding, and rest.

- The refuge would require additional water development for livestock if grazing were to be used more efficiently as a management tool. The construction of a small dugout in each grazing unit would probably be the most viable option for meeting short-duration watering needs.
- Management treatments would be used only as frequently as necessary to maintain the stand in a vigorous and healthy condition. Grassland monitoring would indicate when various management treatments would be applied.
- Native trees, such as cottonwoods and willows that naturally grow in the riparian zone and provide habitat for eagles and other prairie raptors, would not be removed.

The refuge would acquire areas approved by the Migratory Bird Conservation Commission when the land becomes available from willing sellers.

The Mud Lake dike and part of the Columbia Road dike would be removed to allow the free-flow of the James River through the refuge. This would be done to slow the silt accumulation. Water levels would vary with flows in the river. Lower water levels overall would result in an increase in grassland acreage.

The five subimpoundments would be managed as shallow water, seasonally flooded wetlands used by waterfowl breeding pairs and broods, nesting black terns, pied-billed grebes, foraging water birds, and shorebirds. Drawdowns would be accomplished in the subimpoundments in different years, depending on the ability to move water out of the unit.

The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.

To maximize the biological potential of the refuge, current levels of on-site public use would be decreased to minimize wildlife disturbance and reclaim public use areas back to productive native habitat. Several on-site programs may be eliminated, while other on-site activities would be modified.

- Hunting and fishing programs would be modified to minimize wildlife disturbance.
- The Columbia and Hecla day use areas would both be eliminated.
- The auto tour route and other public access roads would be closed to the public during the breeding season.

- All field trips, tours, and environmental education activities would be restricted to the headquarters area.
- Emphasis would be placed on off-site and in-classroom activities.

## MANAGEMENT DIRECTION

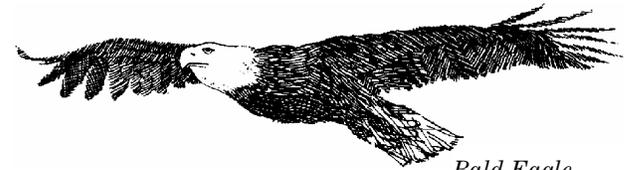
The objectives and strategies below describe how this alternative would be carried out to meet the overall goals for the refuge. Habitat conditions under alternative 2 are shown in figure 9.

### BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

#### Threatened and Endangered Species Subgoal:

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.



*Bald Eagle*  
© Cindie Brunner

#### Threatened and Endangered Species Objective:

Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present. (Same as alternative 1.)

#### Strategy

— Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities. (Same as alternative 1.)

#### Waterfowl and Grassland-nesting Birds Subgoal:

Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

#### Waterfowl and Grassland-nesting Birds

**Objective:** Maintain or develop 8,000–12,000 acres of nesting habitat for waterfowl and grassland-nesting, nongame birds within 10 years of CCP approval, as conditions change due to dike breaching.

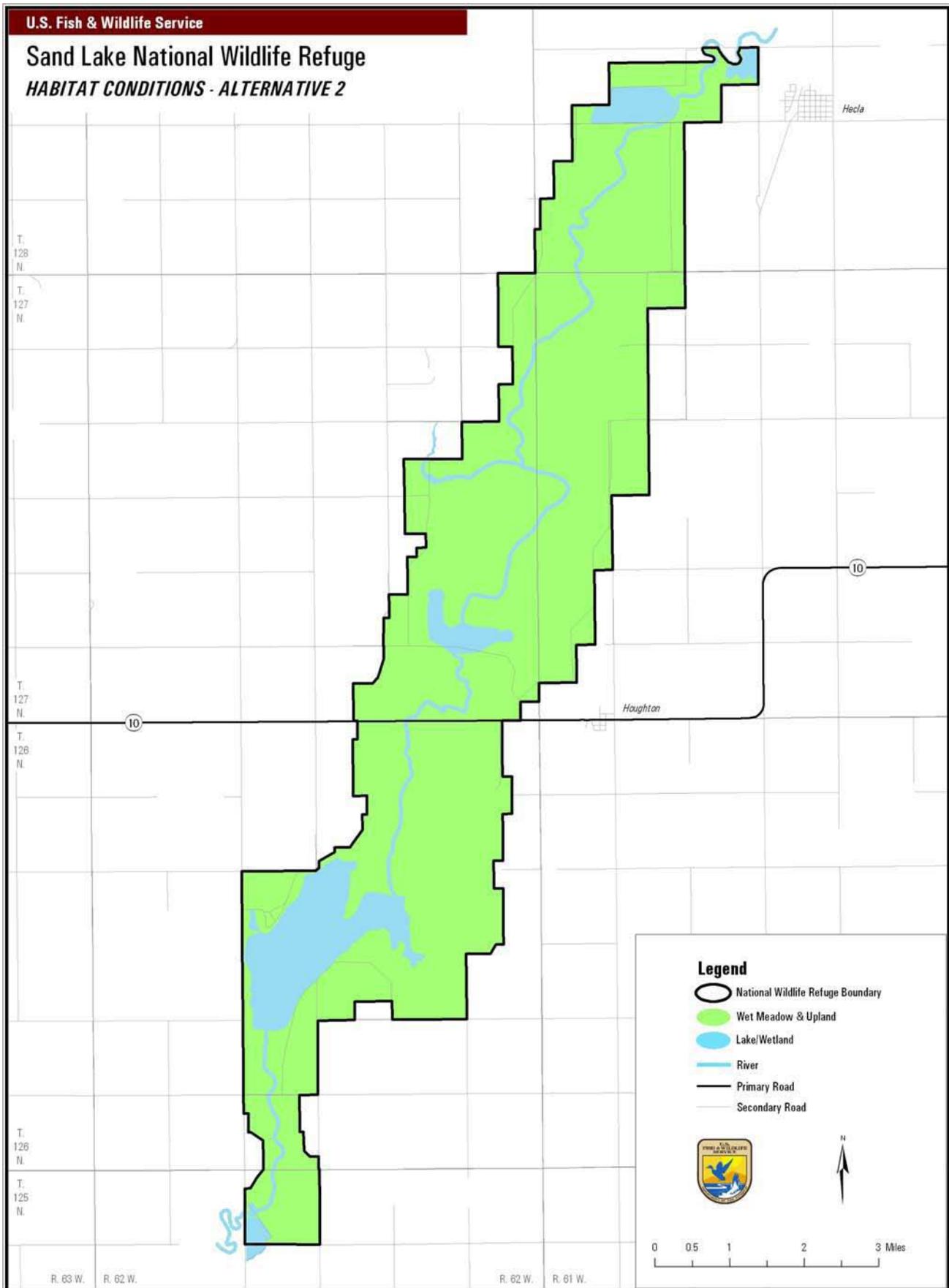


Figure 9. Habitat conditions under alternative 2 for the CCP, Sand Lake National Wildlife Refuge, South Dakota

**Strategy**

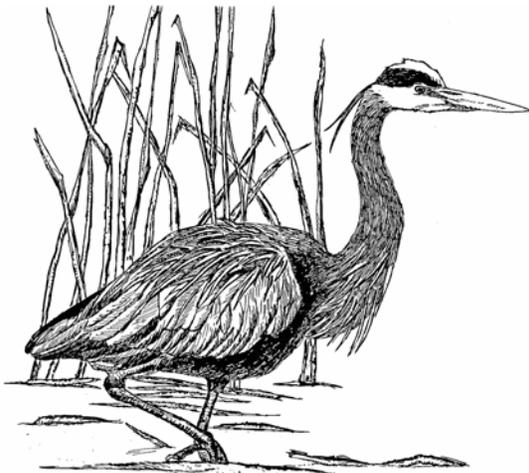
- Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.  
(Same as alternative 1.)

**Colonial Birds Subgoal:** Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

**Colonial Birds Objective:** If natural flooding or high flows attract colonial-nesting birds, protect and provide for their well-being.

**Strategy**

- When colonial-nesting birds are on the refuge, manage nesting areas for maximum nest success. Due to the breaching of the dikes at Mud and Sand lakes, there would be no manipulation of water levels and the refuge would only attract large numbers of colonial-nesting birds during wet years. During dry years, nest success of colonial-nesting birds would likely be decreased due to both lack of suitable habitat and increased predator access, which could have a negative effect on the refuge's classification as a GIBA and WII.



Great Blue Heron  
© Tom Kelley

**Resident Wildlife Subgoal:** Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

**Resident Wildlife Objective:** Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.

(Same as alternative 1.)

**Strategy**

- Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.  
(Same as alternative 1.)

**Grassland Habitat Subgoal:** Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

**Grassland Block Objective:** Maintain or develop 8,000–12,000 acres of grassland habitat with a minimum of 80 percent of grassland habitat managed in blocks of at least 300 acres within 15 years of CCP approval.

**Rationale**

With the United States' grasslands listed as critically endangered, i.e., greater than 98 percent declines (Noss et al. 1995), larger blocks of contiguous grassland would benefit grassland-dependent species.

An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found hatching rates of waterfowl were generally higher in larger patches of habitat (Howerter 2002). In Minnesota's tall-grass prairie, nest-depredation rates were lower on large (321–1,201 acres) versus small (40–79 acres) grassland blocks (Johnson and Temple 1990).

By creating larger grassland blocks, more favorable habitat is created for grassland birds of special concern that are known to nest on the refuge (table 3). Of these 15 species, 9 use grassland growth forms in the tall- or medium-height category (Dechant et al. 1998b–d, 1998f, 1999a–c, 1999e, 1999f). These nine species, along with the more abundant savannah sparrow, bobolink, sedge wren, and clay-colored sparrow (Dechant et al. 1998a, 1998e, 1999d; Swanson 1998), have the greatest capacity to indirectly benefit from the management of tall, dense vegetation for nesting waterfowl (table 4).

Eight of these 13 species (table 4) avoid woody vegetation (Dechant 1998a, 1999f; Wildlife Habitat Management Institute 1999); 7 of the 13 are area sensitive (Dechant et al. 1998b, 1998d, 1999a, 1999d, 1999f; Swanson 1998); and 6 of the 13 experience brood parasitism by brown-headed cowbirds (Dechant et al. 1998a–b, 1998f, 1999d–e; Swanson 1998).

**Vegetative Structure and Composition Objective:** Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15).

**Table 3. Grassland birds of special concern with known nesting activity on Sand Lake National Wildlife Refuge<sup>1</sup>, South Dakota**

Species	<i>PIF<sup>2</sup> Priority Species<sup>3</sup></i>		<i>USFWS<sup>2</sup></i>	<i>Audubon</i>	<i>TNC<sup>2</sup></i>	<i>SDNHP<sup>2</sup></i>
	<i>Northern Mixed-Grass Prairie<sup>4</sup></i>	<i>Prairie Potholes<sup>5</sup></i>	<i>Birds of Conservation Concern<sup>6</sup></i>	<i>Watchlist<sup>7</sup></i>	<i>"Unlucky 13"<sup>8</sup></i>	<i>Rare Bird Species<sup>8</sup></i>
American bittern		X	X			
Chestnut-collared longspur	X	X	X		X	
Dickcissel			X	X		
Grasshopper sparrow		X	X			
Le Conte's sparrow	X	X	X			X
Loggerhead shrike			X			
Marbled godwit	X	X	X	X		
Nelson's sharp-tailed sparrow	X	X	X	X		X
Northern harrier		X	X			
Sharp-tailed grouse		X				
Short-eared owl		X	X	X		
Swainson's hawk	X	X	X	X		X
Upland sandpiper		X	X			
Willet	X	X	X			
Wilson's phalarope	X	X	X	X		

<sup>1</sup>Source: U.S. Fish and Wildlife Service 1996b, Meeks and Higgins 1998.

<sup>2</sup>PIF=Partners in Flight; TNC=The Nature Conservancy; SDNHP=South Dakota Natural Heritage Program; USFWS=U.S. Fish and Wildlife Service.

<sup>3</sup>Based on input from the breeding bird survey (Sauer et al. 2001) and other sources.

<sup>4</sup>Physiographic area S37 (Partners in Flight 2002a).

<sup>5</sup>Bird conservation region 11 (Partners in Flight 2002b).

<sup>6</sup>U.S. Fish and Wildlife Service 2002.

<sup>7</sup>National Audubon Society 2002.

<sup>8</sup>South Dakota Ornithologist's Union 2002.

**Table 4. Species benefiting from grassland management of Sand Lake National Wildlife Refuge<sup>1,2</sup>, South Dakota**

Species	Avoids Woody Vegetation	Area Sensitive	Brown-headed Cowbird Brood Parasitism
American bittern <sup>3</sup>			
Bobolink	X	X	X
Clay-colored sparrow			X
Dickcissel			X
Grasshopper sparrow	X	X	X
Le Conte's sparrow	X		X
Northern harrier	X		
Savannah sparrow	X	X	X
Sedge wren <sup>3</sup>			
Sharp-tailed grouse		X	
Short-eared owl	X	X	
Upland sandpiper	X	X	
Wilson's phalarope	X	X	

<sup>1</sup>Grassland birds that use grassland growth forms in the tall- or medium-height categories for nesting, which can benefit most from active management for nesting waterfowl. The Nelson's sharp-tailed sparrow also uses grassland growth forms in the tall and medium categories, but was not included due to a lack of information.

<sup>2</sup>This is not an all-inclusive list.

<sup>3</sup>This species would benefit from grassland management, but does not avoid woody vegetation, is not area sensitive, and is not affected by cowbird parasitism.

#### **Introduced, Cool-season Grasses Objective:**

Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15).

**Seeded Natives Objective:** Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR

of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15).

#### **Rationale for the above vegetation, grasses, and natives objectives**

Grasslands are categorized as DNC, introduced cool-season grasses, and seeded native grasses. Vegetative structure differs greatly between the three habitat types; therefore, it was necessary to set grassland objectives specific to each habitat type. Despite the quantitative differences between objectives, all three objectives are similar in that they describe the maximum height-density of vegetation that can realistically be achieved for that habitat type within the constraints of climate and soil type.

Refuge grasslands are managed for tall dense cover because it is attractive to ducks. Several studies have reported high nest success in dense cover (Cowardin et al. 1985, Duebbert and Lokemoen 1976, Higgins and Barker 1982, Kirsch et al. 1978, Livezey 1981, Schranck 1972).

In addition to benefiting waterfowl, moderate to tall vegetation is also favored by many other grassland-nesting birds (Dechant et al. 1998a–f, 1999a–f; Swanson 1998).

As the refuge was specifically established to improve and maintain habitat for nesting waterfowl and other migratory birds, managing grasslands in the tall-dense category aligns well with the refuge's mandates and wildlife priorities (table 5).

**Table 5. Priority ratings of bird groups relative to habitat management on Sand Lake National Wildlife Refuge, South Dakota**

Priority Rating	Bird Group
1	Waterfowl
2	Colonial-nesting birds
3	Grassland-nesting passerine birds
4	Shorebirds
5	Other marsh and water birds
6	Raptors
7	Woodland-nesting passerine birds
8	Resident species

A majority of the lands surrounding the refuge are annually managed as cropland or nonresidual grasslands, which provide some habitat in the other categories of short-sparse and medium height density. Therefore, managing grasslands in the tall-dense category of vegetation provides a vegetation class that is not well represented in Brown County.

In the process of applying treatments to habitat in greatest need of management, blocks of grassland that conform to the short-sparse and medium height density vegetation categories would be created, thereby providing a diversity of vegetative structure within any given year.

Forb composition varies with treatment type and time since last disturbance. Forb coverage typically is 20–40 percent of the vegetation in the year following a habitat treatment, and gradually decreases to 10 percent within 5–6 years.

*Strategies for the above vegetation, grasses, and natives objectives*

- Eliminate all croplands.

All existing cropland would be seeded back to grassland cover, consisting of either a tame grass and legume mixture or a combination of cool-season and warm-season natives.

- Maintain the health and vigor of grassland habitat.

Grasslands would be managed through a program of grazing, haying, and prescribed burning. The management tool selected would be dependent on the availability of water, fences, livestock, ease of firebreak construction, and suitability for haying. Management would be focused on obtaining the maximum height and density of grasslands, with some type of management action occurring every 4–5 years. Grazing would be used most commonly to reduce litter, increase vigor, and stimulate forb species.

- Eliminate shelterbelts.

When the refuge was established in the mid-1930s, hardwood tree and shrub shelterbelts were established to reduce wind erosion, provide cover and protection for winter wildlife, and diversify the habitat. Today, the health and vigor of the shelterbelts are in decline. Shelterbelts are in the process of dying due to excessively high water levels and the perennial flooding of the James River during the past 8 years. Diseases, particularly Dutch elm disease, have also adversely affected American elms.

All existing shelterbelts would be eliminated and seeded back to grassland. Removal of the shelterbelts would reduce areas used for deer- and upland game-hunting and would reduce opportunities for viewing woodland-associated wildlife. However, their removal would provide an

estimated 424 additional acres of grassland habitat for waterfowl and other grassland-nesting birds, increase grassland block size, and decrease fragmentation between grassland blocks.

- Eliminate Russian-olive trees.

A major proactive effort would be undertaken to eliminate volunteer Russian olives. These nonnative invaders have spread quickly and proliferated in specific locations. Removal of Russian olives would eliminate a source of food for winter wildlife and reduce nesting sites for some migratory birds. However, it is believed that these benefits are outweighed by the adverse impacts on grassland communities.

- Favor native communities in compliance with other objectives.

Most of the cropland acres would be seeded back to a mixture of warm-season and cool-season native grasses and forbs, depending on the availability of seed. In addition, some of the existing tame grasslands would be converted to a native composition. This approach promotes a more natural setting that is generally more aesthetically pleasing. When established, the native vegetation is easier to manage with prescribed fire and would likely require less chemical control for Canada thistle.

Native grasslands and DNC each support prairie bird species unique to that habitat type (Renken and Dinsmore 1987). Thus, further information is necessary before an investment in funds and staff-power is made towards converting all existing grasslands to native grasslands. In addition, the economic feasibility of increasing forb abundance in native grass seeding needs to be explored.

- Substantially reduce invasive plants.

State and federal laws require landowners to control state-designated primary invasive plants on their properties. In addition, the Federal Noxious Weed Control Act places additional burdens on federal agencies to ensure that sufficient control is achieved on their respective properties.

A major and continuous effort would be made to reduce substantially invasive plants. This strategy would promote healthy grasslands, comply with state and federal regulations, and resolve some of the issues raised by private landowners. Emphasis would be placed on using grassland management techniques in addition to chemical application to control invasive plants if objectives for forb composition are to be met.

- Increase habitat monitoring, especially associated with management treatments.

Management decisions would be based on the step-down plan for habitat management to be

developed after the CCP is approved. The plan would include a monitoring section, which would describe how monitoring could be used to help indicate how and when specific habitat units need management.

Grassland monitoring efforts would be dedicated mostly toward monitoring pre- and postmanagement treatments as a way of evaluating the effectiveness of management strategies. Wildlife response to management treatments may also be evaluated as a supplement to habitat monitoring. History has shown that it is difficult to evaluate the merits of various treatments when relying on wildlife response alone.

In addition, grassland habitat would be systematically monitored to assess the overall health of uplands. However, this type of monitoring would be completed less frequently than the pre- and postmanagement monitoring.

— Round out the refuge boundary.

To maximize the biological potential of the refuge, acquisition would be proposed for areas initially approved by the Migratory Bird Conservation Commission when the refuge was established in 1935. This action would be accomplished when land becomes available from willing sellers or when other options are presented.

— Proactively manage predators.

To enhance nesting success, waterfowl nest predators would be removed from selected areas during the nesting period via trapping. Priority would be given to the predator enclosure, which provides the greatest potential for human manipulation of waterfowl-nesting success. Intensive predator management would be implemented inside the enclosure using Conibear traps. The integrity of the enclosure near the outside boundary would be maintained by removing predators.

In addition, Mud Lake Island has the potential for enhanced nesting success with management, but it would only be managed as time and resources permit.

— Monitor and react to wildlife disease issues.

Avian populations would be monitored for mortality due to avian botulism, West Nile virus, avian chlamydiosis, and other potential wildlife diseases. In the case of a disease outbreak, infected carcasses would be collected and properly disposed. Freshly-collected specimens would be sent for testing to confirm the cause of death.

Personal protective equipment would be used by refuge staff when contact with sick or dead birds and other wildlife presents a human-health risk.

If the threat of chronic-wasting disease increases, refuge staff would cooperate with the SDGFP to assess the impact on the refuge population of white-tailed deer. The refuge would continue to make use of the most current information to stay informed of current wildlife disease threats.

— Improve technological support, especially using the geographic information system (GIS).

Technological support of management actions would be improved. Spatial and GIS data would be collected and analyzed with the assistance of the habitat and populations evaluation team in Bismarck, North Dakota and the area GIS coordinator for North Dakota and South Dakota. Selected staff would be responsible for maintaining and sharing these databases.

To use fully the potential of spatial databases in refuge management, selected staff would become familiar with the use of global positioning systems (GPS), Trimble GPS Pathfinder Office, ERDAS Imagine geographic imaging, Environmental Systems Research Institute (ESRI) ArcView and ArcGIS, and Microsoft Access, or use the expertise of others to analyze spatial data. Additional technological advances including the use of spreadsheets, Microsoft PowerPoint, and statistical software would be increasingly used.

**Wetland Habitat Subgoal:** Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.



*Ruddy Duck*

**Impoundment Objective:** Remove or breach the Mud Lake dike and water control structure and the Sand Lake dike and water control structure to reduce sedimentation within the boundaries of the refuge to an average of 0.08 inch or less per year within 10 years of CCP approval.

**Rationale**

Impoundments on river systems have long been known to have finite life spans, mostly due to sediment deposition. This is true especially in the northern Great Plains, where intensive agriculture

within watersheds has increased soil erosion and the surface runoff that contributes sediment to rivers. Sediment can fill the impoundments and change their hydrology. The potential for sedimentation to degrade, directly or indirectly, wetland productivity and wetland functions is great (Gleason and Euliss 1998).

From a wildlife perspective, sedimentation can alter water depths that are critical to management. Loss of full-pool depth hampers the ability of managers to manipulate water levels to promote the cycling of vegetation and interspersions of cover that is important for wildlife. Mud and Sand lakes, the two main impoundments, are no exception.

During August 2000, personnel from USGS at the Northern Prairie Wildlife Research Center collected sediment cores from Mud Lake to determine vertical accretion rates. Accretion rates were greatest near the dam (0.5 inch per year), with less accretion (0.08 inch per year) occurring in the upper reaches of Mud Lake. As expected, the accretion was highest near the dam where water velocities and greater water depth facilitate sediment deposition.

Since 1959, sediment accretion has reduced the maximum pool depth near the Mud Lake dam by 21.7 inches. Assuming that sediment accretion rates remain the same in the future, it is projected that Mud Lake would have a maximum pool depth of 30.3 inches by 2020 and 20 inches by 2040. Over this same period, water depth in the upper reaches of Mud Lake would be reduced to less than 0.8 inch. This projected future loss of water depth would severely limit the ability of managers to manipulate pool levels in Mud Lake to cycle vegetation and create interspersions of cover and water to meet the wildlife habitat objectives.

It is anticipated that, over the next 20 years, sediments entering Mud Lake would reduce water depths to the point that current wildlife management objectives cannot be achieved through customary water-level manipulations (Gleason et al. 2003).

The removal or breaching of the two main dikes and water control structures would not allow for any active management of water levels. The principal water right for the refuge would probably be lost. Water levels and aquatic vegetation structure within the refuge would be determined by flows and natural fluctuations in the James River. The James River is characterized by high spring flows that gradually diminish, often to near zero, by late summer.

#### *Strategies*

- Remove or breach dams.

The removal or breaching of the dams to decrease the sedimentation rate in the pools would prolong the life and health of the marsh. The natural flows

in the James River would determine habitat conditions and resultant wildlife use of the marsh.

- Limit management of the larger expanse of cattails anticipated with this action to manipulation of emergent vegetation through grazing, haying, and prescribed burning.

***Subimpoundment Objective:*** Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounces per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15.

#### *Rationale*

The subimpoundment objective purposely includes broad ranges, as water levels are intended to vary like natural wetlands. The success and timing of such management actions are subject to dynamic weather patterns.

Plant communities in prairie wetlands are continually changing because of short- and long-term fluctuations in water levels and salinity. Prairie wetlands have evolved under these fluctuating conditions. The process of cycling with wet and dry periods makes prairie wetlands productive. For instance, exposure of mud flats during drought periods is necessary for the germination of many emergent macrophytes and facilitates the oxidation of organic sediments and nutrient releases that maintains high productivity.

Within the framework of a dynamic wetland system, management of the subimpoundments is directed toward waterfowl (foraging, breeding pairs, and broods), shorebirds, and wading birds. This objective sets an upper and lower threshold of emergent vegetation, because an interspersions of emergent vegetation and wetland openings is preferred by both dabbling and diving ducks and their broods (Kantrud 1986).

Interspersed emergent vegetation also benefits other marsh-dwelling birds and mammals (Seabloom 1958, Vogl 1973, Weller and Spatcher 1965). Such conditions may also result in avian communities of greater species diversity or richness (Weller 1978, Weller and Spatcher 1965). In addition, Voigts (1976) found maximum invertebrate abundance occurring where beds of submerged vegetation were interspersed with stands of emergent vegetation.

A lower invertebrate biomass threshold is part of the subimpoundment objective. Invertebrate

abundance is quantified relative to biomass in June, because that is when invertebrate biomass is known to peak in most wetlands (Euliss and Mushet 2003). Abundance of aquatic macroinvertebrates is positively related to waterfowl use (Kaminski and Prince 1981, Schroeder 1973, Swanson and Meyer 1973) and early growth of ducklings (Chura 1961, Perret 1962, Sugden 1973). Aquatic invertebrates also are important food resources for shorebirds (Eldridge 1987), amphibians (Clark 1978, Deutschman 1984), and other marsh birds (Weller 1981).



© John Jave

*Avocets in a Sand Lake wetland.*

Shallow water conditions during some portion of the year are also favorable. Deep water may reduce the availability of invertebrates to feeding waterfowl (Laperle 1974, Murkin and Kadlec 1986) and shorebirds. Optimum foraging depths for dabbling ducks, shorebirds, and wading birds are 2–9.8 inches, 0–9.8 inches, and 3–23.6 inches, respectively (Jasmer 2000). Diving ducks can also exploit food resources in shallow water (Fredrickson and Reid 1988).

### *Strategies*

- Conduct drawdowns and subsequent reflooding events.

Water could be moved in and out of the five subimpoundments opportunistically, as flows in the James River and water levels in Mud and Sand lakes allow.

When management action is necessary and water elevations in the main pools are not conducive to take advantage of gravity flow, a 16-inch Crisafulli pump could be used to move water into or out of these subimpoundments. This would add

significantly to the cost, would be time consuming, and must not violate restrictions placed on the refuge's water rights. However, it could create the desired habitat conditions when other management alternatives are not available.

Most of the subimpoundments are smaller areas separated from the main pools by an embankment. Water could be diverted into or out of the subimpoundments by gravity flow. Because of their smaller size and isolation from the main pools, it would be possible to provide some water level control, thereby influencing the plant and invertebrate communities, as well as the productivity of the subimpoundments.

Plant and invertebrate production could be maximized through carefully planned drawdowns and subsequent reflooding events. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year. The need for rejuvenation of plant and invertebrate communities within each unit and the ability to move water out of the unit would largely determine when drawdowns could be conducted.

- Control cattail.

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersed cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to

drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

## PUBLIC USE

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

## WILDLIFE-DEPENDENT RECREATIONAL USE GOAL

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

**Consumptive Use Subgoal:** Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

**Hunting Objective:** Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.

### Strategies

- Provide hunting opportunities for deer, upland game birds, and waterfowl.

Areas would be designated for deer-, upland game bird-, and perimeter boundary waterfowl-hunting. An additional universally accessible hunting blind and parking area would be developed to increase opportunities for physically challenged hunters.

The refuge would open to upland bird hunting after the close of refuge rifle deer seasons according to state regulations and permit archery and firearm deer seasons based on consultation with the state, local landowners, and hunters.

- Create an updated hunting brochure and map for distribution at various locations around the refuge to provide hunters with up-to-date hunting rules and regulations.
- Develop a proactive law enforcement program including the establishment of a permanent, full-time law enforcement position to regulate hunting activities on the refuge and enforce wildlife laws.

**Fishing Objective:** When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating. Restrict or eliminate fishing at one or more (or all) of the designated areas to minimize disturbance to migratory bird areas.

## Rationale

Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. Limited access has produced a high density of users in limited areas. There is also a high demand for ice fishing. Motorized and nonmotorized boating is not allowed and no facilities for fishing exist. Species sought by anglers include northern pike, walleye, and yellow perch. Ice fishing is limited to areas within close proximity to designated fishing areas.



Paul Kerris/USFWS

Fishing is considered opportunistic because fish populations flourish during wet cycles on the James River and winterkill during periods of low flow or lower water levels in refuge lakes. Sand Lake is generally thought of as being too shallow to support a viable game fishery. Water depths at full pool are less than 6 feet, which is insufficient to overwinter game fish except during years of high flows in the James River.

By limiting fishing to the five sites easily accessed from public roads, disturbance to migratory birds is limited. Fishing is not consistent with legal mandates pertaining to migratory birds.

### Strategies

- Allow fishing at five designated locations.

The opening day of the fishing season would coincide with the opening of deer hunting, usually November 1, and would close March 1. The public would be made aware of the fishing program through notification of rules, updated brochures, and information in the state fishing handbook.

- Develop a proactive law enforcement program including the establishment of a permanent full-time law enforcement position to monitor and regulate fishing activities and enforce wildlife laws.

**Nonconsumptive Recreation Subgoal:** Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

**On-site Visitors Objective:** Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.

#### Strategies

- Increase on-site public education opportunities.

An on-site education center would be constructed to provide space and materials to inform students, educators, and the visiting public about the refuge, wildlife conservation, and the National Wildlife Refuge System.

- Update information kiosks.

Information and interpretive kiosks at the refuge headquarters would be updated to reflect management practices, with themes based on issues described in this document. Kiosks would provide general information about wildlife conservation and the refuge.

**Nonconsumptive Recreation Objective:** Provide opportunities for wildlife observation, wildlife photography, and interpretation annually. Confine these activities to the headquarters area during the breeding season to reduce human impact on migratory grassland-nesting birds and other breeding wildlife.

#### Strategies

- Provide nonconsumptive recreational opportunities while decreasing human impacts during breeding season.

Due to direct conflicts and human impacts on breeding, nesting, and brooding wildlife, nonconsumptive recreational activities would be limited to the headquarters service area during the breeding season.

The Highway 10 viewpoint would be maintained. Staff would work with county and state road departments to develop other highway viewpoint areas that allow visitors to view and photograph wildlife without creating human-caused disturbance to wildlife.



Bob Savannah/USFWS

- Update information kiosks.

Kiosks at refuge headquarters would be updated to reflect the new management approach and to educate the public about grassland-nesting birds and habitat needs.

## PUBLIC EDUCATION AND OUTREACH GOAL

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

### Public Education and Outreach Objectives

(Same as alternative 1)

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.
- Construct an education center.

**Local School Districts Objective:** Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.

#### Strategy

- Increase educational opportunities while decreasing human impacts.

To decrease conflicts with breeding, nesting, and brooding wildlife, most on-site educational programs would be confined to the headquarters service area. Outdoor classroom programs on other areas would be reduced or eliminated to decrease human impact on nesting and brooding wildlife.

A major shift in education and outreach would occur, from a combination of on- and off-site programs to almost exclusively off-site programs. Facilities at the Columbia and Hecla day use areas would be removed and reclaimed to grassland-nesting bird habitat.

Use of the education center would provide space and materials for students and educators for learning about wildlife and the National Wildlife Refuge System, while reducing impacts on wildlife species.

In-school programs and teacher use of learning trunks would be extensively promoted. Teacher workshops would be established to give teachers the ability to facilitate their own in-classroom wildlife programs.

**Communities Objective:** Promote awareness of and generate support for the refuge, the Refuge System, and general conservation within local and regional communities by creating five new partnerships with local and regional interest groups. Continue weekly media contacts with the “Refuge Corner Update.”

### *Strategy*

— Seek educational opportunities for local and regional communities to promote the refuge and wildlife conservation.

Speakers would be provided for community and civic groups. Refuge staff would frequently update local congressional offices and key staff on emerging or potentially controversial issues. Refuge staff would participate in local fairs, outdoor shows, the Water Festival, and other public events, and continue the annual Eagle Day event.

The refuge’s Website would be maintained and improved to provide up-to-date information on refuge policies, regulations, and wildlife.

Educational and interpretive kiosks promoting the refuge and wildlife conservation would be developed and located off-site at the Aberdeen Regional Airport, Wylie Park, Northern State University, and other strategic locations within the community.

News releases and articles would be made available to local media outlets including television, radio, and newspaper.

## **ALTERNATIVE 3**

### **INTEGRATED MANAGEMENT— PROPOSED ACTION AND DRAFT CCP**

This alternative takes an integrated approach with management practices that would serve to improve the biological potential of the refuge for migratory birds. This alternative balances the best management practices for producing migratory birds and finds a balance with reducing cropland, while ensuring depredation is minimized.

## **MANAGEMENT SUMMARY**

Upland habitat management would be geared toward providing tall and dense nesting cover on a high percentage of the uplands for nesting birds, especially waterfowl. Rejuvenation of decadent grasslands and the control of invasive plant species would be emphasized. This would be accomplished through an active management program of grazing, prescribed burning, haying, farming, reseeding, invasive plant control, and habitat monitoring.

- Cropland acreage would be reduced.
- No new shelterbelts would be planted. Existing shelterbelts would be allowed to die out to increase the size of grassland blocks for nesting migratory birds. In addition, selected shelterbelts would be removed and the disturbed sites seeded to grass.
- Invading Russian-olive trees would be removed or controlled where they are threatening the productiveness of grassland-nesting migratory bird species.

The refuge would acquire areas approved by the Migratory Bird Conservation Commission when the land becomes available from willing sellers.

Both Mud and Sand lakes would be managed to provide a wetland category preferred by overwater-nesting birds and waterfowl. The five subimpoundments (figure 10) would be managed as shallow-water, seasonally flooded wetlands—used by waterfowl breeding pairs and broods, nesting black terns and pied-billed grebes, and foraging water birds and shorebirds. Drawdowns would be accomplished, depending on the amount of flow in the James River; water can only be moved out of the units when there are low flows in the river. Siltation problems within Mud and Sand lakes would be addressed.

Wildlife-dependent recreational activities would be expanded and improved on and off refuge lands.

- The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.
- Support facilities for hunting and fishing opportunities would be improved.
- The Columbia and Hecla day use areas would continue to be managed for public activities. Improvements such as updated signing, interpretive kiosks, and expanded trails would be made to each site.
- On-site tours, school field trips, and educational activities would be promoted and associated facilities would be improved.
- Off-site programs would promote visitation to the refuge.

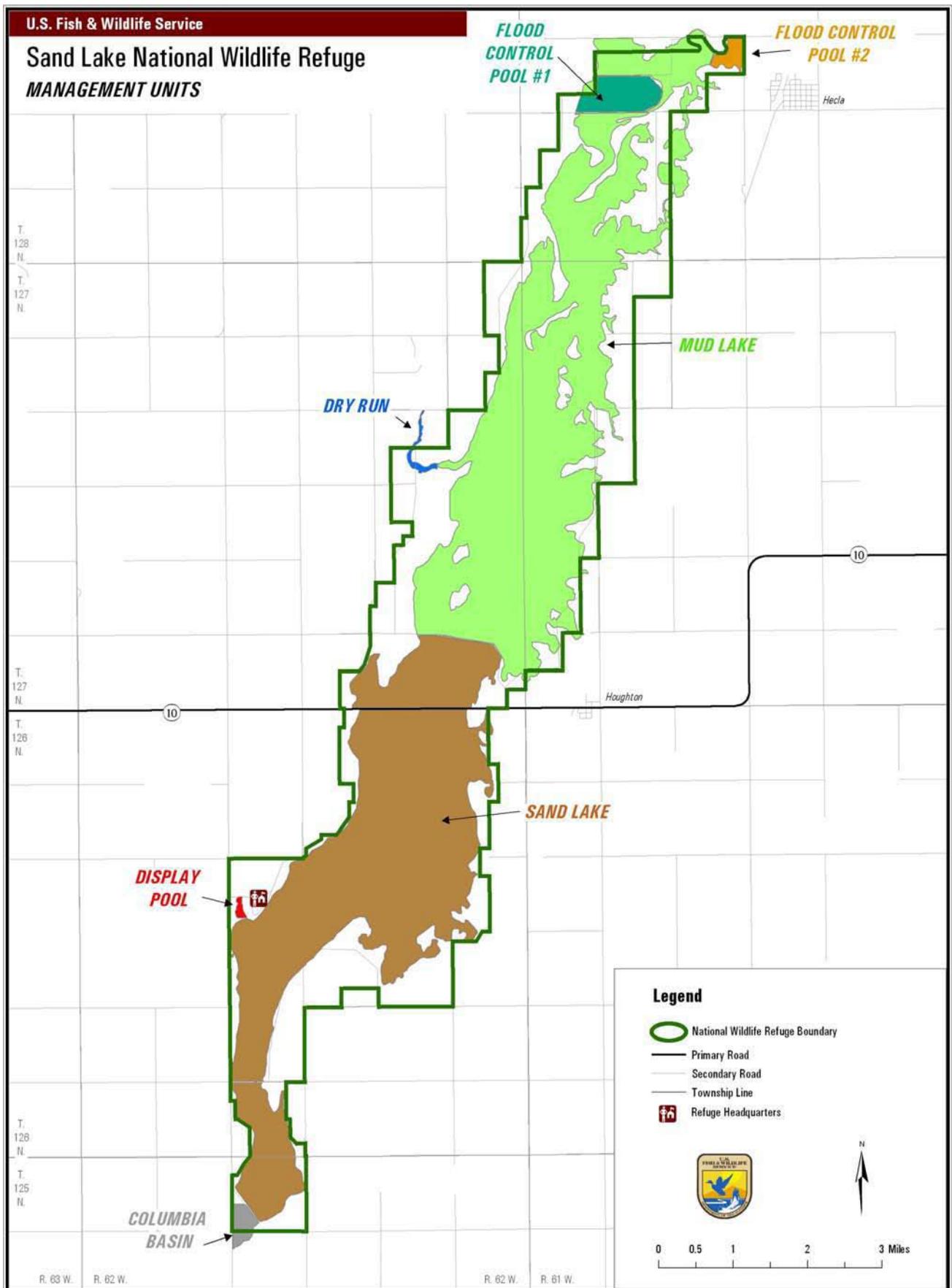


Figure 10. Water management units, Sand Lake National Wildlife Refuge, South Dakota

## MANAGEMENT DIRECTION

The objectives and strategies below describe how this alternative would be carried out to meet the overall goals for the refuge. Habitat conditions under alternative 3 are shown in figure 11.

### BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

#### Threatened and Endangered Species Subgoal:

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

#### Threatened and Endangered Species Objective:

Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.

(Same as alternative 1.)

#### Strategy

- Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities.

(Same as alternative 1.)

#### Waterfowl and Grassland-nesting Birds Subgoal:

Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

#### Waterfowl and Grassland-nesting Birds

**Objective:** Maintain or develop a minimum of 8,000 acres of nesting habitat for waterfowl and grassland-nesting nongame birds within 10 years of CCP approval.

#### Strategy

- Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.

**Colonial Birds Subgoal:** Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

**Colonial Birds Objective:** Manage the emergent vegetative zones through water level manipulations to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.

(Same as alternative 1.)

#### Rationale

(Same rationale as for wetland habitat objectives in alternative 3.)

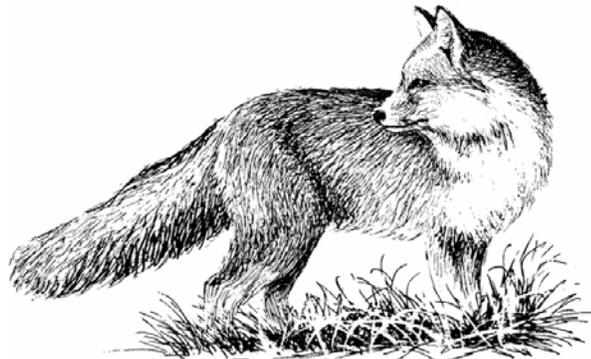
#### Strategy

- Manipulate water levels in the major impoundments.

(Same as alternative 1.)

(Same discussion as for wetland habitat strategies in alternative 3.)

**Resident Wildlife Subgoal:** Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.



Red Fox

Bob Savannah/USFWS

**Resident Wildlife Objective:** Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.

(Same as alternative 1.)

#### Strategy

- Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.

(Same as alternative 1.)

**Deer Management Objective:** Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.

(Same as alternative 1.)

#### Strategy

- Allow the refuge's share of the farm program crop to remain in the field and available during winter months.

(Same as alternative 1.)

**Grassland Habitat Subgoal:** Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

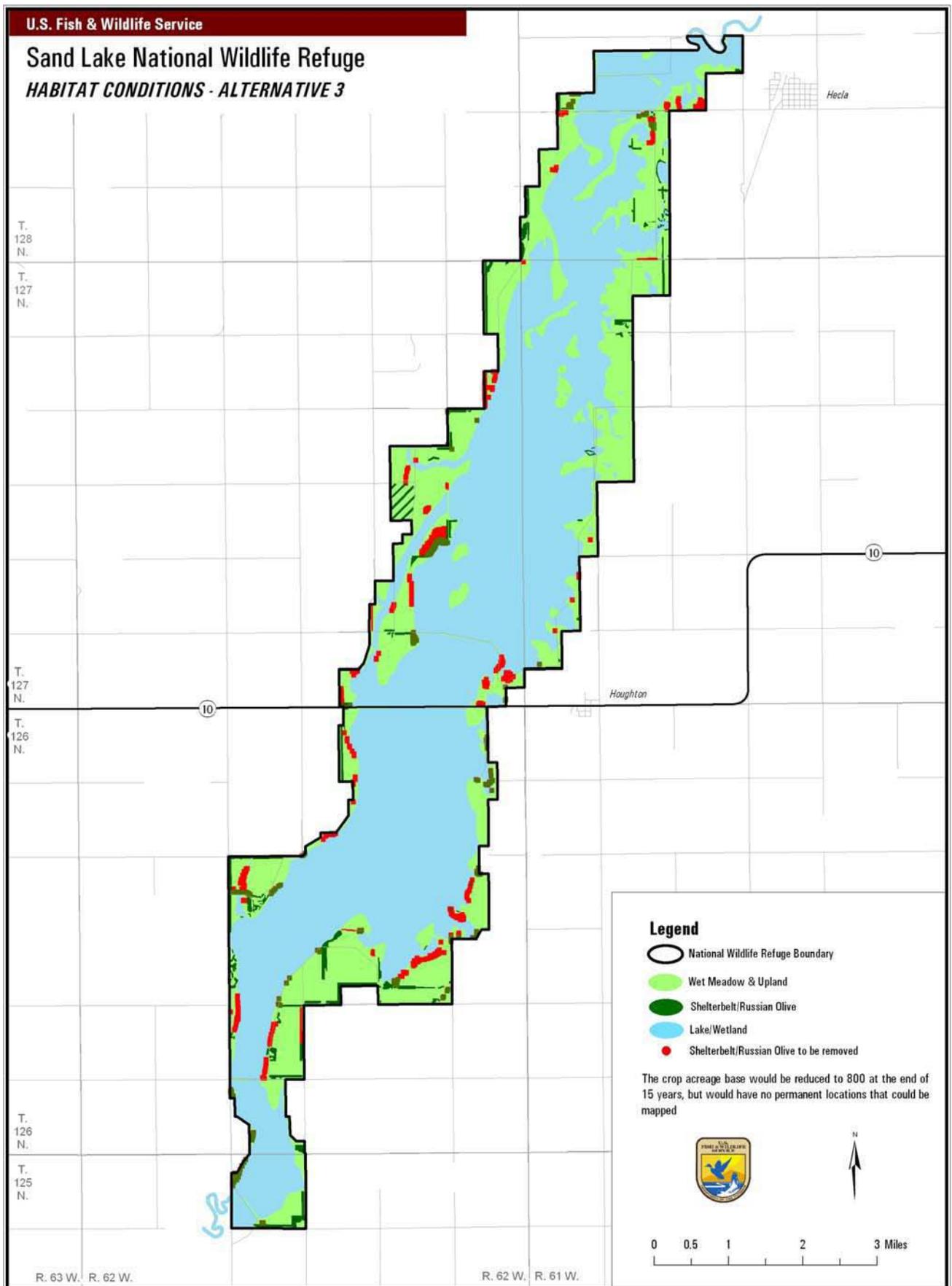


Figure 11. Habitat conditions under alternative 3 for the CCP, Sand Lake National Wildlife Refuge, South Dakota

**Grassland Block Objective:** Manage at least 8,000 acres of grassland habitat with a minimum of 80 percent of the grassland habitat managed in blocks of at least 160 acres within 15 years of CCP approval.

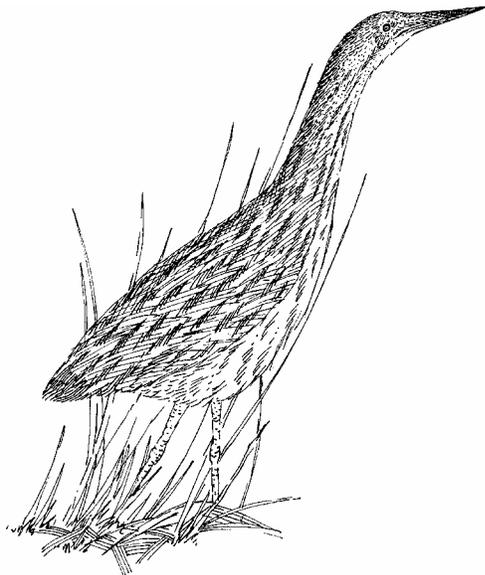
**Rationale**

(Same as alternative 2.)

With the United States' grasslands listed as critically endangered, i.e., greater than 98 percent declines (Noss et al. 1995), larger blocks of contiguous grassland would benefit grassland-dependent species.

An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found hatching rates of waterfowl were generally higher in larger patches of habitat (Howerter 2002). In Minnesota's tall-grass prairie, nest-depredation rates were lower on large (321–1,201 acres) versus small (40–79 acres) grassland blocks (Johnson and Temple 1990).

By creating larger grassland blocks, more favorable habitat is created for grassland birds of special concern that are known to nest on the refuge (table 3). Of these 15 species, 9 use grassland growth forms in the tall- or medium-height category (Dechant et al. 1998b–d, 1998f, 1999a–c, 1999e, 1999f). These nine species, along with the more abundant savannah sparrow, bobolink, sedge wren, and clay-colored sparrow (Dechant et al. 1998a, 1998e, 1999d; Swanson 1998), have the greatest capacity to indirectly benefit from the management of tall, dense vegetation for nesting waterfowl (table 4).



American Bittern  
© Cindie Brunner

Eight of these 13 species (table 4) avoid woody vegetation (Dechant 1998a, 1999f; Wildlife Habitat Management Institute 1999); 7 of the 13 are area sensitive (Dechant et al. 1998b, 1998d, 1999a, 1999d,

1999f; Swanson 1998); and 6 of the 13 experience brood parasitism by brown-headed cowbirds (Dechant et al. 1998a–b, 1998f, 1999d–e; Swanson 1998).

**Vegetative Structure and Composition Objective:**

Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15). (Same as alternative 2.)

**Introduced, Cool-season Grasses Objective:**

Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15). (Same as alternative 2.)

**Seeded Natives Objective:**

Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15). (Same as alternative 2.)

**Rationale for the above vegetation, grasses, and natives objectives**

(Same as alternative 2.)

Grasslands are categorized as DNC, introduced cool-season grasses, and seeded native grasses.

Vegetative structure differs greatly between the three habitat types; therefore, it was necessary to set grassland objectives specific to each habitat type. Despite the quantitative differences between objectives, all three objectives are similar in that they describe the maximum height-density of vegetation that can realistically be achieved for that habitat type within the constraints of climate and soil type.

Refuge grasslands are managed for tall dense cover because it is attractive to ducks. Several studies have reported high nest success in dense cover (Cowardin et al. 1985, Duebbert and Lokemoen 1976, Higgins and Barker 1982, Kirsch et al. 1978, Livezey 1981, Schranck 1972).

In addition to benefiting waterfowl, moderate to tall vegetation is also favored by many other grassland-nesting birds (Dechant et al. 1998a–f, 1999a–f; Swanson 1998).

As the refuge was specifically established to improve and maintain habitat for nesting waterfowl and other migratory birds, managing grasslands in the tall-dense category aligns well with the refuge's mandates and wildlife priorities (table 5).

A majority of the lands surrounding the refuge are annually managed as cropland or nonresidual grasslands, which provide some habitat in the other categories of short–sparse and medium height density. Therefore, managing grasslands in the tall–dense category of vegetation provides a vegetation class that is not well represented in Brown County.

In the process of applying treatments to habitat in greatest need of management, blocks of grassland that conform to the short–sparse and medium height density vegetation categories would be created, thereby providing a diversity of vegetative structure within any given year.

Forb composition varies with treatment type and time since last disturbance. Forb coverage typically is 20–40 percent of the vegetation in the year following a habitat treatment, and gradually decreases to 10 percent within 5–6 years.

*Strategies for the above vegetation, grasses, and natives objectives*

- Reduce tilled acreage to 878 acres.

Conversion of cropland to grassland is prioritized according to which conversion projects can create or contribute to the largest grassland blocks. The 80-acre block of cropland adjacent to Goose Corner (cropland block A-99a) was converted to grassland in 2004. Cropland blocks A-94 (202 acres) and A-99 (57 acres), which are adjacent to Goose Corner and Hanson's Point, also have been identified as priority areas for conversion to grassland. Conversion of these three cropland blocks would create a 339-acre contiguous block of grassland and reduce the total cropland acreage from 1,217 acres to 878 acres.

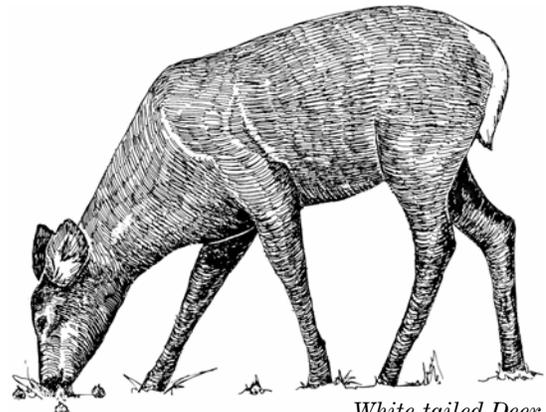
- Use farming as a tool to rejuvenate DNC, fight colonization of invasive plants, prepare ground for native grass seeding, and reduce use of non-selective broadleaf herbicides over the long term.

The focus of the farming program would change. Short of a more effective tool to control invasive plants on the James River flood plain, tillage holds the most promise and would be aggressively applied. By using the 800-acre farm model described under the invasive plant strategy below, the refuge would have the opportunity to renovate 3,000 acres of decadent, invasive plant-infested habitat blocks during the life of this CCP. The future of farming beyond 15 years would be determined by how effective the refuge is at improving upland habitat through use of this tool and others, and by success in developing a management strategy with SDGFP and the public to deal with the deer depredation issue.

- Prepare a management plan in cooperation with SDGFP that deals with wildlife depredation, invasive species management, and upland grassland restoration. The public, in particular

local landowners, would be part of the management planning process after the CCP is finalized.

The farming program would provide critical habitat for white-tailed deer during severe winters. Continuation of some level of farming on the refuge would provide for flexibility in management options while working cooperatively on the deer depredation issue with the SDGFP. By recognizing and acting on the fact that the Service has a stake in deer management on and near the refuge, it would preserve credibility with the SDGFP, refuge neighbors, and the public.



*White-tailed Deer*  
Tom Kelley/USFWS

Thousands of acres of cattails provide thermal cover used extensively by the regional deer herd. There is seasonal movement into the James River corridor that appears directly related to winter severity. A study conducted by South Dakota State University between 1992–94 documented movements as far as 132 miles (Kernohan et al. 1994). Local landowner tolerance for whitetails relates directly to deer density and damage to crops, particularly during summer months (Naugle et al. 1994).

Depredation of crops on private lands adjoining the refuge has been, and will continue to be, a concern. The partnership previously described would address this issue.

- Control invasive plants.

The future of the refuge and the value of its grassland habitats would be shaped largely by how effective management is in combating the invasion of Canada thistle. Canada thistle is a pervasive pest for which there is no known control measure available for effective, one-time use on the refuge.

Canada thistle reduction would remain the highest priority until sufficiently controlled. Refuge staff would collaborate with other agencies and specialists to incorporate new control methods as they become available.

Prescribed fire would continue to be used as a tool to control exotic cool-season grasses such as quackgrass, smooth brome, and Kentucky bluegrass in reseeded native grass areas. In addition, grazing, mowing, and haying would continue to be used to fight invasive plants.

Additional exotic species such as purple loosestrife and spotted knapweed would be prevented from colonizing through a rigorous program of monitoring and complete eradication of initial patches.

It is estimated that no less than 3,000 acres of uplands and wetlands are heavily infested with Canada thistle. In the past, an average of 800 acres was treated annually using the Service's IPM program. Current control measures within the integrated pest management program include prescribed fire, chemical application, haying, grazing, biological agents, and rotary mowing. Despite aggressive efforts to control Canada thistle using these control measures, infestations continue to increase.

Grasslands that are infested with Canada thistle would be completely renovated by converting those areas to cropland and replanting them to grassland once the infestation is controlled. This strategy is based on the premise that Canada thistle would not grow in fields planted with genetically modified varieties of "Roundup ready" corn or soybeans that are sprayed with the nonselective herbicide, Roundup. By maintaining these no-till crops in production for several years, the percentage of viable Canada thistle seed in the upper soil layer should be significantly depleted and the germination potential of Canada thistle probably reduced.

Grassland areas that are heavily infested with Canada thistle are the best candidates for conversion to farmed acreage. Meanwhile, farmed acreage deemed to be free of viable invasive plant seed would be replanted to a grass and forb mixture. The farmed acreage would then shift to other weedy grassland areas in need of renovation. Such an approach would provide a cost-effective alternative to control methods such as chemical application or mowing. These control methods, which often contribute to degraded grassland habitat, would likely need to be used only on small areas of infestation within new seeding. As a result, this approach should provide for reestablishment of a more diverse plant community and higher quality habitat for migratory birds.

Averaged over the next 15 years, rotation of 800 acres of cropland would improve control of Canada thistle on an estimated 3,000 acres of upland. Under this CCP, 200 acres per year could be reasonably converted to deal with invasive plants.

This would involve "breaking out" (i.e., sod preparation) of 200 acres of invasive plant-infested grassland and planting another 200 acres of retired cropland to a grass/forb mixture. For those 200 acres of invasive plant-infested grasslands identified annually, the rotation would progress as shown below.

<i>Year 1</i>	Till areas dominated by invasive plants and fallow
<i>Year 2</i>	Plant with "Roundup ready" crop variety
<i>Year 3</i>	Rotate field into different "Roundup ready" crop variety
<i>Year 4</i>	Prepare seedbed with "Roundup ready" soybeans
<i>Year 5</i>	Replant to grasses and forbs

In any given year, 200 acres of upland would be in fallow, 600 acres would be in cropland, and 200 acres would be replanted to grasses and forbs. Several key factors would create the dynamic in which this invasive-plant reduction program would be applied, including the following:

- The speed at which Canada thistle is encroaching on farmable uplands
- The time required to significantly reduce the amount of viable invasive plant seed in the upper soil layer
- Funding and staff constraints
- The robustness and growth of the invasive plant problem in other areas such as marsh edges, fence lines, and tree belts, i.e., size of the local source of invasive plant seed
- The ability of the refuge to find interested cooperators as the size of farm fields shrinks
- Annual budgetary constraints associated with the cost of the grass/forb seed mixture and herbicides

Adjustments may need to be made to the extent of the overall invasive plant reduction program and to the acreage slated for cropland retirement in any given year. Regardless of the annual retirement rate, the acreage base of cropland would be reduced to 800 acres at the end of 15 years.

- Use DNC and native grasses to improve waterfowl and grassland bird production.

The value of grassland habitats would be shaped largely by how effectively habitat blocks of decadent DNC and smooth brome are reclaimed. As infestations of Canada thistle expanded, renovation of grassland blocks was minimized to

avoid breaking sod. Without renovation, these stands of tame grass lost their vigor and became root-bound. In addition, use of herbicides to control Canada thistle has degraded the plant diversity within these established grasslands. Much of the desirable broadleaf forb component has been exterminated.

The degraded condition of 2,136 acres of smooth brome and decadent DNC within manageable habitat blocks demands attention. There are also 495 acres of reseeded native grasses that may need to be renovated in the future, should those areas become overrun with invasive species such as smooth brome.

Areas of cropland appropriate for conversion to dense nesting cover or native grass would be identified through development of a step-down plan. As concern for native species restoration continues to increase, some DNC may be converted to native grass where appropriate. Historically, native grass has established better on the east side of the refuge, which is dominated by sandy and loamy soils of the Hecla–Hamar–Ulen association (U.S. Department of Agriculture 1993). Native grasses seem to thrive better in these soils, which are less likely to harden or compact during dry conditions than the silty and sodium-affected silty soils of the Great Bend–Beotia association on the west side of the refuge (U.S. Department of Agriculture 1993).

DNC establishes more aggressively and is more resilient to silty soils and, therefore, may be favored over native grass on the west side of the refuge. Staff would continue to expand their knowledge of restoration techniques including site-specific seed mixes, site preparation, planting, and postplanting methods to improve their ability to successfully establish native grasses and forbs. Additional information is needed on the use of DNC and native and tame grasses by nesting waterfowl and grassland birds to improve management decisions.

- Provide some degree of water development for livestock if grazing were to be used as a tool for management of established grassland blocks.

The construction of a small dugout in each grazing unit is probably the most viable option to meet any short-duration livestock-watering needs.

- Remove selected shelterbelts.

Further fragmentation is not likely to benefit the upland wildlife species of highest priority. As a result, new shelterbelts or tree rows would not be planted. The majority of shelterbelts would be allowed to die out naturally.

In the past, shelterbelts were planted on the refuge, largely by homesteaders and the CCC

(figure 6). Shelterbelts in agricultural areas provide substantial benefits for 29 species of birds (Johnson and Beck 1988). Avian communities were dominated by edge and generalist species in planted woodlands in eastern South Dakota (Bakker and Higgins 2003) and farmstead shelterbelts in Minnesota (Yahner 1982).

However, providing edge habitat such as shelterbelts to maximize local wildlife diversity may not always be a desirable objective if it is detrimental to habitat specialists or rare species that are dependent on extensive stands of undisturbed habitat (Hair 1980, Harris 1984). Shelterbelts decrease the size of grassland blocks and increase the amount of edge habitat, which can allow greater invasion by exotic species, predators, and brood parasites (Hagan and Johnston 1992).

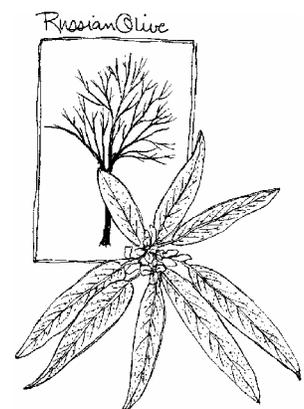
An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found that duck-hatching rates increased with distance from a habitat edge (Howerter 2002). Habitat loss and fragmentation on the breeding grounds of grassland birds are known to contribute to poor reproductive success (Best 1978; Gates and Gysel 1978; Johnson and Temple 1986, 1990).

In Minnesota's tall-grass prairie, nest depredation and brown-headed cowbird brood parasitism on grassland birds decreased farther from woody edges (Johnson and Temple 1990). Grassland birds that nested in remnants of tall-grass prairie near wooded edges produced fewer young than birds that nested far from wooded edges (Johnson and Temple 1986).

Due to the high expense of tree removal, most of the current shelterbelts and tree rows would not be actively removed. A few select shelterbelts dividing large grassland blocks with high wildlife potential would be removed when funds allow. For example, the tree row bordered by habitat block SN-16 on the north and D-50 on the south is a high priority for removal as it is dissecting two large grassland areas on Hanson's Point.

- Reduce volunteer Russian-olive trees.

Historically, Russian-olive trees were planted in the shelterbelts. The trees produce a heavy crop of persistent fruit every year that is a favored food of more than 40 kinds of birds and mammals (Borell 1951). However, the species is considered invasive because the



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seeds are widely dispersed by wildlife (particularly birds), remain viable for up to 3 years, and can germinate even on well-vegetated soils (Pearce and Smith 2001).

“Volunteer” Russian-olive trees are invading lowland areas and wetland (figure 6). As a result, Russian-olive woodlands threaten to displace native riparian vegetation (Olson and Knopf 1986a), as they have in many South Dakota marshlands (Olson and Knopf 1986b). In addition, Russian olives may depreciate waterfowl-nesting habitat, as waterfowl may avoid wetlands rimmed by dense stands of Russian olive (Olson and Knopf 1986b).

Volunteer Russian-olive trees in undesirable locations would be removed by cutting the trees and painting or spraying the stumps with an herbicide to prevent regrowth. This control method is most effective (Olson and Knopf 1986b), although repeated aerial application of 2,4-D or 2,4,5-T for 1–2 years has also been found effective for large trees (Bovey 1965).

Removal priority would be given to volunteer Russian-olive trees that are adjacent to or encroaching on valuable wetlands or larger habitat blocks. Russian-olive trees within shelterbelts would be allowed to remain.

Volunteer olive trees adjacent to the shelterbelts, which likely originated from seed trees within the shelterbelts, would be removed.

- Proactive predator management.  
(*Same as alternative 2.*)

To enhance nesting success, waterfowl nest predators would be removed from selected areas during the nesting period via trapping. Priority would be given to the predator enclosure, which provides the greatest potential for human manipulation of waterfowl-nesting success. Intensive predator management would be implemented inside the enclosure using Conibear traps. The integrity of the enclosure near the outside boundary would be maintained by removing predators.

In addition, Mud Lake Island has the potential for enhanced nesting success with management, but it would only be managed as time and resources permit.

- Monitor and react to wildlife disease issues.  
(*Same as alternative 2.*)

Avian populations would be monitored for mortality due to avian botulism, West Nile virus, avian chlamydiosis, and other potential wildlife diseases. In the case of a disease outbreak, infected carcasses would be collected and properly disposed. Freshly-collected specimens would be sent for testing to confirm the cause of death.

Personal protective equipment would be used by refuge staff when contact with sick or dead birds and other wildlife presents a human-health risk.

If the threat of chronic-wasting disease increases, refuge staff would cooperate with the SDGFP to assess the impact on the refuge population of white-tailed deer. The refuge would continue to make use of the most current information to stay informed of current wildlife disease threats.

- Monitor habitat using adaptive resource management.

Adaptive management requires an ongoing commitment to evaluate and monitor the effects of habitat management strategies and incorporate new knowledge into updated plans and objectives. An upland monitoring plan that is consistent with the requirements of adaptive resource management, as well as the goals and objectives of this CCP, is being developed.

This habitat-monitoring plan emphasizes monitoring on three levels:

- Refuge monitoring determines whether habitat objectives are being met
- Habitat block monitoring determines which habitat blocks are in greatest need of treatment
- Treatment monitoring assesses vegetative response to treatments and determines whether treatment objectives were met

Through treatment monitoring, the future application of successful treatments can be validated and methods that were not successful in meeting treatment objectives can be modified. In addition, monitoring vegetative response to habitat treatments would produce the most reliable information, as site-specific effects are more informative than data gleaned from research conducted elsewhere.

- Improve technological support, especially using GIS.  
(*Same as alternative 2.*)

Technological support of management actions would be improved. Spatial and GIS data would be collected and analyzed with the assistance of the habitat and populations evaluation team in Bismarck, North Dakota and the area GIS coordinator for North Dakota and South Dakota. Selected staff would be responsible for maintaining and sharing these databases.

To use fully the potential of spatial databases in refuge management, selected staff would become familiar with the use of global positioning systems (GPS), Trimble GPS Pathfinder Office, ERDAS Imagine geographic imaging, Environmental Systems Research Institute (ESRI) ArcView and ArcGIS, and Microsoft Access, or use the expertise of others to analyze spatial data.

Additional technological advances including the use of spreadsheets, Microsoft PowerPoint, and statistical software would be increasingly used.

- Acquire remaining land within the legislated boundary of the refuge.

The boundary of the refuge was established on September 4, 1935, by executive order of President Franklin D. Roosevelt. Of the 23,103 acres encompassed within that original legislative boundary, 21,498 acres have been acquired.

In an effort to provide a wider buffer zone around the edge of the wetland habitat and to establish larger tracts of habitat for grassland-dependent wildlife species, purchase of the final 1,605 acres of privately owned land within the legislated boundary would be strongly considered when that land becomes available for purchase.

**Wetland Habitat Subgoal:** Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.



*Forster's Tern*

Bill Schultze/USFWS

#### **Impoundment Objectives:**

- Manage the Mud Lake impoundment for 30–50 percent emergent vegetation within the area from Mud Lake dike to 2 miles north of the dike, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.
- Manage the Sand Lake impoundment to provide 30–60 percent emergent vegetation within the area from State Highway 10 to 2 miles south of the highway, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.

#### **Rationale**

Overwater colonial-nesting birds rank high on the hierarchy of wildlife priorities of the refuge (table 5). This objective describes the deepwater/dense-emergent category of wetland habitat preferred as

overwater nest sites by a high percentage of colonial-nesting birds found on the refuge, as follows:

- Franklin's gull (Burger 1974, Guay 1968)
- White-faced ibis (Ryder and Manry 1994, Zeiner et al. 1990)
- Black-crowned night-heron (Davis 1993)
- Eared grebe (Dechant et al. 2002)
- Western grebe (Short 1984)
- Forster's tern (Gorenzel 1977, McNicholl 1979)

By managing the specified areas of Sand and Mud lakes for overwater-nesting birds, habitat for other wetland birds would naturally be provided in areas of different depth.

- Deepwater/sparse-emergent habitat would be provided along the edges of deepwater/dense-emergent areas and in areas of variable depth.
- Shallow-water/emergent habitat would be provided along the marshy edges of Sand and Mud lakes and in the northern part of Mud Lake.
- Open-water/submergent habitat would be provided in the deeper, center part of Sand Lake and in the deeper pockets of Mud Lake.
- Shallow-water/sparse habitat would be provided along the lake edges and shorelines.

The location and amount of each habitat type would vary with the natural wetland cycles. As emergent vegetation gradually decreases, the habitat type would change. This can happen gradually over time or within several years if water levels are extreme.

#### **Strategies**

- Maintain consistent water elevations.

When emergent cover is in optimal condition, conventional water strategies would be applied. This consists of moving spring runoff through the refuge as quickly as possible, until water levels have fallen to full-pool elevation (1,287.52 feet above sea level). Full-pool elevation would be maintained through the nesting season (May 15–August 1). Refuge staff would continue to coordinate with upstream dam managers to minimize negative impacts to overwater nesters.

- Manage drawdowns.

Control of water levels to manage wetland habitats is dependent on the flows of the James River. Conditions on the river can change quickly and need to be continually evaluated.

After multiple years of high water, cattail stands often need to be reestablished through managed drawdowns. The best time to reestablish cattail in Sand Lake is during low-flow years, when water levels can be drawn down during the summer months.

In Mud Lake, drawdowns would be limited by the level in Sand Lake, but conditions should be sufficient to reestablish cattail during low-flow years.

The coordinated release of water from Dakota Lake National Wildlife Refuge, just north of Mud Lake, may also be an option if the releases benefit both refuges or if the benefits to Sand Lake National Wildlife Refuge override the benefits to Dakota Lake National Wildlife Refuge. This would be determined by the managers at both refuges. These releases may be needed to reflood part of Mud Lake after a drawdown or to address a botulism problem in Mud or Sand Lakes.

— Control cattail.

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersions of cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

— Control sedimentation within the upper James River basin.

The James River is embedded within an agricultural landscape where cultivation of wetland catchment areas has likely increased the intensity of runoff events and decreased the time available for infiltration.

Although all major dams constructed on rivers have a finite life span due to natural sedimentation processes, human-caused influences on sedimentation rates have great potential to fill prematurely Mud and Sand lakes, degrading their wetland functions.

Increased sediment in water generally reduces the depth of the photic zone, reducing the light available for primary production by aquatic macrophytes and algae (Ellis 1936, Robel 1961). Sediment depths of 0.1 inch can significantly reduce species richness, emergence, and germination of wetland macrophytes (Jurik et al. 1994, Wang et al. 1994).

Because of the negative impacts on aquatic vegetation from sediments, water quality functions may be altered (Gleason and Euliss 1998). Such loss of standing vegetation structure and algal biomass generally makes wetlands less productive for invertebrates (Euliss and Grodhaus 1987, Kreeker 1939, Krull 1970, Neill and Cornwell 1992). Aside from their obvious role in the feeding ecology of waterfowl and other birds, invertebrates provide critical food chain support for a wide variety of other organisms and play significant roles in nutrient cycling and overall wetland productivity (Murkin and Batt 1987).

In 2000, the USGS estimated the vertical accretion rate of sediment near the Mud Lake dike to be 0.5 inch per year, with sedimentation rates greater than 0.8 inch per year during the 1990s when river flows were especially high (Gleason et al. 2003).

At the current rate of sedimentation, the projected loss of water depth over the next 20 years would prohibit manipulation of water levels in Mud Lake. Lacking the ability to cycle vegetation and create an interspersions of cover and water, current wildlife objectives would not be met. Once Mud Lake fills with sediment, sedimentation rates are expected to escalate in Sand Lake as well.

If Mud Lake basin continues to fill with silt at its current rate, it could lose most of its original wetland volume. Methods to restore the basin would need to be evaluated within the context of economics and the postrestoration potential to provide targeted functions. Future work should assess current sedimentation rates in Sand Lake to project the life span of this impoundment.

Maintenance of the topographic relief of the Mud and Sand lakes basins is essential to maintaining the functions and biological diversity of the wetlands. Management of the upper basin may be the most practical alternative to reducing sediment in these lakes.

Conservation practices that target sustained agricultural production and long-term wetland management can be quite effective in slowing overland input into the James River, as follows:

- fencing out riparian zones
- creating greenways
- establishing grassed waterways and vegetative buffer strips
- implementing the Natural Resources Conservation Service's (NRCS) best management practices

The NRCS has already implemented the wetland reserve and conservation reserve programs on scattered lands along the James River. However, based on lack of significant enrollment in these programs, a new approach may be necessary to achieve coordinated effort among landowners to address effectively runoff issues along the James River.

One approach may include an entirely new program designed specifically for protection of the James River basin. Economic incentives could be used to facilitate landowner implementation of the program. Partners would be needed to develop such a large-scale program and could include the James River Watershed District, soil conservation districts, state and federal agencies, and other conservation organizations.

This approach could also involve a presentation of existing programs with a coordinated effort among multiple state and federal agencies. This outreach effort could be directed toward property owners on the James River flood plain to ensure that they are made aware of their options. Region 6's Partners for Fish and Wildlife Program would be one avenue for promoting new and existing programs to private landowners.

The U.S. Department of Agriculture (USDA) has the conservation reserve enhancement program (CREP), which has great potential although it has not yet been implemented in South Dakota. Based on observations in other states, the CREP program may prove to be a valuable tool to achieve the desired James River environmental goals.

In addition, the possibility of land easements or purchases could be made available. Perpetual protection of the flood plain would be preferable to a temporary solution. However, consideration should be given to the fact that perpetuity clauses may inhibit landowner participation.

**Subimpoundment Objective:** Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the

subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounce per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15. (Same as alternative 2.)

#### *Rationale*

(Same as alternative 2.)

The subimpoundment objective purposely includes broad ranges, as water levels are intended to vary like natural wetlands. The success and timing of such management actions are subject to dynamic weather patterns.

Plant communities in prairie wetlands are continually changing because of short- and long-term fluctuations in water levels and salinity. Prairie wetlands have evolved under these fluctuating conditions. The process of cycling with wet and dry periods makes prairie wetlands productive. For instance, exposure of mud flats during drought periods is necessary for the germination of many emergent macrophytes and facilitates the oxidation of organic sediments and nutrient releases that maintains high productivity.

Within the framework of a dynamic wetland system, management of the subimpoundments is directed toward waterfowl (foraging, breeding pairs, and broods), shorebirds, and wading birds. This objective sets an upper and lower threshold of emergent vegetation, because an interspersion of emergent vegetation and wetland openings is preferred by both dabbling and diving ducks and their broods (Kantrud 1986).



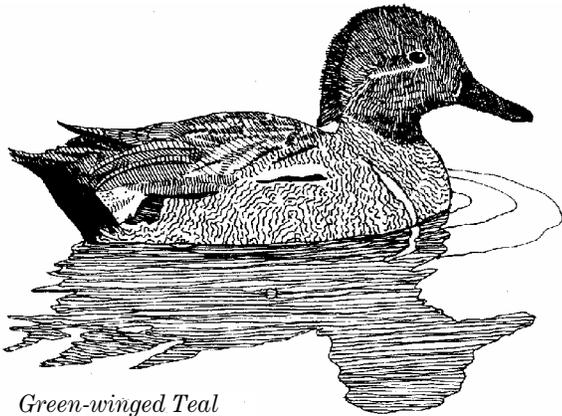
*Young eared grebes keep watch from their mother's back.*

Interspersed emergent vegetation also benefits other marsh-dwelling birds and mammals (Seabloom 1958, Vogl 1973, Weller and Spatcher 1965). Such conditions may also result in avian communities of greater species diversity or richness (Weller 1978,

Weller and Spatcher 1965). In addition, Voigts (1976) found maximum invertebrate abundance occurring where beds of submerged vegetation were interspersed with stands of emergent vegetation.

A lower invertebrate biomass threshold is part of the subimpoundment objective. Invertebrate abundance is quantified relative to biomass in June, because that is when invertebrate biomass is known to peak in most wetlands (Euliss and Mushet 2003). Abundance of aquatic macroinvertebrates is positively related to waterfowl use (Kaminski and Prince 1981, Schroeder 1973, Swanson and Meyer 1973) and early growth of ducklings (Chura 1961, Perret 1962, Sugden 1973). Aquatic invertebrates also are important food resources for shorebirds (Eldridge 1987), amphibians (Clark 1978, Deutschman 1984), and other marsh birds (Weller 1981).

Shallow water conditions during some portion of the year are also favorable. Deep water may reduce the availability of invertebrates to feeding waterfowl (Laperle 1974, Murkin and Kadlec 1986) and shorebirds. Optimum foraging depths for dabbling ducks, shorebirds, and wading birds are 2–9.8 inches, 0–9.8 inches, and 3–23.6 inches, respectively (Jasmer 2000). Diving ducks can also exploit food resources in shallow water (Fredrickson and Reid 1988).



*Green-winged Teal*  
© Cindie Brunner

### Strategies

- Conduct drawdowns and subsequent reflooding events.  
(Same as alternative 2.)

Water could be moved in and out of the five subimpoundments opportunistically, as flows in the James River and water levels in Mud and Sand lakes allow.

When management action is necessary and water elevations in the main pools are not conducive to take advantage of gravity flow, a 16-inch Crisafulli pump could be used to move water into or out of these subimpoundments. This would add significantly to the cost, would be time consuming,

and must not violate restrictions placed on the refuge's water rights. However, it could create the desired habitat conditions when other management alternatives are not available.

Most of the subimpoundments are smaller areas separated from the main pools by an embankment. Water could be diverted into or out of the subimpoundments by gravity flow. Because of their smaller size and isolation from the main pools, it would be possible to provide some water level control, thereby influencing the plant and invertebrate communities, as well as the productivity of the subimpoundments.

Plant and invertebrate production could be maximized through carefully planned drawdowns and subsequent reflooding events. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year. The need for rejuvenation of plant and invertebrate communities within each unit and the ability to move water out of the unit would largely determine when drawdowns could be conducted.

- Control cattail.  
(Same as alternative 2.)

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersion of cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to

drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

## PUBLIC USE

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

## WILDLIFE-DEPENDENT RECREATIONAL USE GOAL

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

**Consumptive Use Subgoal:** Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

**Hunting Objective:** Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.

*(Same as alternative 2.)*

### Strategies

*(Same as alternative 2.)*

- Provide hunting opportunities for deer, upland game birds, and waterfowl.
 

Areas would be designated for deer, upland game birds, and perimeter-boundary waterfowl hunting. An additional universally accessible hunting blind and parking area would be developed to increase opportunities for physically challenged hunters.

The refuge would open to upland bird hunting after the close of refuge rifle deer seasons according to state regulations and permit archery and firearm deer seasons based on consultation with the state, local landowners, and hunters.
- Create an updated hunting brochure and map for distribution at various locations around the refuge to provide hunters with up-to-date hunting rules and regulations.
- Develop a proactive law enforcement program including the establishment of a permanent, full-time law enforcement position to regulate hunting activities on the refuge and enforce wildlife laws.

**Fishing Objective:** When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.  
*(Same as alternative 1.)*

### Strategies

*(Same as alternative 2.)*

- Allow fishing at five designated locations.
 

The public would be made aware of the fishing program through notification of rules, updated brochures, and information in the state fishing handbook.
- Develop a proactive law enforcement program including the establishment of a permanent full-time law enforcement position to monitor and regulate fishing activities and enforce wildlife laws.

**Nonconsumptive Recreation Subgoal:** Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

**On-site Visitors Objective:** Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.

*(Same as alternative 2.)*

### Strategy

- Develop, update, and maintain visitor services.
 

An on-site education center would be constructed to provide space and materials to inform students, educators, and the visiting public about the refuge, wildlife conservation, and the National Wildlife Refuge System.

Updated kiosk panels would reflect modern wildlife management practices and conservation issues, and provide general refuge information.

All brochures would be updated, using the Service's graphic standards format, to provide visitors with current information and refuge policies.
- Nonconsumptive Recreation Objective:** Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.  
*(Same as alternative 1.)*
- Strategy**
  - Develop, update, and maintain on-site nonconsumptive recreational facilities.

The 15-mile auto tour route (“wildlife drive”) would be maintained and improved to provide visitors with a quality experience for viewing wildlife. This would include updating the route’s self-guided brochure, updating and improving signs on the route, and maintaining pull-off sites.

The observation tower and viewing platform would continue to be maintained for public use. The currently accessible Columbia Day Use Area would be improved to provide better wildlife-viewing opportunities through hiking trails, kiosk information, and wildlife blinds.

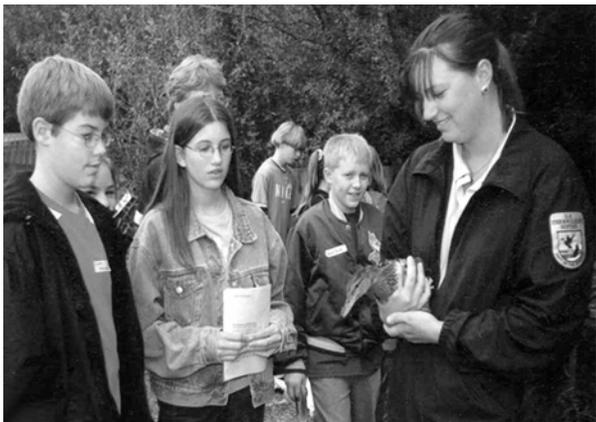
At least one permanent photography blind would be constructed to allow photographers better access to wildlife species.

Information kiosks would be enhanced to provide visitors with up-to-date refuge information at the refuge headquarters, the Columbia Day Use Area, and on Highway 10.

An education center would be constructed to provide the visiting public with space and materials for educating about the refuge, wildlife conservation, and the Refuge System.

## PUBLIC EDUCATION AND OUTREACH GOAL

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.



Students learn hands-on about waterfowl during a school field trip to the refuge.

### Public Education and Outreach Objectives

(Same as alternative 1):

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and

8 television interviews, and annually provide information for newspaper articles at least 30 times.

- Construct an education center.

**Local School Districts Objective:** Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.

(Same as alternative 2.)

### Strategy

- Increase education and outreach opportunities.

A survey to determine the level of awareness of the refuge’s education programs would be conducted within all local school districts.

An education outreach plan would be developed and an education brochure would be created to promote on- and off-site field trip opportunities and to inform educators of the availability of learning trunks, the education trail, and teacher guides.

Up to 25 additional educational opportunities would be created including teacher workshops, in-classroom programs, promotion of conservation learning trunks, and teacher resource kits.

An on-site education center would be built and would offer space for programs and other materials needed for students and teachers who use the refuge for outdoor classroom activities.

**Communities Objective:** Promote awareness of, and generate support for, Sand Lake National Wildlife Refuge and the National Wildlife Refuge System within local and regional communities through participation in a minimum of 3 additional off-site special events within 5 years of funding.

### Strategy

- Increase outreach activities and education activities.

Opportunities would be sought to promote the refuge and wildlife conservation to the public. Off-site opportunities include: (1) providing speakers for community and civic groups; (2) frequently updating local congressional offices and key staff on emerging or potentially controversial issues; (3) participating in local fairs, outdoor shows, and other public events; and (4) continued participation in the Water Festival.

- The refuge’s website would be maintained and improved to provide up-to-date information to the public on refuge policies, regulations, and wildlife.
- New educational and interpretive kiosks promoting the refuge and wildlife conservation issues would be developed at the Aberdeen

- Regional Airport, Wylie Park, Northern State University, and other strategic locations within the community. Five new partnerships with local and or regional interest groups would be sought and fostered to build support for the refuge and general conservation issues.
- A “friends group” would be established to provide the public with an opportunity to support the refuge.
- Weekly media contacts would continue with the “Refuge Corner Update,” and news releases and articles would be made available to local media outlets including television, radio, and newspaper.

## MONITORING AND EVALUATION

Habitat management on refuges is an ongoing process and the Service recommends that planning be conducted within the context of adaptive resource management (USFWS 1995b, 1996a).

Vegetative structure, as indicated by VORs, would be the primary method for monitoring vegetation. The dominant and subdominant species of vegetation also would be recorded annually. At present, more detailed species’ descriptions are not necessary for the floristically simple habitat blocks.

Vegetative species composition would be evaluated relative to the percentage of forbs present and the percentage of Canada thistle present. More in-depth evaluations of vegetative species may be necessary once seeded natives become a more prominent component of the overall upland habitat.

Time permitting, wildlife response to habitat treatments should also be evaluated. However, monitoring wildlife response must be conducted in concurrence with habitat monitoring, as it is difficult and unreliable to evaluate the merits of various treatments when relying on wildlife response alone. A more specific protocol for the habitat-monitoring plan would be outlined within a section of the step-down plan for habitat management, following approval of the CCP.

## PLAN MONITORING AND EVALUATION

Implementation of the CCP would be monitored throughout its effective period, 2005–19.

Accomplishment of objectives listed in this CCP would be monitored annually by the supervisor of the project leader for the refuge. Monitoring of accomplishments is critical to the implementation of the CCP.

It is reasonable to believe that substantial changes could occur within the Service during the next 15

years. The objectives of the CCP would be examined at least every 5 years to determine if revisions are necessary and to allow the addition or deletion of objectives.

## PERSONNEL AND FUNDING

The personnel and funding needed to carry out the CCP are described below.



Bill Schultze/USFWS

*The staff carpenter builds a footbridge on the refuge’s new education trail.*

## PERSONNEL

Currently, the refuge complex has a staff of 13 full-time employees to manage the refuge and the Sand Lake WMD. Table 6 lists these positions along with seven new positions that are needed for full implementation of this CCP (those positions needed only for the refuge). The proposed positions are also included in the database for refuge operations needs (appendix I).

## FUNDING

Funding to implement the CCP is derived from three sources:

- The refuge operations needs system (RONS) includes requests made to the Congress for funding and staffing above the existing base budget needed to administer programs and carry out projects.

- Five of the seven new refuge positions are associated with RONS projects and would have a first-year cost of \$589,500 with an annual cost of \$296,000 (this does not include proposed visitor use or fire positions).
- The maintenance management system (MMS) is a database that documents the maintenance and replacement needs for existing equipment, buildings, roads, fences, and other property (appendix J).
- Cost estimates are developed for projects needed to implement the CCP, which are not yet reflected in the RONS or MMS.

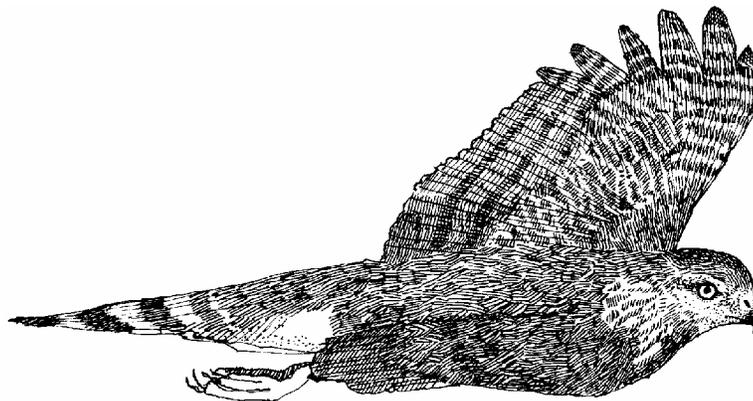
**Table 6. Current and proposed staff, Sand Lake National Wildlife Refuge, South Dakota**

	<i>Current Positions</i>	<i>Additional Proposed Positions (Unfunded)</i>
<i>Management Staff</i>	Refuge complex project leader, GS <sup>1</sup> -14 Deputy project leader, GS-13 Supervisory refuge operations specialist <sup>2</sup> , GS-12 Refuge operations specialist <sup>2</sup> , GS-9 Refuge operations specialist <sup>2</sup> , GS-9	Supervisory refuge operations specialist, GS-11
<i>Biological Staff</i>	Refuge complex biologist, GS-12 Biologist trainee, GS-9 Private lands biologist <sup>2</sup> , GS-11	Resource specialist, GS-11
<i>Public Use Staff</i>	Outdoor recreation planner, GS-11	Law enforcement officer, GS-9 Law enforcement officer, GS-9 (0.5 FTE <sup>3</sup> ) Visitor use assistant, GS-5
<i>Administrative Staff</i>	Administrative officer, GS-9	Clerk, GS-5
<i>Maintenance Staff</i>	Engineering equipment operator, WG <sup>1</sup> -10 Carpenter, WG-9 Biological science technician, GS-6	None
<i>Fire Management Staff</i>	Range technician, GS-6	Fire management officer, GS-9

<sup>1</sup>GS=general schedule employee; WG=wage grade employee.

<sup>2</sup>This position supports both the refuge and the wetland management district (WMD).

<sup>3</sup>FTE=full-time equivalent.



*Sharp-shinned Hawk*

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# 5 Environmental Consequences

The environmental consequences, or impacts, discussed in this chapter are the potential effects on a resource as a result of carrying out the actions of an alternative.

For a better understanding of why these effects may occur, refer to the descriptions of resource conditions and interactions in chapter 3 (affected environment).

Chapter 4 (alternatives) presents the management scenario for each alternative, which could create the consequences described here.

This chapter presents the following:

- Summary of environmental consequences (table 7)
- Environmental consequences by alternative
- Socioeconomic impacts
- Cumulative impacts



Male Wood Duck

Tim McCabe/USFWS

The public scoping meetings, issues workbooks, and refuge information indicated that there are four major issues of concern regarding refuge management. These issues are used to describe expected environmental consequences of the alternatives.

**Table 7. Comparison of impacts and benefits of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ISSUE</b>	<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<b>Wildlife and Habitats</b>	<i>Habitat diversity:</i> greater diversity of habitat by providing a variety of habitats	<i>Habitat diversity:</i> increased for grassland-nesting birds	<i>Habitat diversity:</i> enhanced vegetative diversity of grasslands
	<i>Waterfowl:</i> dominant focus; grasslands managed for upland nesting at current level	<i>Waterfowl:</i> dominant focus; reduced waterfowl numbers during spring and fall migrations due to lack of open water	<i>Waterfowl:</i> dominant focus, with localized increase in habitat
	<i>Deer and pheasant:</i> winter food requirements would be supplemented	<i>Deer and pheasant:</i> deer and pheasants may rely more on crops outside the refuge	<i>Deer and pheasant:</i> same as alternative 1
	<i>Woodland-dependent species:</i> winter shelter (in shelterbelts) maintained for deer and pheasant	<i>Woodland-dependent species:</i> less habitat due to removal of all shelterbelts	<i>Woodland-dependent species:</i> less habitat due to removal of some shelterbelts
	<i>Grassland-dependent species:</i> benefit from reduction in woodland	<i>Grassland-dependent species:</i> more; increased nesting success of grassland birds	<i>Grassland-dependent species:</i> localized increase of habitat
	<i>Overwater species:</i> maintained at current levels	<i>Overwater species:</i> decline due to breached dike and fewer years of adequate pool depth from natural flows	<i>Overwater species:</i> same as alternative 1

**Table 7. Comparison of impacts and benefits of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ISSUE</b>	<b>ALTERNATIVE 1</b> <i>Current management— no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management— proposed action</i>
<b>Water Management</b>	<i>Water levels:</i> relatively stable, benefiting overwater nesters	<i>Water levels:</i> fluctuate naturally with flows in the James River due to breaching of dikes; significant decrease in size and depth of riverine wetlands, changing the vegetation of the wetlands and adjacent uplands	<i>Water levels:</i> same as alternative 1
	<i>Siltation:</i> wetlands for migratory birds slowly lost as silt carried by the James River is deposited in impoundments	<i>Siltation:</i> reduced siltation rates within the refuge	<i>Siltation:</i> same as alternative 1
	<i>Fish habitat:</i> decline in fish production in Mud Lake	<i>Fish habitat:</i> diminished; pool capacity greatly reduced	<i>Fish habitat:</i> same as alternative 1
	<i>Fish habitat:</i> unknown effect on the water table on nearby private lands	<i>Fish habitat:</i> same as alternative 1	<i>Fish habitat:</i> same as alternative 1
<b>Public Use</b>	<i>Hunting:</i> current levels, seasons, and locations	<i>Hunting:</i> possible reduced quality of hunting as harvest opportunities decrease because of less accessibility of game to hunters due to grassland restoration	<i>Hunting:</i> current levels, seasons, and locations
	<i>Fishing:</i> current levels, seasons, and locations; limited parking adjacent to fishing sites	<i>Fishing:</i> less opportunity and angler use due to only fall and winter fishing to avoid conflicts with nesting migratory birds; limited parking adjacent to fishing sites	<i>Fishing:</i> same as alternative 1
	<i>Trapping:</i> allowed only as a management tool	<i>Trapping:</i> same as alternative 1	<i>Trapping:</i> same as alternative 1
	<i>Wildlife observation and wildlife photography:</i> current levels of viewing opportunities	<i>Wildlife observation and wildlife photography:</i> decreased viewing opportunities due to access restrictions	<i>Wildlife observation and wildlife photography:</i> increased viewing opportunities
	<i>Environmental education and interpretation:</i> remain at current levels	<i>Environmental education and interpretation:</i> more environmental education, interpretation, and partnerships, with subsequent increased support of the refuge; enhanced on-site visitor opportunities	<i>Environmental education and interpretation:</i> same as alternative 2

**Table 7. Comparison of impacts and benefits of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<b>ISSUE</b>	<b>ALTERNATIVE 1</b> <i>Current management—no action</i>	<b>ALTERNATIVE 2</b> <i>Maximize biological potential for grassland-nesting birds</i>	<b>ALTERNATIVE 3</b> <i>Integrated management—proposed action</i>
<b>Public Use</b>	<i>Camping: not allowed</i>	<i>Camping: same as alternative 1</i>	<i>Camping: same as alternative 1</i>
	<i>Wildlife: current levels of disturbance to wildlife</i>	<i>Wildlife: less disturbance of wildlife due to road closures and elimination of recreation areas; some increase in wildlife habitat due to elimination of recreation areas and some roads</i>	<i>Wildlife: additional disturbance to wildlife due to new recreational trail</i>
<b>Invasive Plants</b>	<i>Infestations: major problem in grasslands and wetland edges</i>	<i>Infestations: increased opportunities for invasion in the short term due to elimination of croplands and shelterbelts; reduction of invasive plants would prevent their tendency to take over and create monotypic stands</i>	<i>Infestations: reduction of invasive plants would prevent their tendency to take over and create monotypic stands</i>
	<i>Vegetation: reduced forbs and vigor of the grassland community due to chemical control of invasive plants</i>	<i>Vegetation: increased grassland habitat through removal of Russian olive trees and shelterbelts</i>	<i>Vegetation: increased grassland habitat and native riparian vegetation through selective removal of shelterbelts and Russian olive trees</i>
	<i>Wildlife: reduced habitats due to loss of grassland quality (i.e., invasive plants)</i>	<i>Wildlife: elimination of a food source for some species of winter wildlife due to aggressive removal of shelterbelts and Russian-olive trees</i>	<i>Wildlife: same as alternative 2</i>

## ALTERNATIVE 1

### CURRENT MANAGEMENT—NO ACTION

The estimated effects of carrying out alternative 1 are described below.

## WILDLIFE AND HABITATS

Alternative 1 would maintain the current habitat management program at approximately the same intensity. The grasslands would be managed to provide habitat for upland-nesting waterfowl.

Planted woodlands would continue to deteriorate with age and would naturally die out. Grassland-nesting birds would benefit as a result. Species of migratory birds that use fringes would decrease, resulting in a decrease in local species diversity of migratory birds.

Hunters that recreate on and around the refuge place a high value on the large number of waterfowl, pheasants, and deer that use the refuge.

Approximately 800–1,000 acres of cropland would be maintained to provide food for resident wildlife species. In addition, the farming program would be used to control invasive plants for the restoration of grassland.

Maintaining the existing crop production program would sustain deer and pheasant populations and maintain the recreational hunting and viewing opportunities for these species at a high level. Snow geese would continue to have the tendency to use the refuge crop fields very little and fly off-refuge to forage.

Neighbors adjacent to some of the refuge's best deer habitat annually lose some of their crops of corn and alfalfa to foraging deer. Planting cropland on the refuge has attempted to lessen this impact; however,

planting cropland does little to contribute to the production of grassland-nesting birds. Interspersed cropland reduces the size of contiguous blocks of grass, which makes it easier for predators to find bird nests. Cropland management results in the increased use of pesticides, some of which may be harmful and persist in the environment. Farming also increases soil erosion.

## WATER MANAGEMENT

The water cycle affects the fishery and wildlife use of the refuge. Under alternative 1, the current system of dikes and water control structures would be used to implement conventional water strategies when emergent vegetation is in optimal condition. This would consist of passing the spring runoff through the refuge as quickly as possible until water levels have fallen to full-pool elevation. Full-pool elevation would be maintained and any activity upstream that would result in a rise of pool elevations through the nesting season would be discouraged (May 15–August 1).

The ability to hold water levels stable is essential to the success of colonial overwater-nesting birds, which require consistent water levels in their colonies throughout nesting efforts. The current ability to influence wetland conditions through water management provides a broad range of critical habitats that support an array of plant and wildlife species.

The five subimpoundments have some water management capability. Under alternative 1, the subimpoundments are managed as dynamic wetland systems that cycle between drawdown and flood events. Prairie wetlands have evolved under these fluctuating conditions—cycling between wet and dry periods makes prairie wetlands very productive.

By managing the subimpoundments for maximum productivity, the subimpoundments would provide for the greatest production of hydrophytic plants and aquatic invertebrates possible. As an important food resource, these aquatic macroinvertebrates would encourage the use of the subimpoundments by waterfowl, shorebirds, wading birds, amphibians, and other marsh birds, as well as positively influence the early growth of ducklings. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year.

When stands of emergent vegetation need to be reestablished, managed drawdowns of the refuge, Mud Lake, or the subimpoundments would be conducted. Winterkill of game fish is sometimes an unintentional result of late-season drawdowns, with detrimental impacts on fish production in those years.

Currently, no mitigation is occurring to compensate for accelerated sedimentation near the Mud Lake dike. Sedimentation rates are expected to remain elevated near current levels (0.5 inch per year) and continue to degrade the wetland functions of Mud Lake. The refuge's ability to cycle vegetation and create an interspersed cover and water to meet current wildlife objectives in Mud Lake through current water level manipulations would be hindered.

Production of aquatic macrophytes and algae is expected to decrease, resulting in lower invertebrate production. Reduced invertebrate production may retard nutrient cycling and overall wetland productivity, as well as limit a major food source for waterfowl and other wildlife. Species richness, emergence, and germination of wetland macrophytes may be significantly reduced, thereby reducing the ability of the wetlands to provide water quality functions.

Winterkill of game fish may occur more often and, to a larger extent, as Mud Lake becomes shallower. Fishery production in Mud Lake would also be reduced as deepwater habitats become scarcer. Acceleration of sediment accretion rates in the refuge is not expected to occur until Mud Lake fills with sediment. Therefore, game fish would be able to find protection in the refuge during years when managed drawdowns are not occurring. Fish would still be able to traverse the refuge through the James River channel.

It is unknown whether water levels on the refuge affect the water tables on neighboring lands. Water should be moved quickly through the system to keep water tables on adjacent private lands low for agricultural purposes. The extent to which sediment accretion in Mud Lake would impact the water table on private land is unknown.

## PUBLIC USE

Since alternative 1 calls for no change in management strategies, public use would continue at the present level. The refuge would provide quality, universally accessible, recreational opportunities to visitors of all ages and abilities.

Recreational opportunities on the James River are very important to local residents. Opportunities on the refuge include wildlife-dependent and wildlife-compatible uses legislated by Congress and outlined in the National Wildlife Refuge System Improvement Act of 1997—hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. Hiking has also been deemed a compatible use during limited times of the year.

## HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. Hunting also has a long-standing history on national wildlife refuges.



John Stehm/USFWS

*White-tailed Deer*

Under alternative 1, management practices would not change and all seasons would continue as presently managed. The refuge would continue to provide hunting seasons for white-tailed deer, waterfowl, and upland game, in accordance with state and federal laws and regulations.

- Deer seasons and harvests would continue to be set annually in agreement with the SDGFP to meet herd management needs for the refuge.
- Waterfowl hunting would continue to be boundary hunting only. However, the option of eliminating all or some of the spaced blinds has been discussed with the SDGFP, Brown County Sportsmen's Club, and other interested parties.
- An upland game season would continue as a late-season hunt during the last three weeks of December.

No new parking areas for additional hunting access are proposed.

## FISHING

Although there is a high demand for ice fishing, there is no active fisheries management. Due to

annual water fluctuation, low water depths, and practices that prioritize migratory birds over fish, the refuge does not support a reliable game fishery.

The refuge would continue with the present fishing program of providing opportunistic fishing at the current five locations. Limited fishing access at these five right-of-way locations, during both winter and summer seasons, has produced a high density of users in limited areas. Fishing would continue to be provided only in these five areas, where it has been determined that disturbance to breeding, nesting, brooding, and wintering wildlife would be minimal.

Boating, which would decrease the density of users in one area, is not allowed to avoid disturbance to nesting and brooding birds.

Insufficient parking near the five designated fishing areas creates traffic congestion when anglers use road rights-of-way for fishing. Within a short walking distance of the fishing areas are parking areas at Hecla Day use Area and Weismantel Grade/117th Street. The parking area near the Highway 16/Columbia Dam location is especially problematic, as it is located more than 0.5 mile south of the fishing area. All designated parking areas would continue to be marked and maintained and would provide information and brochures for fishing and hunting.

There are no plans to provide parking at the other two fishing areas, located on Highway 10 and north of Brown County 5, because no space is available for parking areas.

## TRAPPING

Trapping is currently only used as a management tool. Its application is based on a year-by-year assessment of needs. Reduction of depredation on ground-nesting birds and minimizing damage to dikes and road grades are the two primary goals.

## WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Current on- and off-refuge opportunities for wildlife viewing, education, and interpretation would be retained. This includes informational kiosks, an auto tour, hiking trails, day use areas, an observation tower and a viewing platform, and educational programs.

## CAMPING

Camping is not allowed and is not a priority use on national wildlife refuges. Camping on the refuge is not wildlife-compatible or wildlife-dependent. Because of the modest size of the refuge, camping is not necessary for reasonable access. A variety of camping opportunities exists within short distances (8–25 miles), including Columbia, Aberdeen, and various sites around Brown County.

## INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

The chemicals used to control invasive plants are of concern from the standpoint of environmental contamination and negative impacts on desirable plant species. Using pesticides reduces diversity and the subsequent quality of grasslands.

The diversified program of integrated pest management to control invasive plants would not change. In addition to herbicides, management tools such as grazing, burning, mowing, and farming would be used to maintain the quality of upland habitat. Control may be conducted on up to 1,500 acres of grasslands annually. Infestations may increase or decrease, depending on environmental conditions.

### ALTERNATIVE 2

MAXIMIZE BIOLOGICAL POTENTIAL  
FOR GRASSLAND-NESTING BIRDS

The estimated effects of carrying out alternative 2 are described below.

## WILDLIFE AND HABITATS

The number of acres of grassland habitat would be maximized by the following:

- Elimination of the farm program
- Decline in wetland acreage with the removal or breaching of the two dikes
- Elimination of shelterbelts

There would be a benefit to grassland-dependent bird species by providing larger blocks of nesting habitat and eliminating predator travel corridors and den sites. Since many grassland-dependent birds are in decline, the changes would help increase biodiversity on a landscape scale, but species diversity on the local (refuge) scale would decline. The numbers and diversity of tree-nesting species and edge species would be reduced.

The grasslands would be managed to provide habitat for upland-nesting waterfowl. Management would be limited to grazing, mowing, haying, and burning. There would be a lack of forbs in much of the grassland due to extensive control of Canada thistle using haying and herbicide application.



Neil Powers/USFWS

*Prescribed fire is used to rejuvenate grassland.*

The diversity of wetland-dependent species using the refuge would decline, due to the decreased wetland acreage of all wetland types and the lack of any water control ability.

Game species, especially waterfowl, geese, pheasant, and deer, are important recreational resources. Use of the refuge by geese would decline due to the drastic decline of wetland acres. White-tailed deer use would be sustained, as in alternative 1, depending on cattail response to the change of water levels from the dike removal and breaching.

Some neighbors of the refuge are losing a portion of their crops of corn and alfalfa to foraging deer. With the elimination of all crops on the refuge, white-tailed deer and pheasants may have to rely more on neighboring crops as a food source. Depredation on neighboring crops may increase throughout the growing season.

## WATER MANAGEMENT

Water management on the refuge affects the fishery and wildlife use of the refuge. With the removal or breaching of the Mud Lake and Columbia Road dikes, water levels on the refuge would fluctuate naturally with flows in the James River. Size and depth of the riverine wetlands would decrease significantly, changing the vegetation regime of the wetlands and the adjacent uplands.

The number of migrating waterfowl, including breeding pairs and broods, using the refuge would probably decline. However, it is not known how a decrease in numbers, combined with an improvement in nest success (due to reduced nest depredation and increased grassland acreage), would affect waterfowl production.

Use of the refuge by overwater-nesting colonial birds would decline.

Sedimentation rates in wetlands would decline with the removal or breaching of the dikes, with long-term benefits to water quality expected to occur.

The five subimpoundments have some water management capability. Under alternative 2, the subimpoundments would be managed similarly to alternative 1, but opportunities to fill the subimpoundments would be less frequent due to lower water levels.

Water management used to enhance waterfowl habitat may have a detrimental impact on the fishery, because drawdowns to winterkill rough fish also kill game fish. Under alternative 2, there would be no water management capabilities, except for the subimpoundments. Winterkill of fish would be more frequent due to lower water levels.

Lower water levels within the wetlands on the refuge could result in a lower water table on adjacent lands, especially in the sandy soils east of the James River. This could negatively affect crop yields on these areas during dry years.

## PUBLIC USE

Under alternative 2, public use would be restricted to maximize the biological potential of grassland-nesting birds. The restrictions would limit public use to specific locations by season. Access to the James River would be reduced.

While providing for upland, ground-nesting, migratory birds (focus of alternative 2), the desire of some of those who recreate on the refuge for a great diversity of habitats and wildlife would not be met.

## HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. The refuge would continue to allow deer and upland game hunting. Waterfowl hunting would be allowed along the perimeter of the refuge. These seasons do not interfere with nesting, brooding, or foraging migratory birds.

The removal of all shelterbelts and cropland, and subsequent restoration of native grassland, would adversely affect the quality of hunting, as many game species are dependent on shelterbelts and croplands for food and shelter. Accessibility of deer and upland game to hunters would likely decrease, which in turn would likely reduce harvest success.

Waterfowl-hunting success may also be affected. Without the impoundments, migrating waterfowl may pass through the refuge more quickly during the fall; opportunities for hunters to harvest waterfowl would be reduced. Overall hunter satisfaction may decrease as the quality of hunting and harvest opportunities decreases.

## FISHING

Limited fishing access has produced a high density of users in limited areas. There is also a high demand

for ice fishing. Spring and summer fishing opportunities would be eliminated to avoid direct conflicts with nesting and brooding migratory birds. This would limit anglers' use of the refuge. Fall and winter fishing would still be allowed at the five designated fishing areas.

The refuge does not support a reliable game fishery. Fish populations on the refuge are likely to drop even lower with the removal or breaching of the dikes, as deeper water areas found in the impoundments would be eliminated. Without this critical fish habitat, fish populations would be more likely to suffer winterkill. As a result, it is likely angler use would decrease due to limited harvest opportunities.

Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. There would be no change in fishing access, as in alternative 1.

## TRAPPING

Trapping would only be used as a management tool, as in alternative 1.

## WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Public access to wildlife observation, wildlife photography, environmental education, and interpretation would be greatly reduced, which could result in decreased visitation.



Bob Savannah/USFWS

Nearly all spring and summer recreational use and some fall recreational use of the James River through the refuge would either be eliminated or restricted to avoid conflicts with nesting, brooding, and foraging birds.

General public use would be restricted to the headquarters area during breeding and brooding seasons.

## CAMPING

Camping would not be allowed, as in alternative 1.

## INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

Infestations of invasive plants may increase or decrease, depending on environmental conditions, as in alternative 1. However, the number of acres of invasive plants might increase due to the lower water levels in this alternative. In this case, an increase in the use of haying and herbicide application to control invasive plants may be necessary.

## ALTERNATIVE 3

INTEGRATED MANAGEMENT—  
PROPOSED ACTION AND DRAFT CCP

The estimated effects of carrying out alternative 3 are described below.

## WILDLIFE AND HABITATS

The vegetative diversity of the grassland habitats would be greatly enhanced by reseeding all habitat blocks dominated by smooth brome or decadent DNC to native vegetation or rejuvenated DNC. Invasions of Canada thistle, which can decrease the abundance of desirable plants when it exists in a monoculture, would be reduced.



These healthier grasslands would provide higher quality food and cover than Canada thistle monocultures. Limited areas of diverse, native grasses already exist; therefore, the diversity of species using the grasslands is not expected to increase because of increased vegetative diversity. However, grassland-dependent birds and small mammals that require grasslands with vertical habitat complexity and diverse seed sources to feed or reproduce are expected to become more abundant as the grasslands are restored.

Native forbs are expected to become more prevalent as grasslands are restored. These broadleaf plant species provide excellent habitat for many insect species; therefore, the diversity and abundance of insect species is expected to increase. This increase should contribute to an increase in the abundance of grassland-dependent birds and small mammals that rely heavily on insects as a food source.

Increases in habitat complexity, seed source diversity, insect diversity, and insect abundance may result in an overall increase in the carrying capacity of the grasslands—the total number of grassland-dependent birds and small mammals capable of feeding and reproducing on the refuge may increase.

Game species, especially waterfowl, geese, and deer, are important resources of the refuge. Use of the refuge by geese and white-tailed deer would likely be unchanged.

Neighbors to the refuge are losing some of their crops of corn and alfalfa to foraging deer. In an effort to minimize this impact under current management, cropland blocks on the refuge were placed adjacent to areas of high depredation on private land. Total cropland acreage would ultimately be reduced to 800 acres. Farmed acreage would be rotated as a management tool for controlling Canada thistle to restore degraded grasslands. Benefits for white-tailed deer would be provided indirectly.

## WATER MANAGEMENT

The system of dikes and water control structures on the refuge would be preserved. Water management would have the same impacts as under alternative 1, with the notable exception that accelerated sediment accretion rates within Mud Lake would attempt to be addressed via watershed-level conservation efforts.

Sedimentation rates near the Mud Lake dike are expected to remain elevated near current levels over the next 15 years, thereby continuing to degrade the wetland functions of Mud Lake. The fishery and wildlife would be impacted similar to that under alternative 1 during the next 15 years.

Watershed-level conservation efforts that target sustained agricultural production and long-term wetland management can be quite effective.

However, creating the partnerships necessary to develop and carry out such broad-scale conservation efforts throughout the upper James River basin would be very time consuming. A cumulative reduction in sediment entering the James River because of such a massive effort could take decades to materialize.

Long-term benefits of broad-scale conservation efforts should be evident once conservation programs protecting the upper James River basin are firmly established on the landscape. The life span of Mud Lake would be extended if watershed-level conservation efforts were successful in the short term. In addition, long-term benefits to water quality functions, nutrient cycling, and overall wetland productivity on the James River and the refuge are expected to occur once the desired conservation efforts are in place.

## PUBLIC USE

Recreational opportunities on the James River are very important to local residents. Wildlife-dependent and wildlife-compatible recreational uses along the James River, within the refuge, would continue to be allowed and would be enhanced.

## HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. Hunting programs for white-tailed deer, waterfowl, and upland game would continue to be the same as under alternative 1. Parking areas would be improved, marked, and maintained. Kiosks in parking areas would provide hunter information and brochures.

## FISHING

Limited fishing access has produced a high density of users in limited areas. There is also a high demand for ice fishing. Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. Opportunistic fishing and limited fishing access would be the same as under alternative 1.

## WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Additional opportunities for wildlife observation, wildlife photography, and hiking, along with improved signing, updated brochures, and restored information kiosks would provide visitors with a higher quality visitor experience.

Enhanced management of grasslands would offer visitors a greater chance of viewing grassland-dependent bird species.

## CAMPING

Camping would not be allowed, as in alternative 1.

## TRAPPING

Trapping would only be used as a management tool, as in alternative 1.

## INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

Reduction of Canada thistle would be accomplished by tilling cropland infested with Canada thistle. Cropland would be planted with native vegetation seed or DNC several years later, after the area was considered clear of viable Canada thistle seed. If successful, there would be less reliance on farming as a habitat management tool. Canada thistle will not grow in fields planted with genetically-modified varieties of “Roundup-ready” corn or soybeans that are sprayed with the nonselective herbicide, Roundup. By maintaining these no-till crops in production for several years, the percentage of viable invasive-plant seed in the upper soil layer should be significantly depleted.

Such a strategy holds promise in reducing the germination potential of Canada thistle. Averaged across the next 15 years, a rotation of 800 acres of cropland is expected to improve control of Canada thistle on an estimated 3,000 acres of upland. As a result, Canada thistle should be much more contained than it is currently, reducing the potential for Canada thistle to serve as a seed source invading adjacent or downstream private lands.

Using cropland on a rotational basis is a reasonable alternative to large-scale chemical application. Application of chemicals would likely only need to be used on small infestations within newly seeded areas. This approach should provide for reestablishment of a more diverse plant community and higher quality habitat for migratory birds.

In addition, chemical use is thought to reduce the vigor of any plant community, resulting in an increased opportunity for Canada thistle to dominate. Current chemical use is degrading the plant diversity within established DNC, seeded native grass areas, and native prairie. The forb component is disappearing and habitat blocks are becoming dominated by chemical-tolerant, monotypic grasses.

## SOCIOECONOMIC IMPACTS

The economic impact analysis for implementation of the draft CCP is summarized in this section. This analysis describes how management activities of the refuge affect the local economy. The analysis provides two critical pieces of information:

- Illustrates the refuge's true value to the local community
- Helps determine whether local economic effects are, or are not, a real concern in choosing among management alternatives

For the purposes of an economic impact analysis, a region and its economy is typically defined as all counties within a 30- to 60-mile radius of the impact area. Only spending that takes place within this local area is included as stimulating the changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Based on the relative self-containment in terms of retail trade and distance to other communities, Brown County was assumed to comprise the economic region for the analysis.

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors will and will not be affected by demographic, economic, and policy changes.

Management activities of economic concern in the analysis included the following:

- Refuge staffing
- Refuge spending within the local community
- Recreational activities on the refuge
- Spending in the local community by refuge visitors

The full economic report produced by the USGS (appendix H) looks in depth at the economic effects of the management alternatives for the Sand Lake National Wildlife Refuge.

Table 8 summarizes the direct and total economic impacts for all refuge management activities by alternative.

### ALTERNATIVE 1

Current refuge staffing and budgeting generates 13 permanent and 4 temporary or seasonal employees. The current staff accounted for an annual payroll (including salaries and benefits) of \$910,600 in 2003.

In addition to providing salaries and benefits, the refuge purchased goods and services totaling \$165,200 in 2003, approximately 65 percent of which was spent locally in the Brown County economy.

Currently, visitors to the refuge spend about \$655,500 annually in the Brown County economy. The current level of visitor spending directly generates more than \$152,000 in personal income and 9.4 jobs for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations).

The associated indirect and induced effects generate an additional 4.3 jobs and more than \$102,000 in personal income throughout the Brown County economy for a total economic impact of 13.7 jobs and more than \$254,000 in personal income associated with the current level of refuge visitation.

Economic activity directly related to all refuge operations would generate an estimated 28.1 jobs and more than \$786,500 in personal income in Brown County. Including direct, indirect, and induced effects, all refuge activities would account for 41.3 jobs and \$1.09 million in personal income in Brown County. Current refuge management activities account for 0.15 percent of total county employment and 0.11 percent of county income.

### ALTERNATIVE 2

The anticipated staffing and nonsalary expenditures are the same as for alternative 1, current conditions. Refuge visitation is estimated to decline by 30 percent as compared to alternative 1, resulting in lower (than current) spending and, subsequently, lower generation of personal income.

### ALTERNATIVE 3

Staffing needs are expected to increase by 6.5 additional permanent employees (table 6). Refuge visitation is estimated to increase by 25 percent as compared to alternative 1. These increases would raise spending and personal income above current levels.

## CUMULATIVE IMPACTS

Cumulative impacts result from incremental effects of the proposed action, when these are added to foreseeable actions of the past, present, and future. These cumulative impacts can be the result of individually minor impacts, which can become significant when added over time.

The implementation of the draft CCP (alternative 3, integrated management-proposed action) would reduce the likelihood for cumulative impacts because

**Table 8. Summary of economic effects of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota**

<i>Brown County</i>	<i>Alternative 1 Current management— no action</i>	<i>Alternative 2 (Maximize biological potential for grassland-nesting birds)</i>	<i>Alternative 3 (Integrated management— proposed action)</i>
<b>Total Refuge Staffing and Budgeting Impacts</b>			
<i>Direct Effects</i>			
Annual Income	\$634,478	\$634,478	\$1,144,673
Jobs	18.7	18.7	35.3
<i>Total Effects</i>			
Annual Income	\$840,397	\$840,397	\$1,526,249
Jobs	27.6	27.6	51.6
<b>Recreation Activities</b>			
<i>Direct Effects</i>			
Annual Income	\$152,076	\$106,453	\$190,095
Jobs	9.4	6.6	11.8
<i>Total Effects</i>			
Annual Income	\$254,339	\$178,037	\$317,924
Jobs	13.7	9.6	17.1
<b>Aggregate Impacts</b>			
<i>Direct Effects</i>			
Annual Income	\$786,554	\$740,931	\$1,334,768
Jobs	28.1	25.3	47.1
<i>Total Effects</i>			
Annual Income	\$1,094,736	\$1,018,434	\$1,844,173
Jobs	41.3	37.2	68.7
Proportion of Total County Income	0.11%	0.10%	0.18%
Proportion of Total County Employment	0.15%	0.14%	0.26%

of the incremental approach in which habitats and other programs would be carried out.

The new approach of the proposed action would change the current waterfowl production scheme to a more ecologically oriented, habitat-based management. This approach would alleviate some of the impacts caused by target species management. For example, single species management such as primarily managing for waterfowl may impact nonpriority species.

The NEPA requires mitigation measures when the environmental analysis process detects possible significant impacts to habitats, wildlife, or the human environment. All the activities proposed under alternative 3 are not expected nor intended to produce significant levels of environmental impacts that would require mitigation measures. Nevertheless, the CCP will contain the following measures to preclude significant environmental impacts from occurring:

- Federally listed species will be protected from intentional or unintended impacts by having activities banned where these species occur
- Hunting safety regulations will be closely coordinated with and enforced by personnel from the refuge and SDGFP personnel
- All proposed activities will be regulated to reduce potential impacts to wildlife and plant species, especially during their sensitive reproductive cycles
- Monitoring protocols will be established to determine goal achievement levels and possible unforeseen impacts to resources for application of adaptive management to ensure wildlife and habitat resources, as well as the human environment, are preserved
- The CCP can be revised and amended after 5 years of implementation, for application of adaptive management to correct unforeseen impacts that occur during the first years of the plan.



# Glossary

**accessible**—Pertaining to physical access to areas and activities for people of different abilities, especially those with physical impairments.

**adaptive management**—The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities; a process that uses feedback from research, monitoring, and evaluation of management actions to support or modify objectives and strategies at all planning levels; a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in management plan. Analysis of results helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

**alternative**—A reasonable way to solve an identified problem or satisfy the stated need (40 CFR 1500.2); one of several different means of accomplishing refuge purposes and goals and contributing to the Refuge System mission (Draft Service Manual 602 FW 1.5).

**amphibian**—A class of cold-blooded vertebrates including frogs, toads or salamanders.

**ATV**—All-terrain vehicle.

**baseline**—A set of critical observations, data, or information used for comparison or a control.

**biological control**—The use of organisms or viruses to control invasive plants or other pests.

**biological diversity, also biodiversity**—The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1.12B). The National Wildlife Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

**biomass**—The total amount of living material, plants and animals, above and below the ground in a particular habitat or area.

**biotic**—Pertaining to life or living organisms; caused, produced by, or comprising living organisms.

**canopy**—A layer of foliage, generally the uppermost layer, in a vegetative stand; midlevel or understory vegetation in multilayered stands. Canopy closure (*also* canopy cover) is an estimate of the amount of overhead vegetative cover.

**CCC**—*See* Civilian Conservation Corps.

**CCP**—*See* comprehensive conservation plan.

**CFR**—*See* Code of Federal Regulations.

**Civilian Conservation Corps (CCC)**—Peacetime civilian “army” established by President Franklin D. Roosevelt to perform conservation activities from 1933–42. Activities included erosion control; firefighting; tree planting; habitat protection; stream improvement; and building of fire towers, roads, recreation facilities, and drainage systems.

**Code of Federal Regulations (CFR)**—The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government. Each volume of the CFR is updated once each calendar year.

**colony**—The nests or breeding place of a group of birds such as herons or gulls occupying a limited area.

**compatible use**—A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the director of the U.S. Fish and Wildlife Service, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (Draft Service Manual 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identified stipulations or limits necessary to ensure compatibility.

**comprehensive conservation plan (CCP)**—A document that describes the desired future conditions of the refuge and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge, contribute to the mission of the Refuge System, and to meet other relevant mandates (Draft Service Manual 602 FW 1.5).

**concern**—*See* issue.

**conspecific**—An individual belonging to the same species as another.

**cool-season grasses**—Grasses that begin growth earlier in the season and often become dormant in the summer. These grasses will germinate at lower temperatures. Examples of cool-season grasses at the refuge are western wheatgrass, needle and thread, and green needlegrass.

**coteau**—A hilly upland including the divide between two valleys; a divide; the side of a valley.

**cover, also cover type, canopy cover**—Present vegetation of an area.

**cultural resources**—The remains of sites, structures, or objects used by people in the past.

**cultural resource inventory**—A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

**cultural resource overview**—A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field office background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).

**dense nesting cover (DNC)**—A composition of grasses and forbs that allows for a dense stand of vegetation that protects nesting birds from the view of predators, usually consisting of one to two species of wheatgrass, alfalfa, and sweetclover.

**depredation**—Destruction or consumption of eggs, broods, or individual wildlife due to a predatory animal; damage inflicted on agricultural crops or ornamental plants by wildlife.

**DNC**—*See* dense nesting cover.

**drawdown**—The act of manipulating water levels in an impoundment to allow for the natural drying-out cycle of a wetland.

**EA**—*See* environmental assessment.

**ecological diversity**—The variety of life and its processes including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1.12B).

**ecosystem**—A dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community, together with its environment, functioning as a unit. For administrative purposes, the Service has designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries and their sizes and ecological complexity vary.

**emergent**—A plant rooted in shallow water and having most of the vegetative growth above water such as cattail and hardstem bulrush.

**endangered species, federal**—A plant or animal species listed under the Endangered Species Act of 1973, as amended, that is in danger of extinction throughout all or a significant portion of its range.

**endangered species, state**—A plant or animal species in danger of becoming extinct or extirpated in a particular state within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

**environmental assessment (EA)**—A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

**EPA**—Environmental Protection Agency.

**extinction**—The complete disappearance of a species from the earth; no longer existing (Koford et al. 1994).

**extirpation**—The extinction of a population; complete eradication of a species within a specified area.

**fauna**—All the vertebrate and invertebrate animals of an area.

**federal trust resource**—A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by international treaties, and native plant or wildlife species found on a national wildlife refuge.

**federal trust species**—All species where the federal government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

**flora**—All the plant species of an area.

**forb**—A broad-leaved, herbaceous plant; a seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue but dies down at the end of the growing season.

**fragmentation**—The alteration of a large block of habitat that creates isolated patches of the original habitat that are interspersed with a variety of other habitat types (Koford et al. 1994); the process of reducing the size and connectivity of habitat patches, making movement of individuals or genetic information between parcels difficult or impossible.

**“friends group”**—Any formal organization whose mission is to support the goals and purposes of its associated refuge and the National Wildlife Refuge Association overall; “friends organizations” and cooperative and interpretive associations.

**FWS**—*See* U.S. Fish and Wildlife Service.

**geographic information system (GIS)**—A computer system capable of storing and manipulating spatial data; a set of computer hardware and software for analyzing and displaying spatially referenced features (i.e., points, lines and polygons) with nongeographic attributes such as species and age (Koford et al. 1994).

**GIBA**—Globally Important Bird Area, as designated by the American Bird Conservancy.

**GIS**—*See* geographic information system.

**global positioning system (GPS)**—A system that, by using satellite telemetry, can pinpoint exact locations of places on the ground.

**goal**—Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Draft Service Manual 620 FW 1.5).

**GPS**—*See* global positioning system.

**grassland block**—A contiguous area of grassland without fragmentation.

**habitat**—Suite of existing environmental conditions required by an organism for survival and reproduction; the place where an organism typically lives and grows.

**habitat disturbance**—Significant alteration of habitat structure or composition; may be natural (e.g., wildland fire) or human-caused events (e.g., timber harvest and disking).

**habitat type, also vegetation type, cover type**—A land classification system based on the concept of distinct plant associations.

**hydrophytic**—Pertaining to a plant that grows in water or in very moist ground.

**impoundment**—A body of water created by collection and confinement within a series of levees or dikes, creating separate management units although not always independent of one another.

**integrated pest management (IPM)**—Methods of managing undesirable species such as invasive plants; education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.

**introduced species**—A species present in an area due to intentional or unintentional escape, release, dissemination, or placement into an ecosystem as a result of human activity.

**invasive plant, also noxious weed**—A species that is nonnative to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.

**inviolate sanctuary**—A place of refuge or protection where animals and birds may not be hunted.

**IPM**—*See* integrated pest management.

**issue**—Any unsettled matter that requires a management decision; e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (Draft Service Manual 602 FW 1.5).

**macrophyte**—A plant, especially a marine plant, that is large enough to be visible to the naked eye.

**maintenance management system (MMS)**—A national database which contains the unfunded maintenance needs of each refuge; projects include those required to maintain existing equipment and buildings, correct safety deficiencies for the implementation of approved plans, and meet goals, objectives, and legal mandates.

**management alternative**—*See* alternative.

**migration**—Regular extensive, seasonal movements of birds between their breeding regions and their wintering regions (Koford et al. 1994); to pass usually periodically from one region or climate to another for feeding or breeding.

**migratory birds**—Birds which follow a seasonal movement from their breeding grounds to their wintering grounds. Waterfowl, shorebirds, raptors, and songbirds are all migratory birds.

**mission**—Succinct statement of purpose and/or reason for being.

**mitigation**—Measure designed to counteract an environmental impact or to make an impact less severe.

**mixed-grass prairie**—A transition zone between the tall-grass prairie and the short-grass prairie dominated by grasses of medium height that are approximately 2–4 feet tall. Soils are not as rich as the tall-grass prairie and moisture levels are less.

**MMS**—*See* maintenance management system.

**monitoring**—The process of collecting information to track changes of selected parameters over time.

**moraine**—An irregular mass of glacial drift, usually gravel, sand, and clay.

**national wildlife refuge**—A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System, but does not

include coordination areas; a complete listing of all units of the Refuge System is in the current “Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service.”

**National Wildlife Refuge System (Refuge System)**—Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

**National Wildlife Refuge System Improvement Act of 1997**—Sets the mission and the administrative policy for all refuges in the National Wildlife Refuge System; defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation); establishes a formal process for determining appropriateness and compatibility; establish the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a comprehensive conservation plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

**native species**—A species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

**NAWMP**—North American Waterfowl Management Plan.

**Neotropical migrant**—A bird species that breeds north of the United States and Mexican border and winters primarily south of this border.

**NEPA**—National Environmental Policy Act.

**nest success**—The percentage of nests that successfully hatch one or more eggs of the total number of nests initiated in an area.

**nongovernmental organization**—Any group that is not composed of federal, state, tribal, county, city, town, local, or other governmental entities.

**noxious weed, also invasive plant**—Any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind that is of foreign origin (new to or not widely prevalent in the U.S.) and can directly or indirectly injure crops, other useful plants, livestock, poultry, other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or public health. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed (i.e., invasive plant) is one that causes disease or has adverse effects on humans or the human

environment and, therefore, is detrimental to the agriculture and commerce of the U.S. and to public health.

**NRCS**—Natural Resources Conservation Service of the U.S. Department of Agriculture.

**NWR**—national wildlife refuge.

**objective**—An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work; derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Draft Service Manual 602 FW 1.5).

**overwater species**—nesting species such as diving ducks and many colonial-nesting birds that build nests within dense stands of water-dependent plants, primarily cattail, or that build floating nests of vegetation that rest on the water.

**Partners in Flight (PIF)**—A Western Hemisphere program designed to conserve Neotropical migratory birds and officially endorsed by numerous federal and state agencies and nongovernmental organizations; also known as the Neotropical Migratory Bird Conservation Program (Koford et al. 1994).

**pass shooting**—Hunting waterfowl from a stationary location where waterfowl are expected to fly by.

**passerine bird**—A bird that typically has feet adapted for perching; belonging to the order Passeriformes.

**patch**—An area distinct from that around it; an area distinguished from its surroundings by environmental conditions.

**perennial**—Lasting or active through the year or through many years; a plant species that has a life span of more than 2 years.

**photic zone**—The area of a water body where light penetration is sufficient for photosynthesis.

**PIF**—See Partners in Flight.

**plant community**—An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soil, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community, i.e., ponderosa pine or bunchgrass.

**prescribed fire**—The skillful application of fire to natural fuels under conditions such as weather, fuel moisture, and soil moisture that allow confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish

planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

**priority public use**—One of six uses authorized by the National Wildlife Refuge System Improvement Act of 1997 to have priority if found to be compatible with a refuge's purposes. This includes hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

**proposed action**—The alternative proposed to best achieve the purpose, vision, and goals of a refuge (contributes to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management).

**public**—Individuals, organizations, and groups; officials of federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

**public involvement**—A process that offers affected and interested individuals and organizations an opportunity to become informed about, and to express their opinions on, Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

**purpose of the refuge**—The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing authorization or expanding a refuge, refuge unit, or refuge subunit (Draft Service Manual 602 FW 1.5).

**raptor**—A carnivorous bird such as a hawk, a falcon, or a vulture that feeds wholly or chiefly on meat taken by hunting or on carrion (dead carcasses).

**refuge operations needs system (RONS)**—A national database that contains the unfunded operational needs of each refuge. Projects included are those required to implement approved plans and meet goals, objectives, and legal mandates.

**refuge purpose**—*See* purpose of the refuge.

**Refuge System**—*See* National Wildlife Refuge System.

**refuge use**—Any activity on a refuge, except administrative or law enforcement activity, carried out by or under the direction of an authorized Service employee.

**resident species**—A species inhabiting a given locality throughout the year; nonmigratory species.

**rest**—Free from biological, mechanical, or chemical manipulation, in reference to refuge lands.

**restoration**—Management emphasis designed to move ecosystems to desired conditions and processes, i.e., healthy upland habitats and aquatic systems.

**riparian area or riparian zone**—An area or habitat that is transitional from terrestrial to aquatic ecosystems including streams, lakes, wet areas, and adjacent plant communities and their associated soils that have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes all plant life growing on the land adjoining a stream and directly influenced by the stream.

**RONS**—*See* refuge operations needs system.

**rough fish**—A fish that is neither a sport fish nor an important food fish.

**scoping**—The process of obtaining information from the public for input into the planning process.

**SDGFP**—South Dakota Department of Game, Fish and Parks.

**seasonally flooded**—Surface water is present for extended periods in the growing season, but is absent by the end of the season in most years.

**sediment**—Material deposited by water, wind, and glaciers.

**Service**—*See* U.S. Fish and Wildlife Service.

**shelterbelts**—Single to multiple rows of trees and shrubs planted around cropland or buildings to block or slow down the wind.

**shorebird**—Any of a suborder (Charadrii) of birds such as a plover or a snipe that frequent the seashore or mud flat areas.

**spatial**—Relating to, occupying, or having the character of space.

**special-status species**—Plants or animals that have been identified through federal law, state law, or agency policy as requiring special protection of monitoring. Examples include federally listed endangered, threatened, proposed, or candidate species; state-listed endangered, threatened, candidate, or monitor species; Service's species of management concern; species identified by the Partners in Flight program as being of extreme or moderately high conservation concern.

**special-use permit**—A permit for special authorization from the refuge manager required for any refuge service, facility, privilege, or product of the soil provided at refuge expense and not usually

available to the general public through authorizations in Title 50 CFR or other public regulations (Refuge Manual 5 RM 17.6).

**species of concern**—Those plant and animal species, while not falling under the definition of special status species, that are of management interest by virtue of being federal trust species such as migratory birds, important game species, or significant keystone species; species that have documented or apparent populations declines, small or restricted populations, or dependence on restricted or vulnerable habitats.

**species richness**—The absolute number of species in an assemblage or community; the number of species in a given area (Koford et al. 1994).

**step-down management plan**—A plan that provides the details necessary to implement management strategies identified in the comprehensive conservation plan (Draft Service Manual 602 FW 1.5).

**strategy**—A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Draft Service Manual 602 FW 1.5).

**submergent**—A vascular or nonvascular hydrophyte, either rooted or nonrooted, that lies entirely beneath the water surface, except for flowering parts in some species.

**tame species**—*See* dense nesting cover.

**threatened species, federal**—Species listed under the Endangered Species Act of 1973, as amended, that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

**threatened species, state**—A plant or animal species likely to become endangered in a particular state within the near future if factors contributing to population decline or habitat degradation or loss continue.

**travel corridor**—A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival or reproduction of its migrants.

**trust species**—*See* federal trust species.

**U.S. Fish and Wildlife Service (Service, USFWS, FWS)**—The principal federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. The Service manages the

93-million-acre National Wildlife Refuge System comprised of more than 530 national wildlife refuges and thousands of waterfowl production areas. It also operates 65 national fish hatcheries and 78 ecological service field stations, the agency enforces federal wildlife laws, manages migratory bird populations, restores national significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the federal aid program that distributes millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

**USFWS**—*See* U.S. Fish and Wildlife Service.

**U.S. Geological Survey (USGS)**—A federal agency whose mission is to provide reliable scientific information to describe and understand the earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

**USGS**—*See* U.S. Geological Survey.

**vision statement**—A concise statement of the desired future condition of the planning unit, based primarily on the Refuge System mission, specific refuge purposes, and other relevant mandates (Draft Service Manual 602 FW 1.5).

**visual obstruction**—Pertaining to the density of a plant community; the height of vegetation that blocks the view of predators and conspecifics to a nest.

**visual obstruction reading (VOR)**—A method of visually quantifying vegetative structure and composition.

**VOR**—*See* visual obstruction reading.

**wading birds**—Birds having long legs that enable them to wade in shallow water including egrets, great blue herons, black-crowned night-herons, and bitterns.

**warm-season grasses**—Grasses that begin growth later in the season (early June). These grasses require warmer soil temperatures to germinate and actively grow when temperatures are warmer. Examples of warm-season grasses are Indiangrass, switchgrass, and big bluestem.

**waterfowl**—A category of birds that includes ducks, geese, and swans.

**watershed**—The region draining into a river, a river system, or a body of water.

**wetland management district (WMD)**—Land that the Refuge System acquires with Federal Duck Stamp funds for restoration and management primarily as prairie wetland habitat critical to waterfowl and other wetland birds.

**wetland reserve program**—A voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection. ([www.nrcs.usda.gov/programs/wrp](http://www.nrcs.usda.gov/programs/wrp))

**WII**—Wetland of International Importance.

**wildland fire**—A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

**wildlife-dependent recreational use**—Use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the Refuge System.

**WMD**—*See* wetland management district.

**woodland**—Open stands of trees with crowns not usually touching, generally forming 25–60 percent cover.

**WPA**—waterfowl production area.





# Appendices



# Appendix A—Key Legislation and Policies

This appendix briefly describes the guidance for the National Wildlife Refuge System and other policies and key legislation that guide the management of Sand Lake National Wildlife Refuge.

## NATIONAL WILDLIFE REFUGE SYSTEM

The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Improvement Act of 1997).

### GOALS

- To fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, inter-jurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- 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 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.

### GUIDING PRINCIPLES

There are four guiding principles for management and general public use of the Refuge System established by Executive Order 12996 (1996):

- **Public Use**—The Refuge System provides important opportunities for compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation.
- **Habitat**—Fish and wildlife will not prosper without high quality habitat, and without fish and wildlife, traditional uses of refuges cannot be

sustained. The Refuge System will continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges.

- **Partnerships**—America's sportsmen and women were the first partners who insisted on protecting valuable wildlife habitat within wildlife refuges. Conservation partnerships with other federal agencies, state agencies, tribes, organizations, industry, and the general public can make significant contributions to the growth and management of the Refuge System.
- **Public Involvement**—The public should be given a full and open opportunity to participate in decisions regarding acquisition and management of our national wildlife refuges.

## LEGAL AND POLICY GUIDANCE

Management actions on national wildlife refuges are circumscribed by many mandates including laws and executive orders, the latest of which is the Volunteer and Community Partnership Enhancement Act of 1998. Regulations that affect refuge management the most are listed below.

**American Indian Religious Freedom Act (1978)**—Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

**Americans with Disabilities Act (1992)**—Prohibits discrimination in public accommodations and services.

**Antiquities Act (1906)**—Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

**Archaeological and Historic Preservation Act (1974)**—Directs the preservation of historic and archaeological data in federal construction projects.

**Archaeological Resources Protection Act (1979), as amended**—Protects materials of archaeological interest from unauthorized removal or destruction and requires federal managers to develop plans and schedules to locate archaeological resources.

**Architectural Barriers Act (1968)**—Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

**Clean Water Act (1977)**—Requires consultation with the U.S. Army Corps of Engineers (404 permits) for major wetland modifications.

**Endangered Species Act (1973)**—Requires all federal agencies to carry out programs for the conservation of endangered and threatened species.

**Executive Order 7169 (1935)**—Establishes Sand Lake National Wildlife Refuge “... as a refuge and breeding ground for migratory birds and other wild life... to effectuate further the purposes of the Migratory Bird Conservation Act...”

**Executive Order 11988 (1977)**—Requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the flood plains.

**Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996)**—Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the Refuge System.

**Executive Order 13007, Indian Sacred Sites (1996)**—Directs federal land management agencies to accommodate access to and ceremonial uses of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

**Federal Noxious Weed Act (1990)**—Requires the use of integrated management systems to control or contain undesirable plant species and an interdisciplinary approach with the cooperation of other federal and state agencies.

**Federal Records Act (1950)**—Requires the preservation of evidence of the government’s organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

**Fish and Wildlife Coordination Act (1958)**—Allows the U.S. Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

**Migratory Bird Conservation Act (1929)**—Establishes procedures for acquisition by purchase, rental, or gifts of areas approved by the Migratory Bird Conservation Commission.

**Migratory Bird Hunting and Conservation Stamp Act (1934)**—Authorizes the opening of part of a refuge to waterfowl hunting.

**Migratory Bird Treaty Act (1918)**—Designates the protection of migratory birds as a federal responsibility; and enables the setting of seasons and other regulations, including the closing of areas, federal or nonfederal, to the hunting of migratory birds.

**National Environmental Policy Act (1969)**—Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate this Act with other planning requirements, and prepare appropriate documents to facilitate better environmental decision making. [From the Code of Federal Regulations (CFR), 40 CFR 1500]

**National Historic Preservation Act (1966), as amended**—Establishes as policy that the federal government is to provide leadership in the preservation of the Nation’s prehistoric and historical resources.

**National Wildlife Refuge System Administration Act (1966)**—Defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge, provided such use is compatible with the major purposes for which the refuge was established.

**National Wildlife Refuge System Improvement Act of 1997**—Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System; mandates comprehensive conservation planning for all units of the Refuge System.

**Native American Graves Protection and Repatriation Act (1990)**—Requires federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

**Refuge Recreation Act (1962)**—Allows the use of refuges for recreation when such uses are compatible with the refuge’s primary purposes and when sufficient funds are available to manage the uses.

**Rehabilitation Act (1973)**—Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the federal government to ensure that any person can participate in any program.

**Rivers and Harbors Act (1899)**—Section 10 of this Act requires the authorization of U.S. Army Corps of Engineers prior to any work in, on, over, or under navigable waters of the United States.

**Volunteer and Community Partnership Enhancement Act (1998)**—Encourages the use of volunteers to assist in the management of refuges within the Refuge System; facilitates partnerships between the Refuge System and nonfederal entities to promote public

awareness of the resources of the Refuge System and public participation in the conservation of the resources; and encourages donations and other contributions.



# Appendix B—Draft Compatibility Determinations

## REFUGE NAME

Sand Lake National Wildlife Refuge

## ESTABLISHING AND ACQUISITION AUTHORITY

The Sand Lake National Wildlife Refuge was established by Executive Order 7169, dated September 4, 1935.

## REFUGE PURPOSES

“... as a refuge and breeding ground for migratory birds and other wildlife”

“...for use as an inviolate sanctuary, or for any other management purpose for migratory birds”

“... suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species...”

## NATIONAL WILDLIFE REFUGE SYSTEM MISSION

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

## 1. DESCRIPTION OF PROPOSED USE: FARMING, GRAZING, AND HAYING

*Continue upland management activities such as farming, grazing, and haying that are conducted under cooperative farming or special-use permit by private individuals. Currently these economic uses are used as tools to manage habitat for wildlife.*

Farming currently averages 1,200 acres per year, including fields and grassland restoration activities. Cattle grazing is used as a management tool and it averages about 400 acres per year. Haying is used to improve grassland conditions and control invasive plant species.

The comprehensive conservation plan (CCP) proposes to reduce the base acreage farmed for resident wildlife to 800 acres per year. Farming would be used on 200–600 acres per year as a management tool to restore grasslands. Cooperative farming activities are compatible only on areas that are not native prairie.

Cropland is planted to establish seedbeds free of invasive plants—for the establishment of grassland, to provide winter food for resident wildlife, and to control invasive plants or nonnative plant species. The farming rotation is based on a diversified crop rotation to control invasive plants and insects, and to provide for soil fertility. The crops that may be used in the rotation include, but are not limited to, corn, soybeans, spring wheat, barley, alfalfa, and sweetclover.

The Service’s policy is to restrict pesticide use on national wildlife refuges. All cooperative farming permits do not allow insecticides and restrict the use of herbicides to those least toxic and persistent in the environment.

## Availability of Resources

The needed staff time for development and administration of cooperative farming, haying, and grazing programs is stretched thin to maintain existing programs. If additional staff support were available, these programs could be expanded to use these tools more effectively and additional monitoring could be accomplished.

Additional staff is identified in appendix I. These positions would be needed to fully accomplish the goals of the CCP and improve existing programs.

## Anticipated Impacts of the Use

Current management affects approximately 15 percent of the uplands annually. Under the draft CCP, management would place increased emphasis on managing refuge habitats for migratory birds and maintain less cropland as winter food for resident wildlife.

Without management, general habitat conditions would gradually deteriorate due to long periods of rest. While some habitat disturbance does occur with these activities, the benefits to wildlife outweigh these disturbances.

No cultural resources would be impacted. No impact to endangered species should occur.

## Determination

The use of haying, grazing, and farming as habitat management tools is compatible.

***Stipulations Necessary to Ensure Compatibility***

- Monitor vegetation and wildlife to assess the effects of the management tool.
- Require general and special conditions for each permit to ensure consistency with management objectives.
- Restrict farming permittees to a list of approved chemicals that are less detrimental to wildlife and the environment.
- Restrict haying to after August 1 to avoid disturbance to nesting birds unless the refuge manager deems it necessary to hay earlier to control invasive plants or restore grasslands.
- Hire an additional refuge operations specialist to help administer, and a biologist to monitor grassland habitats.

***Justification***

To maintain and enhance the habitat for migratory birds and other wildlife, some habitat manipulation needs to occur. Upland habitat conditions would deteriorate without the use of a full range of upland management tools. Migratory bird production and ecological diversity would decrease as habitat suitability for these species declines. Exotic and invasive plant species would increase and habitat diversity would decrease.

Farming provides a useful tool to control invasive plants, restore grasslands, and improve habitat conditions for the production of migratory birds. Farming also benefits resident wildlife by providing a source of food during the winter. Farming facilitates wildlife observation, photography, and environmental education by attracting and concentrating wildlife in areas where they are highly visible.

**Mandatory 15-year Reevaluation Date: 2020**

## **2. DESCRIPTION OF PROPOSED USE: ENVIRONMENTAL EDUCATION AND INTERPRETATION**

*Provide opportunities for environmental education and interpretation.*

Environmental education consists of activities conducted by refuge complex staff, volunteers, and teachers. Interpretation occurs in less formal activities with refuge complex staff and volunteers or through exhibits, educational trunks, signs, and brochures.

Currently, environmental education and interpretation activities are conducted at the refuge complex office. Programs and activities are also conducted at the headquarters nature trail and the Columbia Day Use Area. Additional

programs are conducted at schools and other locations as personnel are available.

The CCP proposes an education center to be located near the refuge complex office. The facility would provide enough room, displays, and educational materials to maximize the public's learning experience while visiting the refuge. The remainder of the refuge would provide excellent opportunities for environmental learning. These uses occur year-round, with peak use in the spring and fall when local schools bring students to the refuge.

The CCP proposes to continue with the above uses and add the following to improve environmental education and interpretation opportunities for all visitors:

- Construct an education center on site.
- Update and improve refuge signs.
- Update existing brochures to the Service graphic standards.
- Pave the access roads and parking areas for the headquarters and education center with asphalt.
- Expand and enhance environmental education through various initiatives such as educational displays, presentations, and websites that feature purposes, programs, and wildlife of the refuge.

**Availability of Resources**

Currently all environmental education and interpretation are conducted using available resources. Implementing new programs, activities, and facilities outlined in the CCP is tied to funding requests in the form of refuge operations needs system (RONS) and maintenance management system (MMS) projects (appendices H and I).

**Anticipated Impacts of Use**

Minimal disturbances to wildlife and wildlife habitat would result from these uses at the current and proposed levels. Adverse impacts are minimized through careful timing and placement of activities. Some disturbance to wildlife would occur in areas frequented by visitors. There would be some minor damage to vegetation, littering, and increased maintenance. Location and time limitations placed on environmental education and interpretation activities would ensure that this activity would have only minor impacts on wildlife and would not detract from the primary purposes of the refuge.

No cultural resources would be impacted. No impact to endangered species should occur. Some short-term disturbance to wildlife would occur during construction.

**Determination**

Environmental education and interpretation are compatible.

***Stipulations Necessary to Ensure Compatibility***

- Allow environmental education and interpretation only in designated areas or under the guidance of refuge complex staff, a volunteer, or a trained teacher to ensure minimal disturbance to wildlife, minimal damage to vegetation, and minimal conflicts between groups.
- Annually review environmental education and interpretation activities to ensure these activities are compatible.

***Justification***

Based on biological impacts described in the environmental assessment (EA) and the draft CCP, it is determined that environmental education and interpretation within the Sand Lake National Wildlife Refuge would not materially interfere with or detract from the purposes for which this refuge was established.

Environmental education and interpretation are priority public uses listed in the National Wildlife Refuge System Improvement Act of 1997. By facilitation of environmental education, refuge visitors would gain knowledge and an appreciation of fish, wildlife, and their habitats, which would lead to increased public awareness and stewardship of natural resources. Increased appreciation for natural resources would support and complement the Service's actions in achieving the purposes of the refuge and the mission of the National Wildlife Refuge System.

**Mandatory 15-year Reevaluation Date: 2020**

### **3. DESCRIPTION OF PROPOSED USE: WILDLIFE OBSERVATION AND WILDLIFE PHOTOGRAPHY**

*Provide opportunities that support wildlife-dependent recreation.*

Wildlife observation and wildlife photography are facilitated by an auto tour route, two hiking trails, and two wildlife observation pullouts (one with an observation platform).

The CCP proposes to continue the above uses and add the following to improve wildlife observation and wildlife photography:

- Update and improve refuge signs.
- Construct a fully accessible, wildlife photography blind.

- Update existing brochures to the Service's graphic standards.
- Pave the Columbia Day Use Area access road and parking lot with asphalt.
- Hire a full-time law enforcement officer to enforce wildlife laws.

**Availability of Resources**

Currently, the programs for wildlife observation and wildlife photography are administered using available resources. Implementing new programs, activities, and facilities outlined in the CCP is tied to funding requests in the form of RONS and MMS projects (appendices H and I).

**Anticipated Impacts of Use**

Anticipated impacts from visitors engaged in wildlife observation and wildlife photography include minor damage to vegetation, littering, increased maintenance activity, potential conflicts with other visitors, and minor disturbances to wildlife. These activities would have only minor impacts on wildlife and do not detract from the primary purposes of the refuge. All other potential impacts are considered minor.

**Determination**

Wildlife observation and wildlife photography are compatible.

***Stipulations Necessary to Ensure Compatibility***

- Restrict vehicles to designated roads and trails.
- Monitor use, regulate access, and maintain necessary facilities to prevent habitat degradation and minimize wildlife disturbance.

***Justification***

Based on the anticipated biological impacts above and in the EA, it is determined that wildlife observation and wildlife photography on the Sand Lake National Wildlife Refuge would not interfere with the habitat goals and objectives or purposes for which it was established.

Wildlife observation and wildlife photography are priority public uses listed in the National Wildlife Refuge System Improvement Act of 1997. By facilitating these uses, visitors would gain knowledge and an appreciation of fish and wildlife, which would lead to increased public stewardship of wildlife and their habitats. Increased public stewardship would support and complement the

Service's actions in achieving the purposes of the refuge and the mission of the National Wildlife Refuge System.

**Mandatory 15-year Reevaluation Date: 2020**

#### 4. DESCRIPTION OF USE: RECREATIONAL FISHING

*Continue to provide for recreational fishing at five designated fishing areas in accordance with state regulations.*

The primary game fish are walleye and northern pike. The designated fishing areas are located off of road rights-of-way at bridges where the fishing opportunity is the greatest. Anglers park within the road right-of-way or designated parking areas if available. Boating is not allowed and fishing is restricted to the fishing areas to minimize impacts to migratory birds.

Fishing visitations and success fluctuate according to water conditions in the James River. The James River has a marginal fishery due to its seasonal flows and common fish winterkills. During the prairie's wet cycles, high flows in the James River promote fish spawning and winter survival. Fish populations can flourish until the next drought period or winterkill during a severe winter.

##### Availability of Resources

The current fishing program is administered using available resources. Implementing new programs, activities, and facilities outlined in the draft CCP is tied to funding requests in the form of RONS and MMS projects (appendices H and I).

##### Anticipated Impacts of Use

Fishing and other human activities cause disturbance to wildlife. Fishing near water control structures and bridges may displace migratory birds that may gather in these locations to feed on fish. Restricting fishing access to the designated fishing areas would minimize the disturbance to migratory birds and other wildlife and would not affect other programs.

##### Determination

Recreational fishing is compatible.

##### *Stipulations Necessary to Ensure Compatibility*

- Require that fishing follow state regulations.
- Confine fishing to designated fishing areas.
- Monitor existing use to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.
- Limit icehouses to day use only at designated fishing areas.
- Hire a full-time law enforcement officer to enforce wildlife laws.

##### *Justification*

Based on the biological impacts addressed above and in the EA, it is determined recreational fishing would not materially interfere with the habitat goals and objectives or purposes for refuge establishment.

Fishing is a priority public use as listed in the National Wildlife Refuge System Improvement Act of 1997.

##### **Mandatory 15-year Reevaluation Date: 2020**

#### 5. DESCRIPTION OF USE: RECREATIONAL HUNTING

*Continue recreational hunting of deer, waterfowl, and upland game birds.*

Waterfowl hunting opportunities are limited to a system of spaced hunting blinds inside the perimeter of the refuge that offer hunters a place to pass-shoot waterfowl. Archery and firearm deer seasons help maintain deer populations within management goals and objectives. A December season for upland game birds is held annually for ring-necked pheasant, sharp-tailed grouse, and Hungarian partridge.

##### Availability of Resources

The current administration of hunting programs is conducted using available resources. Implementing new programs, activities, and facilities outlined in the draft CCP is tied to funding requests in the form of RONS and MMS projects (appendices H and I).

##### Anticipated Impacts of Use

Hunting has shown no detrimental environmental impacts to habitats or wildlife. Hunting helps maintain the white-tailed deer population at a level that does not interfere with meeting management goals and reduces impacts to adjacent private property.

Hunting harvests a small percentage of the populations of waterfowl and upland game species, which is in accordance with wildlife objectives and principles.

Restricting vehicle use to designated purposes, times, and established roads, trails, and parking lots protects habitats from damage and minimizes disturbance to wildlife. Closed areas have been established at refuge headquarters, Columbia Day Use Area, around residences on the refuge, and near residences on adjacent private property to provide safety zones and reduce conflicts between hunters and visitors.

**Determination**

Recreational hunting is compatible.

***Stipulations Necessary to Ensure Compatibility***

- Require the use of nontoxic shot, in accordance with current regulations for upland game and waterfowl hunting.
- Limit use of motorized vehicles to designated parking areas, access trails, and public roads for deer retrieval during specified times.
- Prohibit all-terrain vehicles (ATVs).
- Prohibit camping, overnight use, and fires.
- Require that hunting be in accordance with federal and state regulations.
- Promote sound hunting practices for hunter safety and quality experiences.
- Hire a full-time law enforcement officer to enforce wildlife laws.

***Justification***

Hunting on national wildlife refuges has been identified as a priority public use in the National Wildlife Refuge System Improvement Act of 1997. Hunting is a legitimate wildlife management tool that can be used to manage populations.

Deer hunting seasons are necessary to ensure that populations are controlled to reduce impacts to refuge habitats and damage to adjacent landowners' property. Hunting harvests a small percentage of the renewable resources, which is in accordance with wildlife objectives and principles.

Based on the biological impacts anticipated above and in the EA, it is determined that recreational hunting at Sand Lake National Wildlife Refuge would not materially interfere with or detract from the purposes for which this refuge was established or its habitat goals and objectives.

**Mandatory 15-year Reevaluation Date: 2020**

## **6. DESCRIPTION OF PROPOSED PUBLIC USE: TRAPPING FOR REFUGE MANAGEMENT PURPOSES**

*Conduct spring predator trapping at specific sites to improve the nesting success of upland-nesting birds. In addition, trapping would be conducted for animals that are damaging facilities such as roadbeds, dikes, and water control structures.*

**Availability of Resources**

In the past, there was insufficient funding and staffing to develop an EA for a refuge-wide trapping program of spring predators. Currently, the refuge

is in the process of developing that EA. The spring trapping program would be enhanced through additional law enforcement and biological staff for monitoring and meeting the administrative requirements of the program. Both positions are listed in the RONS list (appendix I).

**Anticipated Impacts of the Use**

Spring predator trapping is conducted on the refuge in the fenced predator enclosure and on Mud Lake Island when water levels are sufficient to provide a natural barrier to predators. Trapping removes individual animals from wildlife populations, temporarily reducing predator populations before and during the nesting season. Spring trapping can increase nesting success of upland-nesting birds.

There would be direct mortality of target animals, minor damage to vegetation, and a slight increase in general wildlife disturbance. There is the possibility of injury to nontarget wildlife that are caught in traps. Domestic dogs and feral cats would be year-round nontarget species. Muskrats and weasels would be nontarget species in the spring because they do not depredate upland nests.

**Determination**

Trapping for management purposes is compatible.

***Stipulations Necessary to Ensure Compatibility***

- Conduct trapping in a manner removes only targeted species or species removed for public health and safety concerns.
- Maintain detailed trapping records for all trapping activities.
- Prohibit trapping in areas of high public use and near refuge residences.
- Monitor nest success in areas targeted for predator removal to determine effectiveness of management activities.
- Hire a full-time law enforcement officer to enforce wildlife laws.

***Justification***

Spring predator trapping would benefit upland nesting birds when predator populations are reduced during the nesting season. Long-term negative effects to predator populations would not take place because trapping activities are for short periods in the spring and in relatively small management areas. Trapping to protect facilities would be confined to specified areas and would not conflict with other uses.

**Mandatory 15-year Reevaluation Date: 2020**

**SIGNATURE**

\_\_\_\_\_  
Gene Williams (Date)  
Project Leader  
Sand Lake National Wildlife Refuge

\_\_\_\_\_  
Rod Krey (Date)  
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U.S. Fish and Wildlife Service, Region 6

**CONCURRENCE**

\_\_\_\_\_  
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Assistant Regional Director  
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# Appendix C—Species List

This appendix presents the list of resident and breeding wildlife species at Sand Lake National Wildlife Refuge (Meeks and Higgins 1998), as well as a list of plant species mentioned in this document.

This list includes all of the resident and breeding vertebrates documented during the past two decades. This comprehensive list includes 5 classes, 32 orders, 160 genera, and 202 species of which 6 are amphibian, 5 reptile, 127 bird, 34 mammal, and 30 fish species. Taxonomic order and names follow Banks et al. (1987).

## WILDLIFE

### CLASS AMPHIBIA

#### Order Caudata

- Mudpuppy (*Necturus maculosus*)
- Tiger salamander (*Ambystoma tigrinum*)

#### Order Anura

- Great Plains toad (*Bufo cognatus*)
- Canadian toad (*B. hemiophrys*)
- Western chorus frog (*Pseudoacris triseriata*)
- Northern leopard frog (*Rana pipiens*)

### CLASS REPTILIA

#### Order Testudines

- Snapping turtle (*Chelydra serpentina*)
- Western painted turtle (*Chrysemys picta*)

#### Order Squamata

- Northern prairie skink (*Eumeces septentrionalis*)
- Northern red-bellied snake (*Storeria occipitomaculata*)
- Plains garter snake (*Thamnophis radix*)

### CLASS AVES

#### Order Podicipediformes

- Western grebe (*Aechmophorus occidentalis*)
- Clark's grebe (*A. clarkii*)
- Eared grebe (*Podiceps nigricolis*)
- Pied-billed grebe (*Podilymbus podiceps*)

#### Order Pelicaniformes

- American white pelican (*Pelecanus erythrocephalus*)
- Double-crested cormorant (*Phalacrocorax auritus*)

#### Order Ciconiiformes

- Great blue heron (*Ardea herodias*)
- Great egret (*A. alba*)
- American bittern (*Botaurus lentiginosus*)
- Cattle egret (*Bubulcus ibis*)
- Green-backed heron (*Boturides striatus*)
- Little blue heron (*Egretta caerulea*)

- Snowy egret (*E. thula*)
- Least bittern (*Ixobrychus exilis*)
- Black-crowned night-heron (*Nycticorax nycticorax*)
- White-faced ibis (*Plegadis chihi*)

#### Order Anseriformes

- Wood duck (*Aix sponsa*)
- Northern pintail (*Anas acuta*)
- American wigeon (*A. americana*)
- Northern shoveler (*A. clypeata*)
- Green-winged teal (*A. crecca*)
- Blue-winged teal (*A. discors*)
- Mallard (*A. platyrhynchos*)
- American black duck (*A. rubripes*)
- Gadwall (*A. strepera*)
- Lesser scaup (*Aythya affinis*)
- Redhead (*A. americana*)
- Canvasback (*A. vallisneria*)
- Canada goose (*Branta canadensis*)
- Bufflehead (*Bucephala albeola*)
- Hooded merganser (*Lophodytes cucullatus*)
- Ruddy duck (*Oxyura jamaicensis*)

#### Order Falconiformes

- Cooper's hawk (*Accipiter cooperii*)
- Sharp-shinned hawk (*A. striatus*)
- Red-tailed hawk (*Buteo jamaicensis*)
- Swainson's hawk (*B. swainsoni*)
- Northern harrier (*Circus cyaneus*)
- American kestrel (*Falco sparverius*)

#### Order Galliformes

- Ring-necked pheasant (*Phasianus colchicus*)
- Sharp-tailed grouse (*Tympanuchus phasianellus*)
- Gray partridge (*Perdix perdix*)

#### Order Gruiformes

- American coot (*Fulica americana*)
- Common moorhen (*Gallinula chloropus*)
- Sora (*Porzana carolina*)
- Virginia rail (*Rallus limicola*)

**Order Charadriiformes**

Killdeer (*Charadrius vociferus*)  
 Upland sandpiper (*Bartramia longicauda*)  
 Spotted sandpiper (*Actitis macularia*)  
 Willet (*Catoptrophorus semipalmatus*)  
 Marbled godwit (*Limosa fedoa*)  
 American avocet (*Recurvirostra americana*)  
 Wilson's phalarope (*Phalaropus tricolor*)  
 Ring-billed gull (*Larus delawarensis*)  
 Franklin's gull (*L. pipixcan*)  
 Black tern (*Chlidonias niger*)  
 Forster's tern (*Sterna forsteri*)  
 Common tern (*S. hirundo*)

**Order Columbiformes**

Rock dove (*Columba livia*)  
 Mourning dove (*Zenaida macroura*)

**Order Cuculiformes**

Yellow-billed cuckoo (*Coccyzus americanus*)  
 Black-billed cuckoo (*C. erythrophthalmus*)

**Order Strigiformes**

Long-eared owl (*Asio otus*)  
 Short-eared owl (*A. flammeus*)  
 Eastern screech owl (*Otus asio*)  
 Great horned owl (*Bubo virginianus*)

**Order Caprimulgiformes**

Common nighthawk (*Chordeiles minor*)

**Order Apodiformes**

Chimney swift (*Chaetura pelagica*)

**Order Coraciiformes**

Belted kingfisher (*Ceryle alcyon*)

**Order Piciformes**

Northern flicker (*Colaptes auratus*)  
 Red-headed woodpecker (*Melanerpes erythrocephalus*)  
 Downy woodpecker (*Picoides pubescens*)  
 Hairy woodpecker (*P. villosus*)

**Order Passeriformes**

Eastern wood-pewee (*Contopus virens*)  
 Least flycatcher (*Empidonax minimus*)  
 Willow flycatcher (*E. traillii*)  
 Eastern phoebe (*Sayornis phoebe*)  
 Eastern kingbird (*Tyrannus tyrannus*)  
 Western kingbird (*T. verticalis*)  
 Horned lark (*Eremophila alpestris*)  
 Cliff swallow (*Hirundo pyrrhonota*)  
 Barn swallow (*H. rustica*)  
 Purple martin (*Progne subis*)  
 Bank swallow (*Riparia riparia*)  
 Northern rough-winged swallow (*Stelgidopteryx serripennis*)  
 Tree swallow (*Tachycineta bicolor*)  
 American crow (*Corvus brachyrhynchos*)  
 Blue jay (*Cyanocitta cristata*)  
 Black-capped chickadee (*Parus atricapillus*)  
 White-breasted nuthatch (*Sitta carolinensis*)

Marsh wren (*Cistothorus palustris*)  
 Sedge wren (*C. platensis*)  
 House wren (*Troglodytes aedon*)  
 American robin (*Turdus migratorius*)  
 Eastern bluebird (*Sialia sialis*)  
 Gray catbird (*Dumetella carolinensis*)  
 Brown thrasher (*Toxostoma rufum*)  
 Cedar waxwing (*Bombycilla cedrorum*)  
 Loggerhead shrike (*Lanius ludovicianus*)  
 European starling (*Sturnus vulgaris*)  
 Warbling vireo (*Vireo gilvus*)  
 Red-eyed vireo (*V. olivaceus*)  
 Yellow warbler (*Dendroica petechia*)  
 Common yellowthroat (*Geothlypis trichas*)  
 Dickcissel (*Spiza americana*)  
 Sharp-tailed sparrow (*Ammodramus caudacutus*)  
 LeConte's sparrow (*A. lecontei*)  
 Grasshopper sparrow (*A. savannarum*)  
 Chestnut-collared longspur (*Calcarius ornatus*)  
 Lark sparrow (*Chondestes grammacus*)  
 Swamp sparrow (*Melospiza georgiana*)  
 Song sparrow (*M. melodia*)  
 Savannah sparrow (*Passerculus sandwichensis*)  
 Vesper sparrow (*Poocetes gramineus*)  
 Clay-colored sparrow (*Spizella pallida*)  
 Field sparrow (*S. pusilla*)  
 Red-winged blackbird (*Agelaius phoeniceus*)  
 Bobolink (*Dolichonyx oryzivorus*)  
 Brewer's blackbird (*Euphagus cyanocephalus*)  
 Northern oriole (*Icterus galbula*)  
 Orchard oriole (*I. spurius*)  
 Brown-headed cowbird (*Molothrus ater*)  
 Common grackle (*Quiscalus quiscula*)  
 Western meadowlark (*Sturnella neglecta*)  
 Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)  
 American goldfinch (*Carduelis tristis*)  
 House finch (*Carpodacus mexicanus*)  
 House sparrow (*Passer domesticus*)

**CLASS MAMMALIA****Order Marsupialia**

Virginia opossum (*Didelphis virginianus*)

**Order Insectivora**

Northern short-tailed shrew (*Blarina brevicauda*)  
 Masked shrew (*Sorex cinereus*)

**Order Chiroptera**

Hoary bat (*Lasiurus cinereus*)

**Order Carnivora**

Coyote (*Canis latrans*)  
 Red fox (*Vulpes vulpes*)  
 Raccoon (*Procyon lotor*)  
 Long-tailed weasel (*Mustela frenata*)  
 Least weasel (*M. nivalis*)  
 Mink (*M. vison*)  
 Badger (*Taxidea taxus*)

Striped skunk (*Mephitis mephitis*)  
Spotted skunk (*Spilogale putorius*)

### Order Artiodactyla

White-tailed deer (*Odocoileus virginianus*)

### Order Rodentia

Woodchuck (*Marmota monax*)  
Fox squirrel (*Sciurus niger*)  
Franklin's ground squirrel (*Spermophilus franklinii*)  
Richardson's ground squirrel (*S. richardsonii*)  
Thirteen-lined ground squirrel (*S. tridecemlineatus*)  
Plains pocket gopher (*Geomys bursarius*)  
Northern pocket gopher (*Thomomys talpoides*)  
Plains pocket mouse (*Perognathus flavescens*)  
Beaver (*Castor canadensis*)  
Northern grasshopper mouse (*Onychomys leucogaster*)  
White-footed mouse (*Peromyscus leucopus*)  
Deer mouse (*P. maniculatus*)  
Western harvest mouse (*Reithrodontomys megalotis*)  
Meadow vole (*Microtus pennsylvanicus*)  
Muskrat (*Ondatra zibethicus*)  
House mouse (*Mus musculus*)  
Norway rat (*Rattus norvegicus*)  
Meadow jumping mouse (*Zapus hudsonius*)  
White-tailed jackrabbit (*Lepus townsendii*)  
Eastern cottontail (*Sylvilagus floridanus*)

## CLASS OSTEICHTHYES

### Order Lepisosteiformes

Shortnose gar (*Lepisosteus platostomus*)

### Order Salmoniformes

Northern pike (*Esox lucius*)

### Order Cypriniformes

Common carp (*Cyprinus carpio*)  
Brassy minnow (*Hybognathus hankinsoni*)  
Golden shiner (*Notemigonus crysoleucas*)  
Common shiner (*Luxilus cornutus*)  
Spottail shiner (*Notropis hudsonius*)  
Red shiner (*Cyprinella lutrensis*)  
Sand shiner (*Notropis stramineus*)  
Fathead minnow (*Pimephales promelas*)  
Creek chub (*Semotilus atromaculatus*)  
River carpsucker (*Carpionodes carpio*)  
White sucker (*Catostomus commersoni*)  
Bigmouth buffalo (*Ictiobus cyprinellus*)

### Order Siluriformes

Black bullhead (*Ameiurus melas*)  
Channel catfish (*Ictalurus punctatus*)  
Tadpole madtom (*Noturus gyrinus*)

### Order Gasterosteiformes

Brook stickleback (*Culaea inconstans*)

### Order Perciformes

Green sunfish (*Lepomis cyanellus*)  
Pumpkinseed (*L. gibbosus*)  
Orangespotted sunfish (*L. humilis*)  
Bluegill (*L. macrochirus*)  
Smallmouth bass (*Micropterus dolomieu*)  
Largemouth bass (*M. salmoides*)  
White crappie (*Pomoxis annularis*)  
Black crappie (*P. nigromaculatus*)  
Iowa darter (*Etheostoma exile*)  
Johnny darter (*E. nigrum*)  
Yellow perch (*Perca flavescens*)  
Walleye (*Stizostedion vitreum*)

## PLANTS

Alfalfa (*Medicago* spp.)  
American elm (*Ulmus americana*)  
Barley (*Hordeum* spp.)  
Big bluestem (*Andropogon gerardii*)  
Boxelder (*Acer negundo*)  
Canada thistle (*Cirsium arvense*)  
Cattail (*Typha* spp.)  
Chinese elm (*Ulmus parvifolia*)  
Common reed (*Phragmites australis*)  
Coon's tail (*Ceratophyllum demersum*)  
Corn (*Zea mays*)  
Green ash (*Fraxinus pennsylvanica*)  
Green needlegrass (*Nassella viridula*)  
Hardstem bulrush (*Schoenoplectus acutus*)  
Indiangrass (*Sorghastrum* spp.)  
Intermediate wheatgrass (*Agropyron intermedium*)  
Kentucky bluegrass (*Poa pratensis*)  
Leafy spurge (*Euphorbia esula*)  
Little bluestem (*Schizachyrium* spp.)  
Needle and thread (*Hesperostipa comata*)  
Prairie cordgrass (*Spartina pectinata*)  
Prairie dropseed (*Sporobolus heterolepis*)  
Purple loosestrife (*Lythrum salicaria*)  
Quackgrass (*Elymus repens*)  
Rush (*Juncus* spp.)  
Russian olive (*Elaeagnus angustifolia*)  
Sago pondweed (*Potamogeton pectinatus*)  
Sedge (*Carex* spp.)  
Sideoats grama (*Bouteloua curtipendula*)  
Smooth brome (*Bromus inermis*)  
Soybean (*Glycine* spp.)  
Spotted knapweed (*Centaurea biebersteinii*)  
Spring wheat (*Triticum* spp.)  
Sweetclover (*Melilotus officinalis*)  
Switchgrass (*Panicum virgatum*)  
Western wheatgrass (*Agropyron smithii*)  
Willow (*Salix* spp.)  
Wormwood sage (*Artemisia absinthium*)



# Appendix D—Landscape-level Goals and Objectives

This appendix summarizes landscape-level plans that are relevant to management of Sand Lake National Wildlife Refuge.

## NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

Signed in 1986, the North American Waterfowl Management Plan (NAWMP) is broad policy framework that describes the overall scope of requirements for management of waterfowl in the United States, Canada, and Mexico.

The NAWMP also serves as a guide for the participation of various private organizations and the public in the conservation and management of waterfowl. The goal of the NAWMP is to restore waterfowl populations to the levels recorded during the 1970s, a benchmark decade for waterfowl. The NAWMP is designed to reach its objectives through key joint venture areas, species joint ventures, and state implementation plans within these joint ventures.

The “North American Waterfowl Management Plan, 1998 Update, Expanding the Vision” reflects on the legacy established by the NAWMP and presents three visions to advance waterfowl conservation in the future:

- Plan partners enhance the capability of landscapes to support waterfowl and other wetland-associated species by ensuring that plan implementation is guided by biologically based planning, which in turn is refined through ongoing evaluation.
- Plan partners define the landscape conditions needed to sustain waterfowl, benefit other wetland-associated species, and participate in the development of conservation, economic, management, and social policies and programs that most affect the ecological health of these landscapes.
- Plan partners collaborate with other conservation efforts, particularly migratory bird initiatives, and reach out to other sectors and communities to forge broader alliances in a collective search for sustainable uses of landscapes.

## PARTNERS IN FLIGHT

Nationally and internationally, several nongame bird initiatives are in the planning stage and implementation is expected to begin in the near

future. Partners in Flight (PIF) is developing bird conservation plans, primarily for land birds, in numerous physiographic areas. The plans include priority species lists, associated habitats, and management strategies.

The primary goal of PIF is to provide for the long-term health of the avifauna of this continent.

- The first priority is to prevent the rarest species from going extinct.
- The second priority is to prevent uncommon species from descending into threatened status.
- The third goal is to keep common birds common.

PIF’s general recommendations for the mixed-grass prairie are:

“Although agriculture has taken over much of the mixed-grass, significant areas of native prairie remain, most notably in the glacial coteau of the Dakotas and the sandhills of Nebraska.

These great reservoirs for grassland birds must be retained through easements, protection, and strengthening of ranching economies.

The interests of land birds extensively overlap with those of waterfowl and shorebirds in the wetter portions of this ecosystem.”

## UNITED STATES SHOREBIRD CONSERVATION PLAN

The shorebird plan is designed to complement the existing landscape-scale conservation efforts of the North American Waterfowl Management Plan, Partners in Flight, and the North American Colonial Waterbird Conservation Plan. The plan has three major goals at different scales.

At a regional scale, the goal of the plan is to ensure that adequate quantity and quality of habitat is identified and maintained to support the different shorebirds that breed in, winter in, and migrate through each region (Brown et al. 2001).

There are eleven regional working groups formed in this planning process. The Sand Lake National Wildlife Refuge is in the northern plains/prairie–potholes region. Three major shorebird issues have been identified for this region:

- endangered and threatened species, declining species, and species of special concern
- habitat loss, including fragmentation and degradation
- the need for additional information to evaluate potential threats, such as contaminants, depredation, and invasion of exotic plants, to migrating and breeding shorebirds

The regional goals are:

- maintain biotic integrity and persistence of breeding shorebird populations in the northern plains/prairie-potholes region
- ensure that adequate stopover resources exist to support populations of migrating shorebirds
- identify and fill information gaps, including the development of tools to use within the context of dynamic ecosystem processes
- coordinate with other conservation efforts in a cross-border landscape

## NORTH AMERICAN WATERBIRD CONSERVATION PLAN

VOLUME 1: SEABIRDS AND COLONIAL WATERBIRDS, REVIEW DRAFT II

The goal of this plan is ensure that the distribution, diversity, and abundance of water bird populations and habitats (breeding, nonbreeding, and migratory) is sustained or restored throughout North America (Kushlan et al. 2002).

**Species and population goal**—Have sustainable distributions, diversity and abundance of priority species for conservation and those in decline.

**Habitat goal**—Secure, maintain, and enhance sufficient high quality habitat throughout the year to achieve and maintain sustainable populations of water birds throughout North America.

**Area goal**—Identify, protect, maintain, and enhance important areas needed to maintain sustainable populations and habitats of water birds throughout their ranges in North America.

**Education goal**—Ensure that information for the conservation of water birds is widely available to decision makers, the public, and all those whose actions affect seabird and colonial water bird populations.

## NONGAME MIGRATORY BIRDS CONSERVATION PLAN, REGION 6

This plan outlines the conservation of nongame bird species in Region 6 (Mountain–Prairie Region) of the U.S. Fish and Wildlife Service. Information concerning nongame species in the region is scarce and research is ongoing.

The goal of the nongame migratory bird program is to protect and maintain all native, nongame species at viable population levels and protect their habitats. An important part of this goal is to prevent any avian species from becoming listed as threatened or endangered, or from becoming extirpated from Region 6.

# Appendix E—Ecosystem Goals and Objectives

This appendix summarizes information and includes excerpts from the “Ecosystem Plan, Mainstem Missouri River; North Dakota, South Dakota and East Montana” (USFWS 2001).

The U.S. Fish and Wildlife Service has adopted an ecosystem approach to conservation to enable it to fulfill its federal trust resource responsibility with greater efficiency and effectiveness. Through this holistic approach to resource conservation, the Service can accomplish its mission to conserve, protect, and enhance the Nation’s fish and wildlife and their habitats for the continuing benefit of the American people.

An ecosystem approach to fish and wildlife conservation means protecting or restoring functions, structure, and species composition of an ecosystem, while providing for its sustainable socioeconomic use. Key to implementing this approach is recognizing that partnerships are an essential part of a diverse management to accomplish ecosystem health.

The Service has adopted watersheds as the basic building blocks for implementing ecosystem conservation. The Sand Lake National Wildlife Refuge is located in the Mainstem Missouri River ecosystem, which includes the Dakotas and northeastern Montana. The refuge contains three of the four focus areas for the ecosystem: wetlands, riparian areas, and prairie grasslands.

## WETLANDS

The glaciated prairies of North and South Dakota and northeastern Montana cover approximately 60 million acres. Once a myriad of prairie–pothole wetlands in a sea of native prairie, the area is now intensively farmed and is the bread basket of the country.

Drainage, largely for agricultural purposes, has reduced 7.2 million acres of wetlands by more than 40 percent, to 3.9 million acres. Native prairie, consisting mostly of mid-grass prairie, has been reduced by 75 percent to 14.9 million acres. Much of the remainder is overgrazed by livestock.

The area is rich in wildlife. Prairie potholes are the lifeblood for waterfowl and other migratory water birds. As an example of the importance of the prairie, ducks banded in North Dakota have been recovered in 46 states and 23 other countries. Grassland-nesting, Neotropical migrants have been declining faster than woodland Neotropical migrants or prairie-nesting ducks. Several endangered, threatened, and candidate species, including the ferruginous hawk, black tern, and Baird’s sparrow, breed in the prairie and wetland habitats of this focus area.

Agriculture is the dominant economic activity and force on prairie wetlands and grasslands. No other activity in the focus area affects habitats and wildlife population to the extent that agriculture does. The U.S. Department of Agriculture and various federal farm programs have more influence on natural resources and wildlife than the U.S. Fish and Wildlife Service, all the state wildlife agencies, and all the conservation organizations combined.

The Service has been involved in prairie and wetland resources since the early 1900s. The Service has 69 national wildlife refuges (380,000 acres) and 19 wetland management districts in the focus area. Since 1961, the Service’s small wetland acquisition program has acquired 448,000 acres in fee title and 1.9 million acres in perpetual easement.

The following vision, goals, and objectives are shown as described in the ecosystem plan.

**VISION:** Diverse wetland habitats and watersheds that provide an abundance and diversity of native flora and fauna in the ecosystem for the benefit of the American public.

**Goal 1:** Increase recognition of wetland values by the various publics (communities, conservation organizations, communication people, congressional delegations and staff, and corporate entities) to develop a wetland advocacy.

**Objective A:** Over the next 3 years, develop and implement an information and outreach plan in North and South Dakota and northeastern Montana.

**Goal 2:** Conserve, restore, and enhance wetlands and wetland habitats and functions for trust species and species of concern.

**Objective A:** As a minimum, annually protect 15,000 acres of wetlands through fee and easement over the next 10 years in the ecosystem.

**Objective B:** Assist partners and other agencies in protecting, creating, restoring, managing, and enhancing 10,000 acres of wetlands and associated uplands annually.

**Goal 3:** Protect the water supply and property interests of wetlands on Service lands and easements.

**Objective A:** File for and secure water rights on eligible Service properties and easements over the next 10 years.

## RIPARIAN AREAS

Riparian areas make up a very small portion of the habitat in the ecosystem. However, riparian and riverine wetland habitats are very important to fish and wildlife resources including migratory birds, threatened and endangered species, native fish, rare and declining fisheries, amphibians, and many mammals.

Many vertebrates, including species of nongame wildlife and Neotropical migrants, are dependent on riparian and adjacent aquatic zones for reproduction or foraging. Riparian habitats provide for much of the biodiversity in the ecosystem. Many of the species currently occurring in the ecosystem would be eliminated without healthy riparian habitats.

Riparian habitats are important even to the species that mainly occur in the adjacent upland areas. Many rare and declining Neotropical grassland species need to nest within a short distance from water and will use riparian areas during juvenile dispersal and as critical sites of migratory stopovers.

Many additional wildlife species use these zones as migratory corridors. Riparian habitats are important for stabilizing river banks, reducing sedimentation, and providing woody debris and organic material for invertebrates, thus enhancing fishery habitat.

Many resident wildlife species also use riparian areas for winter survival. These species leave the upland areas, using the riparian areas for food and cover during the winter.

National wildlife refuges have been established along the Souris, James, and Des Lacs Rivers and tributaries of the Red River. These refuges include sites of internationally significant Prairie Pothole Joint Venture projects that are critical to the success of the North American Waterfowl Management Plan.

The following vision, goals, and objectives are shown as described in the ecosystem plan.

**VISION:** Healthy riparian and flood plain ecosystems that provide an abundance and diversity of indigenous flora and fauna.

**Goal 1:** Reduce the conversion of riparian habitats and maintain, restore, or enhance riparian habitats, quality and functions on priority rivers and tributaries.

**Objective A:** Inventory and determine the quality of riparian habitats and associated wildlife populations within the ecosystem by 2004 to provide baseline information.

**Objective B:** Implement an informational program in the ecosystem by 2004 to promote a public appreciation and understanding of the benefits and the threats to riparian habitats.

**Objective C:** Support and assist in locating and control of invasive species in the ecosystem by 2006 to maintain or improve the quality of the riparian habitat and protect national wildlife refuges and other important habitats.

**Objective D:** Use existing programs and opportunities in the ecosystem by 2009 to improve critical riparian habitats.

**Goal 2:** Conserve and recover threatened and endangered species and species of management concern.

**Objective A:** Inventory threatened and endangered species and species of concern along riparian corridors in the ecosystem by 2004 to provide baseline information.

**Objective B:** Develop and implement strategies for conserving and recovering threatened and endangered species and species of concern along riparian habitat in the ecosystem by 2004 and preclude the need to list any further species.

**Goal 3:** Conserve, restore, and create habitat resources in watersheds to enhance the quality and quantity of water flowing into rivers and streams.

**Objective A:** Use existing oversight, coordination, and technical assistance by 2006 to promote sound management on critical watersheds in the ecosystem.

**Objective B:** Use existing programs and opportunities in the ecosystem by 2006 to conserve, enhance, or restore grasslands and wetlands to provide quality water runoff.

## PRAIRIE GRASSLANDS

Prairie habitats in the Mainstem Missouri River ecosystem consist of tall-grass, mid-grass, and short-grass prairies from the eastern Dakotas to the west. Although the plant and wildlife species differ across the gradation from tall to short grass, the threats and issues remain the same; conversion of prairie to other uses. Habitat losses have been the most severe in the tall-grass prairie and least severe in the western reaches of the Dakotas and northeastern Montana.

The tall-grass prairie once spanned millions of acres along the eastern border of North and South Dakota. The focus area is characterized by the dominant vegetation of the tall-grass prairie, including big bluestem, switchgrass, Indiangrass, and prairie dropseed. In North Dakota, this is found mainly in the Agassiz Lake plain, but transitionally can be found along the state's eastern border in a strip 2–3 counties wide. Similarly, in South Dakota, the zone follows the eastern border at a similar width, broadening to the Missouri River at the southern end of the state and extending into northeastern Nebraska. Vast acreage of the habitat has been converted to agriculture. The remaining

prairie sites are found in small, fragmented parcels scattered throughout and are crucial to maintaining and restoring the ecosystem. These sites are threatened by conversion to cropland, invasion of exotics, invasive plants, woody plants, pesticides, and heavy grazing pressure.

The remaining prairie sites support a wide assemblage of plant and animal species including many federal and state rare species. Sites in North Dakota have the largest population of the western prairie fringed orchid, a federally listed threatened plant found in lowland swales within the tall-grass community. The regal fritillary and Dakota skipper are butterflies that are federally classified as candidates for endangered or threatened status. The powesheik skipper is a butterfly of high concern.

Eighteen state-classified rare plants occur in the tall-grass prairie of North Dakota. This prairie also provides primary and secondary breeding habitat for declining Neotropical migrants such as upland sandpiper, bobolink, common yellowthroat, grasshopper sparrow, and clay-colored sparrow. Candidate bird species include Baird's sparrow and loggerhead shrike.

Long-term survival of these small, isolated prairies depends on establishing prairie networks and connecting these prairies and nearby habitats to ward off extinctions and integrating prairies with

their surroundings to reduce harm from improper management on surrounding lands. The following vision, goals, and objectives are shown as described in the ecosystem plan.

**VISION:** Protect, restore, and maintain ecosystem native prairie and other grasslands to ensure its diversity and abundance of indigenous flora and fauna.

**Goal 1:** Prevent degradation and conversion of native prairie grassland.

*Objective A:* Locate, categorize, evaluate, and map native prairie within the ecosystem for baseline information by 2003.

*Objective B:* Protect native prairie by U.S. Fish and Wildlife Service (FWS) easement on a minimum of 100,000 acres per year for the next 10 years.

*Objective C:* By the year 2003, develop and implement informational programs to promote awareness and advocacy for native prairie.

*Objective D:* Develop partnerships to protect 1,000,000 acres of native prairie by 2010.

*Objective E:* Develop partnerships to reduce the extent and curtail the impact of invasive species in native prairie by 2010.

*Objective F:* Strive to work with partners to reduce fragmentation effects to flora and fauna in native prairie communities.

*Objective G:* Identify contaminant issues affecting native prairie and the adverse impact each may be on native prairie and associated wildlife species.

*Objective H:* Develop a plan on how to prevent and/or reduce further contaminants from entering native prairie.

**Goal 2:** Maintain and establish networks of native prairie and planted grasslands on public and private lands.

*Objective A:* Promote and implement prescribed burning and rotational grazing on a minimum of 20 percent of private lands per year to enhance and maintain healthy native prairie.

*Objective B:* By the year 2003, develop informational materials on the importance of proper grazing management of native prairie.

*Objective C:* By the year 2002, identify the key areas in the ecosystem to restore perennial grasslands, maintain and/or increase planted grassland with an emphasis on native species restoration.

*Objective D:* Strive to treat a minimum of 20 percent of FWS-administered grasslands annually using prescribed fire, prescribed grazing, invasive species control, or other recognized management practice.

**Goal 3:** Protect and enhance habitat for trust species and species of special concern.

*Objective A:* Identify grassland species that are in decline by the year 2006.

*Objective B:* Develop information programs on why grassland species in decline are important, approaches to be taken to reverse decline, and the public's role in prairie conservation.

*Objective C:* Develop statewide partnerships to get people involved in species management.

*Objective D:* Develop criteria and identify the most biologically significant grasslands by 2003.

*Objective E:* Over the next 10 years, develop partnerships to enhance and manage native prairie including invasion by non-native species.

*Objective F:* Develop management strategies to enhance species of concern on priority grasslands.

# Appendix F—List of Preparers, Consultation, and Coordination

This document is the result of the extensive, collaborative, and enthusiastic efforts by the members of the planning team shown below.

<i>Team Member</i>	<i>Position</i>	<i>Work Unit</i>
Sean Fields	Biologist, geographic information system (GIS) specialist	U.S. Fish and Wildlife Service (USFWS), Region 6, Lakewood, CO
Bridgette Flanders-Wanner	Wildlife biologist	Sand Lake National Wildlife Refuge, Columbia, SD
John Jave	Refuge manager	Sand Lake National Wildlife Refuge, Columbia, SD
Linda Kelly	Chief of comprehensive conservation planning branch, planning team leader	USFWS, Region 6, Lakewood, CO
John Koerner	<i>Former</i> project leader	Sand Lake National Wildlife Refuge, Columbia, SD
Rachel Laubhan	Wildlife biologist	USFWS, Region 6
Rhoda Lewis	<i>Former</i> regional archaeologist	USFWS, Region 6, Lakewood, CO
Kathleen Linder	Fish and wildlife biologist, <i>former</i> planning team leader	USFWS, Region 6, Lakewood, CO
Adam Misztal	Fish and wildlife biologist, <i>former</i> planning team leader	USFWS, Region 6, Lakewood, CO
Deb Parker	Writer-editor	USFWS, Region 6, Lakewood, CO
William Schultze	Wildlife biologist	Sand Lake National Wildlife Refuge, Columbia, SD
Cindy Souders	Outdoor recreation planner	USFWS, Region 6, Lakewood, CO
Beth Ullenberg	Outdoor recreation planner	Sand Lake National Wildlife Refuge, Columbia, SD
Gene Williams	Project leader	Sand Lake National Wildlife Refuge, Columbia, SD
Cheryl Williss	Chief of division of water resources	USFWS, Region 6, Lakewood, CO

Valuable support to the planning team was provided by the individuals listed on the next page.

<i>Name</i>	<i>Position</i>	<i>Work Unit</i>
Ned (Chip) H. Euliss, Jr.	Research wildlife biologist	U.S. Geological Survey (USGS) Northern Prairie Wildlife Research Center, Jamestown, ND
Doug Johnson	Supervisory statistician	USGS Northern Prairie Wildlife Research Center, Jamestown, ND
Marcia Haaland	Administrative officer	USGS Northern Prairie Wildlife Research Center, Jamestown, ND
Lynne Koontz	Economist	USGS, science center, Fort Collins, CO
Murray Laubhan	Special assistant to the director	USGS Northern Prairie Wildlife Research Center, Jamestown, ND
Jay Lincoln	Engineer	U.S. Army Corps of Engineers, Jamestown and Pipestem project, Jamestown, ND
Will Morlock	Regional wildlife manager	South Dakota Department of Game, Fish and Parks (SDGFP), Watertown, SD
Dave Mushet	Wildlife biologist	USGS Northern Prairie Wildlife Research Center, Jamestown, ND
Tim Temeyer	Chief of water quality and water control section	U.S. Army Corps of Engineers, hydrology branch, NE
Spencer Vaa	State waterfowl biologist	SDGFP, Brookings, SD

Additionally, the following staffs of region 6 of the Service were of enormous help through their review and input on the drafts of this document:

- Bob Barrett, deputy refuge supervisor, ND, SD
- Rick Coleman, assistant regional director
- Shane Delgrosso, fire management officer
- John Esperance, chief of land protection planning branch
- Sheri Fetherman, chief of education and visitor services
- Bernardo Garza, refuge planner
- Galen Green, fire ecologist
- Toni Griffin, refuge planner
- Laura King, refuge planner
- Wayne King, biologist
- Rod Krey, refuge supervisor, ND, SD
- Ralph D. Morgenweck, regional director
- Michael Spratt, chief of division of refuge planning
- Harvey Wittmier, chief of division of realty

# Appendix G—Public Involvement

Public scoping was initiated for the Sand Lake National Wildlife Refuge in a Notice of Intent (NOI) dated August 1, 2001, announcing the availability of an issue workbook and dates for open houses to be held for public input on refuge management and the development of a CCP for the refuge.

An issues booklet was made available to the public, beginning in August 2001, through mailings to interested parties and public meetings.

The first public involvement meeting was scheduled for Hecla, South Dakota on September 11, 2001, with two more to follow that week. The refuge had sent out news releases and flyers during the last two weeks of August advertising the meetings and a “reminder” news release during the first week of September. Given the circumstances surrounding the events of September 11, 2001, the refuge sent out a news release canceling these meetings.

News releases and flyers were distributed the last week of September 2001 and first week of October 2001. A media contact list was compiled and invitations sent. The refuge had a link on their website for information and the issues workbook. Three scoping meetings were held in October 2001 to gather input from the public.

- October 9, 2001 in Hecla, SD
- October 10, 2001 in Columbia, SD
- October 11, 2001 in Aberdeen, SD

Sixty-two people attended these meetings and approximately 35 written comments were received during the open comment period. Comments received identified biological, social, and economic concerns regarding management.

Many of the public comments were general comments for all units of the refuge complex—Sand Lake National Wildlife Refuge, Sand Lake Wetland Management District, and associated waterfowl production areas). They are included here for the refuge as well.

## MAILING LIST

The following mailing list was developed for this CCP.

### Federal Officials

U.S. Representative Stephanie Herseth, Washington, DC; Scott Herreid, area director, Aberdeen, SD

U.S. Senator Tim Johnson, Washington, DC; Sharon Stroschein, Aberdeen, SD

U.S. Senator John Thune, Washington, DC; Judy Vrchota, area director, Aberdeen, SD

### Federal Agencies

Bureau of Reclamation, Dakotas Area Office, Bismarck, ND

U.S. Army Corps of Engineers, Omaha, NE

U.S. Department of Agriculture (USDA), Farm Service Agency, Brown County, SD

USDA, Natural Resources Conservation Service, Aberdeen and Burke, SD

U.S. Fish and Wildlife Service, ND—Arrowwood National Wildlife Refuge (NWR) Complex, Kulm Wetland Management District (WMD), Valley City WMD

U.S. Fish and Wildlife Service, SD—Brookings Wildlife Habitat Office, Ecological Services, Huron WMD, Lacreek NWR, Lake Andes NWR Complex, Madison WMD, Waubay NWR

U.S. Geological Survey, Huron, SD

U.S. National Ramsar Committee, Arlington, VA

### South Dakota State Officials

Representative Paul Dennert, Columbia

Representative Burt Elliott, Aberdeen

Representative Larry Frost, Aberdeen

Representative Jim Hundstad, Bath

Representative Al Novstrup, Aberdeen

Governor Mike Rounds, Pierre

Senator Duane Sutton, Aberdeen

### South Dakota State Agencies

Department of Agriculture, Pierre

Department of Emergency Management, Pierre

Department of Environment and Natural Resources, Pierre

Department of Game, Fish and Parks; Aberdeen, Brookings, Pierre, and Watertown

Division of Forestry, Aberdeen

Division of Water Rights, Pierre

Farm Bureau Federation, Huron

State Conservationist, Huron

State Historic Preservation Officer, Pierre

**Local Agencies and Officials**

Aberdeen Parks, Recreation and Forestry  
 Aberdeen School District  
 Beadle County Commission, Huron  
 Britton School District  
 Brown County Auditor  
 Brown County Commission, Aberdeen  
 Brown County Emergency Manager, Aberdeen  
 Brown County Extension Service, Aberdeen  
 Brown County Highway Department, Aberdeen  
 Brown County Sheriff, Aberdeen  
 Brown/Day Conservation District, Webster  
 Brown/Marshall Conservation District, Hecla  
 Columbia Fire Department  
 Conde Public School  
 Davison County Commission, Mitchell  
 Elm Valley School District, Barnard  
 Groton School District  
 Hanson County Commission, Alexandria  
 Hecla Volunteer Firefighters  
 Hecla-Houghton School District, Hecla  
 Hutchinson County Commission, Olivet  
 James River Water Development District, Huron  
 Lower Crow Creek Watershed District, Claremont  
 Mayor, Aberdeen  
 Mayor, Claremont  
 Mayor, Columbia  
 Mayor, Frederick  
 Mayor, Groton  
 Mayor, Hecla  
 Mayor, Westport  
 Northeast Council of Governments, Aberdeen  
 Redfield School District  
 Richmond Lake/Mina Recreation Area, Aberdeen  
 Roncalli School District, Aberdeen  
 Sanborn County Commission, Woonsocket  
 Spink County Commission, Redfield  
 Yankton County Commission

**State Colleges and Universities**

Northern State University, Aberdeen  
 Presentation College, Aberdeen

South Dakota Fish and Wildlife Cooperative  
 Research Unit, Brookings  
 South Dakota State University, Brookings

**North Dakota Agencies and Officials**

Dickey-Sargent Irrigation District, Oakes  
 Garrison Diversion Conservancy District, Oakes  
 Mayor, Ellendale  
 Mayor, Oakes

**Media**

Krause Publications, Iola, WI

**Organizations, Business, and Civic Groups**

Aberdeen Bird Club, SD  
 American Bird Conservancy, Washington, DC  
 Aberdeen Chamber of Commerce, SD  
 Aberdeen Convention and Visitors Bureau, SD  
 American Fisheries Society–Dakota Chapter,  
 Brookings, SD  
 American Rivers, Lincoln, NE  
 Boy Scouts–Sioux Council, Sioux Falls, SD  
 Dacotah Prairie Museum, Aberdeen, SD  
 Defenders of Wildlife, Washington, DC  
 Ducks Unlimited; Aberdeen, SD and Memphis, TN  
 Farmers Union State Office, Huron, SD  
 Girl Scouts–Nyoda Council, Huron, SD  
 Glacial Lakes and Prairies Tourism, Watertown, SD  
 Izaak Walton League, Gaithersburg, MD  
 Manomet Center for Conservation Sciences,  
 Manomet, MA  
 National Audubon Society, NY  
 National Wildlife Federation, Reston, VA  
 National Wildlife Refuge Association, Washington, DC  
 Northeast South Dakota Walleye Club, Aberdeen, SD  
 Pheasants Forever, Aberdeen, SD  
 Rocky Mountain Elk Foundation, Warner, SD  
 Sierra Club, San Francisco, CA  
 South Dakota Bowhunters Association, Hot Springs, SD  
 South Dakota Ornithological Union, Sioux Falls, SD  
 South Dakota Resources Coalition, Brookings, SD  
 South Dakota Wildlife Federation, Pierre, SD  
 Sportsmen’s Club of Brown County, Aberdeen, SD  
 The Nature Conservancy–Northern Tall-Grass  
 Prairie Ecoregion, Clear Lake, SD

The Nature Conservancy—Samuel H. Ordway  
Prairie, Leola, SD

The Nature Conservancy—South Dakota Chapter,  
Sioux Falls

The Wildlife Society—South Dakota Chapter,  
Brookings

Whitetail Bowmen, Aberdeen, SD

Whitetails Unlimited, Groton, SD

Wild Turkey Federation, Aberdeen, SD

Wildlife Management Institute, Washington, DC

**Individuals**

128 persons



# Appendix H—Economic Analysis

## **Regional Economic Effects of Current and Proposed Management Alternatives for Sand Lake National Wildlife Refuge**

Lynne Koontz, U.S. Geological Survey, Biological Resources Division, Fort Collins, CO 80526

Heather Lambert, U.S. Geological Survey, Biological Resources Division, Fort Collins, CO 80526

### **Introduction**

The National Wildlife Refuge System Improvement Act of 1997 requires all units of the National Wildlife Refuge System to be managed under a Comprehensive Conservation Plan (CCP). The CCP must describe the desired future conditions of a Refuge and provide long range guidance and management direction to achieve Refuge purposes. Sand Lake National Wildlife Refuge (NWR), located 27 miles northeast of Aberdeen, South Dakota, is in the process of developing a range of management goals, objectives, and strategies for the CCP. The CCP for Sand Lake NWR must contain an analysis of expected effects associated with current and proposed Refuge management strategies.

Special interest groups and local residents often criticize a change in Refuge management, especially if there is a perceived negative impact to the local economy. Having objective data on income and employment impacts may show that these economic fears are drastically overstated. Quite often, residents do not realize the extent of economic benefits a Refuge provides to a local community; yet at the same time overestimate the impact of negative changes. Spending associated with Refuge recreational activities such as wildlife viewing and hunting can generate considerable tourism activity for the regional economy. Refuge personnel typically spend considerable amounts of money purchasing supplies in the local lumber and hardware stores, repairing equipment and purchasing fuel at the local service stations, as well as reside and spend their salaries in the community.

The purpose of this study was to provide the economic analysis needed for the Sand Lake NWR CCP by evaluating the regional economic impacts associated with the Sand Lake NWR Draft CCP management strategies. For Refuge CCP planning, an economic impact analysis describes how current (No Action Alternative) and proposed management activities (alternatives) affect the local economy. This type of analysis provides two critical pieces of information: 1) it illustrates a refuge's contribution to the local community; and 2) it can help in determining whether local economic effects are or are not a real concern in choosing among management alternatives.

Sand Lake NWR is currently managed to improve and maintain habitat for nesting and resting waterfowl and other migratory birds, such as diving and puddle ducks, geese, grebes, herons, egrets, gulls, and terns. There are three alternatives evaluated in the draft CCP. Alternative 1, the No Action alternative, would continue Refuge management at current levels and would not involve extensive restoration of cropland, grassland, and wetland habitat or improvements to roads, interpretive, and administrative facilities. No new funding or staff levels would occur and programs would follow the same direction, emphasis, and intensity as they do at present. Alternative 2 would maximize the biological potential of

the refuge for species of grassland-nesting birds. This would be accomplished through intense management of upland habitat for nesting migratory birds, minimal management for resident species, and minimization of public use that may interfere with migratory bird production. The third alternative takes an integrated approach, with management practices that would serve to maximize the biological potential of Sand Lake for migratory birds.

This report first provides a description of the local community and economy near the Refuge. An analysis of current and proposed management strategies that could affect the local economy is then presented. The Refuge management activities of economic concern in this analysis are Refuge personnel staffing and Refuge spending within the local community, and spending in the local community by Refuge visitors.

### **Regional Economic Setting**

Sand Lake NWR is located in Brown County, northeast of Aberdeen, South Dakota. Brown County is part of the Glacial Lakes and Prairies Region of South Dakota and is sometimes called the heart of the Prairie-Pothole Region of North America. The County offers such attractions as the Dacotah Prairie Museum, Centennial Village, Pari-Mutual Horse Racing, Brown County Fair, and the Richmond Lake Youth Camp (Brown County, SD 2004). Brown County has a total area of 1,713 square miles (1,096,320 acres). Aberdeen, the third largest city in South Dakota, is the county seat and the center of commerce for the region.

Aberdeen was nicknamed the "Hub City" because it served as an important intersection for many busy railroad lines. Today's "Hub City" has grown into a diverse, regional trade center with service and manufacturing industries, attractive retail shopping opportunities, convention facilities, a private college, a state university and two large medical centers (Aberdeen Area Chamber of Commerce 2004). For the purposes of an economic impact analysis, a region (and its economy) is typically defined as all counties within a 30-60 mile radius of the impact area. Only spending that takes place within this local area is included as stimulating the changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Based on the relative self-containment in terms of retail trade and distance to other communities, Brown County was assumed to comprise the economic region for this analysis.

### **Population, Employment, and Income**

The 2000 Census estimated Brown County's population at 35,460 persons (US Census Bureau). Approximately 70% of the County's residents reside in Aberdeen (Discover Aberdeen, SD 2004). While the state of South Dakota experienced a 7.8% population increase from 1990 to 2000, Brown County's population decreased 0.4% over the same time frame (U.S. Census Bureau). In 2000, Brown County averaged 21 persons per square mile, the state average was 10 persons per square mile.

The 2000 Census reported 0.7% of the county population consisting of persons of Hispanic or Latino origin, 95.1% of white persons not of Hispanic/Latino origin, 0.3% of Black or African American persons, 2.7% of American Indian and Alaska Native Persons, and 0.4% of Asian persons. Approximately, 86% of the county population 25 years and older were high school graduates, and 24% were college graduates (US Census Bureau). There are two colleges in Aberdeen, Northern State University and Presentation College.

According to the Discover Aberdeen website, the major employers in Aberdeen are hospital/health service, education, manufacturing, hotel reservations, agriculture, higher education, call center, and support services. South Dakota's major exports include computers & electronic production, machinery manufactures, processed foods, and crop production (U.S. Department of Commerce 2002). Local and state employment is shown in Table 1. In 2000, 83.5% of County jobs were in private wage and salary employment (people who work for someone else) as compared to 79.2% for the State of South Dakota.

Table 1. Industry Breakdown of Full Time and Part Time Employment for 2000.

Industry	Brown County		State of South Dakota	
	# Jobs	% of County Total	# Jobs	% of State Total
Total farm	1,205	4.5%	37,659	7.2%
Total nonfarm	25,650	95.5%	483,677	92.8%
<b>Private</b>	22,431	83.5%	412,957	79.2%
Ag. Services, forestry, & fishing	282	1.1%	7,705	1.5%
Mining	(L)	---	1,552	0.3%
Construction	1,416	5.3%	27,956	5.4%
Manufacturing	2,483	9.2%	52,030	10.0%
Transport/utilities	939	3.5%	22,727	4.4%
Wholesale trade	1,393	5.2%	21,652	4.2%
Retail trade	5,148	19.2%	89,412	17.2%
Insurance/real estate	1,897	7.1%	42,523	8.2%
Services	8,868	33.0%	147,400	28.3%
Government	3,219	12.0%	70,720	13.6%
<b>Total full-time and part time employment</b>	<b>26,855</b>		<b>521,336</b>	

Source: U.S. Dept. of commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002. \*(L) less than 10 jobs, but the estimates for this item are included in the totals.

Hunting, fishing, camping, boating, cross-country skiing, bird watching, biking, and snowmobiling are important tourism activities in Brown County. Most jobs pertaining to the recreation and tourism industry are found in the retail trade (spending on supplies, souvenirs, restaurants, and grocery stores) and service (spending on hotels, gas stations, amusement, and recreation activities) sectors in an economy. As shown in Table 1, service and retail trade industries account for 33% and 19% of total County employment respectively.

As shown in Table 2, County per capita personal income was \$28,421 in 2000, which was \$2,606 higher than the state average (U.S. Dept. of Commerce 2002). Total personal income was just over 1.0 billion for Brown County in 2000 (Table 2). In 2000, non farm personal income for Brown County totaled almost \$960 million which accounted for 5.2% of total statewide non farm personal income, while Brown County farm related income accounted for 4.5% of total statewide farm income.

Table 2. Personal Income for Brown County and South Dakota, 2000.

	Brown County	State of South Dakota
Personal Income	\$1,005,276,000	\$19,510,589,000
Nonfarm personal income	\$958,962,000	\$18,475,437,000
Farm Income	\$46,314,000	\$1,035,152,000
Per capita personal income	\$28,421	\$25,815

Source: U.S. Dept. of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002.

## Economic Impacts of Current and Proposed Management Activities

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors will and will not be affected by demographic, economic, and policy changes. The economic impacts of the management alternatives for Sand Lake NWR were estimated using IMPLAN, a regional input-output modeling system developed by the USDA Forest Service (Minnesota IMPLAN Group 2002).

IMPLAN is a computerized database and modeling system that provides a regional input-output analysis of economic activity in terms of 10 industrial groups involving as many as 528 sectors (Olson and Lindall, 1996). The year 2000 Brown County IMPLAN data profile was used in this study. IMPLAN estimates for employment include both full time and part time workers which are measured in total jobs. The IMPLAN county level employment data estimates were comparable to the US Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System data at the 1 digit Standard Industrial Code level for the year 2000.

### Refuge Staffing and Budgeting

For the current conditions, (Alternative 1) staffing at the Refuge consists of thirteen permanent and four temporary/seasonal employees. The current staff accounted for an annual payroll (including salaries and benefits) of \$910,600 in 2003. In addition to providing salaries and benefits, the Refuge purchased goods and services totaling \$165,200 in 2003, approximately 65% of which was spent locally in the Brown County economy.

For Alternative 2, the anticipated staffing and non salary expenditures are the same as current conditions. Under Alternative 3 staffing needs are expected to increase by six permanent employees and one permanent half time employee. Including salaries and benefits, annual funding needed for the proposed personnel/staffing for Alternative 3 is anticipated to cost \$1,171,250 (which is \$260,650 more than Alternative 1). Annual non salary expenditures for Alternative 3 are anticipated to cost \$398,600 annually (which is \$233,400 more than Alternative 1). For each alternative, it is assumed that approximately 65% of non salary expenditures will still be spent locally in the Brown County economy. Table 3 summarizes the anticipated annual expenditures by management alternative.

Table 3. Refuge Staffing and Budgeting Expenditures by Management Alternative

	Annual Expenditures by Alternative		
	Alt 1	Alt 2	Alt 3
<b>Salary</b>	\$910,600	\$910,600	\$1,171,250
<b>Non-salary</b>	\$165,200	\$165,200	\$398,600
<b>Total</b>	\$1,075,800	\$1,075,800	\$1,569,850

Because of the way industries interact in an economy, a change in the activity of one industry affects activity levels in several other industries. For example, an increase in funding could allow the Refuge to start new projects or hire additional staff members. This added revenue will directly flow to the businesses from which the Refuge purchases goods and services and to the new Refuge employees. As additional supplies are purchased or as new staff members spend their salaries within the community, local businesses will purchase extra labor and supplies to meet the increase in demand for additional services. The income and employment resulting from Refuge purchases and Refuge employees' spending of salaries locally represents the *direct* effects of Refuge management activities within Brown County. In order to increase supplies to local businesses, input suppliers must also increase their purchases of inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the *indirect* effects of Refuge management activities within the county (Stynes 1998). The input supplier's new employees use their incomes to purchase goods and services. The resulting increased economic activity from new employee income is the *induced* effect of visitor spending. The sums of the direct, indirect and induced effects describe the total economic effect of Refuge management activities in Brown County.

Table 4 shows the economic impacts associated with current and proposed management staffing. IMPLAN estimates for employment include both full time and part time workers which are measured in total jobs. The current level (Alternative 1) of Refuge personnel directly accounts for 14.6 jobs and almost \$584,000 in personal income. The associated indirect and induced effects generate an additional 7.6 jobs and \$174,000 in personal income throughout the Brown County economy for a total economic impact of 22.2 jobs and almost \$758,000 associated with the current level of Refuge personnel. For Alternative 2, the staffing levels and economic impacts are the same as for Alternative 1. Due to the increased staffing levels for Alternative 3 (Table 3), the associated economic effects generate more jobs and income than Alternative 1 and 2.

Table 5 shows the economic impacts associated with current and proposed management non salary spending in Brown County. For each alternative, it is assumed that 65% of the non salary expenditures reported in Table 3 are spent locally in the Brown County economy. The current level (Alternative 1) of Refuge non salary expenditures directly accounts for 4.1 jobs and almost \$51,000 in personal income. The associated indirect and induced effects generate an additional 1.3 jobs and almost \$32,000 in personal income throughout the Brown County economy for a total economic impact of 5.4 jobs and almost \$83,000 in personal income associated with the current level of Refuge non salary spending in the local economy. For Alternative 2, the non salary spending levels and economic impacts are the same as for Alternative 1. Due to the increased non salary spending levels for Alternative 3 (Table 3), the associated economic effects generate more jobs and income than Alternative 1 and 2.

Table 4. Local Economic Impacts of Refuge Staffing Expenditures

<b>Brown County</b>	Alternative 1	Alternative 2	Alternative 3
<b>Salary Impacts</b> <i>(excludes benefits)</i>			
Direct Effects ( <i>Federal Government Sector</i> )			
Income (\$/year)	\$583,596	\$583,596	\$770,398
Jobs	14.6	14.6	19.3
Indirect and Induced Effects ( <i>in Brown County Economy</i> )			
Income (\$/year)	\$174,181	\$174,181	\$229,935
Jobs	7.6	7.6	10.0
<b>Total Effects</b>			
<b>Income (\$/year)</b>	<b>\$757,777</b>	<b>\$757,777</b>	<b>\$1,000,333</b>
<b>Jobs</b>	<b>22.2</b>	<b>22.2</b>	<b>29.2</b>

Table 5. Economic Impacts of Refuge Non Salary Expenditures in Brown County

<b>Brown County</b>	Alternative 1	Alternative 2	Alternative 3
<b>Non Salary Impacts</b> <i>(65% of total non salary expenditures spent locally)</i>			
Direct Effects			
Income (\$/year)	\$50,882	\$50,882	\$122,771
Jobs	4.1	4.1	9.8
Indirect and Induced Effects ( <i>in Brown County Economy</i> )			
Income (\$/year)	\$31,738	\$31,738	\$76,577
Jobs	1.3	1.3	3.1
<b>Total Effects</b>			
<b>Income (\$/year)</b>	<b>\$82,620</b>	<b>\$82,620</b>	<b>\$199,348</b>
<b>Jobs</b>	<b>5.4</b>	<b>5.4</b>	<b>12.9</b>

Table 6 presents the combined economic impacts associated with refuge staffing and non salary spending in Brown County. Refuge management activities currently generate 27.6 jobs and over \$840,000 in personal income in Brown County. This accounts for less than one-tenth of one percent (0.1%) of total employment in Brown County. Refuge management activities associated with Alternative 2 would generate the same as Alternative 1. The higher staffing and spending levels associated with Alternative 3 would generate more jobs and income than Alternative 1.

Table 6. Combined Refuge Staffing and Non Salary Expenditures in Brown County

<b>Brown County</b>	Alternative 1	Alternative 2	Alternative 3
<b>Total Refuge Staffing and Budgeting Impacts</b> <i>(salary and non-salary)</i>			
Direct Effects			
Income (\$/year)	\$634,478	\$634,478	\$893,169
Jobs	18.7	18.7	29.1
Indirect and Induced Effects <i>(in Brown County Economy)</i>			
Income (\$/year)	\$205,919	\$205,919	\$306,512
Jobs	8.9	8.9	13.1
<b>Total Effects</b>			
<b>Income (\$/year)</b>	<b>\$840,397</b>	<b>\$840,397</b>	<b>\$1,199,681</b>
<b>Jobs</b>	<b>27.6</b>	<b>27.6</b>	<b>41.2</b>
<i>% of Total County</i>			
<i>Income</i>	<i>0.08%</i>	<i>0.08%</i>	<i>0.12%</i>
<i>% of Total County</i>			
<i>Jobs</i>	<i>0.10%</i>	<i>0.10%</i>	<i>0.15%</i>

### Recreation Activities

The Refuge offers a wide variety of year round accessible recreational opportunities that are wildlife compatible. Wildlife observation, bird watching, education, photography, hunting and fishing are all popular activities. The Refuge is a nationally recognized wildlife sanctuary and offers opportunities for the big game hunter, upland game hunters, and waterfowl hunters. Pheasant hunting draws outdoorsmen from across the country each fall, and duck and goose hunters set decoys on the many small lakes and marshes that dot the prairie pothole country. Fishing is allowed year round at five locations on the Refuge.

Major visitor expenditure categories include lodging, food, and supplies. To determine the local economic impacts of visitor spending, only spending by persons living outside the local area (Brown County) are included in the analysis. The rationale for excluding local visitor spending is two fold. First, money flowing into Brown County from visitors living outside is considered new money injected into the Brown County economy. Second, if Brown County residents visit Sand Lake NWR more or less due to the management changes, they will correspondingly change their spending of their money elsewhere in Brown County, resulting in no net change to the local economy. These are standard assumptions made in most regional economic analyses at the local level.

In order to accurately estimate the amount of spending associated with Refuge visitation, visitors must be divided by type of activity and place of residence (local County residents, non local South Dakota residents, and nonresidents). Sand Lake NWR annual visitation was estimated based on the 2003 Refuge annual visitation estimates. The Refuge bases visitation estimates on visitors entering the Visitor Center/Office and general observation. Estimates on the percentage of visitors by place of residence were provided by Refuge personnel. Table 7 summarizes estimated Refuge visitation by type of visitor activity and percentage of visitors by place of residence.

Table 7. Estimated Annual Refuge Visitation by Visitor Activity and Place of Residence.

	Total # of Visitors	Percentage of Local Brown County Visitors	Percentage of Non Local South Dakota Visitors	Percentage of Nonresident Visitors (live outside of South Dakota)
Total Estimated Visitors	43,281			
Non-Consumptive Users				
Interpretation/ Observation	32,140	50%	25%	25%
Environmental Education	3,862	80%	10%	10%
Hunting				
Migratory Bird	3,200	40%	30%	15%
Upland Game	3,600	50%	45%	20%
Big Game	4,100	60%	30%	10%
Fishing	2,900	90%	9%	1%

A key step in estimating total visitor spending is the development of visitor spending profiles. Average daily travel related expenditure profiles for various recreation activities derived from the 1996 National Survey of Hunting, Fishing and Wildlife Related Recreation (U.S. Dept. of Interior 1996) by the U.S. Forest Service (Niccolucci and Winter 2002) were used in this analysis. For each type of visitor activity, the Survey reports trip related spending of state residents and non residents for several different recreational activities. State resident and nonresident spending profiles for big game hunting, small game hunting, migratory bird hunting, and fresh water fishing were used for the Sand Lake NWR hunting and fishing related visitor activities. The state resident and nonresident spending profiles for non-consumptive wildlife recreation (observing, feeding, or photographing fish and wildlife) were used for interpretation/observation and environmental education visitors at Sand Lake NWR. For each visitor activity, spending is reported in the categories of lodging, food & drink, transportation, and other expenses. Total spending per day for state residents and nonresidents by visitor activity is reported in Table 8.

Table 8. Time Spent on the Refuge and Spending per Day for Each Visitor Activity.

	Average State Resident Spending per Day	Average Nonresident Spending per Day
Interpretation/Observation and Environmental Education	\$7	\$104
Waterfowl Hunting	\$17	\$23
Upland Game Hunting	\$18	\$208
Big Game Hunting	\$20	\$31
Fishing	\$25	\$44

Source: Niccolucci and Winter 2002

Visitor spending is typically estimated on an average per day (eight hours) or average per trip basis. In order to properly account for the amount of spending associated with each type of refuge visitor, it is important to determine the average length of trip. Refuge personnel estimate that visitors participating in interpretation/observation and environmental education activities typically spend 4 hours on the Refuge, visitors participating in fishing activities spend 3 hours, waterfowl hunters usually spend a half day (4 hours), upland game hunters spend 6 hours, and big game hunters spend a day (8 hours) on the Refuge. Because the visitor spending profiles are for an 8 hour visitor day, the number of 8 hour state resident and nonresident visitor days for each visitor activity must be calculated. The current number of visitor days per activity is shown in Table 9.

Table 9. Annual Number of Non Local Visitor Days per Activity for Alternative 1.

	Number of Non Local South Dakota Visitors	Number of Non-resident Visitors	Estimated time spent at Sand Lake NWR	Number of Non Local South Dakota Resident Visitor Days (1 day = 8 hours)	Number of Non-resident Visitor Days (1 day = 8 hours)
Interpretation/ Observation	8,035	8,035	4 hours	4,018	4,018
Environmental Education	386	386	4 hours	193	193
Waterfowl Hunting	960	480	4 hours	480	240
Upland Game Hunting	1,620	720	6 hours	1,215	540
Big Game Hunting	1,230	410	8 hours	1,230	410
Fishing	261	29	3 hours	98	11
<b>Total</b>				<b>7,233</b>	<b>5,411</b>

Total visitor spending is determined by multiplying the total spending per day (Table 8) by the number of non local visitor days for each visitor activity (Table 9). Current Refuge visitors spend about \$655,500 annually in the Brown County economy. Table 10 shows the economic impacts associated with current visitation and anticipated changes in visitation by management alternative. The current level (Alternative 1) of visitor spending directly generates over \$152,000 in personal income and 9.4 jobs for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations).

The associated indirect and induced effects generate an additional 4.3 jobs and over \$102,000 in personal income throughout the Brown County economy for a total economic impact of 13.7 jobs and over \$254,000 in personal income associated with the current level of Refuge visitation. For Alternative 2, Refuge personnel estimate visitation declining by 30% as compared to Alternative 1. For Alternative 3, visitation is anticipated to increase by 25% as compared to Alternative 1. The resulting economic impacts associated with Refuge visitation for Alternatives 2 and 3 are presented in Table 10.

As shown in Table 10, the economic impacts associated with current Refuge visitation are limited in terms of contributing to the overall county income and employment. Any decrease in visitation associated with a change in Refuge management will not have a significant economic effect. An increase in the amount of time current visitors spend on the Refuge will increase the amount of daily

spending that can be attributed to visiting the Refuge. An increase in both the length of stay on the Refuge (and in the local economy) and the number of people visiting the Refuge could have a considerable impact on increasing the role Refuge visitors play in the local economy.

Table 10. Economic Impacts of Sand Lake NWR Visitor Spending by Alternative.

<b>Brown County</b>	Alternative 1	Alternative 2	Alternative 3
<b>Visitor Spending Impacts</b>			
<b>Direct Effects</b>			
Income (\$/year)	\$152,076	\$106,453	\$190,095
Jobs	9.4	6.6	11.8
<b>Indirect and Induced Effects (<i>in Brown County Economy</i>)</b>			
Income (\$/year)	\$102,263	\$71,584	\$127,829
Jobs	4.3	3.0	5.4
<b>Total Effects</b>			
<b>Income (\$/year)</b>	<b>\$254,339</b>	<b>\$178,037</b>	<b>\$317,924</b>
<b>Jobs</b>	<b>13.7</b>	<b>9.6</b>	<b>17.1</b>
<i>% of Total County</i>			
<i>Income</i>	<i>0.03%</i>	<i>0.02%</i>	<i>0.03%</i>
<i>% of Total County</i>			
<i>Jobs</i>	<i>0.05%</i>	<i>0.04%</i>	<i>0.06%</i>

## Summary and Conclusions

Table 11 summarizes the direct and total economic impacts for all Refuge management activities for each management alternative. Under current Refuge management (Alternative 1), economic activity directly related to all Refuge operations would generate an estimated 28.1 jobs and over \$786,500 in personal income in Brown County. Including direct, indirect, and induced effects, all Refuge activities would account for 41.3 jobs and \$1.09 million in personal income in Brown County (Table 11). Current Refuge management activities account for 0.15% of total County employment and 0.11% of County income.

Table 12 summarizes the economic effects associated with management changes from Alternative 1. Alternative 2 will slightly decrease employment by 4.1 jobs and personal income by \$76,000 in Brown County because of anticipated decreases in Refuge visitation. Alternative 3 will increase employment by 17 jobs and personal income by over \$422,000 in Brown County because of proposed increases in staffing, non salary expenditures and Refuge visitation.

Table 11. Summary of all Refuge Management Activities by Alternative.

<b>Brown County</b>	Alternative 1	Alternative 2	Alternative 3
<b>Total Refuge Staffing and Budgeting Impacts</b>			
<b>Direct Effects</b>			
Income (\$/year)	\$634,478	\$634,478	\$893,169
Jobs	18.7	18.7	29.1
<b>Total Effects</b>			
Income (\$/year)	\$840,397	\$840,397	\$1,199,681
Jobs	27.6	27.6	41.2
<b>Recreation Activities</b>			
<b>Direct Effects</b>			
Income (\$/year)	\$152,076	\$106,453	\$190,095
Jobs	9.4	6.6	11.8
<b>Total Effects</b>			
Income (\$/year)	\$254,339	\$178,037	\$317,924
Jobs	13.7	9.6	17.1
<b>Aggregate Impacts</b>			
<b>Direct Effects</b>			
Income (\$/year)	\$786,554	\$740,931	\$1,083,264
Jobs	28.1	25.3	40.9
<b>Total Effects</b>			
Income (\$/year)	\$1,094,736	\$1,018,434	\$1,517,605
Jobs	41.3	37.2	58.3
<i>% of Total County Income</i>	<i>0.11%</i>	<i>0.10%</i>	<i>0.15%</i>
<i>% of Total County Employment</i>	<i>0.15%</i>	<i>0.14%</i>	<i>0.22%</i>

Table 12. Economic Effects Associated with Changing from Alternative 1.

<b>Brown County</b>	Alternative 2	Alternative 3
<b>Total Refuge Staffing and Budgeting Impacts</b>		
<b>Direct Effects</b>		
Income (\$/year)	\$0	+\$258,691
Jobs	0	+10.4
<b>Total Effects</b>		
Income (\$/year)	\$0	+\$359,284
Jobs	0	+13.6
<b>Recreation Activities</b>		
<b>Direct Effects</b>		
Income (\$/year)	-\$45,623	+\$38,019
Jobs	-2.8	+2.4
<b>Total Effects</b>		
Income (\$/year)	-\$76,302	+\$63,585
Jobs	-4.1	+3.4
<b>Aggregate Impacts</b>		
<b>Direct Effects</b>		
Income (\$/year)	-\$45,623	+\$296,710
Jobs	-2.8	+12.8
<b>Total Effects</b>		
Income (\$/year)	-\$76,302	+\$422,869
Jobs	-4.1	+17.0

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# Appendix I—Refuge Operations Needs System Projects

<i>RONS<sup>1</sup></i> <i>Number</i>	<i>Project Description</i>	<i>First-Year Need (\$1,000)</i>	<i>Recurring Annual Need (\$1,000)</i>	<i>Personnel FTE<sup>2</sup></i>
R-01003	Increase habitat management capability (refuge manager)	139.0	74	1.0
R-97015	Provide station administrative assistance (administrative clerk)	110.0	45	1.0
R-03001	Expand the station's law enforcement program (law enforcement officer)	136.0	71	1.0
R-97016	Expand the station's law enforcement program (law enforcement officer)	65.5	32	0.5
R-97011	Evaluate and monitor wildlife response to applied management using GIS technology (resource specialist)	139.0	74	1.0
R-98001	Reestablish area and capacity data for Sand Lake National Wildlife Refuge	249.0	0	—
R-00004	Design and update all refuge brochures into the Service's graphic standards format	32.0	4	—

<sup>1</sup>*RONS=refuge operations needs system*

<sup>2</sup>*FTE=full-time equivalent*



# Appendix J—Maintenance Management System Projects

<i>MMS<sup>1</sup></i> <i>Number</i>	<i>Description</i>	<i>Cost</i> <i>(\$1,000)</i>
<i>Deferred Maintenance</i>		
R-90034	Replace outdated educational and interpretive signs and aerial photos	26
R-92003	Replace garages	79
R-99003	Replace Mud Lake water control structure	419
R-00004	Replace station two-way radio system with narrow-band system	151
R-01043	Replace 1,000-gallon, aboveground, Convault storage tank	34
R-01044	Replace 2 bay, 1,000-gallon, aboveground, Convault storage tanks	34
<i>Large Construction</i>		
R-99002	Construct education center—Centennial Legacy Project (design and construction)	1,036
<i>Heavy Equipment</i>		
R-01013	Replace 1978 John Deere front-end loader	121
R-01019	Replace worn-out 1980 GMC equipment truck	66
R-01035	Replace 1980 auto car, 6x4 diesel tractor (semitruck)	91
R-01037	Replace 1995 Ford 6x4 truck tractor	81
R-01070	Replace 1980 IHC 684 farm tractor	35
R-01046	Replace 1978 John Deere 4440 agricultural tractor	66
R-01047	Replace 1979 IHC TD15 tracked crawler-tractor	152
R-01048	Replace 1992 John Deere 2555 agricultural tractor with front-end loader	40
R-01049	Replace 1996 John Deere 7400 agricultural tractor with loader	66
R-01068	Replace 1999 John Deere tracked excavator	152
R-02003	Replace grader	113
R-02005	Replace 2002 Ford dump truck	80
R-02006	Replace loader, backhoe	55
R-95008	Replace worn-out 1989 Chevrolet extended-cab pickup	28
R-00003	Replace Bobcat loader	48
R-93004	Replace worn-out lowboy trailer	58
R-00005	Replace worn-out 1993 pickup	29
R-01002	Replace worn-out 4-wheel ATV <sup>2</sup>	6
R-01003	Replace worn-out 4-wheel ATV	6
R-01006	Replace 1997 Honda 4-wheel ATV	6
R-01009	Replace 1979 John Deere disc	12
R-01010	Replace 1987 native grass drill	22
R-01011	Replace 1965 Clark forklift	15
R-01012	Replace 1985 disc harrow	17
R-01014	Replace worn-out 1999 Dodge Ram 4x4 pickup	30
R-01017	Replace worn-out 1997 John Deere 48-inch deck mower	9
R-01018	Replace worn-out 1989 Chevrolet diesel 4x4 pickup	32

<sup>1</sup>MMS=maintenance management system

<sup>2</sup>ATV=all-terrain vehicle

<i>MMS Number</i>	<i>Description</i>	<i>Cost (\$1,000)</i>
<i>Heavy Equipment</i>		
R-01020	Replace 1998 Chevrolet 4x4 pickup	30
R-01021	Replace 1999 Dodge ¾-ton, 4x4 pickup	30
R-01022	Replace 1999 Dodge ½-ton, 4x4 pickup	30
R-01023	Replace 1999 Chevrolet ¾-ton, 4x4 pickup	30
R-01025	Replace 1992 Dodge Dakotah 4x2 pickup	25
R-01026	Replace 1991 Chevrolet 4x4 dual pickup	30
R-01030	Replace 1993 Chevrolet 4x4 pickup	30
R-01032	Replace 1995 Ford 4x4 pickup	30
R-01034	Replace 1995 Ford 4x4 pickup	30
R-01038	Replace 1999 Chevrolet Suburban	32
R-01039	Replace 300-gallon Western fire pumper	15
R-01040	Replace 1988 300-gallon Wajax Pacific fire pumper	15
R-01041	Replace 1997 Arctic Cat snowmobile	5
R-01042	Replace 1991 300-gallon Wajax Pacific fire pumper	15
<i>Small Equipment</i>		
R-01050	Replace 1990 Trail Eze tilt-bed implement trailer	51
R-01052	Replace 1999 Honda 4-wheel ATV	6
R-01053	Replace 1999 Honda 4-wheel ATV	6
R-01054	Replace 1999 Honda 4-wheel ATV	6
R-01055	Replace 2000 Wildcat snow blower	9
R-01056	Replace 1999 Blumhardt weed sprayer	6
R-01057	Replace 2000 forward hydraulic hoist	10
R-01058	Replace 2000 Honda 4-wheel AT V2	6
R-01059	Replace 2000 Honda 4-wheel ATV	6
R-01060	Replace 2000 Blumhardt weed sprayer	6
R-01061	Replace 2000 John Deere riding lawn mower	8
R-01062	Replace 2000 John Deere riding lawn mower	9
R-01063	Replace 2000 Chevrolet Tahoe	33
R-01065	Replace 1999 Dodge ¾-ton, 4x4 pickup	30
R-01067	Replace 2001 Chevrolet ¾-ton, 4x4 pickup	30
R-01069	Replace 1999 Truax grass drill	25
R-02007	Replace Canon Image Runner 330 Copier	13
R-02001	Replace 2002 Chevrolet pickup	20
R-02004	Replace 2002 Ford fire truck and tank	41
<i>Road Rehabilitation</i>		
R-91009	Preliminary engineering (route 12,101;18 miles)	400
R-02002	Preliminary engineering and construction (Sand Lake Recreation Area Road and three parking lots (route 100, 901-03; 18 miles)	340
R-99003	Preliminary engineering and construction (route 010, 0.49 mile, parking lot 900)	283
R-03001	Construction (route 12, 101; 18 miles)	4,000
R-03002	Construction (route 11, 14.9 miles)	4,000
R-03003	Preliminary engineering (route 11, 14.9 miles)	400

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