

Appendix H: Environmental Assessment

FINDING OF NO SIGNIFICANT IMPACT

Mark Twain Complex of Refuge Comprehensive Conservation Plan and Environmental Assessment

For the reasons briefly presented below and based on an evaluation of the information contained in the supporting references enumerated below, I have determined that adoption and implementation of the Comprehensive Conservation Plan (CCP) covering the Mark Twain Complex of national wildlife refuges (Port Louisa, Great Rivers, Clarence Cannon, Two Rivers, and Middle Mississippi River National Wildlife Refuges) is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons:

- Threatened or endangered species occurring or possibly occurring in the affected area will not be negatively impacted and will generally benefit under the CCP implementation
- The CCP provides a clear statement of direction for future management of the Complex.
- The CCP gives refuge neighbors, visitors and the general public an understanding of the Service's management actions on and around Complex refuges.
- The CCP ensures that Complex management actions and programs are consistent with the mandates of the National Wildlife Refuge System.
- The CCP ensures that Complex management is consistent with federal, state and county plans.
- The CCP provides a basis for the development of sound budget requests reflecting Complex refuges' operation, maintenance, and capital improvement needs.
- All issues raised were addressed.

Supporting References:

1. Mark Twain National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment
2. Statement of Compliance Checklist
3. Environmental Action Statement
4. Intra-Service Section 7 Biological Evaluation Form
5. Realty Feasibility Report



Regional Director, FWS, Region 3

Date: JUL 27 2004

Chapter 1: Purpose and Need for the Proposed Action	301
1.1 Purpose and Need for Action	301
1.1.1 Purpose	301
1.1.2 Need for Action	303
1.2 Decision Framework	304
1.3 Background	304
1.3.1 The United States Fish and Wildlife Service	304
1.3.2 The National Wildlife Refuge System	305
1.3.3 Mark Twain National Wildlife Refuge Complex	305
1.3.4 Mark Twain Refuge Complex Vision Statement for Desired Future Condition	306
1.3.5 Area of Ecological Concern	307
1.4 Scoping and Public Involvement	308
1.4.1 Issues and Concern	308
1.5 Legal, Policy and Administrative Guidelines	310
1.5.1 Legal Mandates	310
Chapter 2: Alternatives Including the Preferred Alternative	311
2.1 Rationale for Alternative Designs	311
2.2 Description of Alternatives	312
2.2.1 Alternative A: Expanded Boundaries, Increased River Connectivity (Preferred Alternative)	315
2.2.1.1 Background on Land Preservation Component	315
2.2.1.2 Alternative A, Expanded Boundaries, Increased River Connectivity (Preferred Alternative) Description	318
2.2.2 Alternative B: Current Program	320
2.2.3 Alternative C: Existing Boundaries, Maximum River Connectivity	320
2.2.4 Alternative D: Existing Boundaries, Least River Connectivity:	321
2.2.5 Elements Common To All Alternatives	321
2.2.5.1 Fire	321
2.2.5.1.1 Prescribed Fire	322
2.2.5.1.2 Fire Prevention and Detection	323
2.2.5.1.3 Fire Suppression	324
2.2.5.1.4 Listed Species and Other Species of Interest	326
2.2.6 Elements Common to All Alternatives	327
2.2.6.1 Cultural Resources	327
2.2.6.2 Environmental Justice	327
2.2.6.3 Climate Change Impacts	327
Chapter 3: Affected Environment	347
3.1 Description of Existing Units Within Mark Twain NWR Complex	347
3.1.1 Port Louisa NWR	347
3.1.2 Great River NWR and Clarence Cannon NWR	347
3.1.3 Two Rivers NWR	347
3.1.4 Middle Mississippi River NWR	347
3.2 Habitat Overview	348

3.2.1	Forested Resources	348
3.2.2	Wetland Resources	349
3.2.3	Grassland Resources	349
3.2.4	Invasive Species	349
3.2.5	Sedimentation and Water Quality	350
3.2.6	Geomorphology and Soils	351
3.2.6.1	Geomorphology	351
3.2.6.2	Soils	352
3.3	Wildlife	353
3.3.1	Migratory Bird Species	353
3.3.2	Fish Species	353
3.3.3	Freshwater Mussels	354
3.3.4	Mammals, Upland Game Birds	354
3.3.5	Amphibians and Reptiles	354
3.3.6	Federally Listed Threatened and Endangered Species	354
3.3.6.1	Mammals	355
3.3.6.2	Birds	355
3.3.6.3	Fish	356
3.3.6.4	Mussels	356
3.3.6.5	Reptiles	357
3.3.6.6	Plants	357
3.3.6.7	Invertebrates	357
3.4	Public Use	357
3.5	Socioeconomics	358
3.6	Cultural Resources	360
Chapter 4:	Environmental Consequences	362
4.1	Effects Common to All Alternatives	362
4.1.1	Environmental Justice	362
4.1.2	Cultural and Archaeological Resources	362
4.1.3	Climate Change Impacts	362
4.1.4	Prescribed Fire as a Management Tool	363
4.1.4.1	Social Implications	363
4.1.4.2	Cultural and Archaeological Resources	364
4.1.4.3	Flora	364
4.1.4.4	Listed Species	365
4.1.4.5	Soils	365
4.1.4.6	Escaped Fire	366
4.1.4.7	Trapping	366
4.2	Alternative A: (Expanded Boundaries, Increased River Connectivity)	366
4.2.1	Listed and Other Species of Interest	367
4.2.2	Habitat Management	367
4.2.3	Sedimentation and Water Quality	368
4.2.4	Floodplain Management	368
4.2.5	Public Use and Education	368
4.2.6	Monitoring	369

4.2.7	Coordination and Socioeconomic Impacts	369
4.3	Alternative B: Current Program	370
4.3.1	Listed and Other Species of Interest	370
4.3.2	Habitat Management	370
4.3.3	Sedimentation and Water Quality	371
4.3.4	Floodplain Management	371
4.3.5	Public Use and Education	371
4.3.6	Monitoring	371
4.3.7	Coordination and Socioeconomic Issues	371
4.4	Alternative C: Existing Boundaries, Maximum River Connectivity	372
4.4.1	Listed and Other Species of Interest	372
4.4.2	Habitat Management	372
4.4.3	Sedimentation and Water Quality	373
4.4.4	Floodplain Management	373
4.4.5	Public Use and Education	373
4.4.6	Monitoring	373
4.4.7	Coordination and Socioeconomic Issues	374
4.5	Alternative D: Existing Boundaries, Least River Connectivity	374
4.5.1	Listed and Other Species of Interest	374
4.5.2	Habitat Management	374
4.5.3	Sedimentation and Water Quality	375
4.5.4	Floodplain Management	375
4.5.5	Public Use and Education	376
4.5.6	Monitoring	376
4.5.7	Coordination and Socioeconomic Issues	376
4.6	Cumulative Impacts	376
	Chapter 5: List of Preparers	383
	Chapter 6: List of Agencies, Organizations, and Persons Contacted	384
	Chapter 7: Appendices	388
7.1	Appendix 1, References	388
7.2	Appendix 2, Acronyms and Abbreviations Used in the EA	390

**U.S. Fish and Wildlife Service
Department of the Interior**

**Environmental Assessment
for
Implementation of the Comprehensive Conservation Plan
for Management Direction
Mark Twain National Wildlife Refuge Complex**

Abstract

The U.S. Fish and Wildlife Service is proposing to implement a Comprehensive Conservation Plan (CCP) for the Mark Twain National Wildlife Refuge Complex, consisting of various Refuges in Iowa, Missouri, and Illinois. This Environmental Assessment (EA) considers the biological, environmental, and socioeconomic effects that implementing the CCP (the preferred alternative is the proposed action) and three other alternatives would have on the most notable issues and concerns identified during the planning process. The purpose of the proposed action is to establish the management direction for the Refuges for the next 15 years. This management action will be achieved by implementing a detailed set of goals, objectives, and strategies described in a CCP.

Responsible Agency and Official:
Robyn Thorson, Regional Director
U.S. Fish & Wildlife Service
Bishop Henry Whipple Federal Building
1 Federal Drive
Ft. Snelling, MN 55111

Contacts for additional information about this project:

Richard Steinbach, Complex Manager
Mark Twain National Wildlife Refuge Complex
1704 North 24th Street
Quincy, IL 62301
217/224-8580

Thomas Larson, Chief of Conservation Planning
U.S. Fish & Wildlife Service
NWRS/AP
Bishop Henry Whipple Federal Building
1 Federal Drive
Ft. Snelling, MN 55111
612/713-5430

Chapter 1: Purpose and Need for the Proposed Action

1.1 Purpose and Need for Action

1.1.1 Purpose

The U.S. Fish and Wildlife Service is proposing to prepare and implement a Comprehensive Conservation Plan (CCP) for the Mark Twain National Wildlife Refuge Complex (Complex); the Complex, headquartered in Quincy, Illinois, includes five refuges with several divisions in Iowa, Missouri, and Illinois (Figure 1).

The purpose of the proposed action is to establish the management direction of the Complex for the next 15 years. The action is needed because adequate, long-term management direction does not exist for the refuge. Management is now guided by several general policies and short-term plans. Future management direction will be defined in a detailed set of goals, objectives, and strategies described in the CCP.

An additional purpose for preparing this Environmental Assessment is to analyze and adopt a separate step-down Fire Management Plan for the Complex.

Refuge Purpose Statements are primary to the management of each refuge within the System. The Purpose Statement is derived from the legislative authority used to acquire specific refuge lands and is, along with Refuge System goals, the basis on which primary management activities are determined. Additionally, these statements are the foundation from which “compatibility” uses of refuges are determined through a defined “compatibility process.” Purpose Statements for Mark Twain Refuge Complex:

A... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds...@, 16 U.S.C. ' 715d (Migratory Bird Conservation Act)

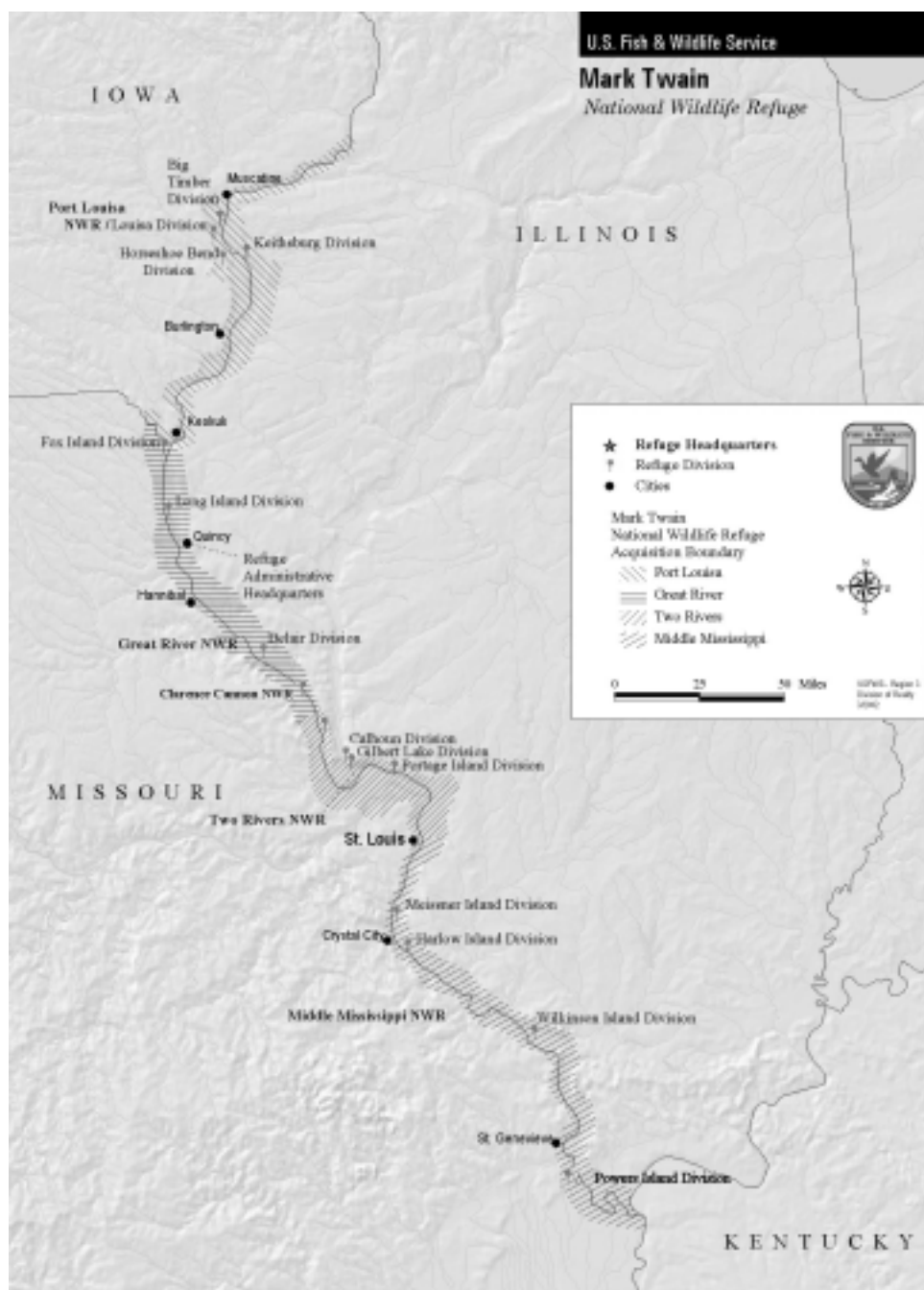
A... shall be administered by [Secretary of the Interior] directly or in accordance with cooperative agreements.... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon,...@, 16 U.S.C. ' 664 (Fish and Wildlife Coordination Act)

A... 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...@, 16 U.S.C. ' 460k-1 (Refuge Recreation Act)

A.... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions...@, 16 U.S.C ' 3901(b) 100 Stat. 3583 (Emergency Wetlands Resources Act of 1986)

A...for conservation purposes@, (1985 Food Security Act in conjunction with the transfer of Farm Service Agency, formerly Farmers Home Administration, property)

Figure 1: Map of the Mark Twain NWR Complex



The action is also needed to assess existing management issues, opportunities and alternatives, and then determine the best course for managing the natural resources in each refuge of the Complex. Further, this action will satisfy the legislative mandate of the National Wildlife Refuge System Improvement Act of 1997 which requires the preparation of a CCP for all National Wildlife Refuges.

This Environmental Assessment (EA) was prepared using guidelines of the National Environmental Policy Act of 1969. The Act requires us to examine the effects of proposed actions on the natural and human environment. This EA describes four alternatives for future Complex management, the environmental consequences of each alternative, and our preferred management direction. Each alternative has a reasonable mix of fish and wildlife habitat prescriptions and wildlife-dependent recreational opportunities. Selection of the identified preferred alternative was based on its environmental consequences and ability to achieve the Complex's purpose.

1.1.2 Need for Action

A Comprehensive Conservation Plan is needed to address current management issues and propose a plan of action that the Service and its partners can use to achieve the vision for the Refuge Complex. The CCP ultimately derived from this EA will set the management direction for the Complex for the next 15 years. This EA will present four management alternatives for the future of the Complex. The preferred alternative will be selected based on its ability to meet identified goals. These goals may also be considered as the primary need for action. They reflect Service trust responsibilities and priorities based upon species needs, environmental conditions and Service policy. Goals for the Complex were developed by the planning team and encompass all aspects of Complex management including public use, habitat management and maintenance operations. Each of the four management alternatives described in this EA will be able to at least minimally achieve these goals.

The goals for the Mark Twain Complex of refuges include:

1. *Wetlands and Aquatic Habitat:* Restore, enhance, and manage complex wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.
2. *Forest Habitat:* Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.
3. *Other Terrestrial Habitats:* Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl and neotropical migrants.
4. *Sedimentation and Water Quality:* Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.
5. *Floodplain Management:* Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.
6. *Public Use and Education:* Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving complex programs and facilities, and partnering with others to increase awareness of the Mark Twain National Wildlife Refuge (NWR) Complex, the Mississippi River, and the National Wildlife Refuge System.
7. *Monitoring:* Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Complex management programs and to provide information for adaptive management strategies.

1.2 Decision Framework

This Environmental Assessment is an important step in the Service's formal decision-making process. In compliance with the National Environmental Policy Act, the Regional Director of the Great Lakes/Big Rivers Region will consider the information presented in this document to select a preferred management alternative.

The Regional Director will determine whether the preferred alternative is a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. If it is determined not to be a major Federal action, a Finding of No Significant Impact, (FONSI) will be issued. A FONSI means that the preferred alternative is selected and can be implemented in accordance with other laws and regulations. A Decision of Significant Impact would indicate the need to conduct more detailed environmental analysis in an Environmental Impact Statement.

1.3 Background

1.3.1 The United States Fish and Wildlife Service

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

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

Service goals are:

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

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

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

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

1.3.2 The National Wildlife Refuge System

The National Wildlife Refuge System (System) is an integral component of the Service with the mission of “administering 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.”

The Service manages more than 500 national wildlife refuges covering more than 93 million acres that are specifically managed for fish and wildlife and their habitats. The majority of these lands, almost 83 percent of the land in the Refuge System is found in the 16 refuges in Alaska, with the remaining acres spread across the remaining 49 states and several territories. More than 88 per cent of the acreage in the System was withdrawn from the Public Domain. The remainder has been acquired through purchase, from other Federal agencies, as gifts, or through easement/lease agreements.

Goals of the National Wildlife Refuge System are to:

Fulfill our statutory duty to achieve refuge purposes 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, interjurisdictional 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 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, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

1.3.3 Mark Twain National Wildlife Refuge Complex

The Mark Twain National Wildlife Refuge was established in 1958 under the Fish and Wildlife Coordination Act (16 U.S.C. Subsection 664), which states that the refuge A...shall be administered by him [Secretary of Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon...@ In addition, Migratory Bird Conservation Act legislation (16 U.S.C. Subsection 714d,) confirms the refuge “for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. [16 U.S.C. ' 715d]” Finally, the Refuge Recreation Act (16 U.S.C. Subsection 460k-l) states the refuge-s purpose as “...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...”

In the 1930s, the U.S. Army Corps of Engineers (Corps) purchased thousands of acres of river floodplain in preparation for the Mississippi River nine foot navigation channel project. In 1945, management rights on much of these lands were transferred, under the “Flood Control Act” (Pub. 534, 78th Congress, approved 2/22/44) to the Service,

subsequently becoming the Mark Twain National Wildlife Refuge. Today the Service owns approximately 17,000 acres purchased in fee title (excluding the Iowa River Corridor) and manages approximately 17,000 acres in General Plan lands owned in fee title by the Corps.

In June 2000, Mark Twain Refuge was divided into five separate National Wildlife Refuges – Port Louisa NWR, Middle Mississippi River, NWR, Two River NWR, Great River NWR and Clarence Cannon NWR. This change came about during the Refuge Comprehensive Conservation Plan process. The Refuge Complex is scattered along 342 miles of the Mississippi River floodplain and short distances up the Illinois and Iowa Rivers. The Refuge Complex administration office, located in Quincy, Illinois, has retained the Mark Twain name.

The Complex provides important resting and feeding areas for thousands of migrating ducks, geese, shorebirds, and songbirds using the Mississippi Flyway. Hundreds of wintering Bald Eagles gather on and near the Complex to feed on fish and other prey in open water areas. The Complex is also home to many resident wildlife species including turkeys, owls, woodpeckers, deer, raccoon, opossum, beaver, fish, frogs, turtles, and snakes.

1.3.4 Mark Twain Refuge Complex Vision Statement for Desired Future Condition

Each spring and fall for thousands of years, the Mississippi River (River) corridor has served as an important migration route for millions of ducks, geese, shorebirds, waterbirds, songbirds, hawks, eagles and gulls. This network of wetlands, forests, and wet prairies has also provided habitat for a variety of fish and resident wildlife species. The Upper Mississippi River (UMR) and its floodplain have been greatly altered for agriculture, urbanization, navigation and flood control. The quantity and quality of wildlife habitat on the river has declined. The future is one of expanding partnerships to achieve long-term sustainability of the natural resource and economic values of the river.

The River will provide a mosaic of open water, wetland, forest, and grassland habitats to sustain healthy populations of native wildlife. Cooperative working relationships between federal and state agencies, local communities, industry, and the public are crucial to achieving a balance between commercial navigation, recreation, and riverine habitat for wildlife and ultimately, human health. Research and monitoring data must be current, readily available, and applicable to land management decision-making needs. In the future, the Complex management programs on UMR will be a national model for partnerships and science-based wildlife management.

Managed lands, such as those within the Complex, have become critical toward the goal of sustainability on the UMR. A balanced program of habitat protection, enhancement, and restoration will consider overall riverine habitat needs and the best use of land on the pool, reach, and watershed levels. In the future, the Complex will provide high-quality habitat along the UMR for migratory birds and resident wildlife. Waterfowl sanctuary areas in the fall will be of adequate quality, size, and spacing to meet the needs of migratory bird populations. Management programs will be effectively monitored for success and adapted and modified as new scientific information becomes available.

Refuge management activities are conducted with public funds and thereby enhanced public benefits are produced. While wildlife management remains the paramount responsibility of the Service, compatible public use and enjoyment of those resources are an important product of the overall management program. The Complex will provide an

array of environmental and wildlife education programs as well as other related activities for the public. Wildlife abundance and quality facilities will attract thousands of visitors annually for compatible wildlife-dependent recreational opportunities. The partnership with the Corps= Riverlands Project area, located near St. Louis, Missouri, will be a model program of off-refuge wildlife and habitat education and interpretation within an metropolitan area. Our vision for the future includes local communities recognizing and appreciating the value of water quality, habitat and wildlife components of the river corridor along with its utilitarian functions. The Service will be viewed as an effective partner in enhancing and protecting these historic values.

1.3.5 Area of Ecological Concern

If the planning approach on the Mississippi River is viewed as a watershed issue, the resulting “planning area” would include a good portion of the continent. While it is helpful to consider all the cause/effect actions within the watershed, such as farming practices and runoff impacting development, this macro scale view is clearly beyond the management capability of the Complex staff. A more manageable approach to defining an Area of Ecological Concern for planning purposes was to outline the 500-year floodplain between the Quad Cities and the confluence of the Ohio River. This area was further modified as appropriate to accommodate the practical limits of Service habitat concerns. For instance, highly developed areas are not considered to be likely locations for riverine habitat restoration. However, all land types and uses are being monitored within the 500-year floodplain as a measure of river status and trends compared to the natural resources available at various times in the past, and at present. The Habitat Needs Assessment (HNA), which was required by the 1999 Water Resources Development Act, and the Long Term Resource Monitoring (LTRM) program are COE-funded efforts to monitor river conditions. Each of these efforts focus on the river within the context of the historic 500-year floodplain.

The Complex contains some of the better wildlife habitat along the lower half of the Upper Mississippi River System (UMRS). While the entire river corridor is important, particularly to the health and recruitment of aquatic species, habitat values vary greatly from one river reach to the next. Reaches where the diversity, quantity and quality of habitat are the highest are considered core areas. The entire UMRS riverine habitat base has been in decline due to inherent hydrological and sedimentation problems. As an integral part of the system, the Complex needed an integrated approach to assess its relationship to the broader river values and to identify the best opportunities for reversing habitat declines both within and beyond Complex boundaries. The Service proposes to assure long-term availability of habitat diversity in the AEC through the implementation of a set of goals, objectives and strategies for each refuge and division of the Complex. These goals, objectives and strategies are expected to benefit fish, migratory birds and other wildlife using the floodplain. Both consumptive and non-consumptive public use opportunities will also be enhanced. The management action proposed in this EA is expected to enhance the environmental quality of the AEC in the following ways:

- Implement management activities to benefit migratory birds and provide some inviolate sanctuary within the Complex;
- Conserve, maintain and manage wildlife resources and habitat;
- Reduce the degradation/decline of wetlands, forests, grasslands and other habitats due to flood events, human development, sedimentation and exotic species;
- Provide compatible fish and wildlife-dependent recreation opportunities;

- Reduce conflicts between recreational uses and biological resource quality; Increase public awareness, appreciation and understanding of the complex's contribution to the Area of Ecological Concern;
- Expand the habitat base through acquisition of highly restorable lands within the Area of Ecological Concern and,
- Provide an organizational framework to administer interagency cooperative agreements regarding Complex lands.

1.4 Scoping and Public Involvement

The Complex hosted six open house sessions August 25-27, November 17-18, and December 15, 1998, to inform the public of our planning process. These open houses were held at Wapello, Iowa, Keithsburg, Illinois, Alexandria and Annada, Missouri, and Ursa and Brussels, Illinois, respectively. Complex staff answered questions from visitors and provided maps, information on the National Wildlife Refuge System, and brochures. Constituents attending each open house were asked to express their concerns regarding refuge operations; issues were recorded and are on file at Complex headquarters. News releases were issued to local media prior to each open house. News and/or television media covered four of the open houses. In addition, meetings with the Corps of Engineers, the Iowa Department of Natural Resources, the Illinois Department of Natural Resources and the Missouri Department of Conservation officials assisted the staff in identifying most of the natural resource related issues.

The National Audubon Society (NAS) and Upper Mississippi River Conservation Commission (UMRCC) hosted twelve Habitat Needs Assessment public meetings in April and May 1999 to gather public input on current and future priorities for the river system. Mark Twain Complex staff participated in six (those held in the Area of Ecological Concern) of the meetings as an integrated part of our CCP public involvement. Staff consulted with the public, non-governmental organizations and personnel from other Federal and State agencies. Issues discussed below were compiled from written statements made by individuals attending the meetings.

Mailing lists were compiled of interested individuals, non-governmental organizations, State and Federal agencies, and elected officials, and from attendance sheets for each open house and public meeting. Comprehensive Conservation Plan updates were mailed in May 1999 and February 2000, to these parties. The updates informed our constituents of progress in our planning process, and requested any additional input they had to offer. The planning mailing list includes more than 500 contacts, including the media.

A diverse range of issues emerged during the scoping process with input from the general public, governmental agencies, and non-governmental organizations. The issues were consolidated into the categories listed below. Each category is included in the environmental effects matrix in Table 3 at the end of Chapter 4. Management goals, objectives and strategies of the Complex are also based on these categories.

1.4.1 Issues and Concern

Listed Species and Other Species of Interest – Issues in this category relate to protection and perpetuation of Federally listed threatened and endangered species as well as other Service trust species such as migratory birds and interjurisdictional fish. These issues will be addressed primarily through habitat and public use management activities.

Habitat Management – The Complex includes habitats of concern to managers such as wetlands and aquatic vegetation, floodplain forest and other terrestrial habitats (grasslands); managers must determine how management of these habitats could affect wildlife populations. Issues identified in this area focused on:

Wetland and Aquatic Habitat

- restoration of backwaters, side channels, and associated wetlands
- assure availability of habitat for waterfowl while providing for overall healthy wildlife populations, achieving habitat and species abundance
- enhance fishery resources

Forest Habitat

- forest management and restoration;
- assure availability of habitat for waterfowl and non-game migratory birds, providing for healthy wildlife populations, achieving habitat and species abundance

Other Terrestrial Habitats

- management of agricultural lands
- native grassland restoration

These issues relate to achieving a balance of varied habitats and land use to meet diverse species needs.

Sedimentation and Water Quality – Issues include:

- reduce siltation and sedimentation
- improve water quality; reduce contaminants

These issues relate to identification and reduction of the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.

Floodplain Management – This category would cover system-wide interagency issues concerning floodplain connectivity and habitat and water level management.

These issues relate to interagency partnerships and enhancement of floodplain functions, enhancement of habitat, and mimicking historical water level fluctuations throughout the river corridor.

Public use and Education – This category will address the following issues:

- recreational opportunities
- wildlife disturbance from recreational users
- hunting, fishing, and trapping opportunities
- balances between competing uses and users of the river.

These issues relate to allowing and providing wildlife-dependent recreation opportunities where appropriate, and improving the quality and safety of the recreational experience.

Monitoring – Issues in this category relate to the need to develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor; to evaluate the effectiveness of Complex management programs, and to provide information for adaptive management strategies.

Coordination and Socioeconomic Issues – Some issues are common to all alternatives and include:

- land acquisition
- effects of land acquisition on the socio-economics of the area where land may be acquired
- interagency coordination
- the Corps= Environmental Management Program
- protection of cultural resources which the Service has legal mandates to protect and preserve.
- Complex operations and maintenance

These issues relate to changing Federal budgets and other factors that necessitate prioritizing projects that compete for funding and staffing.

1.5 Legal, Policy and Administrative Guidelines

1.5.1 Legal Mandates

Administration of refuges is ultimately guided by bills passed by the United States Congress and signed into law by the President of the United States. These statutes are considered to be the law of the land; so, too, are Executive Orders issued by the President. A list of pertinent statutes establishing legal parameters and policy direction to the National Wildlife Refuge System can be found in Appendix I of the draft CCP, “Guiding Laws and Orders.”

Chapter 2: Alternatives Including the Preferred Alternative

This chapter describes four alternatives considered by the Mark Twain NWR Complex, including Alternative A, the proposed action.

2.1 Rationale for Alternative Designs

The United States Congress has assigned the management of the Mississippi River and its flood plain to the Corps. When Congress authorized river improvements to aid navigation, the Corps built a series of locks and dams, wing dams, and closing structures to constrict the channel and control its depth. The Corps was also given flood control responsibilities which led to the construction of levees to protect agricultural and municipal lands. These changes to the natural flow of the river have created a reliable 9-foot-deep navigation channel and have provided a level of protection from flooding. However, the navigation and flood control systems have altered the natural river hydrology and increased backwater sedimentation, resulting in long term deterioration of fish and wildlife habitat.

The narrowing of the floodplain, through developments for flood protection of agricultural and municipal lands, is a key element contributing to increasing flood frequencies and magnitudes. The record-setting 1993 Midwest flood accelerated the move toward a more balanced floodplain management approach. Some areas were so damaged by the 93 flood that there was uncertainty as to whether these lands could, or should, be restored to pre-flood conditions. National attention was focused on the need for an integrated approach to floodplain management; an approach that balances flood protection and economic development with the need to reduce flood damage, enhance fish and wildlife habitat, and reconnect the river to its floodplain. One proposal, for example, was a series of levees set back from the river's edge, still providing flood protection while opening more of the floodplain to the river's fluctuations. Although impractical on a system-wide scale, setback levees may be feasible in some parts of the AEC in the near term. Floodplain wildlife refuges like the Mark Twain Complex can have an effect similar to setback levees when their lands are allowed to remain open to flood pulses.

The lands that once constituted the floodplain are now in various ownerships including federal, state and private, with each owner having their own management objectives, which are often in conflict. Reconnecting the river with its former or natural floodplain in some places is desirable and refuge lands can contribute to that goal.

However, fish and wildlife habitat that is not protected from the river shows continued deterioration due to sediment influx and the artificial water level fluctuations required to maintain the 9-foot channel. While impoundment for navigation created a variety of backwater and side channel habitats, the dams and training structures also slowed off-channel river currents, increasing the retention of sediment. And, historically, floods occurred in the spring and fall, wetlands dried out in summer, and changes in water level were fairly gradual. Floodplain flora and fauna were adapted to this cycle. Now, however, many areas are permanently flooded and water fluctuations are more rapid and irregular,

resulting in loss of aquatic vegetation necessary for high quality fish and wildlife habitat. Areas protected behind berms or levees can be managed to re-create the historical water level regime.

The challenge for natural resource managers is to find ways to address the sometimes conflicting goals of enhanced floodplain function and high quality fish and wildlife habitat, while at the same time not negatively affecting the navigation channel or municipal/ agricultural flood control needs.

2.2 Description of Alternatives

The alternatives are compared and summarized by goal in Table 1 below. A more detailed comparison of alternatives by specific objectives and general strategies may be found in Table 2 at the end of this chapter.

Table 1: Comparison of Alternatives by Refuge Complex Goals

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
1. Wetlands and Aquatic Habitat: Restore, enhance, and manage complex wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.	Manage 5,200 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 300 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 3,000 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; increased river connectivity over no action alternative	Manage 3,500 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 300 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 2,900 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control	Manage 2,100 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 900 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 4,000 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; maximum river connectivity	Manage 8,100 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 100 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 1,800 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; less river connectivity than other alternatives

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
2. Forest Habitat: Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.	Maintain existing floodplain forest plus restore an additional 800 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 2,500 acres of floodplain forest by 2015	Maintain existing floodplain forest; natural succession as the main tool to conserve & enhance woody species age & diversity on 1,000 acres of floodplain forest by 2015	Maintain existing floodplain forest plus restore an additional 3,000 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 1,000 acres of floodplain forest by 2015	Maintain existing floodplain forest plus restore an additional 800 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 3,500 acres of floodplain forest by 2015
3. Other Terrestrial Habitats: Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl and neotropical migrants.	Provide 3 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 500 acres of smaller patches of grassland habitat; provide 400 acres of smaller wet meadow areas; provide 450 acres of scrub-shrub habitat; plant 1,000 acres annually of seed & browse crops; plant 400 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 2 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain existing 350 acres of smaller patches of grassland habitat; provide 200 acres of smaller wet meadow areas; provide 450 acres of scrub-shrub habitat; plant 2,500 acres annually of seed & browse crops; plant 400 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 1 area greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 150 acres of smaller patches of grassland habitat; provide 150 acres of smaller wet meadow areas; provide 300 acres of scrub-shrub habitat; plant 500 acres annually of seed & browse crops; plant 200 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 3 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 500 acres of smaller patches of grassland habitat; provide 560 acres of smaller wet meadow areas; provide 600 acres of scrub-shrub habitat; plant 1,000 acres annually of seed & browse crops; plant 700 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type
4. Sedimentation and Water Quality: Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.	Continue current and develop new partnerships; reduce sedimentation and improve overall water quality on refuge lands by 2010	Continue current partnerships; reduce sedimentation and improve overall water quality on refuge lands by 2010	Same as Alternative A	Same as Alternative A

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
5. Floodplain Management: Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.	Conduct activities & promote partnerships and inter-agency coordination which encourages a balanced floodplain mgmt. program throughout the AEC; manage refuge lands for wildlife first, while considering UMR floodplain functions & contributing to improving those values	Same as Alternative A	Same as Alternative A	Same as Alternative A
6. Public Use and Education: Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving complex programs and facilities, and partnering with others to increase awareness of the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.	Enhance visitor experiences involving wildlife observation & photography through addition of new facilities over current levels; enhance education & interpretive programs through expanded facilities & programs over current levels; improve fishing opportunity by improving access at 5 Divisions by 2010; improve quality and safety of hunting programs & increase opportunity	Provide opportunities for wildlife observation & photography at current levels; improve quality of existing education & interpretive programs. by improving existing facilities and programs; maintain existing fishing opportunities; maintain hunting programs	Same as Alternative A	Same as Alternative A

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
7. Monitoring: Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Complex management programs and to provide information for adaptive management strategies.	Actively monitor habitat communities, wildlife use, public use and environmental education programs; work with partners to monitor systematic fish, wildlife, & habitat resources of the UMR floodplain & to gather data; develop & implement a record keeping & data analysis system, compatible with HNA	Monitor habitat communities, wildlife use, public use and environmental education programs as time & resources allow; work with partners to monitor systematic fish, wildlife, & habitat resources of the UMR floodplain & to gather data; as time & resources allow, develop & implement a record keeping & data analysis system, compatible with HNA	Same as Alternative A	Same as Alternative A

2.2.1 Alternative A: Expanded Boundaries, Increased River Connectivity (Preferred Alternative)

Restore Riverine Habitat for Migratory Birds and Indigenous Fish and Increase Floodplain Functions Such As Connectivity and Flood Water Storage Via Expanded Boundary and Adaptive Management Techniques (Preferred Alternative)

Broaden Refuge Complex opportunities both to expand river/floodplain connectivity and to manage for habitat diversity for fish and wildlife resources on the Upper Mississippi River System through land acquisition (up to 27,659 acres above current authorized boundaries) and use of adaptive management techniques within the 500-year floodplain of the Area of Ecological Concern.

2.2.1.1 Background on Land Preservation Component

Alternative A includes an expanded land preservation component that could include expansion of the Refuge boundaries. The total expansion acreage is 27,659 acres. While nearly 28,000 acres represents a notable effort, the total area identified is modest when it is considered within the context of a more than 1.3-million-acre Area of Ecological Concern, or planning area.

An initial concept of identifying up to 60,000 acres spread over 487 miles of the River to the Complex's potential acquisition boundary originated in the early 1990s, when the Service initiated efforts to examine a larger section of the Upper Mississippi River corridor. This evaluation included the AMiddle Mississippi River® (local name for the lower 200 miles of the UMR) which had not been included in earlier efforts.

In response to the Great Flood of 1993, the Service prepared a Big Rivers Ascertainment Initiative that proposed strategies for evaluating lands to be acquired for the protection and restoration of sustainable representative habitats along the Illinois, Missouri and Mississippi rivers. There was also a smaller, more focused PPP prepared for four areas in the Middle Mississippi River in response to the flood. Congress funded the Complex for this land acquisition as part of a broader federal strategy to assist flood prone farm landowners and to restore some floodplain function. This effort was initially referred to as the Tanahkwe District of the refuge, but the unit was not staffed as a separate station at the time. No lands were purchased at Powers Island. In spite of a great deal of initial interest there, was eventually a very low percentage of landowners applied to enroll in the Wetland Reserve Program. Lands were purchased at Wilkinson Island, Harlow Island and Meissner Island. The Shawnee National Forest also acted to address the flood issue by purchasing some of the Wetland Reserve Program (WRP) easements on floodplain lands and has evaluated a proposal to extend their boundary westward to the river's edge between Grand Tower and Thebes. This effort has been called the Inahgeh addition to the forest. The American Land Conservancy has worked in partnership with the Shawnee National Forest since the start of the post flood project. The presence of this government/non-government joint endeavor on the Illinois side of this section of the Middle Mississippi River is the reason the CCP Area of Ecological Concern (AEC) was adjusted to exclude this section of the 500-year floodplain. However the Forest Service has not expressed an interest in the islands and side channel elements in this reach, so these parts of the river corridor have been included in the CCP expanded boundary proposal, as they represent important opportunity to contribute to refuge goals and will complement rather than overlap or compete with Shawnee National Forest efforts.

In 1997, final approval was obtained from the Washington Office to study the potential addition of 60,000 acres to the Mark Twain NWR Complex. Since the CCP planning effort was scheduled to begin soon, it was decided that the detailed evaluation of the expansion would be incorporated into the plan. Specific parcels were identified by evaluating those locations that best contribute to accomplishing the goals and objectives outlined in this plan. The land acquisition and subsequent implementation of habitat restoration efforts represent essential strategies to achieving plan goals and objectives on a systemic scale within the 1.3 million-acre AEC.

Considerations for selecting specific parcels and their priority in this expansion include:

- refuge purposes;
- the goals and objectives of this CCP;
- interagency input, such as the jointly prepared Middle Mississippi River Habitat Rehabilitation Initiative, and other habitat focus areas, such as the Pool Level Management effort in Pool 25;
- the sites-potential to restore riverine wetland and forest values;
- Levee District flood histories;
- the Habitat Needs Assessment (HNA) developed by the Corps, Service, USGS and five UMR states; and
- the opportunity to remove agriculture from the most flood prone and erodible areas.

Parcels contained in the expanded project will not only contribute to the goals of the CCP, but these lands will also assist with public policy matters addressed by other federal, state, and local agencies. Nutrient cycling on additional floodplain lands will contribute to the reduction of nitrogen flowing down the river and a subsequent reduction in Gulf

Hypoxia. By opening the width of the floodplain and increasing flood water storage, the potential damage to urban areas and other developed and protected lands is reduced. Also, some flood prone farm lands have been more expensive to the government through disaster relief payments in recent years than the fee value of the land to purchase. The increase of recreational opportunity is another positive in addition to the primary goal of restored habitat values. The identified lands all contribute to the habitat needs within the River corridor. They also complement broader federal government goals and responsibilities for fiscal management and good government practices beyond the Interior Department objectives.

Much of the land within the proposed boundary is located in the Middle Mississippi River reach of the UMR. Very little public ownership exists there and floods have been particularly hard on floodplain farmers in that portion of the river. Most of the lands there will be managed for forest and aquatic habitats. The forests will provide a contiguous corridor for nesting and migrating birds and aquatic habitats will be managed for the benefit of big river fish. Expansions of the flood zone will contribute to the floodplain management and water quality goals. An exact prediction of the habitat types that will result in any area can not be made until the areas have been acquired and various detailed options can be explored on-site. However, it is estimated that locations of the expansion above St. Louis will result in habitat types that are proportioned close to the distribution which now occurs in those refuges. Generally being; forest types 50 percent, wetland and aquatic types 30 percent, and other terrestrial types 20 percent. Since there will be an increased emphasis on connectivity rather than isolated wetlands in the Middle Mississippi River section, the proportions there are estimated to be 65 percent forest, 20 percent wetland, and 15 percent other terrestrial habitats.

The initial demarcation of the proposed boundary was accomplished using refuge Geographical Information System (GIS) data, which is used primarily for biological analysis. Evaluating locations that best contribute to accomplishing the goals and objectives outlined in this plan identified specific parcels. Prioritizing areas into four tiers further refined this process and identified approximately 56,000 acres for consideration. The top priority tier in this process contains 27,659 acres; Tier 2 contains 14,084 acres; Tier 3 contains 8,537 acres; and Tier 4 contains 5,393 acres. Following evaluations of these tiered options at the Regional and Washington Office levels, the Refuge was approved to advance the planning process at the Tier 1 level. This top priority level is split among four refuges in the following amounts: Port Louisa NWR, 6,681 acres; Great River NWR, 5,237 acres; Two Rivers NWR, 983 acres; Middle Mississippi River NWR, 14,758 acres.

During the 15-year planning period outlined in this plan it is not expected that the Complex will actually acquire an interest in all the lands included in the proposed boundary. The Land Acquisition Priority System (LAPS) was revised 3 years ago to include more objective factors for assessing resource values and ecological setting contributions. Even though the Complex has rated in the top five projects nationally in each year since the revision, it is recognized that under normal budget conditions acquiring 12,000 to 15,000 acres is a realistic estimate during the 15-year plan period. This also considers the likelihood of reduced acquisition costs due to partnering with USDA set aside programs as well as possible funding through Federal Emergency Management Agency flood relief programs. However it is still important to plan for a larger project area. The needed habitat for a sustainable system is estimate to be an additional 130,000 acres according to the HNA. Partner agencies, particularly the Corps of Engineers, have looked to the Fish and Wildlife Service to identify the highest priority lands for meeting sustainable system needs. The areas identified in the CCP boundary expansion proposal will also be used by those partners as specific resource information along the corridor in the event of another disaster mobilization. It is anticipated that other authorities, such as

the Corps or FEMA, could be used to purchase lands in the event of another flood on the scale of 1993. Other opportunities are possible, such as purchase of lands by the Corps for Environmental Management Program projects. State NRCS offices can also assign Special Designation Areas along the river corridor to target Wetland Reserve Program easements. The proposed boundary will help delineate the highest priority areas for system scale resource attention.

In addition to the parcels detailed in plan maps, the Complex has also been coordinating on this issue with the Ameren/Union Electric power corporation. The company owns land in the pool 19 river area since their hydro-electric plant was built in Keokuk, Iowa, in 1913, which predated the 9-foot navigation channel project. Ameren/UE was in the process of realty research to identify and clear titles in their possession during this planning process. Some of this land is submerged and has a long history of resource value, particularly for fish and diving ducks. The lower pool is too large to include in the proposed boundary without a better resolution to the legal status of the area. However the company has expressed an interest in working with the refuge at the conclusion of its research. Long-term leases to the Complex, or the sale of small, key parcels that enable an open water restoration project anchor point, have been discussed as a possibility.

It is estimated that the cost to acquire 27,659 acres would be anywhere from \$20 million to \$28 million. Since acquisition would only be on a willing seller basis, it is likely that if this acquisition were to occur, it would be over a period of decades.

The estimate for long-term Operations and Maintenance funding needs to manage these lands is relatively low for two reasons. First, most of the land will simply be opened to the River and farming practices stopped. Subsequent forests and wetlands will develop naturally under those conditions. Posting will be required and additional law enforcement coverage may be needed to accommodate the additional public use on the expanded refuge areas. The second reason O&M costs will be lower than normal situations is the presence of partnerships in place on the River. Lands that contain a particularly high restoration value if some level of development is applied can be achieved through programs such as the Corps EMP, or other authority to improve environmental conditions on the river. In all instances, the forces of the River will be employed in attempts to mimic natural conditions and reduce O&M costs wherever possible.

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

2.2.1.2 Alternative A, Expanded Boundaries, Increased River Connectivity (Preferred Alternative) Description

The current divisions of the Complex have varying amounts of water level control, flood control, and floodplain connectivity. Some divisions are completely open to the river and its flood pulses; others are partially protected by levees with spillways; and two divisions (Louisa and Delair) receive protection from major levees constructed by the Corps and private agricultural drainage districts, respectively, prior to Service acquisition.

Refuges in the Complex are managed using an integrated approach to floodplain management. When making floodplain management decisions within the AEC, each refuge manager considers a range of desirable options including:

- Connecting the river to its floodplain.
- Reducing backwater sedimentation.
- Managing water levels to re-create natural wet/dry cycles.
- Reducing agriculture and facilities in flood-prone areas.
- Promoting partnerships and interagency coordination to encourage a balanced floodplain management program throughout the AEC.

Under Alternative A, refuge staff will continue using this approach on lands within the Complex. All of these options cannot be applied to every Refuge and division. The lands would be managed to accomplish the previously stated Complex goals. Decisions on how to manage each unit are based on local and system-wide habitat needs, area elevation, geomorphology and landscape features, authorized purposes of the unit, political and social considerations, and funding limitations.

Considerations to this alternative include impacts flood waters will have on private land surrounding each refuge division. The Service cannot alter the drainage of water from private land, nor allow private land to be flooded by its management actions. Conversely, the Service has no obligation to implement extraordinary measures to protect adjacent property unless appropriate legal arrangements are made.

Allowing floodplain lands to reconnect with the River may involve opening any Service-acquired levees or drainage outlets that restrict free flow onto or through the acquired lands. When such alterations are considered, they will be coordinated with the Corps and made compatible with the operations of adjacent private land owners or levee/drainage districts, and done in accordance with National Environmental Policy Act (NEPA) guidelines.

The Complex staff has developed priorities for additional land acquisition within the AEC. One factor that was considered in selecting priority tracts is the potential to restore river connectivity. Complete connectivity provides fisheries access and flood water storage, but gives managers little or no ability to control water levels and often results in high rates of sedimentation.

Additional staffing and funding would be needed with implementation of Alternative A. Also under this alternative, additional public use opportunities would be created by acquiring additional floodplain lands, and enhanced on current divisions. New nature trails, observation platforms, information kiosks and boardwalks would offer educational opportunities to the public. Visitor centers, contact stations and exhibits would be constructed and/or enhanced to provide optimal outreach efforts. Additional hunting, fishing and non-consumptive wildlife uses would be implemented where biologically compatible. Monitoring would assess biological changes to the floodplain following land acquisition and implementing adaptive management techniques.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.2 Alternative B: Current Program

Current Management Strategies and Acquisition Within Existing Boundaries (No Action)

Limit the Mark Twain NWR Complex land acquisition to currently approved boundaries. Current management strategies would continue.

Under Alternative B, the Complex would continue to operate under the same general framework with no changes made to programs outlined under Alternative A. Land acquisition would be limited to currently approved boundaries along the lower 200 miles of the UMR from a previous expansion approved following the Flood of 1993. Refuge staff would maintain best possible management in all programs on the current acreage, with no additional staff or funding. Program improvements would remain a high priority, but would only be accommodated as limited staffing, funding and time permits.

The Complex would continue to operate using the current management strategies but opportunities to enhance river/floodplain connectivity or habitat management ability would be minimal.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.3 Alternative C: Existing Boundaries, Maximum River Connectivity

Increase River Connectivity Via Spillways, Levee Breaches, and Acquisition Within Existing Boundaries

Increase the river/floodplain connectivity by reducing effectiveness of existing protective levees, even at the cost of increased sedimentation and loss of water level management capability.

There are currently eight divisions open to all river fluctuations. That is, as river levels rise and fall, so does the water level within Big Timber, Horseshoe Bend, Fox Island, Long Island, Portage Islands, Harlow Island, Meissner Island and Wilkinson Island Divisions. Several divisions provide some protection from small river level fluctuations, but during flood events, become contiguous with the river (Keithsburg, Gilbert Lake, Batchtown Divisions, Clarence Cannon NWR). Swan Lake on the Calhoun Division maintains connectivity through its lower unit, while the middle unit is designed to annually overtop by flood waters. Two divisions, Delair and Louisa, are isolated from the Mississippi River by tall levees. The levee bordering Delair Division is a privately owned agricultural levee, and cannot be breached, while the levee bordering Louisa Division is Corps owned. The Louisa Division and associated Lake Odessa State Wildlife Area can be selectively open or closed to the river through large gates, providing water control capabilities and fish passage.

Implementation of Alternative C would allow the Mississippi River complete access to its floodplain on all Complex lands, except Delair Division. Where levees or berms currently exist, e.g., Louisa, Gilbert Lake, Keithsburg, etc., deep notches or spillways would be cut, to allow the river access to its floodplain. On the Clarence Cannon NWR, the existing spillway would be lowered to provide greater access to the river's water level fluctuations.

Alternative C would decrease habitat quality on refuge lands and waters due to increased sediment deposition and loss of ability to re-create the historical water level fluctuations critical to effective fish and wildlife habitat management in the floodplain.

Considerations to this alternative again include impacts flood waters would have on private land surrounding each refuge division. As stated under Alternative A, the Service cannot alter the drainage of water from private land, nor allow private land to be flooded by management actions. Conversely, the Service has no obligation to implement extraordinary measures to protect adjacent property unless appropriate legal arrangements are made.

It is anticipated that Service owned lands acquired under either Alternative A or C would be opened in some capacity, to river flows thereby providing flood storage that could have a cushioning affect on flood magnitudes. This mitigative effect would be mostly local and applicable only in small to moderate flood events. Acquisitions within levee districts may provide enhanced opportunities for habitat management

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.4 Alternative D: Existing Boundaries, Least River Connectivity:

Enhance Habitat Protection Via More Flood Protection, Less River Connectivity on Refuge Lands Within Existing Boundaries

Increase flood protection on existing lands and lands in order to increase effectiveness of habitat management practices on wetlands, grasslands, and bottomland forests, even at the cost of reduced river connectivity.

As previously mentioned, many divisions provide some level of levee protection from rising river waters. Under Alternative D, berms or levees would be built up to protect 9 divisions and Clarence Cannon NWR from the river's fluctuations. For instance, Gilbert Lake and Batchtown Divisions currently have spillways cut into their berms, allowing flood water to slowly fill the units. Alternative D would provide an opportunity to build these berms up, fill in the spillways, and prevent the river from accessing its backwaters, unless by excessive flooding. Enhanced habitat management in these units would be attained with this action.

Development of Alternative D on newly acquired lands would provide additional habitat management and public use opportunities; however river connectivity would be greatly diminished by exercising this alternative.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.5 Elements Common To All Alternatives

2.2.5.1 Fire

The following section addresses aspects of the Fire Management Plan recently prepared for the Complex. An additional purpose for preparing this Environmental Assessment is to analyze and adopt a separate step-down Fire Management Plan for the Complex. Implementation of the preferred alternative in the CCP will include the objectives and strategies of the Fire Management Plan.

2.2.5.1.1 Prescribed Fire

Prescribed fire is a habitat management tool that is used on the Refuge Complex regularly. Refuge Complex staff annually burn areas of the Refuge Complex to enhance habitat for upland game, waterfowl, and other species of interest. The periodic burning of grasslands, and sedge meadows reduces encroaching vegetation such as willow. It also encourages the growth of desirable species such as cord grass.

All prescribed burns are carried out by highly trained and qualified personnel who perform the operation under very precise plans. The Refuges in the Complex have approved fire management plans that describe in detail how prescribed burning will be conducted on the Complex. No burning takes place unless it meets the qualifications of the prescription for each unit. A prescription is a set of parameters that define the air temperature, fuel moisture, wind direction and velocity, soil moisture, relative humidity, and several other environmental factors under which a prescribed burn may be ignited. This insures that there is minimal chance the fire will escape the unit boundaries and that the fire will have the desired effect on the plant community.

Prescribed burns will occasionally be conducted within or near Refuge Complex development zones, sensitive resources, and boundary area to reduce the risk from wildfire damage. To the greatest extent possible, hazard reduction prescribed fires will only be used when they complement resource management objectives.

Combustion of fuels during prescribed fire operations may temporarily impact air quality, but the impacts are mitigated by small burn unit size, the direction of winds the burns are conducted with, and the distance from population centers. All efforts will be taken to assure that smoke does not impact smoke sensitive areas such as roads and local residences.

Burn frequency will vary from every 3 to 5 years or longer on established grassland, savanna, and wet meadow units dependent on management objectives, historic fire frequency, and funding. As part of the prescribed fire program, a literature search will be conducted to determine the effects of fire on various plant and animal species, and a monitoring program will be instituted to verify that objectives are being achieved.

Prescribed fires cannot and will not be ignited when the area is at an extreme fire danger level and/or the National Preparedness level is V, without the approval of the Regional Fire Management Coordinator. In addition, the Refuge Complex will not ignite prescribed fires when adjacent counties or the State in which the burn unit is located have instituted burning bans without the applicable State DNR concurrence.

Drought can have an effect on fire severity and control. One or more drought indicators (PDI - KBI) will be used to determine the degree of drought. These indicators can be accessed on the web at <http://www.boi.noaa.gov/fwweb/fwoutlook.htm>

Spot fires, slop-overs, and escapes can be an expected occurrence on any prescribed fire. They can be caused by any of a number of factors that can not always be accounted for in the planning process. A few minor occurrences of these events on a prescribed burn can usually be controlled by holding forces of the burn crew. If so, they do not constitute a wildfire. The burn boss is responsible for evaluating the frequency and severity of these events and taking mitigating measures such as slowing down or stopping the burn operation, ordering additional holding forces from within Refuge Complex Staff, or taking measures to extinguish the prescribed burn. Should an escape event exceed the ability of existing holding forces to control, and additional assistance become necessary in the form

of DNR involvement, the event will be classified a wildfire and controlled accordingly. Once controlled by these forces the prescribed burning operation will be stopped for the burning period. A fire number will be obtained to implement wildfire funding to cover the cost of control, a wildfire report will be generated and a Wildland Fire Situation Analysis will be prepared.

Prescribed burns can be conducted at any time of year depending on resource objectives and prescription. However, the normal prescribed fire season begins approximately April 1, and ends by May 31, due to early bird nesting. Fall burning may begin again August 15, and end October 31.

Precautions will be taken to protect threatened and endangered species during prescribed burning. Nesting trees for Bald Eagles will be protected and burning will not be conducted at a time or in a way to negatively impact any nesting eagles. If any of the approximately 20 known disjunct populations of Decurrent False Aster are in or near a burn unit, precautions will be taken to avoid the plants.

Existing firebreaks will be used. They may undergo minor improvements such as graveling or rotoation (vegetation disruption). General policy dictates that any new firebreaks or below surface improvements to existing firebreaks will be approved by the Regional Historic Preservation Officer.

The Refuge Complex Biologists will be responsible for supervising the development of resource management objectives for individual units. The Refuge Complex staff will provide assistance in the selection of the appropriate management tool needed to meet objectives. Prescribed fire is just one of a combination of tools available. If needed, the Zone Fire Management Officer (Zone FMO) will be consulted for assistance in developing a prescription that will achieve the desired results.

Burn plans (The Fire Management Plan) are written that document the treatment objectives, the prescription, and the plan of action for carrying out the burn. Burn plans are written by or under the guidance of a qualified burn boss. The burn plan follows the format in the Services Fire Management Handbook or a format approved by the Regional Fire Management Coordinator and addresses all aspects as specified in the Services Fire Management Handbook. Details regarding fire resources and procedures may be found in the individual fire plans for each refuge in the Complex. All burn plans are reviewed by the Refuge Complex Manager, Zone FMO, and approved by the individual Refuge Managers prior to implementation.

2.2.5.1.2 Fire Prevention and Detection

Although fire may have historically played a role in the development of habitats on the Refuge Complex, human ignited fires and natural ignitions burning without a prescription are likely to result in unwanted damage to cultural and/or natural resources. In order to prevent wildfire, an educational program will be utilized to reduce the threat of human caused fires. Ongoing monitoring will be conducted by Refuge Complex staff, visitors, and cooperators to detect fire ignitions. Actions taken to implement this include:

- Fire prevention will be discussed at safety meetings, prior to the fire season, and during periods of high fire danger. Periodic training of staff in regards to fire prevention will be conducted.
- During periods of extreme fire danger, warnings will be posted at visitor information stations.

- Public contacts will be made via press releases and verbal contacts during periods of extreme fire danger.
- A thorough investigation will be conducted of all fires suspected to have been illegally set. Upon completion of the investigation, appropriate action will be taken.
- The Refuge Complex relies on neighbors, visitors, cooperators, and staff to detect and report fires. In addition, the step-up plan provides for increased patrols by Refuge Complex personnel during periods of very high and extreme fire danger.
- All fires occurring within or adjacent to (within two miles) the individual Refuges will be reported to the respective Refuge headquarters. The person receiving the report will be responsible for implementing the Fire Dispatch Plan and assume duties of Fire Dispatcher until relieved or released.
- For local fires, the Fire Dispatcher will stay on duty until: (1) all Refuge resources return; (2) relieved by another dispatcher; or (3) advised by IC that he/she can leave. The Fire Dispatcher will not be required to stay on duty if the fire occurs outside Refuge radio coverage but the dispatcher must notify the applicable State Dispatcher that a Dispatcher is not on duty at the Refuge before leaving.
- The Fire Dispatcher will be responsible for coordinating the filling and delivery of any resource orders made by the Incident Commander (IC) for all operational and logistical needs, including engines, aircraft, tools, supplies, and meals. The IC will place all resource orders through the Dispatcher, and specify what is needed, when it is needed, and where it is needed. The Dispatcher will promptly determine if the resource orders can be filled or procured locally and notify the IC. If a resource order can not be filled locally, the Dispatcher will place the order with the Nicolet Interagency Fire Dispatcher in Woodruff, Wisconsin (715-358-6863). The Zone FMO for the Refuge Complex will generally be able to assist with ordering resources from outside the area.
- Requests for assistance by cooperators on fires not threatening an individual Refuge must be made to the Refuge Manager or designee. Only qualified and properly equipped resources meeting NWCG standards will be dispatched off of the Refuge.
- Firefighter and public safety always take precedence over property and resource protection during any fire management activity. Under moderate to severe fire danger index ratings, flaming fronts are capable of moving at fast speeds in all fuel models. In order to eliminate safety hazards to the public, all public access into the burn units will be closed the day of the burn. Fire crews will be briefed that should an individual who is not a member of the fire crew be observed in the prescribed burn unit, they will be immediately escorted out of the area. The fire crew will keep the fire scene clear of people except for Service firefighters and cooperating fire crews.

2.2.5.1.3 Fire Suppression

Service policy requires the Refuge Complex to utilize the Incident Command System (ICS) and firefighters meeting NWCG qualifications for fires occurring on Refuge Complex property. All suppression efforts will be directed towards safeguarding life while protecting the Refuge Complex's resources and property from harm. Mutual aid resources responding from Cooperating Agencies will not be required to meet NWCG standards, but must meet the standards of their Agency. Mutual aid resources will report

to the Incident Commander (IC) in person or by radio and receive their duty assignment. Mutual aid forces will be first priority for release from the fire. If additional firefighters are needed, appropriate procedures will be used to acquire them.

All fires occurring on the Refuge Complex and staffed with Service employees will be supervised by a qualified IC. The IC will be responsible for all management aspects of the fire. If a qualified IC is not available, one will be ordered through the appropriate area office dispatch center. All resources will report to the IC (either in person or by radio) prior to deploying to the fire and upon arrival to the fire. The IC will be responsible for: (1) providing a size-up of the fire to dispatch as soon as possible; (2) determine the resources needed for the fire; and (3) advising dispatch of resource needs on the fire. The IC will receive general suppression strategy from the Fire Management Plan, but appropriate tactics used to suppress the fire will be up to the IC to implement. Minimum impact suppression tactics (MIST) will be used whenever possible.

Severity funding may be essential to provide adequate fire protection for the Refuge Complex during periods of drought, as defined by the Palmer Drought Index or other appropriate drought indicators. Severity funds may be used to hire additional firefighters, extend firefighter seasons, or to provide additional resources. The Service Fire Management Handbook provides guidelines for use of severity funding.

The incident commander (IC) on a wildland fire or the prescribed fire burn boss on a prescribed burn will be responsible for the completion of a DI-1202 Fire Report as well as Crew Time Reports for all personnel assigned to an incident and return these reports to the Assistant Manager. The IC or burn boss should include a list of all expenses and/or items lost on the fire and a list of personnel assignments on the DI-1202. The Zone FMO will enter all data into the FMIS computer database within 10 days after the fire is declared out. The Zone FMO will also inform the timekeeper of all time and premium pay to be charged to the fire and ensure expended supplies are replaced. In addition, the following provisions will apply:

- Utilize existing roads and trails, bodies of water, areas of sparse or non-continuous fuels as primary control lines, anchor points, escape routes, and safety zones.
- When appropriate, conduct backfiring operations from existing roads and natural barriers to halt the spread of fire.
- Use burnouts to stabilize and strengthen the primary control lines.
- Depending upon the situation, either direct or indirect attack methods may be employed. The use of backfire in combination with allowing the wildfire to burn to a road or natural firebreak would be least damaging to the environment. However direct attack by constructing control lines as close to the fire as possible may be the preferred method to establish quicker control.
- Retardants may be used on upland areas.
- Constructed fire line will be rehabilitated prior to departure from the fire or scheduled for rehabilitation by other non-fire personnel.
- The Incident Commander will choose the appropriate suppression strategy and technique. As a guide: On low intensity fires (generally flame lengths less than 4 feet) the primary suppression strategy will be direct attack with hand crews and engines. If conditions occur that sustain higher intensity fires (those with flame lengths greater than 4 feet) then indirect strategies which utilize back fires or burning out from natural and human-made fire barriers may be utilized. Those

barriers should be selected to safely suppress the fire, minimize resource degradation and damage and be cost effective.

- The use of earth moving equipment for suppression activities (dozers, graders, plows) on the Refuge Complex will not be permitted without the approval of the individual Refuge Manager or his/her designated representative in the event of their absence.
- All areas in which wildfires occur on the Refuge Complex or Refuge Complex administered lands will be evaluated prior to the aerial or ground application of foams and/or retardants. Only approved chemical foams and retardants will be used (or not used) in sensitive areas such as those with riparian vegetation.
- Hazard reduction prescribed fires may be used in fire adapted communities that have not had significant fire for more than twice the normal fire frequency for that community type.
- Utilization of heavy equipment during high intensity fires will be allowed only with the approval of the individual Refuge managers of the Complex.
- Wild fire use for resource benefit will not be utilized.
- Engines will remain on roads and trails to the fullest extent possible.
- Whenever it appears a fire will escape initial attack efforts, leave Service lands, or when fire complexity exceeds the capabilities of command or operations, the IC will take appropriate, proactive actions to ensure additional resources are ordered. The IC, through dispatch or other means, will notify the Complex FMO of the situation. With Zone FMO assistance the Refuge Manager at each Complex Refuge will complete a Wildland Fire Situation Analysis (WFSA) and Delegation of Authority.
- The IC will be responsible for mop-up and rehabilitation actions and standards on Refuge Complex fires. Refuge Complex fires will be monitored until declared out.
- Rehabilitation of suppression actions will take place prior to firefighters being released from the fire. Action to be taken include: 1) All trash will be removed; 2) Fire lines will be refilled and water bars added if needed; 3) Hazardous trees and snags cut and all stumps cut flush; and 4) Damage to improvements caused by suppression efforts will be repaired, and a rehabilitation plan completed if necessary. Service policy states that only damage to improvements caused by suppression efforts can be repaired with fire funds. Service funds cannot be used to repair damage caused by the fire itself (i.e. burnt fence lines). If re-seeding is necessary, it will be accomplished according to Service policy and regulations.

2.2.5.1.4 Listed Species and Other Species of Interest

Chapter 3 of the Mark Twain National Wildlife Refuge Complex Comprehensive Conservation Plan describes the current status of fish and wildlife in the area of interest to refuge staff in development of the plan (area of ecological concern – AEC). Prescribed burning will be conducted in a manner that avoids conflicts with listed species and other species of interest. Specifically, burning will not be carried out during nesting and fledging periods. Burn units will be thoroughly surveyed for potential Indiana bat maternal colonies or summer roost trees. Burn plans will reflect consideration of the seasonal requirements of forest-dependent endangered species.

Section 7 of the Endangered Species Act outlines a mechanism for ensuring that actions taken by federal agencies do not jeopardize the existence of any listed species. We conducted a “Section 7” review concurrent with the review of the draft CCP.

2.2.6 Elements Common to All Alternatives

2.2.6.1 Cultural Resources

Archeological studies and surveys will be performed, as necessary, to assure preservation from proposed actions on acquired lands. In the event an unidentified archeological site is discovered, the project by which it was discovered, will be stopped until the resources are adequately protected.

Cultural resources would be protected as mandated by law under all alternatives.

2.2.6.2 Environmental Justice

None of the proposed management alternatives disproportionately place an adverse environmental, economic, social, or health impacts on minority or low-income populations. Improvements in any refuge facilities or expanded land base near such population centers as St. Louis will likely benefit minority or low income populations in that they will make wildlife dependent recreational opportunities more readily available to them.

2.2.6.3 Climate Change Impacts

The actions proposed under any of the alternatives would preserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 1. Wetlands & Aquatic Habitat: Restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.			
<p>Objective 1A: Provide a 6-year average of 2200* acres (2800* acres maximum) seasonal, 1,800 acres (2,350 acres maximum) semi-permanent, and 1,200 acres (1,580 acres maximum) of permanently flooded wetland vegetation types in refuge <u>wetland impoundments</u> for waterfowl, shorebirds, and other wetland-dependent wildlife species. Objective acres are 80 percent of maximum potential acres available due to effects of flooding and need to set back succession in some years.</p> <p>Strategies: Manage wetlands and impoundments to protect and enhance wetland vegetation; convert fields to wetlands; enhance existing wetlands with installation of wells; various methods to restore and/or enhance water control: install control structure in dike; partnership with adjacent landowner.</p>	<p>Objective 1A: Same as Alternative A except that it involves a six-year average of 1500 acres (1900 acres maximum) seasonal, 1100 acres (1400 acres maximum) semi-permanent, and 900 acres (1200 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 79 percent of maximum acres available.</p> <p>Strategies: Continue management of existing wetlands and impoundments. Minimal improvements as staffing and funding allow.</p>	<p>Objective 1A: Same as Alternative A except that it involves a six-year average of 900 acres (1500 acres maximum) seasonal, 700 acres (1200 acres maximum) semi-permanent, and 500 acres (800 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 60 percent of maximum acres available.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 1A: Same as Alternative A except that it involves a six-year average of 3400 acres (4000 acres maximum) seasonal, 3000 acres (3500 acres maximum) semi-permanent, and 1700 acres (2000 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 85 percent of maximum acres available.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 1B: Protect, enhance, and maintain a six-year average of 300 acres (385 acres maximum) of isolated backwaters and ephemeral wetlands, providing seasonal and semi-permanently flooded wetland vegetation types in unveeved areas of the refuge with little water level control for the benefit of migratory birds and other wetland-dependent species. Strategies: Manage isolated wetlands to protect and enhance vegetation; determine feasibility of fall pumping; evaluate fishery resources and methods of improving winter connectivity with the Iowa River; evaluate alternatives for improving backwater habitat.</p>	<p>Objective 1B: Same as Alternative A Strategies: Continue management of existing unveeved backwaters with minimal improvements as staffing and funding allow.</p>	<p>Objective 1B: Same as Alternative A except that it involves a six-year average of 900 acres (1100 acres max) Strategies: Same as Alternative A.</p>	<p>Objective 1B: Same as Alternative A except that it involves a six-year average of 100 acres (130 acres max) Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 1C: Protect, enhance, and maintain 3,000 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge for migratory birds and fish. Increase bathymetric diversity and wetland plant growth in these areas as feasible by 2015 where little or no local water level control exists.</p> <p>Strategies: Investigate costs, need and benefits of dredging at opening mouth of lakes; dredging to enhance deep water habitat and provide habitat for over-wintering fish; investigate feasibility of re-connecting side channel and main channel, Middle Miss.; enhance wetlands using potential techniques such as deepening, improving connectivity, and construction of partial closing structures and environmental pool management (Port Louisa).</p>	<p>Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 2900 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge.</p> <p>Strategy: Maintain backwater and channel habitat by improving connectivity as time and resources allow.</p>	<p>Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 4000 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 1800 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge.</p> <p>Strategies: Same as Alternative A</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 2. Forest Habitat: Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.			
<p>Objective 2A: Conserve and enhance floodplain forest block size and spatial distribution along the river corridor through management of existing 18,000 acres and restoration of an additional 800 acres by 2011 for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife.</p> <p>Strategies: Maintain existing tracts of floodplain forest; develop a step-down plan to determine management needs; Rip rapping bank line to protect forest habitat from further loss; convert units to floodplain forest leaving many areas idle for succession; extend off-bank rock wall to protect shoreline and prevent loss of forest and promote island growth in some areas.</p>	<p>Objective 2A: Conserve and enhance exiting floodplain forest of 18,000 acres for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife.</p> <p>Strategies: Maintain existing tracts of floodplain forest; develop a step-down plan to determine management needs.</p>	<p>Objective 2A: Conserve and enhance floodplain forest block size and spatial distribution along the river corridor through management of existing 18,000 acres and conversion of an additional 3000 acres by 2011 for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 2A: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 2B: Conserve and enhance structural (age and species) diversity on 2500 acres of refuge floodplain forests by 2015 for the benefit of neotropical migrants, raptors, bats, and cavity nesting birds.</p> <p>Strategies: Develop a forest management plan focusing on management actions needed for maintenance of healthy bottomland forest habitats, in cooperation with the Corps; plan might include: replanting flood-damaged areas; selective cutting; and/or prescribed fire. Maintain existing hard mast (mesic bottomland) component through thinning of mature hard mast trees, mowing, maintain pecan seed bank; plant hard mast trees and install two water control structures; large dead trees will be left in place for nesting bats and birds; deer hunting program will reduce browsing damage; cottonwood seedlings will grow to maturity to provide roosting sites for bald eagles; study of bird species composition and productivity in early successional forests to evaluate habitat type; work with navigation industry, public and COE to eliminate forest resource damage; plant portion used for HREP dredge material disposal, remainder allowed to convert by regeneration; agricultural fields to be planted with hard mast trees.</p>	<p>Objective 2B: Same as Alternative A except that it involves the conservation and enhancement of structural (age and species) diversity on 1000 acres of refuge floodplain forests by 2015.</p> <p>Strategies: Use natural succession as the primary means to develop structural diversity; large dead trees will be left in place for nesting bats and birds; deer hunting program will reduce browsing damage; work with navigation industry, public and COE to eliminate forest resource damage.</p>	<p>Objective 2B: Same as Alternative B.</p> <p>Strategies: Leave dead trees... Deer hunting program... Work with nav industry...</p>	<p>Objective 2B: Same as Alternative A except that it involves the conservation and enhancement of structural (age and species) diversity on 3500 acres of refuge floodplain forests by 2015.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 3. Other Terrestrial Habitats: Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl, and neotropical migrants.			
<p>Objective 3A: Provide three large areas (>150 acres) of contiguous native grassland/wet meadow complexes on refuge divisions by 2010 to benefit migrating as well as declining nesting populations of grassland birds.</p> <p>Strategies: Plant native grassland and wet meadow species; prairie cordgrass planting; water level manipulation; burning; exotic plant control; mowing, prescribed fire, and possible grazing.</p>	<p>Objective 3A: Same as Alternative A except that it involves providing two large (>150 acres) areas of contiguous native grassland/wet meadow complexes by 2010.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 3A: Same as Alternative A except that it involves providing one large (>150 acres) area of contiguous native grassland/wet meadow complexes by 2010.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 3A: Same as Alternative A except that it involves providing three large (>150 acres) areas of contiguous native grassland/wet meadow complexes by 2010.</p> <p>Strategies: Same as Alternative A.</p>
<p>Objective 3B: Maintain 500 acres of smaller patches of grassland habitat where established for levee maintenance, cultural resource protection, or environmental education using techniques such as mowing, prescribed burning, and/or spraying of undesirable vegetation as needed (typically on a three to five year cycle).</p> <p>Strategies: Maintain small grasslands; native grasses established to protect cultural resources; mowing, prescribed fire, spraying of undesirable vegetation, potential seed bank, enhancement of water level control; establish cool season grasses.</p>	<p>Objective 3B: Same as Alternative A except that it involves the maintenance of 350 acres of smaller patches of grassland habitat.</p> <p>Strategies: Maintain existing small grassland patches, no new ones will be established.</p>	<p>Objective 3B: Same as Alternative A except that it involves the maintenance of 150 acres of smaller patches of grassland habitat.</p> <p>Strategies: Maintain existing small grasslands where still feasible after new levee breaches.</p>	<p>Objective 3B: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 3C: Provide a 6-year average of 400 acres (500 acres maximum) of smaller wet meadow areas for marsh and grassland birds and spring foraging waterfowl using a combination of water level manipulation, mowing, discing, and burning. Water level manipulations may occur annually; other techniques are typically necessary on a three to five year cycle. Most sites border existing wetland or grassland units. Strategies: Manage small wet meadow sites; use a combination of water level manipulations; enhancement of <i>Boltonia decurrens</i>; develop step-down plan with endangered species specialists; control encroaching willow by mowing, discing, burning.</p>	<p>Objective 3C: Same as Alternative A except it will provide a 6-year average of 200 acres (300 acres maximum) of smaller wet meadow areas. Strategies: Same as Alternative A.</p>	<p>Objective 3C: Provide a 6-year average of 100 acres (150 acres maximum) of smaller wet meadow areas for marsh and grassland birds and spring foraging waterfowl. A combination of water level manipulation, mowing, discing, and burning will be used when possible, but management actions will be limited by lack of water level control. Strategies: Same as Alternative A.</p>	<p>Objective 3C: Same as Alternative A except it will provide a 6-year average of 560 acres (700 acres maximum) of smaller wet meadow areas. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 3D: Provide a six-year average of 450 acres of scrub/shrub habitat for waterfowl broods and neotropical migrants through a combination of water level manipulation, mowing, discing, and burning. Water level manipulation may occur annually; other techniques typically are necessary on a three to five year cycle. Most scrub/shrub sites occur naturally at the interface between wetland and forest, but may need management action to hold back succession. Strategies: Maintain existing scrub/shrub habitat; use a combination of water level manipulation, mowing, discing and burning; develop partnerships with adjacent landowners to enhance water control capabilities.</p>	<p>Objective 3D: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 3D: Provide a six-year average of 300 acres of scrub/shrub habitat for waterfowl broods and neotropical migrants. Most scrub/shrub sites occur naturally at the interface between wetland and forest. Little management will be possible to hold back succession. Strategies: Maintain existing scrub-shrub as feasible with little or no water level control.</p>	<p>Objective 3D: Same as Alternative A except it will provide a six-year average of 600 acres of scrub/shrub habitat. Strategies: Same as Alternative A.</p>
<p>Objective 3E: Plant seed and browse crops to provide a dependable supplement to natural food sources for waterfowl, and to provide needed open space resting areas. The amount and spacing of this refuge resource along the river corridor is based on historic concentration areas (bird use days) while considering surrounding conditions off-refuge including hunting pressures that may reduce utilization of habitats outside refuge sanctuary units. Approximately 1000 acres will be planted annually Complex-wide. Strategies: Plant seed and browse crops.</p>	<p>Objective 3E: Same as Alternative A except approximately 2500 acres will be planted annually. Strategies: Same as Alternative A.</p>	<p>Objective 3E: Same as Alternative A, but approximately 500 acres will be planted annually. Strategies: Same as Alternative A.</p>	<p>Objective 3E: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 3F: Utilize agriculture as a management tool, as necessary, to maintain high-quality wildlife habitat in refuge wetlands by periodically setting back succession or invasion of undesirable species. Approximately 400 acres will be planted annually. Where practical, manage this temporary land cover type in a manner that provides supplemental food value as a secondary benefit. Strategies: Plant annually; use cooperative farming program to set back succession.</p>	<p>Objective 3F: Same as Alternative A except approximately 400 acres will be planted annually. Strategies: Same as Alternative A.</p>	<p>Objective 3F: Same as Alternative A, but approximately 200 acres will be planted annually. Strategies: Same as Alternative A.</p>	<p>Objective 3F: Same as Alternative A except approximately 700 acres will be planted annually. Strategies: Same as Alternative A.</p>
<p>Objective 3G: Use farming techniques to maintain 675 acres of open fields until they can be converted to another planned habitat type, such as on newly acquired lands. Conversion will occur by 2012. Strategies: Reforestation through combination of natural regeneration and hard mast tree planting.</p>	<p>Objective 3G: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 3G: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 3G: Same as Alternative A. Strategies: Combination of reforestation and conversion to managed wetland.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 4. Sedimentation and Water Quality: Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.			
<p>Objective 4A: Continue current and develop new partnerships with government agencies and private landowners to reduce the effects of erosion and contaminant runoff affecting fish and wildlife resources in the Upper Mississippi River watershed.</p> <p>Strategies: Partner with agencies and private landowners to encourage participation in various agricultural and habitat programs e.g., CRP, PFW, WRP, EWRP, FSA easements; partner with agencies to promote environmental pool management; provide technical and financial assistance for watershed improvement projects; train refuge personnel to assist with spill response efforts.</p>	<p>Objective 4A: Continue current partnerships with government agencies and private landowners to reduce the effects of erosion and contaminant runoff affecting fish and wildlife resources in the Upper Mississippi River watershed.</p> <p>Strategies: Partner with agencies and landowners as feasible with limited staff.</p>	<p>Objective 4A: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 4A: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 4B: Reduce sedimentation and improve overall water quality on refuge system lands by 2010 for the benefit of fish and wildlife populations. Strategies: Develop program to monitor water quality and sedimentation during flooding; conduct comprehensive contaminant survey of wetlands; dredge and construct closing structure to reduce sediment loading and provide deep water fisheries habitat; dredge side channel areas to improve water quality and over-wintering habitat for fish; Create ANo Wake Zone® to reduce shoreline erosion and decrease turbidity; create a treatment wetland to reduce contaminant and nutrient loading; dredging to prevent low dissolved oxygen levels during draw downs; allow commercial fishing, by special use permits, to reduce exotic fish populations; special use permits, to reduce exotic fish populations; draw down Swan Lake to reduce effects of sedimentation; dredge deep holes to improve water quality for fish; Complete Contaminant Assessment Program reports; analyze ditch runoff; partner with COE and states to develop habitat restoration projects; evaluate tracts for potential to contribute to nutrient recycling and other water quality improvements; use integrated pest management techniques; ensure that Spill Prevention Control and Countermeasure Plan are available.</p>	<p>Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 5. Floodplain Management: Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.			
<p>Objective 5A: Conduct activities and promote partnerships and interagency coordination which encourage a balanced floodplain management program throughout the AEC. Strategies: Promote Environmental Pool Management and work to acquire additional lands to move pool control hinge points; develop habitat improvement plans for pooled and unpooled river reaches, partnering with COE, states, and private organizations; encourage private landowners to participate in CRP or WRP; participate in COE dredged material management program; enhance migration and spawning opportunities for fish species; reduce impacts of sedimentation through the location of river training structures.</p>	<p>Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.</p>
<p>Objective 5B: Manage refuge lands for wildlife first, while considering UMR floodplain functions and contributing to improving those values. Strategies: Evaluate and monitor management activities on sedimentation, water quality, wetland vegetation, and fish passage; evaluate tracts for potential to contribute to nutrient recycling, river connectivity, and potential habitat improvement/restoration; increase bathymetric diversity; manage impoundments to recreate natural wet/dry cycles.</p>	<p>Objective 5B: Same as Alternative A. Strategies: Same as Alternative A, but restoration, management and monitoring will be limited by lack of funding.</p>	<p>Objective 5B: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 5B: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Goal 6. Public Use and Education: Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving refuge programs and facilities, and partnering with others to increase awareness of the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.</p>			
<p>Objective 6A: Enhance visitor experiences involving wildlife observation and photography. This will be accomplished in part by constructing observation platforms, kiosks, trails, and auto tour routes where appropriate. All facilities will be ADA-compliant and where necessary, “flood friendly”. Two platforms will be constructed by 2005 and two trails by 2008. Strategies: Construct and/or improve observation platforms, trails, and auto tour routes; develop/improve public access on county roads, parking areas and other accesses.</p>	<p>Objective 6A: Provide opportunities for wildlife observation and photography at current levels. Strategies: Maintain existing visitor facilities on the refuge.</p>	<p>Objective 6A: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 6A: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 6B: Enhance the education and interpretive program on Complex refuges by providing visitors key river resource messages through contact stations, kiosks, interpretive panels, educational programs and special events. The visitors experience will focus on the messages of: changes in the floodplain, wildlife management choices in this changed setting, and the public's opportunity to be involved in river issues and the Refuge Complex responses.</p> <p>Strategies: Expand headquarters/visitor contact station (If the expansion is of a scale that requires formal environmental impact analysis, it will be done when a design and building details are developed); improve interpretive exhibits in visitor center; provide interpretive panels on proposed auto tour route, trails, boat ramps; construct vehicle turnout with interpretive signs along public road; improve educational curriculum material used by local schools; conduct open house every 3 years; develop information brochure for Spanish-speaking population; provide interpretive eagle viewing tours; develop refuge events calendar; develop information brochures; develop comprehensive species lists for the AEC and each refuge; develop/conduct wildlife education curriculum modules; produce videos for each refuge; develop outreach program material on issue of Acasual mooring® and its effects.</p>	<p>Objective 6B: Improve quality of existing education and interpretive programs on Complex refuges by improving existing contact stations, kiosks, interpretive panels, educational programs and special events. Strategies: Improve facilities and programs as time and resources allow.</p>	<p>Objective 6B: Same as Alternative A. Strategies: Same as Alternative A except fewer trails, tour routes, kiosks, and interpretive signs will be developed due to increased flooding on some divisions.</p>	<p>Objective 6B: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 6C: Enhance outreach through off-refuge activities by conducting education and interpretive programs for schools, youth, civic and conservation groups to increase understanding and appreciation of wildlife and wildlife habitat on the river corridor. Strategies: Continue annual event, Big River Days; partnership with an interpretive display for proposed Heritage Center; partner with county conservation board to provide interpretive and educational activities; Develop refuge exhibit to be located at state park; partnership with county to develop annual wildlife celebration event; co-sponsorship of family fishing fair at state park; develop on and off-site environmental education program; install kiosk; Create portable exhibit showcasing refuge resources/messages; develop and conduct off-site wildlife education curriculum modules; develop website containing maps, events, and other refuge information; develop kiosks for partner managed lands; prepare outreach folders; maintain urban environmental education efforts partnering with COE; develop partnership with Eco-Watch organization to assist with river monitoring and other activities; co-produce with COE a video for teachers highlighting curriculum-based programs; assist with developing and installing exhibits in COE museum; Provide news releases on events and achievements; consider monthly news column and/or radio broadcast on seasonal activities; expand public presentations describing the value of the refuge; develop educational trunks; expand volunteer program; partner with state/local authorities to incorporate refuge information into National Scenic Byway kiosks, visitor centers.</p>	<p>Objective 6C: Enhance outreach through off-refuge activities by conducting education and interpretive programs for schools, youth, civic and conservation groups to increase understanding and appreciation of wildlife and wildlife habitat on the river corridor. Strategies: Continue current activities; enhance outreach by improving quality of current activities.</p>	<p>Objective 6C: Same as Alternative A. Strategies: Same as Alternative A.</p>	<p>Objective 6C: Same as Alternative A. Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 6D: Increase fishing opportunity by improving access at five Divisions by 2010. Strategies: Evaluate and improve boat ramps, landings and parking areas; install fishing pier and transfer dock.	Objective 6D: Maintain fishing opportunities on Complex refuges. Strategies: Maintain existing boat ramps, landings and parking areas.	Objective 6D: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6D: Same as Alternative A. Strategies: Same as Alternative A.
Objective 6E: Improve the quality, as measured through visitor satisfaction surveys, and safety of the hunting program and increase opportunity, where appropriate, in accordance with sound biological management objectives by 2008. Strategies: Open refuge for special hunt to control deer population, includes construction of several small parking lots; monitor deer populations and state special seasons and adjust if necessary; coordinate with ILDNR on waterfowl hunting program and placement and/or elimination of blinds before each drawing period; set minimum distance of 200 yards between hunters; open lands to upland and big game hunting; areas open to upland & big game hunting & fishing will be clearly posted.	Objective 6E: Maintain the hunting program in accordance with sound biological management objectives. Strategies: Coordinate with ILDNR on waterfowl hunting program and placement and/or elimination of blinds before each drawing period; set minimum distance of 200 yards between hunters; open lands to upland and big game hunting; areas open to upland & big game hunting & fishing will be clearly posted	Objective 6E: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6E: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 6F: Increase protection of refuge visitors, natural resources, and facilities through enhanced law enforcement, boundary marking, and sign programs. Refuge facility vandalism and habitat damage will be reduced by 75% by 2010.</p> <p>Strategies: Install entrance gate to prevent off-hours traffic, modify dates for sanctuary period; conduct regular law enforcement patrols; continue partnerships with local and state conservation officers; develop new sign plan including regulatory; ensure proper boundary posting on refuge and Farm Service Agency easements.</p>	<p>Objective 6F: Protect refuge visitors, natural resources, and facilities through law enforcement, boundary marking, and sign programs.</p> <p>Strategies: Modify dates for sanctuary period, continue partnerships, develop new sign plan.</p>	<p>Objective 6F: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 6F: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>
<p>Goal 7. Monitoring: Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of refuge management programs and to provide information for adaptive management strategies.</p>			
<p>Objective 7A: Monitor habitat communities to evaluate the effects of current management actions and gather data to improve future management practices.</p> <p>Strategies: Establish annual transects on wetland units; complete baseline forest inventory; evaluate grassland and wet meadow for species composition, woody vegetation, etc.; run vegetation transects after prescribed burns; develop step-down inventory and monitoring plan.</p>	<p>Objective 7A: Monitor habitat communities to evaluate the effects of current management actions and gather data to improve future management practices as time and resources allow.</p> <p>Strategies: Obtain and analyze data gathered by partners.</p>	<p>Objective 7A: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7A: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 7B: Monitor wildlife use to verify a response to habitat management efforts and to contribute to systematic scale evaluations on the river with partners.</p> <p>Strategies: Monitor waterfowl, shorebird, and neotropical songbird use of land during migration; monitor size of deer population and habitat damage; develop step-down inventory and monitoring plan.</p>	<p>Objective 7B: Monitor wildlife use to verify a response to habitat management efforts and to contribute to systematic scale evaluations on the river with partners as time and resources allow.</p> <p>Strategies: Monitor waterfowl use of refuges during migration; monitor size of deer population and habitat damage.</p>	<p>Objective 7B: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7B: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>
<p>Objective 7C: Monitor public use and environmental education programs to ensure compatibility with wildlife purposes, visitor satisfaction and safety and outreach effectiveness.</p> <p>Strategies: Track visitor numbers and activities; monitor public use effects on wildlife and habitat in areas of concern; evaluate visitor satisfaction.</p>	<p>Objective 7C: Same as Alternative A.</p> <p>Strategies: Casual observation and anecdotal reports as time and resources allow.</p>	<p>Objective 7C: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7C: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>
<p>Objective 7D: Work with partners to monitor systemic fish, wildlife, and habitat resources of the UMR floodplain and gather data to assist with resource management decision-making.</p> <p>Strategies: Promote research projects; continue partnerships and monitoring of key fish, wildlife and habitat through LTRM, INHS aerial flights, and COE; continue partnerships to evaluate floodplain management, connectivity and sedimentation; monitor status and trends of threatened and endangered species.</p>	<p>Objective 7D: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7D: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7D: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
<p>Objective 7E: Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate management decision-making.</p> <p>Strategies: Maintain records of management actions and conditions; develop database/graphs/tables to aid management and analysis of monitoring data; maintain GIS; compare monitoring data with CCP strategies annually; HNA and land acquisition.</p>	<p>Objective 7E: Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate management decision-making as time and resources allow.</p> <p>Strategies: Maintain records of management actions and conditions; develop database/graphs/tables to aid management and analysis of monitoring data; maintain GIS; compare monitoring data with CCP strategies annually; HNA and land acquisition.</p>	<p>Objective 7E: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>	<p>Objective 7E: Same as Alternative A.</p> <p>Strategies: Same as Alternative A.</p>
<p>Current authorized Refuge boundaries would be expanded by 27,659 acres; land protection within this area would be accomplished through partnerships, existing programs such as WRP, through any future emergency flood programs (such as those following the 1993 floods), easements, and fee title acquisition</p>	<p>Refuge boundaries would not be increased beyond what is currently authorized</p>	<p>Same as Alternative B</p>	<p>Same as Alternative B</p>

Chapter 3: Affected Environment

3.1 Description of Existing Units Within Mark Twain NWR Complex

This chapter provides a brief introduction to the existing physical and social environment of the Mark Twain NWR Complex, including the location, size and habitat of each of the five refuges that comprise the Complex, river geomorphology, sedimentation and water quality, soils, habitat, wildlife, public use activities, the social environment and cultural resources that are known to exist on Refuge lands. Greater detail on the affected environment is provided in Chapter 3 of the draft comprehensive conservation plan.

The Mark Twain National Wildlife Refuge Complex currently stretches from Muscatine, Iowa, to Gorham, Illinois, covering approximately 342 river miles (Figure 1) and encompassing over 34,000 acres managed by Complex staff. The Complex headquarters is located in Quincy, Illinois, and the Complex includes Port Louisa NWR, Great River NWR, Clarence Cannon NWR, Two Rivers NWR and Middle Mississippi NWR. The units vary in habitat from bottomland hardwoods to moist soil impoundments to grasslands and crop lands. All refuge divisions experienced dramatic habitat changes from several flood events in the 1990s.

3.1.1 Port Louisa NWR

The Port Louisa NWR is based 6.5 miles east of Wapello, Iowa, and is the northernmost Refuge of the Complex. Refuge staff manage four divisions that total 8,373 acres: Louisa, Big Timber, Keithsburg and Horseshoe Bend. Louisa, Big Timber and Keithsburg are located within the floodplain of the Mississippi River.

3.1.2 Great River NWR and Clarence Cannon NWR

The Great River NWR headquarters is located near Annada, Missouri, 40 miles north of the sprawling St. Louis, Missouri, suburbs. Refuge staff manage three divisions totaling 10,146 acres – Fox Island Division, Long Island Division, and Delair Division – and the 3,750-acre Clarence Cannon NWR.

3.1.3 Two Rivers NWR

Headquartered 20 air miles from St. Louis, Missouri, in the small town of Brussels, Illinois, Great River NWR includes four divisions totaling 8,085 acres B Batchtown, Calhoun, Gilbert Lake and Portage Islands.

3.1.4 Middle Mississippi River NWR

The Middle Mississippi River NWR planning area begins below Lock and Dam 26 at St. Louis and continues to the confluence of the Ohio River near Cairo, Illinois. There are no locks and dams in this reach, but the River has been confined to its main channel by rock training structures and large agricultural levees restrict lateral floodplain connection. The 3,835 acres currently comprising the Refuge were purchased in response to the 1993 Flood after the failure of various private levees. The Refuge is comprised of Meissner

Island Division, Harlow Island Division, and Wilkinson Island Division. None of the divisions are actual islands. River structures intended to keep water flowing to the center of the navigation channel have caused sedimentation through the decades, accreting what were once islands to the mainland and eliminating flowing side channels.

3.2 Habitat Overview

The Mark Twain Complex supports a diverse array of riverine and floodplain habitat. Habitat includes islands, sloughs, backwaters, marshes, moist soil, open waters, bottomland forests, and crop lands that assist a variety of birds, mammals, amphibians, reptiles and fish in their life cycles.

Throughout the River corridor, two of the most historically prevalent and now highly impacted habitat types are forest and aquatic vegetation. The impacts of water level fluctuation, sedimentation and development have been particularly severe south of the Quad Cities.

3.2.1 Forested Resources³⁴

Forests in the UMRS are unevenly distributed along floodplain areas. Forests are more often present in periodically flooded lands adjacent to the rivers. They are less often present in areas that are rarely flooded, such as terraces and levee protected land. Despite a reduction in acreage over the past two centuries, the floodplain forests in the UMRS remain a vital component of the river ecosystem by serving the needs of fish, wildlife and human communities.

Mixed silver maple communities constitute the majority of the floodplain forests in the UMRS. Approximate composition of the UMRS floodplain forests is 80 percent mixed silver maple, 10 percent oak-hickory, 5 percent willow and cottonwood combined, and 5 percent other communities. The acreage of oak-hickory communities was reduced drastically because the rarely flooded, well-drained terraces they occupied were more desirable for cultivation and because the wood was valued for fuel and building material. In many areas, a decrease in willow and cottonwood communities came about because these communities require specific flooding and drying cycles and new depositional soil to reproduce - events that do not occur regularly since lock and dam construction.

All refuge divisions have some bottomland forest components, and a few are almost completely forested (Long Island and Big Timber Divisions). Most of the floodplain forest on the Complex was severely damaged by lengthy inundation during the flood of 1993, causing high mortality rates. The canopy has opened with the falling of dead trees, allowing new seedlings a chance to grow. This early successional growth will provide structural diversity to a variety of passerines using the forested portions of the Complex.

34. Material from this section edited from Ecological Status and Trends of the Upper Mississippi River System, 1999, USGS

3.2.2 Wetland Resources

Emergent and submersed aquatic plants were present but not abundant in the Upper Mississippi River before the construction of locks and dams in the 1930s flooded thousands of hectares of marsh, bottomland forest, and agricultural areas. The creation of navigation pools abruptly altered the hydrology of the River and the diversity, abundance and distribution of aquatic plant species.

Following lock and dam construction, the backwaters created by the impoundments teemed with new life including waterfowl, wading birds, amphibians and fish. These wetlands grew lush stands of vegetation used by wildlife for various portions of the life cycle such as feeding and spawning. However, many of these backwater wetlands have accrued fine sediments and contaminants over the decades following construction. Initially the backwaters provided firm soil conditions to support vegetative growth, but the fine silt deposited over the years will not support emergent or submergent vegetation.

As agricultural levees were constructed in the floodplain, landowners drained and filled wetlands to produce corn and other row crops. Approximately 50 percent of the natural floodplain habitat in the Lower Impounded Reach (Pools 14-26) and Illinois Rivers has been converted to agricultural uses. More than 80 percent of natural floodplain habitat has been lost in the Unimpounded Reach. Statewide, in Illinois and Iowa, 96 percent of the wetlands have been lost.

Some of this former wetland habitat has been restored in Refuge divisions within the Mark Twain NWR Complex, including Louisa, Keithsburg, Clarence Cannon, Delair and Batchtown.

3.2.3 Grassland Resources

Very little of the current Complex is in grassland habitat due to the hydrological changes in the floodplain following impoundment. However, General Land Office surveys and survey notes have helped researchers to reconstruct a picture of the habitat present in the Mississippi River Valley prior to European settlement. Prairie cordgrass, a fire-dependent grass species, was probably a predominant species in the Mississippi River floodplain. The floodplain between pools 25 and 26, (Clarksville, Missouri, to Alton, Illinois), was dominated by a prairie community prior to settlement. Timberlands were restricted to islands, the margins of the River and its tributaries, and valley slopes.

Many of the divisions in the Complex contain managed grasslands. The Horseshoe Bend Division in the Iowa River floodplain has about 250 acres of prairie restored on the highest elevations. In addition, more than 2,000 acres are managed as open grasslands and wet meadows. The Horseshoe Bend prairie is the only large grassland tract found on the Mark Twain NWR Complex. It is interesting to note that following the Flood of 1993, small patches of prairie cordgrass began to reappear on several divisions including Louisa, Horseshoe Bend and Clarence Cannon NWR. It would be desirable for this native species to continue spreading through the floodplain.

3.2.4 Invasive Species

More than 135 non-native species have been introduced to the Mississippi River Basin during the past 100 years, including non-native mammals, birds, insects, mollusks, fish and plants. Exotic, invasive or alien species cause vast ecological and economic damage, sometimes impacting human health. These species range across almost every ecosystem

of the country. Invading species are usually very successful when introduced to a new environment because they have no natural enemies, and they can usually find a niche to exploit.

Many units of the Mark Twain NWR have noxious and exotic weeds that are controlled biologically, mechanically, physically or, when necessary, chemically. Missouri, Iowa and Illinois each have State noxious weed laws that require public lands to control specific weeds including marijuana (*Cannabis sativa*), musk thistle (*Carduus nutans* L.), Canada thistle (*Cirsium arvense*), Johnson grass (*Sorghum halepense*), field bindweed (*Convolvulus arvensis*) and purple loosestrife (*Lythrum salicaria*).

A new genetic strain of common reed (*Phragmites australis*) is frequently regarded as an aggressive invader of wetlands. The species has colonized in areas just north of the Complex.

The Service has made prevention and control of invasive plant and animal species a top priority. It is the policy of the Department of Interior, the Service and Region 3 that all reasonable steps should be taken to minimize or, when feasible, eliminate dependence on chemical pest control agents. Reduction of chemical usage on Service lands is unquestionably the best thing to do for the resources in our care.

3.2.5 Sedimentation and Water Quality³⁵

The quality of water and sediment in the UMR reflects both natural processes and human influences that occur across varying scales of time and space. Sediment and nutrient inputs to the system have been altered by land-use changes that occurred over more than a century and nearly 200,000 square miles of land surface. Many features of the river change naturally from upstream to downstream. For example, the reach below the confluence of the Missouri River has long differed from the reach upstream. Human activity accentuates these differences. Important natural and human-caused events also occur on small scales of space and time: localized sources of contaminants, large floods, and spills of toxic substances can have a notable effect on sediment and water quality.

In some ways water quality in the UMR has improved in recent decades. Gross pollution by domestic sewage has been reduced since passage of the Federal Water Pollution Control Act of 1972 which mandated secondary treatment of sewage effluents. However, the river continues to receive an array of contaminants from agricultural, industrial, municipal, and residential sources. The risks and threats of many of these contaminants to the biota of this riverine ecosystem are largely unknown.

All reaches of the Upper Mississippi River are contaminated with a complex mixture of agricultural chemicals and their degradation products. Mean concentrations of herbicides in water from the main stem Mississippi River during 1987- 1992 did not exceed maximum contaminant level values for drinking water. However, it is unclear whether agricultural chemicals adversely affect biological communities in the river. For example, the responses of submersed aquatic plants to inflows of herbicides after spring and summer storms are unknown.

35. Material in this section edited from the Ecological Status and Trends of the Upper Mississippi River System, 1999, USGS.

The riverine ecosystem seems to be threatened by nutrients from nonpoint and point sources. It is possible that toxic conditions in the sediment have contributed to recent widespread declines of fingernail clams in the UMR. Fingernail clams are sensitive to unionized ammonia, which may reach toxic concentrations in the sediments during low-flow conditions in summer. Changes in nutrient and sediment exported from the UMR basin to the Gulf of Mexico may be having an adverse effect on the Gulf ecosystem (Gulf Hypoxia).

Concentrations of dissolved heavy metals in the UMR are considerably less than U.S. Environmental Protection Agency's guidelines for maximum concentrations in drinking water and in water supporting aquatic life. However, concentrations in suspended and deposited sediments often exceed maximum contaminants levels, and toxic substances accumulated in the bed sediments could remain a potential problem for decades. In particular, contaminated fine-grained sediments deposited during the past century into Lake Pepin (Pool 4) and other depositional sites downstream from metropolitan areas along the river represent a huge reservoir of potentially available toxic substances, posing a continuing hazard to riverine biota. Juvenile bluegills exposed for 28 days to 1 g/L of resuspended sediment from Lake Pepin suffered 24 percent mortality, but the toxic agent in the sediments was not identified.

Human activity has increased the rates of sediment delivery and deposition within the Impounded Reach of the UMR, and suspended and deposited sediments have affected this ecosystem in various ways. Many areas supported dense beds of aquatic plants before an abrupt decline the late 1980s. Reestablishment and recovery of submersed aquatic vegetation in these areas has been hindered by inadequate light penetration caused by turbidity and suspended solids. A variety of water depths and current velocities support a more diverse biological community by providing suitable habitats for an array of fish and wildlife species with differing habitat requirements. Over time, however, the combined processes of erosion and sedimentation have diminished the diversity of water depths in the UMR. The conversion of backwater lakes and marshes to shallow, turbid mud flats in the Illinois River has caused the loss and ecological degradation of many backwater lakes and adversely affected habitat quality and quantity for many fish and wildlife species.

Reduction in sediment inputs to the impounded Upper Mississippi River could retain fertile soil in agricultural fields and reduce entry of sediment and associated contaminants into the river.

3.2.6 Geomorphology and Soils

3.2.6.1 Geomorphology

The upper floodplain reach of the UMR extends from the headwaters to Clinton, Iowa (Pool 14). It is characterized by a narrow river-floodplain terminating at steep bluffs. Varying floodplain topography created by glacial and geologic processes, combined with seasonal flood pulses, created many off-channel permanent and ephemeral aquatic habitats. Deepwater wetlands were present where oxbows, side channel closures, and braided channels occurred. The unregulated river consisted of deep pools separated by shallow bars (shoals) and rapids; there were many rocks and snags.

The lower floodplain reach of the UMR lies between Pool 15 and Alton, Illinois (Pool 26). It flows across glacial outwash below Clinton, Iowa to Fulton, Illinois (Pool 14); between Fulton and Muscatine, Iowa (Pool 16), it flows over or near bedrock. Below Muscatine, the floodplain expands across a wide alluvial valley between high bluffs. Between Clarksville, Missouri (Pool 24) and Alton, Illinois, the average width of the valley floor is 5.6 miles, and

the average slope is 0.5 foot per mile. The floodplain contained many wetlands of various sizes and shapes formed by channel migrations, natural levee formation, and scour. Wooded islands were common in floodplain reaches.

Below the confluence of the upper Mississippi and Missouri Rivers, the Middle Mississippi River takes on a much different character. The river flows through alluvial lowlands known as the American Bottoms to the confluence with the Ohio River. Missouri River flows contributed significant water and sediment inputs that made the Middle Mississippi environment quite different from the upper Mississippi and Illinois Rivers. The channel was deeper and wider than upstream, and many sand islands and side channels were created and destroyed with fluctuating water levels. The channel was much more dynamic than upstream because flows were greater (Theiling 1996).

About 160 kilometers downstream from St. Louis, the Mississippi River flows through Thebes Gap, which resembles the stem of an inverted funnel. Where it exits the gap, the constricted river widens as it enters an ancient sediment-filled lobe of the Gulf of Mexico called the *Mississippi Embayment*. The Mississippi River valley expands to a width of about 50 miles where it meets the mouth of the Ohio River. Floodplain geomorphology provides the template upon which plant communities and habitats develop. The geomorphology and topographic features of the river are diverse along its length, and also laterally from the channel to the bluffs. The longitudinal profile of the upper Mississippi River can be divided into at least ten major geomorphic reaches (Fig. 1 and 2; USACE 1999). The limits of the reaches are defined as:

- Geomorphic Reach 1: Pools 1-3
- Geomorphic Reach 2: Pool 4 (Lake Pepin)
- Geomorphic Reach 3: Pools 5 B 9
- Geomorphic Reach 4: Pools 10 B 13
- Geomorphic Reach 5: Pools 14 - 17
- Geomorphic Reach 6: Pools 18 - 19
- Geomorphic Reach 7: Pools 20 B 22
- Geomorphic Reach 8: Pools 24 B 26
- Geomorphic Reach 9: Below Pool 26 to Thebes Gap
- Geomorphic Reach 10: Thebes Gap to Ohio River confluence

The Mark Twain Complex Area of Ecological Concern begins within Reach 5, and extends through Reach 10. Additional detailed information on the geomorphology of the Mark Twain AEC can be found in the CCP.

3.2.6.2 Soils

Alluvial soil associations predominate those found within the Mark Twain NWR management divisions. Alluvium is water-transported sediment that has been deposited along rivers and streams and on stream terraces.

Many of the floodplain soil associations are defined as hydric, or hydric with inclusions (of other soil types), by the Natural Resources Conservation Service (NRCS). Hydric soil is defined as a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (no oxygen) conditions.

Mississippi River floodplain soils tend to be nearly level in nature and vary from poorly drained to well-drained. Some topographic relief is found within a few divisions such as Louisa and Horseshoe Bend, where some loess soil may be found in the bluffs.

Most of the soil associations mapped by NRCS have noted that they are >well-suited= or suited to trees, habitat for wetland wildlife or crop ground.

3.3 Wildlife

3.3.1 Migratory Bird Species

The Mississippi River is a major bird flight corridor hosting nearly 300 species of migrating or nesting species. The river's north-south orientation and nearly contiguous habitat make it critical to the life cycle of many migratory birds. Diving ducks, swans, pelicans and cormorants use the river's large open water pools. Dabbling ducks, geese, herons, egrets, black terns, bitterns, rails, and numerous resident and neotropical songbirds use shallow backwater riverine wetlands. Bottomland forests support migrating and nesting populations of songbirds, bald eagles, ospreys, herons, egrets, hooded mergansers, mallards and wood ducks.

The Complex bird list contains 294 species that have been observed, with over 110 species known to nest on the divisions. Some point count surveys have been established by LTRM in key navigation pools (4, 8, 13, 26) and by refuge personnel on the Big Timber, Keithsburg and Long Island Divisions. Baseline bird data has been collected on Horseshoe Bend, Harlow and Wilkinson Island Divisions. Additional monitoring is needed to assess use of other refuge divisions and determine trends.

Agricultural, urban and industrial demands have taken their toll on riverine habitats, reducing and fragmenting the remaining critical areas. Concerns about the long-term viability of bird populations that require these habitats relates directly to the adverse effects of sedimentation, operation and maintenance of the 9-foot channel navigation project, navigational developments, industrial and municipal effluent, urban and agricultural runoff, recreation, and other human-induced influences.

Waterfowl are the most prominent and economically important group of migratory birds using the river corridor. Non-consumptive use of bird resources also is important on the Mississippi River. Bird watching at developed recreation areas accounted for approximately 15,000 public-use days in 1990.

3.3.2 Fish Species

There are at least 156 species of fish present in the mainstem Mississippi River. About 50 species are common or abundant in certain pools or reaches. Gizzard shad, common carp, and emerald shiner are the three most common species found River-wide. Although the Upper Mississippi River still hosts most of the species that were present historically, the relative abundance and distribution of some species has changed dramatically in the last 100 years. Some of these changes are attributable to events such as the introduction of the common carp, flood protection projects, and construction of the Keokuk, Iowa, hydroelectric dam in 1913 and subsequent locks and dams in the 1930s.

Fisheries management on the UMRS is critical, because, among biotic resources, fishes support the greatest number of commercial and recreational uses. Direct expenditures to support this popular activity are well over \$100 million dollars per year.

Despite the continued presence of many fish species, their abundance, size, and distribution may have changed as a result of human activity. For instance, fish movement of many species has been impeded by navigational dams (e.g., skipjack herring, American

eel, sturgeons, paddlefish) but other species (i.e., bluegill, largemouth bass) have increased in abundance because of their dependence on lake-like backwaters provided by the impounded waters.

The physical complexity of the unimpounded river was lost with navigation improvements such as training and closing structures. Backwaters, side channels and islands, which provide spawning and over wintering habitat for fish, have disappeared due to sedimentation and floodplain management. Species diversity in this stretch from St. Louis to Cairo, Illinois, is less than in reaches within the impounded river.

Exotic species such as the common carp, and its relatives, the grass, silver and bighead carp dominate commercial fish catches. The round goby, a native of Asia, is making its way down the Illinois River and will eventually get to the Mississippi River. These introduced species compete with native fish for habitat and prey.

3.3.3 Freshwater Mussels

In the main stem of the UMR, 51 species of freshwater mussels have been recorded, although only 30 species are thought to currently exist (Lubinski and Theiling 1999). Freshwater mussels are typically found buried in the substrate in beds containing several different species with similar habitat requirements. Most of these species require flowing water and coarse gravelly substrates, although some survive well in silty lake-like conditions in backwaters. Water and sediment quality are important habitat criteria for mussels.

3.3.4 Mammals, Upland Game Birds

Mark Twain NWR divisions are home to many resident mammal species including white-tailed deer, fox squirrels, cotton-tail rabbits, red fox, coyotes, raccoons, striped skunks, muskrats and beavers. In addition, mice, gophers, voles and moles enhance the diversity and prey base for larger mammals, snakes and raptors.

Four species of upland game birds reside on Complex lands. These are bobwhite quail, ring-necked pheasant, wild turkeys and mourning doves (although there is currently no season on mourning doves in Iowa).

3.3.5 Amphibians and Reptiles

The amphibians and reptiles using the complex are also numerous. Species regularly seen are snapping turtles, painted turtles, box turtles, fox snakes, water snakes and various garter snakes. The complex harbors numerous frog species including Blanchard's cricket frog, western chorus frog, northern spring peeper, bull frog, leopard frog and northern crawfish frog. American and Fowler's toads are also common on Complex lands.

3.3.6 Federally Listed Threatened and Endangered Species

The Area of Ecological Concern (AEC) includes 34 counties in three states with a total of 12 Federally listed endangered or threatened species. These species, the counties in which they are currently listed, and brief habitat descriptions are as follows:

3.3.6.1 Mammals

Indiana bat (*Myotis sodalis*): Muscatine, Louisa, Des Moines, and Lee Counties in Iowa; Henderson, Adams, Pike, Jersey, Madison, Monroe, Jackson, Union, and Alexander Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

During the summer, the Indiana bat frequents the corridors of small streams with well developed riparian woods as well as mature upland forests. It forages for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats varies by season, age, and sex and ranges up to 81 acres (33ha). It roosts and rears its young beneath the loose bark of large dead or dying trees. It winters in caves and abandoned mines.

Gray bat (*Myotis grisescens*): Pike, Madison, Jackson, and Alexander Counties in Illinois

The gray bat occupies a limited geographic range in limestone karst areas of the southeastern United States, including Missouri and Illinois. With rare exception, the gray bat roosts in caves year-round. In winter, most gray bats hibernate in vertical (pit) caves with cool, stable temperatures below 10 degrees Celsius. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer (0.6 mile) of rivers or reservoirs over which bats feed. The summer caves are warm with dome ceilings that trap body heat. Most gray bats migrate seasonally between hibernating and maternity caves. Both types of caves are present in Missouri and Illinois. Gray bats are active at night, foraging for insects over water or along shorelines, and they need a corridor of forest riparian cover between roosting caves and foraging areas. They can travel as much as 20 kilometers (12 miles) from their roost caves to forage.

3.3.6.2 Birds

Bald Eagle (*Haliaeetus leucocephalus*), breeding: Muscatine, Louisa, and Des Moines, Counties in Iowa; Adams, Pike, St. Clair, Madison, Randolph, Jackson, Union, and Alexander Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

Bald Eagle, wintering: Scott, Muscatine, Louisa, Des Moines, and Lee Counties in Iowa. Adams, Alexander, Calhoun, Hancock Henderson, Jackson, Jersey, Madison, Mercer, Monroe, Pike, Randolph, Rock Island, St. Clair, and Union Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The listing for the bald eagle has recently been changed from endangered to threatened.

Least Tern (*Sterna antillarum*) Alexander and Jackson Counties in Illinois

It nests on bare alluvial or dredged spoil islands and sand/gravel bars in or adjacent to rivers, lakes, gravel pits and cooling ponds. It nests in colonies with other least terns and sometimes with the piping plover. There is no critical habitat designated for this species.

3.3.6.3 Fish

Topeka shiner (*Notropis topeka*) Clark County in Missouri.

The Topeka shiner is a minnow of small, clear, low order prairie streams. The dominant substrate type of these streams is most often clean gravel, cobble or sand, although stream bottoms of bedrock or clay hardpan are not uncommon. These streams may cease to flow during dry seasons but permanent pools are maintained by percolation of water through the stream bed, spring flow, or groundwater seepage. Topeka shiners most often occur in pool or run areas of streams, seldom being found in riffles.

Pallid sturgeon (*Scaphirhynchus albus*): Illinois and Missouri counties below the confluence of the Missouri River.

The endangered pallid sturgeon (*Scaphirhynchus albus*) is found in the Mississippi River downstream of its confluence with the Missouri River. The entire stretch of river is considered potential habitat. Little is known of its habitat preferences, however, telemetry studies and commercial fishing bycatch indicate that adults are associated with main channel borders and scour holes. Juveniles may utilize shallower portions of channel borders and downstream island tips. It is suspected that sand/gravel bars may be utilized for spawning.

3.3.6.4 Mussels

Higgins-eye pearly mussel (*Lampsilis higginsii*): Scott, Louisa, and Muscatine Counties in Iowa. Rock Island, Mercer and Henderson Counties in Illinois; and Marion County Missouri.

This species prefers sand/gravel substrates with a swift current and is most often found in the main channel border or an open, flowing side channel.

Fat pocketbook (*Potamilus capax*): transplanted populations in Hancock and Pike Counties Illinois; and in Lewis, Clark, Pike, and Ralls Counties in Missouri.

The fat pocketbook is a freshwater mussel found in sand, silt and clay bottoms, in flowing water a few inches to more than eight feet in depth. The status of this species is unknown, and may be extirpated.

Pink mucket pearlymussel: St. Louis County in Missouri.

The pink mucket pearlymussel is found in medium to large rivers, in habitats ranging from silt to boulders, rubble, gravel and sand substrates in moderate to fast-flowing water, at depths ranging from 0.5 to 8.0 meters. The pink mucket occurs in the Black River in Wayne and Butler counties; the Little Black River in Ripley County; the Meramec River from the Bourbeuse River confluence downstream to the Highway 231 bridge in Franklin, Jefferson and St. Louis counties; the Big River in Jefferson County; the Gasconade River in Maries, Osage and Gasconade counties; the Osage River downstream of Bagnell Dam to its confluence with the Missouri River; and the Sac River in Cedar County. Increases in turbidity and suspended sediments cause nutritional stress and mortality in the pink mucket pearlymussel.

3.3.6.5 Reptiles

The Mark Twain AEC is within the historical range of the massasauga rattlesnake and copperbelly watersnake (*Nerodia erythrogaster neglecta*). The massasauga is a candidate species for listing. Known populations of this snake are currently limited to small areas outside the Area of Ecological Concern in Illinois, but habitat exists on Complex lands to support this reptile. However, no populations are known to exist.

The copperbelly watersnake is listed as threatened in Michigan, Indiana and Ohio. However, a recently confirmed finding of this species on the Port Louisa NWR and Lake Odessa State Wildlife Area means that the snake may be a candidate for listing in Iowa.

3.3.6.6 Plants

Decurrent false aster (*Boltonia decurrens*): Jersey, Madison, Pike, and St. Clair Counties in Illinois; and St. Charles County, Missouri

The decurrent false aster occupies disturbed alluvial soils in floodplains of the Upper Mississippi and Illinois rivers. There is no critical habitat listed for this species.

Running buffalo clover (*Trifolium stoloniferum*): St. Louis County, Missouri

Running buffalo cover is a stoloniferous, perennial clover with erect flowering stems up to 16 inches tall. Running buffalo clover seems to favor moist, partially shaded woodlands, sometimes along stream or river terraces. It is sometimes found in areas disturbed by grazing or mowing that may suppress competing species. Management activities consistent with the maintenance of open woodland habitat should benefit populations.

3.3.6.7 Invertebrates

Illinois cave amphipod (*Gammarus acherondytes*): Monroe and St. Clair Counties in Illinois.

The Illinois Cave amphipod is a species that lives in streams primarily in the dark zone of caves in parts of the Salem Plateau of Illinois. Little is known of the biology and habitat requirements of this species although it has been collected in groundwater mainstream gravel riffles, tributaries, rimstone pools, and from streams with silt overlying bedrock. As a group, amphipods require cool water temperatures and are intolerant of wide ranges in temperature. Limiting factors may include increased nutrient load, sedimentation, hydrologic changes, and other changes in water quality. Historically, it was known to occur in six cave systems in Monroe and St. Clair Counties. Additional populations have been found in four groundwater systems in Monroe County. Its presence has not been recently confirmed in one cave system, and is thought to be extirpated from another in St. Clair County.

3.4 Public Use

The 1997 Refuge System Improvement Act gives priority to six wildlife-dependent recreational uses of national wildlife refuges when these uses are compatible with the purposes for which the refuge was established. These uses, known within the Service as the ABig Six,[®] include hunting, fishing, wildlife photography, wildlife observation, environmental education and environmental interpretation.

Not every division within the Complex is open to each of the Big Six uses. Some refuge divisions are open year-round for public use (Big Timber and Long Island); on the other hand, as a condition of its acquisition from the previous owners, the Delair Division is closed year-round to public use except for specific events. Many of the divisions are closed to public access in the fall and early winter to provide sanctuary for migratory birds. Big game hunting is permitted on seven divisions; fishing is permitted on 13 refuge divisions; upland game hunting is allowed on four divisions; and waterfowl hunting is allowed on three divisions. With 40 percent of all waterfowl in North America relying on the Mississippi Flyway, the opportunities for birding are outstanding.

Wildlife and environmental education programming has been limited due to staff availability, but each station has conducted special events or field trips on an opportunistic basis. Designated hiking trails on the Complex are limited, but visitors can walk, bike, or drive cars on service roads within several divisions during open seasons.

While the Complex refuges are located in rural regions of Iowa, Missouri and Illinois, each Refuge is within 50 miles of a metropolitan area. Two Rivers NWR, Great River NWR and Middle Mississippi River NWR are all near St. Louis, Missouri. Port Louisa NWR is near the Quad Cities (Moline and Rock Island, Illinois, and Davenport and Bettendorf, Iowa). Tourism is increasing within the Upper Mississippi River corridor (Black et al., 1999), providing more opportunities for wildlife education and interpretation. The Great River Road, a network of federal, state and county roads covering 3,000 miles and paralleling the Mississippi River, passes near each Refuge. While the potential exists for the refuges to play a greater role as an educational resource and wildlife observation destination, each office has an inadequate visitor contact station. Public use/education activities account for no more than 10 percent to 15 percent of staff members' job duties at 2002 staffing levels.

3.5 Socioeconomics

The National Environmental Policy Act (NEPA) of 1969 requires agencies to disclose to decision makers and the public what society gains or loses with projects that have the potential of altering the environment. In addition, Executive Order 12898 requires agencies within the Department of Interior to evaluate whether any notable impacts to minority and low-income populations and communities will occur with the proposed project action.

Recently, two economic studies were completed that help characterize the economics of the Mississippi River corridor counties, and the importance of refuges to local community economies.

The Upper Mississippi River Coordinating Committee directed the production of the *Economic Profile of the Upper Mississippi River Region* report. This study provides a snapshot of current regional economic activity dependent on the Upper Mississippi River.

The profile by Black, et al., (1999) encompasses economic activity in all 60 counties in five states, bordering the Mississippi River, including 26 that are outside the Mark Twain Complex boundaries. Specific data to the Mark Twain corridor counties cannot be extrapolated from the totals, but generalities can be implied. The Complex does not include any of the 17 Minnesota or Wisconsin counties included in the report, but does

consist of 14 (of 18) Illinois counties, 5 (of 10) Iowa counties, and 14 Missouri counties. The report uses available databases and literature to characterize ten key economic sectors including:

- Commercial Navigation
- Harvest of Natural Resources
- Water Supply
- Recreation
- Tourism and Cultural/Historical Resources
- Mineral Resources
- Agriculture
- Energy Production
- Manufacturing Natural Resource Services; this last economic sector involves:
 - Wastewater Treatment:* Approximately 280 facilities use the UMR as a sink for discharging wastewater. Dischargers include manufacturers and municipal sewage treatment plants.
 - Wetland Services:* Over 40,000 acres of wetlands in the corridor provide benefits associated with flood control, protection of water quality, water supply, and habitat for wildlife.
 - Wildlife Species and Habitat:* Environmental quality and the health of habitat and species have an intrinsic value, irrespective of human use. This value is reflected in the many past and ongoing efforts to restore and preserve UMR habitat.

Considered together, the 10 economic sectors in the five state area accounts for about \$145 billion in revenue to businesses in the corridor. Approximately 870,000 jobs are associated with this economic activity. The revenue generated by the 10 sectors represents about 40 percent of the total output of the corridor, and 18 percent of the economic activity in the five-state region. Manufacturing is by far the largest sector, generating about \$126 billion in revenues and 602,000 jobs. By removing manufacturing from the equation, revenue data suggest that tourism, agriculture, energy, and commercial navigation are the dominant sectors. The remaining sectors, however, should not be considered less important even though revenue and employment figures are less substantial.

Agricultural land dominates the corridor counties, representing over 70 percent of land in the corridor. Data on average value per acres of agricultural land in different states suggest that the agricultural land in the corridor counties is worth approximately \$23 billion. The second most prevalent land use is forested land, relevant to tourism and recreation. Other land uses in the study area are relatively minor wetland and open water areas are the next most notable, representing about 5 percent of the corridor counties. Residential and industrial land represent only small portions of the study area.

The Service produced *Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation*.⁶ This 1997 report is the first of a multi-phase study investigating the impact of national wildlife refuges on their local economies. It is a broad spectrum report that discusses the income and employment effects that recreational visitors to refuges have on the economies of local regions. In addition, to the economic effects of refuge hunting and fishing programs in local communities, it measures the economic impact of *eco-tourism*,⁷ the relatively recent phenomenon of large numbers of

people traveling substantial distances to take part in non-consumptive uses of the natural environment. Eco-tourism is one way to derive economic benefits from the conservation of wildlife and habitat.

The study found that:

- Recreational visits to national wildlife refuges generate substantial economic activity. In fiscal year 1995, people visited refuges more than 27.7 million times for recreation and environmental education. Their spending generated \$401.1 million of sales in regional economies. As this spending flowed through the economy, more than 10,000 people were employed and \$162.9 million in employment income was generated.
- Non-consumptive use of wildlife at refuges generated far more economic activity than hunting and fishing. Although non-consumptive wildlife users usually stay for shorter periods of time and spend less, their numbers at many refuges far exceed those of hunters and anglers and more than compensate for lower spending per person (Laughland 1997). This is a relevant fact to the conditions throughout the Mark Twain Complex. Since much of the Complex is managed as sanctuary surrounded by areas open to hunting, wildlife observation is a secondary use which can occur on river refuges during the fall.

Another study, conducted by Carlson et al., (1995) measured recreational usage originating from developed sites along the Upper Mississippi River and Illinois River. This study produced basin-wide estimates of the total number of recreation visitors, the activities they engaged in, the amount of money they spent on recreation and the patterns evident in their spending. The researchers estimated that over 12 million daily visits by recreationists took place during the study year. Boating was the most popular activity, with more than half of all visitors participating in this activity (6.9 million boaters).

3.6 Cultural Resources

As a part of the CCP process, the Service contracted for an archaeological and cultural values overview study of the refuge. The resulting report, *AAn Archaeological and Historical Records Study for the Mark Twain National Wildlife Refuge in Illinois, Iowa and Missouri*, by Midwest Archaeological Consulting, (Rusch, McKay, Karstens) was submitted to the Service in draft form in July 1999. The authors divided the study by refuge divisions to facilitate understanding and use of the report. It also included an area within a 2-mile radius outside of each division boundary. Information was provided on nearly 750 previously recorded cultural resources that are located within the Complex and the contextual study area surrounding each of the refuge's 15 divisions. Each of the sites, and its associated information, which are located inside, and those closest outside the refuge boundary (approximately one-quarter mile), have been entered into the Complex GIS system so that the information is readily available for management purposes.

The following summary is based on the overview study and other information as interpreted by the Regional Historic Preservation Officer (RHPO). With approximately 0.5 percent of the refuge having been investigated through detailed archeological survey, the current inventory of 176 known or reported cultural resources sites is thought to be a fraction of the potential sites on the refuge. Although erosion occurs at some sites, the overall trend in the river bottom is to aggrade. Thus deeply buried sites can be expected

and are likely to be in relatively undisturbed condition. Sites and isolated resources from Archaic, Woodland, Mississippian, and historical are known to exist, and many more sites likely exist. Some Complex divisions are close to the Mississippian cultural center at Cahokia, and known Mississippian sites occupy land forms of the kind found on some Complex divisions. In the historic period, river transportation is the single theme that connects all the Complex divisions. In the earliest historic period, people transported materials down-river on flatboats and keel boats, and returned on keel boats or on trails paralleling the river. Landing sites, often with warehouses or stores or residences, exist throughout the length of the river; Turner Landing is known to be on the refuge. Other sites, probably not likely to be identified, would be associated with firewood stockpiling to feed the wood-burning river boats, which reportedly burned up to 10 cords of firewood a day. Land on some divisions is high enough that farming was practical. Other divisions supported camps, cabins, and resorts for hunters. Old roads, including some of historic importance in Missouri, are on or adjacent to Complex divisions. Other than recent administrative and maintenance buildings, no standing structures remain on the refuge. Objectives of the overview study include identifying Indian tribes and other organizations and public groups that might have an interest in cultural resources and historic preservation on the Complex. The study identified 120 organizations and 19 Indian tribes. It also posed noteworthy research questions to guide future archeological and other cultural resources investigation on the Complex.

Chapter 4: Environmental Consequences

This chapter evaluates the potential environmental and social impacts of implementing each management alternative. Table 3, which is located at the end of this chapter, provides a detailed comparison of the alternatives. However, some potential effects will be the same under each alternative and are summarized in the following section.

4.1 Effects Common to All Alternatives

4.1.1 Environmental Justice

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) was signed by President Bill Clinton on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment.

None of the proposed management alternatives disproportionately place an adverse environmental, economic, social, or health impacts on minority or low-income populations. Improvements in any refuge facilities or expanded land base near such population centers as St. Louis will likely benefit minority or low income populations in that they will make wildlife dependent recreational opportunities more readily available to them.

4.1.2 Cultural and Archaeological Resources

During the planning process, an archeological resources study was commissioned for existing Mark Twain NWR divisions. None of the proposed management actions will affect known cultural resources. Coordination with the Regional and State Historic Preservation Officers will provide information regarding cultural resources for proposed land acquisition. Archeological studies and surveys will be performed, as necessary, to assure preservation from proposed actions on acquired lands. In the event an unidentified archeological site is discovered, the project by which it was discovered, will be stopped until the resources are adequately protected.

Cultural resources would be protected as mandated by law under all alternatives.

4.1.3 Climate Change Impacts

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

The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's *Carbon Sequestration Research and Development* (U.S. DOE, 1999) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

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

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

4.1.4 Prescribed Fire as a Management Tool

4.1.4.1 Social Implications

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

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

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

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

The fire prescription portion of the Annual Prescribed Fire Plan for each unit proposed to be burned during the burning season will have specific mitigative measures to deal with unexpected smoke management problems. This will include identified problems that unforecasted wind changes may cause and measures to be employed to protect the public.

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

4.1.4.2 Cultural and Archaeological Resources

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

4.1.4.3 Flora

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

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

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

4.1.4.4 Listed Species

The potential impacts of fire on listed species is likely to be neutral to positive if there is any impact. Of the 12 listed species, 5 are aquatic. The pallid sturgeon, Topeka shiner, Higgins-eye pearly mussel, fat pocketbook, and pink mucket pearly mussel are unlikely to be affected by fire management activities. Bald eagles that nest on the refuge are unlikely to be negatively affected, since burning activities would not typically be carried out during the nesting and fledging period. Fire effects in roosting areas and near known nest trees are anticipated to result in reduced fuel loads and beneficial changes to groundcover and the understory. Least terns are associated with bare sand and gravel bars well away from vegetation for nesting and would not be affected by fire management activities. The Indiana and gray bats would be expected to benefit from fire management activities which reduce fuel loads and open up forest understory. However burn units will be thoroughly surveyed for potential Indiana bat maternal colonies or summer roost trees. Burn plans will reflect consideration of the seasonal requirements of forest dependent endangered species. Because running buffalo clover and decurrent false aster are both associated with open conditions and disturbance, it is likely that the effects of burning will be beneficial by setting back competition. The Illinois cave amphipod is located in the bluffslands adjacent to the AEC and would be unaffected by refuge fire management.

4.1.4.5 Soils

The disturbances to the soil by fire are similar to those caused by any other manipulative practice applied to the land. A farming, logging, or flooding operation will have no greater or lesser impact. All three are applied on the Refuge Complex at the present time.

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

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

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

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

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

4.1.4.6 Escaped Fire

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

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

4.1.4.7 Trapping

Trapping is occasionally used as a management tool under permit or by refuge staff. Removing beaver that are plugging water control structures or muskrats, beaver, or woodchucks that are damaging dikes by undermining them with tunnels are examples of management uses for trapping. The direct impact upon the animal trapped is fatal but impacts upon the overall population of the affected species is negligible in the AEC due to the small number of animals taken and the restricted areas trapped.

4.2 Alternative A: (Expanded Boundaries, Increased River Connectivity)

Restore Riverine Habitat for Migratory Birds and Indigenous Fish and Increase Floodplain Functions Such As Connectivity and Flood Water Storage Via Expanded Boundary and Adaptive Management Techniques (Preferred Alternative).

Broaden Refuge Complex opportunities both to expand river/floodplain connectivity and to manage for habitat diversity for fish and wildlife resources on the Upper Mississippi River System through a Refuge boundary expansion (up to 27,659 acres) and use of adaptive management techniques within the 500-year floodplain of the Area of Ecological Concern.

4.2.1 Listed and Other Species of Interest

Increased connectivity with the river could benefit the pallid sturgeon as well as waterfowl and shorebirds. Restored habitats such as floodplain forest, wet meadow, and wetlands will benefit migratory birds associated with those habitats. As the forest ages, Indiana Bats may benefit from increased roost sites. Periodic flooding could help maintain sandbars favored by the Interior Least Tern. Increased connectivity between the floodplain and river could result in slight reductions in the sedimentation of mussel beds by depositing the sediments elsewhere in the floodplain.

4.2.2 Habitat Management

Under Alternative A there would be an increase in the number of wetlands and the amount of seasonal, semi-permanent, and permanent wetland vegetation due to planned improvements on existing refuge lands. The acquisition of additional lands with some level of protection from the river's fluctuations would also increase the acreage and quality of refuge wetlands. The return of wetlands to a more natural hydrologic cycle, would permit the establishment of a more natural diversity of habitats. Backwater and side channel habitats connected to the river also would be enhanced. In addition, some lands within the potential acquisition boundary would be opened to the river, resulting in an increase in overall floodplain connectivity. Because of these increases in wetland and aquatic habitat diversity and floodplain connectivity, migratory bird, mussel, and fishery resources would be enhanced including the endangered pallid sturgeon.

This Alternative would result in an increase in the amount of forest within the Mississippi River floodplain, as well as enhanced tree species diversity and age structure.. Former cropland in flood prone areas would be restored and reconnected to the river, hard mast trees would be planted, additional lands would be acquired, and a detailed plan for enhancement of forest lands would be developed. The result would be improved habitat for migratory songbirds, waterfowl, red-shouldered hawks, nesting colonial waterbirds, the endangered Indiana bat, and many other species of forest-dependent native wildlife.

There would be an increase in native grassland/wet meadow habitat due to land acquisition and restoration on the Refuge Complex, benefitting grassland-dependent songbird species including Henslow's and grasshopper sparrows, as well as shorebirds, waterfowl, and other resident wildlife species.

Grassland edge sensitive species of migratory birds would benefit from the establishment of three large (>150 acres) of contiguous native grassland/wet meadow complexes. In addition the 500 acres of smaller grassland patches and 400 acres of smaller wet meadow areas would benefit grassland and edge tolerant species. Since this alternative has the second largest acreage (exceeding 1350 acres) of grassland and wet meadow, it will likely be very beneficial for grassland dependent species. However, the increased connectivity of the floodplain to the river will likely somewhat reduce productivity of grassland birds on the Complex due to periodic flooding destroying nests or delaying nesting.

The total acreage of cropland on existing and newly acquired lands would be reduced as lands are converted to wetland, forest, scrub/shrub, and grasslands. However, agriculture would be maintained on approximately 500 acres to provide a dependable supplement to natural food sources for waterfowl, to provide open space for resting areas, and to be used as a management tool to maintain high quality wildlife habitat in refuge wetlands by periodically setting back succession or invasion of undesirable species. Farming techniques would also be used to maintain open fields on approximately 675 acres until they can be converted to another planned habitat type, such as on newly acquired lands.

Since this alternative includes the second largest acreage (1175 acres) in agriculture of any alternative, it will provide significant benefits to those species that utilize such habitats. Waterfowl and deer will benefit in particular. An additional 1000 acres of seed and browse crops planted annually under this alternative will provide a dependable supplement to natural food sources for waterfowl and will provide open space resting areas.

The U.S. Department of Agriculture's definition of prime farmland is cropland, pasture land, range land, forest land or other land, but not urban built-up land, which is capable of being used as prime and unique farmland. This definition excludes lands that are saturated for long periods of time and flood more often than once in two years. But, because of the protection of agricultural land by levees, much of the 500 year floodplain is considered prime farmland. Prior to the 1993 flood, the majority of the floodplain lands had been drained and/or protected by levees. The flood's impact was severe on the drainage and levee system, causing much of the formerly protected lands to lose their prime farmland status. Most of the damaged systems were repaired or replaced after the flood making the protected farmland prime once again. However, lands where protection system have not been repaired do not meet the definition of prime farmland.

Under Alternative A, lands acquired by the Service for the establishment of a refuge in the floodplain may be prime farmland. In considering this impact, the Service has reviewed the Federal Farmland Protection Act, which is administered by the U.S. Department of Agriculture, Natural Resources Conservation Service. In their opinion, the establishment of a refuge would not be an irreversible change of farmland.® On a broad scale, this alternative will have no noticeable effect upon state and nationwide food production over the life of the project.

4.2.3 Sedimentation and Water Quality

Sediment will continue to accrue in areas left open to the river following acquisition. Additional nutrient cycling offered by an open® system may increase contaminant levels where deposited in floodplain soils. However, areas with some protection by modified levees with spillways will benefit from decreased sedimentation. Private lands work will be expanded to improve water quality entering Complex lands. Working with partners in the watershed and the resulting additional protection within the Complex watershed will decrease sedimentation and should improve dissolved oxygen within refuge impoundments. There could be a slight increase in overall floodplain water quality and nutrient settling and recycling capabilities due to refuge lands being more connected to the river.

4.2.4 Floodplain Management

A mixture of managed and open-to-the-river refuge lands will increase opportunities for floodplain connectivity for spawning fish over current conditions. In addition, areas open to the pulse of the river will provide local flood water storage and nutrient recycling, functioning as natural floodplains. The feasibility of restoring natural functions of the floodplain will be carefully evaluated in all refuge expansion areas.

4.2.5 Public Use and Education

Under Alternative A, Complex expansion would permit additional public access to the floodplain and river. Generally, Complex lands are open to the public during daylight hours. State, county and township roads that traverse any portion of the Complex would

remain open to public traffic unless closure was mutually agreed upon by the Service and the appropriate government entity. Access to divisions would be provided from public roads and accommodated at parking lots constructed on Complex lands. Alternative A would permit additional hunting, fishing and non-consumptive public use activities to occur, where compatible with Service and Complex objectives, and the floodplain. Certain areas may be designated closed during migratory periods as a sanctuary for birds and other wildlife.

Within some divisions, hiking trails, observation platforms, information kiosks and auto tour routes would be developed or expanded to provide access for persons with disabilities or an educational experience from a motorized vehicle. Structures will be designed to require minimum maintenance and be minimally at risk during high flow events. Additional environmental education and interpretive activities will be provided, where appropriate. Areas with greater levels of river connectivity will have fewer interpretive opportunities. Law enforcement efforts will be increased.

There may be a slight increase in wildlife disturbance from an increase in recreational users but this will be limited by proper design and location of the recreational facilities. A balance between competing uses and river users should be improved due to the greater area available under refuge expansion and expanded public use areas.

4.2.6 Monitoring

Monitoring of lands acquired under Alternative A will provide a baseline for comparison to follow the biological changes occurring on the land. Monitoring will include vegetative and wildlife responses. Noxious weeds which often invade retired agricultural land will be removed, as necessary, to comply with local regulations. Water quality and sedimentation within newly acquired lands will also be surveyed. Public use surveys as well as habitat and wildlife surveys would also be increased on existing lands. Additional staff will be required for monitoring efforts, to capture the biological changes and maximize opportunities for adaptive management techniques. Existing surveys (vegetative and wildlife) will be expanded.

4.2.7 Coordination and Socioeconomic Impacts

Improved and increased public use access, consumptive and non-consumptive uses, are predicted to promote the Complex and Service mission. Increased visitation to communities will boost local and regional spending; staff additions in local communities will also enhance their economies. Payments in lieu of taxes (revenue sharing) will be made to counties in which refuge divisions are located. By acquiring additional floodplain and leaving it open to the river, there could potentially be a decrease in downstream flood heights, thereby decreasing damage to agricultural and municipal interests.

Acquisition and management of land within the described AEC will have no effect on commercial navigation.

Coordination with other agencies would be improved as the Service sought partnerships to coordinate floodplain management and address sedimentation and water quality issues in the watershed.

The refuge programs and expansion under this alternative would complement the Corps of Engineers Environmental Management Program (EMP) program and the program would provide opportunities for restoration on the refuge.

Under Alternative A, interpretive and environmental education programs on archeological and cultural resources will be presented to the public.

Additional staff will be required to implement Alternative A. However, any staff increases will be determined by future budget allocations and staff ceilings. Increasing staff levels will not only be needed to adequately manage newly acquired lands, but to cover existing deficits. Maintenance of facilities will improve to Service-standard levels. Proposed enhancements and additional facilities would require a substantial increase to current Operations and Maintenance funding. Extra staff would improve and increase habitat management, law enforcement, public use, and biological monitoring efforts.

4.3 Alternative B: Current Program

Current Management Strategies and Acquisition Within Existing Boundaries (No Action)

Limit the Mark Twain NWR Complex land acquisition to completing acquisition within the currently authorized boundaries; current management strategies would continue.

4.3.1 Listed and Other Species of Interest

Under this alternative, the Refuge Complex will continue to restore and manage habitats to benefit threatened and endangered species as well as migratory birds, mussels, fish, and other species of interest to the Service. Existing limited connectivity on some Refuge Complex units between the river and floodplain will limit habitat diversity and access available to fish and wetland associated birds. Smaller forest block size, less diversity in wetland types, and a more artificial hydrologic system compared to Alternative A will negatively impact some edge-sensitive, forest dwelling migratory birds and wetland dependant species. Acquisition of Refuge Complex lands will not occur beyond that which is currently authorized, limiting additional habitats which could be restored or managed to benefit species of interest. Maintaining current practices will likely have a neutral to slight positive impact on the threatened and endangered species in the AEC as habitat restoration and management continues at the current rate.

4.3.2 Habitat Management

The current distribution and quantity of wetland and aquatic habitats would remain largely unchanged. Fishery resources would increase slightly as lands are acquired within the authorized boundary. The amount of habitat available for waterfowl would stay the same or increase slightly as remaining refuge inholdings are acquired.

The impacts of agriculture under this alternative would be similar to those described for Alternative A. The total of 1075 acres in agriculture under this alternative is similar to the 1175 acres under Alternative A. However, a total of 2,500 acres of seed and browse crops will be planted under this alternative to provide a dependable supplement to natural food sources for waterfowl and to provide open space rest areas.

Two large (>150 acres) areas of contiguous native grassland/wet meadow would be provided under this alternative. Therefore, edge-sensitive grassland species would benefit less under this alternative than under Alternative A and D where three large grassland areas are provided. However, those species would benefit more under this alternative than under Alternative C where one large area is provided.

This alternative would benefit grassland associated or edge associated species by providing approximately 550 acres of smaller patches of grassland and wet meadow areas. This is less than Alternatives A and D but more than Alternative C.

The current decline in species diversity and age structure in forest habitats and the minimal regeneration of forest would continue. Habitat available to waterfowl and non-game migratory birds would increase slightly as remaining authorized acquisitions are purchased. The effect on wildlife populations would not change notably from current conditions.

The size and quality of agriculture and other terrestrial habitats would continue.

4.3.3 Sedimentation and Water Quality

Silt and sediment would continue to accumulate at the current rate on Complex lands. Current unacceptable conditions of water quality, nutrient settling, and nutrient recycling in the floodplain would continue.

4.3.4 Floodplain Management

Current levels of water control on refuge wetlands and connectivity to the river would not change.

4.3.5 Public Use and Education

Existing public access and recreational opportunities would increase slightly as additional lands are added to the Complex. Existing recreational facilities would be maintained. Disturbance of wildlife by recreationists would not increase or decrease. Nesting bald eagles and waterfowl would be protected from disturbance by regulations and law enforcement.

4.3.6 Monitoring

The Complex would continue to rely on USGS monitoring data. Sporadic wildlife surveys would be conducted as time permits.

4.3.7 Coordination and Socioeconomic Issues

Planned land acquisition would have no or slightly positive effect on the economy of local communities.

Interagency coordination would continue at the current level or improve slightly due to coordination efforts during the comprehensive conservation planning process. The current participation in the Army Corp of Engineers- Environmental Management Program would continue to be enhanced.

Management of existing facilities would continue at below Service standards.

4.4 Alternative C: Existing Boundaries, Maximum River Connectivity

Increase River Connectivity Via Spillways, Levee Breaches, and Acquisition Within Existing Boundaries

Increase the river/floodplain connectivity by reducing effectiveness of existing protective levees, even at the cost of increased sedimentation and loss of water level management capability.

4.4.1 Listed and Other Species of Interest

Most listed species would benefit under this alternative due to the maximum connectivity between the river and floodplain of any of the alternatives considered in this document. The Decurrent False Aster, Pallid Sturgeon, and Interior Least Tern would likely benefit from increased habitat due to regular flooding of the area. Endangered mussels could benefit from a slight reduction in siltation of the mussel beds as the flood waters spread out and deposited their sediment loads elsewhere in the floodplain. There could be additional feeding areas for such species of interest as waterfowl and fish provided by the back waters and diverse wetlands created by the flooding. However, the Indiana Bat could be negatively impacted if the flooding frequency and duration prevented the regeneration of floodplain forest areas or resulted in a loss of some floodplain forest areas. This could also negatively impact edge-sensitive migratory birds. The successful management of moist soil areas to benefit waterfowl and other migratory birds would be compromised by the inability to control water levels and flooding frequency and duration.

4.4.2 Habitat Management

Under Alternative C, minimal habitat management would occur due to the rivers fluctuating water levels and the desired resource goals would be difficult to achieve. Increased sedimentation would cause further deterioration of existing wetland and aquatic habitat. The loss of seasonally and semi-permanently flooded wetland vegetation and loss of bathymetric diversity will negatively affect waterfowl, shorebirds, marsh birds, fish, and other wetland-dependent species.

Approximately 250 acres of smaller patches of grassland and wet meadow are provided under this alternative. This will benefit grassland and wetland species that are not sensitive to disturbance by species that inhabit adjacent habitats or areas where two or more habitats converge. One large (>150 acres) of contiguous grassland habitat is provided to benefit edge-sensitive grassland species under this alternative. This is the least amount of such habitat of any of the alternatives.

Approximately 500 acres of seed and browse crops planted annually will provide a dependable supplement to natural food sources for waterfowl, and to provide needed open space resting areas. Cropland associated species such as deer and waterfowl at certain periods will benefit from the 875 acres of cropland that will be maintained permanently or until converted to another habitat. This is the least amount of agricultural land of any of the alternatives.

Reduced ability to set back succession on refuge wetlands and grasslands will likely increase the forest component which will benefit forest dependent birds and other wildlife species. Acquired lands will be taken out of agriculture and converted to forest. Early

successional forest will increase temporarily. However, the overall diversity of tree species will be minimal with a continued predominance of silver maple. There may be an increase in scrub/shrub habitat under Aopen® conditions. Lands opened to the rivers fluctuations will be subject to invasive and exotic species including reed canary grass, purple loosestrife and zebra mussels.

Fishery resources may be improved temporarily by greater connectivity of riverine and shallow water habitats, but over time increased sedimentation will cause loss of aquatic vegetation and reduced bathymetric diversity. Invasive non-native fish species will have increased access to Refuge Complex waters. Increased frequency and duration of flooding will reduce cropland production on refuge lands and reduce managed grassland diversity.

4.4.3 Sedimentation and Water Quality

Refuge divisions currently sequestered from high water events will accrue sediment under this alternative. Contaminant levels will increase within refuge boundaries as protected land is exposed to the flow of river water. However, trapping contaminated water and nutrients within refuge lands could fractionally improve water quality downstream (e.g., Gulf hypoxia issues).

The increased floodwater storage capacity will likely benefit overall floodplain water quality by providing nutrient settling and recycling areas and reducing flooding impacts downstream.

4.4.4 Floodplain Management

Under Alternative C, there will be a slight increase in connectivity to the river providing easier fish access to the floodplain. There may be a slight reduction in downstream flood heights and slight increases in nutrient recycling within the floodplain.

4.4.5 Public Use and Education

Alternative C calls for an increased connectivity to the river. Public access to some locations will be precluded during high water events. Existing facilities (roads, parking lots, kiosks) would receive little maintenance or be removed because of fluctuating water levels. Environmental education and interpretive activities would decrease except at the Riverlands office near St. Louis, Missouri. The affected refuge units would provide less habitat diversity and opportunity for environmental interpretation, and fewer facilities for visitors. Disturbance of wildlife due to recreational use would not increase under this alternative. However, hunting, fishing and trapping opportunities would increase as new lands are added to the refuge.

4.4.6 Monitoring

Minimal monitoring will be done with Aopen to the river® conditions. Additional staff, and/or assistance from the Biological Resource Division of the U.S. Geological Survey, would be needed to monitor increased sedimentation, contaminants, rates of change in vegetative habitat types, or changes in use by wildlife.

4.4.7 Coordination and Socioeconomic Issues

The acquisition and management of additional floodplain lands would lead to a slight decrease in downstream flooding. Fewer visitors could be expected on divisions and facilities that are affected by frequent seasonal flooding. These decreases would be felt by local economies as visitors that currently use Complex divisions for non-consumptive uses (e.g., bird watching, hiking) would have diminished access to open areas.

Interagency coordination would see a slight improvement under this alternative, primarily due to the CCP planning effort and public involvement in it. Under Alternative C, additional staff would not be necessary because minimal management will occur. The initial costs to breach levees would be high, but over the long run, operations and maintenance costs would be lowered. Boundary posting and policing of recreational sites would encompass the majority of staff time. Additional law enforcement efforts would be needed under a post and patrol program.

Alternative C would not result in negative impacts to cultural resources. Cultural sites on acquired lands would receive protection under Federal laws.

4.5 Alternative D: Existing Boundaries, Least River Connectivity

Enhance Habitat Protection Via More Flood Protection, Less River Connectivity on Refuge Lands Within Existing Boundaries

Increase flood protection on existing lands and lands acquired within currently approved boundaries in order to increase effectiveness of habitat management practices on wetlands, grasslands, and bottomland forests, even at the cost of reduced river connectivity.

4.5.1 Listed and Other Species of Interest

The loss of connection between the river and its floodplain under this alternative could negatively impact the Pallid Sturgeon, Interior Least Tern, Decurrent False Aster, and the mussel species of interest to the Service. Reduced flooding frequency or access to the floodplain would mean reduced spawning and feeding habitat for fish, reduced natural habitats for wetland dependant birds, greater siltation or scouring of mussel beds, and a more artificial hydrologic cycle. Sandbar formation and maintenance could be negatively impacted by this as well as the periodic inundations that seem to benefit the Decurrent False Aster by inhibiting less flood-tolerant species. The ability to control flooding could aid in the restoration of floodplain forest, benefitting forest associated species. The water control could also facilitate moist soil management, benefitting waterfowl and other wetland dependant migratory birds.

4.5.2 Habitat Management

Under Alternative D, extensive levee protection on Complex lands would permit more reliable and predictable habitat management within current refuge divisions. The amount and diversity of wetland vegetation would increase due to the re-creation of natural water level changes, providing more high quality habitat for waterfowl, shorebirds, marsh birds and other wetland-dependent wildlife species. The levees would permit improved water level management because of protection from flooding and from rapid artificial changes in

river level caused by water releases at the dams. High levees would protect wetlands and other habitat types from increased sedimentation. However, backwater and side channel fisheries and mussel habitat would be reduced, as would fisheries access to the floodplain. Even with levee protection, water seepage can limit management timing on some moist soil units and croplands. And levees can occasionally overtop or fail when river levels are high. There would be a considerable expenditure for maintenance, habitat management, and added structures and facilities.

This Alternative would result in enhanced tree species diversity and age structure. Formerly flood prone areas could be restored with hard mast trees. Acquired lands would be taken out of agriculture and converted to forest. The result would be improved habitat for migratory songbirds, waterfowl, red-shouldered hawks, nesting colonial waterbirds, the endangered Indiana bat, and many other species of forest-dependent native wildlife.

Other habitat types could be maintained more easily due to increased water level control, resulting in benefits for grassland birds, waterfowl, and resident wildlife.

Approximately 1060 acres of smaller patches of grassland and wet meadow areas will benefit grassland and wet meadow species not negatively impacted by habitat edge effects. Edge sensitive species will benefit from three large (>150 acres) areas of contiguous native grassland/wet meadow. In both cases, the affected species will benefit from the presence of food and cover.

Similar to Alternative A, approximately 1000 acres of seed and browse crops will be planted annually to supplement natural waterfowl food sources and to provide needed open space resting areas for waterfowl. Agricultural techniques will be utilized on approximately 700 acres to set back succession or the invasion of undesirable species, maintaining high quality habitat in refuge wetlands in the process. Farming will also be used to maintain approximately 675 acres of open fields until they can be converted to other planned habitat types. Species such as deer will benefit directly from the use of the fields and crops as well as waterfowl at certain times of the year. Setting back successional processes through the use of farming techniques will benefit wetland associated species groups such as shorebirds, wading birds, and waterfowl by providing desirable feeding and loafing sites.

4.5.3 Sedimentation and Water Quality

Less sedimentation is likely to occur by sequestering refuge divisions from most flooding and high water events. Upland runoff within the Complex watershed would continue sending sediments and contaminants into the divisions. Vegetative diversity could decrease if Complex wetlands transition to Atreatment@ wetlands rather than producing optimal vegetative habitat for migratory birds.

4.5.4 Floodplain Management

Under Alternative D, there will be far less connectivity to the river, decreasing spawning habitat for fish. There could be a slight increase in downstream flood levels if the currently-open divisions, which provide floodwater storage, are leveed off from the river. A decrease in the nutrient recycling process will occur without the river-s access to its floodplain.

4.5.5 Public Use and Education

Alternative D could potentially offer increased public use access because of levee protection. Increased staffing on each refuge would be necessary to maintain additional structures, facilities and to provide law enforcement. Levee protection could provide opportunities for added hunting, fishing, bird watching and other consumptive and/or non-consumptive uses. The levees would also provide increased access for walk-in visitors. All facilities would be F I 00cl friendly® due to potential levee failure.

4.5.6 Monitoring

Monitoring of lands and wildlife would be increased under Alternative D. New surveys would observe the biological changes occurring following levee construction. Surveys will also include vegetative, and wildlife responses. Additional staff would be required to acquire biological data.

4.5.7 Coordination and Socioeconomic Issues

Separating each division from the river through levees will permit enhanced opportunities for wetland management (more intensive management), providing avenues to reach habitat management objectives. Maintenance of pumps, structures, ditches, etc., associated with a more intensive wetland management style will be very expensive. However, staffing requirements may not increase above and beyond that suggested under Alternative A, due to a reduced land acquisition component.

Downstream flooding levels may rise slightly due to the decrease in floodplain storage available on refuge lands. Downstream agriculture, municipalities and businesses may be affected by increasing levee heights on the Mark Twain divisions. However, new lands added to the refuge would help to mitigate this impact. Converted croplands on newly-acquired lands would provide floodwater storage capability.

Interagency coordination would see a slight improvement under this alternative, primarily due to the CCP planning effort and public involvement in it. Alternative D would not result in negative impacts to cultural resources. Cultural sites on acquired lands would receive protection under Federal laws. Levees surrounding Complex lands could also provide added protection from flooding and scouring to known historical and cultural sites. However, as in all previous alternatives, any disturbances will be immediately reported to Regional and State Historic Preservation.

4.6 Cumulative Impacts

The floodplain capacity to store flood water will increase under alternatives A and C, remain the same under Alternative B (No Action) and decrease under Alternative D. Increased flood storage capability means reduced flooding downstream and greater sediment retention and nutrient recycling. This in turn could reduce the sediment and nutrient load that eventually reaches the Gulf of Mexico. A reduction in nutrients reaching the Gulf could help moderate the hypoxia situation there that results in depletion of oxygen and the subsequent death of many aquatic species in the broad area that is affected.

While the individual contribution to sediment retention and nutrient recycling is small for any one of the Complex Refuges under any alternative compared to the total sediment and nutrient load reaching the Gulf, the cumulative impact of the Complex Refuges together can be significant. This impact is magnified further if the refuge is expanded and managed to benefit greater floodplain connectivity with the river. Under Alternative A, the maximum expansion of the refuge would occur, bringing the authorized boundaries of the Complex to slightly more than 80,000 acres. River connectivity would be increased on existing Complex lands and much of the expansion area would emphasize connectivity to the river. Under Alternatives B, C, and D, the refuge would not expand beyond the currently authorized boundary of approximately 53,000 acres. Alternative C would seek the maximum river connectivity within the existing authorized boundaries, but would also likely result in lower wildlife and habitat productivity. Alternative B would retain the current level of river connectivity and Alternative D would decrease river connectivity through the use of levees.

The general increase in flood frequency and duration the past few decades appears to be related to the significant drainage of wetlands and channelization of streams that has occurred throughout the Upper Mississippi River watershed. While significant efforts have been made by various states in the watershed and other agencies, including the Service, to restore wetlands and to restore habitats that reduce sediment runoff, much work still needs to be done. Over time, the Service's efforts working through the Mark Twain Complex and other National Wildlife Refuges and Waterfowl Production Areas, the Partners for Fish and Wildlife Program, and through partnerships with the States, the Corps, and other agencies, the cumulative impact of the various programs can provide measurable positive results in improving water quality on the Mississippi River.

The retirement of the relatively small amount of agricultural land under any of the alternatives would have no measurable impact on agricultural production in the region.

The refuge programs compliment other agencies' and partners' habitat and wildlife work in the AEC. For example, many of the Corps' environmental management program projects to mitigate negative impacts of the river navigation system occur on areas administered as part of the Refuge Complex. The Riverlands Project focused upon environmental education and interpretation in the St. Louis area is another example of the Refuge Complex working cooperatively to create the greatest environmental benefits. Both the Corps and the Service are committed to restoring and maintaining a sound and diverse forest resource in support of Refuge Complex goals for wildlife management. Such partnerships ensure that the work being done on the Refuge Complex is coordinated with other state and federal partners. The cumulative effect is greater benefit to habitat and wildlife through a coordinated approach to restoring habitats, monitoring populations, and dealing with threats to wildlife and habitat.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
1. Listed Species and Other Species of Interest				
Preservation/perpetuation of threatened and endangered species and other species of interest to the Service	Fish benefit from increased connectivity with river; expanded boundaries protect and restore greatest amount of habitat, benefitting listed species and species of interest	No Change	Fish benefit from increased connectivity with river; Decurrent False Aster likely to benefit from flooding	Decurrent False Aster could be negatively impacted by reduced flooding frequency; less habitat for fish species due to limited connectivity of floodplain to river
2. Habitat: Wetland and Aquatic				
Restoration of connected backwaters and side channels. Enhancement of managed wetlands	Increase of vegetation in managed wetlands due to ability to mimic natural hydrologic cycle more closely. Increase in high quality side channels and connected backwaters due to land acquisition and restoration possibilities.	No Change; No enhancements or improvements to existing units, impoundments	Decreased diversity of managed wetlands due to inability to control unnatural water level fluctuations. Increase in number of side channel and connected backwaters, but long term decrease in quality.	Increase in moist soil management, other wetland types due to ability to control water levels. Decrease in side channels and connected backwaters due to levee building.
Enhance Fishery resources	Increase due to increased wetland diversity, river connectivity, water control capability, and more habitat due to boundary expansion	Slight increase due to more habitat available as lands are acquired within the current authorized boundaries	Slight increase due to greater connectivity with the river but decreased habitat diversity due to sedimentation and unnatural water level fluctuations.	Decrease due to less connectivity to the river and more managed moist soil areas
Assure availability of habitat for migratory birds while providing for overall healthy wildlife populations, achieving habitat and species abundance	Increased migratory bird habitat availability and habitat and species abundance due to more natural hydrologic cycle permitting reestablishment of the natural diversity of habitats combined with increased habitat available due to boundary expansion	No Change to slight increase as remaining refuge inholdings are acquired	Decrease due to inability to control sedimentation and unnatural water level fluctuations and the resulting effects on habitat diversity	Increase in habitat for waterfowl, shorebirds, and marsh birds due to ability to more precisely manage wetland habitats. Increase in overall populations of wetland dependent wildlife and habitat and species diversity. No negative effect on non-wetland dependent wildlife.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
Trapping: occasionally used as a management tool under permit or by refuge staff	No Change	No Change	No Change	No Change
3. Habitat: Forest				
Forest management and restoration	Increased species diversity and age structure	Species diversity and age structure would continue declining; minimal regeneration	Increase in quantity of trees; decrease in species diversity	Increased opportunities for adding species and age structure diversity
Assure availability of habitat for migratory birds, providing for healthy wildlife populations, achieving habitat and species abundance	Notable Increase in forested migratory bird habitat due to improved ability to achieve reforestation with a diverse tree species and age structure and due to expanded area available for restoration	No Change to slight increase as remaining refuge inholdings are acquired	Stable to decreased migratory bird habitat as tree numbers increase but diversity decreases;	Moderate increase in forested migratory bird habitat due to improved ability to achieve reforestation with diverse tree species and age structure but habitat expansion limited to current refuge boundaries
4. Habitat: Other Terrestrial Habitats				
Management of agricultural lands	Reduced cropland on existing and newly acquired lands; some acreage will be maintained to set back succession in managed wetlands, to provide supplemental waterfowl food and in preparation for conversion to other habitat types	Current cropland acres maintained	Decrease in cropland production due to increased frequency and duration of flooding	Current cropland acres maintained; newly acquired lands may be temporarily cropped, in prep. for conversion to other habitat types
Manage grasslands	Increased grasslands as prairies restored on higher elevations and select areas of wet meadow restored	Existing grasslands maintained	Reduced grassland diversity due to increased flooding frequency and duration in excess of historical occurrence	Increased area of grasslands on higher and lower elevations possible due to ability to restrict floods

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
5. Sedimentation and Water Quality				
Reduce siltation and sedimentation and improve water quality	Increased sediment accumulation on areas newly opened to the river; areas with greater protection would receive less sediment; working with partners in the watershed could reduce sediments and pollution slightly; slight increase in overall floodplain water quality and nutrient settling and recycling capabilities due to refuge lands being more connected to the river	Continued accumulation of silt and sediment and stable or decreasing water quality; no change in overall floodplain water quality or nutrient settling or recycling capabilities	Increased sedimentation due to more direct access to refuge lands by flood waters; increased floodplain storage capacity likely to benefit overall floodplain water quality by providing nutrient settling and recycling areas and reducing flooding impacts on other floodplain areas	Less sedimentation, fewer contaminants entering refuge lands; reduction in overall floodplain storage and nutrient filtering capability.
6. Floodplain Management				
Water level management	Increased floodplain connectivity but less control of water levels on some managed areas; slight reduction in downstream flooding; preservation of floodplain functions in some expansion areas	No change in current levels of water control and connectivity to the river	Increase in connectivity; slight decrease in downstream flooding	Decrease in connectivity of refuge lands to the river; downstream flood levels could rise slightly
7. Public Use & Education				
Recreational opportunities (other than hunting and fishing?) or (non-consumptive?)	Increase. Additional access for consumptive & non-consumptive uses on new lands, trails and facilities.	No change. No expansions or enhancements of existing facilities.	Decrease. Some public use opportunities would be lost with added river connectivity.	Slight increase. Additional impoundment structures would provide more access.
Wildlife disturbance from recreational users	Slight increase. New lands, trails and facilities will increase visitation and stretch law enforcement resources.	No change. Current regulations and law enforcement will limit disturbance to nesting bald eagles and other migratory birds.	Same as B.	Same as B.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
Hunting and fishing, opportunities	Increase for all activities. Up to 27,659 acres added to the Complex and increased diversity of habitats.	Slight Increase. Some new lands added to the Complex as inholdings are acquired.	Same as B.	Slight increase for hunting. More water control ability will increase waterfowl concentrations. No change for fishing.
Balances between competing uses and users of the river	Improved. More riparian acres within the refuge would ease some congestion of uses.	No change.	Same as B.	Same as B.
8. Monitoring				
Refuge ability to monitor fish, wildlife and habitat quality.	Improved (only if staffing and funding are increased). Base-line evaluations will be required for new lands.	No change. Limited staff means limited monitoring.	Improved (only if staffing and funding are increased).	Same as C.
9. Coordination and Socioeconomic Issues				
Effects of land acquisition on the socio-economics of the region	Authorized Boundaries would be expanded by 27,659 acres; Increased and enhanced public use facilities would promote local economies; added revenues to counties; slight decrease in downstream flooding.	Current authorized boundaries do not change; No change to slight improvement in economic factors.	Current authorized boundaries do not change; Slight decrease in visitation as non-consumptive uses less available; no change or slight decrease in downstream flooding.	Current authorized boundaries do not change; Slight increase in visitation. No change or slight increase in downstream flood levels.
Interagency coordination	Improved. Would require more cooperative work toward land protection.	No change to slight improvement due to CCP planning effort.	Same as B.	Same as B.
Corps- Environmental Management Program	Enhanced. New lands and projects could be added through the program.	No change.	No change to overall program.. Types of projects might change.	Same as C.
Facilities operations and maintenance	Improved. Additional staff would improve facilities to "Service-standard" levels	No change. Management of facilities would continue at below "Service-standards"	Initial high cost to breach levees; minimal operation and maintenance costs in following years.	Expensive to build and maintain levees and facilities

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
10. Effects Common to All Alternatives				
Environmental Justice	Same as B but with slightly expanded recreational opportunities due to expanded boundaries	Wildlife Dependent recreational opportunities provided; no concentration of acquisition areas in poor or minority areas	Same as B.	Same as B.
Protection of cultural resources	Same as B. Could provide additional opportunities for interpretation cultural resources protection due to expanded boundaries	Cultural resources protected as prescribed by Federal law	Same as B.	Same as B.
Global Climate Change	Same as B with slight increase in benefit due to increased area protected & restored due to expanded boundaries	Very slight benefit due to conversion of cropland to permanent cover and reforestation activities	Same as B.	Same as B.
Prescribed Fire Management	Same as B.	Enhances habitat for upland game, waterfowl, and other species of interest. Required procedures ensure safety. Monitoring of results ensures beneficial results.	Same as B.	Same as B.
Trapping:	Same as B.	No Change; occasionally used as a management tool under permit or by refuge staff; lethal for individual animals but no impact on populations	Same as B.	Same as B.

Chapter 5: List of Preparers

Mark Twain Complex staff contributors

Dick Steinbach, Mark Twain NWR Complex Project Leader

Karen Westphall, Mark Twain Complex Biologist

Amy Sprunger-Allworth, formerly Mark Twain Complex Refuge Operations Specialist,
now at Desert NWR Complex, Nevada

Branch of Conservation Planning Staff (Lead in EA Preparation)

Tom Larson, Branch Chief, Branch of Ascertainment and Planning

Gary Muehlenhardt, Wildlife Biologist/Planner, Branch of Ascertainment and Planning

John Schomaker, Refuge Planning Specialist, Branch of Ascertainment and Planning

Jane Hodgins, Technical Writer/Editor, Branch of Ascertainment and Planning

Jane Lardy Nelson, Editorial Assistant, Branch of Ascertainment and Planning

Jim Salyer, Southern Missouri Ascertainment Office, Wildlife Biologist

Judy McClendon, formerly Wildlife Biologist, Southern Missouri Ascertainment Office,
currently Wildlife Biologist/Planner, Southern Louisiana Refuges Complex

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

Elected Federal Officials

U.S. Senator Chuck Grassley (Iowa)
U.S. Senator Tom Harkin (Iowa)
U.S. Senator Richard Durbin (Illinois)
U.S. Senator Peter Fitzgerald (Illinois)
U.S. Senator Christopher Bond (Missouri)
U.S. Senator Jim Talent (Missouri)

U.S. Representative Jerry Costello (Illinois)
U.S. Representative Lane Evans (Illinois)
U.S. Representative Leonard Boswell (Iowa)
U.S. Representative Jim Leach (Iowa)
U.S. Representative Todd Akin (Missouri)
U.S. Representative JoAnn Emerson (Missouri)
U.S. Representative Dick Gephardt (Missouri)
U.S. Representative Kenny Hulshof (Missouri)

Federal Agencies

U.S. Army Corps of Engineers, Vicksburg Division, Rock Island and St. Louis Districts
U.S. Geological Survey, Long Term Monitoring Program; Jackson, MO; Alton, IL
U.S. Department of Agriculture/Natural Resources Conservation Service, Carrolton, IL;
Champaign, IL; Hardin, IL; Jerseyville, IL; Carrollton, IL; Columbia, MO; DesMoines,
IA; Jackson, MO; Madison, WI; Murphysboro, IL; Quincy, IL; Waterloo, IA; Stronghurst,
IL; Aledo, IL; Wapello, IA
Environmental Protection Agency, Chicago, IL; Kansas City, KS
Columbia Environmental Research Center, Columbia, MO
Upper Midwest Science Center, LaCrosse, WI
U.S. Coast Guard, Keokuk, IA
Illinois River National Wildlife Refuge
Shawnee National Forest, Murphysboro, IL
U.S. Fish and Wildlife Service, Ecological Services, Rock Island, IL
Upper Mississippi National Wildlife and Fish Refuge, Winona, MN
Farm Services Administration, Monmouth, IL; Wapello, IA
U.S. Postal Service, Wappello, IA

Tribes

Delaware Nation of Oklahoma
Eastern Delaware Tribe
Iowa Tribe of Kansas
Iowa Tribe of Oklahoma
Kickapoo Traditional Tribe of Texas
Kickapoo Tribe in Kansas
Kickapoo Tribe of Oklahoma
Osage Nation
Otoe-Missouria Tribe
Peoria Indian Tribe of Oklahoma

Prairie Band Potawatomi Nation
Forest County Potawatomi Community
Hannahville Indian Community of Michigan (Potawatomi)
Nottawaseppi Huron Band of Potawatomi
Pokagon Band of Potawatomi Indians of Michigan
Sac and Fox Nation of Oklahoma
Sac and Fox Tribe of Missouri in Kansas and Nebraska
Sac and Fox Tribe of the Mississippi in Iowa
Absentee-Shawnee Tribe of Oklahoma
Eastern Shawnee Tribe of Oklahoma
Loyal Shawnee Tribe of Oklahoma

Elected State Officials

Iowa Governor Thomas Vilsack
Illinois Governor Rod Blagojevich
Missouri Governor Bob Holden

State Senator, Vince Demuzio, (IL)

State Agencies

Iowa Department of Natural Resources
Illinois Department of Natural Resources
Missouri Department of Natural Resources
Missouri Department of Conservation
Southern Illinois University
Iowa State University, Iowa Cooperative Fish and Wildlife Research Unit
University of Missouri, Extension Services
Iowa State University, Extension Services
Illinois State Police
University of Illinois, Extension Services
Mississippi River Parkway Commission
Union County Refuge, IL
Shawnee Resource Conservation and Development Area, IL

City/County/Local Governments

City of Canton, MO
City of LaGrange, MO
Calhoun County Commissioners, Batchtown, IL
Village of Batchtown, IL
Greene County Board, IL
Village of Elsay, IL
City of Grafton, IL
Village of Hamburg, IL
Calhoun County Planning Committee, IL
Calhoun County, IL
Jersey County Board, IL
City of Portage Des Sioux, MO
Cape Girardeau County Emergency Management Agency, MO
Keithsburg City Hall, IL
City of Keithsburg, IL
Muscatine County Conservation Board, IA
City of Muscatine, IA
Louisa County Conservation Board, IA
City of Wapello, IA

Public Libraries

Quincy Public Library, 526 Jersey St., Quincy, IL 62301
Chester Public Library, 733 State St., Chester, IL 62233
Rock Island Public Library, 401 19th St., Rock Island, IL 61201
Louisiana Public Library, 121 N. 3rd St., Louisiana, MO 63353
Cape Girardeau Public Library, 711 N. Clark St., Cape Girardeau, MO 63701
Festus Public Library, 222 N. Mill St., Festus, MO 63028
Keck Memorial Library, 119 N 2nd, Wapello, IA 52653
Fort Madison Public Library, 614 7th Street, Fort Madison, Iowa 52627-2907

Organizations

Pike County Tourism Bureau, Bowling Green, MO
Sny Island Levee Drainage District, New Canton, IL
Greater Alton Twin Rivers Convention & Visitors Bureau, Alton, IL
Migratory Waterfowl Hunters, Inc., Alton, IL
c/o Ducks Unlimited, Batchtown, IL
Treehouse Wildlife Center, Brighton, IL
Golden Eagle Wildlife Preserve, Inc., Chesterfield, MO
St. Louis Audubon Society, Chesterfield, MO
Principia College, Elsah, IL
The Nature Conservancy, Havana, IL
Great Rivers Chapter of Illinois Audubon Society, Jacksonville, IL
St. Louis Audubon Society, Kirkwood, MO
Webster Groves Nature Study Society, St. Louis, MO
Webster Groves Nature Study Society, ST Louis, MO
Nature Institute, Alton, IL
Piasa Palisades Chapter, First Unitarian Church, Alton, IL
Bassmasters, Alton, IL
The Wildlife Society, Iowa Chapter, Iowa State University, Ames, IA
Mississippi Interstate Cooperative Resource Association, Bettendorf, IA
Ducks Unlimited, Canton, IL
Nature Conservancy, Chicago, IL
The Conservation Fund, Chicago, IL
Sierra Club, Kaskaskia Group Conservation Chair, Columbia, IL
The American Fisheries Society, Columbia, MO
The Missouri Prairie Foundation, Columbia, MO
The Wildlife Society, Missouri Chapter, MO Dept. of Conservation, Columbia, MO
The Illinois Audubon Society, Danville, IL
The Nature Conservancy, Des Moines, IA
Iowa Wildlife Federation, Inc., Des Moines, IA
Iowa Bass Chapter Federation, Des Moines, IA
The Iowa Environmental Council, Des Moines, IA
Izaak Walton League of America, Inc., Iowa Division, Des Moines, IA
Illinois Wildlife Foundation, Edwardsville, IL
Illinois Rivers Project, Edwardsville, IL
St. Louis Area Chairman, Ducks Unlimited, Florissant, MO
The Audubon Council of Illinois, Forreston, IL
The Izaak Walton League of America, Gaithersburg, MD
The Illinois Chapter Federation, Glen Ellyn, IL
Partners for Wetlands, Godfrey, IL
Illinois Federation of Outdoor Resources, Godfrey, IL
Illinois EcoWatch, Godfrey, IL
The Iowa Audubon Council, Grinnell, IA

Missouri Wildlife Society, Hannibal, MO
 Missouri Conservation Foundation, Jefferson, MO
 Missouri Chapter American Fisheries Society, Missouri Department of Conservation,
 Jefferson City, MO
 The Conservation Federation of Missouri, Jefferson City, MO
 The Missouri Audubon Council, Jefferson City, MO
 The Missouri Bass Chapter Federation, Lake St. Louis, MO
 Sierra Club, Madison, WI
 Sierra Club, Madison, WI
 The American Fisheries Society, Illinois Chapter, Manito, IL
 Southwestern Illinois Resource Conservation and Development, Mascoutah, IL
 Mississippi River Basin Alliance, Minneapolis, MN
 Muscatine County Ducks Unlimited, Muscatine, IA
 Iowa Raptor Foundation, Pella, IA
 The Two Rivers RC&D, Pittsfield, IL
 Upper Mississippi River Conservation Committee, Rock Island, IL
 The Illinois Natural Heritage Foundation, Rockford, IL
 The Illinois Bass Chapter Federation, Springfield, IL
 The Illinois Environmental Council, Springfield, IL
 Green Strategies, Springfield, IL
 Missouri State Chapter, Soil and Water Conservation Society, Springfield, MO
 Center for Plant Conservation, Missouri Botanical Garden, St. Louis, MO
 MARC 2000, St. Louis, MO
 The Audubon Society of Missouri, St. Louis, MO
 Upper Mississippi River Campaign, National Audubon Society, St. Paul, MN
 Illinois-Indiana Sea Grant College Program, University of Illinois, Urbana, IL 61801, IL
 Wildlife Management Institute, Washington, DC
 National Wildlife Foundation, Office of Federal and International Affairs, Washington,
 DC
 American Rivers, Washington, DC
 The Clean Water Fund, National Office, Washington, DC
 Defenders of Wildlife, Washington, DC
 The National Waterways Conference, Inc., Washington, DC
 The National Wildlife Refuge Association, Washington, DC
 The Natural Resources Council of America, Washington, DC
 The Sierra Club, Washington, DC
 National Audubon Society, Washington, DC
 Northeast Midwest Institute, Washington, DC
 Friends of the Upper Mississippi River Refuges, Winona, MN
 Resource Studies Center c/o St. Mary's University of MN #7, Winona, MN
 Izaak Walton League, Davenport Chapter, Davenport, IA
 The Quad Cities Audubon Society, Davenport, IA
 Iowa Natural Heritage Foundation, Des Moines, IA
 The Upper Mississippi, Illinois, and Missouri Rivers Association, Jacksonville, IL
 Louisa County Pheasants Forever, Oakville, IA
 Louisa County Izaak Walton League, Wapello, IA
 Ducks Unlimited, Williamsburg, IA

Individuals

Individuals who participated in open house sessions or who requested to be on the Comprehensive Conservation Plan mailing list.

Chapter 7: Appendices

7.1 Appendix 1, References

- Bellrose, F.C. 1954. The value of waterfowl refuges in Illinois. *Journal of Wildlife Management*. 18(2): 160-169.
- Black, R., B. McKenney, A. O'Connor, E. Gray, and R. Unsworth. 1999. Economic profile of the Upper Mississippi River Region. Prepared for the United States Fish and Wildlife Service Division of Economics by Industrial Economics, Inc., Cambridge, MA. 84 pp. + Appendices.
- Brown, M.D. 1988. Soil survey of Louisa County, Iowa. U.S. Dep. Agric. Soil Conserv. Serv., in cooperation with the Iowa Agric. and Home Econ. Exp. Stn., the Coop. Ext. Serv., Iowa State Univ., and the Dep. of Soil Conserv., State of Iowa. 255 pp.
- Carlson, B.D., D.B. Propst, D.J. Stynes, and R.S. Jackson. 1995. Economic impact of recreation on the Upper Mississippi River System. Technical Report EL-95-16. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.
- Clark County Soil and Water Conservation District. 1990. Soil resource inventory of Clark County, Missouri. Cooperating with U.S. Dep. Agric., Soil Conserv. Serv., Miss. Dep. Of Nat. Res., and Miss. Agric. Exp. Stn. 123 pp.
- Herman, R.J., C.C. Miles, L.A. Dungan, B.E. Currie, and P.W. Ice. 1979. Soil survey of Jackson County, Illinois. U.S. Dep. Agric. Soil Conserv. Serv. and Forest Serv., in cooperation with Ill. Agric. Exp. Stn. 192 pp.
- Laughland, A. and J. Caudill. 1997. Banking on nature: The economic benefits to local communities of national wildlife refuge visitation. Division of Economics, United States Fish and Wildlife Service, Department of Interior. Washington, D.C.
- Lilly, M.E. 1989. Soil survey of Calhoun County, Illinois. U.S. Dep. Agric., Soil Conserv. Serv., in cooperation with the Ill. Agric. Exp. Stn. 113 pp.
- Love, C.L. 1997. Soil survey of Pike County, Missouri. U.S. Dep. Agric. Nat. Res. Conserv. Serv., in cooperation with the Miss. Agric. Exp. Stn. 155 pp.
- Lubinski, K. and C. Theiling, eds. Ecological status and trends of the Upper Mississippi River System 1998: A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, LaCrosse, Wisconsin. April 1999. LTRMP 99-T001. 236 pp.
- Rusch, L., J. McKay, and K. Karstens. 1999. An archeological and historical records study for the Mark Twain National Wildlife Refuge in Illinois, Iowa and Missouri. Department of Interior, U.S. Fish and Wildlife Service, Region 3. Purchase Order No. 301818M602.
- Schwegman, J. E. and R. W. Nyboer. 1985. The Taxonomic and Population Status of *Boltonia Decurrens* (Torr. and Gray) Wood. *Castanea* 50: 112-115.

Smith, M. and T. M. Keevin. 1998. Achene Morphology, Production, and Germination, and Potential for Water Dispersal in *Boltonia Decurrens* (Decurrent false aster), a Threatened Floodplain Species. *Rhodora* 100: 69-81.

Smith, M. and T. Keevin, P. Mettler-McClure, and R. Barkau. 1998. Effect of the Flood of 1993 on *Boltonia Decurrens*, a Rare Floodplain Plant. *Regul. Rivers: Res. Mgmt.* 14: 191-202.

Theiling, C.H. 1996. An ecological overview of the Upper Mississippi River system: Implications for postflood recovery and ecosystem management, *in* Galat, D.L., and Frazier, A.G., eds., Overview of river-floodplain ecology in the Upper Mississippi River Basin, v. 3 of Kelmelis, J.A., ed., Science for floodplain management into the 21st century: Washington, D.C., U.S. Government Printing Office, p. x-y.

Whitney, S.D., K.D. Blodgett, and R.E. Sparks. 1996. A comprehensive evaluation of three mussel beds in Reach 15 of the Upper Mississippi River. Illinois Natural History Survey Aquatic Ecology Technical Report 1996(7), Havana. Reprinted by U.S. Geological Survey, Environmental Management Technical Center, Onalaska, Wisconsin, October 1997. LTRMP 97-R022. 15 pp. + Appendixes A - H.

7.2 Appendix 2, Acronyms and Abbreviations Used in the EA

AEC - Area of Ecological Concern
CCP - Comprehensive Conservation Plan
COE - Corps of Engineers
CRP - Conservation Reserve Program
DNR - Department of Natural Resources
EA - Environmental Assessment
EMP - Environmental Management Program
EWRP - Emergency Wetland Reserve Program
FONSI - Finding Of No Significant Impact
FmHA - Farmer-s Home Administration (now FSA)
FSA - Farm Service Agency
GIS - Geographic Information System
HNA - Habitat Needs Assessment
HREP - Habitat Rehabilitation and Enhancement Project
IADNR - Iowa Department of Natural Resources
ILDNR - Illinois Department of Natural Resources
LTRMP - Long Term Resource Monitoring Program
MODOC - Missouri Department of Conservation
NEPA - National Environmental Policy Act
NRCS - Natural Resources Conservation Service
NWR - National Wildlife Refuge
PFW - Partners for Fish and Wildlife
RM - River Mile
ROS - Refuge Operations Specialist
UMR - Upper Mississippi River (confluence with Ohio River at Cairo, IL, to St. Paul, MN)
UMRCC - Upper Mississippi River Conservation Committee
UMRS - Upper Mississippi River System (UMR and navigable tributaries, e.g., Illinois River)
USDA - United States Department of Agriculture
USEPA - United States Environmental Protection Agency
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
WRP - Wetland Reserve Program