

FWS/ARW/RE-AP

Dear Reader:

The U.S. Fish and Wildlife Service is pleased to provide you with this copy of the Comprehensive Management Plan (Plan) for the Union Slough National Wildlife Refuge (Refuge). The Plan and its supporting documents describe a vision for long-term improvement and use of the Refuge. They specify how the Refuge watershed can become a model of sustainability showing how modern successful agriculture and natural areas can thrive side by side.

Active community participation and support will be vital to the future of the Refuge. We invite you to learn - from this Plan and from visits to the Refuge - more about the Refuge, its purpose and potential, and to become involved in making it all that it can be.

The U.S. Fish and Wildlife Service would like to thank all the people who participated in the planning and public involvement process.

Sincerely,

/s/ William Hartwig
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Region

/s/ Nita Fuller
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A Vision for Union Slough National Wildlife Refuge:

..... ***Watershed, Partners, and Wildlife***

Union Slough National Wildlife Refuge, located in Kossuth County, Iowa, will soon be transformed into a wildlife refuge for the 21st century. The Refuge watershed will become a model of sustainability showing how modern agriculture and natural areas can thrive side by side. Through new partnerships, the watershed will see widespread use of Best Management Practices, Precision Farming, Integrated Crop Management, and other conservation and environmental farming practices. The Refuge will expand to support and maintain a community of organisms having a species composition, diversity, and functional organization comparable to that of native habitats of this region. Wildlife abundance and educational opportunities will increase to attract students of all ages and abilities to learn about the Refuge watershed ecosystem. Local communities will promote the Refuge as a regional destination, which will contribute to the local economy.

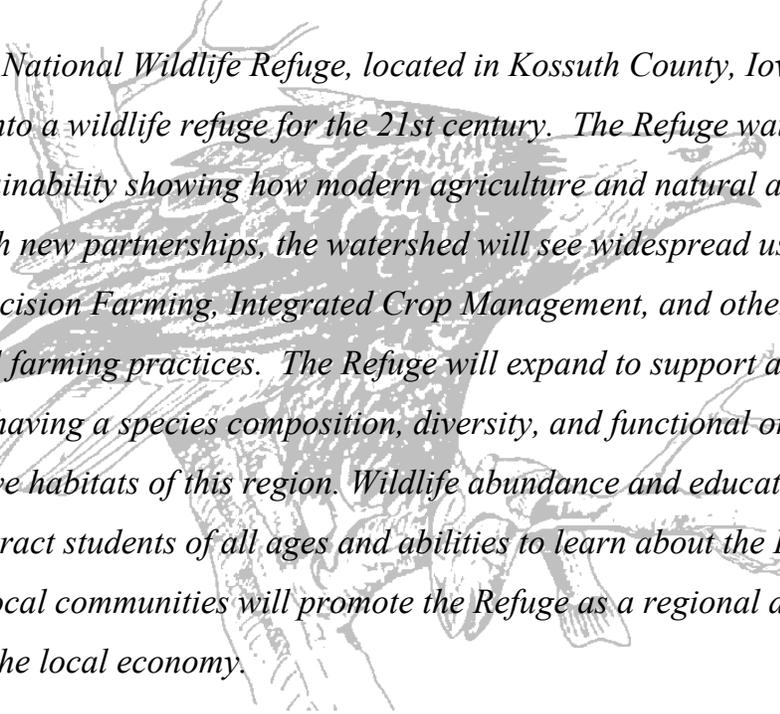


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I. Introduction

1. Charting the Future

For nearly 60 years, Union Slough National Wildlife Refuge (Refuge) has provided important resting, nesting, and feeding habitat for thousands of birds during their annual migrations north and south. During years of drought, the Refuge's stable water conditions provide critical habitat for many regional species. A peak of forty-nine thousand ducks and over 240 different species of birds have been recorded on Union Slough Refuge since its inception. The Refuge, its wildlife, fish, and wildlands attract more than 8,000 visitors each year.



The bobolink is one of the 240 different bird species that utilize the Refuge.

The Refuge is located in Kossuth County, Iowa, approximately 55 miles north of Fort Dodge, Iowa; 160 miles southwest of Minneapolis, Minnesota; and 130 miles north of Des Moines, Iowa. The Refuge has long been an important component of

the Upper Mississippi River/Tallgrass Prairie Ecosystem (Figure 1).

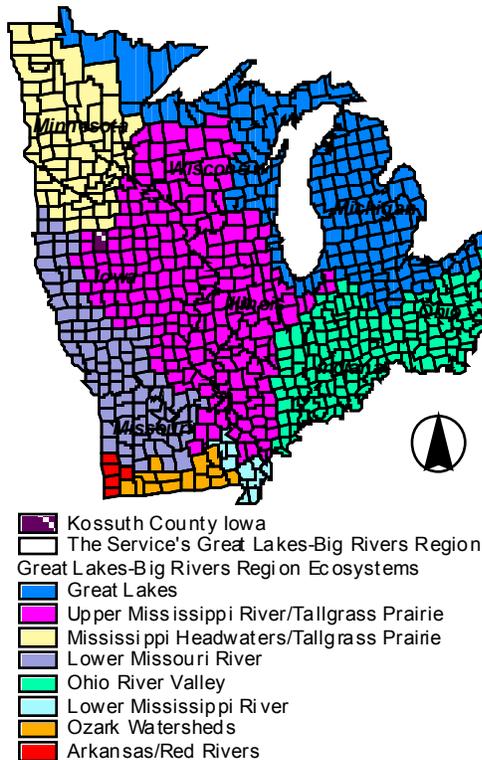


Figure 1 - Regional Orientation of the Refuge and Ecosystems within the Services Great Lakes-Big Rivers Region

The U.S. Fish and Wildlife Service and others are concerned for the Refuge's long-term environmental health and wildlife productivity. Recent studies have documented a declining status of numerous grassland and wetland dependent wildlife populations, while others have demonstrated how habitat loss and alteration are common causal factors in many of these declines. Since the early 1950's, grassland nesting duck production has been unacceptably low, and water quality in Refuge wetlands has deteriorated due to sedimentation and eutrophication due to runoff. More and more it is recognized that the long-term biological health of the Refuge is highly dependent on the ecological health of the Refuge watershed.

In response to these concerns, the decision was made to develop a Comprehensive Management Plan (Plan) for the Refuge. The Plan articulates Service management direction (goals, objectives, strategies) for a 15 year period that would (1) intensify and

concentrate federal, state, local, and private habitat restoration and preservation mechanisms in the Union Slough Refuge and portions of its watershed, (2) improve the quality of water entering the Refuge, and (3) provide the public with additional high quality wildlife-dependent environmental education and recreation opportunities at the Refuge.

The purpose of the Plan is to:

- L **provide a clear statement of the desired future conditions when Refuge purposes and goals are accomplished.**
- L **provide Refuge neighbors and visitors with a clear understanding of the reasons for management actions on and around the Refuge.**
- L **ensure that management of the Refuge reflects policies and goals of the National Wildlife Refuge System.**
- L **ensure that Refuge management is consistent with Federal, State, and County plans.**
- L **provide long-term continuity in Refuge management.**
- L **provide a basis for operation, maintenance and capitol improvement budget requests.**

Implementation of the Plan would rely on partnerships formed with landowners in the watershed, volunteers and interested citizens, farm and conservation organizations, and with appropriate government agencies. Cooperating landowners within the Refuge watershed would be offered incentives and/or compensated through cost-sharing agreements for applying conservation and environmental farming practices and for creating, maintaining, or enhancing habitat for wildlife.

Nineteen projects, ranging from improvements to the auto tour route to upgrading Refuge signs and brochures, have been identified. The total estimated cost to the Service is \$11.2 million dollars. Over the next 15 years, the Service would facilitate the restoration and preservation of 8,325 acres within the Refuge watershed (Figure 6). Of this acreage, the Service would purchase approximately 3,750 acres from willing sellers. The Service would purchase fee-title interest in lands only if lesser property interests are not available, appropriate, or effective (easements, leases, cooperative agreements, etc). Funding for Service land purchases would be the Migratory Bird Conservation Fund (proceeds from the sale of federal duck stamps) using the authority of the Migratory Bird Conservation Act.

The Plan supports the National Wetlands Priority Conservation Plan, the North American Waterfowl Management Plan - U.S. Prairie Pothole Joint Venture and the Iowa Prairie Pothole Joint Venture Implementation Plan, the Service's Regional Wetlands Concept Plan, the Service's Ecosystem Plan for the Upper Mississippi River/Tallgrass Prairie ecosystem, and strategic planning efforts of Kossuth County, which identifies preservation and protection of land and water resources and enhancement of the county's tourism potential as important public needs.

2. The U.S. Fish and Wildlife Service

The mission of the U.S. Fish and Wildlife Service is to provide Federal leadership to conserve, protect and enhance fish and wildlife and their habitat for the American people. The Service is the primary

Federal agency responsible for conserving, protecting, and enhancing America's fish and wildlife resources and their habitats. It shares this responsibility with other Federal, state, tribal, local, and private entities. However, the Service has specific trustee responsibility for migratory birds, endangered species, interjurisdictional fish, certain marine mammals, and lands and waters administered for the management and protection of these and other resources.

3. The National Wildlife Refuge System

The mission of the National Wildlife Refuge System is to preserve a national network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations. The broad goals of the National Wildlife Refuge System are to:

- L preserve, restore, and enhance in their natural ecosystems (when practical) all species of animals and plants that are endangered or threatened with becoming endangered;
- L perpetuate the migratory bird resource;
- L preserve a natural diversity and abundance of fauna and flora on refuge lands; and
- L provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment and to provide refuge visitors with high quality, safe, wholesome and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

New Guidance for National Wildlife Refuges (Executive Order 12996)

On March 25, 1996, President Clinton released new guidance on the management and general use of the National Wildlife Refuge System. The Order affirmed four guiding principles which have been integrated into the Comprehensive Plan for Union Slough. They include:

- (a) **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.
- (b) **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.
- (c) **Partnerships.** America's sportsmen and women were the first partners who insisted on protecting valuable wildlife habitat with wildlife refuges. Conservation partnerships with other Federal agencies, State agencies, Tribes, organization, industry, and the general public can make significant contributions to the growth and management of the Refuge System.
- (d) **Public Involvement.** The public should be given full and open opportunity to participate in decisions regarding the acquisition and management of our National Wildlife Refuges.

4. Union Slough National Wildlife Refuge

A. Refuge Purpose

Union Slough National Wildlife Refuge was established in 1937 by Franklin D. Roosevelt (Executive Order 7976, dated September 14, 1938) primarily to assist with the production and management of waterfowl in the Mississippi Flyway. The purpose of the Refuge is *"a refuge and breeding ground for migratory birds and other wildlife..."*. The mission of the Refuge is to preserve, restore, and manage lands and waters sufficient in size and character to meet the needs of migratory birds and other wildlife for the continued benefit of the American people.

B. Refuge Physiography, Hydrology, and Biology

Union Slough is a pre-glacial riverbed that forms a connection or "union" between the watersheds of the Blue Earth River and the East Fork of the Des Moines River. It is located on the eastern edge of

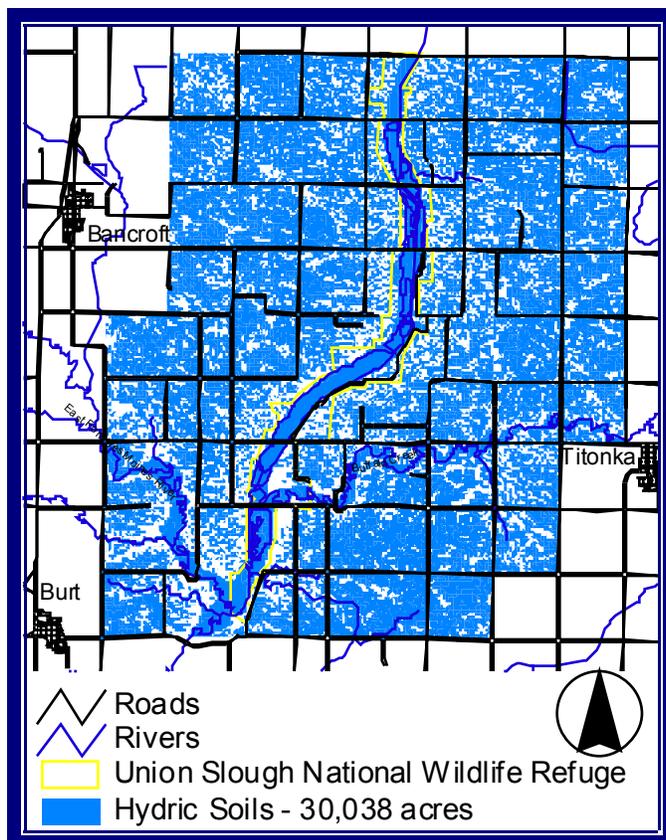


Figure 3 - Hydric soils in and around the Refuge (based on soil map analysis of a 40,000 acre study area).

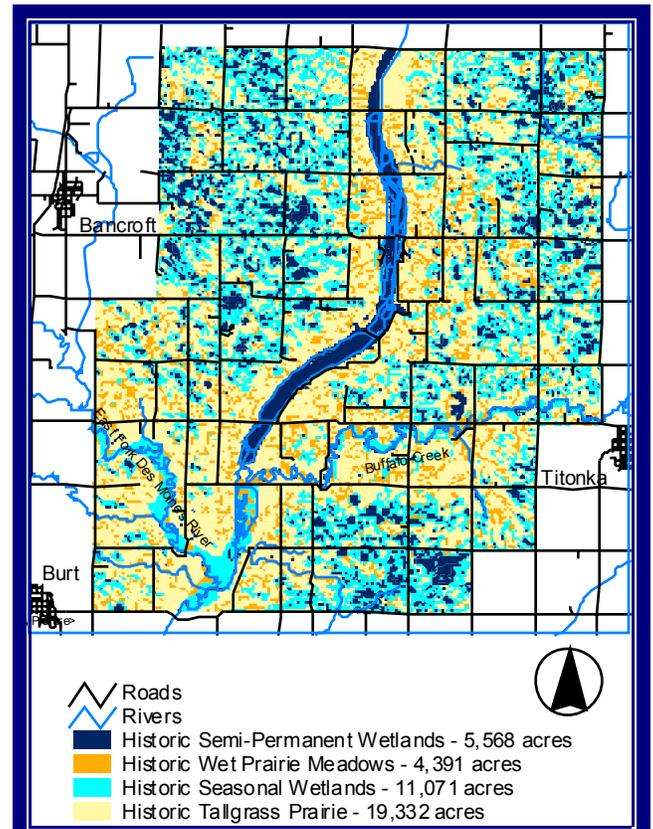


Figure 2 - Historic wetlands, meadows, and tallgrass prairie in and around the Refuge (based on soil map analysis and interpretation of a 40,000 acre area).

the Northern Great Plains within an area referred to as the "Des Moines Lobe" of the Northern Iowa Glaciated Region, which was the terminus of the Great Glacial Advances. As glacial ice receded from the area around 12,000 years ago, it created a rich mosaic of "prairie potholes" stretching from Des Moines to Spirit Lake to Mason City, and totaling nearly 7.6 million acres.

Soil map analysis of a 40,000 acre study area around the Refuge suggests that prior to European settlement, wetlands and tallgrass prairie covered

much of the area (Figure 2). Large depressions, characterized by hydric (wetland) soils are found throughout the area, most of which are now farmed in corn or soybeans (Figure 3). Where water is present at least seasonally, aquatic plants such as bulrush, cattail, bladderwort, and pondweeds flourish. Ridges, knobs, and rises that flank the wet areas historically supported tallgrass prairie plants such as big bluestem, little bluestem, indianguass, as well as an assortment of prairie flowers, while green ash, cottonwood, and willows dominated the stream banks.

The Refuge currently extends approximately 8 miles along Schwob Marsh, Union Slough, and Buffalo Creek, and under normal water conditions, contains 450 acres of open water, 850 acres of marsh, and 1,675 acres of uplands (Figure 4).

Wetlands and open water areas on the Refuge are contained within six manageable units and are recognized by their diversity (or lack thereof) of emergent, floating-leaved, and submersed aquatic plants (pondweeds, coontail, cattails, bull-rushes, smartweed, millet, etc.). Uplands on the Refuge consist mainly of idled hay fields and pastures seeded with mixtures of smooth brome, wheatgrasses and legumes and with mixtures of switchgrass, bluestem, gramma grasses, yellow indianguass, and needlegrasses.

Precipitation is the main source of water for the Refuge, thus the quality of water entering the Refuge is directly related to the ecological integrity of the Refuge watershed (Figure 5). Water control structures within the Refuge regulate drainage and because of nearly level topography, waters flow both north and south. Waters flowing north drain into the Blue Earth River and eventually into the Minnesota and Mississippi Rivers. Water draining south flows into Buffalo Creek, the Des Moines River, and the Mississippi River.

The Refuge watershed is an important biological system connected by a network of natural and manmade waterways (streams, ditches, and subsurface tile) in which materials and energy are transferred. Some provide an important ecological component to the Refuge by connecting biologically diverse food webs and providing important habitat features for wildlife.

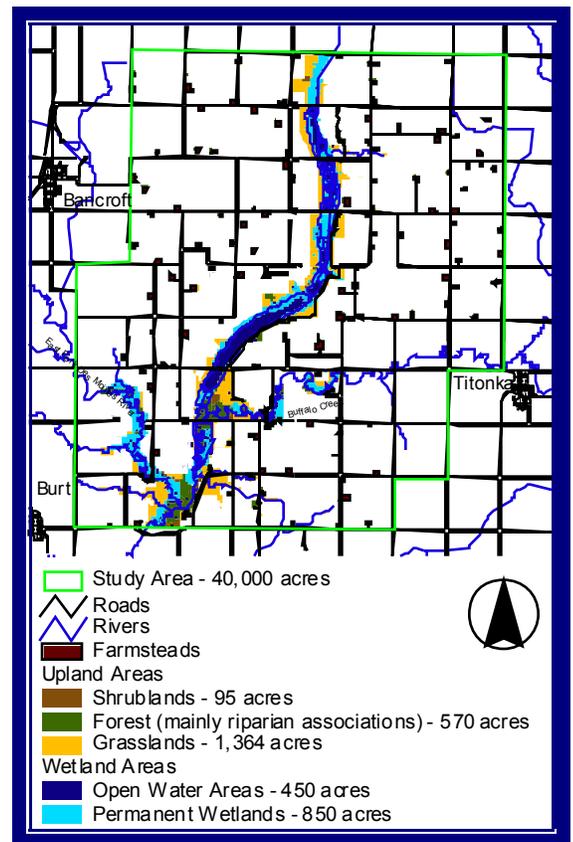


Figure 4 - Current land cover types in and around Union Slough NWR (40,000 acre study area). White areas indicate agriculture.

Mallards, blue-winged teal, wood ducks, white pelicans, great blue herons, dickcissels, warblers, brown thrashers, sparrows, meadowlarks, sora rails, black-crowned night herons, bobolinks, pheasants, grey partridge, red-tailed hawks, northern harriers, and American kestrels are just a few of the birds that utilize the Refuge during spring, summer, or fall. Annual counts of lesser and greater yellowlegs commonly reach 3-4,000 birds, while Canada, snow, and white-fronted geese peak at over 4,000 birds.

The Refuge also supports an assortment of mammals, such as white-tailed deer, woodchucks, red fox, squirrels, raccoons, muskrat, skunk, mink, opossum, shrews, voles, weasels, and badger.

Federally-listed threatened or endangered species that utilize the Refuge include the bald eagle and peregrine falcon. State-listed threatened or endangered species that use the Refuge include the northern harrier, king rail, forsters tern, and black tern, to name a few.

C. Refuge History

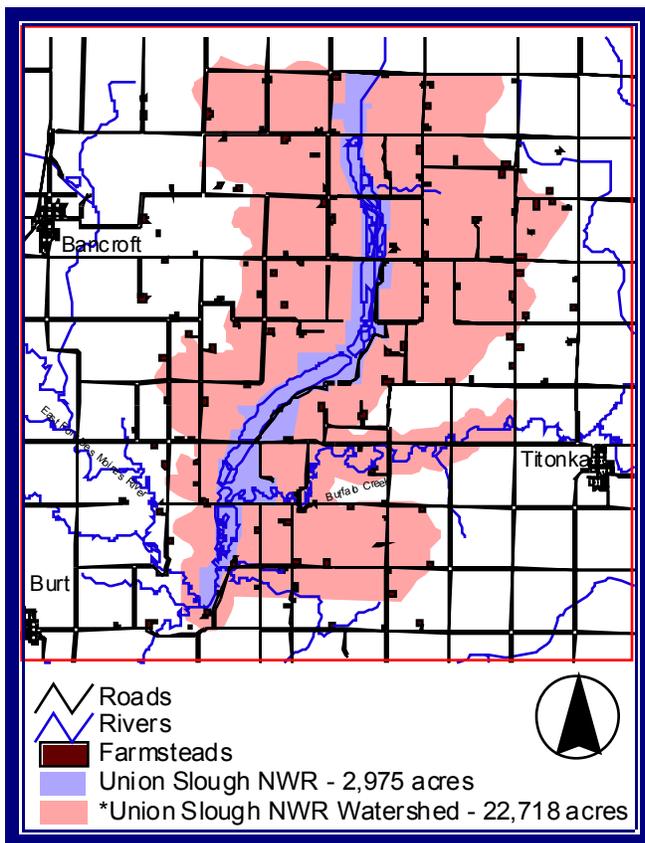


Figure 5 - Union Slough NWR and its primary watershed.
* Does not include entire Buffalo Creek drainage.

1913 - 1934	Union Slough drained and used for row crop agriculture and pasture.
1934	Ding Darling and local conservationists Phil DuMont and Logan Bennet surveyed Union Slough for its potential as a waterfowl refuge.
1938	President Franklin D. Roosevelt signed Executive Order 7976 establishing the Union Slough Migratory Waterfowl Refuge of Iowa. Price per acre ranged from \$10 to \$40.
1951	The town of Bancroft was issued a Special Use Permit to convert the gravel pit area to a recreational site.
1953	First building on the Refuge. A metal storage building 20x30' was purchased from the Reclamation Service in Huron, SD.
1958	First managed deer hunt on the Refuge during Iowa's two day shot gun season. Twenty-eight deer were taken on the Refuge.
1962	First successful nesting attempt by wood ducks in an artificial structure on the Refuge.
1968	Buffalo Creek Picnic Area was developed and opened to the public.
1969	Union Slough's gravel pits were closed because of possible unsafe swimming conditions due to bacterial contamination from cattle in an adjoining pasture.
1970-1980	Continued growth in wood duck structure program and improvements in design lead to a dramatic increase in the breeding wood duck population.
1971	The auto tour was opened for the first time for two weekends in April and September.
1972	The 75' foot bridge spanning Buffalo Creek was completed and a new mile loop Nature Trail was opened to the public at the Deer Meadow area.
1977	Office/vehicle building completed. Total cost: \$59,121.
1979	First tract (Pelzer Tract, 150 acres, Emmet Co.) acquired under the Small Wetland Acquisition program administered by Union Slough NWR.
1986	In exchange for three Service fish hatcheries in eastern Iowa, the Service acquired the Buffalo Creek and Schwob Marsh Units from the State (645 acres). Total Refuge acreage now stands at 2,845.
1988	Union Slough, the Iowa DNR, and Duck's Unlimited begin restoration of wetlands on private land throughout northern Iowa under the new Private Lands Program. One hundred and forty wetlands totaling over 900 acres were restored in its first full year.

E. Management of the Refuge

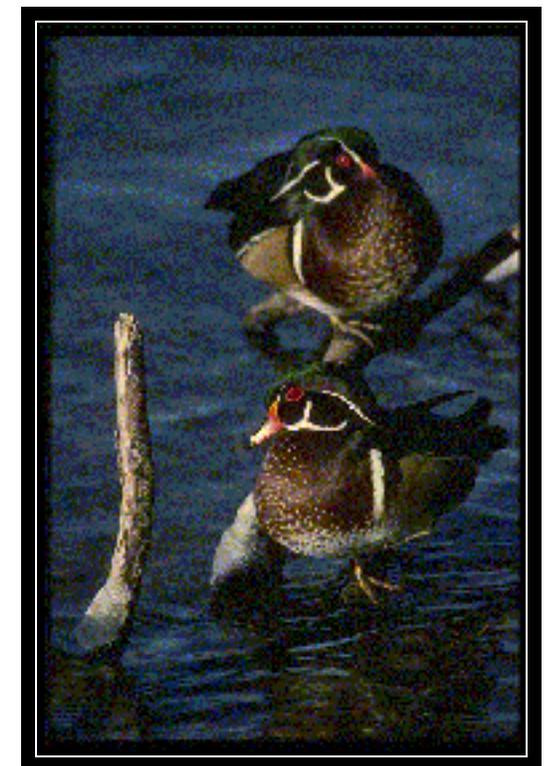
Management of Union Slough Refuge involves using a variety of management techniques to preserve and enhance marsh and upland habitats for wildlife. Wetland management plays an important role in the establishment and maintenance of wetland vegetation on the Refuge, and usually involves the



Mallard female with young

manipulation of water to achieve the desired successional stage or zone of wetland plant communities. Plant zones provide structural diversity to Refuge wetlands and several plant zones are more beneficial to wildlife than are homogenous stands. Each plant species within the wetland attracts its own species of bird, mammal, reptile, invertebrate, amphibian, and fish. Thus, in order to attract and maintain diverse populations of wildlife, Refuge wetlands are managed to promote diverse plant communities. The ideal composition of emergent vegetation (cattails, bull-rushes, phragmites, etc.) and open water areas containing submersed vegetation (pondweeds, coontail, etc.) is a hemi-marsh condition (50% emergent vegetation and 50% open water). Drought conditions, both natural and through periodic draw downs, also play an important role in the life cycle of Refuge wetlands. As wetland areas dry up and soils harden, nutrients are released and made available. This process results in rejuvenation, and when re-flooded, creates an area thriving with animal life and aquatic vegetation essential to wetland wildlife.

Riparian, or streamside areas within the Refuge, serve as the transition zone between the upland and wetland environments. These areas differ from the uplands due to the availability of water that promotes dominance of water-dependent plant species. From a watershed and wildlife management perspective, riparian areas serve several important functions. Riparian vegetation contributes to wetland morphology as available root biomass stabilizes erosive soils, while above ground portions of the plants promote sediment deposition outside the wetland thereby reducing sediment yield. In this same regard, riparian vegetation acts to control nonpoint-source pollution by filtering out nutrients and pesticides that are attached to the sediment particles. As a result of reduced sediment yields, spawning beds for fish can remain relatively free of fine



With the introduction of artificial nest cavities, the Refuge has become a major producer of wood ducks.

sediments, infilling of pools is reduced thereby maintaining water depths and structural diversity, and primary production is enhanced by reducing water turbidity.

Upland management on the Refuge includes establishing and maintaining productive grasslands for waterfowl and other migratory birds. Grasslands surrounding Refuge wetlands provide nesting habitat for waterfowl and other birds and provide a means to control runoff from surrounding lands. Prescribed burning is a tool used to maintain grasslands as burning increases the vigor of desirable vegetation while reducing competition from less desirable plants. Small acreages of brush and timber (mostly riparian associations) are being allowed to expand along Buffalo Creek through natural succession to enhance the habitat diversity for woodland-dependent species, especially neotropical migrant songbirds.



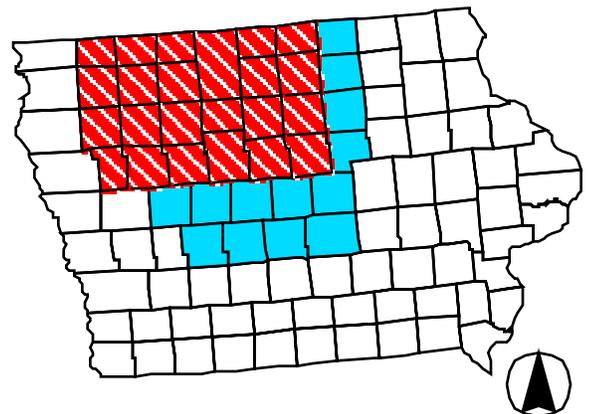
Ring-necked pheasants utilize the Refuge for winter cover, food, and nesting habitat.

F. Partners for Wildlife Program



Union Slough and its cooperating partner the Iowa DNR have focused considerable effort over the past few years on encouraging and assisting private landowners in restoring converted and degraded wetlands and associated upland habitats. In a 23 county area surrounding the Refuge, 521

wetland basins totaling 1,824 acres have been restored since 1987. The Refuge provides technical assistance and cost-sharing to complete the work if the landowner agrees to maintain the area for a period of 10 years or more. The program focuses on restoring and enhancing habitats that provide wildlife, fisheries, water quality, aesthetic, and recreation benefits. Participation in this program is strictly voluntary. In the past two years, landowners have also been offered the opportunity to restore warm season grasses for the benefit of wildlife. Two Refuge staff work exclusively on Partners for Wildlife projects.



 Partner's for Wildlife District
 Fish and Wildlife Management District
 State of Iowa

G. Iowa Wetland Management District

The Refuge also administers the Iowa Wetland Management District (District) with its partner the Iowa DNR. The District encompasses 35 northcentral Iowa counties and currently consists of 10,011 acres of Waterfowl Production Areas (WPA's). The District uses a landscape-scale approach to manage habitat by incorporating a patch-work of wetlands and grasslands to create habitat conditions more favorable for self-sustaining wildlife populations in northcentral Iowa. The Service can purchase a wetland and

surrounding upland area outright, or enter into a perpetual easement with the landowner and only purchase certain ownership rights. Through a Memorandum of Agreement with the Iowa DNR, management of these WPA's is done by the Iowa DNR in cooperation with the Service. The District is not covered by this Plan but will be treated at a later date in a plan for the 11 Districts found within the Great Lakes-Big Rivers Region.

II. Opportunities And Issues

Scoping is a process of identifying opportunities and issues, the knowledge of which would assist management in planning the Refuge's future course of action. The Service publicly announced it was preparing a Plan for the Refuge in November 1994. Information about the project was provided through news-releases, interviews, informational letters, and one-on-one briefings. Six public scoping meetings were held prior to the release of the draft CMP. From questions raised in conversations and correspondence with landowners, the general public, representatives from other Federal and state agencies, local officials, and private conservation organizations, the Service identified ten opportunities and issues currently facing the Refuge that the Plan must deal with. In addition, census data, research studies, and local plans were reviewed for relevant information such as the Kossuth County Community and Economic Development Strategic Plan. In that plan the county calls for reducing soil erosion, restoring wetlands, improving water quality, supporting the CRP program, and encouraging and promoting education programs for youth on the pros and cons of agricultural chemicals. The Service shares these issues and sees an opportunity to work with the County to achieve these common goals.

1. Long-term, Watershed-Based Coordination And Guidance

Several water quality, natural resource, and agricultural programs have emerged in the Union Slough watershed in recent years. The on-going Union Slough/Smith Lake Water Quality Incentive Program (WQIP) is one good example. The Conservation Reserve Program, Wetland Reserve Program, Environmental Quality Incentives Program, and Partners for Wildlife Program are others. The Refuge needs to reevaluate its management role and determine how it can intensify and concentrate these and other programs in the Refuge watershed to benefit Refuge resources. The Refuge's role within the local community and watershed is not well defined.

2. Water Quality And Refuge Wetlands

Recent studies indicate that waters entering the Refuge from surrounding watersheds transport large amounts of silt, sediment, and nutrients (nitrates and ammonia), which over time, cause major physical, chemical, and biological changes to Refuge wetlands. According to a 1995 U.S. Geological Survey study, the mean change in sediment thickness in Refuge pools since 1938 is 2.62 feet, which represents a mean sedimentation rate of approximately .5 inches per year, or the equivalent of dumping 2,230 dump truck loads of sediment into Refuge wetlands each year.

3. Biodiversity

The combined effects of human settlement and development trends have resulted in significant alterations to the natural flora and fauna within the Refuge watershed. Elk, bison, grizzly bear, prairie chickens, and whooping cranes are just a few of the species that have disappeared from the area. Marsh plants such as white top and wild rice that were once abundant in the area have been replaced by narrow leaf cattail, hybrid cattail, and reed canary grass. Many insects and

other prey that are dependent upon native grassland plants to survive, and which serve as the food base for many grassland birds, have also disappeared.

4. Production Of Nesting Waterfowl And Other Birds

Research has shown that hatch rates of dabbling duck nests at the Refuge (mean 11.9%) is lower than most reported areas, and recruitment rates, especially for mallards, is below what is needed to replace losses due to mortality. Predicted annual changes in the mallard population at the Refuge without the influx of pioneering birds has been estimated at -12.6 percent. Nest success rates of 15 percent or greater must be achieved to produce a surplus of dabbling ducks.

Presently Refuge birds must concentrate their nesting effort in a narrow fringe of habitat surrounding Refuge wetlands, where predators such as red fox, striped skunk, and raccoon easily forage. Large native predators (gray wolves, grizzly bear) which historically preyed on bison, livestock, and deer have been eliminated from the area and naturally replaced by medium-sized predators (fox, skunk, raccoon) that prey extensively on birds, their eggs, and their young.



Red fox and other predators severely reduce duck production at the Refuge.

5. Wildlife Disturbance By People

Migrating waterfowl and eagles are easily disturbed by people using the auto tour route. The narrow land base surrounding Refuge wetlands has resulted in alignment of the auto tour route near the waters edge and in close proximity to resting birds. The auto tour route is often closed because of this disturbance.

6. Wildlife Crop Depredation

Neighboring farmers are suffering crop losses due to grazing by geese, ground squirrels, pheasants, and deer. Early season losses following emergence of corn and/or soybeans occur from all species on lands bordering the Refuge. Canada geese graze on soybeans, and to a lesser degree corn, for several weeks after emergence. White tail deer feed on crops throughout the growing season. Crop damage varies by species and location with some neighbors suffering greater losses than others.



Goslings and adult geese leave the nest together within 24 hours of hatching. They feed by grazing on young tender plants and may move several miles if necessary to find suitable browse.

7. Public Awareness Of Opportunities

The Refuge is not well known and understood within the local area. The Refuge needs to better promote its recreation and educational opportunities, including developing additional brochures, a general marketing plan, and utilizing local materials produced for the county and local communities.

8. Old And Deteriorating Facilities/Need For New Facilities

Many of the existing visitor facilities (Deer Meadow Picnic Area, Vanishing Prairie Trail, Refuge Headquarters) are old, in poor condition, or lack accessibility. There is a need to renovate existing facilities for safety and accessibility; to improve visitor information systems (signs and brochures); and to bring public facilities up to Service standards.

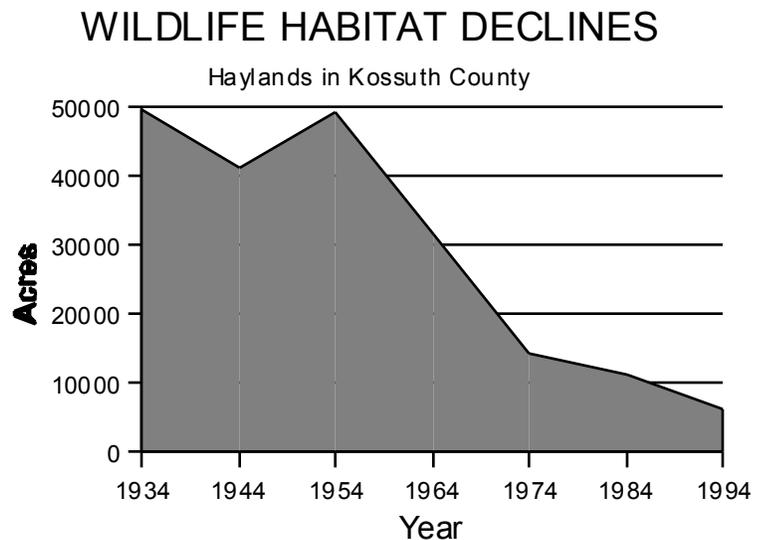
The Service and interested publics have identified several new facilities which will expand opportunities and support the long-term goals of the Refuge, watershed, and the county. The public expressed interest in providing additional places to see wildlife, additional youth environmental education facilities, canoeing, bicycling, and fishing opportunities.

9. Wildlife Habitat Declines

Prior to European settlement, 85 percent of Iowa's landscape was native grasslands. Today, less than 1 percent remains.

Northcentral Iowa contained 2-3 million acres of wetlands scattered among a tallgrass prairie/wetland complex of approximately 7.6 million acres. Today, 98 percent of the wetlands and 99.9 percent of the prairies are gone.

For nearly 50 years following the initial conversion of native prairies around Union Slough, many prairie dependent wildlife remained relatively stable by their ability to colonize agricultural grasslands that surrounded Refuge wetlands. However, since the 1950's the acreage of agricultural grasslands has significantly declined, and in many parts of the region, is at its lowest level in more than 100 years. Consequently, the Refuge has become an island of nesting habitat surrounded by rowcrop fields.



Statistics for Kossuth County indicate that 42,800 acres of haylands were present in 1937 when the Refuge was established. By 1976 that figure had decreased to 13,400 acres, and by 1994, haylands had decreased to 6,300 acres countywide, an 86 percent reduction from 1937. Lands within the Refuge watershed follow these county-wide trends.

10. Resource Inventories And Monitoring Systems

The Service has incomplete inventories for the Refuge's natural resources. For example, the Refuge has incomplete information on reptiles, amphibians, invertebrates, small mammals, fisheries and aquatic life, and migratory birds. Monitoring systems needed to protect and properly manage Refuge resources are also inadequate.

III. Refuge Goals, Objectives, And Strategies

This section presents long-term guidance (15 years) for the Refuge in the form of goals, objectives, and strategies. Refuge goals are qualitative statements that define what the Refuge must be to satisfy its purpose, legal mandates, and the needs of citizens and agencies having a vital interest in what and how the Refuge performs. Refuge objectives provide quantitative (and qualitative) bench marks that indicate progress toward Refuge purpose and goals. Strategies are actions and/or projects that will lead to the accomplishment of Refuge management objectives.

The purpose for which the Refuge was established provides the basic framework for setting Refuge goals, objectives, and strategies. It is within the Refuge purpose that management functions are developed and what uses and facilities can be provided. The requirement that a permitted use be *compatible* with the Refuge purpose governs whether or not an activity or use can be allowed on the Refuge. As such, a compatibility determination is the primary statutory standard determining uses of national wildlife refuge lands. All proposals in this Plan are considered compatible based upon a site-specific evaluation of the anticipated impacts (conflicts) on migratory bird use and habitat. The section is organized into three areas: 1) watershed stewardship, 2) habitat and wildlife management, and 3) public use.

1. Watershed Stewardship Initiative

The quality of wetland habitat in the Refuge is largely related to land management practices within the Refuge watershed. The Watershed Stewardship Initiative provides a means for Refuge management to take a proactive role in addressing Refuge resource issues (and opportunities) that originate outside of the current Refuge boundary. Project implementation would be based on partnerships formed with landowners in the watershed, farm and conservation organizations, and with appropriate federal, state, and county agencies. Water quality, which directly affects Refuge resources, has been targeted for improvement through voluntary programs with neighboring producers. Success of the program is based on the premise that sustainable, profitable agriculture can be maintained and/or enhanced while benefiting Refuge resources and the people who utilize the Refuge. Land acquisition by the Service is an important tool in this initiative, but in and of itself will not meet the broad goals of the Watershed Stewardship Initiative. For that reason partnerships and use of other programs such as Monsanto's Green Stripe program, the Conservation Reserve Program (CRP), Wetland Reserve Program (WRP), Water Quality Improvement Program (WQIP), Environmental Quality Incentive Program (EQIP) and others will be vital to the long-term success of this undertaking.

Refuge staff will work with private landowners, the Iowa Farm Bureau, conservation organizations, and other governmental agencies to bring voluntary programs into the watershed to help meet Refuge water quality goals and the needs of producers. Through these programs and practices, such as Integrated Crop Management, Precision Farming, Conservation Tillage, Manure Management, and others, nutrient and chemical inputs and sediment entering the Refuge can be reduced. Other voluntary programs such as the Conservation Reserve, Wetland Reserve, and the Service easement programs offer means for

landowners to restore highly and extremely erodible areas into permanent grass cover. This initiative aims to give farmers in the Union Slough watershed an opportunity to demonstrate voluntary land management practices important to water quality and wildlife resources on the Refuge.

GOAL: *Through voluntary partnerships, improve water quality and quantity within the Refuge in a manner that is compatible with a healthy farming economy.*

OBJECTIVES:

1. Reduce the annual sedimentation rate in Refuge pools to 1/8" or less per year.
2. Reduce nitrate inputs into Refuge waters to seasonal peak concentrations of 5 ppm or less.
3. Promote the use of environmentally friendly farm chemicals so that a wider variety of products are used and that more than 50% of pesticides applied within the Union Slough watershed are listed in the lowest three levels of toxicity by the Farm Chemical Handbook (practically nontoxic, slightly nontoxic, and toxic)

STRATEGIES/PROJECTS:

- L Establish a Watershed Advisory Committee composed of landowners/producers, agribusiness, private conservation organization, and agency representatives. This Committee would provide long term guidance for the Watershed Initiative and seek new ways to meet its goals and objectives.
- L Develop an outreach packet for distribution to landowners. This packet would contain informational brochures/leaflets on land management practices which would contribute towards project goals (See Project No. 17).
- L Meet with all adjacent landowners one on one over the next year to discuss the Plan.
- L Promote the restoration of steep slopes within the Refuge watershed to grass cover through the Monsanto Green Stripe Program, CRP enrollment, conservation easements, or fee title acquisition (See Project No. 5).
- L Develop an annual water quality monitoring program.
- L Actively promote through education and partnerships Precision Farming Practices, Integrated Crop Management, or other tools on over 75% of cropland within the watershed to reduce use of harmful herbicides and insecticides. Implement these voluntary projects with local partners and funding through the USDA Water Quality Incentive Program (WQIP), Iowa DNR 319 program, or other similar sources (See Project No. 4-5).

- L In selected areas, filter and treat surface runoff and tile water through a series of treatment wetlands to reduce nitrate loading into the Refuge's wetlands. (See Project No. 4-5).
- L With partners, develop an environmental education curriculum that focuses on water quality issues and solutions in Kossuth County (See Project No. 17).

2. Habitat And Wildlife Management

Habitat and wildlife management at the Refuge involves using a variety of management techniques to preserve and enhance marsh and upland habitats for wildlife. Marsh management involves the manipulation of water levels to achieve a desired succession of wetland plant communities to meet the seasonal needs of wildlife populations. Upland management includes establishing and maintaining grasslands to provide nesting and feeding habitat for ducks and various song birds. The Refuge strives to maintain adequate numbers, distributions, variations, and species associations within and between plant and animal populations to promote recovery and ensure continued existence. Management focuses on monitoring and assessing populations, controlling predators and exotic species, and research.

GOAL: *Protect, restore, and manage habitat on the Refuge and within the Refuge watershed with increased emphasis on restoring and preserving a community of life typical of the tallgrass prairie ecosystem.*

OBJECTIVES:

1. Increase Refuge waterfowl breeding pair populations to 5,000 pairs, with a recruitment rate equal to or greater than 0.6.
2. Maintain 400 wood duck boxes in a manner to achieve a 75 percent occupancy rate.
3. Increase and maintain waterfowl nesting success rates to a minimum of 25 percent.
4. Through a combination of voluntary partnerships, easements, and land acquisition, restore and preserve a 1/4-mile grassland buffer around Refuge wetlands (approximately 2,500 acres), with emphasis on establishing high quality waterfowl and migratory bird nesting and feeding habitats and a cost-effective means for safeguarding water quality within Refuge wetlands (See Project No.1).
5. Through a combination of voluntary partnerships, easements, and land acquisition, restore and preserve a 4,300 acre complex of wetlands, wet meadows, and grasslands to meet the needs of breeding waterfowl and area-sensitive grassland bird species (See Project No. 2).
6. Through a combination of voluntary partnerships, easements, and land acquisition, restore and preserve a 1/4-mile grassland buffer around the lower reaches of Buffalo Creek (approximately 1,500 acres)(See Project No. 3).

7. Preserve all remnant tallgrass prairie within the Union Slough NWR watershed.
8. Reduce crop depredation on neighboring lands from geese and deer.
9. Increase bald-eagle use by protecting, restoring and maintaining roosting and feeding sites.
10. Restore and maintain a viable self-sustaining population of Trumpeter swans on the Refuge (minimum 5 pairs).

STRATEGIES/PROJECTS:

- L Restore and enhance fish spawning, nursery, and overwintering habitat by selective dredging, bank stabilization, and controlling carp (primarily Buffalo Creek).
- L Develop monitoring and assessment programs for waterfowl (breeding pair recruitment/nesting success), other wildlife, fish, and Refuge plant communities.
- L Actively manipulate water levels on Refuge pools to produce a mosaic of wetland habitat conditions favorable to a wide variety of waterfowl and wetland wildlife.
- L Review and update the Refuge's waterfowl, migratory bird, and water management plans.
- L Control the populations of medium-sized predators such as skunks, fox, and raccoons on Refuge lands until sufficiently sized blocks of nesting habitat are restored.
- L Work with adjacent landowners to develop and maintain natural vegetative barriers and/or fencing between Refuge wetlands and adjacent farm fields to control field depredation by geese.
- L In cooperation with the State, manage the Refuge deer population through controlled hunts.
- L Restore and maintain mature trees in a zone 300 feet wide around each bald eagle roosting sites.
- L Minimize human activities within 300 feet of bald eagle roosts.
- L Improve collaboration between Service staff and other Federal agencies, the State, local officials, conservation groups, and private landowners (Service partners).
- L Redistribute existing wood duck boxes to new habitats as they become available.
- L Intensify and concentrate Federal, State, local, and private habitat restoration and preservation mechanisms in the Refuge watershed,
- L Using the proceeds from the sale of Federal duck stamps, acquire 250 acres of additional habitat each year for 15 years (willing seller/willing buyer basis).

- L Develop a Geographic Information System (GIS) for the Refuge. (See Project No. 19)
- L Construct and maintain predator proof enclosures for nesting waterfowl (See Project No. 6).
- L Construct and maintain 3-5 predator-free nesting islands for waterfowl within Refuge pools (minimum 150 feet from shore) by limited dredging (See Project No. 6).
- L Construct and maintain 200 additional waterfowl nesting structures within a one mile radius of Refuge wetlands (See Project No. 6).
- L Relocate the Refuge auto tour route at least 1,000 feet from Refuge pools (See Project No. 8)

3. Public Use

Union Slough Refuge currently provides opportunities for birdwatchers, photographers, educators, students, researchers, hunters, anglers, and hikers. Annual visitation is estimated at 8,000 visits per year. The Refuge, the largest parcel of public land in Kossuth County, will provide a greater contribution to the quality of life for county residents by preserving the region's natural and aesthetic beauty and by affording wildlife-dependent recreational and educational opportunities.

Existing Refuge activities and facilities were evaluated based on three criteria: 1) compatibility with wildlife, 2) local demand and need, 3) function and aesthetics. The public use recommendations are a balanced package of programs and facilities that will allow the Refuge to achieve its long-term visitation objective of 14,000 visitors per year while preserving the biological integrity of the Refuge.

Conservation biology principles of preserving blocks of habitat uninterrupted by public facilities and reducing the amount of roads along the marsh edge have been applied where appropriate. Sediment containment ponds and filter wetlands, proposed to preserve the marsh, will be interpreted to educate people on the need for and techniques of watershed stewardship.

A number of wildlife dependent visitor activities will continue to be offered at Union Slough. This Plan includes proposals to renovate most of the existing facilities to bring them up to Service standards. New opportunities are proposed for wildlife viewing, bicycling, and wetland education. Proposed facilities will increase visitor use while at the same time protecting wildlife from excessive human disturbance.

GOAL: *Provide people with high quality environmental education and wildlife-dependent recreation programs and facilities at the Refuge.*

OBJECTIVES:

1. Through improvements to visitor programs, facilities and information, increase the total number of Refuge visitors to 14,000 people per year.
2. Through special events and partnerships with local schools, youth organizations, and county naturalists, increase environmental education programs on the Refuge to accommodate 1,500 students per year.
3. Increase hunting and fishing opportunities on Union Slough NWR to accommodate 4,000 visits per year.

STRATEGIES/PROJECTS:

- L Enhance the Refuge visitor's experience through the development of a clear system of welcome and orientation. Visitors must know where to go and what recreation or education opportunities are available. Develop a Communication Plan that includes a basic package of signs and brochures for the Refuge. Market Refuge activities and events through the local communities.
- L In partnerships with local teachers, county naturalists, and youth organizations, develop curriculum and monitoring programs focusing on Refuge water and watershed issues.
- L Promote the Refuge as a "Watchable Wildlife" destination in northern Iowa. In partnership with county naturalists, local tourism offices, and special interest groups, develop a system of signs,

brochures, wildlife identification materials, and equipment to allow Refuge visitors increased opportunities to see wildlife.

- L With partners, conduct four watchable wildlife workshops per year to educate Refuge visitors on species identification, habitat identification, wildlife observation skills, and wildlife threats and conflicts.
- L Expand tour route access times during peak migration and throughout the summer.
- L Promote winter recreation on the Refuge including wildlife observation, cross-country skiing, and hiking.
- L Evaluate new hunting opportunities on existing and newly acquired lands. In 15 years, an estimated 2,000 additional acres could be opened to hunting.
- L Improve the Refuge headquarters site for visitors by better defining visitor parking, visitor entrance, and providing information on a kiosk overlooking pool C. Construct a 624 square foot addition (Office Space) and use existing office space for school groups and visitors. Design space as a Watershed Education Room to describe Refuge habitat and techniques for protecting and enhancing the Refuge (See Project No. 7).
- L Realign the auto tour route to reduce disturbance to wildlife and to meander through a variety of habitats. Acquire an adequate interest in additional lands to allow for realignment . Increase roadway width and load capacity to accommodate school and tour buses (See Project No. 8).
- L Develop the gravel pit area to function as an outdoor classroom site to study watersheds, wetlands, and water quality. The project will include a wetland boardwalk, wetland sampling sites, shelter, equipment storage, and toilets (See Project No. 13).
- L Develop interpretive pull-off areas along the tour route to provide opportunities to see eagles or learn about wildlife, habitat and the Refuge (See Project No. 9).
- L Develop accessible hiking trails at Deer Meadow and Buffalo Creek to maximize wildlife viewing and wildlife/wildlands interpretation (See Project No. 11).
- L Develop two new hunter parking areas and upgrade others to Service standards (See Project No. 12)
- L Develop fishing access and facilities at the Tienan's Dam site (See Project No. 15).
- L Develop a 5 mile hiking/ biking trail from the Refuge headquarters (See Project No. 14).

IV. Plan Implementation

The future of Union Slough, like most National Wildlife Refuges, is dependent upon a public constituency that is aware of Refuge and environmental issues and is willing to work towards resolving them. The expanded educational, recreational, and partnership opportunities proposed in this Plan will help build and maintain this needed constituency. Promoting the Refuge as a natural and recreational asset of Kossuth County will enhance the Refuge's image and help expand local support.

1. Partnerships

A key component to implementing this Plan will be the formation of private and public partnerships.

2. Watershed Steering Committee

Another key component to implementing this Plan will be the formation of a Watershed Steering Committee made up of individuals representing a variety of organizations involved in the Refuge watershed. The Refuge Manager will promote the establishment of this committee and be responsible for building strong project awareness and support. This committee will be responsible for guiding conservation activities in the watershed.

3. The Partners For Wildlife Program

The Service's Partners for Wildlife program has funded several wetland restorations within the watershed over the past 10 years. With its increased authority to assist with upland restorations as well as wetlands, there is now considerable overlap with the goals of this Plan. Over the next 15 years, Partners for Wildlife biologists will actively seek and develop ways to work with landowners in the Refuge watershed. They will develop voluntary wildlife habitat projects as they have traditionally done, but they will also assume a more active role in water quality projects such as sediment basins, treatment wetlands, filter strips, grassed waterways, and critical area plantings. Upland and wetland easements within the watershed will also be handled by the Partners for Wildlife biologists.

4. Annual Work Plans

Future annual work plans will be written to reflect the priorities and intent of the Plan. When discretionary funding and staff time is available, it will be used to implement components of the Plan.

5. Step-Down Plans

The Plan provides conceptual guidance for potential future expansion, management, and development of the Refuge. Before implementing the strategies and projects, additional plans (step-down plans) will need to be prepared. These range from site development plans to updating the grassland and water management plans. In the past, the Regional Office has provided limited assistance in preparing brochures, signs, and engineering. The trend is to downsize the staff in the Regional Office making the availability of these services more difficult in the future. Refuge staff will need to look for innovative partnerships with local professionals and businesses to help with preparing detailed plans.

6. Funding

Funding will come through a variety of internal and external sources. Refuge Maintenance funds will be used to renovate some of the facilities identified in the plan. However, these funds are in short supply. The Refuge staff will look for ways of leveraging and matching dollars through new and innovative public and private sources. The full implementation of this Plan will be dependent on new sources of funding as a result of partnerships and grants.

7. Refuge Friends Group

A Refuge friends group will be pursued as a means of connecting the Refuge with interested local citizens.

8. Volunteers

Volunteers will play a critical role in assisting staff with fulfilling the future vision of Union Slough Refuge.

9. Two Additional Staff

Two additional staff are proposed for the Union Slough Refuge to work specifically on implementing the Plan. This will bring the total Refuge staff to eight including one refuge manager, two assistant refuge managers, one administrative technician, two Partner's for Wildlife Program biologists, one refuge biologist, and one maintenance person.

10. Monitoring And Evaluation

Every two years the Plan will be revisited to document progress and reassess direction. Public involvement in evaluating progress and Plan implementation will be encouraged. Increased public visitation and new facilities will be evaluated for compatibility with wildlife resources of the Refuge.



1. Development Projects Map

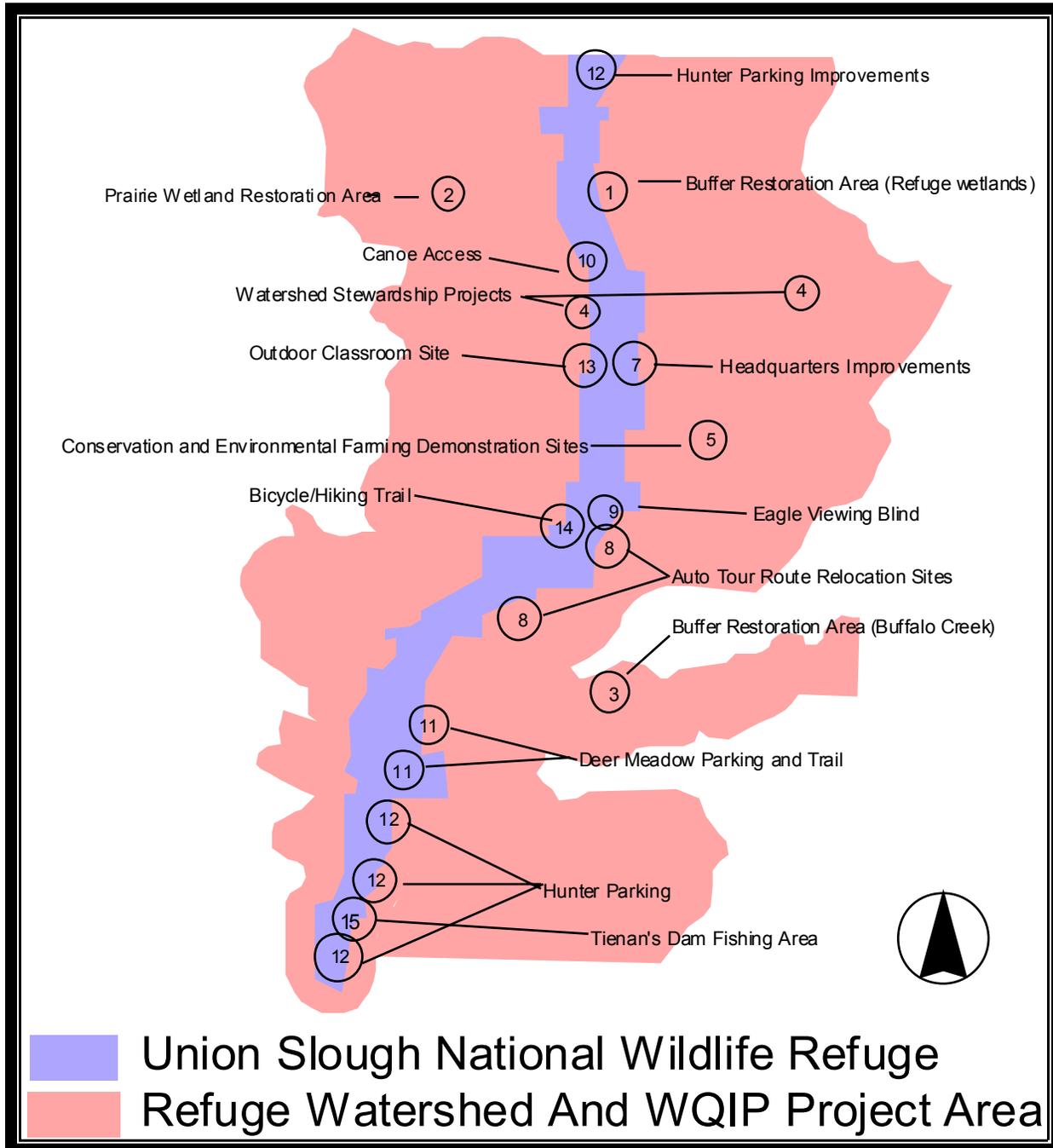


Figure 5 - Map of development projects proposed for the Refuge as a result of the Comprehensive Management Plan.

2. Development Projects Summaries

Project #1 Refuge Wetlands Buffer

Through a combination of voluntary partnerships, easements, and land acquisition, restore and preserve a 1/4 mile buffer between Refuge wetlands and adjacent farmlands (approximately 2,500 acres)(Figure 6). The proposed buffer will substantially reduce erosion and sedimentation, increase the amount (and quality of) nesting habitat for Refuge waterfowl and other migratory birds, and provide the public with additional opportunities for outdoor recreation. Seasonal wetlands would be restored by removing drain tiles or installing ditch plugs. Grasslands would be restored by planting the appropriate mix of native warm season grasses and forbs and controlling woody vegetation and weeds by prescribed burns and other techniques. This project will not adversely affect farm drainage on adjacent private land. Land acquisition by the Service could include 2,000 acres (easements and fee-title) and would be from willing sellers only. Estimated cost to the Service - \$5,600,000 (land acquisition and habitat restorations).

Project #2 Restoration of a Prairie Wetland Complex

Through a combination of voluntary partnerships, easements, and land acquisition, restore and preserve a 4,300 acre complex of wetlands and associated prairie habitats (Figure 6). Located within the Refuge watershed, the restored complex of wetlands and grasslands will reduce runoff and sedimentation into Refuge wetlands and provide important resting, nesting, and feeding habitat for migratory waterfowl, shorebirds, and songbirds. The Service intent is to intensify and concentrate Federal, State, local, and private resources within the Refuge watershed. This will be accomplished through existing incentive programs, easements, and land acquisition. Land acquisition by the Service (easements and fee-title) could include 1,250 acres and would be from willing sellers only. Estimated cost to the Service - \$3,500,000 (land acquisition and habitat restorations).

Project #3 Buffalo Creek Buffer

Through a combination of voluntary partnerships, easements, and land acquisition restore and preserve a 1/4 mile buffer around the lower reaches of Buffalo Creek (approximately 1,500 acres)(Figure 6). The proposed buffer would reduce sedimentation and increase the amount (and quality of) nesting habitat for Refuge waterfowl and other migratory birds. Projects through the Service's Partners for Wildlife Program, such as stream bank stabilizations, cooperative management agreements, and native grass plantings would be emphasized. Land acquisition by the Service (easements preferred) could include 500 acres and would be from willing sellers only. (Estimated cost to the Service - \$1,150,000).

Project #4 Watershed Stewardship Projects

To meet the broad water quality goal and specific objectives for nutrient and sediment control within Refuge wetlands, a long term watershed stewardship initiative will be implemented by the Service and interested partners. Headed by the Refuge Manager and a Watershed Advisory Committee, this initiative will seek to promote widespread use of Best Management Practices, Integrated Crop Management, and other environmentally friendly farming practices within the Refuge watershed. Outreach to farmers in the watershed will be a primary component of this initiative. More specific on-the-ground actions will include stabilizing erosive soils and constructing treatment wetlands to reduce nitrates in tile/ditch water before it enters Refuge wetlands. Treatment wetlands require site conditions with adequate slope to ensure no disruption of farm drainage. Two to three treatment wetlands will be constructed on Refuge property or on private lands with cooperating landowners. (Estimated cost to the Service - \$35,000)

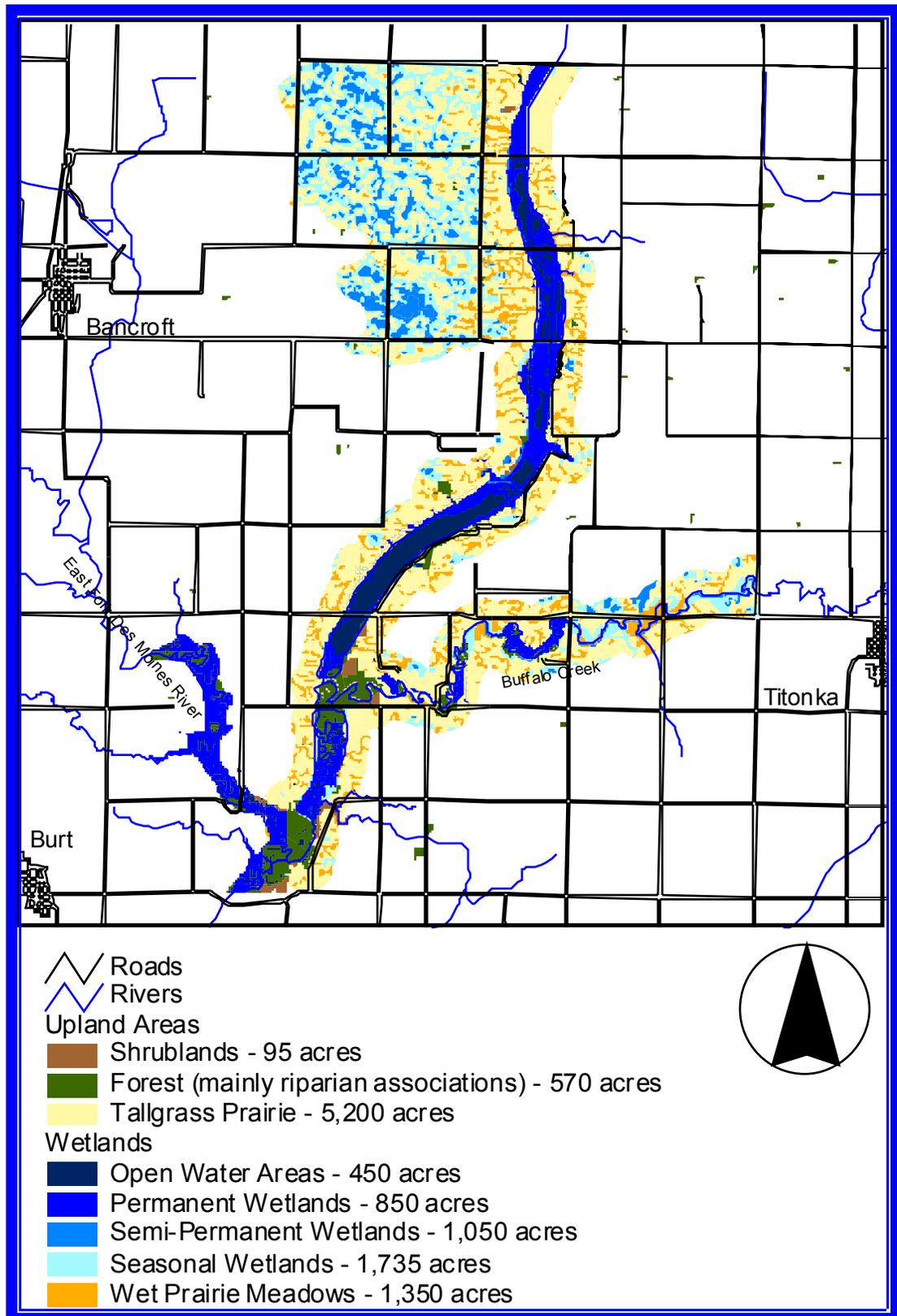


Figure 6 - The Service's desired future habitat condition (conceptual) for the Refuge and surrounding area once the habitat objectives have been met.

Project #5 Conservation and Environmental Farming Demonstration Sites

Selected projects will demonstrate conservation and environmental farming practices along the Refuge auto tour route. Through the use of existing incentive programs, a Service easement, or a private lands extension agreement, the Service will facilitate creation of applicable demonstration sites on lands visible from the Refuge auto tour route (Estimated cost to the Service - \$2,640).

Project #6 Waterfowl Nesting Structures And Predator Exclusion Areas

The Service and interested partners will fabricate and install 200 additional waterfowl nesting structures within a one mile radius of Refuge wetlands, develop two 40 acre predator exclusion areas for nesting waterfowl (electric fence areas), and create two nesting islands within Refuge wetlands to enhance waterfowl production. Actual size and location of fenced areas and nesting islands will be determined through additional studies (Estimated cost to the Service - \$30,000).

Project #7 Refuge Headquarters Improvements

Improvements to the Refuge headquarters will greatly enhance staff and visitor functions at the Refuge. Information will be provided during evening hours and weekends, office space will be more efficient, and an indoor orientation space will be gained for school groups. Improvements include an office addition (624 sf), an observation deck and information kiosk, paving the entrance drive and parking area, installing a gate, and native plant landscaping. (Estimated cost to the Service: \$100,320)

Project #8 Auto Tour Route Relocation

Reduce disturbance to Refuge wildlife by relocating approximately 2 miles of the Refuge auto tour route. Public will benefit by the auto tour route being open for a much longer period. Roadway improvements would accommodate cars and buses and use by bicycles. Old roadway located along Refuge pools will be restored to natural habitat. (Estimated Cost to the Service: \$269,500)

Project #9 Eagle Viewing Blind

In conjunction with the relocation of the auto tour route, construct an eagle viewing blind to allow the public to observe concentrations of Bald eagles at Union Slough. Develop gravel pull-off site to accommodate 5 cars, a trail, and an observation blind at a distance that allows viewing without disturbance to roosting eagles. (Estimated Cost to the Service: \$8,360).

Project #10 Wetland Monitoring and Maintenance Access

A boat ramp will be developed primarily for maintenance and monitoring activities on Refuge wetlands. The area will be constructed one mile north of the Refuge headquarters along pool D near an existing maintenance road. (Estimated Cost to the Service: \$500)

Project #11 Deer Meadow Access and Trail

Renovation of this existing facility will provide handicap accessibility and new opportunities to observe wildlife from an added observation deck. Interpretive information would be provided on the trail as it meanders through a floodplain forest, a hillside prairie, and overlooks the Refuge wetlands. Existing parking areas at Deer Meadow and Deer Watch sites will be renovated with new gravel and post and rail barriers. Trail surface will be constructed of accessible 3/8 minus crushed limestone. The 6 foot wide trail will be approximately 1 ½ mile in length with a loop design. The bridge crossing Buffalo Creek will be replaced to provide linkage to the deer watch site on the north. (Estimated Cost to the Service \$51,700)

Project #12 Hunter Parking Improvements

Upgrade location, capacity and image of seasonal parking areas. New signs will provide the public with information on Refuge opportunities and limitations. Upgrade parking to FWS standards. Add one 10 car and one 5 car parking site at the north end of Buffalo Creek. Upgrade boat launching site at Buffalo Creek by adding signs and gravel. (Estimated Cost to the Service: \$25,300)

Project #13 Outdoor Classroom Development

This project will provide educational benefits to local and regional schools and government agencies by providing an outdoor laboratory to study such things as water quality, wetlands, watersheds, and conservation and environmental farming. Construct a 22' x 32' shelter for gathering, orientation, and group study. Construct a network of trails and floating boardwalk to provide access to wetlands. All facilities will be fully accessible and built to Service standards. (Estimated Cost to the Service: \$128,700)

Project #14 Bicycle and Hiking Trail Addition

Providing bicycle and hiking activities on the Refuge will attract new visitors to the Refuge. Visitors will have an alternative to using a motorized vehicle. Construct a 5-mile bike/hike loop trail that originates and ends at the Refuge headquarters. Trail will utilize the shoulder of auto tour route and county road. New trail on the cross dike and on the west side of Pool C will be made of 6 foot wide 3/8 minus compacted crushed stone. Final alignment will be determined based on ownership patterns, land suitability, aesthetics, and potential for wildlife disturbance. (Estimated Cost to the Service: \$121,000)

Project #15 Tienan's Dam Fishing Access

Because of the problems associated with sedimentation and the need to control exotic fish (namely carp), only one fishing area on the Refuge was selected for improvement. Proposed improvements to this site will increase safety, enhance physical access, and resolve current trespass problems on private land. Conduct fishery evaluation and site investigation. Construct basic visitor access facilities including parking for 5 cars, trail, rip rap, and safety rails at dam and toilet. Access across private land will need to be resolved prior to proceeding with development plans. (Estimated Cost to the Service: \$79,200)

Project #16 Refuge Signs Upgrade

The Refuge's public image, public awareness, and identity will be enhanced through installing new signs and upgrading others. Work with local governments and the Service's Sign Shop to develop a sign plan for Refuge lands and adjacent county roads (Estimated Cost to the Service: \$33,000)

Project #17 Printed Brochures

Public information is extremely important at Union Slough. Printed materials for distribution are needed including a general refuge brochure, handouts for teachers on their use of the Refuge for environmental education, and printed materials promoting conservation and environmental farming practices in the Refuge watershed (Estimated Cost to the Service: \$27,500).

Project #18 Sediment Monitoring System

Construct and install monitoring stations throughout Refuge wetlands to measure current and future rates of sedimentation and to provide a means to measure the success of the watershed stewardship initiative. (Estimated Cost to the Service: \$1,320)

Project #19 Geographic Information System (GIS) Development

The Refuge watershed must be mapped using GIS technology. A GIS will help monitor and evaluate land use/cover trends and will assist landowners in applying conservation and environmental farming practices. With other agency partners, collect, digitize, and analyze data and print and distribute maps which inform and educate people living and working within the Refuge watershed (Estimated Cost to the Service: \$37,500).

GLOSSARY OF TERMS

<i>Biological Diversity -</i>	The variety of life forms and processes, including the complete natural complex of species, communities, genes, and ecological functions.
<i>Biomass -</i>	The weight of all life in a specified unit of environment or an expression of the total mass or weight of a given population, both plant and animal.
<i>Bloom -</i>	A readily visible concentrated growth or aggregation of plankton (plant and animal).
<i>Cumulative Effects -</i>	Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.
<i>Dissolved Oxygen -</i>	Amount of oxygen dissolved in water.
<i>Drainage Basin -</i>	An area mostly bound by ridges or other similar topographic features, encompassing part, most, or all of a watershed.
<i>Ecology -</i>	The study of the relations between organisms and the totality of the biological and physical factors affecting them or influenced by them.
<i>Ecosystem Approach -</i>	A strategy or plan to manage ecosystems to provide for all associated organisms, as opposed to a strategy or plan for managing individual or clusters of species.
<i>Ecosystem -</i>	An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials between the living and nonliving.
<i>Ecosystem Management -</i>	Management of an ecosystem that includes all ecological, social, and economic components which make up the whole of the system.
<i>Effects -</i>	Effects, impacts, and consequences, as used in the environmental assessment, are synonymous. Effects may be direct, indirect, or cumulative.

<i>Endangered Species -</i>	Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register.
<i>Environmental Analysis -</i>	An analysis of alternative actions and their predictable short-term and long-term environmental effects, incorporating physical, biological, economic, and social considerations.
<i>Environmental Assessment -</i>	A systematic analysis of site-specific or programmatic activities used to determine whether such activities have a significant effect on the quality of the physical, biological, and human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary.
<i>Eutrophication -</i>	The intentional or unintentional enrichment of water.
<i>Food Chain -</i>	The dependence of organisms upon others in a series of food. The chain begins with plants or scavenging organisms and ends with the largest carnivores.
<i>Goals -</i>	Broad statements of direction; end results or positions to be achieved.
<i>Interdisciplinary Team -</i>	A group of individuals with varying areas of expertise assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action.
<i>Monitoring -</i>	A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).
<i>National Environmental Policy Act -</i>	An act passed in 1969 to declare a National policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality.

<i>Objectives -</i>	Intermediate-term targets necessary for the satisfaction of Refuge goals; quantifiable measures that serve as indicators against which attainment, or progress toward attainment, of goals can be measured.
<i>Riparian Area -</i>	A geographic area containing an aquatic ecosystem and the adjacent upland areas that directly affects it. This includes floodplain, and associated woodland, rangeland, or other related upland areas. Pertaining to the banks of streams, lakes, wetlands, or tidewater.
<i>Riparian Zones -</i>	Terrestrial areas where the vegetation complex and micro-climate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs, and wet meadows.
<i>Sedimentation -</i>	The settling-out or deposition of suspended materials.
<i>Succession -</i>	A gradual change from one community to another and characterized by a progressive change in species structure, an increase in biomass and organic matter accumulation, and a gradual balance between community production and community respiration.
<i>Sensitive Species -</i>	Those plant or animal species for which population viability is a concern as evidenced by a significant current or potential downward trend in population numbers, distribution, density, or habitat capability.
<i>Strategies -</i>	Step-down approaches that could be used to meet Refuge goals and objectives; provide direction for defining and coordinating operational tasks to effectively perform the Refuge's purpose.
<i>Threatened Species -</i>	Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.
<i>Viable Population -</i>	A viable population is one which has such numbers and distribution of reproductive individuals as to provide a high likelihood that a species will continue to exist and be well-distributed throughout its range.

Watershed -

The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a water body.

Watershed Analysis -

A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis is a stratum of ecosystem management planning applied to watersheds.

Watershed Restoration -

Actions taken to improve the current conditions of a watershed to restore degraded habitat, and to provide long-term protection to natural resources, including riparian, terrestrial, and aquatic resources.

Watershed Treatments -

Specific actions or tools to satisfy the goals and objectives of the watershed initiative project. These may include establishing permanent vegetation on sensitive areas within the watershed (riparian buffers, stream bank stabilization, erosion-prone areas); establishing permanent wildlife habitat for dependent species (warm/cool season grasses, wetlands, sediment retention, erosion, or water control structure basins, field/farmstead windbreaks, shelter rows, and winter food plots); and encouraging Best Management Practices (BMP's) on agricultural lands (strip-cropping systems, terraces, diversions, contour farming, cropland protective cover, conservation tillage, feedlot and manure management).